The Geography of South Africa
Contemporary Changes and New Directions
World Regional Geography Book Series

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The Geography of South Africa
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The Development and Context of Geography in South Africa

Jasper Knight and Christian M. Rogerson

Abstract
The discipline of Geography in South African universities has a history of more than 100 years. Within that time span different themes have been at the forefront of research which has been produced about the country’s physical and human landscapes. Arguably, contemporary South African Geography is more inclusive, integrated and applied than in the past, and the discipline is being reconfigured to address more explicitly the challenges of the post-apartheid world. Contemporary South African Geography is investigating an array of topics which aligns it with international trends in geography. This said, local aspects of the discipline of geography as well as the contemporary South African human landscape continue to bear imprints of the apartheid past. Accordingly, the distinctive character of the development and contemporary directions of South African Geography must be recognised by the international academy.

Keywords
Contemporary geographical debates · History of geography · Human geography · Physical geography · South Africa

1.1 Introduction
South Africa enjoys international attention for a number of reasons. On the one hand, issues of governance, political corruption and struggles with post-apartheid inequality have dogged socioeconomic life in South Africa. Ironically, these issues have meant that South Africa is an excellent laboratory for human geography research. On the other hand, culture, heritage, ecosystems and the spectacular physical environment continue to draw international tourists to the country as well as guide much research activity in physical and environmental geography.

We would submit that, as compelling as South Africa is for international media and tourism, the country’s human and physical landscapes remain fascinating and deserving of increased scholarly attention. At the heart of research debates on South African Geography are the activities of an energetic and vibrant research community. In addition to contributions from local universities, research institutes and government agencies, the physical, environmental and human geographies of South Africa continue to attract scholars from many parts of the world, notably from North America, Europe and Australasia. The internationalisation of research activities, in the post-apartheid era, is a feature in the southern African subcontinent.

1.2 Geography in South Africa
The discipline of Geography in South Africa is now 100 years old (Ballard et al. 2016; Donaldson et al. 2016; Wynn 2016) and the history of the discipline of Geography in different universities across South Africa is documented by Visser et al. (2016). The first lecturer in Geography was appointed in 1917, and Geography as a major discipline area is now being taught at 26 public universities in South Africa, as well as across the school curriculum (Visser et al. 2016). However, the origins of geographical study in the region extend back further, as the themes and early history of Geography at universities in South Africa were based on European traditions (Wesso and Parnell 1992); and mapping, description and analysis of southern African landscapes, resources and peoples predate 1917, with investigations of geology, water,
plants/animals, archaeology and anthropology undertaken throughout the nineteenth century, largely by European explorers, colonial administrators and missionaries. A snapshot of this traditional viewpoint is shown in Fig. 1.1a, of Geography students from the University of the Witwatersrand on a ‘Congo East Africa Expedition’, likely in the late 1940s/early 1950s (date unknown). These white, male students and staff, in their khaki shorts and pith helmets, exemplify the ‘colonial’ nature of Geography at this time. Today, however, the political, cultural and socioeconomic context of
Geography in South Africa is very different compared to that of the past (Cole 2008; Nicolau and Davis 2002; Oldfield and Patel 2016) (cf. Fig. 1.1b), and is discussed in much depth elsewhere (e.g. Crush 1993, 1994; Wesso 1994). These changed contexts have given Geography as a discipline new relevance and urgency in the post-apartheid era, with respect to its potential contribution to national-scale debates on sustainable economic and environmental development, management of natural resources, and transformation of socioeconomic, cultural and political life (Crush 1993, 1994; Nicolau and Davis 2002; Ramutsindela 2015).

1.3 The Past, Present and Future of South African Geography

Visser et al. (2016) outline the histories of 22 Geography departments at South African universities. From this, and with reference to other studies on the history of the discipline (e.g. Nicolau and Davis 2002; Wesso and Parnell 1992), several points can be identified: (1) Research activities and power have historically been concentrated into a few long-standing and traditional universities in South Africa, such as the University of Cape Town, University of Pretoria, Stellenbosch University, and University of the Witwatersrand. (2) Key figures in the discipline in South Africa through the twentieth century have been mainly (but not always) white men (cf. Wesso 1994). There has thus been a disproportional concentration of academic power and research activity by academic figures from this demographic group. (We are aware of our own positionality in making this statement.) (3) Research, particularly in human geography, has been concerned with only some thematic elements of the discipline with other areas under-represented. For example, urban studies has been a long-standing research strength; historical geography has not.

The outcome of these points is that Geography in South Africa has, for decades, been imbalanced in its scope, emphasis and participation. This may be a legacy of the small size of the geographical community, the consequence of apartheid-era academic sanctions, or just individual researchers’ concerns with some aspects of Geography and not with others. This does not by itself mean that Geography has been ‘bad’ or ‘wrong’, but rather that a more holistic, integrated picture of the discipline and its wider relevance has been lacking. Today, these imbalances of the past are starting to being addressed – as is described in this book – and from a number of perspectives. Such developments include (1) broadening the areas of research concern by academic Geographers, (2) broadening the topic areas under discussion in school and university teaching programmes in Geography, (3) rebalancing the gender and ethnic make-up of Geographers (of both staff and students) in South African universities, and (4) repositioning of some Geography research and applications to address real-world issues, either in government, industry or local communities. Geography today is thus more inclusive, integrated and applied than in the past, and the discipline of Geography in South Africa is now being reshaped to address more explicitly the challenges of the post-apartheid and globalised world (Beets and Le Grange 2008; Knight 2018; Knight and Robinson 2017; Wesso 1994). However, there is much more that needs to be done (Knight 2018).

Some geographical research in South Africa today is already applied to address real-world issues. This includes, in no particular order, urban sustainability (Cilliers et al. 2014), food security and agricultural production (Battersby 2013; Jones and Thornton 2009), water management (Cameron and Katzschner 2017), mitigation of climate change impacts (Ziervogel et al. 2014; Zinyengere et al. 2013), reduction of soil erosion and land degradation (Mararakanye and Le Roux 2012), maintaining biodiversity and protected areas (Hély et al. 2006), and hazard and risk management (Coetzee et al. 2016). These topic areas indicate the potential breadth and scope of geographical research as applied to contemporary issues in South Africa and the wider region.

1.4 Themes in This Book

This book of original research chapters on contemporary change and new directions in South African Geography is addressed to both a local and an international scholarly audience of Geographers, students, professional practitioners, managers and policymakers. The book builds from previous books and articles which have sought to variously reflect upon, synthesize or offer signposts for South African physical and human geographies over the past 40 years (e.g. Beavon and Rogerson 1981; Grab and Knight 2015; Hammett 2012; Holmes and Boardman 2018; Holmes et al. 2016; Mather and Ramutsindela 2007; Pirie and Moon 1982; Rogerson and McCarthy 1992).

This book brings together recent ideas in different thematic areas of physical, environmental and human geography, by key figures in the discipline based in South Africa but also beyond its borders. All chapters are original contributions, providing a state of the art research baseline on key themes in physical, human and environmental geography, and in understanding the changing geographical landscapes of modern South Africa. The contributions set the scene for an understanding of the relationships between South Africa and the wider contemporary world, including issues of broader relevance in the Global South. Although aiming to be wide-ranging and integrative in scope, inevitably some areas of Geography are excluded, which may be topics for a
future book. Part I of this volume deals with aspects of the physical and environmental geography of South Africa, including topics in geomorphology, climate, ecosystems; and resources and resource management. Part II discusses aspects of human geography, focusing on both rural and urban settings, and different types of economic and social development and activities, including food, housing and tourism. Part III addresses contemporary and future issues in physical and human environments in South Africa, including globalisation, migration, poverty, climate change, and managing environmental risk. This section also identifies areas of potential future geographical research over the next decades.

In preparing this volume we would like to thank all the contributors for their chapters and to editorial support provided by Arabella Rogerson. All chapters in this book were externally peer-reviewed by at least two independent experts in their fields, and we thank these reviewers for their valuable input.

References


Part I

Physical and Environmental Geography
Abstract

The landscapes of South Africa reflect the impacts of tectonics and climate on the land surface, resulting in weathering, erosion and deposition, and the shaping of distinctive landforms in different environments. Long term geological evolution in the region provides the context for these landscapes. The landscape elements seen today reflect South Africa’s more recent geological history (last ~80 million years) but there is considerable variation in the age of these different elements and thus their interpretive context with respect to tectonic or climatic forcing. Increasingly, human activity plays a role in not only landscape change but also in the workings of geomorphological processes, which have implications for future landscape patterns.

Keywords

Climate change · Human activity · Holocene · Quaternary · Tectonics · Weathering

2.1 Introduction

The South African landscape that we see today is the outcome of over two billion years of Earth’s history (McCarthy and Rubidge 2005). This evolutionary outcome has taken place by a combination of tectonic and geologic events that are driven by regional to continental-scale processes within the Earth, and climatic processes related to regional to hemispheric-scale ocean and atmospheric circulation. These driving factors have resulted in the operation of different sets of geomorphological processes that shape the land surface and which, in turn, influence patterns of topography, soils and vegetation types, and ultimately human activity. Thus, the different landscapes found across South Africa reflect different processes that have varied across time and space, and their interactions (Fig. 2.1). Several studies have examined the development of different individual elements of the South African landscape over time, including coastal sand dunes (Botha and Porat 2007; Roberts et al. 2014), wetlands (Lyons et al. 2013), mountains (Boelhouwers and Sumner 2003; Mills et al. 2017), rivers (Grenfell et al. 2014; McCarthy and Tooth 2004), slopes (Moon and Selby 1983; Singh et al. 2008), soils (Bell and Maud 1994; Boardman 2014), ephemeral pans in semiarid areas (Holmes and Barker 2006; Telfer and Thomas 2006), karstic landforms (Martini and Kavalieris 1976; Stratford et al. 2014), and alluvial fans (Boardman et al. 2005; Kounov et al. 2014). These studies have focused mainly on the interrelationships between geomorphology, processes of sediment transport and deposition, and forcing factors such as climate and human activity. In addition, some studies have also considered in a more integrated way the geomorphology and landscape evolution of single areas, including the Free State (Holmes and Barker 2006), Soutpansberg mountains (Hahn 2011), and Sabie River basin (Rountree et al. 2000). Many individual studies have been synthesised in recent books, including Holmes and Meadows (2012), Grab and Knight (2015), and Knight and Grab (2016), which can be considered as key texts summarising macroscale landscape evolution in South Africa, in particular during the Cenozoic (last 66 million years).

Although, over long time scales and large spatial scales, tectonics and climate broadly control patterns of landscape change in South Africa, processes of forcing and landscape response are not uniform. Geomorphic and dating evidence shows that landscape change has been more rapid at some times, or in some places, than in others (e.g. with respect to rivers as described by Tooth 2016). This evidence leads to two separate deductions about the nature of change and the evolution of the South African landscape. (1) That some of today’s landscape elements are young in age, and some are old. Elements of different ages within the same landscape...
result in what is termed a landscape palimpsest (Knight 2012). This arises where, for example, tectonic or climatic forcing affects one area rather than another, or where differences in rock hardness influence how quickly denudation occurs (Scharf et al. 2013). Young landscape elements may include present-day rivers that experience patterns of channel erosion and deposition in response to real-time variations in river discharge. Old landscape elements may include bedrock summits that are relatively resilient and experience very slow rates of contemporary weathering. (2) That different landscape elements experience different sensitivities to be affected by forcing. Different landscape elements may be affected by different forcing factors. For example, rivers may be highly sensitive to precipitation variations but relatively insensitive to temperature. Bedrock summits may be highly sensitive to temperature (through thermal weathering processes, common in South Africa), but relatively insensitive to precipitation changes. This property is known as geomorphological sensitivity (Knight and Harrison 2013).

The outcome of these two deductions in combination is that we might anticipate spatial and temporal variations in the rate, style and geomorphic signatures of landscape change. However, it is only now that we are beginning to appreciate such nuances with respect to landscape change in South Africa (Knight and Grab 2018a). In order to focus on relationships between different forcings and landscape responses, this chapter summarises regional-scale patterns of geology in South Africa, and then events at three key stages in the development of South Africa’s landscape: the breakup of Gondwana around 85–60 million years ago (Ma); Neogene aridity around 5 Ma; and climate cooling during the last global glaciation around 35,000–10,000 years ago (ka). These time periods are chosen because they represent periods of rapid tectonic or climatic change. These examples highlight the fact that landscape change is not linear – the landscape evolves continuously but often with short bursts of rapid change, and these periods of rapid change are separated (very often) by periods of diminished or minimal change, or where there is little preserved evidence for landscape change (Knight and Grab 2018a).

### 2.2 Geological History and Spatial Patterns of Rock Types in South Africa

Spatial patterns of different rock types in South Africa reflect its long geological history and a wide range of tectonic and climatic events that have affected the surface and subsurface. This background is informed by McCarthy and Rubidge (2005) with more specific technical detail on different rock formations and geological time periods found in the book by Johnson et al. (2006). This summary reflects these two sources. The distribution of major rock types found in South Africa today is shown in Fig. 2.2. This distribution reflects the outcome of tectonic cycles of continental accretion and mountain building, and the development of large sedimentary basins on eroded craton surfaces. The oldest rocks in South Africa (2.9–3.2 billion years ago, during the Archean)
are greenstones that are located in the Barberton area (Mpumalanga Province). The record of geological events and processes during this ancient time period is largely not preserved. Formation of the Kaapvaal craton and Kalahari craton by continental accretion around 2600 and 1000 Ma, respectively, was punctuated by periods of sediment deposition indicative of relative land surface stability. For example, prior to Kaapvaal craton formation, between about 3100 and 2600 Ma, the Pongola, Witwatersrand and Ventersdorp Supergroups were deposited. These comprise continental volcanic, pyroclastic and sedimentary rocks (mainly sandstones and conglomerates) that reflect a relatively stable tectonic setting, with some periods of metamorphic deformation and mineralisation. The rocks now outcrop in very restricted areas near Johannesburg and Swaziland (Fig. 2.2). The degree of intraformational volcanic rocks generally decreases over time during this period. Gold mineralisation within the Witwatersrand Supergroup is important because it was exploitation of these resources that allowed for the foundation of the city of Johannesburg (Knight 2018). On the Kaapvaal craton surface, limestones and clastic sediments were deposited in a subsiding basin, forming the Transvaal Supergroup, found today in a broad strip from the Northern Cape to Limpopo. Into these sediments was intruded the Bushveld Complex around 2000 Ma, a suite of layered igneous rocks associated with platinum-group minerals. The Bushveld Complex outcrops in the region north of Pretoria. Following this, deposition of sediments and lavas of the Olifantshoek Supergroup and equivalent-age formations including the Waterberg and Soutpansberg Groups took place around 2000–1800 Ma, in relatively flat floodplain and coastal plain environments on the margins of the Kaapvaal craton. These rocks are found today in Limpopo and Northern Cape provinces. This was followed by a period of relative tectonic stability of the Kaapvaal craton that terminated with the Namaqua Orogeny (around 1200–1000 Ma) that stretched from KwaZulu-Natal to Northern Cape provinces, and was associated with formation of various igneous and metamorphic rocks. Later activity along this tectonic belt was responsible for the formation of rocks of the Gariep Supergroup (around 800–650 Ma) along the west coast of the country. Intrusion of igneous complexes including the Pilanesberg Alkaline Province (at 1400–1100 Ma) and Cape Granite Suite (550–515 Ma) took place during this period. Depositional fluvial to marine basins, some of which were fault-bounded, opened up at this time along the margins of the Namaqua belt, including the Cape Supergroup which extends through most of the Western Cape and into the Eastern Cape provinces. The Karoo Supergroup refers to a wide range of rocks deposited in a very large subsiding...
sedimentary basin active around 350–170 Ma (early Carboniferous to late Jurassic) and comprising up to 12 km thickness of clastic deposits, dominantly of mudstones and rhythmites around basin margins, and sandstones in the basin centre (Catuneanu et al. 2005). The basal part of the basin fill comprises the Dwyka Group, of diamictites formed in a glacial environment (late Carboniferous to early Permian, around 320–300 Ma), grading up into clastic deposits indicative of warmer and then arid environments. Important fossil remains are contained in particular in the Triassic beds. These clastic sediments outcrop throughout the centre of South Africa, and are in terms of area the most dominant rock types in the country. Also part of the Karoo Supergroup, are igneous rocks belonging to the Karoo Igneous Province around 190–180 Ma (early Jurassic). These include the flood basalts of the Lesotho Formation, which reach up to 1500 m thickness in central Lesotho. These flood basalts are exposed on the land surface today in Lesotho and the Eastern Cape Province. Fold mountains of the Cape Fold Belt in the Eastern Cape and Western Cape provinces (including the Cedarberg, Swartberg and Outeniqua Mountains) were formed during the late Permian and early Triassic (300–250 Ma), possibly associated with subduction of ocean crust. Formation of these fold mountains and volcanic activity of the Karoo Igneous Province may have been precursors of the breakup of the Gondwana supercontinent which started to take place from around 180 Ma (Burke and Gunnell 2008). South America and Africa finally split apart around 115–90 Ma. Cenozoic deposits of the Kalahari Group found in the Northern Cape and North West are mainly sandstones and conglomerates and were deposited on this relatively stable craton surface. It is weathering, erosion and deposition during the Cenozoic that resulted in the formation of many of the geomorphic elements present in today’s South African landscape.

2.3 Breakup of Gondwana and Formation of Planation Surfaces

A significant macroscale feature of South Africa’s landscape is the presence of discontinuous but persistent flat surfaces found at different altitudes. Three main surfaces have been recognized: the African Surface (85–42 Ma), Post-African I Surface (19–15 Ma), and Post-African II Surface (7–3 Ma) (Partridge and Maud 1987), identified on the basis of degree of weathering and stratigraphy. Today, due to postformational denudation, these surfaces appear at different altitudes in the landscape. The trigger for the successive development of these surfaces was lithospheric movement in southern Africa (as part of the larger African Plate) following the breakup of the supercontinent Gondwana around the period 135–115 Ma (the precise timings are unknown) during the Cretaceous. At this time, Africa split from South America, broadly establishing today’s continental-scale geography of Africa. The causes of lithospheric movement across southern Africa during the late Cretaceous and early Cenozoic are under debate (Burke and Gunnell 2008), but include a combination of isostatic uplift following erosion, development and migration of mantle plumes, and tectonic uplift/continental drift (Moore et al. 2009). Several studies have described the geometric properties of the different Surfaces and have described them as peneploains, or eroded surfaces that represent the land surface response to tectonic uplift (Burke and Gunnell 2008; du Toit 1954; King 1948, 1963; Partridge and Maud 1987). The recognition of different African Surfaces is, however, problematic, because it involves circular reasoning, whereby Surfaces are assumed to be of the same age because they have the same altitude. In detail, however, it is likely that the Surfaces are of composite ages, and they are associated with weathered products (such as laterite, calcrete and silcrete layers) that formed over time by chemical as well as physical processes (Marker et al. 2002). Partridge and Maud (2000) discussed the formation of the different Surfaces and specifically linked different stages of land uplift with regional changes in drainage pattern. This is now known to be somewhat more complex than a simple uplift forcing–response because it is associated with phased changes in drainage divide migration through the passage of mantle swells (Moore and Larkin 2001; Moore et al. 2012), as well as changes in drainage density and drainage pattern morphometry related to precipitation and weathering (Knight and Grab 2018b).

2.4 Neogene Aridification

Globally, climate changes in the Neogene (23–2 Ma) culminated in significant periods of aridity around 14–11 Ma which was associated with the development and spread of desert dunes in the Namib Desert and Kalahari Desert of northwest South Africa and Botswana (Roters and Henrich 2010; Senut et al. 2009), and in mineralogical changes in palaeosols in the Western Cape (Eze and Meadows 2014). This period coincides with other climate changes in the Southern Ocean and Antarctica that suggest very strongly that hemispheric changes in climate were the major drivers of responses in the South African landscape. This includes changes in the distribution of Renosterveld and savanna vegetation, including the balance between C3 and C4 vegetation types (Dupont et al. 2013; Sciscio et al. 2016). Such changes are interpreted to reflect migration of the boundary between summer and winter rainfall zones (Pickford et al. 2014). These climate changes during the Neogene also coincide
with periods of hominin evolution, in particular associated with development of bipedalism and changes in cranial capacity, that may reflect changes in the environments in which the hominins inhabited, from closed to more open wooded systems (Heaton 2016). Preserved geomorphological evidence from this time period is generally lacking, but may include periods of enhanced windblown sediment transport offshore from arid land surfaces (Senut et al. 2009) and high river sediment deposition within basins inland (Botha and de Wit 1996). In South Africa, this period also coincides with formation of weathering products on the African Surfaces, suggestive of relative land surface stability and low erosion rates (Beukes et al. 2004; Marker et al. 2002; Pickford et al. 1999).

### 2.5 Quaternary Climate Changes

During the Quaternary (last 2 million years), large scale continental glaciation took place episodically in the northern hemisphere, yet only very small and restricted cirque glaciers were present in highest areas of southern Africa during the last glacial maximum (LGM; ~25 to 19 ka), and these likely only existed under some specific temperature and precipitation conditions (Mills et al. 2012). There was limited impact of the presence of cirque glaciers on mountain landscapes. It is far more likely that cold, periglacial processes were most active and widespread, causing enhanced land surface weathering in mountainous areas and generating some distinctive landforms including blockstreams, blockfields, patterned ground, slope deposits, and turf- and stone-banked lobes (Boelhouwers and Meiklejohn 2002; Hanvey and Lewis 1991; Sumner 2004). Geomorphological responses to Quaternary climate changes are best known from dryer areas of western South Africa, where luminescence dating of river and dune deposits show that variations in moisture availability during different phases of the Quaternary were associated with activation of pans, lakes, caves and springs in wet phases, and Kalahari desert dunes in dry phases (Shaw and Thomas 1996). Responses by river systems likely varied from one system to another, but include such evidence as formation of river terraces (e.g. Sundays River, Vaal River), channel avulsion or migration (e.g. Modder River), and channel incision (e.g. Orange River) (Keen-Zebert et al. 2013). These different responses are mediated by both the nature of climate variability, and by sediment availability within the system (Tooth 2016). As such, different physical systems responded in different ways to Quaternary climate changes in South Africa. A reason for this might lie in changes in atmospheric circulation and thus precipitation patterns. Precession-driven changes in the position of the intertropical convergence zone (ITCZ) during the Quaternary – one of the primary controls on precipitation seasonality in southern Africa – likely affected the zones of summer and winter rainfall (Tyson 1999). In turn, precipitation seasonality affects both river and vegetation dynamics, and pollen records from key sites such as Wonderkrater, Tswaing, Braamhoek and Princessvlei clearly reflect this seasonality (Scott et al. 2012).

### 2.6 Discussion

The traditional view of landscape change in South Africa is that it is controlled by cycles of large-scale tectonic and climatic events, followed by regional-scale weathering and erosion of the land surface, infilling terrestrial sedimentary basins such as the Transvaal basin and Karoo basin, and forming distinctive landscape elements such as the African Surfaces (Partridge and Maud 1987). Recent work based on apatite fission track thermochronometry data has quantified the amount of erosion taking place during different time periods and in different locations, suggesting for example that up to 5.70 km of vertical thickness of rocks were eroded from the Cape Fold Belt mountains in the early Cretaceous alone (Richardson et al. 2017). Other studies also show that there are significant spatial and temporal variations in weathering and erosion during the Cenozoic, and that land surface feedbacks associated with vegetation/soil development, slope stabilisation and bedrock control are also important in amplifying or suppressing responses to tectonic or climatic forcing (Chadwick et al. 2013). Collectively, these factors mean that today’s landforms or landscapes cannot be uncritically considered to reflect either a single time period of formation or a single forcing mechanism. Instead, they should be considered as transient features that evolve over time. The most significant landscape-change processes and products in South Africa, over the timespan of the Cenozoic, are described in the timeline of Fig. 2.3. This shows that there is not a uniform temporal pattern of landscape change, but is driven mainly by changes in tectonic and climatic forcing (not by stable conditions of forcing).

Today’s landscapes, however, are not controlled only by tectonics or climate. Human activity has influenced landscape topography, geomorphic and ecological processes, and the distribution of geological and environmental resources, such as fertile soils, water availability, and ecosystem services. In South Africa, human utilisation of the landscape started in concert with hominin (human) evolution 2 million years ago, but has dramatically accelerated in particular over the past several hundred years following European settlement. Today, South Africa can be considered to be an anthropogenic landscape as a result of the transformation of the land surface by mining, agriculture and urbanisation, and the
ways in which this landscape may evolve over the next centuries to millennia may be vastly different to those that have shaped the landscape in the past. Key questions for the future include (1) the effects of ongoing climate change on land surface processes, (2) how geological and environmental resources can be used sustainably for assuring future food and water security, and (3) how effective environmental management policies can be developed to conserve landscapes and their resources.

2.7 Summary

Geological and climatic processes have been the primary drivers of landscape evolution in South Africa – as they are elsewhere – throughout its long geological history. The landscapes seen in South Africa today reflect the outcomes of these processes, but can also offer windows into the past where certain features have not been eroded away but are preserved in the landscape. Transformation of the land sur-
face by weathering and erosion has not taken place uniformly, however, but tends to respond to changes in tectonic or climatic conditions as opposed to periods of stability. Human activity in the Anthropocene is dramatically changing the properties and processes of all landscapes everywhere, and this is set to continue and accelerate in the future. Thus, it could be argued that South Africa’s landscapes are now more anthropogenically- rather than geologically-controlled.

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Mapping the Environment, Past and Present

Stefania Merlo

Abstract
Maps are descriptions of space, and as such they are products of societal interest and concerns, which may vary geographically and temporally. What is depicted in maps and how this is done has changed through time. The purpose of this chapter is to review the nature and relevance of maps and mapping in South Africa, from colonial times to the present day, focusing on the use of maps to convey environmental information. The chapter considers human understandings of their surroundings, an abbreviated history of mapping in South Africa through examples of maps, and an overview of the nature and scope of environmental mapping. The process of environmental mapping is then discussed, and examples of environmental mapping in South Africa are provided.

Keywords
Environmental mapping · GIS · Spatial data infrastructure · State of the environment · Thematic map · Topographic map

3.1 Background
Maps are the best known way to visualise geographic data, that is, data that refer to the location and the characteristics of objects or phenomena distributed over space on the Earth’s surface. Through a map, we seek the answer a number of questions: Where is it? What is it? What is it like? Why is it there? How is it changing? (Brett et al. 2013). Maps allow for the location of geographical objects, while the characteristics of the objects represented are conveyed most commonly by the use of colours and symbols (Kraak 2005; Parry 1999). Maps can not only represent tangible physical elements such as elevation or phenomena such as rainfall and temperature, but can be used to compare intangible social phenomena such as the distribution of income in populations or the electoral preferences of a nation (MacEachren 1994). They allow us to explore geographical patterns and to see geographical processes evolving over time such as sediment transport or urban growth. Map displays offer insight into how environmental phenomena such as air quality and public health might relate to one another. Today, maps can also be used to explore human movement patterns in real-time, for instance, captured by and hidden in users’ mobile phones (Kraak and Fabrikant 2017).

The introduction of geospatial technologies such as Global Positioning Systems (GPS) and Geographical Information Systems (GIS), coupled with data acquisition through sensor-led and satellite systems, has revolutionised the map-making process in many ways: (1) by increasing the quality, quantity and variety of geographic information available, both spatially and temporally (Lillesand 2008); (2) by replacing printed maps with GPS as the primary source of positional referencing; (3) by enabling complex spatial and predictive modelling and process simulation (Lahr and Kooistra 2010); (4) by changing the understanding and relevance of some cartographic concepts such as scale and resolution, both representationally and analytically (Miller and Schaezl 2014); and (5) by changing the distinction between map users and map designers (Griffin et al. 2017). These developments have afforded the scientific community and the general public enhanced ways of understanding and modelling the world. They have also elicited discussions about different spatial knowledges and their regimes, and universal representations versus indigenous and local understandings of what surrounds us, and its meaning and significance (Pickering 2014).

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3.2 Mapping of South Africa: A Historical Timeline Through a Sample of Different Maps

Maps are human descriptions of space and as such they are products of societal interest and concerns, which vary geographically and temporally. What is depicted in maps and how this is done has changed through time and can differ between cultures. The history of mapping is a reflection of the power that maps have to show perceptions of the world (MacEachren 1994; Pickering 2014). Maps are not just pictures of the world but also instruments of its creation (Wood 2010). Maps can describe the configuration of physical phenomena on the surface of the Earth or the spatial distribution of social parameters, but have been in the past and are still used as political and military instruments of power for planning and executing wars, claiming territories and resources, creating, collecting taxes, and dividing and distributing land (Krupar 2015; Wood 2010). Ultimately, maps are neither neutral nor value-free or universal (Wood 2010). Printed map production (also known as cartography — see Friendly 2009 for a historical timeline) is only one of the many manifestations of human spatial practices, which include how humans act in and across space, how they move things and ideas through space, and how they construct regions and places and give them meaning (Edney 2011). For this reason, the cartographic ideal, embodied in modern (and western) industrialised countries, with its focus on the processes by which the world is observed, measured, scaled down and redrawn on sheets of paper, has been put to question (Edney 2011). The brief history of mapping of South Africa, presented below, is limited in scope in that it presents cartographic examples of maps produced in South Africa from the colonial period onwards (and often by colonial administrators). It serves, nevertheless, as a point of departure for the documentation of mapping in South Africa, a neglected field of study.

3.2.1 Early Cartography

The first separately printed map of southern Africa is a map of the region’s coastline, produced in Germany in 1513 by Martin Waldseemüller. This map was created without direct knowledge of the area but through information obtained from Arab sources (Duminy 2011). The map defines vaguely the shape of the southern part of the continent but lacks detailed information of any of the interior and in fact it reports, in Latin, *Haec pars Africæ antiquioribus mansit incognita* (This part of Africa remains unknown from antiquity). The version of this map by Lorenz Fries depicted in Fig. 3.1 is an imaginative and decorative revision of the original, and it introduces a number of embellishments that are characteristic of several maps of the region and of the continent of Africa more generally, up until the 1800s, when more consistently, maps transitioned from decorated representations to rigorously measured and symbolised representations with little embellishment. The coastline presents Portuguese names of localities and the empty interior is occupied by anonymous mountains, a lake, *Sapah* (from which three rivers radiate), seated rulers, an elephant, snakes and a mythological lizard, the basilisk. The Mountains of the Moon are shown as the sources of the Nile. In the lower right corner, the king of Portugal (*Emanuælis Regis*) rides a sea monster. The map enshrines the perceptions that Europeans had of the continent of Africa at the time: an unknown and mysterious land, exotic, intriguing but also scary. It is a map of the imaginary.

The Dutch East India Company set up a trading station at the Cape of Good Hope in 1652. The Company made initially little effort to explore the interior or to chart the coastline (Duminy 2011). Following the first exploration by Pieter Potter in 1659, a number of individuals set out to explore and map the interior, with the intent to look for commodities that could be of interest to the Company’s directors (Duminy 2011). The priority of these maps was therefore to provide indications of the routes followed to get to main settlements and resources in the interior, and to chart the locations of mineral deposits, timber, and exotic animals (elephants, giraffes, etc.). The map of southern Africa shown in Fig. 3.2 represents one such effort. The map is one of the many drawings (including illustrations of animals, plants and people) and descriptions that Robert Jacob Gordon, a Dutch army colonel of Scottish descent, made during his four expeditions in the Cape between 1777 and 1786. The original map is held in the Rijksmuseum, Amsterdam, and is nearly 2 m² at a scale of 1:750,000. It contains topographical detail (including barometrically measured elevations) and informative notes and drawings that describe the people and animals of the interior (Duminy 2011).

John Arrowsmith’s (1790–1873) map of southern Africa, published in 1834, is an example of the mapping conducted by the British after assuming control of the Cape in 1795 (Fig. 3.3). The British authorities were ignorant of the extensive surveys and mapping of the coastal areas that had been undertaken under Dutch rule, and they considered the country unmapped (Liebenberg 2008). They were eager to obtain reliable topographic information, in particular since a large part of the colony was inhabited by Boer frontier farmers who had fled from the Cape (Liebenberg 2008), and restarted most of the measuring from scratch using estimates of directions and distances travelled, supplemented by astronomical observations of latitude (Duminy 2011). The map was issued both separately and published in Arrowsmith’s *The London Atlas of Universal Geography* (Duminy 2011). The informa-
tion presented in the map is mostly copied from an older map made in 1830 by L. Herbert, who himself consulted maps made by military and civilian land surveyors and narratives of travellers, and is supplemented through the comparison of several thousand sheets of maps, charts and plans (Liebenberg 2008). It displays eleven magisterial districts and provides historically important documentation of travel and exploration in South Africa. It shows well-worn and new tracks used by explorers and travellers. This and subsequent updates of the map provide one of the best cartographic records of the expansion of the Boer settlements to the north and east of the Cape Colony. The map also shows the approximate location of indigenous groups, assigning a large area to the 'Koras or Koranas'. Arrowsmith’s map was considered the most reliable cartographic representation of southern Africa at the time and was accepted as the standard map of the Colony by the mid-1830s (Liebenberg 2008). Largely compiled from exploratory materials and not based on accurate surveys, Arrowsmith’s map is not planimetrically accurate and would eventually be dismissed by later surveyors. Alongside Herbert’s, it represents the most complete cartographic portrayal of southern Africa of the time and in particular the occupation of the British colony on the eve of the Great Trek (Liebenberg 2008).

3.2.2 Topographic Maps

The genesis of modern topographic maps, traceable to the Dutch occupation of the Cape and initially based on the Land Registry used in the Netherlands, is intimately bound up historically with the system of land registration, whereby the position and extent of all land as originally ceded by the government is recorded (NGI 2013). In the initial system, title deeds were accompanied by diagrams showing boundaries and areas, but the grant of land had not been fixed by survey.
Measurements were carried out by pacing a circular shape of around 4 km radius around a central position (NGI 2013). Efforts were made to improve this system since the early 1800s, but it was only the Land Survey Act of 1927 that established the practice of cadastral surveying in South Africa (Wonnacott 2010). In 1928, experiments commenced with terrestrial photogrammetry which eventually led to a decision in 1936 to map the country at 1:50,000 scale. A 15 year plan was commenced using aerial photography, plane table methods and a variety of photographic interpretation techniques. In 1948 the first photogrammetric stereoplotters were commissioned and the capture of topographical data from aerial photography commenced. By the early 1960s, only 20% of the country had been mapped at 1:50,000 scale, and the complete coverage of South Africa was only achieved in 1976 (Wonnacott 2010). Two major developments required the revision and reprint of 1:50,000 maps: the adoption of the metric system in 1970, which required the re-compilation of about 60% of the country’s contours and was completed in 1992, and the replacement of the Cape Datum – which formed the basis of the South African geodetic system since the 1830s – with the Hartebeesthoek94 Datum in January 1999 (Zakiewicz 2011). The 1:50,000 scale topographic sheets are produced and published by the National Geo-spatial Information (NGI), the South African national surveying and mapping agency, and is a series consisting of a total of 1913 map sheets covering the entire country. A standard 1:50,000 topographical map covers a rectangle of 15 min of latitude by 15 min of longitude, or approximately 640 km². These topographic maps depict the location of natural and built features by means of symbols and colours, and elevations by means of spot heights and contours (generally 20 m intervals). Additional information such as place names, boundaries and magnetic data is also included in the map. A new Computer Assisted Map Production System was introduced in 1997. GIS was used to systematically transfer analogue maps into digital format and value-added products such as digital elevations models and orthophoto maps at a scale of 1:10,000 started being produced. Today, all maps produced by NGI are available in digital format, upon request to the Mowbray offices, both as scanned raster of paper maps and as vector layers.
3.2.3 Thematic Maps

Maps used to record the distribution of variables such as geology, climate, vegetation or a particular ‘event’, such as the location of people who had a contagious illness or the extent of a flood, started appearing worldwide in the 1700s and in South Africa in the later 1800s. These types of maps are a combination of locational information of geographical elements such as hydrology and topography, political boundaries, and a representation of the variable of interest. These are known as thematic maps.

E. J. Dunn’s *Geological sketch map of Cape Colony* was published in 1872 and was based on field observations made by himself and a number of other geologists. Three years later, Dunn visited England and published a more extensive map, *Geological sketch map of South Africa* (1875), which included the Transvaal (Fig. 3.4). This map is a summary of several years of fieldwork, and can be considered the first detailed geological map of the whole union and also the first coloured geological map to be printed in South Africa (Hatch and Chalmers 2013).

Alexander Buchan (1829–1907) was a Scottish climatologist and meteorologist. His map of mean annual rainfall of South Africa (Fig. 3.5) is one of a series of meteorological maps of the country which included monthly rainfall from averages of observations in 1894, and makes use of isolines to show contours of equal value in precipitation on a coordinate grid system (a method developed by Edmund Halley in the early 1700s; Friendly 2007), which are then filled in with the same colour shade. This early weather map is strictly climatological. It is an attempt to chart average conditions over a decade and shows horizontal patterns, without incorporating vertical motions, the representation of which will nevertheless soon be charted in circulation diagrams. Buchan created a series of colour maps showing mean temperatures, isobaric lines, and prevailing winds over the globe for each month of the year and for annual values, which accompanied 347 pages of text and tables in his publication *Report on Atmospheric Circulation based on the observation made on board HMS Challenger during the years 1873–1876 and other meteorological observations* (Royal Society 1914).
The first malaria survey of the Union of South Africa was carried out in 1921 for the Department of Health (le Sueur et al. 1993). This resulted in the division of the country into five scheduled areas, which were geographically recorded on a coloured map. This map (Fig. 3.6) represents, using the same methodology, the results of a similar survey carried out in 1938 (the 1921 map is no longer available). This map was only revised in 2000, informed by case notifications and evidence of the presence of suitable transmission vectors (Morris et al. 2013) and as such it is one of the longest-lived maps in the history of mapping in South Africa.

The last map in this brief history of mapping in South Africa is an environmental map produced from digital datasets in 2011 (Fig. 3.7). This map was created by R. Pravettoni from GRID-Arendal, a Norwegian foundation collaborating with UNEP, and published in Working for the Environment, South Africa by the Department of Environmental Affairs. The aim of the publication was “to inform and educate the general public in South Africa on the vital work currently being done by the government to protect the environment and alleviate poverty” (DEA 2011). The map is designed to show that environmental pressures tend to occur in overlapping geographical areas and result in amplified environmental threats in already disadvantaged regions, through positive feedback loops (DEA 2011). It is different from previous maps in many respects. First, it is the combination of different datasets and variables. It displays primary data such as wildfire locations and high alien invasive plant cover, but also secondary, calculated distributions, such as potential arable land and moderate and severe land degradation. These...
are calculated based on established threshold parameters and are not measured directly in the field. Second, the map is not meant for administrators or experts but for the general public, and as such is devoid of jargon, does not make use of grid coordinates or scales, and is very easy to interpret. It is an example of a new generation of maps in South Africa that combine complex and varied datasets and are conceived for the general public (Grainger et al. 2016).

### 3.3 Environmental Mapping and Its Process

Whilst the first forms of environmental mapping are known from the eighteenth century (Pereira et al. 2018), the interest in environmental mapping has greatly increased in parallel with the increasing interest in environmental monitoring and reporting after the Rio Conference in 1992, when the Rio Declaration on Environment and Development and Agenda 21 were adopted (United Nations 1992) and people recognised the need for sound environmental information for improved decision-making (CBD 2010). Ultimately, protecting the environment from increased human-driven detrimental impacts has been recognised as a priority, including evaluating the physical, chemical and biological factors that impact on the environment and predicting trends in environmental degradation and amelioration (Artiola et al. 2004). In South Africa, this value is embodied in the Constitution (Act 108 of 1996, section 24) and National Environment Management Act (NEMA) Act 107 1998, which state that every person living in South Africa has the right to an environment that is healthy and not harmful to their wellbeing, and the right to have the environment protected from degradation.

Environmental mapping, the process of collecting and representing spatially-referenced data about the environment (Armitage 2010), provides a framework not only for understanding, modelling and determining the state of the environment but also for assessing and predicting environmental impacts and trajectories. It is not an end product, rather a process consisting of various operations, namely data acquisition, data processing, data storage, analysis and visualization, all driven by decisions around what aspects of the environment are to be mapped, for what reason, and for the interest of which stakeholder (Armitage 2010).

Environmental mapping is used for a wide variety of purposes: monitoring, modelling, planning, policymaking, man-
Fig. 3.6 Malaria areas in the Union of South Africa. The map created with information collected during a survey by the Department of Public Health in 1938 and printed in Pretoria in 1941. The malarial areas are subdivided in four colour classes representing a different risk of infection, from slight to continuous. (Source: University of Cape Town Libraries)
management of risk and hazards, or meeting sustainable goals (Dutt 1982). Mapping biodiversity and ecosystem services (Martínez-Harms and Balvanera 2012), environmental sensitivity and impacts (González Del Campo 2017), environmental risks, including health and ecological risk (Lahr and Kooistra 2010) are all forms of environmental mapping (Armitage 2010). Environmental data and processes are heterogeneous and extremely complex and they vary both spatially and temporally. Mapping environmental data requires consideration of issues of scale, representations of uncertainty, and levels of analysis. At a data collection level, the increased data acquisition capabilities provided in particular through remote sensing methods have led to an exponential rise and availability of environmental data. At an analytical level, the introduction of geospatial technologies and their possibilities of not only describing the state of an environment but also modelling, predicting and simulating the processes and evolution of environmental interactions, and multidimensionally, has been pivotal in this development in environmental studies (Pereira et al. 2018).

3.4 Examples of Environmental Mapping

3.4.1 State of the Environment Reports

Much of the environmental data collected and analysed at different levels and by different Departments in South Africa is disseminated today through National, Provincial and Specialist State of the Environment reports. A State of the Environment report describes the state of the environment for a defined city, region or country. These reports are used to assess and monitor changes in the environment and to plan environmental management. They are organised based on
themes that can be specific areas of concern (e.g. waste management, human settlements) or can analyse a number of identified issues in these areas (e.g. air quality, waste pollution, water quality). Indicators serve as the measurable properties of the environment and these are derived from environmental data, collected from direct measurements and observations. Indicators have a central role in a State of the Environment report and in environmental mapping since they are designed and used to describe the status of a specific aspect of the environment, to monitor environmental conditions, and to present information about the biophysical environment and related socioeconomic interactions (Fig. 3.8). For the purpose of comparability, indicators tend to be consistent across different reports but they can be updated and re-formulated in response to the evolution and change of the environment, and the policies and practices aimed at protecting it (DEA 2012).

The first comprehensive National State of the Environment report of South Africa was launched in 1999 by the then Department of Environmental Affairs and Tourism (DEAT, now Department of Environmental Affairs, DEA) (DEAT 1999). A second report, known as the South Africa Environment Outlook (SAEO), was published in 2006 (DEAT 2006). The third report, called 2nd SAEO, was published in 2012 (DEA 2012). Since the early 2000s, the DEA has produced sectoral reports which cover The State of Vegetation Report, The State of Estuaries Report, The State of Rivers Report, and The State of Oceans Report. These reports are aimed at providing a range of users, from non-specialists to decision-makers whose primary field may not be the environment, a user-friendly overview of the state of the environment and its trends over time. In its final format, a State of the Environment report combines text, statistical data in the form of charts, graphs and tables, and includes maps’ for single and combined indicators of the state of the environment. Whilst the DEA coordinates the process of production of these reports at a national level, various other government departments, parastatatal bodies and private companies contribute to the assessment, in particular in terms of data collection, collation, map production and review of the different specialist chapters (DEA 2012).

3.4.2 Internet-Based Environmental Mapping

Numerous examples of environmental mapping-based applications can be found on the internet. Two examples of internet-based environmental data repositories and mapping services are the Environmental Geographic Information Systems (E-GIS) webpage and BGIS (Biodiversity GIS) managed by the South Africa Biodiversity Institute (SANBI), both under the umbrella of the DEA.

The Environmental Geographical Information Systems (E-GIS) webpage (available at https://egis.environment.gov.za) provides access to baseline environmental geospatial data, printable maps, interactive mapping tools and map services to government as well as public users. The DEA initiated the development of a natural resource information system in the early 1990s using initially ad hoc developed software, replaced by Arcview in 1994 and ArcGIS Online in 2016. Transitioning from paper maps and gazetteers for information such as the location and extent of protected areas, which requires regular updates, was a strategic goal towards increasing the availability of environmental datasets to all stakeholders in the environmental sector (interview with Deon Marais and Lisa Pretorius, DEA, 3 November 2017). The web portal allows for two types of interaction with datasets: static (through download), and dynamic, through interaction with the databases via a live, browsable map. Data downloads are possible for layers such as South Africa Protected (SAPAD) and Conservation (SACAD) areas (updated quarterly), renewable energy data, geographic area data and land cover maps (1990 and 2013 datasets). Access to the data requires the creation of a user account with a valid email address. The interactive menus allow registered users not only to interact with maps by zooming and interactions between layers, but also to comment on or upload information such as supporting documentation and GIS data, to improve the Protected Area Database or the Renewable Energy EIA applications map. This service provides a basic level of environmental mapping.

BGIS provides very similar services to E-GIS for biodiversity datasets. Additionally, it provides a Land Use Decision

![Fig. 3.8 Relational pyramid of primary data, analysed data, and indicators in the assessment of environmental issues by theme, conducted for State of the Environment reports. (Source: DEAT 1999)](https://egis.environment.gov.za)
Support (LUDS) tool, created with the intention of assisting environmental practitioners in performing a basic environmental assessment. The tool provides the user with the most relevant conservation plan or biodiversity dataset for each land parcel in South Africa. The user can locate their area of interest and print out a report listing all the biodiversity features on that land parcel. The user may also create and attach a map of the area in question to the report submitted within an EIA exercise. BGIS is available at http://bgis.sanbi.org/LUDS/Home.

These examples describe the final stage in the environmental mapping process – visualisation (Kraak 2005; MacEachren 1994) – but they also demonstrate one of the key roles of an environmental mapping project which is providing a visual record of an aspect of the environment (Bishop et al. 2013; Grainger et al. 2016).

3.5 Summary

Maps are spatially and temporally situated and their creation is dependent on a number of preoccupations and priorities of the map makers, map commissioners and to some extent the map users. Printed maps of South Africa made their first appearance in the sixteenth century. Soon after this, the Dutch and British colonial administrations started map production in the region. This was mainly aimed at land (and resource) evaluation, distribution and administration. Early thematic maps of the country were produced in the 1800s and include weather, geological and disease maps. Today, various government and parastatal organizations produce and disseminate topographic and thematic maps of South Africa, in printed form and increasingly via web-based platforms. Environmental mapping, the process of collecting and representing spatially referenced data about the environment, has become a priority in South Africa since the mid-1990s, in response to the realisation that protection of the environment is a fundamental human right. State of the Environment reports are produced by the Department of Environmental Affairs and Tourism to assess and monitor changes in the environment and plan environmental management at national and regional levels. These reports, and various online platforms for the access and distribution of environmental data, represent an attempt to make maps accessible not only to specialists but to the general public.

References


Minerals and Mining in South Africa

Paul A. M. Nex and Judith A. Kinnaird

Abstract

Mining in southern Africa has a long pre-colonial history. Haematite mining in Swaziland can be traced back more than 40,000 years, iron smelting dates from 400 AD or earlier, and copper from 900 AD. The most iconic evidence for pre-colonial mining are the gold artefacts from Mapungubwe dated between 1220 and 1300 AD. In 1681, early Dutch colonists became aware of the copper in the Northern Cape and so began the colonial interest in the metals of South Africa. Since then, diamonds were discovered in 1866 with several large stones still being found. Gold was discovered in Barberton in 1884, then in the Johannesburg goldfield in 1886. Both continue to contribute important sources of revenue to the South African economy. Production of platinum metals began from the Merensky Reef in 1926, leading to South Africa now producing 78% of the world’s platinum. Other world-class deposits of the modern era include iron from Sishen and manganese from Kuruman.

Keywords

Diamonds · Gold · Mining · Minerals · Platinum · South Africa

4.1 Introduction

The mineral wealth of South Africa has been exploited by Homo sapiens for at least 40,000 years and has provided many and varied commodities including gold, platinum and diamonds. This chapter provides a historical perspective on minerals and mining mainly in South Africa, although it does occasionally stray across the borders into neighbouring countries. Mining in South Africa has underpinned the modern economic development of the country, while it is possible that the industry has now passed its peak and is a sunset industry as the gold and platinum mines go ever-deeper to exploit new resources. The production of gold and diamonds is certainly well down from peak production in the 1970s, but South Africa is still the sixth largest producer of both diamonds and gold globally. Despite the decline in production, South Africa is also host to the largest resources of gold still in the ground. It is the world’s largest producer by volume of platinum, rhodium, manganese, titanium, chrome, aluminosilicates and vermiculite. It is the second largest producer by volume of palladium, antimony, vanadium, rutile, ilmenite and zirconium. South Africa is also the world’s third largest iron ore supplier and the sixth largest coal exporter, both by value. Details on the geology and exploitation of coal deposits are beyond the scope of this chapter and the interested reader is referred to Hancox and Gotz (2014) and references therein.

4.2 The Precolonial Era

The precolonial inhabitants of southern Africa exploited metallic mineral deposits principally for iron, copper, tin and gold. Where this took place depended on finding favourable geology and typically the occurrence of mineralization at the surface. The earliest mining known in southern Africa, and possibly the world, is believed to have taken place 43,000 years ago at the Lion Cave, Ngwenya Mine in Swaziland by ancestors of the San people (Coakley 2000). At this site, long before the days of Cleopatra and Helen of Troy, hematite (iron oxide, Fe₂O₃) was mined for cosmetics probably to beautify men and woman, and later red oche was mined probably for rock paintings. Mining continued until 23,000 years ago with no evidence for further activity until about 400 AD (Dart and Beaumont 1969). This phase of mining did not require developed metallurgical techniques for mineral separation and smelting of the ore, which did not
start until about 2000 years ago (Miller 1995). Various sites across South Africa have provided evidence for more technologically advanced iron and copper exploitation, including furnaces, from approximately 400 AD until the 1860s. This includes at Broederstroom (850 AD), Amamzimtoti (850 AD), and Melville Koppies (1050, 1860 AD). In contrast to the early exploitation in Swaziland, this later phase produced iron for utilitarian uses, principally tools and weapons. Iron was the most important metal in the culture and economy of the Iron Age people (100–1840 AD; Huffman 2009). Early evidence of iron smelting comes from Broederstroom (near Hartebeespoort Dam), where slag, iron ore, and charcoal have been found next to the excavated remains of smelting furnaces (Frieke 1980).

Copper was probably chronologically the next metal to be exploited in South Africa from the carbonatites of the Phalaborwa syenite-pyroxenite complex, the hydrothermal copper deposits near Musina in the Limpopo Valley, and the Nabbabeep-Springbok area in the Northern Cape. There is little remaining evidence for precolonial workings at Musina as modern mining activities have largely removed traces of early exploitation. These are thought to have been active from 900 to 1500 AD (Hammel et al. 2000).

At Phalaborwa, the original copper workings around what is now the Palabora copper mine focused on the now-mined-out Lolwe Hill (Loolekop) where copper occurred in an oxidized zone within the minerals malachite (copper carbonate, Cu₂CO₃(OH)₂) azurite (copper carbonate, Cu₃(CO₃)₂(OH)₂) and chrysocolla (copper silicate, (Cu,Al)₂H₂Si₂O₅(OH)₄.n(H₂O)) (Fig. 4.1a). These minerals are strongly coloured and probably enabled the discovery of this mineral deposit by indigenous people. The archaeology and ethnography of Lolwe is described by Van der Merwe and Scully (1971). Lolwe was a site of mine shafts, galleries and adits, which were exposed during blasting as part of modern mining operations. Horizontal galleries and vertical shafts were exposed, and a rough estimate by mining engineers indicates that well over 10,000 tons of rock containing secondary copper ore had been removed from the hill before the start of modern mining (van der Merwe and Scully 1971). According to Van der Merwe and Scully (1971), some of the excavations were small enough to suggest that child labour was used. Within the larger Phalaborwa area, numerous smelting sites occur and age dates from the precolonial mining and processing activities range from 1000 to 1880 AD. When Karl Mauch, a German explorer, visited the area in 1868, mining and smelting were still taking place although these activities had ceased by 1880 (Killick et al. 2016).

In 1681, early Dutch colonists were made aware of copper and iron in the Northern Cape that were being used by indigenous peoples for ornaments and functional articles. The abundance of copper within their society and the display of copper ore led to several colonial expeditions toNamaqualand, although these early expeditions were not particularly successful and did not result in colonial mining (Smallberger 1975). They did however lead to a further expedition in August 1685 by Simon van der Stel, 6 years after he had become commander of the Cape of Good Hope. There is little archaeological context for precolonial mining in the area and some debate still exists as to whether the copper was obtained locally or traded from other areas, or possibly both (Miller 1995).

Tin was mined from the Rooiberg area at least 500 years ago, based on the dating of an old timber prop (to 1515 AD; Friede and Steel 1976) and of a piece of charcoal in a tin ingot (Grant 1994). These are the only precolonial tin mines known from sub-Saharan Africa (Chirikure et al. 2010; Heimann et al. 2010). In these deposits, tin occurs as the mineral cassiterite (tin oxide, SnO₂) in hydrothermal veins related to the granites of the Bushveld Complex. In places, both vein-style deposits and also alluvial cassiterite were mined. A significant smelting industry developed in the area, and tin-smelting slags at two sites near Rooiberg date between ~1650 and ~1850 AD (Chirikure et al. 2010). Baumann (1919) estimated the amount of ore mined in the Rooiberg Valley before 1905 at about 20,000 tons, and thought that some 2000 tonnes of tin ore might have been produced from it. A more recent estimate by Rooiberg mine geologists gave the total mass of rock mined before 1905 as 180,000 tonnes, with 1000 tonnes of tin ore (Chirikure et al. 2010). It is thought that the tin was traded with the societies based in Great Zimbabwe and Mapungubwe as this is where tin artifacts have been found.

At Rooiberg, the cassiterite coexists with chalcopyrite (copper sulphide, CuFeS₂) and pyrite (iron sulphide, FeS₂) and it is possible copper and iron were mined at Rooiberg before tin. However, the volume of copper present is much less than the tin (Fig. 4.1b). Two radiocarbon dates on charcoal trapped in an arsenical copper ingot found at surface, from the Rooiberg Valley, are between 1025 and 1285 AD (Grant et al. 1994).

It is notable that most archaeological information on precolonial mining in southern Africa relates to utilitarian commodities such as iron, copper and tin. Conversely there is relatively little evidence for the exploitation of gold deposits, possibly because insufficient research or detailed excavations and analysis have been done. In a comprehensive study of precolonial mining in Zimbabwe, Summers (1969) concluded that it is likely that gold was mined in Zimbabwe from ~700 individual gold mines by indigenous peoples from 600 AD until approximately 1700 AD. Perhaps the most iconic evidence for early gold mining in the region is the golden rhinoceros from Mapungubwe found with many...
Fig. 4.1 Examples of South African minerals and rocks. (a) Secondary copper minerals azurite (left) and malachite (right); (b) polymetallic vein with a quartz-chalcopyrite core and cassiterite at the margins from the Rooiberg tinfield; (c) restored ‘Cornish’ engine house at the Okiep Mine in Namaqualand, now a national monument; (d) shard of diamond within a sample of kimberlite; (e) skeletal octahedral gold crystals on quartz from the van Dyke Mine, Benoni; (f) layers of anorthosite and chromitite at the national monument site of Dwars River in the eastern Bushveld near Steelpoort.
other gold artefacts in a burial site which dates to 1220–1300 AD (Meyer 1998). So far, no provenance studies have been published which conclusively show where the gold found in Mapungubwe was mined. As Mapungubwe and Great Zimbabwe thrived in the same period, it has been suggested that the gold was derived from Zimbabwean gold mines.

4.3 Colonial to Modern Industrial Mining: Diamonds, Gold and Platinum

In 1685 when Simon van der Stel set out on his expedition to the Northern Cape, he was guided to a hill just east of the present town of Springbok which became known as Koperberge (Copper Mountain). While this was the start of colonial mineral exploitation, commercial extraction of the copper in the area only commenced in 1852, once a suitable export harbour at Hondeklip Bay had been identified. Early colonial miners brought expertise from Europe including tin and copper miners from Cornwall (Fig. 4.1c). The high-grade copper ore comprising mainly chalcopyrite, bornite (copper sulphide, Cu₉FeS₃) and chalcocite (copper sulphide, Cu₂S) was shipped overseas for smelting. The deposits are associated with structurally controlled, igneous intrusions of pyroxenite, norite and anorthosite. Production was from several small mines which became consolidated into two companies in 1862; the Cape Copper Company and the Namaqua Copper Company, and ultimately into a single company (the O’okiep Copper Company) by 1939 (Cairncross and Dixon 1995). The deposit at O’okiep was the richest copper mine in the world during the 1870s, followed by Nababeep, Concordia, Spektakel and Carolusberg, all found around Springbok. Most of the mines had been closed by 1995 with the exception of Nababeep which operated on a small-scale basis until the early 2000s.

The industrialization of South Africa has been considered by several to be associated with the rapid economic changes that took place in South Africa from the 1870s onwards, associated with the discovery of diamonds near Kimberley (1866) and gold on the Witwatersrand (1886), and the subsequent need to create a permanent workforce and the formation of a unified industrialized nation. This has resulted in Africa’s most advanced and richest economy.

4.3.1 Diamonds

The discovery of diamonds in South Africa is credited to a 15-year old, Erasmus Jacob, in 1866. He picked up a ‘shiny’ stone while playing with friends on the banks of the Orange River near Hopetoun (Lynn 1998). It proved to be a 21.25 carat diamond (the Eureka diamond). Three years later in 1869, a Griqua shepherd sold an 83.5 carat diamond to a farmer, Schalk van Niekerk, for 500 sheep, ten oxen and a horse! The stone, which became known as The Star of Africa, started a diamond rush along the banks of the Vaal and Orange rivers. Initially diamonds were recovered from alluvial sources and it was not until later that the miners realised that the diamonds were found particularly associated with rock they termed yellow earth and blue ground. These were in fact igneous rocks that later became known as kimberlite, and is the first example of a rock named after a feature in South Africa (Fig. 4.1d).

In the spring of 1870, a 50 carat stone was found on the farm Jagersfontein, Free State Province, although it would not be until much later that this was recognised as the first diamond from a primary kimberlite pipe source (Lynn 1998). The discovery of several other pipes at Dutoitspan and Bultfontein followed, which led to thousands of diggers flocking to the Kimberley area. Further discoveries and the development of the ‘Big Hole’ at Kimberley were followed in 1888 by an amalgamation of most of the mines into a single company, De Beers Consolidated Mines, headed by Cecil John Rhodes.

The Kimberley cluster of kimberlites is not the sole source of diamonds in South Africa. There are diamond mines at Cullinan near Pretoria, and at Venetia close to the border with Zimbabwe (Fig. 4.2). In addition, alluvial diamond mines along the Vaal and Orange rivers together with marine operations north and south of Oranjemund, the mouth of the Orange River, have also provided significant output. In 2003, the De Beers operations accounted for 94% of the nation’s total diamond output (USGS 2003). This figure includes both gem stones and industrial diamonds. Since then, De Beers has sold a number of its mines in South Africa, although these mines continue to produce, with Petra Diamonds at Cullinan, finding a flawless colour D, 138 carat diamond in 2016.

4.3.2 Gold

The site of the first commercial gold mine in South Africa is not well known, nor is it close to any major goldfield. According to Ward and Wilson (1998), the Eersteling gold mine in the Pietersburg Greenstone Belt, was discovered in mid-1870 and is a vein-hosted deposit where the gold occurs predominantly as native gold. Mining commenced in 1871 and produced 10 kg of gold by the end of 1875, and in 1877 the operations closed. There have been several attempts to reopen the mine and exploration has sporadically continued in the area. This initial mine provided impetus for further exploration and prospecting which led to the discovery of the MacMac gold fields on the Transvaal Escarpment in 1873 followed by the Pilgrims Rest goldfield later in the year by Alec ‘Wheelbarrow’ Patterson. These were initially alluvial gold mining operations, and by the 1890s more costly under-
ground operations were in progress. The consolidation of several Pilgrims Rest mines led to the listing of the first South African gold mining company on the London Stock Exchange, the Transvaal Gold Mining Estates, which continued mining in the area until the mid-2000s (Ward and Wilson 1998). Currently there is no commercial mining in the Sabie–Pilgrims Rest gold field, although exploration and the assessment of remaining deposits continue.

Barberton, the site of some of the world’s oldest and most unusual rocks, was the next goldfield to be found by prospectors in 1881. Initially discoveries by Tom McLachlan in a malarial area were followed by those in the Moodies Hills, southwest of Barberton by Auguste Roberts (‘French Bob’) in an area more conducive to prolonged mining. The town of Barberton was founded in 1884 and the area became a significant destination for prospectors from all over the world, especially after the discovery of the Golden Quarry in 1885 (Anhaeusser 2012). The history of the goldfield is similar to any other boom area, and there are still four operating mines in the vicinity; Sheba, New Consort, Fairview and Barbrook,
which together with the Lily mine have produced ~70% of the gold from the area. The Sheba mine, which started operating in 1885, can justly claim to be the oldest continuously operating gold mine in South Africa.

In addition to these discoveries of vein-hosted gold deposits at Eersteling, Pilgrims Rest and Barberton, vein-style gold was discovered by the Streuben brothers in 1884 in Randburg close to what was to become Johannesburg. These were the precursors to the discovery of the world’s largest repository of gold, the deposits of the Witwatersrand. Then, in 1886, on the farm Langlaagte, the Main Reef and the Main Reef Leader were discovered. The two men who are most closely associated with this were George Harrison and George Walker who were working on local farms and panning for gold in their spare time. The rocks in which the gold was found were unlike any other gold deposit then known. They were conglomerates, with large quartz pebbles in a fine-grained matrix and were particularly unlike the quartz veins which hosted the other deposits in South Africa (Fig. 4.1e). A major gold rush followed and within 10 years South Africa was producing 23% of the world’s gold.

The gold rush on the Witwatersrand resulted in thousands of foreign workers flocking to the region and ultimately this contributed to increased political tensions in the area and the Anglo-Boer War in 1899–1902. After the war, ownership of the consolidated diamond and gold mines became further concentrated in the hands of a few entrepreneurs, largely of European origin, known as the randlords, including Barney Barnato, Cecil Rhodes, Alfred Beit and Julius Wernher. After the First World War, this changed with the formation of mining houses whose interests were multinational including Anglo American and Consolidated Goldfields.

Throughout the rest of the twentieth century the gold mining industry continued production, significantly contributing to the South African economy. Gold production peaked in 1970 at approximately 1000 tonnes of gold and accounted for over 80% of the world’s gold production. It has declined since due to increased mining depths and increased cost of production. In 2002, South Africa had 15% of the world’s gold production and 12% in 2005. In 2016, production was 140 tonnes per year and South Africa was the world’s seventh ranked producer behind China, Australia, Russia, the USA, Canada and Peru. In 2002, the US Geological Survey estimated that South Africa held about 50% of the world’s gold resources, and 38% of its gold reserves.

The mining expertise and capabilities of South African miners are world class. Of the world’s ten deepest mines, eight are gold mines on the Witwatersrand goldfield. Currently, the deepest is Anglo Gold Ashanti’s Mponeng Gold Mine, southwest of Johannesburg, with operations ranging from 2.4 to 3.9 km below surface, producing in the region of 250,000 oz of gold per year. At these depths, the temperature of the rocks is approximately 60 °C, and South Africa leads the world in underground refrigeration techniques.

4.3.3 Platinum and Palladium

The discovery of platinum in South Africa probably dates back to the late 1800s (Cawthorn 2007), when concentrates from Witwatersrand gold mines and from chromitite layers in the Bushveld Complex were analysed and found to contain the metal. The mining of platinum from veins in the Waterberg (1923–1926) and the discovery of platinum in the eastern Bushveld by Lombaard and Hans Merensky (in 1924) is well documented (Cawthorn 1999; McDonald and Tredoux 2005), however these accounts typically refer to the presence of platinum nuggets (native or elemental platinum) and are not specific as to the identity of the platinum minerals. According to Spencer (1926), ‘minute specks’ of sperrylite (platinum arsenide, PtAs) were noted from nickel mines west of the Pilanesberg, later surpassed by the largest sperrylite crystals then known, found on the farm Tweefontein north of Mokopane (then Potgietersrus). One of the notable crystals of sperrylite was donated to the British Museum where it is still on display. In a more recent study, Oberthur et al. (2004) noted more than 40 species of platinum group minerals from alluvial grains found in the eastern Bushveld. This is unique, and South Africa can probably claim to be the home of platinum group minerals, of which there are 135 named discrete phases (O’Driscoll and González-Jiménez 2016).

South Africa produces more platinum and similar metals than any other nation. In 2005, 78% of the world’s platinum was produced in South Africa, along with 39% of the world’s palladium. Over 163,000 kg (5,200,000 oz) of platinum was produced in 2010, generating export revenues of US$3.82 billion. Currently, Russia and South Africa are the biggest palladium producers in the world. No discussion on platinum mining would be complete without mention of the Marikana massacre. In 2012, miners at the Lonmin Mine close to Rustenburg went on strike. A series of violent confrontations occurred between the striking platinum mine workers and the South African Police Service on 16 August 2012. The skirmishes resulted in the deaths of 30 miners and 4 protestors, and injuries to an additional 78 miners.

Recent discoveries and expansion of mining in the northern limb of the Bushveld Complex is potentially resulting in the focus of world platinum mining operations shifting from Rustenburg to Mokopane. New underground mines are being developed at shallower depths than those currently on the western limb, and also with a greater mining width which allows for increased mechanisation of operations. With
potential labour unrest in the mining sector, increased mechanisation is becoming more attractive.

4.4 Other Mines and Minerals

The Bushveld Complex of South Africa has been described as the largest repository of magmatic ore deposits in the world (Willems 1969). Apart from platinum and the other platinum-group metals mined from the UG2 chromite layer, the Merensky Reef and the Platreef, there are other commodities mined from within the Complex and its environs. Copper and nickel are obtained as byproducts from the Merensky Reef and Platreef while a related intrusion of similar age, Uitkomst-Nkomati, is the site of South Africa's only nickel mine.

The presence of chromite in the Bushveld Complex was first noted by Carl Mauch in 1865 in the Hex River near Rustenburg, although it was not until 1908 that comprehensive reports on the mineral were written by Hall and by Humphrey (Schurmann et al. 1998). Small-scale production of chromite began in 1916 on the farm Goudmyn 337KT and on Mooihoek 255KT in 1917. Commercial chromite production began in 1924 in both the Burgersfort and Steelpoort areas (Schurmann et al. 1998). Chromite is now mined at a number of sites around the Bushveld Complex, ultimately leading to South Africa becoming a major world producer of chromite ore and chromium for use in stainless steel and for a variety of other industrial applications. It should be noted that chromium is the element, chromite (iron chromium oxide, FeCr2O4) is the most important mineral of chromium, and chromitite is a rock containing a significant amount of the mineral chromite. The chromitite layers of the Bushveld Complex are world famous and their origin and the origin of igneous layering are still debated amongst geologists (Fig. 4.1f).

In the upper part of the Bushveld Complex, magnetitite layers occur which contain an appreciable amount of vanadium within the magnetite, which has been exploited since 1957. Most vanadium is used as an alloying component in steels, and several vanadium alloys show superconducting behaviour. South Africa produces approximately 16% of the world’s vanadium pentoxide and contains ~18% of the world’s reserves (USGS 2017). The production of vanadium and the economics of mining vanadium on the Bushveld are strongly linked to the price and production of steel.

Fluorite (calcium fluoride, CaF2) is found associated with Bushveld granitic rocks and tin deposits where it has been produced as a byproduct. Currently, the world’s largest single fluorite deposit is situated 67 km north of Pretoria at Vergenoeg within the Bushveld Complex. Here, fluorite occurs within an intrusive pipe-like body where it is mined in an open pit operation. Fluorite is used mainly either for the manufacture of hydrofluoric acid or as a flux in the steel industry. South Africa produces approximately 0.13 Mt of fluorite annually and has the world’s largest reserves of about 41 Mt.

The tin deposits at Rooiberg have already been mentioned in the context of precolonial mining. These and other tin deposits at Zaaiplaats, Stavoren and some smaller localities were mined of which the deposits at Rooiberg were the most important, producing 60% of the tin associated with granites of the Bushveld Complex. Mining continued until the 1990s at Rooiberg and Zaaiplaats while the collapse of the international tin cartel and decreasing grade resulted in the closure of all the tin mines. Currently, exploration and evaluation is underway at some of the deposits although it remains to be seen if they will be economically viable at current tin prices.

Apart from mineral deposits hosted by and associated with the magmatic rocks of the Bushveld Complex, there are deposits of minerals which have formed as a result of the metamorphism and circulating hydrothermal fluids associated with the Bushveld Complex. Shales which are stratigraphically below the intrusion have been heated to temperatures greater than 550 °C and this has resulted in the formation of the mineral andalusite (aluminium silicate, Al2SiO5) in rocks of appropriate chemical composition. The deposits are located around the periphery of Bushveld Complex and represent the world largest resource of andalusite used in refractory materials for blast furnaces and also in ceramics. Deposits which are thought to have formed as a result of hydrothermal fluid circulation include the lead-zinc +/− fluorite deposits of the Zeerust area and the now-closed Pb-Zn mine at Pering. Lead is typically extracted from the mineral galena (lead sulphide, PbS) and zinc from sphalerite (zinc sulphide, (Zn,Fe)S). Whilst the use of lead has declined in recent years, largely due to environmental reasons, the use of zinc continues to increase, principally through its use as an anti-corrosion agent exemplified by galvanized iron or steel. The Pering deposit, together with the other zinc resources in the Northern Cape such as Gamsberg, may be locally important but are not however of world-class size.

Another significant mining area in South Africa is the Sishen–Kuruman area where large opencast mines for iron and manganese occur in sedimentary rocks. At Sishen, the 14 km-long iron ore mine is one of the biggest open-pit mines in the world and has produced more than 900 Mt of iron ore. It still contains 860 Mt of likely reserves and operations there are expected to last about another 20 years. Its importance has resulted in a dedicated railway line to the coast at Saldanha together with its associated iron ore terminal. In the Kuruman area, opencast manganese mines are situated on the world’s largest known land-based manganese deposit and the world’s largest manganese resources of the Kalahari Manganese Field. These were discovered in 1907 and early exploration and small-scale mining took place until
about 1955. Manganese occurs as a variety of generally black and brown minerals, mainly oxides and hydroxides, the most abundant of which are rhodochrosite (manganese carbonate, MnCO$_3$) and braunite (manganese silicate, Mn$^{2+}$Mn$^{3+}$O$_{4}$SiO$_4$) (Cairncross and Beukes 2013). The full delineation of the known deposits and development of large commercial operations, including underground mines, principally by Assmang and Samancor, occurred from 1955 to the present day. Manganese is principally used in steel and aluminium alloys and there are no satisfactory substitutes. These deposits are world class and although they do not attract the publicity of the gold and platinum mines elsewhere in South Africa, they have produced over 80% of world production in 1998.

### 4.5 Summary

The triumvirate of the Bushveld Complex, the Kalahari Manganese field and the Witwatersrand goldfields are unique deposits and have resulted in the South Africa that we see today. However, one of the legacies of the gold mining on the Witwatersrand is the numerous mine dumps of waste material. Many of these dumps have been, or are being, re-exposed to extract small amounts of remaining gold, however re-exposing minerals such as pyrite (FeS$_2$) can lead to acidification of stream runoff and the associated problems of acid mine drainage. Minor amounts of radioactive minerals including uraninite (UO$_2$) may also occur as dust particles blown from the dumps, which may have a deleterious effect on the local environment. Lack of pumping and appropriate mine closures with environmental rehabilitation are also an issue to today’s South Africa. It is unclear who is responsible for the costs involved in rehabilitating abandoned mines.

South Africa’s mines and minerals continue to be of vital importance to the country’s economy. In a time of volatile commodity prices it is difficult to know when or if the next mineral boom will occur. Current rapid changes in technology and recussing to more environmentally-friendly technologies, together with mitigation of global climate change, may alter the world landscape of mining. The choice between fuel cell or electrically powered vehicles has the potential to change the platinum mining landscape in South Africa. New critical metals such as rare earth elements may become as important as gold and copper production was in the past. What will happen in the future is difficult to predict although it is likely that mining and minerals will still form a major component of the South African economy.

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Climate Change During the Late Quaternary in South Africa

Jasper Knight and Jennifer M. Fitchett

Abstract
Climate changes during the Quaternary (last ~2.6 million years) were extremely important in shaping the land surfaces, environments and ecosystems that are present today, and in providing the conditions under which human evolution could take place. Although this period was well marked in the northern hemisphere by cycles of cold ice ages and warmer interglacials, the late Quaternary record in South Africa is more subdued but can be elucidated from a wide range of palaeoenvironmental and palaeoclimatic proxies including landforms and sediments, fossils of biological remains such as pollen, and from isotopes. These records indicate that regional changes in sea level and fluctuations in moisture availability were the primary consequences of the global scale climatic changes that took place throughout this period.

Keywords
Biological records · Climate proxies · Isotopes · Modelling · Palaeoclimate · Sediments

5.1 Introduction

The Quaternary System refers to the most recent time period of Earth’s history, from 2.595 million years ago until present, and is split into two shorter periods known as the Pleistocene and the Holocene (Cohen and Gibbard 2011). The Pleistocene (up to 11,700 years ago) of the late Quaternary is best known for the cyclical development of continental-scale ice sheets, commonly known as ‘ice ages’. The warm Holocene epoch refers to the last 11,700 years. Climate and environments in South Africa during the Holocene are discussed by Fitchett (this volume). This chapter is concerned with climate and environments during the preceding Pleistocene, but for ease we use the term ‘Quaternary’ to refer to this earlier time period since this term is more widely known. In detail, however, this chapter mainly discusses the last ~120,000 year BP of the late Quaternary, during the last interglacial–glacial–interglacial cycle, the period for which the most comprehensive evidence of climatic and environmental change in southern Africa is available. During global glaciations, extensive ice cover developed, in particular on northern hemisphere continents. These ice sheets had an overwhelming impact on regional topography, land surface processes, environments and ecosystems. The southern hemisphere did not experience such widespread development of ice sheets (apart from in southern South America), and southern Africa was almost entirely without glaciers except for possibly some small examples in isolated, high-elevation sites. Thus, inferences of climate and environmental changes during the Quaternary in the southern hemisphere generally, and in South Africa in particular, are based on non-glacial proxy records. The different proxies used cover a range of climatic and environmental settings, yield different types of information on palaeoclimatic and palaeoenvironmental change, and can be dated using different absolute and relative-age techniques depending on the type and estimated age of the material.

The absence of widespread glaciation in southern Africa during the Quaternary ice ages has several important implications for landscape evolution. These implications, in turn, present unique challenges for establishing a high resolution, accurate chronology for climatic and environmental events at this time. The absence of glacial erosion has meant that weathered or loose materials have not been stripped from the land surface. Across South Africa, land surfaces therefore retain a variable but sometimes thick sediment cover that has accumulated over a very long time period (possibly millions of years) and only moved slowly by subaerial processes such as fluvial erosion and mass wasting. Geomorphological, modelling and dating studies show the longevity and age of

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In the absence of instrumental data, climates and environments of the past are reconstructed from proxy or indirect data sources. A variety of proxy data can be used in southern Africa. In this chapter, we (1) discuss the main types of evidence for climate and environmental changes during the Quaternary in South Africa, and then (2) identify some future research directions.

5.2 Evidence for Climate Change in Southern Africa

In the absence of instrumental data, climates and environments of the past are reconstructed from proxy or indirect data sources. A variety of proxy data can be used in southern Africa. Figure 5.1 shows that the number of palaeoenvironmental studies in southern Africa have increased significantly in recent years, and that the proxies used in these studies have become more diverse and, thus, more multidisciplinary in scope. This trajectory is likely driven by changes in technology, methods of data extraction, and radiometric dating. Some of these proxies are now examined in detail, to illustrate their potential usefulness for environmental reconstruction, and their limitations. These different proxies also have different spatial distributions based on the environments in which they were originally formed. These distributions are shaded in Fig. 5.2 and shown in Table 5.1. The diversity of these proxies, which also highlights the wide range of skills required by Quaternary scientists in their application, is shown visually in Fig. 5.3.

5.2.1 Sediments and Landforms

Physical processes on the land surface are strongly controlled by climate and their operation leads to spatial patterns of erosion, transport and deposition that can accumulate sediment and shape different landforms in different places. As such, sediments and landforms existing at the land surface have been very commonly used as indicators of present or past climates, and in different physical settings such as mountains and coasts (Table 5.1).

In the highest mountains of southern Africa, in the Drakensberg sector of the Great Escarpment, relic (inactive) glacial and periglacial landforms have been identified. Boelhouwers and Meiklejohn (2002) considered the implications of different mountain landforms for environmental reconstruction in southern Africa. Purported glacial landforms include ridges interpreted as glacial moraines located in the Sekhokong and Leqooa valleys (Mills and Grab 2005; Mills et al. 2009). Reconstructed equilibrium line altitudes for these small cirque glaciers are at 3095–3298 m asl, consistent with a temperature decrease during the last glacial
maximum (LGM) of 6–8 °C, and a more predominant cold-season precipitation (Mills et al. 2012). Slope sediment accumulations and terrace deposits within Drakensberg mountain valleys are dated, based on interbedded organic layers, to 13–24 kyr BP (Lewis and Hanvey 1991; Marker 1994). Relict periglacial landforms including terraces and sorted stone circles (patterned ground) are also observed on mountain summits, and likely reflect colder conditions during the last glaciation although the climatic boundary conditions are uncertain (Boelhouwers 1994; Grab 2002; Sumner 2004). There is some evidence that periglacial landforms were reactivated episodically during the Holocene (Sumner 2003). Immediately outside of these mountain areas, slope and aeolian sediments accumulated in particular during cold glacial periods (Clarke et al. 2003; Telfer et al. 2014). This Quaternary-age colluvial slope unit, known as the Masotcheni Formation, has been affected by several phases of incision and redeposition (Botha et al. 1994).

During the Quaternary, global sea levels changed in response to the accumulation (sea-level fall) and melting (sea-level rise) of continental ice sheets. During the last interglacial period (~120 to 125 kyr BP), sea levels along the South African coast were 4.5–6.0 m higher than present, forming raised rock platforms, beaches and clifflines (Cooper and Flores 1991). During the last glaciation, falling sea levels to a maximum lowstand of −125 m revealed an extensive continental shelf, in particular on the Agulhas Bank off the Western Cape coastline (Compton 2011). Terrestrial rivers extended into this environment, incising and infilling river valleys, and forming coastal landforms at the palaeoshoreline. Cemented dune and beach sands (aeolianite) located both onshore and offshore and dated using the luminescence technique provide evidence for sea-level transgression and regression phases back to >200 kyr BP (Bateman et al. 2004; Green 2009). The position of aeolianite belts and associated coastal landforms at different dated positions allows for reconstruction of sea-level trends, as well as other environmental variables such as longshore sediment transport, storminess and wave climate (Cawthra et al. 2014; Roberts et al. 2014). Onshore, sand dunes are present extensively along the Western Cape coastline. They have been examined for their stratigraphy, evidence for direction of dune accretion (and thus palaeowind-direction), presence of aeolianite or palaeosol layers, and evidence for past human activity such as shell middens (Roberts et al. 2014). Based on these lines of evidence and through luminescence dating, the chronology of coastal sand dune development and its controls during the Pleistocene can be established. For example, along the Wilderness coastline, Western Cape, coastal barrier dunes built up during sea-level highstands in particular around 241–221, 159–143, 130–120, 92–87, and after 6 kyr BP (Bateman et al. 2011). This was facilitated where sediments were able to be blown from the adjacent beach. Barrier dune sequences were preserved during sea-level regression. Along the Cape St Lucia coast of KwaZulu-Natal, coastal dunes also suggest a total age span of over 200 kyr with suc-
Table 5.1 Different types of proxy data that have been used for Quaternary palaeoclimatic and palaeoenvironmental reconstruction in southern Africa

<table>
<thead>
<tr>
<th>Type of proxy</th>
<th>Region in Fig. 5.2</th>
<th>Indicative locations examined</th>
<th>References</th>
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<tbody>
<tr>
<td><strong>Sediments and landforms</strong></td>
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<tr>
<td>Glacial and periglacial landforms</td>
<td>1</td>
<td>Sekhokong, Leqooa valleys, Lesotho</td>
<td>Mills et al. (2009, 2012)</td>
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<tr>
<td></td>
<td>1</td>
<td>Giant’s Castle, KwaZulu-Natal</td>
<td>Boelhouwers (1994)</td>
</tr>
<tr>
<td>Palaeosols</td>
<td>2</td>
<td>Knysna, Eastern Cape</td>
<td>Butzer and Helgren (1972)</td>
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<td></td>
<td>3</td>
<td>Northern KwaZulu-Natal</td>
<td>Botha et al. (1992)</td>
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<td></td>
<td>4</td>
<td>Langebaanweg, Western Cape</td>
<td>Eze and Meadows (2014)</td>
</tr>
<tr>
<td>Coastal sand dunes</td>
<td>2</td>
<td>Knysna, Eastern Cape</td>
<td>Butzer and Helgren (1972) and Illenberger (1996)</td>
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<td></td>
<td>2</td>
<td>Wilderness coast, Western Cape</td>
<td>Bateman et al. (2004, 2011)</td>
</tr>
<tr>
<td>Sediments and geochemistry</td>
<td>6</td>
<td>Tswaing, Gauteng</td>
<td>Partridge et al. (1997)</td>
</tr>
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<td>Palaeocoastlines</td>
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<td>Cape Agulhas, Western Cape</td>
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<td><strong>Biological evidence</strong></td>
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<td>Pollen</td>
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<td>Wonderkrater, Limpopo</td>
<td>Backwell et al. (2014) and Scott (2016)</td>
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<td>3</td>
<td>Mfabeni, KwaZulu-Natal</td>
<td>Finch and Hill (2008)</td>
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<td>3</td>
<td>Sibudu, KwaZulu-Natal</td>
<td>Renaut and Bamford (2006)</td>
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<td></td>
<td>4</td>
<td>Cederberg, Western Cape</td>
<td>Quick et al. (2011) and Valsecchi et al. (2013)</td>
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<tr>
<td></td>
<td>1</td>
<td>Sekokhong, Lesotho</td>
<td>Fitchett et al. (2016)</td>
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<td>Mahwaqa, Drakensberg</td>
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<td>1</td>
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<td>Henderson et al. (2006)</td>
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<td>2</td>
<td>Oyster Bay, Eastern Cape</td>
<td>Carrión et al. (2000)</td>
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<td>7</td>
<td>Venda, Limpopo</td>
<td>Scott (1987)</td>
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<td>5</td>
<td>Blydefontein, Western Cape</td>
<td>Bousman et al. (1988)</td>
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<td>2</td>
<td>Southern Cape Coast</td>
<td>Quick et al. (2015)</td>
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<td>8</td>
<td>Southern Namib Desert</td>
<td>Lim et al. (2016)</td>
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<tr>
<td>Diatoms</td>
<td>6</td>
<td>Tswaing, Gauteng</td>
<td>Kristen et al. (2007)</td>
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<td>1</td>
<td>Sekhokong, Lesotho</td>
<td>Fitchett et al. (2016)</td>
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<td></td>
<td>1</td>
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<td>Finné et al. (2010)</td>
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<td>Charcoal</td>
<td>6</td>
<td>Wonderkrater, Limpopo</td>
<td>Backwell et al. (2014)</td>
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<td>5</td>
<td>Caledon River</td>
<td>Esterhuysen et al. (1999)</td>
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<td>Phytoliths</td>
<td>6</td>
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<td>Backwell et al. (2014)</td>
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<td>1</td>
<td>Braamhoek, Drakensberg</td>
<td>Norström et al. (2009)</td>
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<td></td>
<td>6</td>
<td>Tswaing, Gauteng</td>
<td>McLean and Scott (1999)</td>
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<td></td>
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<tr>
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<td>Rodent fossils</td>
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<td>Thackeray and Fitchett (2016)</td>
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<td></td>
<td>6</td>
<td>Cradle of Humankind, Gauteng</td>
<td>Avery (2001)</td>
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<tr>
<td>Micromammalian fossils</td>
<td>6</td>
<td>Wonderkrater, Limpopo</td>
<td>Backwell et al. (2014)</td>
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(continued)
cessive dune accretion phases corresponding to sea-level changes (Sudan et al. 2004). Based on grain size and geochemical analysis, sediments making up the sand dunes were derived from the adjacent Tugela River as well as from the continental shelf and were moved onshore during sea-level rise.

5.2.2 Biological Evidence

Biological evidence is the most commonly-used and arguably the most accurate evidence with which to reconstruct past climates and environments. This is because vegetation records from pollen, charcoal, phytoliths and macrofossils can often be identified to species level, are commonly diagnostic of particular environments, and have well-known modern analogues. Different vegetation records are found at several key sites across South Africa and across different biomes (Table 5.1). Nine present-day biomes are identified in South Africa by Mucina and Rutherford (2006). Different pollen records from across the country and in different biomes were considered by Scott et al. (2012) and compared to one another spatially using principal component analysis (PCA). During the last glacial cycle and into the Holocene (26–0 kyr BP), different ecosystems exhibit somewhat different spatial patterns. Based on PCA, the northeast part of the country (subhumid woodland vegetation) shows higher moisture availability during the lateglacial with a clear switch to more arid conditions at the onset of the Holocene. In northern South Africa (dry woodland vegetation), there is virtually no change in moisture availability through this time period. For the Fynbos biome region (southwestern Cape),

<table>
<thead>
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<th>Type of proxy</th>
<th>Region in Fig. 5.2</th>
<th>Indicative locations examined</th>
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</thead>
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<tr>
<td>Isotope</td>
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<td>Spleothems</td>
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<td></td>
<td>2</td>
<td>Cango Cave, Western Cape</td>
<td>Talma and Vogel (1992)</td>
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<td></td>
<td>2</td>
<td>Pinnacle Point, Western Cape</td>
<td>Bar-Matthews et al. (2010)</td>
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<td></td>
<td>6</td>
<td>Wolkgberg Cave, Limpopo</td>
<td>Holzkämper et al. (2009)</td>
</tr>
<tr>
<td>Plant biomarkers</td>
<td>2</td>
<td>Southern Cape</td>
<td>Quick et al. (2015)</td>
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</table>

Regions identified are listed in Fig. 5.2

very significant and sudden shifts between moist and arid episodes are inferred throughout both the last glacial and Holocene. These spatial differences likely reflect changes in atmospheric circulation patterns, in particular the shifting boundary between the winter and summer rainfall zones and the latitudinal position of the ITCZ.

Biological records of different types are well developed in natural topographic depressions such as the Tswaing impact crater (formerly known as the Pretoria Saltpan), located north of Pretoria in northeast South Africa. The timeframe of the sediment infill within the crater is not well constrained but extends >200 kyr. Lacustrine sediments dominate the upper 90 m of the record, and sedimentary, chemical, mineralogical and isotopic data from this part of the record appear to be synchronous with orbital forcing (Kristen et al. 2007; Partridge et al. 1993, 1997). Diatoms within this section show an increase in salinity and alkalinity over time as the lake evolved, but drying out during the LGM and continuing in a semi-dry state through the Holocene (Metcalf 1993). Pollen contained within the lake sediments, although with time gaps, can inform on regional vegetation patterns. Between ~75 and 68 kyr BP, the region is inferred to be characterised by savanna woodland with high occurrence of aquatics and cryptogams (lower plants including ferns, mosses, algae and lichen) and low occurrence of grasses, interpreted as moderately cool and wet with local fresh water bodies (Scott 2016). Between ~63 and 32 kyr BP, the proportion of savanna woodland decreases and there is a much lower abundance of aquatics, but increased abundance of shrubs, Artemisia, Asteraceae and Amaranthaceae, while the proportion of grass pollen is generally high. This indicates a switch to more arid conditions, although short episodes of increased proportions of aquatics exist at ~61, 44 and 32 kyr BP (with the latter pulses appearing to coincide with the timing of northern hemisphere Heinrich events). The nearby site at Wonderkrater is a spring mound that has sustained 8 m of peat accumulation over the last 35 kyr (McCarthy et al. 2010) but with deeper elements, recovered by cores, extending back to ~60 kyr BP (Scott 2016). Much more rapid changes in pollen assemblages are seen from the Wonderkrater record, reflecting variations in spring-fed moisture availability (Scott 1999).
The general absence of vegetation records in the dryer northwest and west of the country prompted the exploration of more unusual biological records. Prominent is the record from rock hyrax (*Procavia capensis*) middens, preserved mainly due to the dry climate. Pollen evidence from middens shows limited ecological change in the period 19–7 kyr BP (Quick et al. 2011) but stable N and C isotopic evidence indicates synchronicity with the Greenland ice core record, suggesting that time periods such as the Younger Dryas are well-identified in the South African record (Chase et al. 2011).

### 5.2.3 Chemical and Isotopic Data

Speleothem (stalactite, flowstone) records are quite commonly found in South Africa because of the presence of karstic caves in which these precipitates can form, particularly near the south coast (Cango Cave, Pinnacle Point) and in the northeast (Cold Air Cave, Sudwala, Lobatse, Wolkberg, Gladysvale). Speleothems are useful because they are often annually-layered, can be accurately dated at high resolution using the U/Th method, and their calcium carbonate or dolomite layers can be examined for stable oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$) isotopes, which can inform on regional climate. The record from Cold Air Cave extends, with some breaks, back to 24 kyr BP and indicates a LGM temperature depression of 6 °C (Holmgren et al. 2003). A depositional hiatus between 12 and 10 kyr BP likely reflects a period of regional aridity, and thus the record is linked most closely with atmospheric circulation and precipitation patterns. At Cango Cave, the oxygen isotopic record between ~30 and 14 kyr BP shows a slow decline in temperatures towards the LGM, reaching a value around 5.5 °C lower than present, but with marked variability between 18 and 16 kyr BP (Talma and Vogel 1992). More recently, new techniques including micro-Raman and petrographic analysis on South African speleothems provide evidence for changes in the proportions of calcite–aragonite in annual laminae (Green et al. 2015) that reflect diagenetic processes taking place within individual caves, but which also respond to changes in surface C$_3$/C$_4$ grass composition. Thus, speleothem data can now be usefully interpreted with respect to wider climate and environments, including summer/winter rainfall variations (Bar-Matthews et al. 2010; Green et al. 2015). In conjunction with palaeoanthropological data within karstic caves, speleothems can also constrain the timing and environments of hominin evolution during the Quaternary (Pickering et al. 2011).

New analytical methods for examining sediment biochemistry have also been used in South Africa (Table 5.1). These methods are concerned with the relationships between climate and the hydrogen isotope deuterium (D or $^2$H) found...
within plants. In South Africa, close relationships exist between δD values and the different rainfall zones and biomes (Herrmann et al. 2017). Based on these relationships, different biochemical analyses have been undertaken on different plant biomarkers, including leaf wax lipids and n-alkanes. For example, analysis of lipids from the Tswaing record reveals a close relationship between δD values and tropical sea-surface temperatures in the adjacent Indian Ocean (Schmidt et al. 2014). At regional to local scales, the changing abundance of C_{37} and C_{38} alkenones in this record reflects variations in lake salinity, while the abundance of C_{4} grasses comprising the regional vegetation of the site changes the ratio of n-alcohol to n-alkanes contained in the leaf waxes of the Tswaing sediments (ibid.). Different lipid biomarkers within the Tswaing sediments, in combination with δ^{13}C values, can reveal information on the workings of the local carbon cycle within the lake during different climate periods (Kristen et al. 2010). The same methodology has also been used to reconstruct Holocene sea-level change in South Africa (Carr et al. 2015).

### 5.3 Discussion and Future Research Directions

A range of different proxy data sources exists with which to reconstruct past climates and environments in South Africa (Table 5.1). However, the analysis of these proxies to reveal the climate or environment of a given time period is not straightforward. Different proxies are responsive to different climatic variables independently and in combination, and therefore it is not easy to decouple temperature and precipitation, for example, as forcing factors influencing the development of any one proxy. Indeed, precipitation itself may not be the key variable, but rather surface moisture availability, which is the net result of precipitation minus evapotranspiration loss. However, spatial and temporal patterns of these changes are not well understood (Stone 2014; Tyson 1999), but are likely linked with the source of climate variability, whether that is insolation, ocean thermohaline circulation, the latitudinal extent of seasonal shifts in the position of the ITCZ, monsoonal circulation, strength of southern hemisphere westerlies, and shifts in the position of the winter/summer rainfall zone boundary (Chase and Meadows 2007; Gasse et al. 2008). The development of new proxies, especially informed by isotopic analyses, provides more innovative quantitative data on environmental change, and this is an important area of future research.

Many studies now take a more multidisciplinary approach, by integrating different proxies from a single record, in order to develop a better understanding of Quaternary climate and environmental change (e.g. Fitchett et al. 2016; Quick et al. 2015). Despite this, there are still several limitations in this analysis (Fitchett et al. 2017; Stone 2014). The spatial and temporal evolution of climate patterns in southern Africa is still unclear, due mainly to a lack of data and in many cases lack of dating control. Comparison with hemispheric-scale records such as the Antarctic Vostok record can inform on leads/lags in the climate system to have affected South Africa (Scott et al. 2003), but the expression and significance of these climate changes in different proxies requires further analysis.

### 5.4 Summary

Although not marked by the widespread glaciations that characterised the Quaternary of the northern hemisphere, proxy records for South Africa demonstrate marked changes in climatic conditions throughout this period. Previous research has reconstructed changes in moisture availability, rainfall seasonality, mean atmospheric temperature and sea level for South Africa, which broadly coincide with global-scale shifts into and out of Quaternary glacial periods. However, the palaeoclimatic interpretations of these proxies are in many cases subject to high uncertainty, and the different environmental factors that contribute to development of the proxy (temperature, precipitation, soils, ecosystems) are sometimes difficult to disentangle. The Quaternary palaeoclimatic record for South Africa remains both spatially and temporally limited, despite ongoing efforts to develop palaeoenvironmental reconstructions and to use more innovative proxies throughout South Africa. Given the significance of the country as the ‘Cradle of Humankind’, concerted efforts to improve the spatial and temporal resolution of the Quaternary climatic record for the region are imperative.

**Acknowledgements** We thank Marion Bamford and Mulalo Rabumbulu for their comments on an earlier version of this chapter.

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Mills SC, Grab SW (2005) Debris ridges along the southern Drakensberg escarpment as evidence for Quaternary glaciation in southern Africa. Quat Int 129(1):61–73
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Abstract

Variations in Holocene climate are of importance in understanding the contemporary diversity found in global climates and biogeography. This is particularly true for South Africa, which spans the subtropics and midlatitudes, and is bordered to the east by the warm Indian Ocean Agulhas Current, and to the west by the cold Atlantic Ocean Benguela Current. Holocene variations in South African climate include evidence for globally synchronous warming and cooling events, and for locally discrete variations in both precipitation amount and seasonality. The study of Holocene climates relies heavily on fossil proxies. Due to the aridity of much of the region in the Holocene, poor preservation of these proxies has been a critical challenge. Key future trajectories in South African Holocene climate science include concerted efforts to better spatially and temporally resolve the climate record, for key periods of interest, and more generally to determine local-scale climatic variability and climatic drivers.

Keywords
Multiproxy · Precipitation · Ocean currents · Rainfall zones · Seasonality

6.1 Introduction

The Holocene refers to the present interglacial, an Epoch that commenced around 11,700 calibrated years before present (cal yr BP). Arguably, this Epoch has terminated recently with the advent of the Anthropocene Epoch (Waters et al. 2016; Zalasiewicz et al. 2017). Compared to preceding Epochs, the Holocene represents an extremely short time period in Earth’s history, but is perhaps of greatest significance to humankind as it has spanned the period of the development of modern human societies (Wanner and Büntikofer 2008). The transition from the Pleistocene to the Holocene marks the point of termination of the last glaciation, thus the Epoch has been characterised by comparatively warm interglacial conditions globally (Wanner et al. 2011). Compared to the Pleistocene Epoch, during which at least eight ice ages occurred, the Holocene is marked by a comparatively stable climate (Dansgaard et al. 1993; Gaffney and Steffen 2017). However, the climate fluctuations, cycles and changes that have occurred during the Holocene have been notable due to the increase in human population, and the impacts that even small amplitude climatic impacts have had on resource availability, coupled with the increasing anthropogenic impact on the climate systems (Bond et al. 1997; Wanner et al. 2011).

The fluctuations in Holocene climate are of particular interest in South Africa, from climatological, biogeographical and archaeological perspectives. South Africa is in a relatively unique geographic position, spanning the subtropics to midlatitudes, and surrounded by two thermally distinct ocean basins (Fitchett et al. 2017). Consequently, the contemporary climate of the country is highly spatially heterogeneous, roughly defined by an east–west decline in mean annual precipitation, and distinct summer, winter and year-round rainfall zones (Fitchett and Bamford 2017). The climatic variability of the country is heightened by the distinct Great Escarpment, separating the coastal periphery from a raised inland plateau (Tyson and Preston-Whyte 2005). This climatic variability has resulted in a rich biodiversity, hosting three of the world’s major biodiversity hotspots (Myers et al. 2000). Climatic stability during the Holocene would have been of importance in retaining the biodiversity established in the late Pleistocene, while the low amplitude climate fluctuations created the more subtle biogeographic distributions seen today (Bamford et al. 2016). Within this rich landscape, a wealth of archaeological evidence from the Middle to Late
Stone Ages has been discovered, providing clues to the cultural innovation and societal developments during the Holocene in a region of globally significant archaeological history (Mitchell 2016). Furthermore, given the contemporary heterogeneity in climatic conditions across South Africa, it is unlikely that climatic changes during the Holocene would have been uniform in distribution, magnitude, duration or biogeographic influence (Fitchett et al. 2017; Scott et al. 2012).

Contemporary climatic conditions are measured through a combination of ground-based meteorological measurements for the past few decades to centuries, depending on the location, and global satellite imagery spanning the past ~40 years (Rotberg and Rabb 2014). The investigation of climatic variability that took place during times preceding meteorological measurement relies on the use of proxies that record environmental conditions and changes over a given period of time (Charman et al. 2004), and in South Africa are found in natural geoarchives such as lake sediments (e.g. Reinwarth et al. 2013), peat wetlands (Fitchett et al. 2016b) and hyrax middens (e.g. Quick et al. 2011). The environmental changes deduced from such records can then be used to infer contemporary climatic factors, provided that a reliable modern analogue of the environment can be observed (Charman et al. 2004). Such so-called proxies often include the remains of plants or animals preserved in the fossil record, or sedimentary markers of continual environmental change (Fitchett et al. 2017; Uhl 2006). Pollen has been the most commonly used proxy for southern African Holocene climate reconstructions, but more recently there has been an increasing use of diatoms, phytoliths, stable isotopes and sediment or biological geochemistry (Fitchett et al. 2016a, 2017). In particular, since the early 1990s, there has been an increase in the use of speleothems as a palaeoenvironmental archive, which affords high accuracy isotope analysis, supported by temporally well-constrained high resolution chronologies (e.g. Holmgren et al. 2003; Sundqvist et al. 2013). Stable isotopes are also increasingly used from a range of archives including sediment cores, hyrax middens, and shells and bones at archaeological sites (Meadows 2014; Wündsch et al. 2016). The increasing diversity of palaeoenvironmental proxies being used enables a wider range of palaeoenvironmental variables, climatic tipping points, and stressors to be analysed, and facilitates multi-proxy investigations (Meadows 2014). The few studies utilising foraminifera (Strachan et al. 2015), phytoliths (Burrough et al. 2012; Cordova and Avery 2017), dinoflagellate cysts (Dupont et al. 2004) and biomarkers (e.g. Hahn et al. 2017; Norström et al. 2014), suggest that there is potentially a greater wealth of palaeoenvironmental proxies available in southern Africa than have traditionally been used; these too have much potential to improve our understanding of Holocene climatic conditions.

This chapter explores the Holocene climate of South Africa, on the basis of evidence from some of these palaeoenvironmental proxies. Although distinct temperature fluctuations are arguably apparent for the Holocene, the spatial heterogeneity of South African Holocene palaeoclimates is highlighted most clearly in the synthesis of reconstructed patterns of precipitation and its seasonality. An exploration of the variation in these climatic variables is followed by a critical analysis of the ways forward in Holocene palaeoclimatic research in South Africa.

6.2 Temperature Variability

Temperature variations of sufficient amplitude to have influenced human activity and behaviour are largely believed to be globally synchronous (Wanner et al. 2011). An increasing body of literature from the southern hemisphere seeks to interrogate this assumption (cf. Petherrick et al. 2016), yet the reconstruction of temperature profiles for the late Quaternary in South Africa remains strongly framed by well-established northern hemisphere departures in temperatures from the contemporary mean (Fitchett et al. 2017). Northern hemisphere Holocene variations in temperature for which evidence exists in some parts of South Africa (Fig. 6.1) include the ‘8.2 kyr’ cold event (Holmgren et al. 2003), the Little Ice Age (Tyson et al. 2000), and the Holocene climatic optimum (Neumann et al. 2014). There is yet no conclusive published evidence from South Africa of distinct, temporally synchronous ‘Bond cycles’ in the temperature record throughout the Holocene (Bond et al. 1997; Wanner and Bütkofer 2008), which arguably include the more extensively documented ‘4.1 kyr’ or ‘2.8 kyr’ Neoglacial cold events found in the northern hemisphere (Mayeweski et al. 2004; Wanner et al. 2011). Unresolved questions include whether these supposedly globally-synchronous temperature events occurred in southern Africa or the southern hemisphere more generally, the spatial heterogeneity of any temperature departures, and the specific environmental conditions potentially associated with such climatic fluctuations.

The Holocene follows directly after a global cooling event referred to as the Younger Dryas (Alley et al. 1993; Andres et al. 2003; Thackeray and Scott 2006), which interrupted the progressive warming associated with deglaciation (Mayeweski et al. 2004). Proxy evidence coherent with this event, driven by meltwater pulses in the high latitudes of the northern hemisphere, has been found across a range of sites in South Africa, including both coastal and inland locations (e.g. Chase et al. 2015a; Thackeray and Scott 2006). A similar short-lived cold period driven by a large meltwater pulse in the northern Atlantic Ocean, often assumed to have influenced climates only in the northern hemisphere, is the 8.2 kyr event (Alley and Ágústsdóttir 2005; Mayeweski et al. 2004).
Some records exist suggesting cooling during this period in southern Africa, including stable carbon and oxygen isotope records from the Caledon River Valley in western Lesotho (Smith et al. 2002), and diatom and pollen records from Mafadi summit on the border of eastern Lesotho and the South African Drakensberg (Fitchett et al. 2016b). Proxies for cooling at this time from within the borders of South Africa includes isotope markers for the commencement of a cool period at ~8500 cal yr BP from the Makapansgat speleothem (Holmgren et al. 2003) and phytolith evidence for an increase in C3 vegetation from Braamhoek wetland at ~8000 cal yr BP, indicating regionally cooler conditions mimicking the contemporary vegetation at higher altitudes (Finné et al. 2010), which may be synchronous with these events (within age uncertainties) (Norström et al. 2014). More recently, a cool period identified from the De Rif hyrax midden record from the Cederberg has been used to support evidence for the 8.2 kyr event (Chase et al. 2015b). It would therefore appear that cold events in the northern Atlantic caused by meltwater pulses can be detected in the South African palaeoenvironmental fossil record, providing valuable information regarding ocean heat transport and climate teleconnections during the early Holocene.

By contrast, there is extensive proxy evidence for the Holocene climatic optimum period in southern Africa, between 7000 and 5000 cal yr BP (e.g. Chase et al. 2013; Scott et al. 2012; True et al. 2013), although the timing and duration of this event varies between records, potentially reflecting spatial variability (Scott 1993) and uncertainties in the individual chronologies (Haberzettl et al. 2014). Locations of proxy data sites are shown on Fig. 6.2. Many proxies also indicate the existence of a Little Ice Age cold period in South Africa, from AD 1300 to 1850 (Tyson and Lindesay 1992; Zinke et al. 2014) and the earlier Medieval Warm Period or Medieval Climatic Anomaly (Holmgren et al. 2003; Nicholson et al. 2013). The majority of studies presenting evidence for this event in South Africa are based on stable isotopes from speleothems, due to the high resolution afforded by such records (Lee-Thorp et al. 2001; Sundqvist et al. 2013). While the existence of a Little Ice Age cold event has been confirmed across much of the region, the local temperature decrease for this period remains to be quantitatively constrained. Suggestions of temperatures 1 °C colder than present during the Little Ice Age and 3 °C warmer than present in the earlier Medieval Warm Period (Tyson et al. 2000), remain unconfirmed against inferences of more severe cooling, as this event reflects the most pronounced δ18O deviation within the 25,000 years. Cold Air Cave speleothem record (Holmgren et al. 2003). Evidence for the Medieval Warm Period derives from the same Cold Air Cave speleothem record (Holmgren et al. 2003), and from Cango Cave and Wonderkrater (Nicholson et al. 2013), but the degree of warming remains poorly resolved.

### 6.3 Precipitation Variability

While temperature records for the Holocene are believed to be globally synchronous, at least when measured at low resolution, there is consensus that precipitation variability during this period is regionally specific (Chase and Meadows 2007; Guiot et al. 1993). A significant continental-scale precipitation event is the African Humid Period recorded for East Africa, occurring in the early Holocene within the period ~14,800–5500 cal yr BP (Burrough and Thomas 2013; Chase et al. 2009). Evidence for this event from the early Holocene is also present in hyrax midden records in Namibia, suggesting that the African Humid Period extended as far south as 23° (Chase et al. 2009). The extensive aridity in the Kalahari during this period poses contradictory evidence, and while there are lake highstands in the Makgadikgadi dated to this...
period, it is argued that these are fed from distant sources (Burrough and Thomas 2013). Although not referred to specifically as the African Humid Period, and with varying time periods throughout the early Holocene, reference has also been made to humid periods following postglacial warming, with evidence from peat development (Meadows 1988), Caledon River charcoal (Esterhuysen and Mitchell 1996), and pollen records across the South African interior (Scott 1993; Van Zinderen Bakker and Coetzee 1988).

Moisture records have been examined in detail around the time periods in which there are marked temperature changes, revealing spatial heterogeneity in precipitation changes. Although the bulk of these records explores spatial variability during the Last Glacial Maximum which preceded the Holocene (see Fitchett et al. 2017, for greater detail), similar patterns are also observed for the period of the Little Ice Age. Evidence suggests that broadly dry conditions occurred during the Little Ice Age in the summer rainfall zone of South Africa (Holmgren et al. 1999; Leetorhp et al. 2001; Neumann et al. 2010), while wet conditions were experienced in the winter rainfall zone (Stager et al. 2012).

Spatial variations in the Holocene precipitation record for South Africa, and in particular the significance of the summer, year-round and winter rainfall zones as a feature controlling much of this heterogeneity, have been explored in detail in recent work by Zhao et al. (2016). They classified precipitation records for South Africa into early (>7800 cal yr BP), middle (7800–2400 cal yr BP) and late (<2200 cal yr BP) Holocene periods on the basis of relative spatial similarities. Their early Holocene period is characterised by low summer rainfall in the summer rainfall zone, and wet conditions in the winter rainfall zone; the middle Holocene by increased precipitation in the summer rainfall zone; and the late Holocene by increased aridity in the summer rainfall zone, but stability in the winter rainfall zone except during the Little Ice Age. Within these broad patterns is significant spatial variability in the degree of precipitation change, the onset dates of change, and the duration of periods of transition (Fig. 6.3). This confirms difficulties in the comparison of pollen-derived moisture records from two key inland summer rainfall sites, Tswaing Crater and Wonderkrater (Scott 1999), and in regional reconstructions of moisture for the Holocene Climatic Optimum (Partridge et al. 1999). A final remark on Holocene precipitation records is that as much of these are derived from palaeoenvironmental proxies in which precipitation is seldom directly represented, but rather inferred from records that are more closely recording moisture availability (Chevalier and Chase 2016). This should be carefully considered, as the precipitation–evaporation balance is rarely equivalent to the absolute precipitation found in a location over a given time period (ibid.).
6.4 Seasonality Fluctuations

Reconstructions of precipitation for the Holocene have reflected the significance of the climatic dichotomy between the summer and winter rainfall zones. In addition to the discrimination of climatic events on the basis of these geoclimatic zones, potential fluctuations in the boundaries between these zones must be considered. There is a wealth of evidence suggesting a northward displacement of the winter rainfall zone during the Last Glacial Maximum, to include Lesotho and much of the Karoo (Fitchett and Bamford 2017; Mills et al. 2012; Norström et al. 2014). Winter rainfall in South Africa is driven by the passage of Atlantic Ocean mid-latitude cyclones which are displaced northwards due to the seasonal shift in the position of the Intertropical Convergence Zone (ITCZ) and variations in the Antarctic sea ice extent (Engelbrecht et al. 2015). A northward displacement in the winter rainfall zone could therefore have been the result of either a weakening of the ITCZ, or greater annual variability in the position of the ITCZ, potentially induced by an enhanced tilt of the earth’s axis (Mills et al. 2012; Wanner 2014). Following this northward displacement of the winter rainfall zone during the Last Glacial Maximum, poleward retreat of this climatological zone must have occurred during at least the early Holocene to result in the contemporary conditions under which winter rainfall is largely restricted to the southwestern tip of the country (Fitchett and Bamford 2017).

The majority of the earlier work exploring shifts in the winter rainfall zone in South Africa during the Holocene has been based on pollen analysis (e.g. Scott and Nyakale 2002; Van Zinderen Bakker 1983). Recently, shifts in South African precipitation seasonality have also been inferred through the use of diatoms (Finné et al. 2010; Stager et al. 2012), rodent fossils (Thackeray and Fitchett 2016), coccoliths (Weiser et al. 2016), biomarkers (Hahn et al. 2017) and microcharcoal and stable carbon and nitrogen isotopes from hyrax middens (Chase et al. 2015a). However, few of these approaches have been objectively assessed on their accuracy to discriminate winter and summer rainfall regimes in the contemporary record. Pollen-derived seasonality discrimination has been achieved by studies that identify periods in which flora, that are more commonly found in the contemporary winter rainfall zone, can be detected outside of this region (e.g. Neumann et al. 2014; Scott et al. 2004; Van Zinderen Bakker 1983). Another group of studies utilises shifts in the ratio of Asteraceae:Poaceae (daisy:grass) in the fossil pollen record, proposed by Coetzee (1967) to be indicative of the strength of precipitation seasonality (Fitchett and Bamford 2017). The results of these studies are usually corroborated by seasonality shifts indicated by at least one other palaeoenvironmental proxy, including diatoms, sediment properties and phytoliths (e.g. Norström et al. 2009, 2014; Scott and Nyakale 2002), and has been confirmed statistically to successfully discriminate summer and winter rainfall...
zones (Fitchett and Bamford 2017). Finally, a third group of studies attempts to explore shifts in dominant synoptic rain-bearing mechanisms over southern Africa using a more complex set of plant taxa common to a set of pollen records, in comparison with contemporary distributions (Chevalier and Chase 2016; Truc et al. 2013).

An examination of the Asteraceae:Poaceae fossil pollen ratios as a proxy for seasonality confirms the hypothesis of a progressive poleward retreat of the border of the winter rainfall zone during the Holocene (Fitchett and Bamford 2017). The early Holocene (11,600–8000 cal yr BP) is characterised by a large proportion of Asteraceae relative to Poaceae, indicative of winter rainfall conditions at latitudes as low as northern Lesotho (Fig. 6.4). This is consistent with diatom and phytolith evidence from Braamhoek wetland in the northern Drakensberg (Finné et al. 2010; Norstöm et al. 2014). From 7900 to 4000 cal yr BP, winter rainfall zone conditions retreat southwards to Blydefontein in the Karoo. By 3900 cal yr BP, winter rainfall zone conditions are constrained to the position of the contemporary winter rainfall zone. Within the last 2000 years, two periods of anomalous Asteraceae:Poaceae ratio scores indicate winter rainfall zone conditions at Tswaing Crater near Pretoria between 1900 and 1000 cal yr BP, and at one site in eastern Lesotho between 900 cal yr BP and present (Fig. 6.4). This likely reflects a combination of increased anthropogenic influence on the vegetation of the region, localised climatic fluctuations, and potentially an increased pollen productivity of Asteraceae species in the locality; historical records do not suggest winter rainfall conditions in these discrete zones during this period (Fitchett and Bamford 2017; Neukom et al. 2014).

### 6.5 Uncertainties and Avenues for Future Research

Despite a considerable effort over recent decades to explore the Holocene climates of South Africa, there remain notable spatial and temporal gaps in the record (Fitchett et al. 2017). This presents challenges in determining the degree of synchrony between northern and southern hemisphere climatic events, to determine the spatial extent of locally coherent climatic zones, and in determining rates of change in the geographic position of seasonal rainfall belts. A key theme repeated in many review papers on southern African palaeoclimatology is the need for concerted efforts to address the spatial gaps in the record. This is arguably being achieved through designating transects of interest across the country (Chase and Meadows 2007), and exploring alternative proxies and archives from which palaeoclimatic information can be derived, especially for regions of poor microfossil preservation (Fitchett et al. 2017). The RAiN (Regional Archives
for Integrated iNvestigations) Project, now in its second stage, is possibly the largest scale project aimed at addressing this issue, with a large network of coastal and inland study sites across South Africa and a multiproxy approach involving a range of microfossils, geochemical tests and isotope analyses (Haberzettl et al. 2014). However, more in-depth single-site studies remain important in contributing to locally-specific details of analysis, and such sites often contain records of a higher temporal resolution than large scale palaeoenvironmental assessments. It is important to continue to motivate for such studies, with a deliberate effort to standardise approaches in the analysis of proxies and the dating of samples to ensure comparability between studies and sites.

Collaborations between climate modellers and palaeoclimatologists also represent an important avenue for future research. This synergistic relationship involves the contribution of palaeoclimatic data to climate modellers to improve the predictive strength of their projections, while climate modellers can assist in better understanding the synoptic processes responsible for spatial variability in palaeoclimates across the country (Barrable et al. 2002). This is particularly important in South Africa, where instrumental meteorological records seldom extend back past the last 50–100 years.

### 6.6 Summary

The Holocene Epoch is one of relatively warm and stable climatic conditions globally. However, the low-amplitude fluctuations in temperature, moisture availability and seasonality of the Holocene are of significance to humankind, as the development of human societies and large-scale social organisation commenced during the Holocene. In South Africa, many of these small amplitude climatic changes were specific to small geographic locations, controlled by the varied topography, the relatively large latitudinal range of the country, and the contrasting influence of the warm Indian Ocean and cold Atlantic Ocean. More contentious are larger amplitude climatic changes, which may represent a local expression of climatic events in the northern hemisphere, including the 8.2 kyr cold event, the Holocene Climatic Optimum, the late Holocene Neoglacial, the Medieval Warm Period and the Little Ice Age.

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South African Biomes and Their Changes Over Time

Jemma M. Finch and Michael E. Meadows

Abstract

A biome is the largest geographical unit used for biotic classification, based on plant and animal life in conjunction with climate. Here we introduce the biomes of South Africa, and illustrate their changes over time through the use of case studies. An historical context for this analysis is provided by summarising key national vegetation classification schemes, including the most recent classification of nine biomes. Each of these biomes is briefly introduced, describing their location, characteristics, climate, ecology and conservation importance. Longer-term vegetation changes linked to climate and human activity in the Succulent Karoo/Fynbos ecotone are explored using palaeoecological evidence. Recent bush encroachment in the grassy biomes is reviewed, drawing on results from a range of methodologies. Finally, we review future projections for the ecologically important Fynbos biome under anthropogenic climate change, based on bioclimatic modelling. These studies demonstrate the dynamic nature of South African biomes, and the range of natural and anthropogenic drivers which influence their composition and distributions.

Keywords

Biogeography · Biomes · Conservation · Fynbos · Karoo · South Africa

7.1 Introduction

South Africa is host to a range of biomes, which encapsulate the biological diversity of the country. These can be attributed to the presence of strong environmental gradients including of rainfall, temperature, geology, soils, fire and herbivory (Potts et al. 2015). A biome is defined as a “broad ecological unit that represents a major life zone extending over a large natural area” (Rutherford and Westfall 1994, p.1). The current biome classification (Mucina and Rutherford 2006) subdivides the country into Fynbos, Desert, Succulent Karoo, Nama-Karoo, Albany Thicket, Savanna, Grassland, Forest, and Indian Ocean Coastal Belt (Figs. 7.1 and 7.2). These biomes have experienced natural and anthropogenically-driven changes in composition and extent over both long-term and recent timescales (Masubelele et al. 2015), and are predicted to continue to change in the future (Moncrieff et al. 2016). This chapter summarises the history of vegetation classification in South Africa, describes each biome in turn, and provides selected case studies to illustrate different (1) timescales (long-term, recent and future); (2) selected biomes in detail (Succulent Karoo, Grassland/Savanna, Fynbos) and their properties; (3) drivers (human activity, fire, grazing, climate change); and (4) methods of detecting vegetation change (palaeoecological, historical imagery, modelling).

National scale vegetation mapping and classification of South Africa dates back to Pole Evans’ map in 1936, with key contributions summarised in Table 7.1. The seminal work of Acocks’ (1953) Veld types of South Africa greatly advanced our understanding of vegetation patterns, providing an important foundation for further developments. Huntley (1984) was the first to apply the biome concept within the South African context. Rutherford and Westfall (1986, updated in 1994) produced the first objective categorization of South African biomes, using a climatological approach based on plant life forms (Raunkiaer 1934). The most recent biome classification of nine biomes by Mucina...
and Rutherford (2006) was developed using Geographical Information Systems, combining aerial photography, satellite imagery, spatial modelling, large databases and ground truthing. Each of these nine biomes are now briefly described in turn.

### 7.1.1 Fynbos

The Fynbos Biome, endemic to South Africa (Rebelo et al. 2006), occupies the Mediterranean-type climate of the southwestern and southern Cape (Fig. 7.1). Literally translated as ‘fine-leaved bush’, the vernacular term *fynbos* describes evergreen sclerophyllous shrubland, dominated by proteoid, ericoid and restioid vegetation. The topography of the biome is strongly influenced by the Cape Fold Mountains, with fynbos vegetation largely restricted to oligotrophic, sandy soils (Cowling et al. 2003). In addition to fynbos, the biome includes the major vegetation complexes of strandveld and renosterveld (Rebelo et al. 2006), although Bergh et al. (2014) have argued that the floristically distinct renosterveld warrants independent biome status. Fynbos and renosterveld vegetation is fire-dependent, exhibiting a range of adaptations to fire. Fire intervals of 5–50 years are typical for fynbos, and 2–10 years for renosterveld (Rebelo et al. 2006).

The biome is globally recognized for its remarkable plant species diversity and levels of endemism, and is broadly coincident with the Cape Floristic Region (CFR; Cox 2001), although the CFR additionally includes Succulent Karoo, Forest and thicket vegetation (Bergh et al. 2014). The CFR is acknowledged as a global biodiversity hotspot on the basis of high biological diversity under threat from human activities.
Fig. 7.2  Biomes of South Africa. (a) Table Mountain Fynbos, (b) desert in the Richtersveld, (c) Succulent Karoo, (d) Nama-Karoo near Jansenville, (e) Albany Thicket along the Kariega Estuary, Eastern Cape coast, (f) grassland in Cobham, KwaZulu-Natal Drakensberg, (g) savanna at Mapungubwe National Park, (h) forest patch within grassland mosaic, Cathedral Peak, KwaZulu-Natal Drakensberg, (i) Indian Ocean Coastal Belt, Cwebe Nature Reserve, Eastern Cape coast. (Photos: (a) A. Shawka, distributed under a CC0 1.0 license; (b) V. van Oosten, distributed under a CC0 license; (c) Michael Meadows; (d) Trevor Hill; (e-i) Jemma Finch)
Such threats include alien invasive species, habitat transformation, urbanisation (Rebelo et al. 2006), a highly modified fire regime, and climate change.

### Desert

Distributed along the extreme northwest coastline of South Africa, and extending northwards into Namibia (Fig. 7.1), is the Desert Biome. The deserts of southern Africa are almost entirely represented by the Namib (Jürgens et al. 2003) outside of South Africa’s borders. The extreme hyperarid desert climate is typified by low and unpredictable rainfall, coupled with high temperatures (Jürgens 2006). Vegetation cover varies from unvegetated through to dense, with the latter comprising herbs and dwarf shrubs, and occasional trees (Jürgens et al. 2003). In response to these extremes, desert biota have evolved a range of unique behavioural, morphological and physiological adaptations (see Lovegrove 1993).

#### 7.1.3 Succulent Karoo

The Succulent Karoo Biome, situated along the West Coast of South Africa (Fig. 7.1), is a winter rainfall desert, averaging 170 mm of rainfall per annum (Mucina et al. 2006a). This biome boasts exceptional diversity of leaf and stem succulents, rendering it one of only two arid region biodiversity hotspots on the globe (Mittermeier et al. 2004). The biome is host to approximately 5000 vascular plant species, with 40% plant endemism (Young et al. 2016). The two largest plant families represented are the Aizoaceae and Crassulaceae (Milton et al. 2003), with a rich diversity of annual geophytes. The Namaqualand area is renowned for its spectacular springtime annual flowering displays, providing a key tourist attraction (O’Farrell et al. 2010) (Fig. 7.3a). Succulent Karoo is well preserved relative to other biodiversity hotspots; some estimates suggest up to 29% of the land area remains in a relatively undisturbed state (Desmet and Cowling 2004).

#### 7.1.4 Nama-Karoo

Occupying the western interior of South Africa (Fig. 7.1), is the semi-arid to arid Nama-Karoo Biome, which receives 70–500 mm annual rainfall (Mucina et al. 2006b). The biome is typified by low biomass dwarf shrubland, comprising grasses, succulents, geophytes and annual forbs (Mucina et al. 2006b). The Nama-Karoo is highly susceptible to disturbance by overgrazing, fire and soil erosion (Mucina et al. 2006b). Despite relatively low productivity (Meadows 2000), the biome is an important source of grazing for the meat and wool production industries (Palmer and Hoffman 2003), thus requiring careful management in light of potential disturbance factors. A further threat to the broader Karoo lies in the prospect of potential hydraulic fracturing, or ‘fracking’, for shale gas. This contentious issue has been hotly debated (summarized by de Wit 2011), in light of environmental health concerns, particularly potential water contamination, and threats to biota (Crous 2015).

<table>
<thead>
<tr>
<th>Date</th>
<th>Author(s)</th>
<th>Area</th>
<th>Scale</th>
<th>Vegetation classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1936</td>
<td>Pole Evans</td>
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<td>1:3,000,000</td>
<td>12 vegetation types</td>
</tr>
<tr>
<td>1938</td>
<td>Adamson</td>
<td>South Africa</td>
<td>1:8,000,000</td>
<td>14 vegetation types</td>
</tr>
<tr>
<td>1953</td>
<td>Acocks</td>
<td>South Africa</td>
<td>1:1,500,000</td>
<td>70 veld types in 7 veld type groups</td>
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<tr>
<td>1984</td>
<td>Huntley</td>
<td>South Africa</td>
<td>1:14,000,000</td>
<td>7 biomes (Fynbos, Karoo, Grassland, Arid Savanna, Mois Savanna, Lowland Forest, Afromontane Forest)</td>
</tr>
<tr>
<td>1986, 1994</td>
<td>Rutherford and Westfall</td>
<td>Southern Africa</td>
<td>1:10,000,000</td>
<td>7 biomes (Fynbos, Succulent Karoo, Nama-Karoo, Savanna, Grassland, Forest)</td>
</tr>
<tr>
<td>1996</td>
<td>Low and Rebelo</td>
<td>South Africa</td>
<td>1:1,800,000, 1:2,000,000, 1:3,880,000</td>
<td>68 vegetation types within 7 biomes (Fynbos, Succulent Karoo, Nama-Karoo, Thicket, Savanna, Grassland, Forest)</td>
</tr>
<tr>
<td>2006</td>
<td>Mucina and Rutherford</td>
<td>South Africa</td>
<td>1:1,000,000</td>
<td>435 vegetation types within 9 biomes (Fynbos, Desert, Succulent Karoo, Nama-Karoo, Albany Thicket, Savanna, Grassland, Forest and Indian Ocean Coastal Belt)</td>
</tr>
</tbody>
</table>
Thicket consists of dense, spiny, semi-succulent shrubs and small trees (Cowling et al. 2005; Hoare et al. 2006), described by Rutherford et al. (2012) as a form of dry, dwarf forest. Located along South Africa’s eastern seaboard at the boundary of the year-round rainfall zone (YRZ) and summer rainfall zone (SRZ) (Fig. 7.1), the biome receives 200–900 mm of mean annual precipitation, which falls bimodally with no clear dry season (Hoare et al. 2006). The biome forms the south-
western component of the Maputaland-Pondoland-Albany biodiversity hotspot (Steenkamp et al. 2004). Land degradation and overgrazing constitute potential threats (Rutherford et al. 2012), with van Luijk et al. (2013, p.14) describing subtropical thicket as “one of the most extensively livestock degraded ecosystems in the country”. Ecosystem changes associated with thicket degradation include biomass reduction, invasion of alien species, and soil erosion (Rutherford et al. 2012).

7.1.6 Savanna

The iconic Savanna Biome is the most widespread in South Africa, and comprises the southernmost extension of the African savannas. This tropical vegetation type is distributed in the SRZ (Fig. 7.1), with a single wet season (Scholes 2003). Savanna vegetation structure is typified by a continuous grassy understorey, with a discontinuous overstorey, albeit with a great deal of variation in the prominence of these two elements. Where woody elements dominate, the vegetation is termed bushveld, whereas grassveld is dominated by the grassy component (Meadows 2000). The vegetation is, like fynbos, pyrophytic, or fire-dependent, and demonstrates a range of fire adaptations. According to Rouget et al. (2004), only 8.9% of the Savanna Biome is afforded Type 1 protection status (i.e. given the status of National Park or Provincial Nature Reserve); however, private reserves and game farms may increase the effective conservation of the biome where sound management practices prevail. South African savannas are economically important, contributing to a variety of land use types including ranching, cultivation, and conservation, among others (Grossman and Gandar 1989). In particular, the Savanna Biome is renowned for its spectacular large mammal fauna (Rutherford et al. 2006) (Fig. 7.3d), a critical feature of South Africa’s wildlife tourism industry. Moreover, savannas provide a range of natural resources for surrounding communities, including fuelwood, fruits and vegetables, grass and wood for tools and utensils (Shackleton and Shackleton 2004). Important potential threats to the biome include alien invasive species, habitat transformation (e.g. for urban development or agriculture), and bush encroachment (Fig. 7.3e).

7.1.7 Grassland

The Grassland Biome is centrally located in South Africa, including the central plateau and the eastern escarpment up to altitudes of 3450 m asl (Fig. 7.1). The biome is characterized climatically by cold, dry winters, with frost and snowfall experienced at high altitudes (Carbutt et al. 2011) (Fig. 7.3b). The biome is located in the SRZ and receives 400–2500 mm mean annual precipitation (Carbutt et al. 2011). As in the Savanna Biome, grasses utilizing the C4 photosynthetic pathway dominate the Grassland Biome, with C3 grasses found at high altitudes (Vogel et al. 1978). South African grasslands can be classified as warm temperate or cool temperate (Mucina et al. 2006c), with the subtropical grasslands of Maputaland and Pondoland classified separately under the Indian Ocean Coastal Belt Biome (Carbutt et al. 2011). A single grass-dominated layer is characteristic of this vegetation type. South African grasslands are rich in plant species diversity (O’Connor and Bredenkamp 2003), predominantly associated with the forb component of the vegetation, whereas the grassy component contributes higher biomass (Carbutt et al. 2011). Major threats include the agriculture, mining and forestry sectors, with relatively few grasslands protected outside of the uKhahlamba–Drakensberg Park (Carbutt et al. 2011).

7.1.8 Forest

Forest is the smallest of South Africa’s biomes, occurring as an archipelago of small patches along the escarpment and coastal lowlands (Mucina and Geldenhuys 2006) (Fig. 7.1), often situated within a grassland matrix (Fig. 7.2h). The biome comprises two main forest types, Afrotemperate and coastal. Afrotemperate forests occur on the escarpment and along the southern Cape coastline, forming part of the Afromontane region (Mucina and Geldenhuys 2006). Coastal forests occur on the subtropical coastal seaboard of KwaZulu-Natal and the Eastern Cape (Mucina and Geldenhuys 2006). Forest patches range from as small as <1 ha (Lawes et al. 2004a) to the largest continuous forests in the Knysna–Tsitsikamma area of the southern Cape (Midgley et al. 2003a). Other relatively large forest blocks can be found in the Amatole Mountains (Eastern Cape), the KwaZulu-Natal Midlands, northern Mpumalanga and the Limpopo Province (Lawes et al. 2004a). The complex multi-layered canopy structure is dominated by evergreen and semi-deciduous trees, with stand height ranging from 3 to 30 m (Mucina and Geldenhuys 2006). During the colonial period, many forests were heavily exploited for timber harvesting, affecting contemporary forest diversity, composition and structure (Adie et al. 2013). South Africa’s forests continue to provide an important natural resource base on which rural communities depend for timber, medicinal plants, handicraft materials, fuelwood, building poles, honey and hunting (Lawes et al. 2004b). Habitat destruction and fragmentation are a concern for forest conservation in South Africa, with specific issues including selective timber harvesting and poaching (Castley and Kerley 1996).
7.1.9 Indian Ocean Coastal Belt

The Indian Ocean Coastal Belt stretches along a narrow, 800 km-long coastal strip from the Mozambique border southwards to East London in the Eastern Cape (Mucina et al. 2006d) (Fig. 7.1). The biome is densely populated and largely transformed, thus leaving open questions as to its original condition (Mucina et al. 2006d). Mucina et al. (2006d) support the view that, prior to transformation, the biome consisted predominantly of forest vegetation, broken by grassland patches in areas with suitable soils and moisture availability. These grassland patches were formerly classified as part of the Grassland Biome (Low and Rebelo 1996; Rutherford and Westfall 1986), but reclassified by Mucina and Rutherford (2006) as part of the Indian Ocean Coastal Belt. The biome contains extensive secondary grasslands (Mucina et al. 2006d). Forests within the biome are typified by trees, lianas and epiphytes (Mucina et al. 2006d). The Indian Ocean Coastal Belt falls within the Maputaland-Pondoland-Albany biodiversity hotspot, the second richest hotspot in Africa based on species numbers (Steenkamp et al. 2004). Major threats to the conservation of the biome include agriculture, plantation forestry (Mucina et al. 2006d) and further urban development.

7.2 Case Studies

The following section outlines three case studies of environmental change in South African biomes, focusing on the evidence for and reasons behind environmental changes in these specific biomes. Further, this analysis illustrates the different controls underlying biome dynamics.

7.2.1 Past Human Impacts at Verlorenvlei (Fynbos/Succulent Karoo Transition)

Verlorenvlei, a semi-estuarine coastal lake, lies in the semi-arid to arid winter-rainfall dominated ecotone between the lowland vegetation formations of the Fynbos and Succulent Karoo biomes (Figs. 7.1 and 7.3). The characteristic mosaic of xeric vegetation (and associated coastal lowland landscape) that currently prevails along this part of the west coast is known as Sandveld. Typical of ecotone regions, there is considerable biodiversity; the lake, together with its riparian wetlands, was one of South Africa’s first formally recognised Ramsar sites (Baxter and Davies 1994), although it still has no formal conservation status. Conventional wisdom holds that Verlorenvlei and its catchment have been left relatively undisturbed and unaffected by human activities; the view emerged that this dryland aquatic system largely avoided widespread and pervasive human disturbance (Baxter and Davies 1994). This is a view that can of course be tested, if suitable sediments exist, through the methodologies of palaeoenvironmental reconstruction. Sediments often contain so-called proxies, indicators of the conditions at the time of their deposition and, if they can be reliably dated, enable reconstruction of changing vegetation communities over time and possible drivers thereof. Such sediments do exist at Verlorenvlei and a record of environmental change from several cores within the site has emerged extending back through much of the Holocene (e.g. Baxter and Meadows 1994, 1999; Carr et al. 2015; Meadows et al. 1994; Meadows and Asmal 1996; Meadows and Baxter 1999), thus enabling the assumption of limited human impact to be systematically evaluated.

The pollen record of vegetation change provides a narrative of considerable environmental variability during the Holocene arising from fluctuations in moisture availability (Meadows et al. 1994) and sea-level change (Meadows and Baxter 1999). Although the record is temporally fragmented, the picture emerges of a mid-Holocene (~8000 to 4000 years BP) characterised by greater aridity and higher sea levels. This was followed by a period from 4000 to 2500 years BP in which both pollen (Meadows et al. 1994) and leaf-wax alkane proxies (Carr et al. 2015) indicate higher moisture availability as sea level retreated, although more xeric conditions return thereafter until about 1000 years BP.

Signs of human disturbance become much more prominent in the postcolonial era as indicated in the Verlorenvlei palaeoecological record. The phase immediately preceding European colonisation of the Sandveld appears to have been one of higher rainfall than today, indicated by pollen (Baxter and Meadows 1994; Meadows et al. 1994), diatoms (Stager et al. 2012) and leaf-wax alkane records, especially during the period that corresponds approximately to the global Little Ice Age (~1550 to 1850 AD). However, the arrival of the first European settlers in the region around 1655 AD was soon followed by the introduction of cattle and the clearance of sandy slopes around the lake for wheat and other crops (Sinclair 1980). The precolonial and postcolonial phases show markedly contrasting vegetation communities. An ecosystem indicative of higher catchment rainfall and abundant fresh water in the lake is quite rapidly replaced by one in which there are (1) increasing proportions of riparian plant types that point to a shallower lake with more seasonal freshwater, and (2) higher levels of disturbance through grazing pressure indicated by the abundance of Asteraceae pollen types (Baxter and Meadows 1994). This substantial shift in conditions (Fig. 7.4), was accompanied by a rapid increase in the rate of sedimentation in the lake caused by the accumulation of a large volume of inblown sand, which is presumed to have been derived from the surrounding slopes as they were cleared to plant crops (Meadows and Asmal 1996). The sedimentary farming lifestyle was, furthermore, associated with
the virtual elimination of the endemic megafauna, including elephant and hippopotamus, which would have had a profound effect on the ecosystem, not least on the riparian and aquatic vegetation itself.

The picture emerges, then, of a landscape that was extensively altered within a short period of time following European colonization, and that is consequently far from ‘pristine’. The transitional state of the system, although it seems to have retained many elements of its resilience to natural variations – such as the unreliability of winter rain – has nevertheless been placed under even more pressure in recent years due to the widespread introduction of centre-pivot irrigation for potato and wheat production (Heydenrich 1993). Baxter and Davies (1994, p.268) noted the precarious situation of this important site more than 20 years ago, arguing that “without the urgent imposition of appropriate conservation management strategies the equilibrium of this unique dryland aquatic ecosystem will soon become irreversibly altered to a new state”. The palaeoecological record emphasises the vulnerability of Verlorenvlei and, given its significance especially in regard to biodiversity, one that requires considerably more attention from an environmental and conservation perspective than it has thus far been afforded.

7.2.2 Recent Bush Encroachment in South African Grasslands and Savannas

Over recent decades, bush encroachment has emerged as a serious environmental management concern in South Africa’s grassy biomes. Trollope (1980, p.173) defines bush encroachment as the “phenomenon whereby trees and shrubs invade into open grassland or thicken up in already wooded areas” (see example in Fig. 7.3e). Bush encroachment changes the tree:grass ratio, thereby reducing carrying capacity for domestic livestock due to the loss of palatable grasses to relatively unpalatable woody species (Ward 2005). Aside from impacts on agricultural productivity, bush encroachment alters biodiversity (Ward 2005) and ecosystem functionality (Buitenwerf et al. 2012). The process has been widely recorded using repeat fixed-point and aerial

![Fig. 7.4 Pollen diagram from Verlorenvlei indicating vegetation changes over the past 450 years. Ages are approximate. (From Baxter and Meadows 1999)](image-url)
The drivers of bush encroachment are poorly understood (Britz and Ward 2007; Ward 2005) but depend on the interaction of environmental history, management and vegetation (O’Connor et al. 2014). Important local factors such as fire and grazing (Ward et al. 2014) relate to the disturbance regime. More recently, the influence of global climate change on woody encroachment has been emphasized (Bond 2008; Bond and Midgley 2012), as increased atmospheric CO₂ concentrations increase the growth rates of trees relative to grasses (Buitenwerf et al. 2012). However, the confounding interactions of CO₂ effects with changes in disturbance regime, and indeed rainfall, mean that the underlying drivers of woody thickening can be difficult to pinpoint (Buitenwerf et al. 2012). Long-term studies are required to disentangle the relative importance and interplay of these drivers (Ward et al. 2014) and allow for informed management of encroached areas into the future. O’Connor et al. (2014) provide a detailed review of the nature and causes of bush encroachment in southern Africa.

### 7.2.3 Fynbos Distribution Under Future Climate Change

The biome concept itself is fundamentally a reflection of the close relationship between global biogeographical pattern and climate, so it follows logically that climate change must impact such distributions. The extraordinary diversity within the Fynbos Biome is at least partly a consequence of longer term climatic stability (Altwegg et al. 2014) but the scale and rate of current and predicted future climate change may signify an unprecedented level of ecological stress. Such changes may exceed the thresholds of the ‘sweetspot’ of the environmental niche that seems to have prevailed in the area of the Fynbos Biome in the past (Altwegg et al. 2014), and may significantly threaten the maintenance of the Fynbos Biome. Anthropogenic climate change, caused by increased atmospheric concentrations of greenhouse gases (especially CO₂, which in itself induces change because of its differential effects on plants with different photosynthetic pathways), has been shown to have strongly impacted global biogeographic distribution patterns (Parmesan and Yohe 2003). In general, climate warming, which is of course only part of the climate change nexus, is likely to enforce species range shifts both poleward and upslope (Chen et al. 2011). The Cape Floristic Region biodiversity hotspot (Mittermeier et al. 2004; Myers et al. 2000) is especially vulnerable to such threats due to the high levels of endemism and restricted distribution of many of its taxa.

Bioclimatic modelling has been widely employed as a means of assessing the environmental limits for vegetation at both the biome and species level in the Fynbos Biome (Hannah et al. 2005; Midgley et al. 2002, 2003b; Midgley and Thuiller 2011). Midgley et al. (2002) predict, under the x2 CO₂ scenario of the HadCM2 climate model, a contraction of the bioclimatic envelope of the Fynbos Biome of 65% by 2050, with particularly significant losses at the northern limits of its modern distribution (Fig. 7.5). A more detailed, and arguably more alarming, picture emerges from analyses at the species level. Of the 330 species of the Proteaceae family that occur within the biome, some 10% of these fall within parts of the biome predicted to be completely lost, and a further 40% may experience loss of up to one third of their range (Midgley et al. 2002, 2003b). Such losses clearly present an extinction risk for some species, more especially because the biome continues to undergo significant landscape transformation under cumulative anthropogenic pressures (Rouget et al. 2003). The situation has been explored for other taxa too, for example birds (Lee and Barnard 2015) and even at the local scale (e.g. Guo et al. 2016, for Restionaceae). The spatial distribution of protected areas becomes an important factor in determining which species will likely be most (or least) impacted by future climate change (Hannah et al. 2005), although conservation strategies cannot only be based on predicted bioclimatic range shifts (Gillson et al. 2013).

Although there have been suggestions that the topographic heterogeneity of the Fynbos Biome may serve as a buffer to climate change and that some more recent approaches do not predict an especially marked reduction in the Fynbos climate niche (Driver et al. 2012), there seems little doubt that, against a background of increasing anthropogenic pressure, the future of the Fynbos Biome, with its associated biodiversity, ecosystem services and the livelihoods that these provide for, is increasingly uncertain.

### 7.3 Summary

South Africa is host to nine biomes which have been described according to their characteristic features, ecology and conservation status. Spatial and temporal changes in biome distribution and composition may be caused by a range of natural and anthropogenic processes. Palaeoenvironmental studies reveal that systems previously thought to be in a pristine condition have been in fact significantly impacted by human activities, particularly in the colonial era. On a multidecadal timescale, the process of bush encroachment has been widely recorded across grassy...
biomes at both the local and national scale, impacting agricultural productivity and biodiversity. Predictions for the future impacts of anthropogenic climate change are illustrated for the Fynbos Biome and point to an alarming reduction in biome extent and associated loss of species. Such predictions are a major concern given the global conservation significance of Fynbos. Conservation management strategies should take cognisance of historical ecosystem processes, and future predictions of biome extent and composition.
References


Ecosystem Services in South Africa

Catherine Sutherland and Bahle Mazeka

Abstract

South Africa is endowed with a rich biodiversity and a relatively high production of ecosystem services. However, these services are under threat, which has consequences for the transformation of South Africa to a more just, resilient and sustainable society, which is in part dependent on the ways in which ecosystem services are valued and managed. This chapter defines the concept of ecosystem services and presents different approaches that have been adopted in valuing ecosystem services in South Africa. Ecosystem services can be considered in terms of their value to social and environmental well-being, particularly in addressing poverty; their economic value; their benefits for climate change adaptation; their inclusion in planning and development; and their social construction, which in some cases, results in an ‘ethics of care’. However, the institutionalisation and implementation of the ecosystem services concept in policy and practice in South Africa remains challenging.

Keywords

Ecological infrastructure · Ecosystem services · Ethics of care · Natural capital · Resources · Socioecological relations

8.1 Introduction

The earth’s ecosystems and the services they provide are critical to biosphere integrity and the well-being of humanity (Everard 2017; Griggs et al. 2013; SANBI 2014; WWF 2016). However, the world is reaching its planetary boundaries as a result of irreversible changes to the earth’s ecosystems (Steffen et al. 2015; Swyngedouw 2015), and hence research into the conservation and management of ecosystem services has become increasingly important (Everard 2017; MEA 2005; van Jaarsveld et al. 2005). The concept of ecosystem services includes the ways in which natural resources support both human wellbeing, and the functioning of ecosystems which produce these services (Everard 2017). It is embedded in the disciplines of ecology, conservation biology and ecological economics. It reflects and embodies relationships between humans and the environment and has a strong spatial dimension, and therefore there has been a call for “geographers to engage with the ecosystem services concept, which is an increasingly dominant global model for environmental policy and management” (Jackson and Palmer 2015, p.122). This chapter presents the different ways in which the concept of ecosystem services has been constructed and applied from a geographical perspective in South Africa.

8.2 Defining Ecosystem Services

Ecosystem services are the “ecological characteristics, functions, or processes that directly or indirectly contribute to human well-being” (Costanza et al. 2011, p.1). They include provisioning services (such as food, water and timber); regulating services (which control climate, disease, waste and water quality); supporting services (such as soil formation, plant growth through photosynthesis and nutrient cycling); and cultural services (which provide spiritual, recreational and aesthetic benefits) (MEA 2005). Ecosystem services is therefore a systemic concept with an anthropocentric focus (Everard 2017). However, the need to protect ecosystem services due to their value to humans, is also used in South Africa as an argument to support biodiversity conservation for natural wellbeing (or ecosystem functioning) (Blignaut et al. 2008). The concept of ecosystem services is therefore framed by the conceptualisation of the environment as the
critical asset-base upon which all life depends. This transformative interpretation of the relations between economy, society and the environment argues that the economy and society are dependent on, and embedded in, natural capital (Cartwright and Oelofse 2016; Dryzek 1997; Griggs et al. 2013; WWF 2016). Whether building resilience or moving towards ‘just sustainability’, the critical bottom line is that the protection and sustainability of ecosystem processes and services are essential for our future on earth (Griggs et al. 2013; Steffen et al. 2015; WWF 2016) and hence better choices need to be made in relation to natural resources (see Fig. 8.1).

Gómez-Baggethun et al. (2010) and Everard (2017) provide a useful account of the origin of the concept of ecosystem services and how its conceptualisation and application has shifted over time. Aldo Leopold through his essays A Sand County Almanac (1949) played a significant role in raising awareness and understanding about human dependence on the environment, arguing for a ‘land ethic’ that recognised the value of natural resources (Everard 2017). The ecosystem services concept first emerged in scientific discourse in the late 1960s through a utilitarian lens, revealing the value of ecosystems to humans as a means of increasing public concern and interest in biodiversity conservation (Ehrlich and Ehrlich 1981; Everard 2017; Gómez-Baggethun et al. 2010). This concept was later expanded to include the economic value of ecosystem services and their benefits for adaptation to environmental risks, such as climate change. By the 1990s, ecosystem services had become a well-established concept both in the literature and in practice (Jackson and Palmer 2015). Constanza and Daly’s (1992) seminal work paved the way for the inclusion of ecosystem services in ecological economics, as the interest in methods for placing an economic value on these services increased (Gómez-Baggethun et al. 2010). In 2005, the Millennium Ecosystem Assessment (MEA 2005) placed ecosystem services firmly on the global policy agenda (Fisher et al. 2009).

Payment for ecosystem services programmes and the development of markets for ecosystem services reflect the different methods developed for valuing the environment in monetary terms. However, the approach of placing an economic value on ecosystem services has restructured human–environment relations using a neoliberal logic. It is criticised because of the inequality and exploitation that can result from the commodification of nature, as those who have financial means can secure greater access to valuable natural resources.
than those that do not (Büscher 2012; Harvey 1996; Heynen et al. 2006; Jackson and Palmer 2015). Ecosystem services are not conventional economic goods. They are owned by multiple private and public entities, they are consumed implicitly by people, who are often not aware of the value of these services to human wellbeing, and they are usually considered to be free (Cartwright and Oelofse 2016). Mander (2016) argues that the valuation of ecosystem services in monetary terms does not reflect their full value in, for example, providing municipal services or improved quality of life.

This has led to a call for alternative approaches to be developed which consider the full value of ecosystem services through an ‘ethics of care’. More recently the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has developed a conceptual framework that focuses on the notion of nature’s contributions to people. The critical difference between this framework and that proposed by the MEA (2005), is that it recognises the critical role that culture plays in defining human–environment relations, and the importance of understanding context in shaping how nature is valued, as many of the case studies presented in this chapter show. It also stresses and elevates the role of indigenous and local knowledge in understanding nature’s contributions to people (Díaz et al. 2018).

Nature’s contributions to people is a new approach and its reporting categories are still being developed through the IPBES Global Assessment, however the approach is already shifting the ways in which nature is being constructed and valued (Díaz et al. 2018). The multiple ways of valuing ecosystem services is evident in South Africa due to the country’s history and its biophysical and social diversity. More recently the concept of ecological infrastructure has emerged as a means of inserting ecosystem services in to the system of ‘infrastructures’ that provide the platform for human wellbeing and development. Jewitt (pers. com. 2017) defines ecological infrastructure as “naturally functioning ecosystems that produce and deliver valuable services to people”.

Having provided a broad overview of the concept of ecosystem services, some of the different framings and approaches adopted for the valuing of ecosystem services in South Africa from a geographical perspective are now presented.

### 8.3 Ecosystem Services in South Africa

#### 8.3.1 The Spatial Distribution of Ecosystem Services in South Africa

South Africa has relatively high biodiversity, including the Maputaland-Pondoland-Albany biodiversity hotspot (Perera et al. 2011) and the Cape Floristic Region (Goodness and Anderson 2013), and an abundance of ecosystem services which are recognized and protected for both bioethical and human motives (Blignaut et al. 2008; Cartwright and Oelofse 2016). The protection of biodiversity through conservation planning has shown some congruency with the provision of ecosystem services (Egoh et al. 2010). When data on ecosystem services are included in biodiversity conservation plans, the quality of outcomes in relation to the provision of ecosystem services increase. However, this can come at some cost to biodiversity protection. Consequently, trade-offs need to be made, as was evident in the development of conservation interventions in the Little Karoo, southern Cape (Egoh et al. 2010). In this example, data on the ecosystem services of carbon storage, water recharge and fodder provision were used in conjunction with biodiversity targets to evaluate different conservation scenarios (Egoh et al. 2010, 2011). The study found that by a small decrease in biodiversity targets, the protection and benefits of ecosystem services could be increased at no extra cost. Benefits can be achieved by supporting both ecosystem services and biodiversity, but often trade-offs need to be made, which requires good governance.

Egoh et al. (2008) mapped five critical environmental services, namely carbon sequestration, surface water supply, water flow regulation, soil accumulation, and soil retention in South Africa, and investigated the spatial correlations between them. This study revealed that although ecosystem services are predominantly found in one third of the land area of the country, the low levels of spatial congruence between the five services suggest that almost all of South Africa is important for the conservation and management of these services. This highlights the large responsibility across South Africa for the protection and sustainability of the country’s valuable environmental assets (Cowling et al. 1989; Egoh et al. 2008). Blignaut et al. (2008) overlaid four of these five ecosystem services with areas of poverty present at the municipal scale. The spatial distribution of areas of high ecosystem services productivity is strongly associated with areas that are underdeveloped and which have high poverty levels (see Fig. 8.2). This result is significant, as it supports an approach to ecosystem services management that addresses social challenges of South African society, in particular poverty and job creation, rather than being focused on conservation alone. This transformative approach, with its resultant suite of methods and tools, is being developed in South Africa at different scales and in different contexts, through employing scientific and local knowledge, experimental and social learning and multi-actor partnerships, as the examples in this chapter will show (e.g. Cartwright and Oelofse 2016; Mander 2016; Roberts et al. 2012; World Bank 2016).
Fig. 8.2 Maps at a municipal level in South Africa showing (a) ecosystem goods and services (EGS) production based on four priority services; and (b) poverty levels. (Source: Blignaut et al. 2008)
8.3.2 Payment for Ecosystem Services and Investment in Ecological Infrastructure

Payment for ecosystem services reflects the monetary valuation of ecosystem services, drawing them into a capitalist, commodity logic. One such example is the Cape Action for People (CAPE) program which is a partnership between the government and civil society to conserve and restore the biodiversity of the Cape Floristic Region and the adjacent marine environment, which deliver benefits to the citizens of the region (www.sanbi.org.za, accessed 18/10/2017). CAPE has secured international funding and the Expanded Public Work Programme’s resources to employ the poor in biodiversity rehabilitation and restoration projects for the common good. One of the main lessons learnt from the implementation of the CAPE programme, as well as similar initiatives in the City of Cape Town, was the challenge of pricing ecosystem services based on supply and demand (Cartwright and Oelofse 2016; SANBI 2014). The approach has now shifted towards investment in ecological infrastructure and developing the green economy, given the challenges of creating markets and willing buyers for ecosystem services (Cartwright and Oelofse 2016; SANBI 2014).

South Africa is a water scarce country. Figure 8.3 presents the benefits to society from investing in ecological infrastructure to secure water, through supporting and protecting ecosystem services. The uMngeni Catchment in KwaZulu-Natal Province supports South Africa’s third largest regional economy (the Durban–Pietermaritzburg urban area) (Hay 2017). Although the uMngeni River system is highly productive, the water resources of this system are at risk as a result of drought, seasonal rainfall, pollution and environmental degradation. The uMngeni Ecological Infrastructure Partnership, which is a partnership between multiple state, private, research and community-based actors, is based on the principle that ecological infrastructure can enhance the efficiency of water service delivery through improving water quality, reducing sediment loads and flood risk, and increasing yield through increased winter base flows, thereby supporting engineering investments (Sutherland and Roberts 2014; www.grasslands.org, accessed 9/7/2014). One component of the uMngeni Ecological Infrastructure Partnership, which is facilitated by the Duzi Umngeeni Conservation Trust and reflects the idea of payment for ecosystem services, is the funding of ‘ecochamps’ who are selected from local communities to contribute to catchment and river rehabilitation. By managing and improving the catchment’s umbrella ecosystem services, which then provide a wide range of secondary services, water security in the catchment increases and jobs are created.

Organisations that benefit from investing in ecological infrastructure, or who are mandated to invest in natural capital, are important to identify. The main ecosystem services that have emerged in South Africa for attracting investment are related to water security and disaster risk reduction, with a climate adaptation focus in both (SANBI 2014). Government is the main stakeholder in both these cases, although there is the potential to draw the private sector in to investing in ecological infrastructure to support these domains. One such example is where the private sector in the town of Ceres, namely the pome and stone fruit farmers and
their markets, which are high-end local and international food retailers, have invested in a conservation partnership with the Breede Gouritz Catchment Management Agency, the Alliance for Water Stewardship and local informal communities. The purpose of this is to secure high-quality water in the Breede Catchment and Koekedouw Dam through ecosystem restoration in the catchment. Farmers and the fruit industry in Ceres are dependent on access to high-quality water to ensure the acceptability of their fruit on global markets. The decline in water quality due to unmanaged urban growth poses a risk to the development and sustainability of this industry. Volunteers from local communities, under the Witzenberg Water Savers, have been engaged in conservation projects to improve ecological infrastructure in the catchment, as part of the conservation partnership (www.wwf.org, accessed 30/07/2017).

The national Department of Environmental Affairs has invested in the restoration of ecosystem processes and services while alleviating poverty and creating jobs through its Natural Resource Management program. Its flagship programme, Working for Water, which has won numerous local and international awards, has the aim of controlling alien invasive plant species which impact on biodiversity, water resources and the productivity of land, through the employment of poor and unemployed local people (SANBI 2014; Shackleton et al. 2008). It has strong political support as a result of its ability to create jobs. However, payment for ecosystem services has also been criticised for drawing ecosystem services into the neoliberal project, indirectly producing social and environmental injustice where the aim is to develop capitalist markets (Büscher 2012; Díaz et al. 2018). Büscher (2012) in his study of the Maloti–Drakensburg Transfrontier Project, which is considered to be an exemplary payment for ecosystem services project in South Africa, argues that the success of the project has been promoted by the very epistemic communities who advance payment for ecosystem services programmes as the best approach for securing ecosystem services in South Africa. A more critical evaluation of these projects is therefore required.

### 8.3.3 Ecosystem-Based Adaptation

Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change (Secretariat of the Convention on Biological Diversity 2009). Climate adaptation can be strengthened by including ecosystem based approaches as they are often cost-effective, sustainable, and they alleviate poverty by providing labour-intensive job opportunities. They result in multiple benefits for the poor who live at the closest interface with the environment, and who rely on ecosystem services for protection from environmental risks and hazards (Cartwright and Oelofse 2016; Laros et al. 2013; Roberts et al. 2012; Sutherland et al. 2016).

As part of its Municipal Climate Protection Program, eThekwini Municipality which includes the city of Durban (KwaZulu-Natal Province), has developed an innovative community-based climate protection model, Community Ecosystem Based Adaptation. This programme restores ecosystems that are critical to the welfare of both the urban poor, and the municipality as a whole, through a partnership between the municipality and the Wildlands Conservation Trust (Laros et al. 2013; Roberts et al. 2012). This programme not only supports climate adaptation but delivers co-benefits, including improving human wellbeing, providing jobs, enhancing service delivery, building social cohesion, and supporting services which are ‘free’, thereby avoiding the high costs of installing hard infrastructure. It also builds political agency of the climate change agenda (Roberts et al. 2012). While Durban’s programme has delivered benefits, it has been termed “technically challenging and resource intensive” (Roberts et al. 2012, p.167). An example of Durban’s Community Ecosystem Based Adaptation programme is the establishment of a large-scale community reforestation initiative in the buffer zone around the Buffelsdraai regional landfill site. This program has focused on addressing biodiversity loss, carbon sequestration, and the provision of ecosystem services through adjacent communities planting trees as part of the Wildlands Conservation Trust’s ’treepreneur’ programme (Roberts et al. 2012). Community members grow trees in their own neighbourhoods which are then exchanged for credit notes for food, building materials, schools’ fees and money. This programme has resulted in valuable social learning and training on Community Ecosystem Based Adaptation approaches as a result of its successes and challenges.

### 8.3.4 Recognition of the Value of Ecological Infrastructure and Ecosystem Services in Planning and Development

South Africa has a well-established system for implementing systematic conservation planning, which is supported by progressive legislation (SANBI 2014). Mainstreaming biodiversity conservation and the protection of ecosystem services into land use planning and decision making is undertaken at both the national and local scales. Systematic biodiversity plans have informed conservation action across
the country through their influence on environmental management, such as in Environmental Impact Assessments, Forestry Expansion Plans and agricultural planning, and in spatial planning at the municipal level where biodiversity planning and ecological infrastructure layers are integrated into municipal Spatial Development Frameworks (Holness and Skowno 2013; SANBI 2014). In many municipalities, open space systems, which are comprehensive plans that represent the presence and need for protection of biodiversity and ecosystem services, form a layer of the municipal Spatial Development Framework, thereby guiding and limiting development. One such example is the Knysna Open Space System. Knysna Municipality, Western Cape Province, recognizes that “the environment IS the economy” (Knysna Municipality 2017, p.33) and hence one of the dominant layers in the municipality’s Spatial Development Framework is its green network. This reflects the continuity of biodiversity networks, systems and features, which aim to protect and secure the municipality’s environmental assets (Mander 2016; Sutherland 2016). The political, social and economic value of ecological infrastructure is reflected in the proposal to include it as one of South Africa’s Strategic Infrastructure Programs (SIP), SIP 19. This is also evident at local government level where Cartwright and Oelofse (2016) argue that the challenges South Africa faces in maintaining its built infrastructure could be reduced by relying on less technical, more cost effective, easier to maintain, and employment producing ecological infrastructure. Municipalities are now motivating to spend part of their Municipal Infrastructure Grants on restoring and maintaining ecosystem goods and services.

8.3.5 Social Constructions of Ecosystem Services and an Ethics of Care

The value of ecosystem services is constructed differently by actors in different contexts. In South Africa, indigenous knowledge holds and produces critical information on the value and benefits of natural resources. This is not always included, or recognized, in formal biodiversity planning. In the Palmiet Rehabilitation Project in Durban, local communities have begun to reshape their relations with the Palmiet River through participatory governance (Vogel et al. 2016). Members of River Watch, a community-based organization, are committed to the rehabilitation of the river and its catchment and the ecosystem services they provide, through a biodiversity-focused ’ethics of care’ project. Further down the river in the Quarry Road West informal settlement, a group of residents who are participating in the Palmiet Rehabilitation Project are influencing the waste management practices of the community, who lack access to basic services, through social learning and the erection of ‘no dumping’ signs (Fig. 8.4).

A group of women have stated that they want to clean up the river because:

“When I moved to the settlement in 1999 the river was in a good state. We washed in the river and used it for drinking water” (Quarry Road West informal settlement resident 1, 24/08/2014).

Fig. 8.4 Communicating an ‘ethics of care’ in Quarry Road West informal settlement. (Photo: Catherine Sutherland, 24/04/2016)
“If the river was in a good state we could use it to swim, wash, gossip next to the river (the river takes the gossip away) and for fishing” (Quarry Road West informal settlement resident 2, 24/08/2014).

This reflects an ‘ethics of care’ based on the health of both humans and rivers in a particular locality. Ordinary citizens are reshaping their relations with nature and its resultant ecosystem services, engaging with the local state in order to gain support for local projects (Vogel et al. 2016), and revealing the micropolitics of river life (Strang 2013).

Research conducted on the social construction of ecosystem services in a rapidly densifying periurban area in Durban revealed the spiritual value of nature (Sutherland et al. 2016). Residents stated that they wanted to become stewards of the environment and take care of it because they:

- have forgotten the nature. Those who believe in the Almighty and ancestors, they are saying we are being punished by our ancestors because we no longer have the sound and good rivers that we go and pray to Unomkhubulwane (the rain guardian). Long time ago they used to visit the uMngeni River to pray if there is no rain during summer time. (Local Resident 1, 07/03/2016; cited in Sutherland et al. 2016)

This resident is reflecting on the loss of a spiritual service which, through its presence, enabled residents to address the impacts of drought.

South Africa’s biodiversity stewardship programmes, initiated in 2004, reflect an ‘ethics of care’ outside of the strict economic valuation of ecosystem services. Within this programme, the state, private sector and communities enter into a voluntary partnership agreement to protect and manage priority biodiversity areas. These programmes are primarily implemented by provincial conservation agencies and entities (SANBI 2014), but have also been implemented by South African National Parks and the World Wildlife Fund. This is a cost-effective approach for the state, as the costs of conservation are borne by the private landowner who has invested in biodiversity conservation through an ‘ethics of care’.

8.4 Discussion

There are a number of challenges for the institutionalisation and full valuing of ecological infrastructure in South Africa. The protection of ecosystem services is often perceived to reflect an ‘anti-development’ approach, advocated by ‘green’ environmentalists. The colonial and apartheid legacies of controlling African peoples’ rights to nature and development, or green activists’ desires to protect nature at all costs, has undermined the argument that ecosystem services form part of the social and economic transformation agenda. It has therefore been marginalised in a country where development, job creation and poverty alleviation is paramount. The socioeconomic and cultural diversity of South African society means that consensus around what natural capital should be valued, by whom and for whom, is very difficult to achieve, and hence it becomes difficult to assign budgets or makes choices around the protection of ecosystem services, or decide on what level of economic growth or development to forego to ensure environmental sustainability (Cartwright and Oelofse 2016).

The valuation of ecosystem services using well-developed pricing mechanisms has not been yet able to convince decision-makers of their value (Cartwright and Oelofse 2016; Mander 2016). Decision-makers question the big numbers that are produced in ecosystem evaluations and argue for more robust and evidence-based benefits of ecosystem services to society before institutional budgets, mandates and planning can be changed to include ecological infrastructure. Mander (2016) argues that social learning processes can lead to greater understanding, by multiple actors, of the full value of ecosystem services, while Jackson and Palmer (2015) argue for the reconfiguration of peoples’ socioecological worlds to reflect the full value of socio-nature relations.

8.5 Summary

It is evident from this chapter that a wide range of mainstream and innovative approaches has been developed in South Africa to value, support and draw benefit from ecosystem services, which are critical to human and environmental wellbeing in the country. Elements of the new IPBES nature’s contributions to people approach (Díaz et al. 2018) are already present, and continue to emerge in South Africa, as the country grapples with protecting its valuable ecological infrastructure and ecosystem services, which are constructed and used in different ways by different people, in the face of social, economic and environmental transformation. The ongoing destruction of environmental assets in South Africa is of great concern, as it is these very assets that will support a resilient and sustainable development path for the country’s environment and people. The interdisciplinary approach of nature’s contributions to people, which argues for the stronger inclusion of social science perspectives in a science- and economics-dominated field of knowledge, offers new insights around how to reorientate the scholarship and practice undertaken in this area thus far. Geography, with its focus on society–space–environment relations, therefore has a critical role to play in advancing the full value ecological infrastructure and ecosystem services in South Africa.

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Multi-Scale Drivers of the South African Weather and Climate

Christopher Lennard

Abstract
The weather and climate of a particular region is a function of multi-scale controls in both space and time. South Africa exhibits a range of present day climate regimes that result from these controls, giving rise to generally hot, wet summers and cold, dry winters, except in the southwestern parts that are dry in summer and wet in winter. This chapter examines the drivers of the regional climates through the lens of scales in space and time. It presents selected synoptic circulation patterns responsible for weather over different parts of the country, and smaller scale features associated with relevant synoptic circulation patterns, as appropriate. Also included is a discussion of how synoptic processes may be modulated by larger scale atmospheric and oceanic processes. The chapter concludes by linking socioeconomic activities such as agriculture, water resources and health to the regional climate.

Keywords
Cyclones · El Niño–Southern Oscillation · Intertropical convergence zone · Synoptic circulation · Teleconnections · Weather

9.1 Introduction

The present weather and climate of South African are as varied as the people who inhabit it. The semiarid desert of the Karoo, the tropical east coast, the Cape of Storms in the southwestern Cape, the snow-covered Drakensberg range, and the thundery Highveld all have characteristic short-term weather phenomena and distinctive long-term climate regimes. Seasonality plays a significant role in the South African climate, with typically hot summers and cold winters that result in many regions experiencing below zero winter temperatures. Over most of the country, precipitation occurs during summer except in the southwestern Cape that experiences winter rainfall, and parts of the southern Cape that experience rainfall all year round. These regional climates can be characterised using rainfall and temperature in a Köppen-Geiger map (Köppen 1936; Rubel and Kottek 2011) which shows the climate of South Africa becomes hotter and drier as one moves from east to west having regional expressions within this generalized pattern (Fig. 9.1).

The climate of a particular region derives from the weather it experiences over a long period of time, typically as a 30-year average, and is referred to as the regional climatology. For example, using meteorological station data available for the Cape Town International Airport, the 30-year (1980–2009) maximum temperature climatology is computed to be 27.6 °C. In Johannesburg and Durban, which experience completely different climate regimes to Cape Town (and each other), the maximum temperature climatologies are 26.6 and 27.8 °C, respectively. However, the weather of any particular day may have maximum temperatures above or below this average, giving rise to the popular saying ‘Climate is what you expect, weather is what you get’.

The climate and weather of a particular region is governed by a number of atmospheric and oceanic phenomena that occur on different time and space scales which may interact with each other. In this chapter these multi-scale phenomena are presented to elucidate the relationship between the large-scale drivers and the regional weather responses to these drivers in South Africa. This begins with an understanding of the importance of scale, as the greater climate system functions across multiple scales in time and space.
In the climate system there are many atmospheric phenomena that operate across scales in time and space. Phenomena may be small (less than 2 km in size) and last seconds to minutes, for example dust devils, and are called microscale phenomena. Others may last hours to days, can be between 2 and 2000 km in size and include individual thunderstorms, supercell thunderstorms, squall lines and land and sea breezes. These are termed mesoscale systems. Synoptic-scale systems are larger than 2000 km in size and include frontal systems and tropical cyclones and extra-tropical high- and low-pressure systems. Other phenomena exist at scales of thousands of kilometres to hemispheric scale and may have periodicities of months to decades and include the seasonal cycle, El Niño–Southern Oscillation (ENSO), Indian Ocean Dipole (IOD) and climate change itself (Fig. 9.2).

These multi-scale phenomena (in time and space) operate together to determine the weather and climate of a particular region, as they establish the synoptic environment in which smaller scale phenomena occur. For example, the microburst of a Highveld thunderstorm (a microscale process) is often embedded in a squall line (mesoscale) that forms in summer (seasonal scale) and these are likely to occur more often during a La Niña than an El Niño.

It is therefore important to view the South African climate through the lens of scales in time and space at which various processes operate and how they interact. The lens of scale is fundamental to the discipline of geography, in which weather and climate are an intrinsic component. This begins with understanding the large-scale environment of South Africa and the effect that physical features like topography and oceans have on the climate of the region.

9.3 Physical Controls of the South African Climates

9.3.1 The Location and Topography of South Africa

As one moves further away from the equator, less incoming solar radiation arrives at the surface of the earth and this results in a heat imbalance between the equator and poles. In a never-ending attempt to correct this imbalance, heat moves from the equator to the poles and is the fundamental reason the Earth experiences the weather it does. The latitude of a region therefore determines the type of climate it experiences: tropical climates are experienced between 23.5° North and South, temperate climates between 23.5 and 66.5°, and polar or arctic climates
between 66.5 and 90°. South Africa is situated in a latitudinal band between ~22 and 35° South and experiences a range of climates, from tropical to temperate (discussed later).

These latitudinally determined climates are modulated by the physical relief of the country that includes a mountainous escarpment separating the coastal plain from a high-lying interior plateau, and affects regional climate in a number of ways. First, as altitude increases from the coastal plains up the escarpment, temperatures decrease with height, and winter snowfall in the highest parts of the escarpment is not uncommon, especially in the cold peaks of the Drakensburg and Cape Fold Mountains. Second, the escarpment affects westerly flow in the mid-latitudes during winter, and easterly flow in the subtropics during summer. In each season a respective low-pressure trough forms in the lee of the escarpment as a result of the descending air, which would not exist were there no escarpment present. These troughs are termed the westerly and easterly waves, respectively. During winter, the rear of the westerly trough (located generally over the western Cape) experiences surface convergence, uplift, cloud and rainfall, whereas ahead of the trough (generally over the interior and eastern parts of the country) there is subsidence, surface divergence and clear skies. During summer, the rear of the easterly wave is located over the interior and eastern parts of the country and associated with surface convergence, uplift, cloud formation and rainfall whereas ahead of the trough over the western interior and west coast subsidence, surface divergence and clear skies are characteristic. It should be noted that the elevated plateau receives significantly less rainfall than it would were it at sea level and if there was no escarpment present.

The escarpment also interacts with the descending limb of the Hadley cell to facilitate or restrict the flow of moisture from the warm Agulhas current to the east of the country into the interior. The Hadley cell stretches from the equator to the subtropics and results from convectively-ascending air in the tropics that, on reaching the top of the troposphere, is forced poleward. As the air moves poleward it cools and sinks in the subtropics, resulting in a subtropical high-pressure system and characteristically clear skies. Over South Africa, this subsiding air results in an elevated subsidence inversion at about 3000 m height over the interior of the country in the summer, and about 1750 m height in the winter (Tyson and Preston-Whyte 2000). During summer, the base of the subsidence inversion is situated above the escarpment and moisture from the warm ocean can reach the interior of the country (Fig. 9.3). However, during winter, the base of the subsidence inversion is situated below the escarpment and moisture from the warm ocean cannot reach the interior of the country, and also traps pollutants in the region (Tyson et al. 1996). Additionally, the escarpment is responsible for the development of a system called a coastal low (described later).

The latitudinal location and physical relief of the country are therefore the first considerations in understanding the environment responsible for the climate of the region. Next we consider the oceans that surround South Africa that have a very large influence on the climate of the region.
9.3.2 The Effect of Local Ocean Currents

Oceans surrounding the coast moderate the seasonal temperature variations of coastal regions. In this maritime climate, summers at the coast may be cooler and winters warmer than inland locations at similar latitudes. If the surrounding ocean is warm, rainfall amounts are also usually higher.

Two major ocean currents surround the coastline of South Africa and affect its climate: the Agulhas current on the east and south coast and Benguela current along the west coast. The Agulhas current is a warm, fast-flowing eastern boundary current that follows the east coast in a southward direction and is then deflected away from the landmass by the Agulhas Bank (Lutjeharms 2006). During summer, moisture and energy from the current is transported into the interior of the country by onshore airflow over the escarpment and through the Limpopo valley and is critical for the production of rainfall over the interior during the summer months (Jury et al. 1993). The Benguela current is a cold western boundary current that, together with subsidence associated with the descending limb of the Hadley cell, is the primary reason for the arid and semiarid conditions in the western part of the country. During summer, a strong southeasterly wind blows along the west coast, resulting in offshore flow of the surface sea water that is then replaced by cold, nutrient-rich bottom water, and results in a very rich and diverse marine ecosystem (Andrews and Hutchings 1980; Shannon and Nelson 1996).

The latitudinal position of South Africa at the southern tip of the continent, and its physical environment including the escarpment, plateau and surrounding oceans, are the first-order drivers of the climate of the country at different time and space scales. These phenomena are both remote and local. In the next section, three of the most influential remote (teleconnective) controls of the South African climate are presented. Although these are presented as separate phenomena, they interact with each other and may modulate their relative influences.

9.3.3 Remote Controls of the South African Climate

The southern African climate is strongly influenced by large-scale teleconnections, the best known of which is the El Niño–Southern Oscillation (ENSO). This refers to a sea surface temperature (SST) oscillation in the equatorial Pacific Ocean between warmer than normal and cooler than normal conditions, over a period of 3–6 years (Philander 1983). Generally, when SSTs are warmer than average (El Niño phase) summers in southern Africa are drier than normal, and when SSTs are cooler than average (La Niña phase) summers in southern Africa are wetter than average (Reason and Rouault 2005; van Heerden et al. 1988). Furthermore, the seasonal frequency of tropical cyclones in the southwest Indian Ocean is higher during strong El Niño years and lower during strong La Niña events (Fitchett and Grab 2014; Reason et al. 2000). The peak of an El Niño or La Niña is during the southern hemisphere summer months, and the effect is most noticeable in this period. It should be noted that this is not always the case – even very strong El Niño years have produced normal rainfall (e.g. the El Niño of 1997–1998). There is also a neutral phase of ENSO when there is no significant deviation from average equatorial Pacific Ocean SSTs.
A second teleconnective control exists in the Indian Ocean where there is a similar pattern of oscillations between warmer and cooler SSTs, in this instance off the east African coast north of Madagascar. This phenomenon is called the Indian Ocean Dipole (IOD), where warmer SSTs off the east African coast are matched with cooler SSTs in the eastern Indian Ocean near Indonesia and the Australian northwest coast. When water off the east African coast is warmer (positive phase of the IOD) there is increased likelihood of above-normal rainfall in the South African summer rainfall region, as more moisture is available for precipitation. During a negative phase of the IOD, SSTs off the east African coast are cooler and this increases the likelihood of lower than normal summer rainfall. As with ENSO, there is also a neutral phase when there is no significant deviation from average Indian Ocean SSTs.

One further teleconnective control that is not SST based is the Antarctic Oscillation (Rogers and van Loon 1982; Thompson and Wallace 2000). The Antarctic Oscillation (AAO) is usually characterised as an upper air geopotential height anomaly dipole between the Antarctic and the mid-latitude zonal band. During the positive phase of the AAO, the geopotential height anomaly over the mid-latitude zonal band is positive and over the Antarctic the anomaly is negative. This results in a strengthening and poleward shift of storm tracks over the Southern Ocean with subsequently less rainfall over the winter rainfall region of South Africa. During the negative phase of the AAO, the opposite is true and wetter winters in the winter rainfall region of South Africa are usually experienced (Reason and Rouault 2005). The AAO has a high-frequency periodicity of 30–60 days and it may also interact with ENSO during the peak summer months, as El Niño corresponds with a negative AAO phase and La Niña with a positive AAO phase (Pohl et al. 2010). However, there is also a low frequency periodicity of 8–16 years associated with the AAO that governs the amplitude of the high frequency effect.

The physical environment and teleconnective processes discussed above establish the large-scale context in which synoptic and mesoscale processes operate and modulate the effects of seasonal weather cycles. However, we need to first discuss the seasonal control of South African climate as the seasonal cycle remains the most biogeographically and socio-economically relevant control of the South Africa climate system affecting agriculture, energy, health, biodiversity and ecosystem services, amongst others (Niang et al. 2014).

### 9.4 Synoptic States Influencing the South African Climate

Each regional control mentioned above has particular synoptic states associated with it that, in turn, display particular weather characteristics (Harrison 1984). These are now described. A selection of these states is shown in Fig. 9.5.

#### 9.4.1 Mid-latitude Cyclones

These temperate phenomena are cold low-pressure systems that move from west to east south of the country, and are more colloquially known as cold fronts because they are associated with a transition zone between relatively warmer and colder air at a frontal zone. Winds are strongest at the...
Fig. 9.4 Average monthly rainfall at Cape Town and Johannesburg International Airports demonstrating the seasonality in rainfall at each location. (From Lennard and Hegerl 2015)

Fig. 9.5 Selected surface synoptic features influencing the South African climate. (After Tyson and Preston-Whyte 2000)
centre and weakest at the extremities of the system. During winter, these frontal systems are shifted towards the equator and primarily affect the southwestern and southern parts of the country. They are associated with rainfall, cold temperatures and northwesterly winds and, if particularly deep, can result in extreme rainfall and gale force winds (Taljaard 1996) from which the ‘Cape of Storms’ derives its name. These frontal systems may move over the interior of the country and result in snow over the Drakensberg mountain range and very cold conditions over the interior, sometimes referred to as a ‘cold snap’.

### 9.4.2 Cut-Off Lows

Passing cold fronts may spawn cut-off lows (COLs). These form in the upper atmosphere as a closed low-pressure system that detaches from the equatorward side of a mid-latitude cyclone (or becomes ‘cut off’) to form a cut-off low. The frontal system keeps moving eastwards and leaves the COL to move slowly over South Africa in a generally southwest to northeast direction. These systems are easily seen in upper air pressure contours but it is difficult to identify them using only surface level data. Rainfall occurs on the eastern side of the COL (if there is enough moisture in the atmosphere), typically over the south and east coast, as well as over the interior of the country in the transition area between summer and winter rainfall zones. These systems occur all year round but they have a maximum contribution to rainfall in the autumn (Singleton and Reason 2007) and spring (Favre et al. 2013). When these systems are deep and/or if they move very slowly or become stationary, regional scale extreme rainfall may occur, resulting in flooding such as occurred in Laingsburg (Western Cape Province) in 1981, much of the coast of KwaZulu-Natal Province in 1987, and in Montagu (Western Cape Province) in 2003.

### 9.4.3 Berg Winds and Coastal Lows

One to two days before a cold front makes landfall over the Western Cape, very warm temperatures may occur. These warm temperatures are a result of an offshore wind flow set up by the approaching cold front that moves air from the interior of the country, down the escarpment and out to sea. As the air moves from the relatively lower pressure of the interior of the country down the escarpment to the relatively higher pressure of the coast, it warms adiabatically, resulting in unseasonably warm temperatures. These ‘berg winds’ are often (but not always) associated with a coastal low system, which is a very shallow, closed low-pressure system that is trapped between the escarpment and the approaching cold front. The system forms on the west coast as the frontal system approaches the western Cape as air descends the escarpment, and begins to rotate cyclonically (which is clockwise in the southern hemisphere). It travels along the coastline ahead of the cold front and dissipates once it moves over Mozambique when there is no longer an escarpment against which to trap the system. As a coastal low passes over an area, the leading edge is associated with warm temperatures and offshore wind flow (berg winds) and the trailing edge with colder, onshore flow and often fog.

### 9.4.4 Subtropical Anticyclones

Subtropical high-pressure systems are a function of the descending limb of the Hadley cell circulation and are associated with dry, sunny weather. In the southern hemisphere they rotate in an anticlockwise direction, and over South Africa they occur all year round but over different parts of the country in different seasons. Winds are strongest at the extremities and weakest in the centre of the system. During winter, the weather of the interior of the country is dominated by the subtropical high-pressure system and results in mild sunny days and cold clear nights. Frost may occur in the early morning hours and a surface temperature inversion results in a cold surface air layer that traps air pollution.

During summer, the anticyclone is absent over the interior but dominates the weather in the southwestern and southern parts of the country. Here the eastern extremity of the South Atlantic high-pressure system results in the well-known southeasterly wind that blows along the west coast of the country. This wind may be gale force at times and is the cause of coastal upwelling along the west coast. This southeasterly wind is periodically turned off by the passage of a mid-latitude cyclone to the south of the country, which temporarily disrupts the position of the high-pressure system. However, as the frontal system translates eastwards, the south Atlantic high pressure located behind it (a ‘ridging high’) follows the front eastwards. This results in onshore flow over the south coast and often orographic rainfall over the escarpment. The southeasterly wind then begins to blow along the west coast again.

### 9.4.5 Easterly Wave Low

During summer, a thermal heat low develops over the central interior of the country as a semi-permanent trough, and is called an easterly wave low. Wind flow is from east to west and this circulation advects warm, moist air from the Agulhas region into the interior of the country. This moisture advection, forced orographic uplift, conservation of absolute vorticity and thermal convection are all factors that result in the summer rainfall associated with the easterly wave low. The
southerly position of the ITCZ during summer also provides a source of moisture for the development of convective systems over the interior of South Africa (Dyson and van Heerden 2002), and at times the heat low may develop into a closed low-pressure system, which is often associated with severe weather conditions (Engelbrecht et al. 2013).

Thunderstorms are the main mesoscale phenomenon associated with rainfall in the summer rainfall region. These are convective systems that require a warm surface, topography or an air mass boundary to trigger convection, moisture to provide energy that fuels the storm, and a small amount of vertical wind shear to ensure the storm has a slight vertical slant such that downdraught and updraught regions can develop to the front and rear of the storm, respectively. Individual storms may form that affect a small, localized region, or large-scale squall lines composed of many individual storms may affect a larger region. These storms are usually associated with very strong winds at the leading edge of the storm (termed a microburst), heavy rainfall that may cause flash floods and, if the storm begins to rotate as a mesocyclone, tornadoes may occur.

9.4.6 Tropical-Temperate Troughs

One of the most important rain-bearing summer synoptic states in South Africa are tropical-temperate troughs (TTTs). A TTT is a band of low pressure that extends from the tropics to the temperate mid-latitudes and can be seen as a cloud band across the country with a northwest–southeast orientation. These systems contribute 30–60% of rainfall in the summer rainfall region and occur from November to March (Hart et al. 2013). Mesoscale systems form within TTTs as individual thunderstorms or squall lines, and these bring rainfall to central and eastern parts of the South African interior.

9.4.7 Tropical Cyclones

Tropical cyclones are warm-cored cyclones that may have a diameter of up to 2000 km and a lifespan of a few days from development to dissipation. Usually they form over the warm waters of the equatorial West Indian Ocean and translate westwards towards Madagascar and southern Africa. They may, however, also develop over the Mozambique Channel. If the tropical cyclone moves southwards following the Mozambique current, it may impact the northeastern parts of South Africa as a result of its large diameter, however they rarely move inland beyond the escarpment. They periodically influence these regions with strong winds, heavy rainfall and flooding. Recent examples include Tropical Cyclones Domoina (1984) and Dineo (2017).

The synoptic states described above do not operate in isolation but interact with each other either concurrently, as in the case of a TTT, or sequentially. An example of the latter would be a characteristic 4–6 day winter sequence of synoptic events over a coastal location in the Western Cape with an approaching cold front: initially a coastal low affects the weather with associated hot berg winds as the leading edge passes and colder temperatures and fog with the passage of the trailing edge. Following the coastal low would be the cold front with rainfall, a drop in temperature and a wind direction change from northerly to southerly. Thereafter, southerly winds from the ridging south Atlantic high-pressure system would keep temperatures cold and skies clear until the advent of the next frontal system.

9.5 Summary

As shown above, the South African climate is a function of multiple factors including its physical location at the southern tip of Africa, its physical relief, the surrounding oceans, large scale teleconnective influences, and synoptic and mesoscale atmospheric processes. The interaction between these drivers is expressed in the day-to-day weather experienced across the country that is both strongly seasonal and regionally specific, and contextualises various activities such as agriculture, water resource management, health services, disaster risk and energy provision. As the drivers of South African weather and climate operate at various spatial and temporal scales, it is important to be cognizant of the concept of scale to enhance our understanding of how these multi-scale ocean and climate phenomena impact biophysical and socioeconomic activities across the country, both currently and into the future.

References


Water Resources in South Africa

Jasper Knight

Abstract

Issues to do with water, its quality, quantity and availability, underpin all areas of life and environment in South Africa. This chapter identifies the key areas in which water issues are relevant for physical and human environments in South Africa, and identifies and discusses the interlinkages between these different areas. This analysis shows that although there is a good understanding of water systems within the physical environment (hydrological cycle) and within the human environment (water supply, treatment and management), there is a lack of understanding in two key areas. First, water is involved in all types of activities contributing to economic and sustainable development, in both direct and indirect ways, but the nature of these relationships is not well understood. Second, the interlinkages between water usage in physical and human environments, in particular with respect to differing levels of water quality required for different activities, are not well understood or managed. A better and more integrated understanding of water systems in their totality is required in order to manage water resources more effectively in South Africa over coming decades, against a background of increased water scarcity and decreased water quality caused mainly by climate change and urbanisation.

Keywords

Agriculture · Climate change · Evapotranspiration · Urbanisation · Water infrastructure · Water quality

10.1 Introduction

All elements of physical and human systems in South Africa are influenced by water. Water is a multifaceted and complex resource because it has different functions in the operation of different physical environments, and the nature of interactions of water (both as individual molecules and as a bulk volume) with these environments can lead to very rapid changes in water properties such as chemistry, temperature, etc. In addition, the interactions of water with the physical environment can lead to changes in the environment itself, by chemical, geological and biological processes associated with, for example, floods, droughts and water contamination (Pitman 2011). Thus, water and its surrounding environments interact with each other and change their mutual properties through feedbacks that are complex, and can vary spatially and temporally. The net result is that both water availability (volume) and water quality (properties) can vary over space and time, and both these characteristics have to be considered with respect to the allocation and management of water resources. Figure 10.1 schematically illustrates the range of both human and physical factors involved in the dynamics of water systems. The baseline for this illustration is the near-surface hydrological cycle, since it is mainly near-surface water that is most readily available for all aspects of human activity and the environment. A wide range of factors at the landscape scale also influence the workings of the near-surface hydrological cycle, and are in turn influenced by its workings. As an illustration, and demonstrating the interconnectedness of different factors in the human and physical environments, Fig. 10.2 shows the potential and highly diverse impacts of a single rainstorm event. There are interlinkages and feedbacks between several of these impacts. Some impacts of short-term events may not manifest until months or years after the event, but may contribute incrementally to environmental degradation or increased population vulnerability.

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This chapter discusses selected different aspects of water systems and resources in South Africa, broadly following the trajectory of water transfer through the system, from source to sink. The chapter first discusses rainfall and surface water, including water chemistry; then subsurface water components, including groundwater abstraction, mining and acid mine drainage; and then focuses on water management, its infrastructure and limitations. Finally, the importance of water resource systems for equity and sustainable economic and environmental development in the context of post-apartheid South Africa is discussed.
A starting point to consider the dynamics and management of water resources across South Africa is with patterns of precipitation (Fig. 10.3). A commonly-cited statistic is that South Africa has an annual average precipitation of 465 mm, which is a much lower value than the global average of 860 mm (e.g. Dennis and Dennis 2012; DWS 2018). However, this statistic is entirely misleading since it is not based on clear evidence, and depends on the datasets available, the locations of weather stations from which these data are derived, and the resolution of analysis. This viewpoint also does not capture spatial and temporal variations in precipitation across the country. The east to west decrease in precipitation corresponds to large-scale synoptic circulation patterns that control precipitation sources and seasonality. Broadly, the east of the country has high rainfall totals, lies in a summer rainfall zone, and is capable of supporting dense subtropical vegetation and agriculture; whereas the west of the country in the winter rainfall zone is semiarid to arid and able to support only sparse vegetation and extensive grazing agriculture. The amount of rainfall returned into the atmosphere through evapotranspiration (ET) is dependent on land surface conditions including topography, vegetation and soils. Values of ET can be compared to values of potential evapotranspiration (PET), which refer to the total amount of water-equivalent that can be evaporated from a pan under prevailing atmospheric conditions, and is thus controlled largely by air temperature and relative humidity. Based on MODIS satellite data, Jovanovic et al. (2015) showed that values of PET are high across the country, with highest values in the hottest, driest areas of the Northern Cape and lowest values around the coast where higher humidity, high cloud cover and lower temperatures prevail (Fig. 10.4a). Actual values of ET, however, are highest in eastern and coastal areas of the country where there is highest surface moisture availability for evaporation, whereas lowest ET values are found in areas inland and in the west where there is least surface water available (Tongwane et al. 2017) (Fig. 10.4b). Thus, such maps in combination show the distribution of potential surface water availability.

Fig. 10.3 Map showing mean annual precipitation (mm) in quaternary catchments in South Africa, Lesotho and Swaziland. (Source: Department of Environmental Affairs and Tourism, 1990)

10.2 Precipitation and Surface Water Systems
River systems are the most common surface expression of water availability, others being lakes, ponds and pans. The national Department of Water and Sanitation (DWS) alongside the government-funded Water Research Commission (WRC) recognises 9 Water Management Areas (WMAs), as from July 2012; these replace 19 WMAs identified prior to this date with the intention of the DWS to establish a single Catchment Management Agency by early 2019. WMAs are largely based on catchment boundaries, except for those catchments that cross international borders. Within these WMAs, rivers are subdivided into secondary, tertiary and quaternary catchments (Bailey and Pitman 2016b). Spatial variations in rainfall as well as variations in catchment size and physical properties mean that even adjacent quaternary catchments exhibit different river patterns and dynamics (Knight and Grab 2018) and have implications for water resource availability. A total of 10,200 million m$^3$ year$^{-1}$ of water is made available through dams, basin transfers and other water resource developments (total surface water yield), of which around 70% is already stored within dams (DWS 2018). The high volume of surface water already captured in dams suggests there is relatively little capacity to increase this in future.

A summary of the workflow used in South Africa for establishing surface water availability and its relationship to water systems monitoring and prediction of sustainable yield

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*Fig. 10.4 Patterns of (a) potential evapotranspiration, and (b) evapotranspiration in South Africa and Lesotho, derived from MODIS analysis. (From Jovanovic et al. 2015)*
Groundwater is an ‘unseen’ yet vital water resource. The total natural runoff of water flowing along our watercourses to the sea (total naturalised streamflow), predicted largely based on precipitation, was estimated to be 49,251 million m³ year⁻¹ in 2012. Each river system, however, shows somewhat different real measured values compared to naturalised values, depending on water abstraction, land use changes, and inter-basin transfers. The latter corresponds to around 3000 million m³ year⁻¹ (DWS 2017). These real streamflow values are thus 60–90% of naturalised values. The climatic context of South Africa means that seasonal and event-scale variations in rainfall give rise to significant spatial and temporal variations of river discharge unaccounted for by aggregated values of total streamflow (Bugan et al. 2012). The result of this seasonal imbalance is hydrological floods and droughts. Significant recent floods have taken place in the North West Province (2017), Lephalale in Limpopo (2014), Somerset West in Western Cape (2013), and Vereeniging in Gauteng (2010) (DWS 2017). A detailed example of a recent drought is discussed later in this chapter.

10.3 Subsurface Water: Groundwater and Mining

Groundwater is an ‘unseen’ yet vital water resource. The estimated amount of groundwater yield that is accessible for use is 4500 million m³ year⁻¹, which is less than half of total surface water yield (DWS 2018). The total volume of groundwater present yet inaccessible is unknown. This water nearest the land surface ultimately has a meteoric origin, but there are few studies that have radiometrically dated groundwater and thus evaluated its residence time. Based on dissolved noble gases in deep groundwater within mines (0.7–3.3 km below ground surface), Lippmann et al. (2003) estimated water residence times in the order of 1–100 million years. Shallower aquifers are very likely to have shorter residence times and are more likely to be directly sustained by surface water infiltration, and are therefore climatically controlled (e.g. Mazor et al. 1977). Groundwater resource abstraction is dependent on hydraulic conductivity, rock permeability and potential size of the storage aquifer, and these vary considerably. For example, in the eastern Kalahari basin, Kalahari Group sandstones contain over twice the amount of water than associated dolomites, but are not actively recharged and are vulnerable to saline contamination which thus reduces water quality and potential uses (Jonker and Abiye 2017).

Groundwater properties have been substantially affected by mining in South Africa. Subsurface mining requires drawdown of the groundwater table to allow for mechanised mining operations to take place. For example, the Witwatersrand aquifer has been dewatered continuously over the last 60 years down to 2 km depth, with a peak pumping rate of up to 60 million l/day (Withhüser et al. 2015), resulting in groundwater table depression of several hundred metres. Modelling results suggest that when groundwater pumping is switched off, mine shafts would be flooded within 17 years and the aquifer would be recharged to pre-mining levels within 60 years (ibid.). The most significant impacts that mining has on groundwater systems is through acid mine drainage (AMD), resulting from chemical leachates from mine ore reprocessing escaping into surface and groundwater systems. Several case studies have examined groundwater chemistry especially in central mining areas of the Witwatersrand basin (e.g. Abegunde et al. 2016; Aphere and Vermeulen 2015; Geldenhuis and Bell 1998; Njinga and Tshivhase 2017; Tutu et al. 2008). Runoff from AMD tends to have low (acidic) pH values, high sulfate concentration, and high electrical conductivity and Eh values (Tutu et al. 2008). Change in water chemistry is the outcome of groundwater, meteoric water and AMD movement through rocks, surface sediments and contaminated mine tailings, and leaching by water movement results in acidic soils with low bioavailability and high phytotoxicity of contaminants (Kamunda et al. 2016; Rössner and van Schalkwyk 2000). Such environments are also associated with significant human health impacts (Plumlee and Morman 2011). The issue of water quality is compounded in urban settings where there may be AMD runoff, sewage/sanitation and microbial contamination of both surface and subsurface water supplies (Lapworth et al. 2017; Sorensen et al. 2015).

Groundwater systems are highly vulnerable to climate change with respect to aquifer recharge (Dennis and Dennis 2012) and the balance between the needs of non-consumptive groundwater use to provide ecosystem goods and services, and groundwater abstraction for human consumption (e.g. Seward 2010). The National Water Act (1998) includes provision for groundwater management, based on data availability and management systems, but this is enacted at the municipal level and thus there are problems with ensuring that there are appropriate technical skills available at this local level (Adams et al. 2015). Groundwater systems are viewed as a potential future resource to be exploited (DWS 2018), but there are problems in evaluating its yield sustainability or its vulnerability to contamination by salts or AMD. There is also a ‘policy gap’ in the area of interactions between groundwater and surface water systems (Levy and Xu 2012).

10.4 Water Infrastructure and Monitoring and Management Systems

The DWS is tasked with the planning and management of water infrastructure systems in South Africa, which is done through regional partnerships with private water companies.
The number of institutional actors involved in water provision, distribution, treatment and management, from national to local levels, means that in many cases there is potential for confusion over jurisdictions, responsibilities and accountability (cf. Baleta and Winter 2017). The water infrastructure system in South Africa is planned centrally, delivered by private companies and/or the state, administered by private companies working under statutory guidelines and regulated by the DWS, but also influenced by a variety of users who can significantly impact water use and quality, notably the mining and agriculture sectors. Thus, there are a range of actors involved at all levels of water infrastructure governance and management and on different scales, with the result that water management is highly complex and in some instances, different actors and agencies have different priorities and management approaches (Jonker 2007; Pietersen et al. 2012; Pitman et al. 2011). Limitations of an integrated water resources management approach have led to a governmental shift in the DWS towards developmental water management, in which equity, poverty reduction and sustainable development are important guiding principles for water provision (van Koppen and Schreiner 2014). There has been a particular research focus on management of urban water systems, mainly because of the greater population and the better connected water infrastructure of these areas. Water system design is increasingly being incorporated into urban planning from the outset, to better manage water resources and to increase water use efficiency (Lottering et al. 2015; Piketh et al. 2014). There has also been some consideration of water management in informal urban settlements, which often lie outside of municipal stormwater management plans.

Another important element of the water infrastructure mix in South Africa is transboundary water transfer, between adjacent river basins and across national boundaries. Water transfer is framed in the context of both equity and water justice (Zeitoun et al. 2014); and as a key tool driving economic development, which poses water availability as a hydropolitical issue (Lévite and Sally 2002; Turton et al. 2006). Water has therefore a political context, both within and outside of South Africa (Mirumachi 2007). An example of transboundary water transfer is the Lesotho Highlands Water Project (LHWP). This project was established in 1978 with the intention of transferring water from high precipitation areas of Lesotho (Orange-Senqu River) via the Vaal River to the rapidly-growing urban area of Johannesburg in South Africa, a distance of around 300 km. Upland catchments in mountainous Lesotho receive precipitation values of >1000 mm year\(^{-1}\), and have relatively efficient runoff coefficients, meaning high surface water availability (Sene et al. 1998). The LHWP involves five storage dams with a combined capacity of 6500 million m\(^3\) and associated hydroelectric power plants (capacity 110 MW), connected by 225 km of tunnels (LHDA 2002). The Katse Dam, completed in 2009, is one of the largest in Africa with a dam wall height of 185 m and has a total usable water storage capacity of 1520 million m\(^3\). It could be argued that both sides are winners in this transaction of the LHWP, with infrastructure development and payment for water used on the Lesotho side, and more reliable water supplies on the South African side (Rousselot 2015). However, the policy and political implications are not so clear cut (Bourblanc 2017) and there may be significant unintended consequences for local communities on both sides that are not clearly understood (Ryan 2015).

The National Water Resource Strategy 2 (DWA 2013) was developed to guide water management in South Africa based on the requirements given in the National Water Act and the National Development Plan. The vision of the National Water Resource Strategy 2 is for ‘sustainable, equitable and secure water for a better life and environment for all’ and explicitly links water to sustainable development, elimination of poverty and inequality, job creation, and environmental protection and management. The National Water Resource Strategy 2 provides the context for actions undertaken in individual catchments by the nine WMAs.

A governmental move towards developmental water management requires balancing the needs of different water users, and their roles in poverty reduction and sustainable development. In terms of water use, irrigation-based agriculture uses 61% of the total annual water volume available from both surface and groundwater sources, and municipal/domestic use represents 27% of the total. However urban use (24%) is volumetrically more important than rural water use (3%) (DWS 2017). It is estimated that around 1660 million m\(^3\) year\(^{-1}\) of water is lost from municipal water systems as ‘non-revenue’ water, including from leaking pipes and illegal connections. This represents a loss of around 35% of total supplies which is significantly higher than the global best-practice average of 15%. The DWS (2018) aspires to reduce urban water loss from 35% to 15%, and reduce domestic demand from present values of 237 to 175 l/person/day, by 2030. This, in simple budgetary terms, would make water ‘sustainable’ despite a projected increase in water requirements from 15,294 million m\(^3\) year\(^{-1}\) in 2015 to 17,559 million m\(^3\) year\(^{-1}\) in 2030 (DWS 2017). However, some 11% of households still do not have access to water supply infrastructure, only 64% of households receive a reliable water supply, and 44% of water and 56% of waste water treatment plants do not work properly (DWS 2018). There is also significant variability in these metrics between municipalities and provinces – 87% of households have a reliable water supply in the Western Cape whereas this is only 49% in the Eastern Cape (DWS 2017). Case studies describing different technical and water management solutions, at the municipal levels, are given by Rabe et al. (2012).
A number of national-scale initiatives exist, run through the DWS, for both monitoring water quality and discharge, and for water management (e.g. Huizenga et al. 2013). Near real-time data are available for many different water parameters. Archives of water quality data include the National Groundwater Archive, Blue Drop (for drinking water), Green Drop (for sewage), and Rivers database (for biodiversity monitoring). There are also national monitoring programmes for water chemistry, eutrophication status and water microbiology (Hobbs 2017; van Ginkel 2011). These are done with reference to potable water standards. However, there are problems with data quality, lab contamination and data accuracy (Bailey and Pitman 2016a; Pitman 2011).

10.5 Discussion

Water in South Africa has a powerful link not only to all aspects of the physical environment, but to poverty reduction, sustainability, equity, and economic development. Water mediates all aspects of health and sanitation, agriculture and food, ecosystems and biodiversity, and many other aspects of life and the environment (Rockström et al. 2014; Ziervogel et al. 2014). The statutory underpinning of water management in South Africa – the National Water Act (1998) – has its limitations, including how policy is enacted at the local level (Meissner 2016; Schreiner 2013). Building on from this Act, development of the paradigm of integrated water resources management (IWRM) in South Africa has been problematic. The reasons for this include lack of connectivity between different government departments and agencies and between national and provincial levels, and applying policy to local situations where issues of land and water (both ownership and management) have political and cultural dimensions (Anderson et al. 2008; Denby et al. 2016; Mehta et al. 2014). The challenge therefore is development of water resource management strategies at the catchment scale that are integrative, holistic, flexible and produce workable solutions for all (Bourblanc 2017). A case study of the recent drought in the Western Cape shows how developing an IWRM strategy requires complex and integrated analysis of both human and physical environmental variables, as well as managing engineering infrastructure and understanding of group psychology and effective stakeholder communication.

10.5.1 Western Cape Drought 2017–2018

The significant drought period experienced around the Western Cape region, and in particular affecting Cape Town during 2017–2018 (and still continuing at the time of writing), is the culmination of several years of anomalously low seasonal rainfall, compounded by inadequate water management and other human-related issues (Botai et al. 2017).

The strong El Niño in 2015–2016 led to seasonal dryness across southern Africa, in particular the western part of South Africa, leading to significant problems with water quality resulting in cholera and other disease outbreaks in several towns, and significant impacts on farmers in the Free State and North West (Botai et al. 2016). Low winter rainfall values in the Western Cape in 2016 and 2017 meant that dams were not sufficiently topped up, leading to less water availability in the succeeding dry summer periods. It was widely assumed that winter rainfall would return to average values and thus not requiring any water management actions; this proved to be a false assumption.

In total, 44 dams of different capacities, age and locations serve the Western Cape Province. For dams serving the City of Cape Town, it was calculated that when dams reach storage levels of 13.5% total capacity, water supply from these dams will cease – the timing of this step was termed ‘Day Zero’. As of the week commencing 26 March 2018, the six major dams feeding the City of Cape Town were on average at 22.2% capacity, containing 50,000 million litres of water less than the same week in 2017, and one dam (Theewaterskloof) is hydrologically inoperable (capacity below 13.5%). According to DWS guidelines, water restrictions are enacted when 1 in 50-year drought conditions are met, based on precipitation and water availability. This criterion, applied to all Western Cape dams supplying Cape Town, indicates a 1 in 311-year drought situation (90% confidence) (City of Cape Town 2018). Based on water supply drawn from the six largest dams serving Cape Town, present daily demand (March 2018 values) is dominated by urban water requirements for the city itself (66–71% of total demand), the other requirements being mainly for agriculture. Thus, managing urban water use is critical and more complex in this situation compared to irrigated agriculture. Water restrictions are gauged on a scale from 1 (low) to 6 (high). Level 6B water restrictions came into force in the City of Cape Town on 1 February 2018, limiting water use to 50 l/person/day based on reducing total water use to 450 million litres/day. (Current daily water use is around 520 million litres.) This step corresponds to Phase 1 of the City of Cape Town Disaster Management Plan. In order to monitor and communicate patterns of water use, an interactive web-based water map has been used to plot total water use on a house by house basis (available at https://citymaps.capetown.gov.za/waterviewer/). This has been used effectively to ‘name and shame’ excessive water users who are fined under the City of Cape Town Water By-Law (2010). However, some industrial and commercial users, and townships relying on municipal water, were exempt from restrictions, whilst other users who could afford fines have largely ignored the water restrictions and not changed their water use practice. It therefore appears
that mainly middle class consumers have been most responsive to water restrictions. The timing of Day Zero, when potable dam supplies would run out and taps would be turned off, has moved over time. It was predicted to be in March 2018 (from a baseline of October 2017). It then moved to 13 May 2018 (on 16 November 2017), 12 April (on 22 January 2018), 4 June (on 14 February), and to August 2018 (on 22 March). The media attention on Day Zero also creates a false sense of both alarm and safety. For example, when the timing of Day Zero has progressively been moved into the future, this was widely seen as an indication that the drought was not as severe as previously thought. Day Zero is now (29 March 2018) stated to be in 2019, thus the water crisis in 2018 is (superficially) over.

In an effort to increase water supplies, a number of strategies have been implemented, termed ‘augmentation’. Water has been abstracted from Cape Flats and Table Mountain Group aquifers at a rate of 80 million litres/day and 50 million litres/day, respectively, in addition to increasing the already-operating capacity of abstraction from the Atlantis aquifer (from 12 to 20 million litres/day) (City of Cape Town 2018). Water has been transferred from adjacent dams and rivers, such as ~60 million litres/day from the Groenland Water User Association (an agricultural growers’ organisation focused in the Palmiet River catchment) over a 2 month period; and ~7.5 million litres/day abstraction from springs and the Oranjezicht and Lourensriver systems. Other short term measures include temporary desalination plants at Monwabisi, Strandfontein, the V&A Waterfront, and Cape Town harbour, and the Zandvliet water reuse system. These may increase capacity by ~26 million litres/day. However, the environmental impacts of both increased groundwater abstraction and use and management of desalination plants are largely unknown, and these elements have not been considered in depth with respect to short-term water provision (e.g. Adelana et al. 2010).

Social and economic impacts of this still-evolving situation are difficult to evaluate. Regional drought has resulted in wine production decreasing by 20% in 2018 (following a decline of 47% in 2017), fruit and vegetables by 15% (Crabtree 2018), overall agricultural production by 20%, and around 30,000 job losses from the agricultural sector (Smith 2018). The agricultural sector is predicted to need 8–10 years to recover from this situation (Smith 2018). Tourist numbers in Cape Town are also likely to decline and there may be reputational damage to the city and region from the drought (there are no data on these aspects yet, however).

Moving forward, strategic planning for IWRM is required in order to ensure future water security for Cape Town (Schreiner et al. 2014). Structural problems including water distribution and management systems need to be addressed, moving towards a more diverse water mix that increases adaptive capacity and resilience. There is also a need for communication between different actors and institutions with respect to integrated water management. A concerning note, hidden in drought response justification by the City of Cape Town authorities, is that “Global climate models are in agreement, that while simulations have very different outcomes, that it is not reasonable to plan for a scenario in which it does not rain in the future or in which it only rains at 2017 levels” (City of Cape Town 2018, p.2). This is a (deliberate?) misinterpretation of the purpose and scope of climate models. This suggests a clear unwillingness to face up to and plan effectively for future and possibly more severe drought situations.

10.5.2 Future Issues in Water Resource Management in South Africa

Water resource management in South Africa is more about effective and efficient water management rather than merely total water availability. As an example, the Western Cape drought has arisen from a combination of physical and human factors and should be managed as such, but this combination of factors and involvement of a wide range of actors means that equitable management solutions are difficult to identify and even more so to implement. More effective and integrated water management requires capital investment, possibly including new dams, grey water reuse systems, community water hubs, and desalination plants, but according to DWS (2018), reused and desalinated water will only supply 1.7% and 2.0% of national water demand by 2030, which is clearly a missed opportunity. DWS (2017) lists a number of factors to consider in the future national water mix, including waterless sanitation, reconciling supply and demand systems, infrastructure development of new dams and water supply systems including inter-basin transfer, groundwater abstraction infrastructure and artificial recharge schemes, desalination projects, water reuse, control of invasive alien vegetation, equitable water reallocation, and flood protection infrastructure. Reducing loss of ‘non-revenue’ water should also be done. Recent estimates suggest that South Africa needs to invest R70.4 billion a year in water infrastructure whereas the current budget is only R43.4 billion, a shortfall of 37% (GreenCape 2018).

Several local-scale initiatives have already been identified as contributing to more efficient water use in South Africa. Rainwater harvesting (capturing of rainwater from house roofs or from surface overland flow) is a longstanding, low-technology and relatively cheap intervention at the domestic or community level which can supplement existing water
supplies, particularly in rural areas (Mwenge Kahinda et al. 2007, 2010). There are also significant implications for harvested water in small-scale field irrigation in terms of agricultural sustainability and food production especially during dry seasons (van Rensburg et al. 2012). Using a GIS, Mwenge Kahinda et al. (2008) estimated that 30% of agricultural land in South Africa is suitable for in-field and 25% for ex-field rainwater harvesting. In urban environments, rainwater harvesting may also be suitable (Fisher-Jeffes et al. 2017). However, in urban areas there are issues with chemical contamination and event-scale flood management to deal with, hence water reuse systems and more effective surface water management through soakways and biofiltration may be more appropriate (Friedrich et al. 2009; Knight 2017). Water reuse systems already exist in some areas such as Beaufort West and George (Western Cape) (Lottering et al. 2015), and nationally indirect water reuse is estimated to account for 14% of total available water (DWS 2017). There is thus potential to develop this capacity through direct treatment of waste water from treatment plants (e.g. Friedrich et al. 2009) although there is likely public resistance to this idea.

10.6 Summary

Water is a critical underpinning of all areas of life and environment in South Africa, and is thus central to national-scale themes of poverty reduction, economic and sustainable development, and maintenance of the biosphere and environmental management (Pitman 2011). Although many of these interrelationships are appreciated and broadly understood in theory, especially from an academic viewpoint, there are problems in translating (1) theory into policy, and (2) policy into practice. Government institutions and agencies on different levels are key role-players in negotiating between different stakeholders and in building synergy between theory, policy and practice (Anderson et al. 2008; Jonker 2007).

Effective water resource management involves understanding all elements of the water cycle (literally, source to sink) and the volumetric and economic interconnections between water and agriculture, biodiversity, health and sanitation, tourism and culture. In many cases, effective water management is constrained by the limitations and capacity of water infrastructure, not just the built infrastructure but also technical expertise and training, communications and reporting, water system monitoring and modelling, and engagement with all relevant stakeholders. Although these are typical limitations of developing-world countries, dealing with these issues will greatly facilitate sustainable socio-economic and environmental development over coming decades.

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Contemporary Surface Processes and Landscape Change

Peter Holmes

Abstract

Contemporary, as opposed to palaeo- (past) processes are those Earth surface processes currently active in modifying South Africa’s physical (geological, geomorphological, pedological) environment. These processes provide the energy to perform the work necessary to alter the morphology of landforms and landscapes. External (surface) or exogenic processes are the manifestation of a number of agents of weathering and erosion. In this context, erosion refers to the removal and transportation of weathered rock material, unconsolidated sediment and soil. Ultimately, such material is laid down elsewhere via deposition of the transported material. In this way, landforms change over time. Contemporary landforms found in South Africa are usually a product of both past and present processes. In addition, landforms may be products of erosion, or deposition, or a combination of the two. In this chapter, our current understanding of the role of weathering (a static process, which is distinguished from erosion), important agents of erosion, namely running water (fluvial), wind (aeolian), and the sea, is reviewed. This is done in the context of the most recent research into contemporary surface processes and landscape changes in South Africa. The impacts of humans on contemporary processes, and vice versa, are also considered.

Keywords

Contemporary surface processes · Erosion · Landforms and landscapes · Geomorphological processes · Mass movements · Weathering

11.1 Introduction

From a geomorphological perspective, landscapes comprise assemblages of landforms, which in turn contribute significantly, but not exclusively, towards creating the unique physical environment of a particular region. Landscapes may be defined at different scales and may carry colloquial descriptors, for example the Karoo landscape or the Highveld. All landscapes are a product of regional or local geological forces (taken here to mean dynamic drivers operating within and beneath the Earth’s crust) and geomorphological processes (taken here to mean surface forces driven by weather and climate, gravity and, increasingly, human activity). These act to modify and shape landforms and landscapes. Furthermore, landscapes are a product of both past and present forces and processes (Figs. 11.1 and 11.2). The role of geology in landscape evolution, Quaternary environmental change, and the current South African landscape, are the subjects of separate chapters in this volume. In order to appreciate fully the nature and directions of current research around contemporary processes, this chapter should not be considered in isolation. Similarly, themes in environmental geography would be incomplete without considering the impact of contemporary surface processes on South Africa’s biophysical environment.

This chapter focuses on our understanding of geomorphological processes currently acting on the landscapes of South Africa. Current research into process geomorphology seeks to understand both contemporary surface processes and, importantly, the drivers behind such processes. The changes which result from these dynamic drivers at the interface between land, ocean and the Earth’s atmosphere are briefly reviewed. Contemporary, as opposed to historical or palaeo-processes (also discussed elsewhere in this volume) are briefly examined from a geographical perspective, and in light of recent literature dealing with contemporary surface processes in a South African context. Pedological (soil) processes are not discussed in detail other than that such processes...
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are largely controlled by weathering, and the movement of water, minerals and plant nutrients within the soil profile.

11.2 Contemporary Surface Processes

Contemporary processes are those Earth surface processes currently acting and interacting to modify the landforms and landscapes around us. The precise significance of climate in these processes may be debatable (Summerfield 1991) but climate certainly plays a role (see for example Grab and Knight 2015). Whereas relict landforms might reflect processes which are no longer active in a region, the drivers of contemporary processes will be typically controlled or influenced by present environmental conditions. Earth surface, or exogenic, processes are generally classified as weathering, erosion and mass movement (Table 11.1).

11.2.1 Understanding Contemporary Surface Processes

The study of contemporary surface processes forms part of the domain of geomorphology, as well as physical geology and pedology. The most recent comprehensive synthesis of this domain is to be found in Holmes and Meadows (2012).

Fig. 11.1 Examples of southern African landscapes subject to very different processes. (a) Landscapes of the Cederberg of the Western Cape, showing the weathering characteristics of Table Mountain Group sandstones. (b) Kalahari landscape dominated by recent and contemporary wind erosion and deposition. (Photos: Peter Holmes)
However, half a decade has since passed, and a significant volume of literature around contemporary surface processes has appeared since then. Research into contemporary processes has also benefitted from new techniques in the earth sciences, or the refinement of existing techniques (see for example Cook et al. 2013). In particular, advances and refinement in dating techniques (cosmogenic radionuclide and luminescence dating) have contributed to our understanding of both palaeo- and contemporary surface processes. For an up-to-date summary, see Grab and Knight (2015). The use of remote sensing and the large amount of spatial data from satellite imagery has also contributed significantly (Fig. 11.2). Allied to this, geomorphology, as with all other Earth surface disciplines, has benefitted greatly from technological advances in data capture and processing. Computer modelling of surface processes has allowed us to better understand contemporary processes and the ways in which they impact on biophysical landscapes (see for example Mayaud et al. 2017).

### 11.2.2 Weathering

Weathering processes are those operating at the Earth surface–atmosphere interface to disaggregate solid rock in preparation for a variety of processes to break it down further, utilise it to form soil, or to move it and deposit it elsewhere. Weathering is generally regarded as static; rock and mineral material is broken down in situ. Temperature and moisture or changes in these are the drivers of weathering processes. Hall (1988) presented the first detailed review of weathering processes across southern Africa. Sumner et al. (2012) provided a comprehensive overview covering aspects of rock weathering. Attention has also been paid to the impacts of weathering processes on rock art (Sumner et al. 2009). To appreciate more fully the role of weathering within the context of southern Africa, consider the weathering index proposed by Weinert (1980). This index is a function of evaporation during the warmest month of the year and annual rainfall. Where $N>5$, disintegration of rock material (a mechanical process) predominates; where $N<5$, decomposition (a chemical process) predominates. $N$ is calculated as:

$$N = \frac{12E}{Pa}$$

where $N$ is a dimensionless index reflecting a propensity towards either mechanical or chemical weathering, $E$ is evaporation, $j$ is the warmest month and $Pa$ is annual rainfall.

Southern Africa, and in particular its southern, central and southwestern parts, is an arid to semi-arid subcontinent. Broadly speaking, a division between a predilection towards mechanical weathering on the one hand, and chemical...
weathering on the other, can be made. This division corresponds generally with the position of the 500 mm isohyet (Fig. 11.3). It can be traced running broadly north–south between Bloemfontein and Kimberley, continuing northwards into Zimbabwe. The implication is that, if atmospheric conditions alone are considered, weathering processes are predominantly controlled by changing moisture conditions in the eastern half of South Africa, and changing temperature conditions in the far more arid western half. However, this by no means always the case due to the complexity of factors which control weathering. Amongst the latest research is the role of lightning strikes as an agent of rock weathering (Knight and Grab 2014). Finally, weathering processes are also integral to the formation of soils and ongoing changes in, for example, soil quality (Mills and Fey 2004). Chemical weathering contributes minerals to the soil, which in turn provide plant nutrients.

11.2.3 Erosion

Erosion can be defined as the movement or removal of weathered material on or close to the Earth’s surface. Ultimately, this unconsolidated rock material or soil is deposited elsewhere. Erosional processes are dynamic. To erode and transport sediment and soil requires energy, which is integral to the specific geomorphic process performing this work. When this energy dissipates, the transported material is deposited. Within the South African context, the main contemporary agents and processes of erosion are now discussed.

11.2.3.1 Running or Flowing Water (Fluvial) Erosion

Running water is by far the most important contemporary agent of erosion in southern Africa. This is apparent where perennial rivers flow, in particular the major southern African rivers such as the Orange, Limpopo and Zambezi rivers. Partridge et al. (2010) provided a comprehensive analysis of the geomorphic provinces of South Africa and Swaziland, with particular reference to drainage lines. In summary, the rivers to the east of the Great Escarpment (Mpumalanga, KwaZulu-Natal and the Eastern Cape Provinces) have steeper gradients and (relative to water volume) experience higher energy conditions than those rivers flowing westwards into the Atlantic Ocean. However, fluvial geomorphology is not simply a matter of understanding river systems at a subcontinental or regional scale, because each river or river reach exhibits its own unique properties, dynamics and controls. For discussion of fluvial geomorphology on a southern African scale, and linkages with, for example, catchment management, the reader is referred to Rowntree (2012). The dynamics of fluvial processes are complex and range from channel incision and net erosion (Larkin et al. 2017) to controls on sediment preservation (Keen-Zebert et al. 2013; Tooth et al. 2013). At a subregional or local scale, understanding linkages between contemporary fluvial processes and soil erosion can contribute to improved management and conservation practices. For example, the long-term study of headwater catchments in the Sneuuberg Range, Eastern Cape (Boardman et al. 2017), has demonstrated the vulnerability of this landscape to opportunistic agriculture.

Fig. 11.3 Approximate position of the 500 mm isohyet through South Africa, defining weathering zones. (As defined by Weinert 1980)
11.2.3.2 Wind (Aeolian) Erosion

Wind erosion is prevalent across the arid Namib and Kalahari deserts of southern Africa. Both these deserts have been the subject of extensive research with regard to both aeolian processes and resultant landforms, but in South Africa itself, the impact of aeolian processes has arguably been overlooked. Nevertheless, it is an important modifier of landscapes in both the semi-arid west-central interior of South Africa, as well as in coastal and near coastal environments (Carr and Botha 2012). Agricultural areas in South Africa’s summer rainfall area are particularly vulnerable to wind erosion, because newly-tilled fields have no vegetation cover at the time (in September and October) when winds are strongest. There are few detailed process studies on aeolian erosion in South Africa. Wiggs and Holmes (2011) examined wind erosion on Free State agricultural lands and suggested that farming practices, which take into account prevailing wind directions and their seasonal shifts, can minimise the impact of wind erosion. Holmes et al. (2012) examined the evidence for land degradation under aeolian erosion in the west-central Free State. Contemporary sand and dust mobility is evidenced by the ubiquitous fence-line dunes of the region. Mahasa (2015) undertook a spatial analysis of wind erosion and soil susceptibility in the same province. Outside of this region, Dougill and Thomas (2002) looked at the formation and controls on nebkha dunes in the Molopo River Basin, North West Province, and their validity as indicators of soil degradation. There is also research on dust emissions in Namibia (Mayaud et al. 2017) and from the Makgadigadi Pans in Botswana (Vickery 2014). These provide good examples of the interconnections between geomorphology and atmospheric modelling. Similarly, wind erosion may play a role in unexpected areas, such as the high Drakensberg (Grab 2010), where local pan alignment by wind deflation reflects the dominant wind direction.

Given the vulnerability of the semi-arid interior of South Africa to climate- and human-driven environmental change, aeolian processes deserve far greater attention. In coastal and near-coastal environments, the role of contemporary aeolian processes in building and modifying dunes, dune fields and sandy shores have been examined in several studies in particular along the western and southern Cape coastlines (e.g. Holmes and Luger 1996; MacHutchon 2012) and in KwaZulu-Natal (Jackson et al. 2013).

11.2.3.3 Coastal Erosion

Given its geographical position at the foot of the continent, South Africa has a relatively long coastline and also lacks natural indentations such as estuaries and bays. The ocean-land interface is a particularly dynamic zone with regard to erosion. Coastlines can be classified as hard (rock) or soft (beaches and dunes), and in the case of South Africa’s coastline, 27% of its length is ‘hard’ and 42% ‘soft’ with the remainder being mixed (Griffiths et al. 2010). By implication, soft coastlines are more vulnerable to contemporary processes including wave action and aeolian erosion.

The coastal zone, which comprises the coastline and adjacent seaward and landward components, is typically the most dynamic type of geomorphic environment. In the soft and mixed zones in particular, rapid and extreme changes in the form of both erosion and deposition can occur, quite literally, overnight. Beaches may appear or disappear as the result of a single storm event (e.g. Fig. 11.4a). Waves, tides and sea-level change play an important role in modifying coastal environments over short and long timescales respectively, and influence how high up the beach or rock face incoming wave energy be reach (Fig. 11.4). Carr and Botha (2012) discuss sea-level change along the South African coast. Because the coastal zone includes estuaries (Cooper 2001) and lagoons (de Lecea et al. 2016), as well as barrier dunes and beaches, coastal erosion encompasses a more varied and complex set of dynamics than other geomorphic environments. Both fluvial and aeolian processes contribute to this.

11.2.3.4 Soil Erosion

Soil erosion is not a process per se but, rather, the manifestation of surface runoff or wind action which removes top soil. Whilst soil erosion is a natural process, accelerated erosion is typically driven by some perturbation or interference with the steady state of a landscape. This is often human induced, for example through the application of inappropriate farming practices. As such, soil erosion is an important contributor to land degradation (Boardman et al. 2012).

11.2.3.5 Mass Movements

Slopes are an integral part of virtually all landscapes (Garland and Holmes 2012). Mass movements are defined as the downslope movement of unconsolidated rock and sediment driven by the force of gravity. Water may be present, and may act as a lubricant to facilitate the mass movement, but it is not the driving force. Water may be present, and may act as a lubricant to facilitate the mass movement, but it is not the driving force. Water may be present, and may act as a lubricant to facilitate the mass movement, but it is not the driving force. Water may be present, and may act as a lubricant to facilitate the mass movement, but it is not the driving force. Water may be present, and may act as a lubricant to facilitate the mass movement, but it is not the driving force. Water may be present, and may act as a lubricant to facilitate the mass movement, but it is not the driving force. Water may be present, and may act as a lubricant to facilitate the mass movement, but it is not the driving force. Water may be present, and may act as a lubricant to facilitate the mass movement, but it is not the driving force. Water may be present, and may act as a lubricant to facilitate the mass movement, but it is not the driving force. Water may be present, and may act as a lubricant to facilitate the mass movement, but it is not the driving force.
ment and potential mass movement when and wherever slope modification might result in the downslope movement of rock material or soil, or both. Garland and Holmes (2012) provided a number of South African case studies involving mass movement. Most of these occurred in the (steeper and wetter) geomorphic landscapes of the eastern part of the country, or in the winter rainfall area of the Western Cape Province. Localised mass movement events present a challenge for planners and engineers (e.g. along the N2 highway of Chapman’s Peak Drive, at Knysna and in the Eastern Cape and KwaZulu-Natal Provinces) but are not regarded as a perennial problem on the scale of the high altitude, high latitude environments of Asia, Europe and South America.

Fig. 11.4 Examples of coastal erosion and deposition. (a) Severe damage caused by strong wave action attacking a beach at Balito, KwaZulu-Natal (Photo: John Clark). (b) Blown dune sand encroachment at Hout Bay, Western Cape. (Photo: Peter Holmes)
11.3 Human Drivers

By their actions in modifying landscapes and landforms, typically towards their own ends, humans have come to have a significant influence on contemporary geomorphic processes. The influence of human impacts may have intended or unintended consequences. Deliberate, intended modification of slopes, for example, may make them more suitable for building, or road construction. The numerous mountain passes, which link the coastal regions of South Africa to the high-lying interior, serve as examples. Applied geomorphology is a recognised facet of the broader discipline which has established itself over the past 50 years (Garland and Holmes 2012). It deals with problems as a result of human modification of the physical landscape, and their solutions. As such, it is at the interface of geomorphology, planning, civil engineering, and mining and construction. Issues range from impacts on rock art (Leuta 2010) to long-term studies of land degradation and their impact on landscapes (Boardman et al. 2017). Humans frequently exacerbate or accelerate contemporary surface processes by interfering with natural checks and balances. The role and capacity of humans to impact on surface processes, frequently with unintended consequences, should not be underestimated.

11.4 Discussion

Contemporary surface processes reflect a complex and dynamic interaction between physical and chemical processes (weathering and erosional forces) in varied permutations of geological, atmospheric and biological conditions. Indeed, it is often impossible to separate out or distinguish between, for example, mechanical and chemical weathering processes, or between wave and wind action in the coastal zone. Add to this human impacts and global environmental change and it becomes apparent that compartmentalising an analysis of contemporary processes is convenient, but simplistic. South Africa can be considered unique in that its varied geology, exceptionally long coastline, and its range of climatic conditions have given rise to a variety of contemporary processes. It is only South Africa’s modest altitudes and relatively low latitudinal position which preclude glacial activity as a contemporary process.

The challenge facing the geologist, geomorphologist or soil scientist researching contemporary surface processes is to effectively analyse two or more processes interacting at the same time in a particular environment. Hence new subfields, such as biogeomorphology, bioweathering, bi erosion and microgeomorphology are increasingly recognised as important facets of geomorphology as a whole. These are new areas of geomorphic research in South Africa.

11.5 Summary

This chapter has provided a brief overview of the current understanding of contemporary surface processes and landscape change. These processes are active in the South African biophysical landscape, modifying it on an ongoing basis. Surface processes should not be studied or considered in isolation, and the geology of South Africa and its post-Gondwana landscape evolution provide a context and backdrop for the contemporary surface processes and landscapes that we see today. Managing the biophysical environment requires an appreciation of how and why surface processes act as they do and respond to climate changes or human activity. Surface processes can also result in unintended or disastrous consequences, such as ongoing rock falls on Chapman’s Peak Drive, Cape Peninsula, or seasonal inundation of informal housing along the Jukskei River, Gauteng. It is the role of geomorphologists to research the dynamics of contemporary processes at the full range of scales, from macro to micro, and to contribute to an improved understanding of landscape change.
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Soils, Agriculture and Food

Chris C. du Preez, Elmarie Kotzé, and Cornie W. van Huyssteen

Abstract

Pre-1994 land policies caused South Africa to have a well-developed commercial agricultural sector and an underdeveloped communal agricultural sector. Both sectors are still operational today for either crop or livestock production despite significant political and social changes that have taken place since 1994. Climate, irrespective of agricultural sector, dictates together with soil the location of crop production regions and, together with vegetation, the location of livestock production regions. In recent years the production of crops and livestock has intensified. This intensification can be devastating to soil and vegetation because both natural resources are very susceptible to degradation. In addition to land degradation, climate change and land claims may impact negatively on future food production and security. A combined approach between agricultural and governmental stakeholders is therefore essential to counteract these potential negative impacts.

Keywords

Commercial agriculture · Communal agriculture · Crop production · Land degradation · Land use · Livestock production

12.1 Introduction

South Africa covers an area of 122 million ha of which 101 million ha is used for agriculture (Table 12.1). Commercial agriculture is practised on 86 million ha of freehold title land. The remaining 15 million ha land under communal title is used for communal agriculture. These two kinds of farmland ownership and coinciding agricultural production systems resulted from pre-1994 land policies of separate development based on race (DEAT 2007). Although the majority of land in South Africa is used for agriculture, the contribution of this industry to the country’s gross domestic product has declined tenfold from 23% to 2.3% over the past 100 years. Agriculture’s true importance to the economy is, however, much greater when one considers its current upstream and downstream linkages, for example the manufacturing and marketing of equipment (tractors, planters, harvesters etc.) and production inputs (fuel, fertilisers, pesticides etc.) on the one hand, and the food processing, distribution and storage sectors of produce on the other hand (DEAT 2007).

A large proportion of the population in South Africa therefore depends in one way or another on agriculture. In 2011, 19.9% of the total households were involved in agriculture. This proportion dropped to 13.7% in 2016. During this 5-year period the number of agricultural households decreased from 2.9 to 2.3 million, while the total households increased from 14.5 to 16.9 million. This large decline in agricultural households can, in addition to the general process of urbanisation, probably be attributed to the severe droughts in recent years (StatsSA 2016). Within individual provinces, the highest proportion of households that were engaged in agriculture in 2016 was 27.6% in the Eastern Cape. This was followed in decreasing order by Limpopo (24.1%), KwaZulu-Natal (18.6%), Mpumalanga (18.2%), Free State (16.6%), Northern Cape (13.8%) and North West (13.4%). Gauteng and Western Cape had the lowest proportions, with 4.9% and 3.6% respectively (StatsSA 2016).

If self-sufficiency and food security is the aim, then South Africa needs to ensure a healthy agricultural industry that contributes to the country’s gross domestic product and hence the welfare of numerous households, while also preventing land degradation to ensure sustainable food production. Against this background, this chapter will firstly deal with soil and climate as physical determinants of agricultural production. Then the production of crops and livestock are

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discussed separately to review their current status, followed by the intensification of both. Lastly, the changes facing either crop or livestock production are addressed.

### 12.2 Soil and Climate

Soil and climate are important determinants of agricultural production. A thorough knowledge of a country’s soil types and distribution in relation to climate is therefore essential in the appreciation of the current status of agricultural production and the future challenges that may be faced.

#### 12.2.1 Soils

Generally, soils develop in a systematic manner, due to the influence of climate, topography and organisms on parent material over time (Fanning and Fanning 1989). This results in the formation of unique soils in distinctive environments, suitable for specific agricultural activities. Soil classification is a mechanism to enable, inter alia, the communication of these differences. Two soil classification systems are recognised internationally – USDA Soil Taxonomy (Soil Survey Staff 2014) and the World Reference Base for Soil Resources (IUSS Working Group WRB 2014). A different scheme, the Soil Classification – A Taxonomic System for South Africa (Soil Classification Working Group 1991), is used in South Africa due to the unique soils found in the country, and the ease of use of the system. The South African system classifies soils into 74 soil forms at the highest level and numerous soil families at the lower level. Soil forms are identified based on a unique sequence of diagnostic horizons, which is in turn based on the identification of master horizons (Fig. 12.1). Fey (2010) has, however, grouped the soil forms into soil groups, expediting communication at a less technical level. The distribution of soils in South Africa (Fig. 12.2) is closely governed by parent material and climate, with topography, organisms, and time functioning in subdominant roles. A concise description of the soils in each mapping unit is given in Table 12.2.

#### 12.2.2 Climate

South Africa is an arid country overall (Fig. 12.3), with an average annual precipitation (mainly in the form of rainfall) of about 460 mm year\(^{-1}\), compared to the world average of about 860 mm year\(^{-1}\). This is exacerbated by the extremely high potential evapotranspiration, ranging from less than 1800 mm year\(^{-1}\) in the east to more than 3000 mm year\(^{-1}\) in the northwest. For the major part of South Africa, rainfall occurs mainly in the summer months, in the form of brief afternoon thunderstorms. The exception is the Western Cape which has a typical Mediterranean climate where rainfall is concentrated in winter. Snow is uncommon in South Africa, but can occur in the winter months on the mountain peaks of the Southern Cape and Drakensberg. South Africa has cold winters (June–August) and warm summers (November–February). Minimum temperatures in winter can drop below freezing, primarily due to the altitude. A detailed discussion on the current climate and the uncertainties thereof due to climate change is given in the chapters by Lennard and Jury, respectively. Climate, in addition to soil and vegetation, determines to a large extent the most viable agricultural production practice in any one location (Fig. 12.4). For crop

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**Table 12.1** Synopsis of land utilization in South Africa and its provinces in 1991 (area in millions of ha) (DAFF 2016)

<table>
<thead>
<tr>
<th>Country and provinces</th>
<th>Farmland</th>
<th>Potentially arable land</th>
<th>Arable land utilized</th>
<th>Grazing land</th>
<th>Nature conservation</th>
<th>Forestry</th>
<th>Other</th>
<th>Total area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Commercial agriculture</td>
<td>Communal agriculture</td>
<td>Dryland</td>
<td>Irrigation</td>
<td>Commercial agriculture</td>
<td>Communal agriculture</td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>100.67</td>
<td>14.19</td>
<td>2.55</td>
<td>11.54</td>
<td>1.36</td>
<td>71.99</td>
<td>11.93</td>
<td>11.79</td>
</tr>
<tr>
<td>Eastern Cape</td>
<td>14.82</td>
<td>0.64</td>
<td>0.53</td>
<td>0.41</td>
<td>0.19</td>
<td>10.17</td>
<td>3.47</td>
<td>0.62</td>
</tr>
<tr>
<td>Free State</td>
<td>11.79</td>
<td>4.19</td>
<td>0.04</td>
<td>3.86</td>
<td>0.14</td>
<td>7.39</td>
<td>0.15</td>
<td>0.27</td>
</tr>
<tr>
<td>Gauteng</td>
<td>0.83</td>
<td>0.44</td>
<td>–</td>
<td>0.38</td>
<td>0.03</td>
<td>–</td>
<td>0.39</td>
<td>–</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>6.53</td>
<td>0.84</td>
<td>0.36</td>
<td>0.70</td>
<td>0.13</td>
<td>2.60</td>
<td>2.73</td>
<td>1.38</td>
</tr>
<tr>
<td>Limpopo</td>
<td>10.55</td>
<td>1.17</td>
<td>0.53</td>
<td>0.50</td>
<td>0.16</td>
<td>5.98</td>
<td>2.86</td>
<td>1.16</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>4.98</td>
<td>1.60</td>
<td>0.14</td>
<td>1.61</td>
<td>0.13</td>
<td>2.89</td>
<td>0.35</td>
<td>2.33</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>29.54</td>
<td>2.41</td>
<td>–</td>
<td>0.03</td>
<td>0.19</td>
<td>29.09</td>
<td>–</td>
<td>4.29</td>
</tr>
<tr>
<td>North West</td>
<td>10.10</td>
<td>0.45</td>
<td>0.95</td>
<td>2.21</td>
<td>0.10</td>
<td>4.38</td>
<td>2.36</td>
<td>0.76</td>
</tr>
<tr>
<td>Western Cape</td>
<td>11.56</td>
<td>2.45</td>
<td>–</td>
<td>1.84</td>
<td>0.29</td>
<td>9.11</td>
<td>–</td>
<td>0.73</td>
</tr>
</tbody>
</table>

\(^{a}\) In former homelands

\(^{b}\) e.g. Urban, mining and industry
production, climate and soil are the main determinants, while climate and vegetation are the primary determinants for livestock production.

### 12.3 Crop Production

Potentially arable land in South Africa amounts to 16.8 million ha of which 14.2 million ha is for commercial agriculture and 2.6 million ha for communal agriculture (Table 12.1). Currently, 12.9 million ha is used for crop production, comprising of 11.5 million ha under dryland and 1.4 million ha under irrigation (DAFF 2016).

#### 12.3.1 Winter Rainfall Zone

Annual rainfall in the Mediterranean climate of the southern coastal area varies from 200 mm to more than 3000 mm in the mountains, with a 80–85% incidence in April to September. This results in hot and dry summer months. Commercial agriculture is dominant in the winter rainfall region. The eastern part, with annual rainfall of 350 to 500 mm, is primarily a sowing and grazing region where small grains such as wheat and barley (Table 12.3), and livestock farming on planted pastures is practised, each as a complement to the other. In the western part, wheat is the major crop grown primarily under monoculture system with 250–500 mm of rain per annum. The fallowing of land is, however, practised on up to 20% of the 350,000 ha under winter cereal production. Canola, with an annual production of 94,000 tonnes, has gained momentum in recent years as an alternative rotation crop for either wheat or barley (DAFF 2016).

Although dryland crop production on 1.8 million ha is the major enterprise, intensive vegetable, viticulture and fruit farming mainly under irrigation also make a valuable contribution to agricultural production. Unfortunately, salinization of water and soil impacts negatively on the productivity of these irrigated crops, such as along the Berg and Breede Rivers for example (van Rensburg et al. 2011). Viticulture is historically and culturally an important farming activity in the winter rainfall region.

Winter cereals are mainly grown on shallow duplex or lithic soils derived from shale and/or schist. Generally, these soils’ arable potential is rated as low to marginal for crop production. This is because the soils have low water and nutrient storage capacities, low organic matter contents and pH values, and are prone to crusting and water erosion. Heavy downpours often lead to waterlogging and runoff, thus aggravating the situation. Cultivation is by conventional mouldboard and disc ploughing, while there is a strong trend towards shallow no-till cultivation to conserve soil resources and reduce production costs (Beukes et al. 2004).
The remaining arable land in South Africa receives summer rainfall. Annual rainfall varies from 400 mm in the west to more than 1000 mm in the east. More than 75% of this rain falls between November and March. Midsummer drought is a general phenomenon coinciding with the flowering period of summer crops, often causing poor flowering and consequent low yields. The largest proportion of this arable land has therefore a low to moderate crop production potential. Moderate to high potential arable lands are only found in Gauteng, Limpopo and Mpumalanga.

Maize, wheat, soybean, sunflower, barley, grain sorghum, dry bean and groundnut are the major crops produced on about 9.7 million ha of dryland areas by commercial or communal farmers in the summer rainfall region (Table 12.3). Maize and grain sorghum are grown largely in monoculture systems, while other field crops are more often produced in rotation. However, cultivation of crops without proper rotation systems results in the build-up of root pathogens in soils. Examples are *Fusarium graminearum*, *Gaeumannomyces graminis* and *Rhizoctonia solani* which often cause yield losses (Hensley et al. 2006). Grain sorghum is mainly planted on the vertic soils found as patches in semiarid parts of the Free State, Limpopo and Mpumalanga provinces. This is because the soils are characterised by a low water supplying capacity due to high clay content, and have excessive water loss through runoff and evaporation that render them unfavourable for other field crops such as maize and wheat (Hensley et al. 2006).

Cultivation is done by mouldboard and disc ploughing, while reduced tillage with residue mulching under tine or chisel plough cultivation is also practised to a lesser extent. Although the beneficial effects of mulching due to build-up of organic matter, protection of aggregates against raindrop impact, and improved water storage are well understood, especially by commercial farmers, residue-borne diseases in maize and wheat have led to the slow adoption of this practice.

**Fig. 12.2** Dominant soils' distribution in South Africa (Generalised from Land Type Survey Staff 2000). A detailed description of the legend is given in Table 12.2
The adoption of reduced tillage with residue mulching has gained momentum on the more clayey cropped soils of Gauteng, KwaZulu-Natal, Limpopo and Mpumalanga provinces (Beukes et al. 2004). On large areas of sandy soils in the Free State and North West provinces, till implements are extensively used in a controlled traffic system (where wheel tracks confined to set paths) to conserve water, prevent wind erosion and combat subsurface compaction (du Preez 2003). Warm summer temperatures, low and erratic rainfall, and high evaporation have often led to low crop yields and sometimes crop failures on these soils. It is therefore essential that tillage practices should aim at maximum water storage and conservation (Hensley et al. 2006).

Table 12.2 Key to the soil map (Fig. 12.2), with the dominant soil groups (After Fey 2010), and the constituting soil forms (Soil Classification Working Group 1991)

<table>
<thead>
<tr>
<th>Map unit</th>
<th>Soil group description (and soil forms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay soils (swelling and duplex)</td>
<td>Duplex soils have distinct clay accumulation in the subsoil horizon, resulting in strong structure and a marked clay increase, often with a clear or abrupt upper boundary. These soils are very common throughout South Africa, especially in drier areas. (Estcourt, Klapmuts, Sterkspruit, Sepane, Valrivier, Swartland forms)</td>
</tr>
<tr>
<td></td>
<td>Vertic soils are characterised by swelling and shrinking, strong structure, and deep cracks, due to the high smectitic clay content, are chemically and physically active, and are therefore extremely difficult to manage. (Rensburg, Arcadia forms)</td>
</tr>
<tr>
<td></td>
<td>Melanic soils have strong structure, high base status, and dark colours even in the dry state, forming an intergrade between humic and vertic soils. (Willowbrook, Bonheim, Steendal, Immerpan, Mayo, Milkwood, Inhoek forms)</td>
</tr>
<tr>
<td>Red, yellow, and grey plinthic soils</td>
<td>Plinthic soils form through Fe and Mn oxides segregation and accumulation (with or without hardening) under conditions of a fluctuating water table. These soils occur mainly in the wetter eastern parts of South Africa. Oxidic soils occur subdominantly. (Longlands, Wasbank, Westleigh, Dresden, Avalon, Glencoe, Bainsvlei, Lichtenburg forms)</td>
</tr>
<tr>
<td>Red and yellow apedal soils</td>
<td>Oxidic soils have uniformly red and/or yellow coloured subsoils due to iron oxides. They vary greatly in degree of leaching and is widely distributed through South Africa. Plinthic soils occur subdominantly. (Pinedene, Griffin, Clovelly, Bloemdal, Hutton, Shortlands forms)</td>
</tr>
<tr>
<td></td>
<td>Humic soils have marked accumulation of humus, without water saturation and are therefore restricted to high rainfall and cool temperature areas, typically found on the elevated plateaus in the coast hinterland and midland mist belt regions of the Tugela Basin of KwaZulu-Natal. (Kranskop, Magwa, Inanda, Lusiki, Sweetwater, Nomanci forms)</td>
</tr>
<tr>
<td>Rock and rocky soils</td>
<td>Lithic soils have undergone so little soil formation that the parent material rock or saprolite is still recognisable. (Glenrosa, Misshap forms)</td>
</tr>
<tr>
<td></td>
<td>Podzolic soils are characterised by accumulation of illuvial organic material and sesquioxides, without a textural contrast. These soils are almost exclusive to the higher rainfall, mountainous areas of the Western Cape. (Tsitikamma, Lamotte, Concordia, Houwhoek, Jonkersberg, Witfontein, Pinergrove, Groenkopp forms)</td>
</tr>
<tr>
<td>Sandy soils (alluvial and aeolian)</td>
<td>Cumulic soils occur extensively throughout South Africa and are characterised by young unconsolidated colluvial or alluvial deposits, which has undergone soil formation. (Dundee, Namib forms)</td>
</tr>
<tr>
<td>Swamps and alluvial plains</td>
<td>Gleycic soils are characterised by continuous wetness, resulting in either removal or accumulation of colloidal material. These soils do not occupy vast areas and are typical of wetlands. (Katspruit, Kroonstad forms)</td>
</tr>
<tr>
<td></td>
<td>Organic soils have accumulated &gt;10% organic carbon under extreme wet, cold, and/or acidic conditions. These soils are therefore very localised and are always indicative of wetlands. (Champagne forms)</td>
</tr>
<tr>
<td>Weakly developed soils</td>
<td>Cumulic soils occur extensively throughout South Africa and are characterised by young unconsolidated colluvial or alluvial deposits, which has undergone soil formation. (Tukulu, Oakleaf, Montagu, Augrabies forms)</td>
</tr>
<tr>
<td></td>
<td>Silicic soils are characterised by a dry, hard subsoil, in which silica is the major cementing agent and are exclusively found in arid landscapes. (Garies, Oudtshoorn, Trawal, Knorrivle forms)</td>
</tr>
<tr>
<td></td>
<td>Calcic soils are characterised by the accumulation of secondary (i.e. pedogenic) calcium and/or magnesium carbonate (with or without hardening). (Molopo, Askham, Kimberley, Plooysburg, Eetsha, Gameoep, Addo, Prieska, Brandvlei, Coega forms)</td>
</tr>
<tr>
<td></td>
<td>Anthropic soils have soil formation in deposits produced by human activities. It includes subsoil material such as mine spoils and rehabilitated techniques. (Witbank forms)</td>
</tr>
</tbody>
</table>

(du Preez et al. 2011). The adoption of reduced tillage with residue mulching has gained momentum on the more clayey cropped soils of Gauteng, KwaZulu-Natal, Limpopo and Mpumalanga provinces (Beukes et al. 2004). On large areas of sandy soils in the Free State and North West provinces, till implements are extensively used in a controlled traffic system (where wheel tracks confined to set paths) to conserve water, prevent wind erosion and combat subsurface compaction (du Preez 2003). Warm summer temperatures, low and erratic rainfall, and high evaporation have often led to low crop yields and sometimes crop failures on these soils. It is therefore essential that tillage practices should aim at maximum water storage and conservation (Hensley et al. 2006).

Soils in the higher rainfall areas of KwaZulu-Natal and Mpumalanga are highly weathered and leached and hence naturally acidic, even in the subsoil. Further acidification of these soils is induced by cropping and in some instances by mining. Very acid soils impact negatively on the growth and development of most crops, resulting in low yields that are
not economically viable. A proper liming program is therefore of utmost importance to rectify acidity in these particular soils and also other soils under cropping (du Preez 2003).

Subtropical and tropical fruit crops are produced in parts of KwaZulu-Natal, Mpumalanga and Limpopo provinces where the climate and soils are suitable. Sugarcane is also an important field crop in these areas with an annual production of 17 million tonnes on 452,000 ha, giving a yield of 39 t ha\(^{-1}\) year\(^{-1}\) (DAFF 2016). A variety of field and horticulture crops are planted under irrigation in the summer rainfall region. In some of the irrigated areas, for example along the lower Vaal River and its tributaries, productivity of these crops is reduced by waterlogging and salinisation (van Rensburg et al. 2011). Crop production under irrigation has, however, a stabilizing effect on national food security since the risk of crop failure is reduced in dryland areas which are otherwise prone to droughts.

Fig. 12.3 Average annual precipitation and average annual potential evaporation isohyets (mm) in South Africa. (Interpolated from Schulze et al. 2001)

12.4 Livestock Production

About 69\% of South Africa’s land surface is only suitable for grazing (Table 12.1), which makes livestock farming the largest agricultural sector in the country. There are about 13.7 million cattle, 21.1 million sheep and 1.9 million goats in South Africa, in addition to smaller numbers of pigs, poultry and farmed ostriches (DAFF 2016). These livestock numbers vary in response to rainfall and economic factors. More cattle are held in the communal than in the commercial sector, with the communal sector contributing the least to formal beef sales. Beef production is the most important livestock related activity in South Africa, followed by small stock (sheep and goat) production. Wool, mohair, mutton and lamb from the small stock sector are mostly exported. The combined livestock sector contributes roughly 75\% to the total agricultural output in South Africa (DAFF 2016). Per capita consumption of beef has declined since the 1970s, and the consumption of chicken
### Table 12.3  Yield of field crops (in thousands of t year\(^{-1}\)) in South Africa for the 5-year interval 2011 to 2015 (DAFF 2016)

<table>
<thead>
<tr>
<th>Country and provinces</th>
<th>Maize</th>
<th>Wheat</th>
<th>Soybean</th>
<th>Sunflower</th>
<th>Barley</th>
<th>Grain sorghum</th>
<th>Dry bean</th>
<th>Groundnut</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Africa</td>
<td>10,499</td>
<td>1790</td>
<td>835</td>
<td>652</td>
<td>302</td>
<td>140</td>
<td>64</td>
<td>55</td>
</tr>
<tr>
<td>Eastern Cape</td>
<td>96</td>
<td>17</td>
<td>2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Gauteng</td>
<td>4433</td>
<td>322</td>
<td>263</td>
<td>351</td>
<td>1</td>
<td>59</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>Free State</td>
<td>551</td>
<td>6</td>
<td>46</td>
<td>5</td>
<td>–</td>
<td>2</td>
<td>4</td>
<td>–</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>526</td>
<td>39</td>
<td>85</td>
<td>–</td>
<td>–</td>
<td>2</td>
<td>6</td>
<td>–</td>
</tr>
<tr>
<td>Limpopo</td>
<td>280</td>
<td>150</td>
<td>60</td>
<td>71</td>
<td>3</td>
<td>19</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>2571</td>
<td>26</td>
<td>337</td>
<td>7</td>
<td>–</td>
<td>46</td>
<td>10</td>
<td>–</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>670</td>
<td>295</td>
<td>10</td>
<td>–</td>
<td>59</td>
<td>–</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>North West</td>
<td>1336</td>
<td>109</td>
<td>31</td>
<td>218</td>
<td>7</td>
<td>12</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Western Cape</td>
<td>36</td>
<td>826</td>
<td>1</td>
<td>–</td>
<td>232</td>
<td>–</td>
<td>1</td>
<td>–</td>
</tr>
</tbody>
</table>

**Fig. 12.4** Dominant agricultural production areas in South Africa. (Adapted from WWF 2010)
is increasing in South Africa and currently exceeds the total consumption of red meat, a trend that is likely to continue (Palmer and Ainslee 2006; WWF 2010).

The potential animal stocking rate of land in South Africa increases from west to east, mimicking the rainfall gradient. Cattle are mainly found in the eastern, wetter regions of the country, as well as in North West and Northern Cape provinces where the rangelands generally have a higher carrying capacity, whereas sheep are largely found in the drier western and central areas of the country (Fig. 12.4). Grazing land area has declined over time due to growing human settlements and activities such as cropping, forestry and mining. This decline in grazing land is especially prominent in Gauteng and the Western Cape provinces with their high rates of urbanisation, although communal districts in Limpopo, KwaZulu-Natal and the Eastern Cape provinces have also lost significant grazing lands. South Africa also holds a rich and diverse wildlife resource, with almost 10% of the country being designated as National Parks and formal conservation areas. However, a substantial amount of wildlife exists outside formally proclaimed conservation areas, with numerous livestock farmers gaining some or all of their income from game ranching.

There are two contrasting types of livestock production systems in South Africa. Commercial farms have clear boundaries, individual property rights, and clear commercial production objectives. In communal areas, there are often unclear boundaries, generally open access rights to grazing areas, and the farmers are subsistence-oriented, due to land tenure issues that largely obstruct the introduction and adoption of improved land management practices. Production under these two land systems is now examined.

### 12.4.1 Commercial Livestock Production

Commercial livestock production is responsible for a substantial 75% of national agricultural output, which comes from 52% of the total grazing land (DAFF 2016). The largest contributor to commercial farming income is beef cattle, with the major breeds being Brahman, Afrikaner and Simmentaler. Sheep are mainly concentrated in the drier western and also in the southeastern parts of South Africa, with the Dohne merino being bred largely for wool, and the Dorper for meat production. Boer goat and Angora goats are widely spread across South Africa. Grazing livestock are mostly raised under extensive ranching conditions that rely on natural pasture, occasionally supplemented by protein and/or mineral licks. Ostrich farming is found in the southern parts of the country where natural vegetation is utilized and supplemented by fodder and concentrates.

Commercial systems are normally practiced on fenced farms, subdivided into numerous paddocks and commonly with some form of rotational grazing. Stocking rates are inclined to be more conservative here than in communal systems. In the higher elevated rangelands, fire is applied to provide grazing during the early growing season, by removing low quality material that remained after the winter and to encourage the flush of short green grass during spring time. There has, however, been a clear increase in game farming and ecotourism in the commercial areas, due to the difficulties and consequences of farming with monospecific (grazer) domestic stock.

### 12.4.2 Communal Livestock Production

The communal livestock production areas make up nearly 17% of the total farming area of South Africa, and are primarily restricted to the eastern and northern parts of the country where about 52% of the total cattle population, 72% of the goats and 17% of the sheep are held (DAFF 2016). The communal production systems differ significantly from the commercial production systems in their objectives and property rights, where the grazing areas tend to be shared by community members. There is also a significantly higher human population per unit area in the communal than the commercial sector, with infrastructure (access roads, fences, water provision, power supply, dipping facilities) mostly lacking. The communal production systems are built on pastoralism, with the bulk of households being subsistence-based and labour-intensive. Livestock ownership in these systems has much more diverse outputs and objectives than in commercial systems, and include animal draught power, milk, dung, meat, cash income and capital storage, and is influenced by sociocultural factors. In these systems, a strategy of herd maximization rather than turnover is followed, where even the large herd owners tend to sell only for the purpose of meeting cash needs.

Communal livestock production systems do not contribute significantly to South Africa’s formal agricultural output. Herd sizes vary greatly between and within different regions, and livestock ownership is strongly skewed, with only a small number of people owning large herds and the majority owning few animals or none at all. In comparative terms, there seems to be an uneven distribution of stock numbers in communal compared to commercial sectors.

Mixed livestock ownership is more common in communal than commercial areas, with cattle generally being preferred, because of the importance of animal draught power. However, due to economic and ecological conditions, the possibilities of cattle ownership is often hampered, with goats and to a lesser extent sheep also commonly found in communal areas. A few communities in the higher regions of the Eastern Cape focus on sheep only. Pigs and poultry in the communal sector tend to be free-ranging and scavenging.
Communal livestock farmers avoid the use of fire in rangeland management, and this has encouraged bush encroachment in some regions of South Africa, to the detriment of the grazing potential for cattle and sheep.

12.5 Intensification of Agriculture

12.5.1 Crop Production

The area planted with maize and wheat has declined significantly by 34% and 72% respectively, when comparing 5-year means from 1985 to 2014 (Table 12.4). Over this period, 5-year mean yields of maize increased from 9.2 to 12.4 million tonnes, and wheat from 1.8 to 2.2 million tonnes. The result is that maize yields increased from 1.98 t ha$^{-1}$ to 4.01 t ha$^{-1}$, and wheat yields from 1.01 t ha$^{-1}$ to 3.38 t ha$^{-1}$. Similar trends with regard to area planted and crop yield are observed for barley, dry bean, grain sorghum, groundnut and sunflower. In contrast, the area planted under canola in the winter rainfall region increased from 0.94 t ha$^{-1}$ to 1.41 t ha$^{-1}$, probably as a result of drought at this time. These trends point to an overall intensification of crop production. This phenomenon can be attributed to the fact that commercial farmers in particular adjusted to a more competitive environment, namely increased input costs and reduced subsidies. In achieving this, farmers are using soil resources more optimally and are increasing yields by adopting improved cultivation practices and using higher yielding crop varieties. The application of precision farming (e.g. variable rates of plant density and fertiliser application) further contributes to higher crop productivity.

Higher crop productivity could enhance soil degradation that often coincides with commercial and communal cropping. This degradation results from the physical, chemical and biological processes displayed in Fig. 12.5. These processes, which may be natural or anthropogenically induced, do not occur independently. For example, salinization of soils, especially with sodium salts, results in structural decay which cause surface sealing and hence increased runoff and water erosion. It is estimated that 10% of irrigated lands in South Africa (136,000 ha) are subject to salinization. Acidification of soil results in the simultaneous fixation of phosphorus in an unavailable form and the release of aluminium in an available form for uptake by plants. Phosphorus is essential, while aluminium is toxic to plants. It is estimated that of the 13 million ha land under cropping, the topsoil of about 4 million ha and the subsoil of about 2 million ha are severely acidified due to human activities. Most of the degradation processes outlined in Fig. 12.5 are exacerbated by a decline in organic matter, which has declined by almost 50% in cultivated soils. The extent to which the different soil degradation processes occur under crop production, and the ways in which farmers combat them, are described in detail elsewhere (e.g. du Preez 2003; du Preez et al. 2011; Hensley et al. 2006; Swanepoel et al. 2016). Farmers who practising crop production should aim to prevent and even improve the capacity of soils to function effectively and sustainably.

12.5.2 Livestock Production

South Africa is predominantly arid to semiarid, and therefore prone to land degradation that can lead to desertification and the irreversible loss of productive rangeland (Ghetibouo and Ringler 2009). This is because the majority of rangeland in South Africa is stocked beyond its long-term carrying capacity. Exceedance of the carrying capacity of rangeland is especially marked in communal agricultural areas of Limpopo, KwaZulu-Natal and Eastern Cape provinces, which support more than half of the cattle numbers in the country. Overstocking leads to trampling which promotes surface degradation processes, which may be natural or anthropogenically induced, do not occur independently. For example, salinization of soils, especially with sodium salts, results in structural decay which cause surface sealing and hence increased runoff and water erosion. It is estimated that 10% of irrigated lands in South Africa (136,000 ha) are subject to salinization. Acidification of soil results in the simultaneous fixation of phosphorus in an unavailable form and the release of aluminium in an available form for uptake by plants. Phosphorus is essential, while aluminium is toxic to plants. It is estimated that of the 13 million ha land under cropping, the topsoil of about 4 million ha and the subsoil of about 2 million ha are severely acidified due to human activities. Most of the degradation processes outlined in Fig. 12.5 are exacerbated by a decline in organic matter, which has declined by almost 50% in cultivated soils. The extent to which the different soil degradation processes occur under crop production, and the ways in which farmers combat them, are described in detail elsewhere (e.g. du Preez 2003; du Preez et al. 2011; Hensley et al. 2006; Swanepoel et al. 2016). Farmers who practising crop production should aim to prevent and even improve the capacity of soils to function effectively and sustainably.

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Table 12.4 Production of canola, maize, soybean and wheat in South Africa for a number of 5-year intervals (DAFF 2016)

<table>
<thead>
<tr>
<th>Crop and production period</th>
<th>Total production (thousands of t)</th>
<th>Area planted (thousands of ha)</th>
<th>Yield (t ha$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000–2004</td>
<td>31</td>
<td>33</td>
<td>0.94</td>
</tr>
<tr>
<td>2005–2009</td>
<td>38</td>
<td>35</td>
<td>1.09</td>
</tr>
<tr>
<td>2010–2014</td>
<td>82</td>
<td>58</td>
<td>1.41</td>
</tr>
<tr>
<td>Maize</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985–1989</td>
<td>9164</td>
<td>4637</td>
<td>1.98</td>
</tr>
<tr>
<td>1990–1994</td>
<td>10,384</td>
<td>4111</td>
<td>2.53</td>
</tr>
<tr>
<td>1995–1999</td>
<td>9480</td>
<td>3785</td>
<td>2.51</td>
</tr>
<tr>
<td>2000–2004</td>
<td>9808</td>
<td>3360</td>
<td>2.92</td>
</tr>
<tr>
<td>2005–2009</td>
<td>10,688</td>
<td>2877</td>
<td>3.71</td>
</tr>
<tr>
<td>2010–2014</td>
<td>12,345</td>
<td>3076</td>
<td>4.01</td>
</tr>
<tr>
<td>Soybean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995–1999</td>
<td>149</td>
<td>98</td>
<td>1.52</td>
</tr>
<tr>
<td>2000–2004</td>
<td>216</td>
<td>129</td>
<td>1.67</td>
</tr>
<tr>
<td>2005–2009</td>
<td>399</td>
<td>228</td>
<td>1.75</td>
</tr>
<tr>
<td>2010–2014</td>
<td>833</td>
<td>519</td>
<td>1.61</td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985–1989</td>
<td>1922</td>
<td>1906</td>
<td>1.01</td>
</tr>
<tr>
<td>1990–1994</td>
<td>1800</td>
<td>1174</td>
<td>1.53</td>
</tr>
<tr>
<td>1995–1999</td>
<td>2148</td>
<td>1100</td>
<td>1.95</td>
</tr>
<tr>
<td>2000–2004</td>
<td>2121</td>
<td>885</td>
<td>2.40</td>
</tr>
<tr>
<td>2005–2009</td>
<td>2011</td>
<td>718</td>
<td>2.80</td>
</tr>
<tr>
<td>2010–2014</td>
<td>1793</td>
<td>531</td>
<td>3.38</td>
</tr>
</tbody>
</table>

*Period for which data are available*
crusting, compaction and erosion of soil, and the ultimate removal of vegetation. This again causes a reduction in productivity and soil fertility, and consequently soil degradation (Fig. 12.5). The degradation of soil due to livestock production was previously a neglected topic since the focus was mainly on rangeland condition. However, lately research attention has shifted towards soil condition (Kotzé et al. 2013, 2017; Sandhage-Hofmann et al. 2015).

In order to improve livestock production areas, some commercial farmers add fertilizers and palatable plant species to increase the carrying capacity of their land. These techniques are expensive and can lead to the pollution of the environment. If fertilization is poorly managed, this can further lead to changes in plant species composition which may result in a decrease in basal grass cover, and ultimately to reduced productivity, increased water runoff and erosion (Swanepoel et al. 2015). Improving pastures can have a significant negative impact on any sensitive ecosystem, because it can alter not only the ecological structure of the habitats, but also the nutrient regimes and animal populations. In general, fertilizing and irrigating non-arable land is costly and is not considered a viable option for most farmers.

12.6 Food Production

South Africa has a dual agricultural industry, with a well-developed commercial sector and a less-developed communal sector. Both sectors, comprising crop and/or livestock production, are still operational, despite significant political and social changes since 1994. These socio-political changes did, however, cause a shift to large-scale intensive farming, as well as a shift from low-value, high-volume products intended for domestic consumption, such as wheat and milk, to high-value products intended for export, such as fruit and game. The resulting intensification of crop and/or livestock production can be devastating to soil and vegetation, since both these natural resources are increasingly vulnerable to improper land management. A drive towards land management for sustainable agricultural production should therefore be non-negotiable. This will require a collective approach, encompassing the agricultural industry as a whole and relevant governmental departments and other actors to ensure sufficient food production through limited natural resources for an increasing population.

Prior to present day conditions, South Africa was largely independent of agricultural imports and food aid on account of adequate crop and livestock production. The situation may change in the near future for the following reasons, which are not to be viewed as exhaustive:

- Total food production in South Africa has increased over recent years but production per capita is declining, which may threaten food security;
- Production of more food in South Africa depends on the intensification rather than the extensification of agriculture, due to limited soil and water resources available for expansion;
- Access to land is one of South Africa’s most important social and political issues, which may impact negatively on food production and security due to the unsuccessful implementation of land reform policies by government;
- Challenges faced by the land reform process are the inadequacy and even absence of financial support and exten-
tion services to enable the new beneficiaries to be successful farmers;

- Water insecurity is a serious concern for all farmers in South Africa since most of the country is arid to semi-arid and subject to a highly variable climate;

- Uncertainty regarding the impacts of climate change on agricultural production in South Africa, despite global climate models that show a wetter eastern part and a drier western part, with the southern coastal region having a shorter future rainfall season;

- Bush encroachment of rangeland due to overgrazing may endanger the sustainability of livestock production, especially in savanna areas;

- Degradation of the soil resource base as a result of poor land management practices may further threaten food production and security in South Africa in the long term;

- Despite the fact that the agronomic, economic and environmental benefits of conservation agriculture are increasingly being recognized worldwide, the adoption rate of this practice in South Africa is relatively slow, and ways should be found to enhance it to further limit soil degradation under cropping.

12.7 Summary

Agriculture is practised by commercial and communal farmers on 83% of South Africa’s 122 million ha land under its arid to semi-arid climate. A large proportion of the country’s population depends on agriculture when its upstream and downstream linkages to the economy are taken into account. Thus, for the welfare of numerous households, a healthy agricultural industry is of importance. The aim of commercial and communal farmers should therefore be to prevent or effectively manage land degradation for sustainable food production. Intensification of crop and livestock production of the last decades may enhance the degradation of soil and vegetation that usually coincide with farming. It is suggested that a collective approach by all stakeholders in South African agriculture is required for the sustainability of this industry over the long term.

References


Land Type Survey Staff (2000) Land types of South Africa. ARCS, Pretoria


Part II

Human Geography
Human Evolution, Archaeology and the South African Stone Age Landscape During the Last 100,000 Years

Sarah Wurz

Abstract

During the past 100,000 years the fluctuating climate that included two glacials and three interglacials resulted in a continuously changing South African landscape. The multitude of archaeological sites on the landscape shows that climate presented no obstacle to anatomically modern humans’ ability to flexibly adjust to a variety of ecoregions. Humans interacted dynamically with the environment throughout this time and changing population densities, fluctuating levels of cultural connectivity and variations in behavioural complexity occur. During interglacial Marine Isotope Stages (MIS) 5 and 3 sites appear in regionally restricted areas on the landscape and the lithic technocomplexes indicate minimal cultural connections between the groups. By contrast, in the Howiesons Poort of glacial MIS 4, more sites on the landscape, homogeneity in lithic flaking systems, and an increase in the expressions of complex behaviours occur on a sub-continental scale. There is no straightforward relationship between such expanded archaeological signals and colder periods, as the glacial MIS 2 archaeological occurrences are largely similar to those from MIS 5 and 3. It is only with the Holocene interglacial Oakhurst and Wilton technocomplexes that the increases in site density and homogeneity in lithic systems over the entire South Africa landscape occur again. This is associated with an exponential increase in the complexity of behavioural expressions such as the use of pigments, bone and shell in Holocene assemblages. To further investigate these subtle links between climate, environment and human evolution, additional high resolution chronological frameworks, environmental proxies and archaeological cultural data with even geographical representation are needed.

Keywords

Howiesons Poort · Later Stone Age · Middle Stone Age · Population dynamics · Still Bay · Technocomplex

13.1 Introduction

During the Quaternary (the last 2.6 million years), the South African landscape was inhabited by hunter-gatherers that used stone tools in hunting and gathering activities. These durable items remained behind in caves and open air sites and represent the most prolific evidence that human ancestors lived on the landscape. The style of making stone tools changed regularly throughout the Quaternary, resulting in a variety of lithic technocomplexes, for example the Howiesons Poort, Oakhurst and Wilton (Fig. 13.1) that are used to mark archaeological time, forming the basis of the cultural–stratigraphic framework for the Early, Middle and Later Stone Ages of South Africa (Lombard et al. 2012). The focus in this chapter is the archaeological evidence for human development in the last 100,000 years (100 ka), encompassing part of the Middle Stone Age (300–40/20 ka BP) and the Later Stone Age (40/20–0.3 ka BP).

The multitude of archaeological sites on the South African landscape shows that hunter-gatherers of the past 100 ka adapted successfully to the full range of ecoregions present, including deserts, temperate grasslands, and Mediterranean-like Cape Fynbos. They utilised a range of weaponry, including handheld spears with hafted stone tips and, from 65 ka onwards, bows and arrows with stone and bone inserts. Bone tools, jewellery and engraved items were made and pigments were utilised, but the occurrence of these complex cultural items varied through time. Site density, probably driven by fluctuating population sizes and environments, also varied.
through the last 100 ka. Landscape-scale syntheses of such changes through time are frequently discussed in relation to the Marine Isotope Stages (MIS) and modern rainfall zones (winter, summer and year round zones) (Carr et al. 2016; Mackay et al. 2014). This convention is followed here to allow integration with current literature, but it has to be noted that rainfall seasonality patterns and regions changed through time (e.g. Thackeray and Fitchett 2016), and that the MIS boundaries are not set in stone. In the following section the major climatic trends for MIS 5c to MIS 1 (Fig. 13.1) and how they correlate with shifts in site visibility, lithic technocomplexes and the complexity of past behaviours are discussed. The majority of the examples and case studies described are from the southern Cape, as this area remains one of the better researched regions in South Africa (Carr et al. 2016).

13.2 Time Periods of Archaeological Sites and Their Evidence

13.2.1 106–71 ka BP (MIS 5c to 5a)

MIS 5c to 5a covered two relatively warmer phases interrupted by a cooler spell during MIS 5b (~92 to 88 ka BP). At Blombos Cave in the southern Cape (Fig. 13.2), the warmer and drier conditions resulted in increased winter rains and presence of C3 grasses, as suggested by the isotopic composition of $\delta^{13}$C and $\delta^{18}$O from ostrich eggshells (Roberts et al. 2016). The Crevice Cave speleothem record, also from the southern Cape, indicates similar conditions at this time (Bar-Matthews et al. 2010). The warming trend peaked at 83.4 ka after which time sea surface temperatures decreased until 74 ka. In the north of South Africa, relatively warm conditions occurred for the whole of the period MIS 5c to 5a, as the proxies from Tswaing Crater show (Scott 2016).

Archaeologically this period is under researched, but sites from this time period occur in all of the current rainfall zones (Wadley 2015). At the vast majority of MIS 5 sites, hunter-gatherers focused on grazers and large ungulates (Clark and Kandel 2013). Points form an important part of lithic assemblages, and they have been used in projectile weapons such as spears, and as cutting implements. In the winter and year-round rainfall zones, unretouched points are typical, as for example at Klasies River, Blombos Cave, Nelson Bay Cave and Diepkloof Rock Shelter (Douze et al. 2015), while bifacial and unifacial points have been preferred in the summer rainfall zone, for example at Bushman Rock Shelter and Border Cave (Wadley 2015). Further investigation of landscape-scale lithic technological patterns and demographic changes and how they link to the environment can only be done once more high-resolution dates and proxies from all of the regions from South Africa become available.

By 100 ka BP, hunter-gatherers evolved to such an extent that complex behaviours were the norm. This is why, in MIS 5, there is a noticeable incidence of artefacts that reflect complex production sequences (known as chaînes opéra-toires), especially relating to pigment utilisation. The production and storage of ochre compounds in abalone ochre toolkits, found in M3 layers from Blombos Cave, indicate deliberate forward-planning and thus complex behaviour. Other worked ochre dating to this period include small incised nodules from Blombos Cave and incised and worked ochre from Klasies River (Wadley 2015) (Fig. 13.3). Complexity was also expressed through the use of bone artefacts. Formally worked bone dating to MIS 5 occurs at Klasies River (Fig. 13.4), whereas somewhat younger examples come from Blombos...
**Fig. 13.2** Map of South Africa with sites mentioned in the text: Byeneskranskop 1 (BNK), Blombos Cave (BBC), Boomplaas (BP), Border Cave (BC), Bushman Rockshelter (BRS), Diepkloof Rock Shelter (DRS), Elands Bay Cave (EBC), Florisbad (FRB), Hollow Rock Shelter (HRS), Klein Kliphuis (KKH), Klasies River (KRM), Klipdrift Shelter (KDS), Melkhoutboom (MKB), Nelson Bay Cave (NBC), Peers Cave (PC), Pinnacle Point (PP), Rose Cottage Cave (RCC), Sibudu Cave (SC), and Umhlatuzana (UMH)

**Fig. 13.3** Striated ochre crayon from a ~100 ka layer at Klasies River
and Sibudu Cave (Wadley 2015). It is thought that these innovative behaviours may have developed independent of climate shifts (Roberts et al. 2016), but climate change plays a more prominent role in the southern Cape refugium hypothesis.

According to this hypothesis, the southern coast provided a refugium during MIS 6 when many regions in Africa experienced adverse climatic conditions. The southern Cape coast’s ambient temperature, year-round access to dense beds of intertidal shellfish and edible plants such as geophytes (Marean 2016) would have provided a refuge for a small group of hunter-gatherers. Mentally mapping the location and seasonal variation of plant food, scheduling shellfish foraging trips to the coastal rhythms, the phases of the moon and the tides conferred evolutionary advantage to such refugees, leading to the development of symbolic capabilities, true coastal economies and eventually larger populations in MIS 5 (Marean 2016). The thick ~110 to 100 ka shell midden deposits from Klasies River, Pinnacle Point and Blombos Cave are thought to represent the first entry into the dense and predictable foraging niche of more sedentary populations. The resulting larger population size would have led to increased territoriality, which, according to economic defendability theory, predicts heightened levels of interpersonal conflict connected to defending intertidal resources. This, in turn, would have encouraged the selection of hyper-prosociality manifesting in ‘modern’ behaviours such as everyday cooperation between group members, even at a cost to individual members (Marean 2016). It may be that the scrape and cut marks on the MIS 5 human remains from Klasies River reflect an increase in such episodes of interpersonal violence, but ritual cannibalism (Deacon 2008) cannot be ruled out. This theory-driven scenario incorporates the dataset from the southern Cape coast, but does not explain the evidence for occupation of the interior during MIS 6, as for example at Florisbad (Wurz 2013) and Border Cave (Wadley 2015), the period during which the southern Cape might have been a refugium.

13.2.2 71–57 ka BP (MIS 4)

MIS 4 was a global glacial period with lower temperatures and pronounced climatic instability as indicated in speleothem and marine records (Bar-Matthews et al. 2010) and stable isotopes from ostrich eggshells from the southern Cape (Roberts et al. 2016). The Crevice cave stable δ18O and δ13C isotope compositions indicate cooler conditions, an increase in C4 grass and summer rain (Bar-Matthews et al. 2010). Conversely, an increase in winter rain, related to the equatorward shift of the westerlies and expansion of the winter rainfall zone, has been proposed for this period (Chase 2010; Fitchett et al. 2017). The savanna region in the north also experienced increased humidity, as indicated by the pollen record of the Tswaing sequence dating to between 72 and 68 ka BP. Grassy savanna with warm and somewhat dry conditions for the last phase of the Howiesons Poort technocomplex is indicated (Scott 2016). Changes in the relative proportions of grazers to browsers in the Howiesons Poort sequences at both Klipdrift Shelter in the year-round rainfall zone (Reynard et al. 2016) and Sibudu Cave in the summer rainfall zone (Clark 2017) further suggest a fluctuating environment during the Howiesons Poort era.

The colder conditions in MIS 4 also affected human subsistence patterns. There is a marked increase in dietary breadth as small mammals (<4.5 kg) and small (size 1) ungulates dominate faunal assemblages from almost all sites (Clark and Kandel 2013). The increase of small prey animals in the Howiesons Poort diets has been linked to the use of remote-capture methods such as snares and bow and arrow technology at Sibudu Cave (Wadley 2015). Faunal remains in the Howiesons Poort are frequently fragmented and burnt. At Pinnacle Point (Karkanas et al. 2015) and Klipdrift Cave (Reynard et al. 2016), such burnt remains occur as palimpsests, indicating subsistence intensification and more intense occupation of sites.
During MIS 4, two lithic technocomplexes occur in relatively rapid succession (Fig. 13.2). The bifacial point-rich Still Bay appears between 80 and 70 ka BP at a handful of sites, including Peers Cave, Hollow Rock Shelter, and Diepkloof (winter rainfall zone), Blombos Cave (year-round rainfall zone), and Umhlatuzana and Sibudu Cave (summer rainfall zone). The earliest Howiesons Poort-like assemblages with small blades and geometrically backed tools are from Diepkloof, at an anomalously early date of ~100 ka BP, and Pinnacle Point at 71 ka BP. After 65 ka BP, site visibility increases noticeably and the Howiesons Poort technocomplex occurs over the entire South African region (Mackay et al. 2014). The MIS 4 lithic technocomplexes differ from those in MIS 5 and 3 in the increased reliance on fine-grained raw materials, heat treatment of silcrete, and more extended reduction sequences and prevalence of retouched types (e.g. Delagnes et al. 2016; Henshilwood et al. 2014; Mourre et al. 2010). This may have been due to the environmental conditions during MIS 4 which led to stockpiling of lithic raw materials at base camps and more intensive utilisation of raw materials (Wilkins et al. 2017).

Artefacts reflecting cultural complexity are present in higher frequencies in MIS 4 than in MIS 5. At Sibudu Cave, for example, backed artefacts were hafted using compound adhesives that were made by combining and heating carefully chosen ingredients in a controlled way, a practice that probably extended to other Howiesons Poort sites (Wadley 2015). At Sibudu in the 77 ka-layers, there is further extraordinary evidence for cultural complexity in the use of sedge nutlets as bedding, topped with leaves that would have kept insects at bay (Wadley 2015). Perforated shell beads, from *Nassarius kraussianus* shells at Blombos Cave and *Afrolittorina africana* shells at Sibudu Cave, appear for the first time in MIS 4 in the archaeological record of South Africa (Wadley 2015). The small 77 ka ochre slab with geometrically engraved patterns from Blombos Cave, an engraved ochre fragment from Klein Kliphuis, geometrically incised ostrich eggshells from Diepkloof Rock Shelter and Klipdrift Shelter, and formal bone tools from Sibudu Cave further signal increased complexity, possibly symbolic, behaviours during this period (Wadley 2015). This trend is bolstered by the burial of an infant, associated with a conus shell, in the ~74 ka Howiesons Poort layers at Border Cave, the first occurrence of this practice in Africa (d’Errico and Backwell 2016). The increase in site density, amplified archaeological signals of cultural complexity and the homogeneity of lithic flaking systems indicate heightened interaction, or coalescence, of populations across South Africa (Mackay et al. 2014).

**13.2.3 50–29 ka BP (MIS 3)**

MIS 3 was also marked by fluctuating climatic conditions that included very wet periods (Wadley 2015). At Boomplaas Cave in the southern Cape, for example, the 39.7–36.0 cal ka BP layers were deposited during a wet period with relatively more summer rainfall compared to other phases at this site. This is indicated by stable isotope values from faunal tooth enamel, an increase in the relative amounts of alecelaphines such as wildebeest and hartebeest, and microfaunal evidence. Comparable isotopic values only occur again in the second half of the Holocene (Sealy et al. 2016). MIS 3 faunal assemblages, like those from MIS 5, contain relatively larger proportions of grazers and large to very large bovids (Clark and Kandel 2013). From around 58 ka BP, there is a virtual abandonment of sites in the southern Cape, possibly related to development of hyperarid conditions (Deacon and Thackeray 1984), although the possibility that occupied sites from this region were flooded by rising sea levels cannot be excluded. In other areas of South Africa there was continued and even increased occupation (Wadley 2015).

Many sites dating to the first part of MIS 3 contain points, often unifacially retouched, for example at Border Cave, Klein Kliphuis, Sibudu Cave, Diepkloof, Klasies River, Umhlatuzana, and Rose Cottage Cave (Wurz 2013). Such post-Howiesons Poort or Late Middle Stone Age lithic assemblages are similar only on a regional scale. The first ‘Early Later Stone Age’ assemblage characterised by bipolar technology and microlithic artefacts occurs at Border Cave at ~46 to 43 ka BP (Bousman and Brink 2018). Other Early Later Stone Age assemblages appear gradually over a period of more than 25 ka, co-occurring with Late Middle Stone Age industries (Fig. 13.2). Even though conditions during MIS 3 may have contributed to fragmentation of populations and limited sharing of ideas on stone tool production, the degree of behavioural flexibility did not return to MIS 5 levels (Kandel et al. 2016). Continued cultural complexity is particularly reflected at Sibudu Cave where the post-Howiesons Poort occupation is the most intensive in the sequence. Extensive ochre working on cemented hearths, worked bone and maintained bedding and hearths indicate complexity in cognition and behaviour (Wadley 2015). The Early Later Stone Age assemblage from Border Cave contains an impressive variety of bone artefacts that are extraordinarily well preserved, leading to its description as ‘early evidence of San material culture’ (d’Errico et al. 2012).

**13.2.4 29–0.3 ka BP (MIS 2 to 1)**

MIS 2 is associated with the Last Glacial Maximum, the most recent period in the Quaternary during which ice sheets in the northern hemisphere reached their maximum extent.
Conservatively defined, the Last Glacial Maximum was from 24 to 18 cal ka BP (Chase and Meadows 2007). There is debate, however, on the timing and the duration of the Last Glacial Maximum and when the coldest conditions occurred, but it possibly spanned two cold events that resulted in precipitation patterns different to those of today (Fitchett et al. 2017). Boomplaas Cave, for example, was probably located in the winter rainfall zone during the Last Glacial Maximum (Thackeray and Fitchett 2016). At Boomplaas, the δ13C and δ18O isotopic values from faunal tooth enamel in the 25.8–20.6 cal ka BP layers indicate an environment dominated by C3 vegetation, confirming the δ13C record from the Cango Cave speleothem. There was, however, continued availability of C4 grasses. The faunal community richness is highest for the Boomplaas sequence, indicating the most productive terrestrial environment for the period that the site was occupied (Sealy et al. 2016).

After the Last Glacial Maximum, temperatures increased gradually and environments changed. In the Boomplaas area, for example, the environment became more closed and there was a loss of productive grassland habitats. C4 grasses once more became dominant and the onset of summer drought that persisted into the Holocene took place (Sealy et al. 2016). The Younger Dryas, a short cold spell from ~13.0 to 11.5 cal ka BP that interrupted postglacial warming (Thackeray and Scott 2006), had variable regional climate effects (Fitchett et al. 2017). The Pleistocene/Holocene transition around 12.7 ka BP, as well as the Holocene itself, experienced significant climate fluctuations (e.g. Scott 2016). A cold event at 8.2 ka BP observed in the northern Atlantic is much less detectable in southern Africa, but a cool period is reflected in proxy records from the Cederberg around this time (Fitchett et al. 2017). From the mid-Holocene onwards, conditions became relatively warmer and wetter (Meadows and Quick 2016).

The rise in sea level at the end of the Pleistocene led to a change in resource availability. In the Cape region for example, drier conditions led to a general reduction in grassland availability, resulting in the extinction of the species that would have depended on it (Klein 1983). The extinction of the long-horned buffalo (Syncerus antiquus), Cape zebra (Equus capensis) and possibly the southern Springbok (Antidorcas australis) is broadly correlated with the Pleistocene/Holocene transition, whereas Bond’s springbok (A. bondii), the giant hartebeest (Megalotragus priscus) and a caprine antelope did not become extinct until well into the Holocene (Faith 2014). In the Cape coastal region, subsistence practices changed with greater amounts of shellfish, smaller terrestrial animals, and plant foods such as geophytes, fruits and nuts included in the diet (Mitchell 2013). The better preservation of plant remains in archaeological sites of the mid to late Holocene shows that plants might have been a staple food in the Later Stone Age, and possibly also the Middle Stone Age (Deacon 1993).

Relatively few archaeological sites have been recorded for the Last Glacial Maximum, with a virtual absence of occupation in the interior (Mitchell 2013). This low archaeological visibility continues after 22 ka BP and the Robberg technocomplex appear at only a few sites, for example at Elands Bay Cave, Boomplaas Cave, Nelson Bay Cave and Rose Cottage Cave (Fig. 13.2). The Robberg technocomplex, associated with a microlithic toolkit with small, mostly unre- touched bladelets, is replaced by the Oakhurst technocomplex, characterised by large macrolithic flakes and scrapers, from around 13 ka BP. The transition from the Robberg to the Oakhurst technocomplexes, between ~19 and 10 ka BP, is associated with an increase in sites on the landscape and population expansion into the interior (Wadley 1993). This increase in site density is comparable to that of the Still Bay to Howiesons Poort transition in the Middle Stone Age. The greater density of sites in the Oakhurst is, as in the Howiesons Poort, also accompanied by greater homogeneity in flaking systems (Ryano et al. 2017) and an increase in complex cultural items such as beads in shell and bone, bone points and engraved ostrich eggshell, especially after 10 ka BP (Wadley 1993). Deliberate burials with grave goods further exemplify complexity in social systems and behaviour at this time (Wadley 1993). From 8 ka BP onwards, the Wilton technocomplex with small backed microliths and scrapers replace the Oakhurst, and is found on a similarly extensive geographical scale (Wadley 1993). The transition from the Robberg to the Oakhurst and the Wilton at Nelson Bay Cave and Byneskranskop 1, both in the Cape region, were not synchronous, as demonstrated by recent radiocarbon dates and Bayesian modelled chronologies (Loftus et al. 2016). This underscores the importance of using robust chronological frameworks to model landscape-wide demographic patterns on the basis of lithic technological change.

After 4 ka BP there is again a noticeable increase in site visibility, but this time resulting in a breakdown of homogeneity of lithic assemblages (Lombard et al. 2012) and simplification of lithic flaking systems (Sealy 2016). This is the opposite of the pattern observed for the Howiesons Poort where complexity in lithic assemblages accompanied the increase in site density. This cautions against simply correlating site density with behavioural complexity (Sealy 2016). A significant component of post-22 ka BP assemblages consists of artefacts that, in the Middle Stone Age, are interpreted to reflect complex cultures. Beads made of ostrich eggshell, bone and shell, tortoiseshell bowls, engraved ostrich eggshell, pigments and many formal bone tools including incised points occur in relatively large quantities. The Oakhurst and Wilton layers from Matjes River in the southern Cape, for example, contain such items, as well as ground stone pallettes and upper and lower grindstones,
some of which were used in ochre production (Wadley 1993) (Fig. 13.5). Burials occur regularly from 11 ka BP onwards (Wadley 2015) and are associated with ochre and grave goods, implying complex religious beliefs (Wadley 1993).

### 13.3 Summary

The last 100,000 years in South Africa have seen significant climatic changes, and hunter-gatherer groups flexibly adjusted to and exploited a wide range of environments. Changing conditions must have affected occupation density on a landscape level, connections between groups and their cultural expressions, but available evidence only allows broad patterns to be discerned. The MIS 5 and MIS 3 interglacials with relatively warmer conditions were marked by regionally-confined lithic flaking conventions and comparatively few culturally complex items. In the Howiesons Poort of glacial MIS 4, however, there was an increase in the density of sites in the landscape, homogeneity in lithic flaking systems, and increases in complex behaviours. However, glacial conditions do not always result in this type of archaeological signal in the landscape. The last glaciation between 29 and 14 ka BP is characterised by relatively few sites and more diversity in flaking systems. It is only after 14 ka BP and in the Holocene that population densities increased again, and technocomplexes such as the Oakhurst and Wilton with clear lithic technological similarities can be found across all of South Africa. In these Holocene assemblages, complex cultural items such as beads in ostrich eggshell, bone and shell, engraved ostrich eggshell, tortoiseshell bowls, ochre and many formal bone tools become commonplace. The increase in site density that took place after the Wilton period is associated with a breakdown in cultural homogeneity on a landscape scale. These archaeological trends did not occur exactly in phase with climatic fluctuations, but more detailed high precision temporal frameworks and equal geographical representation of archaeological and other proxy data are needed to understand how climate, environment and past behaviour correlate.

### Acknowledgements

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### References


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**Fig. 13.5** Upper and lower grindstone from the Wilton layers at Matjes River. (Photo: National Museum of Bloemfontein)
Thackeray JF, Fitchett JM (2016) Rainfall seasonality captured in micromammalian fauna in Late Quaternary contexts, South Africa. Palaentol Afr 51:1–9
The Geography of Heritage in South Africa

Clinton D. van der Merwe

Abstract
Heritage tourism scholarship is a growing domain of research in South Africa and with contributions from a range of different academic disciplines, including geography. Heritage tourism was identified early in post-apartheid planning as an important niche for tourism promotion and diversification of product mix, as well as offering unexploited potential for local and regional tourism development. The geography of heritage assets in South Africa is an important, albeit neglected, research topic. This chapter analyses the geography and organisation of heritage assets in South Africa and shows its uneven potential for local and provincial economic development.

Keywords
Heritage · Heritage asset · Heritage tourism · Geography · South Africa

14.1 Introduction
South Africa has an abundance of heritage assets. Some of these assets have been the foundation for the development of heritage tourism, a theme of growing interest to tourism policymakers and tourism geographers. Heritage tourism scholarship is a growing domain of research in South Africa and with contributions from a range of different academic disciplines, including geography (Masilo and van der Merwe 2016; Rogerson and van der Merwe 2016; van der Merwe 2013, 2014; van der Merwe and Rogerson 2013, 2018). This chapter contributes to an expanded geographical understanding of the heritage assets (and by implication, the heritage tourism economy) of South Africa. The focus is upon exploring the definitions of heritage in South Africa; elucidating and discussing the different types of heritage assets in the country, which is anchored upon the definitions provided in the Republic of South Africa’s (RSA) National Heritage Resources Act (NHRA), 25 of 1999; and finally, examining the geographical distribution of heritage assets at a provincial and local level. Within existing heritage scholarship, the mapping out of the spatial distribution of heritage assets as the foundation for heritage tourism in South Africa has so far remained an investigatory void (van der Merwe 2017).

The analysis of the geography of heritage assets in South Africa builds upon the construction of a comprehensive national database of South Africa’s declared heritage sites. Using the South African Heritage Resources Agency (SAHRA) database (SAHRA 2015, 2016a, b), the spatial patterns of heritage assets can be explored in order to highlight the potential implications of heritage tourism for local and regional development in South Africa. Structurally, this chapter falls into three parts, which relate to policy issues, defining heritage assets, and unpacking the geography of heritage in South Africa. The major analysis is based upon the building of a national heritage asset database which differentiates 15 different forms of heritage and with a geographical distribution across South Africa’s 278 local municipalities, and by province.

At the outset, it must be recognised that various policies, at national, provincial and local levels, impact upon and influence heritage assets in South Africa. Since the advent of the democratic South Africa in 1994, cultural and heritage tourism development has been put squarely on the policy agenda (van der Merwe 2016). In relation to this desire to grow the tourism economy, ten key policy documents relating to heritage tourism are identified (Table 14.1), which frame the national landscape of heritage tourism planning and policy in South Africa. Currently, the most significant is the National Heritage and Cultural Tourism Strategy (RSA 2012).
Table 14.1 List of key South African policies which govern and guide heritage assets (in date order)

<table>
<thead>
<tr>
<th>No.</th>
<th>Policy/Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>White Paper on Arts and Culture, 1996 (under revision)</td>
</tr>
<tr>
<td>3.</td>
<td>National Heritage Council Act, No. 11, 1999</td>
</tr>
<tr>
<td>4.</td>
<td>National Heritage Resources Act, No. 25, 1999</td>
</tr>
<tr>
<td>5.</td>
<td>World Heritage Convention Act, No. 49, 1999</td>
</tr>
<tr>
<td>10.</td>
<td>Tourism Act, No. 3 of 2014</td>
</tr>
</tbody>
</table>

14.2 Defining and Demarcating Heritage in South Africa and the National Heritage Asset Base

The SAHRA controls and administers all heritage resources in the country, with each of the country’s nine provinces having a Heritage Resources Agency to administer and govern the protection of heritage sites within the province. It is clearly stated that “SAHRA is a statutory organisation established under the National Heritage Resources Act, No. 25 of 1999, as the national administrative body responsible for the protection of South Africa’s cultural heritage” (SAHRA 2016b). SAHRA has developed the South African Heritage Resources Information System (SAHRIS), which documents and characterises each and every ‘declared’ heritage object or ‘site’ in South Africa (Smuts et al. 2016). SAHRA or any member of the public is eligible to identify places to be declared national heritage sites that are “deemed to have qualities so exceptional that they are of special national significance”. This process includes consultation and public participation, and culminates in the publishing of the National Heritage Status of the site in the Government Gazette. These sites will be marked with a badge or plaque on a building, on site.

The Heritage Resources Management Unit (HRMU) of SAHRA is responsible for the identification, assessment and management of all heritage resources in South Africa (as outlined in the NHRA, 25, 1999). The HRMU aims to reflect and maintain the diverse cultural heritage of South African, multicultural society. “Through multi-stakeholder processes, the Unit ensures that heritage awareness is raised amongst the stakeholders and, particularly, also amongst the public and communities through awareness activities. These activities are held to engage stakeholders, create awareness and educate South Africans on the role of SAHRA in protecting and preserving the heritage, and to position SAHRA as a leader in heritage management” (SAHRA 2016a). Table 14.2 outlines the 15 categories of heritage assets as recognised in South Africa.

14.3 Understanding the Geography of South Africa’s Heritage Asset Base

In understanding the asset base for heritage (in tourism), it is necessary to undertake two levels of analysis, which relate to different categories of heritage tourism assets and attractions. Overall, South Africa’s heritage tourism assets are comprised as follows. First, are those heritage tourism assets as defined in terms of UNESCO inscription as World Heritage Sites. Second, are those which may be styled as ‘second tier’ heritage sites that are defined and recognised by SAHRA.

14.3.1 World Heritage Sites in South Africa

South Africa joined the World Heritage Convention (WHC) on 10 July 1997. The country has nine inscribed World Heritage Sites (WHS) that are key anchors of the heritage tourism economy. According to UNESCO (2016), in order “to be included on the World Heritage List, sites must be of outstanding universal value and meet at least one of ten selection criteria”. World Heritage Sites are broadly divided into three categories: cultural sites; natural sites; and mixed sites. The nine South African World Heritage Sites are categorised into these three groupings in Table 14.3. Figure 14.1 shows the location of these nine WHSs in South Africa.

Beyond these nine designated WHSs there are six other sites that are in early stage of nomination for WHS status. These six potential new WHS and their locations are: Early Farmsteads of the Cape Winelands (Western Cape); Human Rights, Liberation Struggle and Reconciliation: Nelson Mandela Legacy Sites (Gauteng, KwaZulu-Natal, Eastern Cape and Western Cape provinces) – which includes Liliesleaf Farm in Rivonia, Johannesburg (see Fig. 14.2); Liberation Heritage Route (Gauteng, Limpopo, Mpumalanga, Free State, Northern Cape, North West, Eastern Cape, Western Cape and KwaZulu-Natal provinces); Succulent Karoo Protected Areas (parts of South Africa and parts of Namibia); Barberton Mountain Land, Barberton Greenstone Belt or Makhonjwa Mountains (Mpumalanga); and Emergence of Modern Humans: The Pleistocene occupation sites of South Africa (Eastern Cape, KwaZulu-Natal and Western Cape provinces).

The potential inscription of six new WHSs will result in WHS tourism assets being situated across all provinces of South Africa, thus creating opportunities for leveraging of these assets for potential heritage tourism-led regional and local economic development. Of significance is that, of the existing WHS, five are situated in parts of South Africa that are underdeveloped, peripheral and poverty-stricken regions. Specifically, the Cradle of Humankind (see Fig. 14.3), Mapungubwe, Maloti–Drakensberg, iSimangaliso Wetlands, and the Khomani Cultural Landscape all fall into what is
Table 14.2 Types of heritage in South Africa

<table>
<thead>
<tr>
<th>Type of heritage</th>
<th>Brief definition</th>
</tr>
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<tbody>
<tr>
<td>Archaeological</td>
<td>Any material remains from human activity (in a state of disuse), in or on land that is older than 100 years, including artefacts, human and hominid remains and artificial features and structures</td>
</tr>
<tr>
<td>Battlefield(s)</td>
<td>The site(s) where a significant battle took place, marked and recorded in history, which battlefield, cultural or heritage tourists would visit</td>
</tr>
<tr>
<td>Buildings</td>
<td>Any physical structure older than 60 years in age</td>
</tr>
<tr>
<td>Burial grounds and graves</td>
<td>Places of interment, including the contents, headstone or other marker of such a place, and/or structures on or associated with such a place</td>
</tr>
<tr>
<td>Cultural significance (landscape)</td>
<td>A place of aesthetic, architectural, historical, scientific, social, spiritual, linguistic, or technological value or significance</td>
</tr>
<tr>
<td>Heritage objects/sites</td>
<td>Any movable property of cultural significance, which may be protected, such as: any archaeological artefact; palaeontological or rare geological specimens; meteorites or any other artefact of heritage or cultural significance</td>
</tr>
<tr>
<td>Heritage resources</td>
<td>Any artefacts or place of historical, cultural or heritage significance</td>
</tr>
<tr>
<td>Living heritage</td>
<td>Any intangible aspects of inherited culture – including: cultural tradition(s); oral history; performance; ritual(s); popular memory; skills and techniques; indigenous knowledge systems (IKS); and, the holistic approach to nature, society and social relationships</td>
</tr>
<tr>
<td>Meteorite</td>
<td>Any naturally occurring object of extra-terrestrial origin</td>
</tr>
<tr>
<td>Palaeontological</td>
<td>Any fossilised remains or fossil trace of animals or plants, which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial uses, and any sites, which includes such fossilised remains or trace</td>
</tr>
<tr>
<td>Place</td>
<td>Any site, area, region, a building or other structure, which may include equipment, furniture, fittings and articles associated or connected with heritage and culture. A group of buildings associated with heritage and culture; an open space, including a public square, street or park. This includes the management of a place and the immediate surroundings of that place</td>
</tr>
<tr>
<td>Public monuments and memorials</td>
<td>All monuments and memorials – erected on land belonging to any branch of government; or an organisation funded by any branch of government; or which were paid for by public subscription, government funds, public-spirited or military organisation; or land belonging to any private individual</td>
</tr>
<tr>
<td>Rock art</td>
<td>Any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, including any area within 10 m of such a representation</td>
</tr>
<tr>
<td>Structure</td>
<td>Any bridge, building, works, device, or other facility made by people and is fixed to land, including any fixtures, fittings and equipment associated with heritage and culture</td>
</tr>
<tr>
<td>Wrecks</td>
<td>Any vessel or aircraft (or any part thereof) which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or maritime culture zone of South Africa, which is older than 60 years or which SAHRA deems worthy of conservation; feature, structures and artefacts associated with military history which are older than 75 years; and, the sites on which they are found</td>
</tr>
</tbody>
</table>

From van der Merwe (2017)

Table 14.3 World heritage sites in South Africa, by category

<table>
<thead>
<tr>
<th>Cultural sites</th>
<th>Natural sites</th>
<th>Mixed sites</th>
</tr>
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<tbody>
<tr>
<td>Fossil Hominid Sites of South Africa (Gauteng, Limpopo and North West provinces)</td>
<td>iSimangaliso Wetland Park (KwaZulu-Natal)</td>
<td>Maloti–Drakensberg Park (KwaZulu-Natal, shared with Lesotho)</td>
</tr>
<tr>
<td>Robben Island (Western Cape)</td>
<td>Cape Floral Region Protected Areas (Western Cape)</td>
<td></td>
</tr>
<tr>
<td>Mapungubwe Cultural Landscape (Limpopo)</td>
<td>Vredefort Dome (North West and Free State provinces)</td>
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<tr>
<td>Richtersveld Cultural and Botanical Landscape (Northern Cape)</td>
<td></td>
<td></td>
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<tr>
<td>The Khomani Cultural Landscape (Northern Cape), shared with Namibia and Botswana</td>
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</table>

classified as the ‘distressed areas’ of South Africa, which currently are the major focus of national government initiatives for promoting economic development.

14.3.2 National and Provincial Heritage Sites in South Africa

Inclusive of the nine WHSs, South Africa currently has a total of 51,911 heritage (sites or objects) assets, which are listed by SAHRS. This total, however, includes a myriad of artefacts, stored in a particular place, within South Africa or abroad (SAHRA 2015); of these ‘sites or objects’, only 26,467 of the sites are publically listed on the SAHRIS database. The rest (many of which are objects) are kept confidential for conservation and protection purposes (most are sites of significant rock art) (Jackson 2016). Of the 51,911 identified and classified heritage sites in South Africa, analysis of the SAHRIS database (in July 2016) reveals that only 2824
Fig. 14.1  The location of South Africa’s nine World Heritage Sites

Fig. 14.2  Liliesleaf Farm, a national heritage site, in Rivonia, Johannesburg, South Africa. (Photo: Clinton van der Merwe)
are graded and declared as national or provincial heritage sites. In addition, there are 654 further sites on the heritage register, which have been nominated for heritage status by the provinces, but are still in the process of being assessed by SAHRA before grading or declaration is finalised.

Table 14.4 shows the numbers of each of the national and provincial declared heritage sites for the 15 different categories of heritage in South Africa. It is evident from Table 14.4 that overwhelmingly the largest group of sites are buildings, which represent 91.6% of the total of national and provincial heritage sites. The next most significant categories of heritage assets are those which SAHRA classifies variously as archaeological (2%), burial grounds and graves (1.9%), cultural significance (landscape) (1.4%), places (1.2%), paleontological (0.7%), battlefields (0.3%), and ‘others’ (0.6%) (Table 14.4). The geographical distribution of these national and provincial heritage assets will now be examined from a provincial and then local level of analysis.

14.4 Provincial Geography of Heritage in South Africa

As has been pointed out, each of the nine provinces has a provincial heritage authority and has the mandate of nominating potential sites for classification and then ultimately, declaration as national or provincial heritage sites. In addition, in terms of tourism promotion in South Africa, the provinces enjoy considerable power, which is exercised through the operations of provincial tourism authorities. An uneven geography of heritage tourism assets on a provincial basis is shown in Table 14.5. It is evident that in terms of the classification of national and provincial heritage sites, the provinces that have the greatest assets and opportunities for heritage tourism are the Western Cape, Eastern Cape and KwaZulu-Natal. Taken together, these three provinces account for 77.4% of all declared national and provincial heritage sites. By contrast, the provinces of Mpumalanga, Limpopo and North West have only a total of 132 sites or 4.7% of the national total. Each province therefore has a set of distinctive heritage tourism assets that offers potential opportunities for leveraging of tourism development.

At the provincial level of analysis, in terms of the different categories of heritage assets, the nine provinces have different asset bases (van der Merwe 2017). Of note is the large numbers of significant heritage buildings in the Western Cape, followed by the Eastern Cape and KwaZulu-Natal. In terms of archaeological sites, KwaZulu-Natal is most significant, followed by Free State, Limpopo, Western Cape and Gauteng. In the category of battlefields (see Fig. 14.4), Free State and KwaZulu-Natal are the most significant; in the cat-
category of burial grounds and graves, it is the Western Cape, KwaZulu-Natal and the Free State; in the category of cultural landscapes, it is the Western Cape and KwaZulu-Natal; and in the category of places (where specific areas of a particular town or city is of special cultural and heritage significance), it is KwaZulu-Natal, the Free State and Gauteng. Many provincial heritage authorities have registered several heritage sites (currently on the national heritage register) for consideration to grading and declaration as either national or provincial heritage sites, or both.

### Table 14.4  Heritage sites in South Africa, by category

<table>
<thead>
<tr>
<th>Type of heritage</th>
<th>National Heritage Sites</th>
<th>Provincial Heritage Sites</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archaeological</td>
<td>12</td>
<td>45</td>
<td>57</td>
</tr>
<tr>
<td>Battlefield(s)</td>
<td>0</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Buildings</td>
<td>25</td>
<td>2563</td>
<td>2588</td>
</tr>
<tr>
<td>Burial grounds and graves</td>
<td>12</td>
<td>43</td>
<td>55</td>
</tr>
<tr>
<td>Cultural significance (landscape)</td>
<td>1</td>
<td>39</td>
<td>40</td>
</tr>
<tr>
<td>Heritage objects/sites</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Heritage resources</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Living heritage</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Meteorite</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Paleontological</td>
<td>5</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>Place</td>
<td>5</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>Public monuments and memorials</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Rock art</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Structure</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Wrecks</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>63</td>
<td>2761</td>
<td>2824</td>
</tr>
</tbody>
</table>

Based on SAHRA (2016a); data correct as of 3 July 2016

### Table 14.5  Declared National and Provincial Heritage Sites, by province

<table>
<thead>
<tr>
<th>Province</th>
<th>Number of National Heritage Sites</th>
<th>Number of Provincial Heritage Sites</th>
<th>Total</th>
<th>% of heritage sites in SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauteng</td>
<td>19</td>
<td>165</td>
<td>184</td>
<td>6.5</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>0</td>
<td>52</td>
<td>52</td>
<td>1.8</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>1</td>
<td>256</td>
<td>257</td>
<td>9.1</td>
</tr>
<tr>
<td>North West</td>
<td>4</td>
<td>51</td>
<td>55</td>
<td>1.9</td>
</tr>
<tr>
<td>Limpopo</td>
<td>2</td>
<td>23</td>
<td>25</td>
<td>0.9</td>
</tr>
<tr>
<td>Western Cape</td>
<td>30</td>
<td>1305</td>
<td>1335</td>
<td>47.3</td>
</tr>
<tr>
<td>Free State</td>
<td>2</td>
<td>148</td>
<td>150</td>
<td>5.3</td>
</tr>
<tr>
<td>Eastern Cape</td>
<td>4</td>
<td>589</td>
<td>593</td>
<td>21.0</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>1</td>
<td>172</td>
<td>173</td>
<td>6.2</td>
</tr>
<tr>
<td>South Africa</td>
<td>63</td>
<td>2761</td>
<td>2824</td>
<td>100%</td>
</tr>
</tbody>
</table>

Based on SAHRA (2016a); data correct as of 3 July 2016

14.5  The Local Geography of Heritage in South Africa

This section outlines issues relating to the local development potential of heritage tourism assets. The distribution of heritage assets is examined first across the different levels of the South African urban hierarchy or settlement system. Specifically, a differentiation is made between the groups of (1) the country’s eight metropolitan areas (Tshwane, Johannesburg, Ekurhuleni, eThekwini, Cape Town, Mangaung, Buffalo City, and Nelson Mandela Bay); (2) its 22 second tier or secondary cities as defined by the South African Cities Network (SACN 2012); and (3) the country’s remaining small towns and rural areas.

Table 14.6 shows the aggregate results of the distribution of heritage assets across different levels of the urban hierarchy in the South African settlement system. It is evident that the largest share of heritage assets is located across the small towns and rural areas of South Africa, which account for almost 50% of the total heritage assets in the country. The cities of South Africa account for the other half of heritage assets with a larger proportion in metropolitan areas (31.8%), than in the group of secondary cities (18.6%). Table 14.7 gives details on heritage assets on an individual municipal
The results provide important signals for local municipalities, in terms of seeking to utilise heritage tourism assets to expand local tourism economies, and potentially for local/urban economic development opportunities. Several key points are highlighted. First, heritage assets are strongly concentrated in a relatively small number of locations in South Africa. The leading 12 local municipalities account for 1621 heritage assets or 57% of the national total. Second, is the national dominance in terms of heritage assets by the City of Cape Town, which accounts for 20.5% of the total national and provincial heritage assets, affording it major opportunities to leverage for growing a heritage tourism niche. Other metropolitan areas with significant heritage assets are Johannesburg, Nelson Mandela Bay (Port Elizabeth), Tshwane (Pretoria), eThekwini (Durban) and Mangaung (Bloemfontein). Third, is the importance of heritage tourism assets in both a number of South Africa’s secondary cities and small towns, in particular Stellenbosch, Paarl, Kimberley and Pietermaritzburg. Outside of these cities, significant heritage tourism assets are present in the small towns of Graaff-Reinet and Grahamstown (Eastern Cape), and Swellendam and Tulbagh (Western Cape). Strong heritage assets in these secondary cities and small towns create a solid foundation for opportunities to be leveraged for local tourism development and local economic development.

In providing a wider geographical picture of the heritage asset bases of South Africa, Fig. 14.5 seeks to capture the national situation. It demonstrates two critical themes. First, is that taken together with the geographical distributions of WHSs (existing and proposed), there are opportunities for heritage tourism development across most parts of South Africa. Nevertheless, these opportunities are clearly uneven in terms of individual assets. Much greater potential exists for developing a growing heritage tourism base around

### Table 14.6 Heritage assets in South Africa 2016, differentiated by level and settlement hierarchy

<table>
<thead>
<tr>
<th></th>
<th>Metropolitan municipalities</th>
<th>Secondary cities</th>
<th>Towns, small towns and rural areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Heritage Sites: 63 sites</td>
<td>14 sites 22.2%</td>
<td>33 sites 52.4%</td>
<td>16 sites 25.4%</td>
</tr>
<tr>
<td>Provincial Heritage Sites: 2761 sites</td>
<td>883 sites 31.9%</td>
<td>493 sites 17.9%</td>
<td>1385 sites 50.2%</td>
</tr>
<tr>
<td>Total – 2824 sites</td>
<td>897 sites 31.8%</td>
<td>526 sites 18.6%</td>
<td>1401 sites 49.6%</td>
</tr>
</tbody>
</table>

Based on SAHRA (2016a, b)
### Table 14.7 Top 30 individual places ranked by number of heritage assets

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Major centre</th>
<th>NHS</th>
<th>PHS</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Cape Town</td>
<td>Cape Town</td>
<td>5</td>
<td>573</td>
<td>578</td>
<td>20.5</td>
</tr>
<tr>
<td>Camdeboo</td>
<td>Graaff-Reinet</td>
<td>5</td>
<td>242</td>
<td>247</td>
<td>8.6</td>
</tr>
<tr>
<td>Stellenbosch</td>
<td>Stellenbosch</td>
<td>1</td>
<td>171</td>
<td>172</td>
<td>6.1</td>
</tr>
<tr>
<td>Drakenstein</td>
<td>Paarl</td>
<td>21</td>
<td>129</td>
<td>150</td>
<td>5.3</td>
</tr>
<tr>
<td>Makana</td>
<td>Grahamstown</td>
<td>0</td>
<td>83</td>
<td>83</td>
<td>2.9</td>
</tr>
<tr>
<td>City of Johannesburg</td>
<td>Johannesburg</td>
<td>5</td>
<td>76</td>
<td>81</td>
<td>2.9</td>
</tr>
<tr>
<td>Nelson Mandela Bay</td>
<td>Port Elizabeth</td>
<td>0</td>
<td>80</td>
<td>80</td>
<td>2.8</td>
</tr>
<tr>
<td>Witzenberg</td>
<td>Tulbagh</td>
<td>0</td>
<td>73</td>
<td>73</td>
<td>2.6</td>
</tr>
<tr>
<td>City of Tshwane</td>
<td>Pretoria</td>
<td>2</td>
<td>65</td>
<td>67</td>
<td>2.4</td>
</tr>
<tr>
<td>Sol Plaatje</td>
<td>Kimberley</td>
<td>0</td>
<td>58</td>
<td>58</td>
<td>2.1</td>
</tr>
<tr>
<td>eThekwini</td>
<td>Durban</td>
<td>0</td>
<td>54</td>
<td>54</td>
<td>1.9</td>
</tr>
<tr>
<td>Swellendam</td>
<td>Swellendam</td>
<td>0</td>
<td>50</td>
<td>50</td>
<td>1.8</td>
</tr>
<tr>
<td>The Msunduzi</td>
<td>Pietermaritzburg</td>
<td>0</td>
<td>48</td>
<td>48</td>
<td>1.7</td>
</tr>
<tr>
<td>Buffalo City</td>
<td>East London</td>
<td>1</td>
<td>45</td>
<td>46</td>
<td>1.6</td>
</tr>
<tr>
<td>Langeberg</td>
<td>Montagu</td>
<td>0</td>
<td>43</td>
<td>43</td>
<td>1.5</td>
</tr>
<tr>
<td>Mangaung</td>
<td>Bloemfontein</td>
<td>2</td>
<td>32</td>
<td>34</td>
<td>1.2</td>
</tr>
<tr>
<td>Breede Valley</td>
<td>Worcester</td>
<td>0</td>
<td>32</td>
<td>32</td>
<td>1.1</td>
</tr>
<tr>
<td>Prince Albert</td>
<td>Prince Albert</td>
<td>0</td>
<td>30</td>
<td>30</td>
<td>1.1</td>
</tr>
<tr>
<td>George</td>
<td>George</td>
<td>0</td>
<td>28</td>
<td>28</td>
<td>1.0</td>
</tr>
<tr>
<td>Tlokwe City Council</td>
<td>Potchefstroom</td>
<td>0</td>
<td>25</td>
<td>25</td>
<td>0.9</td>
</tr>
<tr>
<td>Oudtshoorn</td>
<td>Outshoorn</td>
<td>0</td>
<td>23</td>
<td>23</td>
<td>0.8</td>
</tr>
<tr>
<td>Kopanong</td>
<td>Philipolis</td>
<td>0</td>
<td>19</td>
<td>19</td>
<td>0.7</td>
</tr>
<tr>
<td>Ndlambe</td>
<td>Port Alfred</td>
<td>0</td>
<td>19</td>
<td>19</td>
<td>0.7</td>
</tr>
<tr>
<td>Umsobomvu</td>
<td>Colesberg</td>
<td>0</td>
<td>19</td>
<td>19</td>
<td>0.7</td>
</tr>
<tr>
<td>Dihlabeng</td>
<td>Bethlehem</td>
<td>0</td>
<td>18</td>
<td>18</td>
<td>0.6</td>
</tr>
<tr>
<td>Umtsheni</td>
<td>Estcourt</td>
<td>0</td>
<td>18</td>
<td>18</td>
<td>0.6</td>
</tr>
<tr>
<td>Amahlati</td>
<td>Cathcart</td>
<td>0</td>
<td>17</td>
<td>17</td>
<td>0.6</td>
</tr>
<tr>
<td>Blue Crane Route</td>
<td>Somerset East</td>
<td>0</td>
<td>17</td>
<td>17</td>
<td>0.6</td>
</tr>
<tr>
<td>Cederberg</td>
<td>Clanwilliam</td>
<td>0</td>
<td>16</td>
<td>16</td>
<td>0.6</td>
</tr>
<tr>
<td>Swartland</td>
<td>Malmesbury</td>
<td>0</td>
<td>16</td>
<td>16</td>
<td>0.6</td>
</tr>
<tr>
<td>Sub-total</td>
<td></td>
<td>42</td>
<td>2119</td>
<td>2161</td>
<td>76.5%</td>
</tr>
<tr>
<td>Other places in SA</td>
<td></td>
<td>21</td>
<td>642</td>
<td>663</td>
<td>23.5%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>63</td>
<td>2761</td>
<td>2824</td>
<td>100%</td>
</tr>
</tbody>
</table>

*NHS National Heritage Site, PHS Provincial Heritage Site*

### 14.6 Summary

The most critical policy foundations for shaping the directions of national heritage tourism in South Africa are the National Heritage Resources Act of 1999, the National Tourism Sector Strategy of 2011, and the landmark National Heritage and Cultural Tourism Strategy of 2013. Different types of heritage assets exist in South Africa, which are rooted upon the definitions in the National Heritage Resources Act. The country’s existing and potential World Heritage Sites are core to South Africa’s heritage tourism economy, especially in an international context. The geographical distributions of national and provincial heritage assets are highly uneven, suggesting there are mixed levels of opportunity for heritage tourism to be a lever for tourism and economic development, between the country’s nine provinces; between metropolitan areas, secondary cities and small towns/rural areas; and for regional and local development, in particular in the country’s distressed areas (van der Merwe 2017). It can be concluded that South Africa’s heritage asset base needs to be more strategically managed, segmentally marketed, and sustainably utilised for economic development success.
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Fig. 14.5 Number of heritage sites per local municipality (LM) in South Africa
Agriculture and Agrarian Change in South Africa

Stephen Greenberg

Abstract
South Africa is a dry country with limited arable potential. Commercial agriculture is found in pockets on the central Highveld, and in smaller pockets in KwaZulu-Natal and Western Cape provinces. Ecosystems have contributed to shaping settlement and transport patterns, but so has politics, especially in the form of spatial segregation associated with apartheid. Farming and agro-food systems are increasingly concentrated and centralised under corporate-financial control. Deregulation and liberalisation have consolidated these trends. This has produced some winners (e.g. capital intensive export-oriented horticulture) and some losers (e.g. indebted family farmers in low value bulk commodity crops). Farm worker numbers have dropped sharply and workers are fragmented and differentiated in new ways. A small layer of black commercial farmers has arisen over recent years but these are still economically weak in comparison with their large-scale white counterparts. A broad periphery of food producers mostly located in the former homelands receives limited support. Land reform and agriculture have been connected in programming, but around a commercial agenda.

Keywords
Agrarian change · Commercial agriculture · Farm workers · Land reform · Smallholders · South Africa

15.1 Introduction
This chapter covers contemporary agriculture and agrarian change in South Africa. It includes discussion on production trends and scale, food system interconnections and spatial dimensions, and follows Cousins’ (2014) distinction between small-scale and smallholder farmers. Agriculture refers to the production of food, feed and fibre materials directly from the earth. Agrarian change refers to changing structures of production and settlement in the countryside. In a co-production with the non-human natural environment (Goodman 1999; Lefebvre 1991; Moore 2015), historically embedded material and social infrastructures shape spatial production and settlement patterns and trajectories, and South Africa is a good example of these principles in action.

Agriculture and its form in the agrarian structure is part of a broader food system. Agricultural production has industrial linkages backwards (inputs) and forwards (outputs). This is structured within an increasingly financially-driven global corporate food regime (Bernstein 2015; Chemnitz et al. 2017; ETC Group 2017; Friedmann and McMichael 1989; McMichael 2009), of which South Africa is a conduit.

South Africa’s contemporary agrarian structure and agriculture are built on sharp inequalities in access to land and dispossession. Land redistribution for settlement and production and tenure security are political issues with significant resonance, and are required to move South Africa’s economy off the base of dispossession and rebalance it on principles of justice, cooperation and solidarity. The chapter considers existing land reform as a means to deliberately alter the agrarian structure with greater equity in the distribution of land and economic assets as a primary goal. The required land redistribution has geographical implications in the form of spatial restructuring in rural economies and must occur in the context of a corporate-dominant agro-food system. Ecological dimensions of agrarian change in South Africa are discussed in brief, particularly in relation to climate change and the implications for agriculture and the agrarian structure in South and southern Africa. The chapter concludes with a brief summary and outlook.
15.2 Background to South African Agriculture and the Agrarian Structure

In the era up to the discovery of gold in 1884 there was some farming in South Africa for export in a colonial relationship with the British metropole. Products included wheat and wine from the Western Cape, some sheep, and sugar from what is now KwaZulu-Natal Province. After the discovery of gold, mining was at the centre of the economy. This generated a number of support requirements including energy and food. This led to the rise of maize in South African agriculture (Bernstein 2004; Legassick 1977) and the development of a grain–livestock complex at the centre of the agricultural system from the 1940s onwards. This was similar to the hegemonic United States’ model of national agricultural systems (see Friedmann 1993). In the same period, manufacturing including agro-processing developed in South Africa. Over time, South Africa shifted from a colonial outpost to integration as a node or hub in global circuits of capital.

South Africa is overall a dry country with large semiarid areas in most of the centre and west (Fig. 15.1). There is a small amount of good arable land in South Africa, generally accepted to be around 10–11% of the total land area (see Cowling 1991; World Bank 2017). The central plateau (Highveld) is at the core of commercial cropland and the grain–livestock complex, extending along the eastern escarpment to the KwaZulu-Natal coastal belt, with big pockets of commercial cropland in the Western Cape and smaller scattered pockets in the Eastern Cape. The Cape core is composed of high value irrigated crops (horticulture and some field crops). Grassland and wooded savannah ecosystems surround commercial cropland on the Highveld. These ecological regions are amenable to extensive livestock (open grazing).

Fig. 15.1 Ecosystems of South Africa. (Source https://www.lib.utexas.edu/maps/south_africa.html)
The impact of climate change in southern Africa is a tendency towards longer dry spells and drought, with less rainfall predictability. Under these conditions, harder crops and species will be favoured, with a movement from crops to livestock to game. The commercial agro-food system plays a big role in greenhouse gas emissions, including nitrogen release in crop production, methane from livestock, and transport in the food system (GRAIN 2011; Vermeulen et al. 2012). On the other hand, agriculture has a potentially central role in climate change mitigation. Photosynthesis in plants is a major source of carbon extraction from the atmosphere. Therefore, abundance of plant life, especially forests, is a key priority in absorbing excess carbon.

Sustainability requires a transition in commercial agriculture and agro-food systems. According to Wilson (2008), there is a significant role for ‘large, economically buoyant farms’ in shifting to more multifunctional and ecologically embedded landscapes and systems. Stewardship of the land is still a recognised function of the farmer more generally. Incentives could be developed to encourage such a shift. Drought tolerance is a key research and development priority, although larger systemic issues of reducing greenhouse gas emissions especially from the industrial production system at a global level need to be addressed first. There are also new pests (e.g. fall army worm that ravaged southern African maize and other grain crops in 2016–2017) and diseases. Centralised research and development is not conducive to context-specific responses to climate and ecological threats. This requires greater decentralisation and participation of producers.

Figure 15.1 shows a geographical relationship between areas of extensive cropland use and national urban centres: Johannesburg–Pretoria (Gauteng city region), Cape Town, Durban–Pietermaritzburg, and to a lesser extent Nelson Mandela Bay (Port Elizabeth in Fig. 15.1) in the Eastern Cape. Land for settlement was selected historically partly for agricultural production potential. Certainly at a local level, agricultural production potential strongly influenced the location of district and regional service centres. National centres had wider strategic importance (minerals, ports). However, agricultural production played a role and these centres also shaped the spatial development of commercial agriculture for supply. Fresh produce including fruit and vegetables, dairy, poultry and large-scale commercial, intensive livestock feedlots are located close to the urban centres or along major transport corridors.

Boundaries between land use zones (extensive livestock, crop production and urban) are dynamic, adjusting over time depending on various markets, production options and ecological changes. Markets include finance and property. For example, Tongaat Hulett in KwaZulu-Natal is one of the three dominant sugar corporations operating in southern Africa. It is in possession of large amounts of high value land along the KwaZulu-Natal coast. This constitutes a big share of arable land in the country as a whole. Tongaat Hulett has become a property development company, converting some of the land into urban development because there are greater returns on that activity. This is a highly profitable arm of the business, generating over R1 billion in 2014 (Tongaat Hulett 2014). This is an example of private decisions being made about the use of scarce arable land, which is a national asset. This land will be destroyed irretrievably, altering the agrarian structure with ripple effects into farming communities, and reshaping ecological boundaries.

The current agrarian and agricultural structure in South Africa is still essentially based on old apartheid divisions, with white-owned commercial farms dominating the landscape, and impoverished black farming still concentrated in the former homeland areas (Fig. 15.2). Under apartheid, the homelands were the only parts of the country where black people were allowed to attain property rights (even though these were more constrained than title deeds and full freedom). There has been some expansion after democratisation in 1994 of black settlement and production into formerly ‘white’ areas through freedom of movement, private market land transfers and land reform.

15.3 Commercial Farming

White commercial large-scale farmers were a core political constituency for the National Party under apartheid. Commercial farmers received a high level of government support including subsidies for production and controlled marketing arrangements that ensured their profitability (Bayley 2000; World Bank 1994). In the 1980s, as South Africa entered into an organic crisis (Gelb 1991), a programme of restructuring and liberalisation took place (Bayley 2000). Export-oriented commercial farmers pushed for liberalisation while their poorer subsidised and credit-dependent relatives producing bulk commodities for domestic markets were marginalised. The number of commercial farming units in South Africa peaked at the start of the 1950s at 117,000 (Marcus 1989). After this time, the number of producers declined as farms were consolidated into fewer, larger units. This accelerated following a wave of mechanisation especially in grain production in the 1970s (de Klerk 1984). This process of concentration saw the fusion of capital into agribusinesses that linked upstream and downstream activities with production (Bernstein and Amin 1995). Agro-processing came to constitute a quarter of industrial production in South Africa (DACST 1999). Similar processes of concentration and centralisation were replicated in agro-processing, and food manufacturing and distribution. At the end of formal apartheid in 1994, there were around
60,000 commercial farming units, with high levels of corporate concentration throughout the agro-food system.

Agricultural deregulation and liberalisation had started in the 1970s and gathered pace throughout the 1980s with privatisation, transfer of state regulatory functions to commercial self-regulation, and dismantling of restrictive marketing channels (Bayley 2000; World Bank 1994). These were context-specific developments but were moulded into the framework of the World Trade Organisation (WTO) Agreement on Agriculture, which was launched in 1995 with South Africa as a party. The Marketing of Agricultural Products Act of 1996 introduced a radical restructuring of the institutional and political architecture of commercial agro-food system governance, production and distribution. Over the next decades, the impacts rippled through the agro-food system. Key features include increasing concentration and centralisation in livestock, horticulture and field crops alike; greater power and control to corporate food retailers; an increasing reliance on high value fruit and wine exports to maintain a positive agricultural trade balance; and more recently investment out of South Africa, and increasing foreign ownership and financialisation of the commercial food system (Greenberg 2017).

Commercial agricultural production was valued at R247 billion in 2015 (DAFF 2017). It is responsible for around 93% of total farm output (including small and subsistence farming, discussed below). The grain–livestock complex remains at the centre of the agro-food system. Poultry products (meat and eggs), cattle (meat and milk) and maize combined constituted 50% of the total value of commercial production in 2014 (Greenberg 2017). Beyond this, the grain–livestock complex extends upstream (animals purchased, animal feed, commercial seed, a large share of fertiliser and machinery). Downstream, it extends into grain storage and handling, processing and further value addition, and also has numerous connections into other agricultural products (e.g. soya, and molasses from sugar into animal feed). These all add to its economic weight.

South Africa is generally food self-sufficient, with a positive balance of trade in agricultural products. Horticulture...
and wine mainly from the Western Cape are key exports, standing at 43% of agricultural export value in 2016 (DAFF 2017, p. 81). An estimated 67% of South Africa’s land surface is considered commercial farmland – over a third of this is in the arid Northern Cape. These are mainly white commercial farmers although approximately 10% (7.95 million hectares) of commercial farmland has been transferred to black owners through land reform (PLAAS 2013).

There are approximately 210,000 commercial producers in total in South Africa. There are an estimated 40,000 mainly white commercial producers, according to the 2007 Census of Agriculture (StatsSA 2010, p. 10). This may be an underestimate, but there are also long term processes of consolidation of farm units as marginal farmers leave the business, and the Census is already 10 years old. This group of farmers can be divided into a concentrated core, and a wider commercial periphery (Fig. 15.3). Liebenberg (2013, p. 28) indicated that just 0.6% of commercial farming units (237 units) accounted for a third of total income in 2007. This can be compared with the top 5% of farms accounting for 10% of income in 1993, showing increasing concentration. Also using 2007 Census of Agriculture data, Kirsten (2011) indicated that 57% of commercial farmers had an annual gross income of R500,000 or less, and just 7% of all commercial farm units had a gross income of R5 million or more.

If we draw a fairly arbitrary line at 500 large-scale commercial enterprises as a core, this leaves a commercial periphery amongst these mostly white owned farming units of probably more than 39,500. To this number we should add a few hundred or few thousand larger black commercial farmers and around 167,000 black (commercial) smallholder households (i.e. those who farm for a main or extra source of income) (Aliber and Mendoza 2014, p. 1). The majority of farming units in this commercial periphery are small enterprises constructed around families. The commercial periphery generates an estimated 48% of the total value of production (Fig. 15.3). An upper and lower limit can then be put to the definition of the commercial periphery based on annual turnover adjusted for inflation. This will give a very different geographical and spatial picture, with more commercial activity identified in and around the former homelands alongside the ‘traditional’ commercial farming areas. Within this category there are differentiated support requirements and priorities (especially racial and gender redress).

Farm workers historically and today are a very exploited and marginalised section of the South African workforce. There has been an overall sharp decline in the number of workers on commercial farms from a peak of over 1.6 million workers (permanent and temporary) in 1970 (DAFF 2017) to approximately 480,000 in 2014 (Visser and Ferrer 2015). One cause is adoption of mechanisation and other technologies (de Klerk 1984; Marcus 1989). This has led to greater differentiation in the labour force, between a relatively skilled core of workers focused on processing, machine operation and management; and a wider periphery of increasingly precarious casual and seasonal workers with generally poor labour conditions and remuneration. Management was also divided between
‘neo-paternalist’ and neo-apartheid relationships on family farms, and an increasingly corporate industrial relations framework on industrial farms and amongst skilled workers (Du Toit 1993; Du Toit and Ally 1993; Ewert and Hamann 1999; Human Rights Watch 2011; Visser and Ferrer 2015).

Processes of deregulation and liberalisation were followed by relative stagnation in productivity and physical production per capita in commercial agriculture, a strong shift from field crops towards horticulture measured in value of output, a rise in the contribution of processed over unprocessed exports (Vink and van Rooyen 2009), and economic diversification including into agro-processing and out of agriculture (Genis 2015). With political liberalisation from the early 1990s, labour legislation was extended to farms for the first time in the form of the Agricultural Labour Act in 1993 which applied the Basic Conditions of Employment Act, and the Labour Relations Act, to farm workers. The Extension of Security of Tenure Act and the Land Reform (Labour Tenants) Act, both passed in 1996, sought to secure tenure and land rights for farm dwellers on commercial farms. However, there were loopholes allowing farmers to retrench workers for operational reasons determined by employers. Permanent tenure rights were only established after long service.

The combination of these laws, with global competitive pressures mounting, led to a wave of pre-emptive evictions, the destruction of farm dweller housing, the movement of farm workers and dwellers off the farms and into increasingly concentrated ‘informal’ settlements around towns and along transport corridors. Inhabitants adopted multiple strategies to secure livelihoods and household reproduction, and farm working as a distinct identity is now becoming more poorly defined (Visser and Ferrer 2015). There is a high amount of surplus labour (high unemployment) and job competition, so wages and returns on economic activity are very low. Government support to farm dwellers’ tenure claims was limited in practice and inspection and regulatory bodies were under-resourced and reactive. By 2004, more farm dwellers had lost access to land than people who had benefited from the entire post-1994 land reform programme (Wegerif et al. 2005).

Commercial agriculture is bound into the broader food and economic system especially through retailer-driven corporate value chains. There are pockets of concentrated power and control in food retail, industrial food manufacturing, feedlots, grain trading and processing, commercial seed and fertiliser, agricultural machinery and others, with the heavy hand of global finance capital looming over them all (ETC Group 2017; Greenberg 2017; Isakson 2013). The extent of agricultural commercialisation is unique in southern Africa. The commercial South African agro-food system is integrated into global value chains, and is expanding into the wider region from input supply and finance through to retail.

In agriculture maize, soya, animal feed, poultry and sugar are key sectors.

15.4 Small-Scale Farming and Land Reform

There is a gradual transition from the commercial periphery into semi-subsistence production, small backyard plots and kitchen gardens, in both urban and rural areas. This wider agricultural periphery is composed primarily of an estimated 2.3 million mainly black households who farm for an extra or main source of food (Aliber and Mdoda 2014, p. 1). They are located mainly in and around the former homelands and are the product of deliberate restriction, marginalisation and underinvestment in colonial and apartheid times. Semi-subsistence food producers are undertaking some agricultural production (crops and livestock) mainly for their own use with occasional surpluses being sold. They do not directly produce all their own household food requirements, necessitating food purchase or exchange. They are hence integrated into the cash economy. There is some arable land in the former homelands, but there is little or no investment in production in conditions of widespread asset poverty.

Historically, black smallholder farmers out-produced white farmers (Bundy 1988) before their production was restricted, their control over land reduced and denied, and preferential government support provided to white farmers, including control over land occupied by black farming families, and the construction of segregated (white) commercial farming and African locations. Homelands were theorised within apartheid discourse as places where a reserve army of labour could be kept to be drawn on as needed by white industry, and in the meantime inhabitants should produce some food for their own needs (Letsoalo 1987; Morris 1976; Wolpe 1972). However, deliberate lack of investment resulted in a growing social crisis in these areas. In response, in the 1950s, the government launched the Tomlinson Commission which proposed the creation of a smallholder commercial farming class to sustain livelihoods in the reserves and to establish a class buffer for the white state. In the following decades, the Commission’s findings and recommendations were selectively and unevenly implemented in the homelands. In the 1980s, this took the form of the farm support programme led by the Development Bank of Southern Africa, the apartheid homeland development agency (van Rooyen et al. 1987). Private sugar companies had the greatest success with their smallholder outgrower model, mainly in KwaZulu-Natal. This initiative began in the 1970s and 1980s, with a peak of 50,000 smallholder farmers in the early 2000s producing sugar for commercial markets. Subsequent structural collapse resulted in reduction of the number of contract growers (Dubb 2016).
After 1994 government policy on smallholder production was ambivalent and agriculture was not initially tied to the land reform programme. Land reform was considered as a separate issue to agricultural production, which would be taken care of by large-scale commercial producers. Support for smallholder production was half-hearted and ineffectual. After 2000, in the era of peak neoliberalism in South Africa, agricultural support and land reform were more directly interconnected, but based on a commercialisation model, which increasingly sought to support larger-scale commercial black farmers (Cousins and Scoones 2010; Greenberg 2015; Hall 2010; Hebinck and Cousins 2013). Through a combination of government support and market forces, a comparatively weak commercial black farming class has now arisen. The large majority of semi-subsistence farmers were allocated to social welfare and health for some vegetable production for local use with limited support from the agriculture department.

The value of production from this wider periphery was estimated at R15.5 billion in 2014 (based on Aliber and Mdoda 2014, adjusted for inflation), or about 7% of the total value when combined with commercial production (Fig. 15.3). Urban and peri-urban backyarders and food gardeners who may not be captured in the statistics could also be included in this wider periphery, even if only conceptually, since there are no real statistics regarding these producers. Some of these may be in the commercial periphery but many are not. Including these producers into the definition of semi-subsistence, small-scale production brings the urban environment into the picture and impacts the spatial distribution of this periphery, now encompassing peri-urban and urban areas, including around smaller rural towns and even in pockets on commercial farmland. In the shadow of the dominance of corporate food production, small-scale production is not considered a real option by the private sector and government alike. Whatever the rhetoric, in practice business and government alike do not consider small-scale farming to be a viable economic model on which to build. There are comparatively few programmes with black farmers in the commercial periphery especially through value chain integration. Although these interventions may assist in building a black presence in the commercial periphery, it is very slow developing and the economic weight likely remains insignificant. There are no national statistics on this.

Land dispossession lies at the base of the South African economy and agrarian structure, as described above. The idea of land reform after 1994 was to overcome the racial imbalances in land ownership. A land reform programme, negotiated as part of the political resolution leading to the end of formal apartheid in the early 1990s, had three core components: tenure security, redistribution, and restitution. The latter is a form of redistribution but based on specific circumstances of loss of land under apartheid. The programme has its roots in ongoing struggles against forced removals and loss of land rights in rural areas throughout South Africa. The World Bank had a strong presence in shaping the negotiations, and the plan that emerged was a redistribution of 30% of land by 1999 based on the ‘willing buyer, willing seller’ model. The essence of the model was that the state would pay market-related prices to acquire land and would not expropriate land for purposes of redistribution. The model failed in South Africa and elsewhere (Borras 2003; Lahiff 2007). The state could not afford to buy the land needed for the programme, it did not have the capacity to manage land reform on a large scale, beneficiaries were forced into groups for acquisition purposes, there was a lack of agricultural or settlement support, rapidly changing spatial economies, and many other factors that contributed to this failure. Although plans have been tabled since 2005 to move away from the ‘willing buyer, willing seller’ model, there has been no meaningful restructuring of the programme. The 30% target was continually pushed back before being abandoned entirely. Little more than 10% of commercial land was transferred through the programme by 2012 (PLAAS 2013) and the system remains barely functional, bogged down in intractable issues and political infighting.

There is general acceptance in South Africa that some kind of land redistribution is needed, although there are disagreements about how to achieve this, ranging from market forces to nationalisation and expropriation without compensation. The Constitution currently allows for a value calculated on an assessment of the historical use of the land, including government subsidies, and then a payment below market value based on these. There is a question about how to redistribute land on a large scale without destabilising the food supply. This may be more about planning than feasibility.

Tenure security refers to individuals and groups having access to land with a socially recognised right to remain there and use the land in various ways. The situation of farm dwellers on commercial farms was discussed earlier. In communal areas, traditional authorities allocate and manage land. There are conflicts around chiefly authority and popular will, and gender inequity in land allocation (Claassens and Cousins 2008). Land cannot be sold although informal land markets do operate where land is rented, bought and sold (Kingwill 2007). There are free market arguments for the expansion of the formal land market into communal areas through titling. The goal is a single system across the whole country with private ownership, which will allow people to use land as collateral for access to finance, and to move freely because their property is exchangeable (De Soto 2000; Zille 2014). Although there are some internal challenges, the tenure system in communal areas offers some security because land cannot be alienated. Title and private ownership will undermine this essential foundation of survival in these areas.
Demand for land for production and settlement, including redistribution and restitution, is also geographically differentiated. In urban areas, land is mostly sought for settlement but there may be pockets of demand for agricultural production (e.g. Philippi Horticultural Association, which is a smallholder commercial farming area within Cape Town city boundaries). Rural demand is for a combination of settlement and production, including integrated patterns, with some demand for land for commercial agriculture, especially medium-scale production. Land reform offers an opportunity to also consider a shift in production methods, based on subdivision of a portion of large commercial landholdings in the commercial periphery. Access to water is key to success and will need to be planned. This points to an agrarian structure of smaller units, decentralised, more local markets, combined settlement and production, and communal or individual grazing in demarcated areas. Differentiated support based on needs will be required, along with the promotion of socially and ecologically sound production practices.

15.5 Summary

Overall, South African agriculture and its agrarian structure continue to operate in the mould of apartheid spatial patterns. There is ongoing concentration of economic power and landholdings in agriculture. Public and private sector investments do not favour small-scale farming. Land reform is required, but the existing programme is inadequate for the task. Left unchecked, capitalist development will intensify concentration in all its forms, from economic and political power to settlement patterns. A planned response to construct an alternative vision and material agrarian practices is required, which may offer opportunities to propose alternative development paths.

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Abstract
Small towns are the base for a significant proportion of the South African population and its economy, however, these places have historically been a research lacuna. This chapter will attempt to show that small towns have started to receive greater academic attention including to themes such as population and economic change, innovation, policy shortfalls, the importance of post-productivist activity, dependency and depopulation. New challenges are posed by climate change and local government failings which make the search for development alternatives all the more pressing.

Keywords
Depopulation · Post-productivism · Rural areas · Small towns · South Africa · Social and economic change

16.1 Introduction
Current urban policy and academic discourse in South Africa has a defined focus on the challenges and effects of rapid urbanization, particularly as it affects the largest urban centres, with the net result that equally important trends in small town and rural South Africa are effectively ‘off-the-radar’. This is despite the key role that such areas play in the nation’s economy and society as sources of food supply and resources, being home to over a quarter of the population, and the locus of activities ranging from tourism to family support for the vulnerable sent to rural areas to escape the challenges of the cities. These places have some of the highest levels of seemingly intractable poverty and dependence, which are proving difficult to address in the context of a market-driven economy, environmental stress and the city-focused policy context (Chutle 2016; Steyn and Ballard 2013; Todes et al. 2010; Toerien 2017).

Rural areas and small towns in South Africa have undergone enormous changes socially and economically over the last century and a half (Nel et al. 2011). The influence of colonial regimes compounded by the discovery of gold and diamonds helped lead to the current dense settlement network of small towns, while the rise of apartheid ensured the racial division of space within urban centres but also across rural space, with defined regions of exclusive black rural and small town residence being enshrined along with deep-seated structural inequalities, which persist to this day. Post-1994 democratic changes have gone some measure towards addressing extreme poverty and marginalization, but ultimately the poorest and most vulnerable in society live in small, generally disadvantaged towns and their hinterlands (Hoogendoorn and Visser 2016). Many small towns in South Africa, and in a number of other countries, have entered what can be considered a type of post-industrial phase, often called post-productivism in rural geography, where some small towns now have tourism and creative industries as their economic mainstays (Ingle 2010). By contrast, many other small towns have entered a phase of long-term economic decline, often burdened by the social and economic chains of the past. The latter is particularly true of small towns in the former Homelands, apartheid’s racial reserves (Hoogendoorn and Nel 2012; Nel 2005).

After consistent population growth in all small towns across the country, despite economic decline in the twentieth century, a number of small towns are now, in the current century, facing the loss of population for the first time (Todes et al. 2010). It must however be noted that populations have still increased in aggregate terms in small towns, yet at a lower rate when compared to that in the cities. Significantly, some of this growth relates to dependents moving from the
cities to rural areas looking for support from extended family networks (Nel et al. 2011). It can be argued that small town South Africa will continue to be in a state of flux for a considerable period given continued economic and social changes nationally, but also globally.

In the light of these dramatic changes, researchers in South Africa have started investigating what is taking place in small town South Africa, partially also in response to the identification in the early 1990s that small towns were ‘research lacunae’ (Krige 1995). The new interest accorded to small town geographies in recent years has systematically built on existing knowledge, culminating in an edited collection by Donaldson and Marais (2012) entitled Small Town Geographies in Africa: Experiences from South Africa and Elsewhere. On a positive note, research on small town geographies has continued with more research projects planned by a number of academics. Unfortunately geographers’ understanding of small town geographies is still limited to a series of core themes, many related to economics, with a large number of research gaps still present (Hoogendoorn and Visser 2016). This chapter seeks to advance research into small towns through a reflection on, and providing a synthesis of, research findings to date and a discussion of key emerging themes which, we would argue, will help steer future research into the key issues which small towns face and, by implication, should be key future research foci.

16.2 The State of Knowledge of Small Town South Africa

Throughout the twentieth century, a series of studies drew attention to the diversity of small towns and the risks they faced in terms of population loss, with an initial focus on white people only and the economic ramifications of economic and social change on livelihoods, employment and the associated risks of marginalization (e.g. Nel and Hill 1998). Krige’s (1995) work on the research gaps which existed and the need to actively consider the diverse realities of South African small towns, in particular the differences between Homeland and non-Homeland areas, helped catalyse further thinking into the nature, development implications and needs of such places. Indirectly, this can be linked to a growing number of studies looking into emerging Local Economic Development (LED) and tourism interventions in small towns and debating options for the wider application of LED and tourism support (Gibb and Nel 2007; Halseth and Meiklejohn 2009). While obviously an important focus, other dimensions of small town development were relatively under-played, including social issues, protest, infrastructure etc., in this relevant but rather singular focus (Hoogendoorn and Visser 2016). Nel (2005) sought to overview the differing histories of small towns in the country, to develop a typology for different types of settlement, and to reflect on development options for towns losing their agricultural, resource or transport base upon which they had depended historically. Parallel studies have sought to examine issues of emerging post-productivism in South Africa and the potential of tourism as a new economic mainstay in small towns (Hoogendoorn 2010; Hoogendoorn and Visser 2016), with tourism being the core focus area for the majority of research on small towns in South Africa (Donaldson 2018). Another research strand which has emerged in the last 20 years has been efforts to systematically analyse the selective growth potential or its absence across networks of settlements, drawing on statistical data and geoinformatics. This research has helped identify disparities in the settlement hierarchy which have significant policy and developmental implications (Donaldson et al. 2012; Zietsman et al. 2006).

Since the demise of apartheid and the gradual move from a productivist to a post-productivist state, changes in South Africa’s rural economy have shaped, and will continue to fundamentally shape, the nature of small towns (Hoogendoorn 2010). The regionality of small town issues remains key to understanding processes of rural change. For example, the forces impacting small towns in the Western Cape, such as tourism opportunities and business innovations and inter-regional linkages (see Booyens and Rogerson 2016; Zietsman et al. 2006), are significantly different from the challenges faced by small towns in the Free State and the Northern Cape that often have to deal with agricultural change and mining-related issues such as disinvestment and mine closures (Marais and Cloete 2009; Marais et al. 2005). The Eastern Cape also has a number of regionally-specific issues to contend with, such as persistent poverty and a declining rural agricultural base, which has helped catalyse the pursuit of small town LED interventions, support for tourism and the pursuit of urban agriculture (Gibb and Nel 2007; Thornton 2008). The transition to post-productivism and the role played by second home development and tourism in small towns have been a well-established genre of research (Campbell 2016; Hoogendoorn 2010). The particular challenges faced by mining towns, not least the loss of jobs and associated economic contraction when mines close and the often critical housing shortages associated with both the growth of new mining towns and the displacement of workers in places experiencing mine closure, have emerged as some of the most challenging issues for small towns. Another factor is the limited success of the mines’ social and labour plans to address local development backlogs (Marais et al. 2017; Rogerson 2012).

The most comprehensive overview of the state of knowledge of small towns in South Africa comes from the key edited work by Donaldson and Marais (2012) which collated a series of studies exploring the historical, economic and social development of small towns, the current challenges
they face in terms of social protest, sustainability, marginalization and planning, and the related search for new development opportunities and economic anchors. One of the key findings of this work was the reality that there is a need “for integrated research to analyse and address the spatial, economic, social and historical geographies of small towns and that the under-conceptualisation of small towns in academia and government has reinforced policy implementation weaknesses” (Donaldson and Marais 2012, p. 12). One of the key under-researched themes in small town enquiries in South Africa is the situation faced by the hundreds of former Homeland towns and villages. Under apartheid, these impoverished service centres had to cope with the resettlement of displaced people from declared white group areas. From the 1990s, these areas also started to receive miners and industrial workers displaced by economic restructuring in the main urban centres. Their weak or non-existent agricultural base, historic underdevelopment, lack of tourism potential and high levels of poverty had made the residents of such towns almost exclusively dependent on welfare payments and state employment (Nel 2005). Although under-researched, there are some recent research enquiries into the deep-seated challenges and limited development options available to these centres (Qayi 2012; Xuza 2012).

### 16.3 Current Small Town Realities

While a clear case can be made to justify policy support and intervention in small towns undergoing systemic change, these places currently do not enjoy any particular policy support and instead are burdened by their often low and declining tax bases and severe shortage of skilled workers, often leading to service delivery failures, lack of effective leadership and service related protests (Nel 2005; Steyn and Ballard 2013). The current guiding national urban policy, the Integrated Urban Development Framework (COGTA 2016), while calling for a national vision of spatial development and acknowledging the importance of rural–urban linkages, has no particular focus on small towns and instead concentrates on the sustainable management of growth in the largest settlements. To a limited degree, small towns do receive attention in the policy formulations in the National Development Plan (National Planning Commission 2013), and the Department of Rural Development and Land Reform (2017), albeit only from the perspective of agriculture productivity. This department has recently sought to promote the establishment of ‘agri-parks’ across the country to serve as centres for agricultural innovation, production, processing and marketing. These are located in small towns in district municipalities such as Chris Hani in the Eastern Cape, Witzenburg in the Western Cape, and Ehlanzeni in Mpumalanga.

One of the stark realities facing small towns is that population loss is now starting to emerge as a significant trend for the first time. Until recently, the dominant understanding was that all small towns were growing, albeit marginally in many cases, in population terms, even though many were declining in economic terms (Nel 2011). This was because of natural increase, the ‘poverty trap’ in which many towns find themselves, people leaving or being forced off farms, and the return of retrenched miners and industrial workers to rural areas and small towns (Nel et al. 2011). Since the 2001 census, it would now seem that issues such as the absolute economic decline in many Homeland towns, and in agricultural and mining centres, is forcing people to leave in search of a better livelihood in the larger centres. Based on census statistics (StatsSA 2015) it is apparent that out of the 531 urban centres captured in the data, 39 or 7% are now declining in population terms (Fig. 16.1). These include large former mining settlements such as Carltonville and Virginia and former Homeland towns, and industrial centres such as Thaba Nchu, Mdantsane and Dimbaza. If one considers municipalities, 59 out of the 278 local authorities are experiencing population loss with 15 falling by more than 10% between 2001 and 2011. These population shifts are having a profound effect on the settlement hierarchy and the viability of these declining areas, and the changes it will effect on service provision, job opportunities and infrastructure have yet to be fully appreciated.

Of equal significance is the reality that, despite over 20 years of democratic rule, most rural local governments are struggling to address the growing challenges of service supply and housing demand (Human et al. 2008; Marais and Krige 2000). Unemployment and inequality has not been addressed and the poor remain trapped in situations from which they are often unable to escape (Hoogendoorn and Visser 2016; Todes et al. 2010).

### 16.4 Emerging Research Themes

The challenges facing small town and rural South Africa are becoming starker in the face of persistent marginalization and economic and social change, but also, more recently, as a direct result of climate change and environmental risk. This both prompts and justifies new research foci on a series of emerging issues. In this section, the issues detailed are not presented in any order of priority, but are rather a series of key themes which will likely shape the future of small towns and thus small town research.

Small towns in South Africa are increasingly feeling the impact of global environmental change and in particular climate change that has severely impacted the agricultural sectors as a result of diminishing rainfall. To date, these themes have only rarely been researched in the country (Hoogendoorn
et al. (2016) is an exception). Severe weather events like drought will become more commonplace as a result of the inevitability of climate change. The drought at the end of 2015 and early 2016 was one of the worst in recorded history in many parts of South Africa, and as Wessels (2016) notes, it severely affected the economies of small towns in the central, western and some eastern parts of the country, and led to increased unemployment. Because of the adverse impact on business, municipal income has also been affected. Wessels (2016) further mentions that as an increasing number of farmers have gone bankrupt or have severely limited cash flow, many will have to let labourers go, which may increase small town populations and lead to increased unemployment. The threats which climate change poses to small towns and their hinterlands and the limited capacity of impoverished municipalities to put in place coping strategies has merited recent attention from Chutle (2016), and are clearly considerations which deserve significantly greater attention. Future predictions regarding climate change in South Africa are for increasing temperatures, unreliable rainfall patterns, and more frequent severe climatic events (Fitchett et al. 2017). Given the low adaptive capacity of rural South Africa, this is a major concern, and could lead to the death knell of a number of agriculturally-driven economies and their small towns (Hoogendoorn and Fitchett 2016). One way of addressing issues around drought is to increase rural and small town adaptation capacity and measures to gain a level of self-sufficiency, especially by using water saving mechanisms and innovation (Booyens and Hart 2018).

Another possible topic of investigation regarding small towns in South Africa would be to look at the increased presence of foreign nationals from especially China, Pakistan, India and Bangladesh in its retail economy. This has potential to change the entrepreneurial environment of small town economies, just as it is changing the nature of retail sectors in major cities because of the increase of low price-point products (Willemse 2014). This topic remains chronically under-researched except for the now-dated work by Park and Chen (2009) which looked at the presence of Chinese businesses and the number of Chinese individuals visible in small towns in the Free State. While providing low cost items to small town residents in what was becoming an increasingly constrained market, as long-established businesses have closed, issues of competition with existing businesses and

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**Fig. 16.1** Annual population changes in declining urban centres, 2001–2011. (Based on StatsSA 2015 data)
xenophobia are very real small town concerns. An interesting future research topic could be to consider the impact of the remittances and welfare payments that flow from South African cities to South African small towns which then, in some cases, if Chinese business are successful, Chinese business employees or owners will send back to China.

With continued rural decline and rural change in South Africa, the influence of technology will become increasingly important for entrepreneurs and resident populations trying to bridge the gap between the lack of service delivery and infrastructure. One example could be web-to-cell technologies as described by Morais et al. (2016) designed to assist, for example, micro-entrepreneurs with making and receiving payments from clients and service providers. A well-known example of this is M-Pesa that has been successfully utilised in a number of countries such as Kenya (Aker and Mbiti 2010). While M-Pesa has not been successful in South Africa, other variants of these types of technologies may become more prevalent if rural and small town decline continues. Also, the reinterpretation of accommodation platforms such as AirBnB may be developed to suit the conditions of a variety of small town’s regionalities, where entrepreneurs may not have access smart technologies and where other booking methods could be developed such as web-to-cell (Visser et al. 2017).

As local municipalities become less able to support and promote small town economic development, there is an emerging research focus on the actual and potential role which small town enterprises can play in servicing and supporting local economies. Of equal significance is the vulnerability of the local employment base to structural change (Antoni and Umejesi 2014). This recalls earlier research in the Karoo which established that centres with less than 10,000 population experienced significant loss of business and economic activity as the rural economy contracted, despite the fact that their populations were generally still expanding, posing the risk of greater impoverishment (Nel and Hill 2008). While foreign nationals, as discussed above, may partially address a retail void, the hollowing out of small town economies as their rural hinterlands contract, is clearly a theme which merits further attention. Detailed statistical research by Toerien (2017) has sought to investigate the business enterprise diversity in different parts of the country and, by extension, to establish if there is scope to expand particular sectoral niches or whether market saturation has been reached. With South Africa’s reliance on a market-based economy and the apparent failures of the local state as an agent of development, this is an area which clearly deserves greater attention in efforts to strengthen local economies. In parallel, particularly for the poorest communities, food security is a persistent challenge and one which merits further attention, both in research and policy terms. With limited exceptions, such as the work of Thornton (2008), urban agriculture in small towns remains under-researched, and there is scope to extend Ward and Shackleton’s (2016) recent work on local food production and natural resource use in small towns.

Other issues include identity, social construction, conflict and protest, urban regeneration projects, gentrification and heritage conservation in small towns. While such issues have received attention in the cities there is clearly scope to provide a small town dimension (Steyn and Ballard 2013). Associated with this are associated considerations of the psychological impacts of marginalization and dependency which many small town residents and their local governments have to contend with.

16.5 Summary

This discussion illustrates the vulnerable position which small towns in South Africa presently find themselves in in the post-apartheid economy. Climate, economic and political changes have marginalised most small towns. While some are pursuing alternatives such as tourism, others reliant on agriculture and resource extraction are experiencing increasing marginalization. This is true for small towns in former Homelands, but also for an increasing number of declining mining and agricultural centres. The reality that, for the first time, a number of small towns are depopulating gives expression to the severity of the changes which small towns are experiencing. Yet developmental challenges remain and small towns will have to contend with issues such as climate change, weak local governments and economic constraints. While Halseth and Meiklejohn (2009) argue there is a need for small towns to reinvent themselves, as Hoogendoorn and Visser (2016) point out, many small towns may in fact become redundant.

References

The Geography of Education: From Race to Class Apartheid?

Tracey McKay

Abstract
South Africa’s education system has changed from one divided by race to one divided by class. Those with financial and sociocultural capital are accessing quality education and, consequently, realise substantial academic success. Broadly speaking, this class is urbanised, resides in the economically-dominant provinces of Gauteng and the Western Cape, and has become racially mixed. But poor South Africans – who are predominantly (but not entirely) black and who live in rural areas, townships and the poorer provinces – are relegated to schools still suffering from apartheid’s resource neglect. These schools have an inadequate number and standard of toilets, libraries, teaching resources, computer facilities and science laboratories; or in some cases, none at all. They also have high learner to teacher ratios, weak school management and poor academic achievement levels. Despite considerable education policy and legislation changes, as well as significant financial inputs by the state, for the vast majority of these learners, this class apartheid is now so entrenched that neither their legal rights with respect to school choice, nor even their geographical proximity to good schools, grants them access to quality education.

Keywords
Apartheid · Class · Commuting · Inequality · Poor outcomes · Schooling

17.1 Introduction

South Africa’s education system has changed substantially in the last 20 years (Soudien 2007). Enrolment is near universal, especially at primary school level (compulsory schooling ends at the age of 16 or completion of Grade 9). This can be considered as an achievement with respect to the millions of young people who, prior to 1994, were not enrolled in schools, coupled with rapid population growth (Fataar 1997; Gustafsson and Patel 2006). It is however estimated that some 400,000 learners are out of school, most of whom are poor, male, coloured or Black African (Branson et al. 2014). There is also now a single education department instead of the nineteen of the apartheid era. Parents, via school governing bodies (SGBs), can now input into how schools are managed (such as regulating school fees, determine the medium of instruction and hiring additional teachers) (Karlsson 2002). The school curriculum has also been changed multiple times (initially to remove the old unequal apartheid curriculum) (Bloch 2010). Schools are now legally desegregated, although in reality, desegregation is confined to high-fee independent schools and public schools that were originally deemed for white, coloured and Indian learners. This is true for every province, metropolitan area, secondary city and even small towns across South Africa. For example, desegregation can even be seen in Ladybrand, a small agricultural town of 25,000 people in the Free State Province, where the majority (65%) of learners in schools formerly designated as ‘whites only’ (namely, Ladybrand High and Ladybrand Primary schools) are Black African (Mnguni 2015). In terms of independent schools, some are racially mixed (mostly those charging very high fees of R50,000 or more annually). Moderate to low-fee independent schools tend to be overwhelmingly Black African (Hofmeyr and Lee 2002). Rural and township schools are still almost entirely populated by black learners (de Kadt et al. 2014). For example, a study by McKay (2015) found that in Alexandra township (a very poor residential area in Gauteng) virtually all the learners are Black African, with only 2.8% classifying themselves as either Asian or coloured. Thus, for the most part, Black African learners, especially poor ones, do not attend mixed race schools.

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17.2 School Choice

One crucial aspect of dismantling apartheid education was implementing school choice. This was legislated with the passing of the South African Schools Act (Act No 84 of 1996) or SASA, which grants learners the right, regardless of social status and geographical location, to access any public school. While school choice can be ascribed to the rise of a neoliberal ‘retreat of the state’, for South Africa it was unequivocally tied to the removal of apartheid-era legal restrictions where race and geography decided who could attend which school. However, it was recognised that such a wide-ranging right was difficult to administer, so school admission is regulated by the National Education Policy Act (Act No 27 of 1996) (NEPA). NEPA regulates school admissions using a combination of geographical catchment zoning and designated feeder schools. This use of feeder primary schools and catchment zoning is rife across South Africa and is an historical legacy practice (Horn and Henning 1997; Lemon 2004).

Gauteng illustrates this point. In Gauteng, South Africa’s wealthiest and most populated province, former white schools use geographic zoning. As such, learners can only request access to the school closest to where they live, and even then this is subject to capacity constraints. Thus, unless a learner lives near to such a school, gaining admission is not easy (Pienaar and McKay 2014). In a context where quality education is mainly confined to these former white schools (due to the historical legacy of apartheid education), demand for access is high. But these schools are few in number and located in the former designated white residential areas. Massive demand for places in these schools, in conjunction with the legacy of spatial apartheid, mean that the conflicts between SASA and NEPA are real, inasmuch as NEPA has become a tool for school management teams to manage their intake (Bell and McKay 2011). For example, under NEPA, Gauteng schools have a 5 km catchment zone and mostly only those learners living within this zone can access the school. Thus, while it is essential for all schools to manage their teacher to learner ratios, the result is learners can be turned away from their school of choice even if it is their nearest one. This means that despite SASA and a school fee waiver system (learners enrolled in a fee-charging school who can prove they are unable to afford the fees, can apply for a fee waiver), it is predominantly those with financial and sociocultural resources who manage to enrol their children in former white schools in Gauteng (Lemon 2004; Weber 2002).

This has created serious problems for provincial authorities. For example, in Gauteng in 2017, some 4700 learners were left without a school at the start of the school year. In some instances it took the Gauteng provincial authorities until the end of term one (mid-March 2017) to place these learners in schools (Chaskalson 2017). With demand for former white schools far exceeding supply, there is a view that the NEPA provisions relating to feeder schools and catchment zoning should be abolished. But, as managing enrolment is still necessary and cannot be done on a first-come-first-served basis or based on entrance tests (as they would both be unlawful in terms of SASA), the ANC Provincial leadership wants to enlarge the catchment zones from 5 to 30 km radius (Henderson 2016). It is doubtful if this strategy will have the desired impact of equalising access to these schools, however, as it does not solve supply problems (and may even increase demand on particular schools).

Most township and rural schools however do not experience such enrolment pressures. This is because these schools have a lack of sufficient resources for effective teaching and learning, and poor academic performance (Dubbelman 2011; Howie et al. 2008; Lemon and Battersby-Lennard 2009). For instance, basic reading and mathematical literacy scores are low (Mullis et al. 2017; Soudien 2004). Moreover, Lam et al. (2011, p. 121) found that “grade progression … is poorly linked to actual ability and learning”. Until this is rectified, most of these schools will not be ‘schools of choice’. Indeed, the literature abounds with evidence that black learners leave township schools for either former white suburban or independent schools (Fataar 2007; Sekete et al. 2001; Soudien 2010). Thus, those learners who do enrol in the poor quality and poorly resourced township and rural schools, are doing so either because they lack the financial resources to pay the school fees demanded by independent and former white public schools, cannot gain access to the schools as they live outside of the catchment zone (or the schools are full), do not know they qualify for a school fee waiver in these public schools, or they cannot afford the commute costs and other school-related expenses (McKay 2015).

Even then, however, enrolment into most township schools in Gauteng is controlled by the school management team using a feeder school system, or by matching home language to the medium of instruction. For example, only enrolling learners whose home language is either IsiZulu, Sepedi or Setswana because these three languages constitute the medium of instruction of the school. This policy is strongest in primary schools. Thus, speakers of dominant languages (such as IsiZulu) have a far greater school choice compared to those who speak minority languages. In Alexandra township for example, primary school children who speak Xitonga and TshiVenda have to commute (at additional cost) if they wish to be schooled in their home language (McKay 2012). Even then, teaching in the home language usually ceases post Grade 4, where schools (theoretically) switch to English. What actually happens is that although textbooks and tasks are in English, most teachers usually switch from English to the dominant vernacular
language much of the time. This is known as code switching, the effectiveness of which is debatable (Maarof 2017). Thus, for many of South Africa’s poor black households, school choice only exists on paper.

17.3 School Infrastructure

The demand for fee-charging, former white and independent schools remains high, as most former white schools were (and still are) substantially resourced. By contrast, under apartheid, schooling for learners who were not designated white was of very poor quality and inequality was built into the system (Fig. 17.1). Classrooms were overcrowded, poorly equipped, lacked teaching and learning materials (as well as windows, ceilings and toilets in many cases), and had insufficient teachers, many of whom were unqualified or underqualified (Fataar 1997). Unfortunately this apartheid resource backlog has not been fully addressed and these schools continue to resemble apartheid ones (Case and Deaton 1999; Reschovsky 2006). For example, an education NGO, Equal Education, reported on 60 rural schools in the Eastern Cape (South Africa’s poorest province) and found that 17 had no access to water, electricity or sanitation. The majority (44) of schools reported that they only have access to water some of the time. Only 15% of schools visited had flush toilets installed, and half of all the schools had more than 30 learners per toilet, with one school having a ratio of 294 learners to one toilet. Toilets were routinely filthy. Four schools had no electricity whatsoever, 14% did not have regular access to electricity and more than one third only had electricity in the administration block. Another 13 were mud schools, with some operating from zinc shacks (Equal Education 2016).

While such a poor resource situation might unfortunately be expected in a rural area of a very poor province, a case study of physical resources in all the schools in Alexandra township in Gauteng, found resources to be only marginally better. While all of the schools had flushing toilets, the toilet-to-learner ratios varied from 1:23 to 1:245, and the toilets were mostly in a poor state of repair, filthy and infested with flies. Only one school had a fully functional library, thanks to books sponsored by the USA government and the private sector. Only one high school had an operational science laboratory with equipment, chemicals and a science teacher who regularly used it. Not all the schools had a computer laboratory. One had its computer facilities destroyed by vandalism. All complained that computers were regularly stolen. Many claimed that access to many websites (even educational ones) was often blocked by the state-appointed service provider or that their computers lacked anti-virus software. In four of the schools, the computer laboratory had a learner to computer ratio of 1:1, but in six, two learners have had to share one computer. Although all of the primary schools had

Fig. 17.1 A high school in the Eastern Cape that would be viewed as ‘functional’ and ‘fairly resourced’ compared to many schools in South Africa. (Photo: L. Perkins)
feeding schemes, only two of the high schools had. Most of the food is donated by community members and local business people, with unemployed women doing the cooking. Primary school teachers indicated that since the advent of feeding schemes, very high levels of school attendance have been recorded, an indication that learners attend for the food rather than for an education (McKay 2012).

In the light of such a catastrophic infrastructural, teaching and learning resource backlogs, along with perceptions that township schools are unsafe, teaching is weak and ill-discipline is rife, it is little wonder that parents with the financial means shun these schools. A study by Mnguni (2015) on Ladybrand in Free State Province, found that Black African parents living in the local townships of Manyatseng and Mauersnek (where Black African people were forced to live under apartheid) opt to pay on average R5150 per learner per year to access former white schools which are some 40 min away, even though they could send their child to a no-fee neighbourhood school. Another study by Machard and McKay (2015) of low-fee independent schools in the inner city of Johannesburg, Gauteng, found similar results, with parents from Soweto, who can enrol their children in no-fee neighbourhood schools, rather electing to place them in independent schools despite the additional cost that many can ill afford. This exodus of learners is so great that twenty Soweto schools have closed since 1994 (Nkosi 2015). Thus, the result of massive demand for resourced schools is that the cost of schooling for those who can access these schools is significant. The combination of demand, the rise of independent schools and advent of a ‘quasi-market’ public school system in South Africa has resulted in considerable education inflation for those who can pay.

17.4 The Rising Cost of Schooling

Under apartheid, schooling for white children was mostly free, with minimal fees introduced only in the 1970s. For children of other races, school fees were also low, usually voluntary, and many parents paid what they could afford (some reported paying in chickens). However, in the dying days of apartheid, a quasi-market public school system was launched whereby the state drastically reduced its subsidy to white schools and simultaneously allowed SGBs to determine school fees to make up for the funding shortfall (Hofmeyr 2000). This resulted in a fundamental shift to a cost-recovery, cost-sharing education model. This model was retained by the post-apartheid government, with the rights of SGBs to levy school fees being embedded in the South African Schools Act (Act No 84 of 1996). State schools that charge school fees are deemed Quintile 4 and 5 schools (based on the relative wealth of their neighbourhood or learner profile). Most of these are located in the former white suburbs and most are former white schools. Since 1994, however, school fees have increased drastically. For example, at Rynfield Primary School in Benoni (Gauteng), school fees have moved from R52 per annum in 1990 to R19,025 per annum in 2017. Old Mutual, a financial services provider, claims that annual education inflation stands at 9.5% (BusinessTech 2017), which would mean that the fees should have moved from R52 to R600 per annum in this time. The difference between this calculated and actually fees value could mean that Old Mutual has underestimated education inflation, or it could be an indication of just how much this former white school was subsidized by the apartheid government. It could, however, also reflect the rise in teachers’ salaries, which many schools now pay directly (Armstrong 2009; van der Berg and Burger 2010). It is however, also a reflection of the effect of the commodification of education since 1996.

Another reason for education inflation is the rise of private or independent schools. Demand for private education has increased significantly post 1994, and in taking advantage of this, the number of independent schools has risen enormously, from 518 in 1994 to 1681 in 2013 (Hofmeyr et al. 2013; Tooley and Dixon 2006). Demand is partly linked to difficulties in accessing quality public schools as well as ‘white flight’ from the former white public schooling system. It is estimated that roughly 6% of South African learners are now enrolled in an independent school. South Africa has three main categories of independent schools: low-fee schools charging less than R13,000 per annum; medium-fee schools charging less than R50,000 per annum; and high-fee schools that charge between R50,000 and R135,000 (although a minority charge up to R254,000 per annum if boarding is included). The fees charged by these independent schools have also risen greatly. For example, St Andrews School in Bedfordview (Gauteng) charged annual fees of R8400 in 1986 whereas in 2017 fees were R118,410 (less than an annual 9.5% inflation rate). The majority of independent schools in South Africa, however, fall into the low-fee category. For example, parents of learners enrolled in low-fee inner city private school reported paying between R5000 and R8000 per year (Machard and McKay 2015). Low-fee independent Catholic schools charge between R2500 and R5500 per annum, but other non-religious, low-fee, independent private schools in Soweto charge up to R12,600 per annum.

In light of the arguments made that school fees are a type of regressive tax, and were a leading factor in children dropping out of school, the vast majority of state schools have in recent years been declared no-fee schools (Ahmed and Sayed 2009). These schools are known as Quintile 1, 2 and 3 schools. Designation as a no-fee school is dependent on if the school is located in a low-income area or where the majority of learners hail from low-income homes. The no-fee school system was introduced in 2007. By 2015, it was
estimated that some 9.2 million learners were enrolled in no-fee schools (DBE 2015). This constitutes the vast majority of the South African learner population. StatsSA (2017) estimates that the introduction of no-fee schools resulted in a 10.6% decline in education-related expenditure for South African households between the years 2010 and 2015. However, while no-fee schools have reduced education spend for poor parents, state subsidies have not made up for resultant income shortfall, and learner retention has only marginally increased (Branson and Lam 2017). Thus, retention would be better addressed with more school feeding schemes and making schooling compulsory until the age of 18 or the completion of Grade 12.

Although thousands of state schools declared as no-fee schools, state education is not free. First, schools are allowed to ask for donations, and there are also additional items that parents must pay for. In a case study of no-fee high schools in Alexandra township, McKay (2015) found that some 17% of parents reported paying ‘donations’ in the region of R500 per annum to the school (although the schools themselves reported they only ‘requested’ annual donations of less than R100). Parents also bear additional school costs, with some 93% saying they paid for school uniforms, 54% bought school stationery, 41% paid for extra-curricular activities, 23% bought school notebooks, 8% paid for school sports, and 7% purchased school textbooks. A study by Aderibigbe (2015) of five no-fee schools in Limpopo Province (South Africa’s second poorest province) found that, on average, parents of Grade 12 learners were paying in R60 per year in ‘donations’, and approximately R535 in school uniforms, R40 for stationary, R23 for school books, R38 for textbooks, R140 for sports activities, R390 for extracurricular activities, and R2192 for extra mathematics classes (with a total average school-related costs of R3391 per child). These hidden costs of schooling may further impoverish poor households. In particular, the high cost of school uniforms, extracurricular activities and tutoring needs to be investigated. Gaillard-Thurston (2017) notes that, despite school uniforms being mass produced and the types of clothing items regulated by National Norms and Standards, school uniforms have risen in price considerably (whilst quality has deteriorated rapidly) and are now considered costly by many parents. Another important aspect of school choice, school resources and discriminatory cost, is the rise of an abnormally long or expensive school commute.

### 17.5 The School Commute

South Africa, due to its unique educational policies and marred political history, has a set of complex variables that directly cause a lengthy and costly school commute (Ginsburg et al. 2011). In particular, this involves very unusual learner commuting patterns with many children traveling long distances to school (Hofmeyr 2000). De Kadt (2012) found that over 25% of Johannesburg school children travelled more than 10 km to school and back. Almost 60% attended a non-neighbourhood school, and fewer than 20% attended the school nearest to their home. Much of this commute can be attributed to a desire to access quality education (Moses et al. 2017). In a case study of high schools in Alexandra township in Johannesburg, Bell (2009) found that to transport their children to school each month, 4% of parents paid up to R200, 3% paid between R201 and R400, and 3% paid between R401 and R800. A study of Ladybrand by Mnguni (2015) found that typically parents were spending R300 a month on school transport for their children. These findings are supported by many other studies (e.g. Fleisch and Woolman 2004; Ndima 2006; Redpath 2006).

The nature of the commute also varies by socioeconomic status and race. For example, it is mainly poor children (especially those in rural areas) who walk to school. A study by Nala (2015) of a rural black community residing in the Umnini Tribal Authority, KwaZulu-Natal, found that some 80% of learners walk to school, usually between 3 and 6 km per day. Most of those who walk (75%) live with extended families, grandparents or in single parent households. Wealthier children across South Africa are heavily reliant on mini-bus taxis, dedicated school transport vehicles, buses and private cars to get to school (Behrens and Muchaka 2011). There is a noticeable dependence by Indian and white learners on private cars, and black learners on mini-bus taxis (Machard and McKay 2015; McKay 2015). Low levels of active commuting (walking/biking) are due to distance, concerns about crime and the dangers posed by road traffic (Holmes 2015; Koekemoer et al. 2017). Due to these commuting costs and the apartheid-era legacy, poorer learners are less able to access more distant but better resourced schools.

The school commute has spawned an entire school transport industry, used by millions each day. Unfortunately this industry is plagued by poor safety records, a high accident rate, poor driving behaviour, unroadworthy vehicles and overloading (van Niekerk et al. 2017). Another problem is access, as the case study by Nala (2015) of the Umnini Tribal Authority, highlights. In this area, learners who live more than 3 km away from school are entitled to use a state-provided bus. Unfortunately this free bus service is inadequate with one bus servicing seven schools, and it only does two trips per day. Thus, the bus is overcrowded, unsafe and in particular, access to the bus service is not regulated. Thus there is a tendency for male high school children to force younger primary school and female children to walk.

Considering the hurdles that most poor black African children have to overcome to both get to and stay in school, one would hope that their lives would be immeasurably improved by attending school and attaining a secondary
school education. This, however, is seldom the case and poor black African children continue to have poor educational outcomes (Moses et al. 2017).

17.6 Poor Outcomes

Although there has been a massive increase in money spent on black learners post-1994 and an allocation of 6% of South Africa’s GDP on schooling (which is high by international standards), overall expenditure has been, and continues to be, insufficient to fully upscale the education system and address the massive and systemic apartheid backlogs (Evoh and Mafu 2007; Gustafsson and Patel 2006; Redpath 2006). However, most of this spend is on personnel and not on the long-term betterment of school resources (Motala 2011). In addition, a population increase of 43% (from an estimated 38.3 million in 1994 to 54.9 million in 2016) presents education planners with a moving target when it comes to building schools and employing teachers. Some scholars also argue that the adoption of neoliberal economic policies (i.e. fiscal restraint) has also hampered full financial redress (Louw 2004; Soudien 2007). For example, in the early post-apartheid era many teachers were retrenched (Chisholm et al. 1999). Others have mentioned the challenges associated with the effects of education inflation (Motala 2011). Consequently, the education system is floundering. For example, in 2002, Grade 3 learners on average scored only 68% for listening comprehension, 54% for life skills, 39% for reading comprehension and 30% for numeracy. Thus, learners at Foundation Phase (the first 3 years of schooling) have very limited ability to read and work with numbers. Another national test in 2004 found that this poor performance persisted, with Grade 6 learners attaining an average of only 41% for natural science, 35% for language and 27% for mathematics (Motala 2011). In 2013 for Grade 9 mathematics, the average score was only 13%, with many learners scoring zero (Adler and Pillay 2017). Mullis et al. (2017) indicate that eight out of ten South African Grade 4 learners cannot read for understanding. Thus, schools are not performing their full function and the problem is chronic and pervasive. As a caveat, these high-level averages can be misleading and education outcomes are not uniformly poor across all South African learners. Firstly, there is a difference by gender, with boy learners more likely to drop out of school, more likely to perform poorly in reading and less likely to proceed to tertiary education (Boyce et al. 2017; Mullis et al. 2017). In terms of race, white and Indian learners are far less likely to drop out of school, far more likely to achieve good academic results and enrol in tertiary education than their Black African peers (Adler and Pillay 2017; Moses et al. 2017).

There are also serious issues relating to teacher quality, in terms of weak training and classroom practice. For example, some teachers currently in the system are products of the old apartheid teacher training system where black teachers were deliberately undertrained (this does not mean older white teachers were automatically trained to international standards, but rather they were given better training than their black peers) (Christie and Collins 1982). The systematic retrenchment of teachers in the 1990s also meant many experienced teachers were lost to the system and not replaced, and the learner to teacher ratio is still suffering as a result (Armstrong 2009). In addition, the abolition of teacher training colleges by the then (now late) Minister of Education, Kader Asmal, also had significantly negative impacts as the universities who have now taken over the role of training primary school teachers are woefully underequipped in terms of human capital to rise to the task (Taylor 2014). Although teachers’ salaries have increased, they are low compared to what educated, qualified people can get elsewhere in both the public and private sector (Armstrong 2009). Lastly, weak school and political leadership in education, and the dominance of the teacher union SADTU, means that schools are often poorly managed, discipline is weak, good teachers ‘encouraged’ to leave, and corruption (such as the buying of posts) is rife (van der Berg and Burger 2010).

The greatest impact on educational outcomes is class, however. Lemon and Battersby-Lennard (2009) found that the lower the socioeconomic status score of the school, the lower the educational outcomes of the learners enrolled in it. Similarly, Motala (2011) found that learners enrolled in lower quintile schools were far more likely to repeat a grade or drop out of school. Juan and Visser (2017) also found that home and school resources were positively associated with success in international science tests. In the international Trends in International Mathematics and Science Study (TIMMS) test of 2015, Grade 9 learners in Quintile 4 and 5 schools outperformed learners in no-fee schools by 24% on average. Learners in independent schools outperformed Quintile 4 and 5 learners by 13% on average. Only learners enrolled in independent schools managed to exceed the international mean (by 6%) (Moses et al. 2017). Thus, the failure of the public schooling system is strongly linked to socioeconomic status. It is also linked to spatial apartheid (which has proven to be inordinately persistent), with township and rural schools characterized by low pass rates, poor school governance and low educational outcomes (Mestry 2014; Pienaar and McKay 2014).

There are also differences between urban and rural outcomes, socioeconomic status, and geography. This is well illustrated by the variation in achievement by schools across the nine provinces of South Africa. In terms of provincial income and pass rates for 2016, there is a strong relationship (with $r = 0.767$, $p = 0.016$, $n = 9$; Spearman). There is an even stronger relationship between schools that achieved 100% pass rate for 5 years in a row and provincial income ($r = 0.827$, $p = 0.002$, $n = 9$; Pearson) (see Table 17.1). Additionally, of the schools that achieved 100% pass rate for
5 years in a row, only one of the 111 is a no-fee school, with
53 (48%) being independent schools (Fig. 17.2). In terms of
schools that performed consistently poorly over the last
5 years, the dominance of the three poorest and mostly rural
provinces (Eastern Cape, KwaZulu-Natal and Limpopo) is
stark. These three provinces also have a high proportion of
former ‘homeland’ territories and schools administered by
the various homeland governments. Thus, they would have
faced extraordinary high levels of poverty and neglect under
apartheid, whereas while Gauteng and Western Cape, the
provinces with the highest GDP per capita, boast the most
schools with a 5-year 100% pass rate by a significant margin.
In response, much internal migration is taking place in South
Africa as learners exit Eastern Cape, Limpopo and KwaZulu-
Natal schools, heading for the Western Cape and Gauteng.
As a result, the Eastern Cape is facing falling enrolment rates
and has announced that it plans to close 2000 schools in the
near future (Haden 2015).

Table 17.1 Provincial Grade 12 (end of secondary school) pass rates
compared to income

<table>
<thead>
<tr>
<th>Province</th>
<th>GDP per capita 2015 (Rands)</th>
<th>Percentage of schools with pass rate of 40% or less 2016</th>
<th>Percentage of schools with 100% pass rate 2016</th>
<th>Number of schools with 100% pass rate for the past 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Cape</td>
<td>163,220</td>
<td>0.7</td>
<td>20.2</td>
<td>31</td>
</tr>
<tr>
<td>Gauteng</td>
<td>140,676</td>
<td>1.0</td>
<td>16.5</td>
<td>32</td>
</tr>
<tr>
<td>Free State</td>
<td>85,298</td>
<td>0.3</td>
<td>19.8</td>
<td>12</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>83,517</td>
<td>2.7</td>
<td>4.0</td>
<td>3</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>81,258</td>
<td>2.9</td>
<td>14.0</td>
<td>2</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>73,503</td>
<td>19.8</td>
<td>4.9</td>
<td>19</td>
</tr>
<tr>
<td>Eastern Cape</td>
<td>72,390</td>
<td>24.4</td>
<td>4.8</td>
<td>7</td>
</tr>
<tr>
<td>North West</td>
<td>69,192</td>
<td>1.1</td>
<td>10.0</td>
<td>3</td>
</tr>
<tr>
<td>Limpopo</td>
<td>61,011</td>
<td>18.4</td>
<td>2.8</td>
<td>2</td>
</tr>
</tbody>
</table>

Sources: DBE (2017) and StatsSA (2017)

Fig. 17.2 Grade R and Grade 1 classrooms of a medium fee private school in Gauteng, one of the 111 schools in South Africa which has achieved 100% matric pass rate in the last 5 years. (Source: Miss Gabryk and McAuley House School)
17.7 Summary

South Africa remains a highly unequal society and this extends to education. It is likely that poor quality education is creating a vicious cycle whereby schooling does not enable intergenerational mobility (Moses et al. 2017). This chapter has shown that socioeconomic status, enrolment in resourced schools, and geographical location strongly determine educational outcomes. While former racial discriminatory practices are partly to blame, the failure to upgrade geographically marginalised black and coloured schools is greatly exacerbating the problem. In terms of the resource backlog, public private partnerships may be a means to achieving resource equity. Poor teaching (especially of numeracy and reading in the lower grades and maths and science in the higher grades), along with weak school management, is partly responsible for the massive demand for former white resourced schools, education inflation, internal learner migration and the long costly school commute. Transformation in terms of numbers and qualifications of teachers and school management systems in the no-fee schools is required if South Africa wishes to improve education quality (Howie et al. 2008; Spaul 2013).

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T. McKay
How Food Secure Are South Africa’s Cities?

Jane Battersby and Gareth Haysom

Abstract

Food insecurity in South Africa remains a persistent challenge. Traditionally, food insecurity has been seen as affecting rural areas only, and this perspective had previously informed, and is still informing, policy and food security responses. South Africa is over 60% urbanised and yet policies and mandates regarding food security do not reflect this shift. This chapter seeks to answer the question ‘how food secure are South Africa’s cities?’, describing the state of food insecurity in South Africa’s cities, but also highlighting the specific nature of urban food insecurity. The chapter argues that food insecurity is the result of poorly framed and mandated policies, that food insecurity is driven by changes in the food system, and that spatial and structural issues also drive food insecurity. These challenges are reinforced in cities where the food insecure rely on the market as a means to ensure food availability. South Africa’s cities are food insecure and will remain so within the current market and governance regimes.

Keywords

Food security policy · Food systems · Informal food economy · Nutrition · Urban food systems

18.1 Introduction

Answering the question ‘how food secure are South Africa’s cities?’ may seem a simple task, but in truth the situation is far more complicated. Earlier definitions of food security focused on the aggregate availability of food in a country, either by sufficient production of food within the country (national self-sufficiency) or by being able to import food that was not being produced (national food security). However, it became increasingly clear that food security at the household or individual level was not determined by availability of food alone. Most food security scholars now use the definition of food security adopted at the 1996 World Food Summit, in which food security is defined as “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO 1996). Under this definition, food security is not simply about an absence of hunger, but about the quality of diet and the capacity of people to access food to meet their needs and preferences. This depends on four pillars: availability, accessibility (physical and economic), utilization, and stability. The complexity of this definition and the subjective nature of food security therefore make measurement of food security levels complex and contested. Despite this focus and shifts in policy and programming, food security remains a persistent challenge globally (FAO et al. 2017), but one where urban food security remains under researched. In South Africa, the policy and programmatic environment remains dominated by questions of availability and simplifies the issue of access to one of sufficient monetary income to purchase a basic basket of food. The determinants of food insecurity extend well beyond monetary poverty, however.

South Africa is 65% urbanised (World Bank 2017). For the vast majority of urban residents, food is accessed through the market and not through production (SACN 2015). Food access requires cash to spend at the market, but this is not sufficient to ensure food security. Food access is also determined by having a food system that is responsive to the needs of urban residents, particularly the urban poor. Market access, the cost of food, stability of food prices and geographical access to food sources all determine food security. This chapter will argue that, when the full Food and Agricultural Organisation (FAO) dimensions of food security are considered, South African cities are largely food-insecure.
places, with nodes of extreme food insecurity in many areas within the urban fabric of the country.

The chapter uses this overview of the state of food insecurity in South Africa and South African cities to delve into some of the drivers of, and issues faced by, the food insecure in South African cities. A significant outcome is that far greater attention must be paid to urban food security issues, and that food security is not just the responsibility of national government but also of local authorities. Further, addressing food security requires inter-departmental, inter-ministerial and inter-sectoral responses — the governance structures currently inhibit such cooperative governance.

18.2 General and Urban Food Security Policies and Approaches

In South Africa, local government has no discreet formal mandate to address food security. Despite this ‘absent policy mandate’, the right to food and nutrition are enshrined in the South African Constitution under Sections 27.1b, 27.2 and 28.1.c:

27.1.b and 27.2 – Everyone has the right to have access to … sufficient food, water … and social security … [and that] … the state must take reasonable legislative and other measures within its available resources, to achieve the progressive realization of these rights. (RSA 1996, p. 1255)

28.1.c – Every child has the right… to basic nutrition, shelter, basic health care services and social services. (RSA 1996, p. 1255)

Schedules 4 and 5 of the Constitution detail specific areas of ‘legislative competence’ (RSA 1996, p. 1331(36)), noting the key food system functions attributable to different spheres of government. It is the duty of national, provincial and municipal government to work towards the realization of the right to food. Read as a guide to inform the responsibilities of the State, the Constitution holds local government responsible for the attainment of these rights and, as such, food security. However, given the framing of food and nutrition security by national government, most urban governance office bearers see food security as the responsibility of some other sphere of government. This assumed ‘absent mandate’ has problematic consequences for the urban food insecure.

Prior to the adoption of the 2014 National Policy on Food and Nutrition Security (RSA 2014), food security in South Africa was driven by three key strategies and programmes: the Integrated Food Security Strategy (DOA 2002), housed in the Department of Agriculture, Forestry and Fisheries; the Integrated Nutrition Programme (DOH 2002) in the Department of Health; and the National School Nutrition Programme (DOE 2013) within the Department of Basic Education. There have also been other programmes but these have been secondary to these key national strategies, of which the Integrated Food Security Strategy (IFSS) has been the dominant one.

By virtue of its location in the Department of Agriculture, Forestry and Fisheries, the IFSS has largely focused on issues of production and has framed the food security problem as one of rural poverty (Dririe and Ruysenaar 2010). However, this framing of food security as a rural problem, based on proportion of households with low income levels, is fundamentally flawed. The IFSS, the strategy that was meant to guide all food security strategies and programmes, states that “compared with others, Gauteng and the Western Cape are wealthier provinces with the least number of poor households at less than 12% each” (DOA 2002, p. 22). These are the most urbanised provinces in the country. The IFSS demonstrates two key flaws. The first is to suggest that food insecurity correlates to income poverty as its primary determinant. Second is the use of percentages to indicate the location of food insecurity. Drawing on household expenditure data in the IFSS document, the SACN report (2015, p. 14) shows how the use of propositions is misleading: “6.1% of Gauteng’s 1 964 168 households spent R600 or less per month compared to 21.7% of the Northern Cape’s 186 984 households. Although the Gauteng proportion is far lower, this equates to 119 814 households in Gauteng, compared to 40 575 households in the Northern Cape.” The point here is that while Gauteng and the Western Cape “may have the lowest proportions of people categorised as poor, the population sizes of these provinces mean that they do not necessarily have the least number of poor households” (ibid., p. 14). The use of proportions generates a misleading understanding about the location of poverty and food insecurity. The rural and production (food availability) framing in the IFSS, which has informed sub-national food security interventions, leaves little scope for municipalities to address food insecurity, as there are generally no equivalent local government departments of Agriculture, Health or Education dealing specifically with food issues. In addition, food security is overwhelming identified as a rural problem. This means that there is no funding allocation to municipalities to systematically address food insecurity (SACN 2015).

The National Development Plan (National Planning Commission 2013) and the Integrated Urban Development Framework(s) provide new framings of food security. These framings allow for fresh approaches to urban food security. However, unless there are immediate fiscal allocations, very little policy change will take place at the municipal level. In 2010, Cabinet adopted the 12 Government Outcomes approach (RSA 2010). These outcomes were developed to frame public service delivery through the three tiers of government. Outcome Number 7 relates specifically to food security, described as being evident in vibrant, equitable and sustainable rural communities and with food security for all.
This outcome has been influential in shaping Provincial responses to food insecurity. The rural framing of food security is clear here.

While local government has no specific policy mandate to work towards food security, all municipalities are directly or indirectly involved in the governing of the urban food system. This includes public health permits, issuing of trading permits, zoning approvals for supermarkets, and the management of transport interchanges, to name but a few. Municipalities are indeed involved in many facets of governing the food system and food security outcomes, even if this is not explicitly recognized. This fundamentally shapes the experience of food security in urban areas (SACN 2015).

The above policy discussion has briefly framed three key issues. Firstly, the rural and production orientation dominates food security framing and policy in South Africa. Secondly, and linked to this framing, is the absence of any real appreciation for the scale and extent of food insecurity in South African cities. Finally, the absence of a formal food security mandate at the municipal level, despite multiple governance and programming activities, impacts urban food security directly. These omissions in policy and practice lay the foundation for a challenging food security environment in South African cities, an environment that is further compounded by the functioning of the South African food system.

### 18.3 The South African Food System

The structure of the food system plays a key role in shaping urban residents’ abilities to have at all times “physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO 1996). This definition highlights the intersection of the four food system dimensions, ensuring that sufficient food is produced (availability), that the food produced can be consumed, bought or traded (access), and that the food can be consumed in a manner that is socially appropriate and in a manner that enables optimal nutrition and health (utilisation). The fourth aspect is that of a stable food system (stability), and one where society can plan food access approaches with certainty (Haysom 2017). It is therefore essential to understand food security as an outcome of the food system and other wider systems. The food system comprises (1) the activities, actors and institutions who grow, process, distribute, acquire, consume and dispose of food and how they interact with other systems and actors, and (2) the outcomes of these activities contributing to food security (adapted from Ericksen 2008; Roberts 2001). Urban food security is thus directly linked to the functions of the wider food system.

Previous actions to address food insecurity have focused on addressing household poverty and have identified unemployment as a key determinant of food insecurity. However, work by the Pietermaritzburg Association for Community and Social Action (PACSA) suggests that many waged households are unable to achieve food security based on their income. PACSA have developed a household food basket used to track prices. Their work suggests that for a family of five to purchase sufficient food to meet their nutritional needs and other essential household costs, they would need an income of over R6600 per month (PACSA 2017, p. 7). This means that even employed households would struggle to achieve a balanced diet. Food insecurity needs to be understood as being caused in part by problems in the food system, a system that makes healthy foods unaffordable for the majority of the population (SACN 2015). Available money for food also needs to be considered in the context of other costs of living, which are generally higher in urban than rural areas.

The interactions of the food system with the urban system generate conditions that hamper food security (SACN 2015). Questions also need to be asked about the drivers of food prices and the relative affordability of healthy and less healthy foods. The South African food system, like that of other countries, has undergone significant consolidation in the past 20 years, facilitated largely by deregulation of the agricultural sector since the 1980s (Kirsten and van Zyl 1996). Within food retailing in South Africa, four major companies account for 97% of all food sales in the formal retail sector (GAIN 2012). This consolidation influences downstream processes in the food system (Bienabe and Vermeulen 2007). In describing the South African food system, Greenberg (2010, p. 11) states that “the food and food products sector is one of the most concentrated sectors in South African manufacturing. Between 1975 and 1996, the contribution to output of the top 5% of firms increased from 65% to 75%. The top 15% of firms had 90% of output in 1996 (Louw et al. 2007, p. 14). A few large corporations dominate the South African food industry: National Brands, Pioneer Foods, Tiger Brands, and Nestle S.A.” In the South African food system, power does not vest with either the producer or the consumer, but rather with multiple actors connected to the food system. This therefore suggests that more complex food security interventions, beyond improving food production to decrease prices, are necessary by the State. In South Africa, food price inflation is generally higher than consumer price inflation (PACSA 2017) and the system is subject to great volatility. The end result is that those who rely on the market to access food are subject to food price fluctuations and food price increases that exceed normal inflation. As the PACSA (2017) data show, despite food availability, it is not just the poor who are unable to ensure a stable food environment with affordable and nutritious food.
18.4 The State of Urban Food Security

Food security figures in South Africa have tended to be reported at the provincial or national level, with no disaggregation between rural and urban. This allowed the presumption of higher rural food insecurity to persist. However, a 2009 report (Altman et al. 2009, p. 354) that analysed the 2007 General Household Survey found “a very large share of seriously hungry households live in a few urban districts … Counter-intuitively, more than 30% of all seriously hungry households lived in Cape Town, Ekurhuleni and Johannesburg in 2007”. Following this, the 2012 South African National Health and Nutrition Examination Survey (SANHANES) disaggregated the figures to offer insight into the locus of food insecurity. This study found that 26% of South Africans experience hunger, while an additional 28% were at risk of hunger (Shisana et al. 2013). Using the earlier dimensions of food security (FAO 1996), this means that a total of 54% of South Africans face food insecurity. When considering the SANHANES data more closely, it was reported that while 37% of respondents experiencing hunger were in the rural informal sector, 32% were in urban informal areas (Shisana et al. 2013). The highest prevalence of risk of hunger was actually in urban informal areas (36%) (Fig. 18.1).

These large-scale national surveys provide evidence of the levels of food insecurity in urban areas. Smaller case studies are also helpful in providing insight into the food geographies of the urban food insecure. In general, most of these place-specific case studies used quantitative surveys using the Food and Nutrition Technical Assistance (FANTA) survey methodology (Coates et al. 2007). In Cape Town, a 1060 pro-poor household survey was conducted in 2008 by the African Food Security Urban Network (AFSUN) using the household food insecurity access prevalence (HFIAP) measure, a component of the FANTA methodology. This study found that 80% of the households in the sample were either moderately or severely food insecure, with 68% falling into the severely food insecurity category (Battersby 2011). This pattern of high levels of food insecurity among the poor was also found among the immigrant population in Masiphumelele, Du Noon and Nyanga townships of Cape Town. The study found that 84% of the surveyed households were moderately or severely food insecure (Crush and Tawodzera 2012). The AFSUN survey conducted in Johannesburg, using the same methodology, found 56% of the households in Orange Farm, Alexandra Park and the inner city to be food insecure (Rudolph et al. 2012). It should be noted that in each of the AFSUN surveys (Cape Town, Johannesburg, and Msunduzi) the sample size was much larger than the General Household Survey sample in those cities, and had a specifically pro-poor sample. This may make their findings a better indicator of food insecurity in low-income areas of these cities than the General Household Survey.

Using a different methodology, Vearey et al. (2009) surveyed three inner city settlements and one informal settlement in Johannesburg and found significantly high levels of food insecurity. A higher proportion of residents of the informal settlement reported experiencing food shortage in the previous 12 months (68%) than residents of the inner city (56%). In Durban, Bikombo (2015) concluded that food security of informal food traders was precarious. The study found that 90% of households (120 households surveyed) indicated experiencing various levels of food insecurity at different times.

Despite assumptions about smaller towns having more direct links to rural production sites, surveys in such towns...
have also identified high levels of food insecurity. Ndobo and Sekhampu (2013) used the HFIAP survey in Kwakwatsi in North West Province and found that 49% of the 225 sampled households were vulnerable to food insecurity. A study in Bophelong (Gauteng) by Grobler (2013) assessed the food security levels of household heads and their vulnerability to food insecurity, again using the HFIAS methodology. The study reported that 24% of households were moderately food insecure and 58% were severely food insecure. Only 7.5% of households were food secure.

Dietary diversity is an indicator of food security that extends beyond caloric sufficiency and can be used to assess nutritional adequacy of diet. Two main measures of dietary diversity have been used in South Africa. A number of studies used the FANTA-developed Household Dietary Diversity Scale (HDDS) (Swindale and Bilinsky 2006). This uses a 12-food group rating. Under this measure, a score of less than 6 is a proxy indicator of malnourishment. The Dietary Diversity Score (DDS), used in the South African Social Attitudes Survey, applies a 9-food group rating. Under this measure, a score of less than 4 is a proxy indicator of poor dietary diversity and poor food security (Labadarios et al. 2011). In the Cape Town AFSUN study, the average HDDS was 6 out of 12. When the actual food types were analysed, it revealed a largely non-nutritive diet of starchy foods, tea and coffee, snack foods and foods cooked in oil (Battersby 2011). Using the DDS, the South African Social Attitudes Survey found that the average national DDS was 4.02 (Labadarios et al. 2011). The finding here is that dietary diversity was only marginally above the DDS score of 4, the proxy indicator for food insecurity.

For a variety of reasons food insecure households tend to be over-reliant on starchy staples, excluding proteins and other essential nutrients from their diet (Savy et al. 2005). Despite eating enough food to meet their calorimetric food requirements, the type of foods consumed by household members does not always have the requisite nutrients for physical and mental health and development. Dietary quality is an important health issue.

The nature of food insecurity is changing. In food insecure households, malnutrition persists but overweight, obesity and diet-related non-communicable diseases such as diabetes are on the increase. The SANHANES study found that over 50% of women and 30% of men are overweight or obese (Shisana et al. 2013). The South African Demographic and Health Survey in 2016 found 68% of women and 31% of men to be overweight or obese (DOH 2017). In addition, 22% of urban women were severely obese (BMI over 35) compared to 17% of non-urban women (DOH 2017). Other dietary-informed nutrient deficiencies also exist across the country, and include low anaemia levels of 22% among adult women and iron deficiency anaemia among women of reproductive age (10%) (Shisana et al. 2013). Vitamin A deficiency among this group (13%) is deemed a moderate public health problem. This double burden of disease exists for many reasons, including declining levels of physical activity, but more important is the nutrition transition that South Africa is undergoing (SACN 2015). Given the scale of food security identified in South African cities, it is reasonable to anticipate that these national figures would be similar across all South African cities.

Food insecurity also has a distinct temporal nature. Despite a constant supply of food to cities, there are distinct hungry seasons. In all case study cities examined, distinct periods of hunger were identified, with January and midwinter being most severe. The January food shortages are related to increased spending cycles over the festive season, where households find themselves facing critical shortages in the following month, coupled with additional expenses such as school fees (or fee supplementation in the case of fee-free schools) and uniforms. Businesses often close down over the December/January festive season, reducing potential casual labour opportunities. Shortages over winter months are linked to adverse weather conditions that reduce casual wage opportunities, but also additional household costs for items such as heating fuel and transport (Battersby 2012a).

Household food insecurity is determined by a number of interconnected factors. Income plays a key role but it is not the sole indicator of food security. As urban households source the vast majority of their food through the market, both formal and informal, a higher income means a greater choice about what to buy, how much and where (Figs. 18.2 and 18.3). Certain food choices may not be available to those...
Fig. 18.3  Food access strategies, Cape Town (2013) (n=2504). (Adapted from Battersby et al. 2016, p. 5)
with a lower income (SACN 2015). Cooke’s (2012) research in Manenberg, Cape Town, found that reliability of income is an important driver of food consumption. If a household has a guaranteed income, it is better able to plan food purchase and preparation, and therefore has higher food security than households of equal or even greater but inconsistent income. Social grants in South Africa form a critical income source for most of the poor, stabilising their income (SACN 2015). However, as the PACSA data show, the amounts paid via the social grant may ensure a stable income but does not translate into the requisite income to enable adequate food security. Despite a stable income, even if inadequate, food price volatility plays a direct role in how the poor are able to access food. The poor are most affected by food price increases, as they spend a higher proportion of their incomes on food (SACN 2015).

A critical but often overlooked determinant of food security is spatial access, one that is frequently missed in the refrain from city officials and politicians that food security is not their area of responsibility. Links between spatial access and food security have emerged as a key area of study, largely in the global North, and specifically in the literature pertaining to food deserts (Beaumont et al. 1995; Wrigley 2002). This literature only partially addresses the South African situation (see Battersby 2012b for a detailed analysis of this). Apartheid and post-apartheid spatial inequality, coupled with high dependence on poorly integrated public transport, leads to lengthy commutes for the working poor, reducing their ability to access affordable, nutritious foods (Zager 2011). Scholars are one such example, travelling long distances daily to get to and from school, often leaving home without a meal and then having to rely on street vendors (Fig. 18.4). Research has shown that groups at high risk of food insecurity often live in residential areas that are not well serviced by shops or have inadequate public transport (Battersby and Peyton 2014). In most residential areas inhabited by the poor, formal shops tend to be sparse and public transport generally poor, factors that have a direct impact on the types of food access used by poor urban residents (Even-Zahav and Kelly 2016; Oldewage-Theron et al. 2006).

Figure 18.3 highlights the different food systems used by different income terciles in Cape Town. While supermarkets are used by all segments of society, two other key aspects are highlighted: first is the important role that the so-called informal sector plays in the food access strategies of the lower income tercile; second, the non-financial food access strategies such as borrowing food and sharing food with neighbours are stresses in the food system and the strategies applied by communities, particularly in the lowest tercile, in their efforts to ensure food access.

Spatial access is not the only non-market related determinant of food security. It is also influenced by the structure of the household. Due to their relatively lower incomes, female-headed households have been found to be generally less food secure than nuclear households (Battersby 2011; Crush and Tawodzera 2012; Ndobo and Sekhampu 2013). However, given similar incomes, female-headed households are often more food secure than nuclear households. The dwelling structure and amenities also influence food security. Lack of adequate refrigeration or storage shapes purchasing habits both in terms of volumes and categories of food bought (Ballantine et al. 2008; Reardon et al. 2004). Within the AFSUN Cape Town survey it was found that shack dwellers were about 20 percentage points more likely to be severely food insecure than house dwellers in the same areas (Battersby 2011).

Poor households are engaged in a constant struggle to find ways to respond to limitations in food access. Multiple cop-

Fig. 18.4 Scholars purchasing food from vendors outside school gates. (Photo: Eric Miller, reproduced with permission)
ing strategies are applied. Many of these involve thick community networks that are often under significant strain. Borrowing food from neighbours, sharing meals, and sending children to play over lunch at households known to have more food, all form part of such strategies (Fig. 18.3). These networks however require constant maintenance and reciprocation if they are to be accessed when needed (Duncan 2013). The challenge with such networks is that while these actions reflect signs of community action, and even agency, they also mask the true extent of food insecurity (Maxwell 1999). Other coping strategies include consumption smoothing, the practice of either reducing the amount of meals eaten or the diversity of diets (SACN 2015). Accessing credit, often without or with limited interest, from certain neighbourhood informal traders (Skinner and Haysom 2016), or more problematic debt via loan sharks or money-lenders, are further common strategies to achieve food security.

Contrary to more popularly held views and policies, urban agriculture and peri-urban production do not provide the ‘silver bullet’ that will address urban food security (Haysom and Battersby 2016). The surveys conducted in poor areas of Cape Town, Msunduzi and Johannesburg suggest that urban agriculture is not a major contributor to food security for the urban poor (Fig. 18.5). Census 2011 provides information on the numbers of households engaged in agricultural activities by municipality across South Africa, showing varied uptake in different cities. Towns and cities with the largest uptake are often those with large peri-urban (effectively rural) areas. Municipalities such as Mafikeng, Lephale and Polokwane recorded over 20% uptake, but Drakenstein, Johannesburg and Cape Town recorded uptake of between 3% and 7% (SACN 2015). In South Africa, a number of case studies have attempted to assess urban agriculture’s impact on food security, comparing the food security of urban agriculture practitioners with a broader population. Thornton’s (2008) work in Rhini and Peddie (Eastern Cape) attempted to put a cash value to urban agriculture in terms of offsetting food purchasing. The results showed limited importance of urban agriculture for food security. In Atteridgeville, Pretoria, van Averbeke (2007) found that the urban agriculture projects studied could account for about 28% of the vegetables required for participating households. Webb (1996, 2000) found that there are no differences between dietary habits and nutritional status of urban farming and non-farming households. Economic benefits from the sale of produce are limited. With the exception of the organic box scheme run by Abalimi Bezekhaya in Cape Town, market channels for urban agricultural producers are limited with little option to sell to municipal markets, supermarkets or the state. Case studies of urban agriculture, over an extended period of time, suggest that despite the intended target being ‘the poorest of the poor’, many of the participants in urban food production do not fall into this category (May and Rogerson 1995; Rogerson 2010; Ruysenaar 2013). This is in part because the most vulnerable cannot afford the time between investment in production to harvest, or the risk of crop failure (SACN 2015).

![Fig. 18.5](image-url) Sources of food: supermarket, informal trade and urban agriculture. (AFSUN, with permission in SACN 2015, p. 22)
18.5 Summary

This chapter has sought to answer the question ‘How food secure are South Africa’s cities?’ Answering this question requires an engagement in the nature and structure of how food security is framed and articulated in policy, but also how it is driven by the activities and functioning of the food system, poverty, place and agency at the household scale. The national-scale surveys paint a picture of a society that is at significant risk of food insecurity, with over a quarter of the population experiencing food insecurity. South African cities reflect these same trends. In urban areas, the food insecure need to access food via the market. South Africa’s increasingly consolidated and formalised food system does not effectively respond to the needs of these people. The consequence is that the urban poor are subject to high levels of food insecurity, coupled with the real threat of nutrient deficiencies which can increase their risk of non-communicable diseases.

From a policy perspective, the actions of many departments, ministries and spheres of government also impact food security. However, addressing food insecurity is not the responsibility of government alone and there are many actors in the food and related peripheral systems. Innovative cooperative governance models are required, particularly at the city scale. The current national government-driven, production-oriented, rural-aligned, food security response is not only inadequate, but this misaligned focus is in part responsible for the high levels of urban food insecurity. Local government, particularly in cities, plays a critical role in food security, despite having no formal food security-specific mandate. This role needs to be developed if the high levels of food insecurity in South Africa’s cities are to be addressed.

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Abstract
The Constitution of South Africa outlines the right of every South African to adequate housing, and sets out the roles and responsibilities of the State in providing these homes. South Africa has a complex history in terms of housing, dating back to colonial and apartheid times when non-white residents were forced onto the periphery of towns and cities. Since 1994, the South African government has worked hard to provide housing for its citizens. This has, however, been a slow, complex and often politicised task which has frustrated a large portion of the population. South Africa has a wide housing typology which includes informal dwellings, state-subsidised housing, and bonded/mortgaged homes. Gaining access to these various types of housing options has proven difficult for many, particularly those who fall into the ‘gap market’, not being rich enough to access a bond from the bank but not poor enough to qualify for state-subsidised housing. This is a major challenge alongside the shortfall in housing provision. This chapter discusses the background of housing in South Africa, the various types of housing that exist, the legislative and policy components of housing, and finally the challenges and opportunities that the housing sector faces.

Keywords
Housing · Informal settlement · Renting · Shacks · Urbanisation

19.1 Introduction
This chapter aims to provide an overview of housing and shelter in South Africa. It begins by providing a background to the South African housing landscape and provides an overview of the various types of housing that exist in the country. It then discusses various legislative and policy aspects of housing provision followed by a section on the challenges and opportunities faced by the housing sector. South Africa’s National Constitution preserves the right of every citizen to adequate housing. The Bill of Rights in Chapter 2 of the Constitution is clear on the universal right to adequate housing and that it is the State’s responsibility to take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of this right (Constitution of the Republic of South Africa 1996). South Africa has a mixed housing stock with both the property market and the State providing housing. Many individuals have access to housing through private means (bonded/mortgage housing and rented properties), others often rely on the State to provide them with housing and shelter (social housing and state-subsidised housing), while the poor find housing in the informal sector. South Africa is currently facing a housing crisis with a number of its residents living in informal settlements and in situations of insecure tenure (Marais and Ntema 2013). The country’s history of colonial segregation and apartheid has meant that much of the population remains without adequate housing and basic services. Arguably, while the State has worked to address the housing backlog, many communities feel that this process has been a slow and frustrating one. Although some residents have received homes through state-subsidised housing schemes, these structures are often of poor quality and inadequate for larger families (Massey 2013). South Africa also has a significant lack of gap-housing stock. For those not rich enough to afford bonded houses and not poor enough to qualify for state-subsidised housing, this has proved a significant challenge. Social-housing schemes have not been as
South Africa has a long history of racial segregation dating back to colonial rule. Apartheid had a particularly significant impact on the landscape which saw restrictive legislation such as the Group Areas Act set aside prime areas of the city for exclusive use by the white population. This forced non-white citizens onto the periphery where they struggled to access basic infrastructure and services as well as economic and social opportunities. Racial segregation and apartheid planning also did much to entrench informal settlements as a predominantly black African problem by forcing black residents of the city into designated areas on the periphery of urban development (Lemon 1991). In 1994, one of the many promises made by the new legislature was that of housing provision. Housing was to be a right enshrined in the Constitution and the expectation of millions of South Africans was that the new government would provide them with homes. This has, however, not taken place as quickly has many had hoped and the delivery of housing and shelter by the South African government has proven to be a slow and complex process. This has caused frustration and tension within a number of communities across the country. The exact number of people still waiting for state-subsidised housing is unclear, which has also been a challenge in addressing the housing backlog (Tissington 2011).

In 2004 the, then-named, National Department of Housing (NDoH) (now Department of Human Settlements (DHS)) estimated that since 1994, R29.5 billion in state-assisted housing investment had resulted in 1.6 million housing opportunities with over 3 million housing subsidies having been approved (Department of Human Settlements 2004). The concern however is that the actual delivery of housing has been significantly slower even though allocations from the Integrated Housing and Human Settlement Development (IHHSD) grant have increased (National Treasury 2009). The National Treasury reported that between 1995 and mid-2008 the IHHSD grant paid out approximately R49 billion (National Treasury 2009). This provided 2.6 million housing opportunities at an average delivery rate of 200,000 units a year (National Treasury 2009). Between 1994 and 2010 the housing backlog grew from 1.5 million to almost 2.1 million (according to the DHS) which translates into approximately 12 million South Africans still waiting for adequate housing (Tissington 2011). Many residents believe their names sit on a waiting list with the Department of Human Settlements but this process has been shown to be flawed (Oldfield and Greyling 2015). Several elements have affected this increase in need including the change in household structures, a rise in urbanisation and urban in-migration (often due to a lack of opportunities in rural areas), and unemployment. Other factors include a growth in the number of households that fall into the subsidy income band and a decrease in access to housing finance.

It is estimated that 2.8 million households in South Africa rent their accommodation (around 20% of the population) (Grant 2009). In many cases, residents rent their shacks in informal settlements from landlords (Gunter and Massey 2017). Most households that rent their properties are classed as low-income with approximately 55% of these renting households earning less than R3500 a month (Grant 2009). Much of the rental stock available, however, could be characterised as slum conditions where properties are not adequately maintained, tenants are exploited (and often unfairly evicted), and living conditions are unhealthy and/or dangerous. Demand for affordable accommodation is so high that residents often have little choice but to remain in these spaces. It is anticipated that for income groups earning between R1600 and R3200 per month, formal renting requirements will increase significantly per annum in metropolitan areas (Department of Human Settlements 2009). There is a major unmet demand for affordable, quality, well-placed rental accommodation in key urban centres. There is also a significant portion of the population who are ‘falling through the cracks’ particularly households that earn between R3500 and R7000 per month (Government Communication and Information System (GCIS) 2010). This part of the population is referred to as the ‘gap market’ in the National Housing Code; the Department of Human Settlements defines this group as those earning between R3500 and R12,500 per month (Department of Human Settlements 2010). This income group does not qualify for the subsidised housing scheme but also does not earn enough to secure a formal loan from a commercial bank. High levels of household debt, low earnings, and restrictions placed on lending through the National Credit Act prevent banks from extending credit to this part of the population. The limits faced in this gap market demonstrate the need for affordable housing which caters for those who fall within this bracket.
There are eight metros in South Africa: City of Johannesburg, City of Cape Town, City of Tshwane, Ekurhuleni Metropolitan Municipality, City of eThekwini, Nelson Mandela Metropolitan Municipality, Mangaung Municipality, and Buffalo City. There are also a number of secondary cities which have an established formal core of commerce, mining, and suburban development which are often linked to former homeland settlements nearby. These cities are also made up of formal townships with backyard dwellers, informal and traditional settlements, as well as subsidised housing on the periphery (Turok and Watson 2001).

As indicated in Fig. 19.1, housing and shelter in South Africa are made up of the following: informal shacks built on squatted land, informal shacks built in backyards of formal dwellings, subsided social housing (often presented as stand-alone houses), social multi-unit housing, formal housing in townships (which are bought or rented), formal free-standing housing in suburbs, formal cluster housing in suburbs (i.e. gated developments and lifestyle estates), and, finally, multi-unit housing in cities (high rise buildings and flats). In this chapter informal housing, low-cost housing, bonded (mortgage linked) housing are the focus.

19.3.1 Informal Housing

The proliferation of informal housing, both in shanty towns, urban centres, informal rural settlements and on farms, points to a significant proposition of people who find both shelter and their livelihoods in informal settlements (Gunter and Manuel 2016). In 2010 it was estimated that the number of informal settlements had risen to more than 2700, housing approximately 1.2 million households (Sexwale 2010). Many of these informal settlements are found on peripheral areas, far from employment and frequently on land that is not suitable for other forms of construction and development (Tomlinson 2007). The historical legacy, specifically with regard to housing and informal settlement, has led to a spatial distribution of informal settlements that most often coincides with the location of apartheid planned townships, either being in or near these original points of entry (Rogerson 2016). The informal sector plays a major role in housing the poor of South Africa and operates on multiple levels and housing typologies, from rented shacks in informal settlements to brick built structures in backyards. The housing backlog has been addressed by the informal sector where millions of dwellings have been built in informal settlements and in ‘backyards’ of formal housing (Lemanski 2009).

Backyard shacks are a unique component of the South African informal housing stock and a large component of housing is found in the ‘backyards’ of formal housing. This informal housing has increased the housing density of many settlements and allows informal dwellers access to some services, such as water and electricity. The current role of ‘backyard’ dwellings provides the basic needs of many of the poor without needing formal financing by the State or the private sector. This concentration of both formal and informal dwellings possibly demonstrates that the urban poor see adding informal dwellings as adding value to their property (Jarbandhan et al. 2016). While there is a need for new social and formal housing in South Africa, it is conceivable that informal housing will play a significant part in housing the urban poor into the future. Despite the role that informal dwellings fulfils, government views informal housing as a blight and aims to replace it with formal housing. Nevertheless, without the informal sector the government would be in no position to provide the numbers of dwelling units needed (Turok and Borel-Saladin 2016).

19.3.2 Low-Cost Housing

In order to provide for the right to housing as well as meet the backlog in housing needs, government has delivered a number of large scale housing developments. These have included social housing units (often in densified layouts and with multiple storeys) and stand-alone houses (colloquially known as ‘match box’ or RDP housing) developed chiefly during the time of the Reconstruction and Development Programme (RDP) and consist of a living area, kitchen, bathroom, and two bedrooms. In 2004 it was estimated that, since 1994, R29.5 billion had been spent in state-assisted housing investment. This said, the delivery of homes has not taken place quickly enough for the growing need of the urban population (Department of Human Settlements 2004). The period between 1994 and 2010 saw the housing backlog grow from 1.5 million to almost 2.1 million which means that approximately 12 million South Africans are still waiting for housing (Tissington 2011).

Much of the housing provided has also been too small, of a poor quality (Gilbert 2004; Omedia 2009) and inappropriately placed in terms of its location (on the periphery, far from social and economic amenities, as well as transport networks). This has left residents in a worsened state of poverty, forcing many of them to move back to informal housing closer to their places of work or to rent out their homes and/or backyard dwellings. Many of the housing units have also been pitched at those with higher incomes leaving those without financial resources without homes. The Cape Town N2 Gateway Housing Project is a good example of a low-income housing project that did not cater for housing the unemployed. In this case, new housing projects built along the N2 highway did not house dispossessed shack owners (Bradlow et al. 2011; Newton 2008, 2009; Steinbrink et al. 2011). This was because the housing units were rented and sold at prices more aligned with working class income levels.
Fig. 19.1 The main housing typology of South Africa. (a) Informal shacks built on squatted land, (b) informal shacks built in backyards of formal dwellings, (c) social ‘match box’/RDP housing, (d) social multi-unit housing, (e) formal housing in townships, (f) formal free standing housing in suburbs, (g) formal cluster housing in suburbs, (h) multi-unit housing in cities. (Photos: the authors)
and not that of the average low-income shack dweller. Other examples of large scale housing developments include Cosmo City, and the Brickfields Housing Project.

19.3.3 Bonded (Mortgage Linked) Housing

Bonded or mortgaged housing is available to a minority of South Africa residents due to low household incomes, overindebtedness, difficulty accessing credit, and the lack of affordable housing stock. Many suburban areas in the country have experienced various property booms (a major contributor to wealth creation in South Africa) (Ballim 2006; Bullard 2004; Clayton 2004; Smal and de Jager 2001). Even in township spaces, property prices have increased, and certain areas of Soweto now have property selling for millions of Rands. However, many township areas have seen little or no rise in value and there is a massive under development of housing stock in this segment of the market.

Despite the recent global economic crisis, property prices in the suburbs of South Africa have managed to hold their value (Ballim 2006; Clayton 2004). The high price of well-placed land has also contributed to the high price of properties. There has been a significant increase in densification in many major cities and the development of housing clusters in ‘security estates’. This development type has held its value well in the current economic environment in South Africa, and large areas of many cities in South Africa are now dominated by these cluster type developments selling in the mid-segment of the market. Yet despite the growth in the formal housing market, the ability to enter the property market has become a challenge for most South Africans.

19.4 Housing Policy and Legislation

Housing has been a central legislative issue both during and after apartheid. During apartheid, the key legislation was about segregated housing for different races; the post-apartheid period has focused on the provision of housing in urban areas. There have been numerous housing policy and legislative documents since 1994. The housing sector is complex and the governance system attached to it is equally broad and intricate. Legislation relates to the financial, regulatory, environmental, technical, developmental, and institutional features of housing. The cornerstone of all housing legislation and policy is the Constitution which protects the rights of all citizens within the country. The Constitution speaks to the right of all South Africans to housing and the responsibility of the State to provide for this right. From this standpoint other key housing-related policy and legislation has been developed, including the Housing Act 107 of 1997 (amended by Acts 28 and 60 of 1999; Act 4 of 2001), the Prevention of Illegal Eviction from and Unlawful Occupation of Land Act 19 of 1998, the Rental Housing Act 50 of 1999 (amended by Act 43 of 2007), the National Norms and Standards for the Construction of Stand Alone Residential Dwellings financed through National Housing Programmes (April 2007) (National Norms and Standards), the Social Housing Act 16 of 2008, the White Paper (on housing): A New Housing Policy and Strategy for South Africa (1994), Breaking New Ground: A Comprehensive Plan for the Development of Sustainable Human Settlements (2004), and finally the National Housing Code (2000, revised in 2009).

The policy and legislation pertaining to housing in South Africa is thus multifaceted and complex. While there are a number of key policies and pieces of legislation such as the 1994 White Paper on Housing, the Urban Development Framework 1997, the National Norms and Standards 2007, and the Breaking New Ground Policy of 2004, for the purpose of this chapter only the Housing Act (1997) will be discussed as it is the primary piece of housing legislation in the country. The Housing Act requires that a sustainable housing development process is developed and lays down the basic principles for the development of housing in all spheres of government. The Act also defines the functions of each level of government (national, provincial, and local) and sets out the basis for the financing of national housing programmes. This document also requires that all spheres of government give precedence to the needs of the poor and ensure that meaningful consultation takes place with individuals and communities affected by housing developments. Every sphere of government must also provide a wide and varied choice of housing and tenure options which are sustainable and economically affordable. This should be based on an integrated development planning process which is administered in a transparent, responsible and impartial manner, and that upholds the practices and principles of good governance. The Housing Act also requires all spheres of government to promote integration (social, racial, physical, and economic) and put in place measures to prohibit unfair discrimination. Other aspects include the promotion of higher housing densities that guarantee the economical use of both land and services, as well as the provision of special housing needs and the delivery of community and recreational facilities (Tissington 2011).

19.5 Challenges and Opportunities in the Housing Sector

There are a number of obstacles and challenges that the housing sector faces. The first of these is the limit of available housing stock which is both affordable and well located. Housing stock is often also of limited economic or social value to beneficiaries, leading many to (a) use their proper-
ties for business purposes, (b) rent out rooms (or the entire property), and/or (c) develop backyard dwellings. The provision of state-subsidised housing has also been slow and riddled with irregularities and corruption. Other issues include lengthy delays in land proclamation, a lack of bulk services and infrastructure (and capacity), the high price of well-located land, and difficulties in the registration of title deeds (Bond and Tait 1997). Poorly located and badly constructed housing has also led to a deepening in the level of inequality and inefficiency in the country and to long term costs for households. Many developers are not willing to invest in low-cost housing because of a lack of local infrastructure (Lizarralde and Massyn 2008). The Banking Association has argued there are issues around the time it takes for municipal approval as well as the quality of contractors. There is also a lack of affordable rental stock available, while those already tenants under landlords face exploitation and unsafe, dangerous living conditions (often within slum conditions). This and other housing challenges are a particular concern for women who are often sole-breadwinners for their families (Moser 1985; Todes and Walker 1992). The challenges of location, availability and affordability of housing and shelter are therefore core issues within the housing sector in South Africa.

There are, however, also opportunities for improvement and innovation. The role of the private sector in housing finance and development should be supported. To date, this sector has struggled to make profits from low-cost housing projects and more innovative approaches need to be explored. Private-public partnerships have been successful in the development of urban renewal programmes and lessons from this method need to be translated into the housing sector. It is also important to stimulate the rental accommodation market and allow for affordable, well-placed letting space to lower-income households. There are also opportunities for municipalities to improve the housing chapters of their Integrated Development Plans, including the provision of a housing needs assessment as well as the identification and release of well-located and affordable land. Other opportunities include the surveying and prioritisation of informal settlements, the promotion of densification, and the linkage of housing with urban renewal. Community and public participation are also key to the success of housing projects and programmes and should not be ignored. The role of banking institutions in providing innovative financing options is also an opportunity that could allow access to loans for a larger proportion of the population. Further, there is a need to move away from ownership and accord more focus to rental options.

19.6 Summary

It is evident that the housing sector in South Africa is multifaceted and contentious owing to the history of housing provision in the country as well as current pressures from urbanisation, in-migration and a drop in household income. This is made more complex by the difficulties faced by the State in governing housing provision while managing corruption and other obstacles to service delivery. There are a number of challenges faced including the availability and affordability of well-placed land for new housing developments, the provision of basic services (water, sanitation, electricity etc.), the quality and affordability of new housing stock, the lack of rental accommodation, and the high prices of land and property. Current debates within the housing sector (both amongst practitioners and academics) centre around how best to meet these challenges, what new innovative housing schemes and innovations exist to help speed up the process of delivery, and what systems can be put in place to help ease the backlog and also allow for those in the gap market to access homes. Housing is a basic right which is protected by the Constitution of South Africa and, while difficult to manage and deliver, must be a central focus of government departments and their agents.

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The Economic Development of South Africa’s Townships

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Abstract

Townships are one of the most distinctive elements of the South African cityscape. After decades of economic neglect as dormitory settlements, the economic development of townships is emerging as an important policy issue. This chapter examines township local economic development with its domination by informal economies, past and present. Key themes of concern surround the emergence of new economic bases for a formal economy, especially in leisure and hospitality services, the role of the informal economy, and of national government-led initiatives for enterprise formalisation. In addition, controversies surrounding the involvement of international migrant entrepreneurs in township businesses are discussed. Overall, township economic development is a critical research agenda for urban and economic geographers.

Keywords

Economic underdevelopment · Entrepreneurs · Informal economy · Policy · Refugee economies · Townships

20.1 Introduction

The evolution and spatial ordering of South Africa’s urban townships must be understood in relation to the country’s colonial and apartheid past (Philip 2014; Swanson 1968, 1976). Conventionally, their origins are associated with the passage of the 1923 Natives (Urban Areas) Act which took the position that South African urban areas should be regarded as exclusive ‘European’ spaces in which there was no place for ‘natives’ (Beavon and Rogerson 1990). Accordingly, the presence of Africans (blacks) in so-called white urban spaces would be permitted only as long as their labour was demanded by the needs of the dominant white population (Swanson 1976). The 1923 Act entrenched the premise that Africans would be merely ‘temporary sojourners’ residing in segregated spaces (‘locations’ and later restyled townships) adjacent to (white) urban areas (Beavon and Rogerson 1990; Swanson 1968). From such roots in the colonial era, the planning of townships was honed during the apartheid period as part of wider structures of political and economic subordination of the black population (Jürgens and Donaldson 2012; Mahajan 2014). Indeed, in the era of apartheid, South Africa townships were stylized by Beavon (1982) simply as controlled labour pools. Overall, throughout the early decades of the twentieth century into the period of democratic change, the ‘townships reflected the tension between the need to keep black people close enough to provide a source of cheap labour but far enough away to ensure a clear social distance – with the option of rolling out the blade wire to maintain that distance if it was ever at risk of being breached’ (Philip 2014, p.31).

Today, townships remain one of the most characteristic elements in the urban geographical fabric of South Africa. The distinctive feature of the township as a human settlement form is as a dormitory space which was constructed at an appropriate distance from economic activity and white residential areas, and usually comprised rows of uniform matchbox houses with minimal infrastructure and services in terms of water, electricity, sanitation or tarred roads (Beavon 1982; Philip 2014). Petersen and Charman (2018) aver that such localities exhibit conditions of economic and social stress. Jürgens and Donaldson (2012) point out that as late as the close of the 1970s the apartheid townships were a neglected research focus and a largely unknown quantity in local scholarship. Jürgens et al. (2013, p.256) could observe that “a systematic or analytical study, which might have allowed for a look either ‘inside’ or even ‘from within’ the townships remained non-existent and politically inopportune until well into the 1970s”. This said, considerable scholarly interest...
was ignited by the 1976 Soweto riots which exposed starkly the fact that local geographers had failed to examine townships, to comprehend their marginality or to question the fundamental structures of apartheid which re-organised and recalibrated the country’s urban spaces.

It is now more than 30 years since Rogerson and Beavon (1980) called for an ‘awakening’ of research interest by local geographers on these overlooked city spaces. Beavon (1982) echoed this sentiment and averred that the black townships constituted a *terra incognita* for the country’s cohort of urban scholars. Over the intervening years, enormous progress has been made in terms of enhanced geographical understanding of the organisation of township spaces as well as aspects of the daily existence and lived worlds of their inhabitants. During the 1980s, a new wave of township-focused geographical research began to emerge and consolidate. Impetus for the rising interest came from the 1986 official state of emergency “which vaunted the wrecked black townships into world prominence as places where state and residents collide with grim regularity and results” (Pirie and Hart 1989, p.315). Among several notable contributions at this time were a cluster of investigations that interrogated questions about township spaces from a historical perspective (Christopher 1987a, b; Pirie 1984; Pirie and Hart 1985; Torr 1987). Other early significant contributions examined creative writing to produce what was described as “a digest of experiential insight” in order to expose the “artificiality of townships which have been spawned by legal writ rather than by organic urban change” (Pirie and Hart 1989, p.315). Good examples of this genre of urban geographical writings on townships are by Pirie (1982), Hart (1986) and Hart and Rogerson (1987). Collectively, such studies revealed that state control and intervention impacted deeply on the consciousness and lived environment of South African urban townships (Pirie and Hart 1989). In the closing years of apartheid, the work by Lammas (1993) confirmed the value of humanistic approaches to geographical research on townships.

With democratic change it was inevitable, perhaps, that township research would expand considerably, including with a further suite of contributions from human geography. Arguably, it was hoped that the townships might become an integral part of the post-apartheid city (Jürgens et al. 2013). This said, the townships have experienced only a slow transition according to Jürgens and Donaldson (2012). After democratic change, the economic and spatial legacy of apartheid proved difficult to transcend. In particular, the economic and spatial segregation of townships was exacerbated by post-apartheid urban development policy. Urban spatial divides were entrenched by the large-scale construction of housing in post-apartheid townships “which are typically as far – if not farther – from economic opportunities as the homelands under the original apartheid model” (Philip 2014, p.41). In researching dimensions of this ‘slow transition’ of townships, housing research issues have dominated the geographical agenda. Useful works to inform understanding of the changing nature of shelter and sustainable development in township areas include Gilbert and Crankshaw (1999), Gunter and Scheepers (2012), Gunter (2014a), Sachikonye et al. (2014), Cloete and Massey (2017) and Gunter and Massey (2017). Infrastructural developments, governance and urban renewal initiatives are further themes that have come onto the research radar of geographers (e.g. Beall et al. 2000; Donaldson and du Plessis 2013; Gunter 2014b).

One additional facet of ‘slow transition’ relates to the economic development of townships and their transformation from mere dormitory settlements. Although local economic development and issues of place-based economic development have been vibrant recent themes in South African geographical scholarship, such discussions have been only minimally addressed in questions surrounding the essential ‘economyless’ structure of townships. Arguably, Philip (2014, p.41) asserts that the new post-apartheid township spaces “have benefited from only limited spatial planning to enable local economic development”. For Jürgens and Donaldson (2012), the imperative to encourage local economic growth within townships remains a critical research issue, more especially with the desperate need for solutions to address urban unemployment and poverty. Mahlangu (2017) describes townships as South Africa’s ‘economic Cinderella’. It is against a backdrop of historical underdevelopment that this chapter is devoted now to an examination of economic development occurring in townships. Key issues of concern surround the emergence of new economic bases for a formal economy, and the role of the informal economy and of formalisation programmes. In addition, the controversial involvement of international migrant entrepreneurs around business enterprise development in townships is discussed.

### 20.2 The Underdevelopment of Formal Business

An understanding of the underdevelopment of the formal business economy in townships requires a longitudinal perspective. Historically, as a consequence of the logic of townships as dormitory settlements with minimal infrastructure and comprising only ‘temporary people’ in urban areas, business development in these urban spaces was limited by legislation. From 1945, municipal authorities in South African urban areas controlled the allocation of formal trading sites within township areas. The legislation restricted the establishment of formal trading businesses only for “those businesses that would provide nothing more than the daily essentials of living” (Beavon and Rogerson 1990, p.267).
Until 1977, formal licensed businesses in townships essentially were limited to general dealers, butchers, milk shops, and fruit and vegetable shops. Other activities such as dry cleaners, pharmacies, bookshops and garages were not permitted in townships as all such businesses catering for more than the ‘barest daily necessities’ were reserved for white entrepreneurs, and were located in the so-called the ‘white’ areas of cities (Beavon and Rogerson 1990; Mkhasibe 2017). Effectively, this legislation choked off formal business growth in townships, especially in respect of trading enterprises, for much of the apartheid years. Indeed, “far from promoting local economic development – apartheid laws curtailed it” in township spaces (Mahajan 2014, p.4). One exception, however, was a programme introduced during the late 1980s and early 1990s to encourage small-scale industrial development at a number of industrial parks established in township areas (Rogerson and da Silva 1988).

Overall, with post-1994 democratic changes, fresh scope existed for the building of township economies. Nevertheless, the expansion of formal businesses remained limited because “many features of the townships’ spatial design continued to militate against this” (Philip 2014, p.45). Accordingly, under democracy, the core character of townships as dormitory settlements remained little changed. The prospects for local development were constrained by the absence or poor quality of economic infrastructure, low effective demand, locational disadvantages in terms of distance from major economic hubs, weak value and supply chains, and the continued essential subordination of most internal economic activities in townships to the economy outside their boundaries (Mahlangu 2017). This said, a number of developments are now impacting the economic base of townships. Foremost has been the growth of 76 township shopping malls since 1995 which have facilitated the entry of large retail chains into township areas to service the demands of an emerging middle class consumer market (Mkhasibe 2017; Todes and Turok 2018). Another notable change has been the expansion from the 1990s of township tourism which represent a new dimension of urban tourism in South Africa (Rogerson 2008).

Under apartheid, the townships had been considered as ‘no-go’ zones for tourists because of safety and crime considerations. However, after political transition, the dropping of economic sanctions and South Africa’s re-entry into the international tourism economy, townships now became more accessible for growing numbers of visitors. With expanding numbers of international tourists in search of ‘poverty’ experiences, the niche of township tourism emerged as a form of what several observers style as ‘slum tourism’ (Frenzel 2016). The phenomenon of slum tourism involves travel to poverty-impacted places in which tourism organizations and tour companies reconstruct and (re-)present poor neighbourhoods to (mainly international) tourists as valued attractions (Gotham 2017). Since the 1990s, slum tourism in South Africa has expanded, with most developments occurring in the townships of Soweto, Khayelitsha, Langa and Inanda (Frenzel 2016; Rogerson 2004a, b, 2008). Koens and Thomas (2015) maintain that the growing economy of township tourism is viewed as an ‘alternative form of tourism’. Nevertheless, it is estimated that as much as 20–25% of all international tourists to Cape Town book a township tour, which is one of the city’s most popular tourism attractions. Across South Africa, the promotion of township tourism is now incorporated into programmes for tourism-driven place-based economic development in most of South Africa’s major cities (Rogerson and Rogerson 2017). Beyond Johannesburg, Cape Town and Durban, efforts have also been made to promote township tourism in other cities, most notably in the townships of Tshwane and Nelson Mandela Bay metropolitan areas.

Arguably, hosting of the 2010 FIFA Soccer World Cup provided a major stage for the showcasing internationally of Soweto as a tourism destination (Rogerson 2008). The development of the formal tourism economy occurs around political heritage sites and museums such as Soweto’s Hector Pietersen Museum as well as newer attractions such as bungee jumping and the hosting of a number of leisure-related festivals. Such developments afford opportunities for the emergence of a new economy of leisure and hospitality services in terms of accommodation and restaurants. The majority of accommodation service establishments are small-scale bed and breakfasts, backpacker hostels or homestays. One exception is the establishment by InterContinental Hotels in 2007 at Kliptown (Soweto) of a four star hotel situated at Walter Sisulu Square of Dedication, a major potential asset for heritage tourism. This establishment is the first internationally branded hotel in Soweto, reportedly built with an investment of US$3.4 million, with 48 bedrooms, two luxury suites, cocktail bar and jazz-themed restaurant (Bowes 2008). Another leisure-related development is the establishment of a craft beer brewery – Soweto Gold – with a two million litres production capacity which opened at Orlando West, Soweto, in 2014. This micro-brewery (which produces both craft beer and premium lager) was the first to be located in a township in South Africa’s flourishing craft beer industry (Rogerson 2016a). According to Matumba and Mondliwa (2015), it is significant also as the first venture into commercial-scale beer production by a black South African (since a failed venture in 1994). The example of Soweto Gold has been followed subsequently by the initiation of other craft breweries in townships around Cape Town and Port Elizabeth.

Notwithstanding these developments in retailing, leisure and hospitality services, it was observed recently that townships essentially “continue to lurk on the margins of neighbouring urban core economies unable to attract formal private investment” (Rakabe 2017, p.1). In addressing the
economic underdevelopment of townships, the expanded development of formal businesses in townships is an urgent policy priority and increasingly framed within a narrative of ‘radical economic transformation’ (Mahlangu 2017; Masha and Bopape 2017). The townships are a focus for area-based policies (Todes and Turok 2018). New strategic economic development initiatives have been launched in Gauteng for township development. For South Africa’s economic heartland, the Gauteng provincial government formulated a township economic revitalisation strategy to support the township economy as “the key driver and a game changer for economic development in Gauteng” (Gauteng Province 2014, p.8). The provincial government has committed to transform the role of township enterprises such that the “township economy contributes at least 30% of the Gauteng GDP by 2030” (Gauteng Province 2014, p.5). Although the strategy acknowledges contributions from a range of sectors including retail, creative industries and tourism, it is particularly focused around two so-called re-industrialisation pillars, namely “re-industrialisation of Gauteng and to take a lead in Africa’s new industrial revolution” (Gauteng Province 2014, p.5). As argued by Ngwenya and Zikhali (2018), value chain development is of critical importance for revitalising township economies.

In support of strategic planning for township economic regeneration in Gauteng, the provincial government is seeking *inter alia* to ensure an appropriate legal and regulatory environment for business development, to promote manufacturing and productive activities, to improve infrastructure for clustered enterprise development, to promote entrepreneurship through business incubators, assist with market access, and to nurture innovation and indigenous knowledge systems. Overall, this ambitious strategy potentially would radically impact the landscape of business development in townships which historically and currently remains dominated by the informal economy.

### 20.3 The Township Informal Economy

Informal economies in urban South Africa existed long before academics discovered the concept in the early 1970s and started to debate its significance for urban development (Beavon and Rogerson 1980; Rogerson 1986a, 1986b). Although the historical record on informal economies remains only barely understood, there is scattered evidence from Soweto to indicate the growth and structure of the township informal economy. Arguably, in South African townships, the underdevelopment of the formal economy was one of many triggers for the historical growth of a suite of informal economic activities. Another compelling driver – especially after the cessation of World War 2 and of reduced demands on the South African war industry – was the inexorable rise of an unemployed class in townships (Beavon and Rogerson 1990). Escalating levels of structural unemployment combined with conditions of poverty-in-employment experienced by most black households under the circumstances of the country’s labour-coercive economy were powerful foundations for the appearance and rise of informal economic activities, especially amongst newly proletarianized women (Beavon and Rogerson 1986). Indeed, it was “these classic pre-conditions for the existence and growth of an ‘informal sector’” which underpin its appearance and growing visibility in townships (Beavon and Rogerson 1990, p.268).

Arguably, the most common forms of informal livelihoods related to an array of trading activities and to the production and sale of alcohol (Beavon and Rogerson 1986; Rogerson and Beavon 1982; Rogerson and Hart 1986). With the rapid post-World War 2 growth of Soweto, the municipal authorities of Johannesburg failed to issue licences and avail premises for sufficient legal traders to supply the permitted ‘babe necessities’. Inevitably, therefore, a surge in unlicensed trade occurred both in the form of street trading and selling goods from home premises. As the local authority was unable to control this growth and started to turn a blind eye, the already proliferating township informal retail economy was further swollen by frustrated applicants for licences. By the early 1950s it could be observed in Soweto that “there was a sizeable community of persons selling daily essentials such as bread, milk, fruit, vegetables, fried fish, *vetkoek* (batter cakes), and *maas* (thick soured milk)” (Beavon and Rogerson 1990, p.271). The production and sale of alcohol through informal shebeens is historically woven into the complex fabric of liquor controls which has been documented for Johannesburg (Rogerson and Hart 1986). Charman et al. (2014, p.624) describe shebeens as “archetypal South African spaces”. In Soweto, shebeens were not only a vital informal economic activity for economic survival or ‘getting by’ but also part of a whole working class leisure culture (Rogerson and Beavon 1982). Overall, the historical growth and survival of shebeens can be comprehended in terms of the shifting balance of forces supporting the conservation, as opposed to those seeking the destruction, of this facet of the everyday world and geographies of township residents (Rogerson and Hart 1986). A much richer evidence base exists to interpret the nature and dynamics of the contemporary informal economy in townships and of its significance for local development. Economically, it is disclosed that “South Africa’s urban townships are dominated by informal micro-enterprise activity” (Petersen and Charman 2018, p.4). This is explained by the structural conditions for the growth of township informal economies which remain conditioned by limited opportunities for formal employment (especially for the youth) and substantive poverty (Charman 2016). In one recent national
investigation of nine townships across South Africa (comprising over 320,000 persons and nearly 100,000 households), there was disclosed a thriving informal economy with an average density of 36 enterprises per 1000 people (Sustainable Livelihoods Foundation 2016). Certain townships exhibit informal economies that are more vibrant than others. In explaining this observation, the evidence points to differences in the spatial design of various townships. The findings of the national survey undertaken by the Sustainable Livelihoods Foundation (2016, p.7) suggest that:

Transport links are an important spatial influence. The evidence indicates that, where the transport system results in increased pedestrian traffic and commuter flow, micro-enterprises emerge as a response to increased consumers passing by. The street infrastructure is also crucial for the incubation of informal businesses. The research found that those townships with market space on high streets have more opportunity as opposed to stalls situated in formal council markets which are often situated away from pedestrian movement streams. Furthermore, the proximity of townships has an impact on micro-enterprises.

Across the nine different township areas, however, categories of enterprise activity are broadly similar with the majority of enterprises engaged in supplying goods and services to local communities (Charman 2017; Sustainable Livelihoods Foundation 2016). Using an innovative small area census approach to profile the informal economy in the nine townships (Charman et al. 2015), a national investigation found the largest components to be enterprises in food and drink retailing, with a burgeoning retail economy of grocery sales (through grocery shops (spazas) and house shops) alongside the well-established informal trade in liquor (Charman et al. 2013; Petersen and Charman 2018). The retail trade in food and drink is estimated to account for more than half of all informal economy operations in townships. The categories of food (groceries and takeaways) and liquor products are followed in significance by businesses engaged in hair care services and recycling (Sustainable Livelihoods Foundation 2016). Signals of potential change in the structure of township informal economies are in evidence. Educares or home-based enterprises that provide out of home care and educational services for children up to the age of 6 years are one notable growth pole in the changing structure of township economies (Charman 2017).

Also of note is the clustering of youth entrepreneurs in lifestyle and leisure sectors with young township entrepreneurs “that run internet-cafes, or produce music at home and DJ at taverns/shebeens, or design flyers or posters, or operate gyms, design and make clothes, or run takeaways that sell westernized ‘fast-food’ to late night revellers” (Charman 2016, p.2). In terms of temporal change the most striking findings relate to the fact that the informal economy is not stagnant. Rapid growth as a whole in informal enterprise activity in townships occurred during the period 2010–2015 when the national economy was in chronic decline with dismal rates of formal employment absorption (Sustainable Livelihoods Foundation 2016). In addition to the expansion of new, mainly survivalist businesses (many operated by middle-aged women), a degree of ‘churning’ in enterprise activities also is apparent in particular with the closure of fixed line phone businesses accompanying the rise of cell phones and vendors of air time.

For urban geographers, a compelling set of results out of the national survey relate to mapping the spatial distribution of particular forms of informal enterprises within townships. Research uncovers that the informal economy is widespread throughout the township environment, but that differences are observable between residential areas and high street environments in the occurrence of particular forms of informal or micro-enterprise. In residential areas, entrepreneurs respond to local demands by opening businesses within close walking distance of residences (Charman 2012; Oldfield 2014). The geographical distribution of both spazas and shebeens is concentrated in residential areas as a response to local neighbourhood consumer demands (Charman et al. 2013, 2014; Oldfield 2014). By contrast, spaza businesses and shebeens rarely are found in ‘high street’ locations which have evolved to service the needs of commuters (Sustainable Livelihoods Foundation 2016). In the high street environment of townships, busiest in the mornings and evenings and much quieter during the rest of the day, the most frequently occurring enterprises are those engaged in street trade, appliance repair, restaurants, car wash and hair care (Sustainable Livelihoods Foundation 2016). Such findings concerning the geographical distribution of varied informal activities have significant ramifications for the future planning of townships.

Two core research issues surrounding the changing township informal economy and contemporary local development relate to the role and activities of immigrant entrepreneurs in South African townships and recent government initiatives to support the informal economy and to encourage ‘formalisation’. Since 2000, foreign entrepreneurs, mostly Somalis but also Bangladeshis, Indians, Pakistanis and Ethiopians, have established a significant presence in township economies (Mkhasibe 2017). In particular, a growing class of these refugee or migrant entrepreneurs has emerged as a competitive player in spaza retailing (Charman et al. 2012; Crush et al. 2017). Using a different business model to South African entrepreneurs, these opportunistic immigrant entrepreneurs have steadily outcompeted local South African entrepreneurs based on a model of hard work, and price competitiveness through co-operative ownership, procurement and distribution practices (Crush and McCordic 2017; Mkhasibe 2017). The consequence has been that many local spaza retailers have chosen to “opt out of the spaza business because it requires less work and is more remunerative to rent their
property to refugees and other migrants” (Crush 2017, p.ix). A wave of xenophobic attacks and violence has occurred in townships towards vulnerable refugee business owners (Crush et al. 2017; Ramachandran et al. 2017). It is argued that much antagonism has been “stoked by South African trader associations who would rather not compete openly and fairly” (Crush 2017, p.ix). From analysis of the experience of township spaza businesses in Cape Town, Charman and Piper (2013, p.97) observe that whilst most South African-owned local businesses that were unable to compete with Somali traders responded to their predicament without violence and handed over their shops to foreigners for a monthly rental, “it seems clear some local businesspersons resort to violence (and more often the threat of violence) as a matter of course to defend their business interests”. Indeed, the term ‘violent entrepreneurship’ is applied to describe the violence and criminal activities which seemingly have been instigated by groups of local business people towards successful refugee businesses (Charman and Piper 2013; Crush 2017).

In terms of assisting South African informal entrepreneurs, the Gauteng provincial initiatives are noteworthy as is the National Informal Business Upliftment Strategy through which national government is enacting a range of support measures for informal enterprises in townships, as well as seeking to nudge them towards formalisation (Rogerson 2016b). This said, the danger exists of an excessive focus on regulatory compliance and of efforts “fruitlessly trying to ‘graduate’ survivalist businesses which clearly have no potential or inclination to operate at more than a survivalist level” (Hartnack and Liedeman 2017, p.3). The national research study on the informal economy concluded that in townships there was a need to acknowledge and accept informality and micro-enterprise as a means for survival of the poor and unemployed, and to concentrate formalisation endeavours upon those informal entrepreneurs with the capacity to create employment (Sustainable Livelihoods Foundation 2016). The failing initiatives to formalise the shebeen trade indicate a lack of understanding of the dynamics of South Africa’s informal economy by many policymakers. Charman et al. (2013, 2014) demonstrate that state enforcement initiatives are an actual driver of informality in the shebeen sector, which they describe as ‘enforced formalisation’. Denoon-Stevens et al. (2017) highlight the difficulties for enterprise formalisation in townships as a consequence of the existence of nightmarishly complex and often incomprehensible land management systems. Indeed, in what is described as a Kafkaesque world of complex legislation, it is concluded that “compliance with land management systems is near to impossible for informal micro-enterprises in townships” (Denoon-Stevens et al. 2017, p.7).

20.4 Summary

Redefining the economic role of townships is under scrutiny on local and national policy agendas (Mahlangu 2017; Masha and Bopape 2017). In terms of local economic development, the colonial and apartheid period witnessed a phase of legislative controls that precluded business development and private investment in townships and rather reassessed their dormitory status. During the post-1994 era, new opportunities potentially opened for building township economies albeit in many cases still shackled by historical spatial divides. It is evident that with the underdevelopment of formal economies in townships, the informal economy has been of necessity an essential driver of local development. Currently, there is evidence that township informal economies are experiencing several important changes. The structural and spatial changes in informal economies, the role of refugee or migrant entrepreneurs, and the shifting policy environment towards formalisation merit further research work by geographers seeking to understand the economic transition of townships and local economic development futures. The township research agenda must also extend beyond South Africa’s metropolitan areas and explore the changing economies of townships in the country’s secondary cities and small towns.

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Gentrification in South African Cities

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Abstract
Gentrification is a form of urban renewal that has seen comprehensive and largely critical debate in urban studies discourse. This chapter aims to position these debates in an urban South African context and assess their relevance. Following a brief review and analysis of gentrification in international scholarship, a narrative is presented in which the prevalence of gentrification in South Africa is explored. It is found that this process is best registered in the empirical realities of Cape Town, but nascent signs of gentrification are also emerging in other contexts.

Keywords
Cape Town · Cities · Gentrification · Johannesburg · Neighbourhood change · South Africa

21.1 Introduction
Gentrification as a form of urban renewal has been extensively debated for more than four decades (Lees et al. 2015). It has been argued that this process has now “gone global” (Lees 2012, p. 155) and, as shown in this chapter, has been manifested in a broad range of countries, among them South Africa. This chapter focuses on gentrification in South African cities, with a particular focus on Cape Town where this process has been most visible. It is argued that, although this process of urban change is often set against the backdrop of cities of the Global North, it has increasing relevance in Southern urban (and rural) contexts too. The chapter sets out to first provide a general outline of contemporary gentrification scholarship by analysing gentrification as an urban process; its definition; the causal mechanisms underlying its genesis; and the expansion in both the global North and South. The analytic lens then turns to South Africa and the various expressions of this process, or lack thereof, in South African urban places. Finally, the chapter highlights a number of issues on a broader canvas, suggesting further research in other South African cities, towns, and rural areas where there are nascent signs of gentrification.

21.2 Defining Gentrification and Understanding the Various Agents Thereof
The meaning of the concept of ‘gentrification’ has evolved over time (Lees et al. 2008). The concept was first coined by London sociologist Ruth Glass in 1964 in an analysis of urban change in Chelsea (Lees and Ley 2008). Early definitions of gentrification referred to a process of the rehabilitation of working class residential neighbourhoods by middle class homebuyers, landlords, and professional developers (Lees et al. 2008). During this process, a reinvestment of capital at the urban centre occurred and the original, typically working class, inhabitants of an area were replaced by more affluent residents and businesses (Smith 1996). Subsequently, the process has expanded and can be seen in a number of cities in the United Kingdom and United States and, indeed, globally (e.g. Eduful and Hooper 2015; Ghertner 2014; He 2012; Kovács et al. 2013; Larsen and Hansen 2008; Lemanski 2014; Lopez-Morales 2011; Mocombe 2011; Visser and Kotze 2008). Some scholars have interpreted gentrification as an attempt by the middle classes to ‘retake’ the central city (Smith 1996; Swanson 2007) and remake it into a space in which the new middle classes can thrive (Ley 1996).

Research on the evolution of gentrification has been divided into four so-called waves (Lees et al. 2008). Generally, the first explorations were descriptive and established the presence of the process in various locations (Lees et al. 2008). These studies are generally referred to as
first-wave gentrification – the earliest manifestations thereof and its reflection(s) in the popular press and academic scholarship. First-wave gentrification points to individuals who acquired property in older neighbourhoods, often in building stock that, relative to other housing stock, has aesthetic appeal if renovated and more space than other properties at the same price-point, and is in close proximity to the CBD’s main employment, services, and leisure functions.

Second-wave gentrification deals with the expansion of gentrification throughout the post-industrial North, focusing on explanatory mechanisms leading to the establishment and expansion of the process itself (Lees et al. 2008; Smith 1996). In terms of understanding the process of gentrification, the academic focus shifted from definitional issues and descriptions of the process, to explanations of the process. Two different types of explanations for gentrification were presented at the time. Through the influential works of Smith (1996) and Ley (1996) in particular, production- and consumption-side theories were used to explain gentrification, mainly in the North American and United Kingdom contexts. Smith’s (1996) work dealt with the idea of the (re)production of capital and rent gaps, pointing towards the oscillation of capital between CBDs and decentralised capital investments, leading to cycles in investment, divestment, and reinvestment. His suggestion was that gentrification was part of capital accumulation and the circulation of capital in urban systems.

The work later extended to Smith’s description of gentrification as part of the revanchist city, essentially the ‘revenge of the middle class’ (later in the 1990s) and efforts to regain access to the old CBD which the poorer classes have taken from them. In many ways, Smith proposed that gentrification is an inevitable developmental outcome and that this mechanism would hold true for large urban complexes throughout the Global North, if not universally. This claim was, however, not empirically proven to be true in either the Global North or within the North American context in which this argument was embedded, providing support for other explanations of gentrification. This aspect of the gentrification discourse relates to the consumption of urban space as the vehicle through which gentrification is enabled (Lees et al. 2008). In these debates, the focus turned on who the gentrifiers were/are. It was argued that a new middle class existed and that these ‘creative classes’ (issues of the late 1980s onwards) led the gentrification process (Ley 1996); thus, it mattered who the gentrifiers were. At the time, it became clear that those leading the process were distinct from the general urban population who had access to capital to invest in residential accommodation. There were sociocultural characteristics and motives of the gentrifiers that were more important in understanding the gentrification of the post-industrial city (Hamnett 2004). Ley’s (1996) ‘new middle class’ aimed to distinguish themselves from both the upper and lower classes through consumption, and specifically through the consumption of the house as an aesthetic object. The further aim was to counter mundane suburban lifestyles prevailing at the time. In addition, the role of single women, artists, and gay communities with financial means were shown to play a key role in gentrification by foiling perceived and experienced marginalisation in suburban neighbourhoods (Florida 2002). For a number of scholars, the 1990s ushered in a new era in the ongoing evolution of gentrification, generally referred to as third-wave gentrification (Lees et al. 2008). In many ways, it was the scale of redevelopment at stake and the introduction of large-scale capital in the form of property developers and individual property investment that thwarted interest in the discourse. Typically, this is a form of gentrification that differs from the one usually seen in office redevelopment and/or conversion to private residences, as well as brownfield redevelopment for similar purposes. This phase of gentrification was particularly pronounced in London (along the River Thames), Manchester, and New York (Lees et al. 2015) and is also linked to government interventions in urban redevelopment trajectories (such as in central city improvement districts) and government ambitions to ‘go global’ and become a ‘world city’. The process even occurred in European cities that initially did not display the required empirical evidence to demonstrate gentrification (Larsen and Hansen 2008; Prêteceille 2007). Overall, these developments aim at attracting the high-order services classes – often in the financial and high-level legal services sectors – to the central city.

Part of the third-wave gentrification is the notion of ‘new-build gentrification’. This form of gentrification, with all the same outcomes of earlier understandings of gentrification, also causes displacement, albeit indirect and/or sociocultural: in-movers are the urbane new middle classes; a gentrified landscape/aesthetic is produced; and capital is reinvested in disinvested urban areas (Lees et al. 2008; Ley 1996). These characteristics demonstrate shared traits with other less controversial understandings of gentrification. It is observed that whether ‘gentrification is urban, suburban, or rural, new-build or the renovation of existing stock, it refers as its gentri-suffixes attest, to nothing more or less than the class dimensions of neighbourhood change – in short, not simply changes in the housing stock, but changes in housing class” (Slater 2004, p. 1144).

Further turns in the evolution of the gentrification discourse are examination of the underlying causes leading to such change. The impacts of local and national government is seen in the ever-increasing desire to be the next/another global innovation or financial services hub. Lees et al. (2008) considered the idea of a fourth-wave gentrification, sometimes called ‘loftification’ in the popular press. It is suggested that this wave combined an intensified financialization
of housing with the consolidation of pro-gentrification policies and polarized urban policies. The state is therefore an intentional initiator of gentrification in order to facilitate urban renewal and elevate a particular city to global significance.

More recently, key gentrification scholars have argued for drawing on comparative urbanism, suggesting that “a geography of gentrification must include a consideration of gentrification of both the spatial and temporal dimensions of gentrification: international, intranational and citywide comparisons; and consideration of the timing of processes” (Lees 2012, p. 155). Attempts to move urban studies towards a postcolonial agenda have only slowly found traction in gentrification debates. Most of the gentrification debates in the 1990s were not registered in the cities of the Global South and, as such, gentrification studies were not yet directly confronted with issues around developmentalism and categorisation. In the academic imaginary, gentrification was conceptually bound to the Global North. Over the past decade there has been a rapid and visceral emergence of state-led gentrification in the Global South – processes of gentrification are now changing the CBDs of cities in China (He 2012), India, Pakistan (Ghertner 2014, 2015), various countries in Latin America (Betabcuur 2014; Inzulza-Contardo 2012; Janoschka et al. 2014; Jones and Varley 1999; Lopez-Morales 2011), and even Africa (Eduful and Hooper 2015; Samasuwo 2004; Visser and Kotze 2008). Lees (2012) argued that gentrification started to take off in the Global South at the beginning of the new millennium, or perhaps more accurately, started to draw the attention of the media and some academics at this time. This claim has, however, been challenged.

Southern scholars have since argued that “it is time to lay the concept to bed, to file it away among those 20th-century concepts we once used to anticipate globalized urbanization” (Ghertner 2015, p. 553). Those putting forward this position have argued that they support gentrification as a global phenomenon if it means nothing more than a rising rent environment and associated displacement. However, this definition is so broad that it diverts attention away from more fundamental changes in the political economy of land in many places in the world. It is argued that gentrification, as an analysis of urban change, renders unthinkable and invisible the regulatory and legal changes that underpin the most violent forms of displacement in cities with enduring legacies of large-scale public land ownership, common property, mixed tenure, or informality. The overall argument, which fits well with current Southern critiques of mainstream urban theory and theorisation practices (see Robinson 2006), is that much of the urban world is, in fact, excluded from the gentrification discourse (Ghertner 2015).

21.3 Gentrification and South Africa

In South Africa, the process of gentrification has seen scant research attention until recently (Visser 2002). There are, however, some limited examples of gentrification to be found in South Africa. In terms of scholarship, the overriding urban narrative for the country’s major cities has been inner city decay, decentralisation, crime, grime, circulation of capital, and ‘white flight’, to name a few (Beavon 2004; Pirie 2007; Tomlinson et al. 2003).

The first gentrification study (in the early 1990s) was more suggestive of a possibility of this process unfolding along the eastern border of the Johannesburg CBD frame (Steinberg et al. 1992) than, in fact, describing its presence. This was a Marxist-inspired production-side argument. It was suggested that gentrification was not likely, even though it theoretically could have found support among an emerging black middle class. In the end, gentrification did not take place there, but first-wave gentrification rather occurred post-apartheid in Parkhurst – a very ordinary, former-white neighbourhood to the north of the old CBD (Rule 2002). More recently, it has been demonstrated that high levels of urban space consumption (second-wave gentrification) has now taken hold in that neighbourhood and has entered a super-gentrification phase (Monare et al. 2014). Only recently have signs of gentrification started to register in the more ‘classic’ neighbourhoods of Braamfontein and Maboneng, situated on the Johannesburg CBD fringe (Gregory 2016; Nevin 2014; Vejby 2015; Walsh 2013).

Within the framework of first- and second-wave conceptualisations of gentrification, Cape Town provides the best examples in urban South Africa. A distinction has to be drawn between where gentrification first appeared and when it was first reported. The process first unfolded in De Waterkant in the late 1970s (Kotze 1998; Kotze and van der Merwe 2000; Visser 2003a, b, c, 2011a, b) but was first registered in academic scholarship by way of Garside’s (1993) paper on gentrification in the Upper Woodstock context (Fig. 21.1). These two types of investigations also described two very different kinds of gentrifiers: in De Waterkant, the key role players were white, and in Woodstock they were ‘people of colour’. In both cases, changes in apartheid Group Areas’ legislation led to these changes being possible. In terms of descriptive accounts of gentrification, earlier manifestations of the process were also registered in work focused on small towns, particularly tourism-led gentrification in Aberdeen in the Eastern Cape (Atkinson 2009) and Greyton in the Western Cape (Donaldson 2009). Other investigations that also hint at gentrification, albeit not central to their analysis, can be found in the works of Hoogendoorn and Visser (2004, 2010a, b, 2011a, b), dealing with a range of small towns in which second homes have become a prominent
A central absence from the scholarly record are reflections on resistance to gentrification taking place in these areas, the most notable exception being work by Fleming (2011).

Although contributions to gentrification scholarship in South Africa are expanding, the extant literature remains limited. Analyses are, however, maturing and the more recent international third-wave treatments of the process are starting to appear (Gregory 2016; Hoogendoorn and Gregory 2016; Nevin 2014; Vejby 2015; Visser and Kotze 2008; Walsh 2013). In most cases, only a handful of scholars have participated in this debate and, for the most part, they were non-specialists in the process and parties interested in tourism and leisure – linked economic activities pointing towards gentrification as a byproduct (e.g. Visser 2014, 2016). In large part, this is because urban renewal and regeneration of central city areas has been ignored by urban and rural scholars in favour of the urban peripheries of South African cities and towns. Those few examples of urban renewal or regeneration are also not really seen through the lens of gentrification but rather through issues of city improvement districts, their links to neoliberal capital accumulation strategies, and displacement of the poor to the urban fringe (Lemanski 2014; McDonald 2008; Miraftab 2007).

In this line of investigation, McDonald (2008) demonstrated that the policy instruments of all the main metropolitan governments in South Africa underline the need to develop vibrant, aesthetically appealing, safe, and competitive central city regions. Similar studies outline how local and provincial government interventions aim to lure national and international capital investment to particular parts of cities. This entails directing infrastructure spending on services and functions that will appeal to the needs and desires of the higher-order service businesses and creative classes, both local and global. Whereas gentrification in Cape Town during the 1990s took place in neighbourhoods such as De Waterkant (Fig. 21.2), Gardens, and parts of Woodstock (all adjacent to the Cape Town CBD), the new millennium witnessed gentrification of the CBD itself. Unlike what happened in the other neighbourhoods, the local state had a direct hand in facilitating this process (Miraftab 2007). The Cape Town Partnership (founded in 1999 as a public/private partnership) established the Central City Improvement District (CCID) in 2000. This was the first of a number of improvement districts that would follow elsewhere in the city. CCIDs on the whole focus on crime and grime prevention and tax breaks. For example, to address the stated requirements of property owners, 50% of the CCID’s annual budget is spent on security, approximately 21% on cleaning, 7% on social development, and 11% on communications and marketing. The remainder of the budget goes towards operational and administrative costs of the CCID.

Fig. 21.1 An example of first-wave gentrification in Upper Woodstock. (Photo: G. Visser)
The objective is to make the CBD globally competitive and effect change in residential, commercial/retail, and office and public spaces. Dramatic physical and symbolic changes to the CBD have subsequently taken place (Fleming 2011; Pirie 2007; Visser 2016; Visser and Kotze 2008; Walsh 2013). In Cape Town, three main consequences of gentrification were discernible. First, informal vendors were forced to relocate to the old Post Office shopping centre site in the heart of the CBD. Second, although the CBD did not have many residents prior to the declaration of a CCID, the poor residents who lived there were displaced and flats that could have housed them were redeveloped for wealthier residents into upmarket loft flats and apartments (Fig. 21.2). A third issue is that, although a number of employment opportunities have been created owing to renewed interest in office space and retail space in the CBD, the types of jobs are not focused on the skill sets of the inner-city poor (aside from low-level service ones in restaurants, bars and cafés, and clothing stores or the cleaning of these various property types) (Fig. 21.3).

For the most part, nothing concerning these issues has appeared in current academic debates. The gentrification debate has, however, recently drawn considerable media attention to Lower Woodstock and the historic Bo-Kaap areas of Cape Town (Kotze 2013; Pather 2017). Despite these neighbourhoods’ prominence in current local public discourse, minimal academic scholarship on these areas has appeared (rare exceptions being Donaldson et al. 2013; Kotze 2013). In Woodstock, poorer residents who have lived in the neighbourhood for generations are now being relocated to among other areas such as ‘Blikkiesdorp’ or Wolwerivier some 30 km to the east, and this process of pushing the poor to the edge of the city has seen animated debate in the newspapers (Pather 2017). The housing options are in the form of state-subsidised structures. Although the displaced residents are poorer than the new incoming ones, they are (relative to their new location) better off living in their original neighbourhood than in the new neighbourhood they are forced to relocate to. This, however, can lead to a hybrid form of gentrification (identified in Lemanski 2014), for example, in Westlake to the south of the metropolitan area. Lemanski (2014, p. 2946) argues that downward raiding is, like gentrification, defined by displacement and exclusion: “As middle-income groups ‘raid’ lower-income areas (often state-subsidised or informal settlements) and undertake service/infrastructural upgrades, low-income residents are both displaced and excluded”. Payne’s analysis of land titling in developing countries argues that, while downward raiding of state-subsidised settlements could indicate integration into the formal property market and the upward
mobility of low-income vendors, it in fact makes it “more difficult for low-income households to obtain housing in areas originally intended for them” (Payne 1996, in Lemanski 2014, p. 2946). In this case there is the potential that, as relatively higher income purchasers improve and resell property, they effectively exclude other low-income beneficiaries (for whom the housing, often state-subsidised, was originally designed) in the short and long term.

Perhaps one of the most important observations is the general lack of critical reflection on gentrification by both the city and provincial governments. These public institutions are mute concerning gentrification in their neighbourhoods, probably because they are part of the process, which is typical of the third- and fourth-wave discourse on this process (Gasnolar 2017; Pather 2017). The possibility of a further wave of new-build gentrification is now emerging in the urban redevelopment discourse in the Culemborg district on the eastern fringe of the Cape Town CBD. This brownfield site would merge the CBD, Waterfront, Salt River, and Woodstock into one contiguously developed area, and requires close monitoring (Visser 2016).

### 21.4 Issues Going Forward

This chapter has focused on gentrification in Cape Town as the location with the most visible iterations of the process in South Africa. On the whole, a key observation is that this process has not been very prevalent in the country and has seen little research attention thus far. There is currently increased attention being drawn to this process in the popular press, but greater urgency in research on gentrification in South Africa – in both urban and rural contexts – is needed. Wyly and Hammel’s (2005, p. 35) observation concerning gentrification in South Africa is that “more than ever before, gentrification is incorporated into public policy – used either as a justification to obey market forces and private sector entrepreneurialism, or as a tool to direct market processes in the hopes of restructuring urban landscapes in a slightly more benevolent fashion.”

Gentrification has not developed evenly throughout South African cities and is relevant only to some urban and rural places. The economic basis for gentrification is also not evenly distributed and there is a need to look beyond the ‘white’ city. Against this backdrop, Lemanski’s (2014) idea of downward raiding has been made some time ago where some townships and lower cost neighbourhoods are the locales of new gentrification frontiers.

Beyond Cape Town and Johannesburg, attention needs to turn to Durban where The Point redevelopment has finally found traction after many years of disinterest. Durban has, since the 1960s, aimed to redevelop the former harbour site of The Point, a rather notorious district on the CBD periphery. The inability of both local government structures and private capital, along with large-scale decentralisation, undermined processes of gentrification in this area. After the

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**Fig. 21.3** The cumulative effect of first, second and third wave gentrification in Cape Town’s De Waterkant. (Photo: G. Visser)
redevelopment of the beachfront leading up to the 2010 FIFA World Cup, the area around the relocated and renamed aquarium uShaka Marine World saw the emergence of new-build gentrification (Gounden 2010; Robbins 2004). Perhaps a larger conceptual challenge is whether the extraordinary newly-built development around the Gateway precinct to the north of the city could be interpreted as third- or fourth-wave gentrification. Beyond cities, there are rural areas and towns to consider. Places in KwaZulu-Natal Midlands and in numerous small towns in the Western Cape are showing signs of gentrification, ranging from first- through to third-wave gentrification. Rural lifestyle gated estate developments close to Cape Town in the Paarl Valley, such as Boschmeer or Vale de Vie, present conceptual challenges too. These are essentially residential neighbourhood developments in rural/semi-rural areas blocking the development of low(er) cost housing in close proximity to them. As a consequence, third-wave gentrification as a conceptual approach seems appropriate.

21.5 Summary

Gentrification is now a well-established process that has seen expansion in a range of urban (and rural) settings. The aim of this chapter was to draw attention to the relevance of gentrification in the South African context. It first considered definitional issues, then the evolution thereafter in a range of places and the relevance of the process to urban South Africa were discussed. It was argued that, on the whole, gentrification has become a major force in the remaking and re-imagining of central Cape Town. The final section suggested that gentrification is starting to emerge in other urban contexts too, which provides a platform for further scholarly engagement.

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Abstract
Creative industries have been used globally as a lever for economic development and urban regeneration. Despite the benefits of creative industries to stimulate urban regeneration, widespread criticism points to the negative impacts of socioeconomic polarisation and gentrification in urban environments. There is evidence of a growing creative economy in Cape Town and Johannesburg, South Africa’s two largest cities. Over the past two decades, both cities have embarked on various urban regeneration initiatives. Inner city Cape Town in particular shows evidence of the use of creative industries as a tool for widespread regeneration. In Johannesburg, the majority of creative industries are located in its northern suburbs; however, in recent years there is evidence of creative clusters emerging in central Johannesburg. This chapter reviews research and debates on creative industries in Woodstock (Cape Town) and Maboneng (Johannesburg), and illustrates the impacts of creative industries on neighbourhood change in the South African urban context.

Keywords
Cape Town · Creative industries · Johannesburg · Maboneng · Neighbourhood change · Woodstock

22.1 Introduction

The term creative industries came widely into urban discourse in the late 1990s when the United Kingdom (UK) government recognised creative industries as central to its post-industrial economy (Banks and O’Connor 2017; Flew and Cunningham 2010; Mommaas 2009). From the late 1990s there was growing application and discourse around the concept of creative industries (Garnham 2005; Hesmondhalgh 2013; Kong 2014). Over the past two decades, creative industries have been seen as a lever for economic growth in the knowledge economy, and as a catalyst for urban economic growth and regeneration (Cunningham and Potts 2015; Flew 2013; Flew and Cunningham 2010; Jones et al. 2015; Kong 2014; Tremblay 2015).

During the early 2000s, the concept of creative industries spread globally and appeared most notably in the national and urban policy agendas of Asia-Pacific countries including Australia, New Zealand, Singapore and China (Banks and O’Connor 2017; Cunningham 2009; Flew and Cunningham 2010; Kong 2014). The uptake of creative industries globally was given considerable impetus by the emergence and popularisation during the early 2000s of the concept of the ‘creative city’ (Landry 2000; Landry and Bianchini 1995) and the ‘creative class’ (Florida 2002), which set forth many scholarly investigations about the relationship between creative industries and urban development (Cunningham and Potts 2015; Flew 2010, 2013; Jones et al. 2015; Kong 2014). This said, the use of creative industries in urban development policies has been widely criticised for their roles in exacerbating socioeconomic polarisation and contributing to gentrification (Barnes et al. 2006; Catungal et al. 2009; Florida 2017; Grodach et al. 2018; Hutton 2017; Peck 2005; Pratt 2008).

Neoliberal urban theory, policy and practice have been implemented in cities in the global South (Robinson 2011). The United Nations Conference on Trade and Development (UNCTAD) (2010) suggested that creative industries are a feasible development option for the global South since they are potential drivers of job creation, innovation and social inclusion, and are expected to diversify economies. Nevertheless, issues arise in the implementation and replication of strategies of the global North, without due recognition of local conditions and challenges (Booyens 2012; De Beukelaer 2014; Flew and Cunningham 2010; UNCTAD 2008, 2010, 2013). Banks and O’Connor (2017, p.637) note
that creative industries have brought “more economistic, capital-driven model of urban renewal which served to undermine many of the promises that had been invested in popular urban culture [for] social democracy”. Despite this, there is growing evidence that the large, developing and transitional economies of Brazil, Russia, India, China and South Africa (BRICS) are embracing creative industries for economic advancement (De Beukelaer 2014; Flew and Cunningham 2010; UNCTAD 2008, 2010, 2013).

### 22.2 Creative Industries in South Africa

According to *Africa Business Magazine* (2014, p.3) “Africa’s contribution to [the creative economy] unfortunately is negligible. While the continent has a deep pool of talent, it lacks the infrastructure and capacity to commercialise its creative talent and reap the vast fortunes that are lying about”. Joffe and Newton (2009) state that creative industries in Africa have attracted little scholarly and policy attention, with the striking exception of South Africa where there is growing acknowledgement of the economic potential of creative industries. In South Africa, the idea of using creativity as a tool for economic development was first established in 1996 with the release of the White Paper on Arts, Culture and Heritage and with the publication of the ‘Creative South Africa: Strategy’ in 1998 (Visser 2014). According to Booyens (2012), a strategic shift occurred from cultural to creative industries over the past decade and a half with the introduction of a range of policy interventions and strategies. Most notably, in 2011, the ‘Mzansi Golden Economy Strategy’ was launched by the Department of Arts and Culture to “reposition the arts, culture and heritage sector as key players in government’s programme of action for social cohesion, creation of sustainable jobs and ensuring social and economic development” (Department of Arts and Culture 2016, p.5). Like many other countries in the global South, the promotion of creative industries in South Africa is associated with various socioeconomic objectives such as job creation, poverty alleviation and community participation; additional expectations include urban regeneration and cultural diversity (Booyens 2012; De Beukelaer 2014; Joffe and Newton 2009; Oyekunle 2017; UNCTAD 2010, 2013; Visser 2014).

Despite creative industries’ potential to act as catalyst for economic growth, creating employment opportunities, skills development and generating social capital and cohesion, they are often viewed as exacerbating socioeconomic inequality. Although Booyens (2012) recognises the potential of creative industries to enhance urban regeneration, economic development and job creation, she stresses that they can also lead to exacerbating existing inequalities and marginalise working class residents. The benefits of ‘creative’ urban regeneration do not necessarily reach poor communities. Notwithstanding widespread criticism, Oyekunle (2017) restates the importance of creative industries in South Africa as a driver for economic development, job creation and sustainable urban development. The Department of Arts and Culture (2015) noted that in pure economic terms the creative economy contributed R90.5 billion to the country’s GDP in 2013/2014. This was largely driven by design, creative services, natural and cultural heritage, media and publishing industries. In terms of employment, 562,726 people were employed within the creative economy in 2013/2014, representing 3.6% of total employment.

### 22.3 Creative Industries in Cape Town

In the South African context, Cape Town has enjoyed the majority of scholarly attention related to creative industries. This section offers an overview on research and debates about creative industries in Cape Town, in particular the inner city neighbourhood of Woodstock, which is an example of an area where a creative class and creative industries are observed as impacting on the local socioeconomic environment, and contributing to neighbourhood change.

Cape Town is South Africa’s second biggest municipal region and widely regarded as South Africa’s most creative city (South African Cultural Observatory 2016). As an aspir ing global city, Cape Town seeks to enhance its competitiveness on the global stage. The city regards culture and creativity as a vehicle for economic development and urban regeneration. One sign of progress is that Cape Town won the title ‘Design Capital of the World’ in 2014 (Booyens and Rogerson 2015). Over the past 10 years, Cape Town has experienced considerable growth in the service and knowledge-based sectors with traditional employment sectors such as manufacturing in decline (Booyens 2012).

The growth of creative industries in Cape Town is documented in several studies. Pirie (2007, p.131) described that “the agglomeration of creative industries in central Cape Town is striking. Hundreds of enterprising young people are nudging edges of the core out of their old industrial identity. Computer-related hardware and software service industries are reprinting small-scale design and manufacturing into the central city. Technology-intensive filming, fashion and ornamentation industries are mushrooming in recycled buildings saturated with inspirational human and technical history”. Pirie (2007) also observed that there were approximately 200 advertising, communication and design firms in central Cape Town. By 2009, there were approximately 1000 creative enterprises in the central city and its immediate fringe areas, the largest number of these enterprises being in film and television (Booyens 2012). The following creative enterprises are also flourishing in the city: media, publishing,
architecture, performing arts, fashion, music, visual arts, literary arts and heritage; and central Cape Town has the highest concentration of creative industries in South Africa (Visser and Kotze 2008). The Western Cape Government (2012) estimates that between 56,000 and 80,000 people were employed in creative industries across the province, the majority of which are based in Cape Town. The Western Cape Government (2012) also states that the Western Cape design sector contributed R13.4 billion to national GDP in 2012. In recent years, Cape Town’s inner city has been redeveloped as an attractive investment, business, recreational, tourist, creative and residential space (Pirie 2007). The policy environment of Cape Town recognises the importance of creative industries in stimulating economic growth. The Central City Development Strategy (CCDS) was developed in 2007 and the Cape Town Partnership was given the responsibility to implement this strategy. Through various place-branding initiatives, the Cape Town Partnership aims to position Cape Town as a premier business location; high quality and sustainable urban environment; a popular tourist destination (domestic and internationally); and a leading centre for knowledge, innovation, creativity and culture in Africa and the global South more generally (Cape Town Partnership 2007).

In 2014 the city of Cape Town strengthened its commitment towards the creative city agenda with the introduction of the Arts, Culture and Creative Industries Policy (ACCIDP), which guides the development of creative industries in the city. The policy states that it supports creative industries as the lifeblood of innovation in the new global economy. In terms of urban growth outcomes, the policy aims to economically, socially and aesthetically improve ‘damaged’ neighbourhoods. This policy makes a clear link between creative industries and urban regeneration. The policy does, however, acknowledge issues of social inequality in the city, but argues that creativity and culture could develop ‘healthy’ neighbourhoods and communities, create social capital, support the vulnerable and ensure community development (City of Cape Town 2014). It is against this backdrop that the following section reviews the impact of creative industries on the inner city neighbourhood of Woodstock.

22.3.1 Creative Industries and Neighbourhood Change in Woodstock

The suburb of Woodstock, situated on the eastern fringe of the central city, is one of Cape Town’s oldest inner city neighbourhoods, and a focal point for creative industry development. Historically, Woodstock was developed as a suburb in the late nineteenth century with land use for light industries and working class residences. Throughout the twentieth century it became an industrial hub with, amongst others, a thriving textile manufacturing industry. Its racial composition has always been mixed with predominantly coloured and white working class families. Unlike its neighbouring suburb, District Six, Woodstock stood out as an area that managed to survive the brunt of the apartheid regime’s forced removals under the Group Areas Act. By the 1980s, there were attempts to reclassify the area as ‘coloured’ but this was opposed by community action known as ‘The Open Woodstock Campaign’ (Garside 1993; Wenz 2012).

Wenz (2012) notes that by the 1990s there was evidence of lingering urban decay and the deindustrialisation of particularly the textile manufacturing industry. Garside (1993) observes that by the late 1980s and early 1990s, with the crumbling apartheid regime, a new wave of white and coloured middle class residents moved into Woodstock for its proximity to central Cape Town and its heritage architecture. Garside (1993, p.33) also observed that not only were middle class families attracted to the area but creatives as well: “many artists, architectural businesses, and small advertising enterprises were attracted by Woodstock’s Victorian architecture, it’s close proximity to Table Mountain and hotchpotch mixture of residential and warehousing activities which was markedly different to the bland uniformity of much of suburban Cape Town” (Fig. 22.1). This first wave of gentrification in Woodstock was from the bottom-up with no state incentives for urban renewal. During the 1990s, artists, creative firms, and entrepreneurial businesses started increasingly to invest in these industrial spaces and Victorian cottages. According to Visser and Kotze (2008), in addition to small entrepreneurs, large firms also began to move into Woodstock.

In 2003 the Woodstock Upliftment Project was established and was reinforced with the establishment of the Woodstock Improvement District in 2005. According to Booyens (2012), there is evidence of the clustering of creative-sector industries in Woodstock. This includes cafes, restaurants, music venues, and trendy shops. Young professionals are following the ‘creative craze’ and property prices are increasing steadily. Following the introduction of the Urban Development Zone tax incentive in 2004, there was a shift towards third-wave gentrification in the area with increased investment in property for creative-led developments and upmarket residential conversions. Wenz (2012, p.24) states that “Woodstock’s current gentrification and creative industry-led urban regeneration has been initiated and driven by private property developers that wanted to reap profits from the ‘Rebirth of Woodstock’ by means of specifically attracting ‘creative industry’ tenants’.

One example of a post-industrial site that has been converted into a creative space is the Old Biscuit Mill which was established in 2005 as a mixed-use creative complex offering studio, office and retail space. The complex is more popularly known for hosting a weekly food and design market,
called the Neighbourgoods market, which attracts wealthy local and international visitors to the area (Joseph 2014; Wenz 2012). Other converted creative spaces includes the Woodstock Exchange which hosts art galleries, film and photographic studios, film production companies, shops, restaurants, and office spaces. The redevelopment in Woodstock corresponds with international trends whereby creative firms establish themselves in post-industrial fringe areas of the inner city. Booyens (2012), however, states that as a result the inner city and its fringe is becoming more expensive, exclusive and gentrified, enhancing existing social inequalities. Another negative impact is the decline in demand for skilled working class labour, coupled with a decline in manufacturing.

The negative impact of creative industries causing gentrification is well documented internationally. Gentrification in Woodstock was first noted by Garside (1993) but linked specifically to creative industries by Wenz (2012). The initial influx of creatives during the 1990s and early 2000s have, since the mid-2000s, turned into a flood of creative-led property developments, which is slowly starting to change the socioeconomic composition of Woodstock. As Future Cape Town (a non-profit organisation promoting inclusive cities) states: “development in [Woodstock] has had an adverse splintering effect on both the urban spatial quality, as well as on the socio-spatial qualities of Woodstock. Residential streets are interrupted by businesses… Developments have a distinctive boundary and small controllable access points… Slowly common spaces are being encroached upon for parking and private use” (Du Trevou 2015, p.2). In recent years, the press has been reporting on the changes occurring in Woodstock, and noting the displacement that has been taking place. Joseph (2014) for example refers to Woodstock as a ‘hipster heaven’. Pather (2016) highlighted the evictions of families from Bromwell Street close to the Biscuit Mill market to a temporary resettlement area 30 km north of the city (Fig. 22.2). The level of gentrification and population displacement in Woodstock has spurred further community action. Campaigns such as ‘Reclaim the City’ are advocating for state-subsidised and affordable housing for poor inner city residents in areas such as Woodstock (Reclaim the City 2017).

### 22.4 Creative Industries in Johannesburg

According to Rogerson and Rogerson (2015), despite its importance in urban Africa, Johannesburg has been relatively neglected by urban researchers. Post-apartheid
Johannesburg still carries the scars of decades of apartheid city planning and is currently struggling to balance aspirations as a world-class city against the demands of meeting the basic needs of the poor (Murray 2011). Policy efforts over the past decade have increasingly focused on reinvigorating, reinventing and reviving the city. Some of these strategic interventions include the use of creative industries as a lever for urban regeneration and economic development (Gregory and Rogerson 2016; Hoogendoorn and Gregory 2016; Rogerson 2006, 2018; Rogerson and Rogerson 2015). This section will review research developments on creative industries in Johannesburg, focusing on the Maboneng precinct where there is evidence of relationships between creative industries and neighbourhood change.

Both the Gauteng provincial government and the City of Johannesburg have been supportive of creative industries as a tool for economic growth and urban regeneration. The Gauteng provincial government developed the Creative Industries Development Framework in 2006 followed by an implementation framework in 2012. The province also has various subsector-specific strategies to support the growth of the craft, music, performing and visual arts sectors. The city of Johannesburg highlights creative industries in its key policies such as the ‘Joburg 2040: Growth and Development Strategy’ and the Integrated Development Plan of the city. Of importance to note is that creative industries should address poverty and inequality and promote job creation (Gregory and Rogerson 2016).

Since the early 2000s, the City of Johannesburg’s policy environment has been favourable towards private investment to assist in urban regeneration (Garner 2011). One example is the introduction of the Urban Development Zone tax incentive launched in 2004. Private property developers have been using creative or cultural-led developments in redeveloping and rejuvenating parts of the inner city and its fringe areas; however, this is still largely limited to pockets or enclaves of renewal (Gregory 2016; Hoogendoorn and Gregory 2016; Murray 2011). Overall, creative industries in Johannesburg are less concentrated than in the case of Cape Town. In a spatial analysis of creative industries across Johannesburg, Gregory and Rogerson (2018) found that the majority of creative industries are scattered across the northern suburbs of the city, and that 2325 creative enterprises operated across Johannesburg in 2015. Many of these are establishing in districts or precincts of the city centre such as Braamfontein, Newtown or Maboneng (Gregory 2016). One
area that has experienced significant neighbourhood change over the past decade is the Maboneng precinct. The growth of the precinct is attributed to property-led development focused on attracting and catering to creative industries and creative consumption (Gregory 2016).

### 22.4.1 Property-led Renewal and Creative Industries in the Maboneng Precinct

The Maboneng precinct is located on the eastern fringe of Johannesburg’s inner city in a post-industrial area that has been experiencing industrial decline since the 1980s (Rogerson and Rogerson 1995). It is close to important facilities such as the Emirates Airline Park rugby stadium (formerly Ellis Park), and the University of Johannesburg (Doornfontein Campus), and borders the low-income area of Jeppestown. Prior to development of the Maboneng precinct, the area was largely occupied by empty warehouses and some light industrial activities. In 2008, the development company Propertuity purchased old warehouse space, which was redeveloped into the ‘Arts on Main’ complex (Fig. 22.3). This mixed-use development houses artists’ studios and gallery, and restaurant and retail space. Initially the developers approached well-known South African artists to take up studio space at Arts on Main. A watershed for the growth of the precinct was the introduction of the weekly ‘Market on Main’ in 2011. This market focuses on artisanal food and design and each week draws up to 2000 visitors. By 2014, Propertuity owned 42 buildings and diversified its portfolio to include residential conversions, retail and commercial space (Gregory 2016).

From the outset, the developer used the arts and creative industries to promote the brand of the Maboneng precinct (Fig. 22.4). Within the last 10 years, the area has grown into an important space for the production and consumption of the arts and an entertainment economy that has also boosted urban tourism in the area (Gregory 2016; Hoogendoorn and Gregory, 2016). In June 2016, Rand Merchant Bank holdings purchased a third of Propertuity, signalling trust in the continued growth of the precinct. In 2018, a desktop audit reported that there are over 60 businesses in the area, ranging from art galleries, to restaurants and bars to various retail outlets (Propertuity 2018).

![Fig. 22.3](Image) The Arts on Main complex in the Maboneng precinct, Johannesburg; an example of a post-industrial redevelopment for creative industries. (Photo: James Gregory)
With renewed investment interest in an area of the city that had experienced decline, there is now evidence of socio-economic and neighbourhood change in the Maboneng precinct (Gregory 2016). The developer had been careful to avoid direct displacement through acquiring buildings that are not occupied, but investment interest in the area had a ripple effect and contributed to indirect displacement in surrounding areas. The City of Johannesburg responded by revaluing properties across the inner city and fringe areas. The revaluations resulted in higher property taxes and an increase in rental rates. In some cases there have been evictions of lower income and illegal residents in buildings surrounding Maboneng. Rental rates within the precinct have also increased significantly, pushing out many of the smaller creative entrepreneurs that were unable to afford higher rents. Displacement of illegally occupied buildings near Maboneng has been documented in the popular press, and the City of Johannesburg has been criticised for not offering alternative accommodation for evictees (Jason 2014; Kinsman 2014). Amongst others, the Socio-Economic Rights Institute of South Africa has assisted vulnerable inner city residents in taking property owners and the city to court to secure alternative housing for evictees.

Interviews with creatives in the precinct disclosed that the high cost of living in the precinct caters to a more affluent consumer, and many service workers and support staff of creative businesses no longer can afford to reside there. Some creative entrepreneurs feel that the community is exclusionary and that the existing and surrounding communities are ‘cast aside’ simply because they cannot afford to access the precinct (Gregory 2016). Walsh (2013) however, states that the precinct offers job opportunities in an area that was previously economically depressed, and that the surrounding areas and city still offer affordable housing in close proximity to the precinct. Nicolson (2015) argues that Maboneng is a small pocket of wealth surrounded by poverty, but that this is part of the larger issue of inequality in South Africa. The urban landscape of South African cities is still largely segregated on income and racial lines. An area such as Maboneng functions as an intersection where opposite-income classes meet, which can lead to conflict over access to space (Nicolson 2015). Walsh (2013) maintains that having an area of relative wealth near poorer areas could minimize the exclusion that is experienced in South African cities. Inclusion is challenged, however, by the highly privatised public spaces and the presence of private security guards in the precinct. As Rees (2013) notes, locals from surrounding communities are ushered away by private security guards. In 2015 violent protests erupted in Jeppestown where people were facing eviction; the precinct was not involved in these protests but was used as a scapegoat and blamed for evictions in nearby areas. Myambo (2017) argues that areas like Maboneng run the risk of reinforcing existing spatial apartheid in urban South Africa. Nicolson (2015), however, argues that it is the responsibility of the city to respond to marginalized residents and offer affordable inner-city housing. The case of the Maboneng precinct fits into a larger global trend of neoliberal urban policies aimed at supporting private property investment and the use of creative or cultural industries for urban regeneration.

22.5 Summary

Creative industries are of growing significance in the South African urban landscape. In Cape Town, creative industries form a substantial part of the inner city economy. In Johannesburg, the majority of creative industries are scattered across the city’s northern suburbs but are now becoming more clustered, particularly in areas such as the Maboneng precinct (Gregory 2016). Creative-city policies and place-branding initiatives have been used to attract investment, affluent residents and visitors back into both Woodstock and the Maboneng precinct. Nevertheless, in common with the experience of creative industries in many Northern cities, creative-led redevelopment is open to criticism for exacerbating socioeconomic problems, gentrification and social exclusion (Grodach et al. 2018). This is contrary to South Africa’s creative industries’ policies for social cohesion, creation of sustainable jobs and ensuring
social and economic development (Department of Arts and Culture 2016). Overall, there is lack of recognition in this policy on how to minimise the impact of exclusion and displacement caused directly or indirectly by the presence of creative industries in urban areas. In South Africa, with a history of racial segregation tied to a highly unequal society, urban policy must be cognisant of the risks of replicating Northern and neoliberal urban policies, which may lead to further socioeconomic polarisation. Oyekunle (2017) calls for policy on creative industries to draw on local methodologies, to focus on social inclusion and poverty alleviation to ensure sustainable urban development.

The impacts of creative industries may be several fold. There may be potential positive impacts on place-making and rebranding initiatives as a source for wider regeneration benefits (Jarvis et al. 2009; Martone and Sepe 2012; Pappalepore et al. 2014). Creative industries can also be used to stimulate physical redevelopment and to promote areas as vibrant and innovative spaces for business and urban tourism, which can foster economic growth and job creation (Jarvis et al. 2009). The latter links with the case of Woodstock and the Maboneng precinct where there is evidence of physical and economic regeneration in spaces that experienced decline in the 1980s and 1990s. However, research is required from urban scholars (including geographers) to further investigate the long-term socioeconomic impacts of creative industries, and in particular to examine exclusion and gentrification. In addition, debate is needed on the development and implementation of policies for the creative industries in urban South Africa in order to illuminate issues surrounding uneven urban development, and to inform recommendations for socially inclusive creative city policy.

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Tourism and Accommodation Services in South Africa: A Spatial Perspective

Christian M. Rogerson and Jayne M. Rogerson

Abstract

Geographers are major contributors to tourism studies. Tourism geographical research has diversified in scope and broadened from earlier issues of spatial analysis to include a range of different theoretical issues, methodological perspectives and empirical agendas. It is argued that a case exists for the re-spatialization of geographical research on tourism. The importance of understanding the shifting spatial landscape of tourism is critical for national and local policymakers in South Africa. In this analysis, insight is provided concerning the changing sector of tourism accommodation services by adopting a spatial perspective. The unevenness of tourism spend patterns provides an essential basis for interpreting the tourism space economy representing the demand-side of the tourism-accommodation nexus. Unpacking bednight data, it is shown that the supply-side of accommodation services in South Africa encompasses both a commercial and a non-commercial component, the latter linked to travel for visiting friends and family.

Keywords

Accommodation services · Re-spatializing · South Africa · Tourism geography · Tourism space economy

23.1 Introduction

Geography with its strong spatial focus and synthesizing approach has exerted a ‘foundational role’ in tourist studies and was one of the earliest disciplines to engage with tourism research (Butler 2004; Che 2018). As argued by Kang et al. (2014, p. 793) “tourism is at its very core a distinctly geographical phenomenon, involving the movement of tourists from one place – their places of origin or generating regions – to one or more destinations via a complex web of multimodal transportation networks”. Gill (2018, p. 185) maintains that “in the early years of academic interest in tourism studies, geographers were seminal contributors”. With geographers’ varied interests in place, space and the environment, invariably they continue to offer significant insight to the multidisciplinary landscape of tourism studies (Crouch 2018; Gill 2012; Hall and Page 2006; Mitchell 1979; Saarinen 2014; Timothy 2018; Williams 2009).

Terkenli (2018, p. 170) considers the scholarly and instrumental contribution of geography to tourism studies as “broadly indisputable”. Likewise Hall and Page (2009, p. 4) contend that “geographers have made a substantial contribution to the field of tourism”. For Timothy (2018), the analytical toolkits of geographers are valued especially for understanding regional patterns, tourism’s impact on places, the industry’s spatial growth, and flows of travellers from home to destinations. Among the list of major issues tourism geographers have made notable contributions are, inter alia, sustainability, conservation and biosafety, destination planning and management, climate change, mobilities, innovation, pro-poor growth, public policy, protected areas, local economic development, tourism planning, and entrepreneurship (e.g. Hall and Page 2009; Hall 2013; Saarinen 2014; Saarinen et al. 2017). Of increased importance is the crossover occurring between tourism and geospatial technologies (Timothy 2018).

One of the first reviews of scholarship by a geographer concerning tourism was published by Pearce in 1979. In this state of the art survey six major areas of interest were defined as core research agendas for geographers, inter alia, spatial aspects of supply, spatial aspects of demand, the geography of resorts, patterns of movements and flows, tourism impacts, and models of tourist space. Informed by the dominant positivist paradigm of the 1970s, Pearce (1979, p. 247) considered that at the time “the geography of tourism was mainly concerned with the spatial differentiation of tourism and the
recognition of general regularities in its occurrence”. Research which exemplified this tradition of tourism geography includes works by Britton (1980), Forer and Pearce (1984), and Pearce (1987). The special focus on spatial issues for geographical researchers was reiterated more than a decade later in a review article by Mitchell and Murphy (1991, p. 63) who asserted the spatial implications of tourism remain “very important to geography”.

During the subsequent 25 years, tourism geographical studies have diversified greatly in scope and broadened from issues of spatial analysis to embrace an array of different theoretical issues, methodological perspectives and empirical agendas (Ferreira 2018; Gill 2012; Hall 2013; Lew et al. 2014; Saarinen 2014; Saarinen et al. 2017). As Müller (2018) observes, this extended agenda reflects wider shifts occurring within geography in which a descriptive tradition and mapping of the world has been exchanged for more analytical approaches, defining geography not as an object of study but instead as a perspective on society and the environment. This said, one dimension of the multidisciplinary domain of tourism studies that remains the particular territory for geographers’ research is interpretation of the spatial organization of tourism. Over recent years, aspects of the geographical structuring of tourism economies and their implications for policy makers have been scrutinized across several countries and from a range of tourism disciplines (e.g. Goh et al. 2014, 2015; Guedes and Jimenez 2015; Kang et al. 2014; Koo et al. 2017; Lau et al. 2017; Li et al. 2016; Tosun et al. 2003; Wen and Sinha 2009). Arguably, interpreting the production and organization of tourism spaces as well as the changing dynamics of the tourism space economy remain central challenges for tourism scholars (Hall 2013; Hall and Page 2006; Lew et al. 2014). Within the vibrant and expanding body of tourism scholarship, Müller (2016) highlights the limited range of geographical studies on locational issues, especially in peripheral regions. Notwithstanding the substantive contribution by geographers to understanding an array of tourism themes as outlined by Hall and Page (2009), Hall (2013), and Saarinen et al. (2017), the case can be made therefore for geographers also to ‘re-spatialize’ our understanding of tourism. Cornelissen (2005) identified this challenge in South Africa by observing that only limited research has been conducted on the spatial dimensions of tourism in the country.

As stressed by Ahebwa and Novelli (2014), an enhanced understanding of the spatial distribution of tourism can result in better informed national development policies. In a growing number of countries the promotion of tourism is increasingly also a component of place-based local development policies (C. M. Rogerson 2014a). For African tourism geographers in particular, the significance of conducting applied research to comprehend the spatial aspects of tourism is vital for informing strategic policy development at both national and local levels of planning (Rogerson and Visser 2011). It is against this backdrop that the analysis in this chapter adopts a spatial lens, which is focused on the tourism accommodation sector in South Africa. The nexus of tourism and accommodation services is critical. The growth and consolidation of a commercial accommodation or lodging sector is viewed as both an accompaniment as well as facilitator for tourism development in any country (Timothy and Teye 2009). Consistently, the availability of a range of accommodation services is recognized as one essential underpinning of an ‘infrastructure for competitiveness’ at any given tourism destination and most especially in emerging tourism regions (Christie et al. 2013; C. M. Rogerson and J. M. Rogerson 2018). Correspondingly, an undersupply or poor quality of adequate accommodation services (particularly hotels) is identified by World Bank investigations as one of the major constraints on tourism development in several African countries. The case of Malawi is instructive in this respect as it shows the historically lagging character of tourism development to be in part a consequence of the inadequate provision of accommodation services (Magombo et al. 2017). Overall, across sub-Saharan Africa, the competitiveness of countries as tourism destinations is conditional upon establishing a network of different forms of accommodation at competitive prices and of acceptable quality standards (Magombo et al. 2017; C. M. Rogerson and J. M. Rogerson 2018).

In examining the tourism accommodation sector in South Africa from a spatial perspective, two brief sections of material and analysis are now presented. The first gives an overview of the key features of the uneven space economy of tourism as representing the demand-side of the tourism-accommodation nexus. Then the supply-side of tourism accommodation services is discussed both in terms of commercial accommodation services and also the little recognized non-commercial provision of accommodation services for tourism. Overall, the analysis builds upon and extends several recent investigations on the spatial organisation of tourism in South Africa and about the structural as well as geographical restructuring of the accommodation sector. This material is supplemented by the inclusion of new data from the IHS Global Insight database on tourism, analysis of official South African Tourism (SAT) data on accommodation services, and recent relevant secondary material concerning the country’s evolving accommodation sector.

### 23.2 Tourism and an Uneven Space Economy

Since the hosting of the FIFA World Cup in 2010, the tourism economy of South Africa has experienced a period of considerable volatility amidst turbulent global and local policy environments. International tourism flows at the global scale have been impacted by the lagged effects of the 2008
financial crisis, the negative impacts of terrorist attacks, and continual uncertainties in the geopolitical landscape, including of the implications of Brexit (South African Tourism 2016). Recently, the poor comparative performance of South Africa in terms of international tourism arrivals is linked to perceptions in certain source markets of the Ebola outbreak and specifically to the introduction by the Department of Home Affairs of misguided visa regulations which seriously impacted South Africa’s tourism competitiveness in several critical source markets (C. M. Rogerson 2017a). According to SAT data, South Africa recorded a 6.8% decline in international tourists from 9.5 million in 2014 to 8.9 million in 2015. The most significant downturns related to China, India and specifically to the introduction by the Department of Home Affairs of misguided visa regulations which seriously impacted South Africa’s tourism economy, also has been under major strain since 2010 (C. M. Rogerson 2015a). Official data from the annual domestic tourism survey suggest a marked downturn in numbers of domestic tourism trips from 29.7 million in 2010 to 28 million in 2014 (Department of Tourism 2017). In 2015, domestic leisure trips dropped by 2.6% but the most substantial downturn of 16% was recorded for trips to visit friends and relatives (VFR), which accounts for the largest segment of domestic tourism (C. M. Rogerson 2015b). The weakened state of domestic tourism is, to a large extent, a reflection of wider macro-economic issues around economic mismanagement and corruption, extended drought conditions, reduced international demand for South African minerals, and issues with the supply and cost of electricity.

Domestic tourism, the core historical base for development of South Africa’s tourism economy, also has been under major strain since 2010 (C. M. Rogerson 2015a). Official data from the annual domestic tourism survey suggest a marked downturn in numbers of domestic tourism trips from 29.7 million in 2010 to 28 million in 2014 (Department of Tourism 2017). In 2015, domestic leisure trips dropped by 2.6% but the most substantial downturn of 16% was recorded for trips to visit friends and relatives (VFR), which accounts for the largest segment of domestic tourism (C. M. Rogerson 2015b). The weakened state of domestic tourism is, to a large extent, a reflection of wider macro-economic issues around economic mismanagement and corruption, extended drought conditions, reduced international demand for South African minerals, and issues with the supply and cost of electricity.

Domestic travel (in particular) is a component of discretionary spend. The Department of Tourism (2017) forecasts with continued low economic growth that further moderation of household expenditure is anticipated in coming years. In addressing these challenges which impact both international and domestic tourism markets, the Department of Tourism (with support from SAT) launched a tourism recovery strategy which focuses on contributing to national goals of inclusive economic growth (Department of Tourism 2017; South African Tourism 2016).

In its policy statements about tourism, national government often acknowledges the challenge of spatial inequities in tourism patterns and in particular of the impacts of uneven tourism spend. For example, in SAT’s strategic plan issued for the period 2017–2022, the problematic nature of tourism’s ‘geographic spread’ is raised (South African Tourism 2016). Again, in the Department of Tourism’s 2017 (revised) National Tourism Sector Strategy, much attention is given to the imperative for extending rural tourism development as one anchor for contributing towards a growing and inclusive tourism economy (Department of Tourism 2017). Indeed, South Africa’s most underdeveloped regions or ‘distressed areas’, which closely align with the former apartheid-created Homelands, are a special focus of policy attention in terms of reducing spatial inequalities in national economic development (C. M. Rogerson 2014b, 2015c; Rogerson and Nel 2016a, b). Research by Visser (2003) and C. M. Rogerson (2015d) reveals the benefits of growth in national tourism are distributed unequally across South Africa between destinations and regions. Accordingly, with tourism viewed as a key driver for local economic development, the uneven character of tourism development becomes a matter of pressing policy concern for all three tiers of government (Nel and Rogerson 2016; C. M. Rogerson 2014b).

The contours and unevenness of the tourism space economy of South Africa are mapped out in detail in several investigations mainly undertaken by local geographers (McKelly et al. 2017; C. M. Rogerson 2014b, 2015a, b, c, 2016a, b, 2017b, C. M. Rogerson and J. M. Rogerson 2014, 2017; Visser 2007). Total tourism spend data provide the best single indicator of the extent of local tourism benefits. Table 23.1 lists the leading 20 municipalities in South Africa, ranked according to tourism spend. By contrast, Table 23.2 shows the most impoverished ten local municipalities according to tourism spend. Several points can be observed. First, the tourism space economy is highly polarised with the benefits of tourism development concentrated upon only a small number of centres (C. M. Rogerson 2014b). Table 23.1 shows that in 2015 almost 50% of total tourism spend is captured by five municipalities, and 67% in the leading 20

Table 23.1 Total tourism spend in the leading 20 South African municipalities, 2001–2015

<table>
<thead>
<tr>
<th>Municipality</th>
<th>2001 share (%)</th>
<th>2015 share (%)</th>
<th>% change (2001–2015)</th>
<th>Total spend 2015 (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Town</td>
<td>15.0</td>
<td>16.5</td>
<td>1.5</td>
<td>39,243,575</td>
</tr>
<tr>
<td>Johannesburg</td>
<td>14.0</td>
<td>13.8</td>
<td>-0.2</td>
<td>32,717,296</td>
</tr>
<tr>
<td>eThekwini</td>
<td>9.1</td>
<td>9.8</td>
<td>0.7</td>
<td>23,229,012</td>
</tr>
<tr>
<td>Tshwane</td>
<td>5.5</td>
<td>5.9</td>
<td>0.4</td>
<td>14,046,917</td>
</tr>
<tr>
<td>Ekurhuleni</td>
<td>3.5</td>
<td>3.3</td>
<td>-0.2</td>
<td>7,848,442</td>
</tr>
<tr>
<td>Mbombela</td>
<td>2.4</td>
<td>2.5</td>
<td>0.1</td>
<td>6,026,739</td>
</tr>
<tr>
<td>Mangaung</td>
<td>1.7</td>
<td>1.8</td>
<td>0.1</td>
<td>4,360,282</td>
</tr>
<tr>
<td>Polokwane</td>
<td>0.8</td>
<td>1.8</td>
<td>1.0</td>
<td>4,232,467</td>
</tr>
<tr>
<td>Nelson Mandela Bay</td>
<td>2.3</td>
<td>1.3</td>
<td>-1.0</td>
<td>3,143,351</td>
</tr>
<tr>
<td>Moses Kotane</td>
<td>1.8</td>
<td>1.3</td>
<td>-0.5</td>
<td>3,119,451</td>
</tr>
<tr>
<td>Hibiscus Coast</td>
<td>1.3</td>
<td>1.1</td>
<td>-0.2</td>
<td>2,689,080</td>
</tr>
<tr>
<td>Bushbuckridge</td>
<td>1.4</td>
<td>1.0</td>
<td>-0.4</td>
<td>2,373,859</td>
</tr>
<tr>
<td>Rustenburg</td>
<td>0.8</td>
<td>1.0</td>
<td>0.2</td>
<td>2,339,529</td>
</tr>
<tr>
<td>Nkomazi</td>
<td>1.0</td>
<td>0.9</td>
<td>-0.1</td>
<td>2,269,280</td>
</tr>
<tr>
<td>Mogale City</td>
<td>0.9</td>
<td>0.9</td>
<td>0.0</td>
<td>2,178,559</td>
</tr>
<tr>
<td>Overstrand</td>
<td>0.7</td>
<td>0.8</td>
<td>0.1</td>
<td>1,877,789</td>
</tr>
<tr>
<td>Buffalo City</td>
<td>0.5</td>
<td>0.8</td>
<td>0.3</td>
<td>1,862,364</td>
</tr>
<tr>
<td>Ba-Phalaborwa</td>
<td>0.6</td>
<td>0.8</td>
<td>0.2</td>
<td>1,861,727</td>
</tr>
<tr>
<td>Stellenbosch</td>
<td>0.8</td>
<td>0.8</td>
<td>0.0</td>
<td>1,857,504</td>
</tr>
<tr>
<td>Knysna</td>
<td>0.9</td>
<td>0.7</td>
<td>-0.2</td>
<td>1,766,147</td>
</tr>
</tbody>
</table>

Based on unpublished IHS Global Insight data
municipalities. Second, as compared to tourism spend data for 2001, the tourism space economy has become even more polarised geographically. In 2001, the leading ten destinations for tourism spend represent 55% of the national share; by 2015 this had risen to 57%. For the top five destinations, the corresponding shares are 47% in 2001 and 49% in 2015. Most striking is the strengthening of Cape Town as South Africa’s most important individual centre of tourism spend, with a 17% national share by 2015. As compared to the significance of leisure tourism for Cape Town and eThekwini, business tourism is most important in Johannesburg and Tshwane (see C. M. Rogerson 2015d; C. M. Rogerson and J. M. Rogerson 2014). Third, despite South Africa’s assets of the ‘big five’ and of iconic nature tourism in rural areas, Table 23.1 confirms that the greatest benefits of tourism development occur in large urban areas rather than small towns or rural areas (C. M. Rogerson 2016b; C. M. Rogerson and J. M. Rogerson 2017). Indeed, the metropolitan municipalities of Cape Town, Johannesburg and eThekwini account for 40% of national tourism spend. Further, the country’s eight metropolitan municipalities collectively record 53% of national tourism spend. Fourth, a significant amount of tourism spend is recorded in smaller non-metropolitan local municipalities. These include the secondary cities of Polokwane and Mbombela, Moses Katane (which benefits from Sun City and the Pilanesberg nature reserve), several small town municipalities close to protected areas of nature tourism (Bushbuckridge, Nkomazi, Ba-Phalaborwa) and a number of coastal (Hibiscus Coast, Overstrand, Knysna) or wine tourism destinations (Stellenbosch). In other research, several of these non-metropolitan tourism spaces have been identified as ‘tourism dependent localities’ in which tourism is isolated as a vital driver for local economic growth and job opportunities (C. M. Rogerson and J. M. Rogerson 2017). Fifth, Table 23.2 reveals that minimal benefits flow to the country’s less visited tourism spaces (C. M. Rogerson 2017b). For example, total tourism spend in Cape Town is over 70 times more than in all the ten lowest ranked local municipalities combined, and almost 770 times more than tourism spend in Kareeberg, South Africa’s least advantaged local municipality for local tourism spend. Overall, the ten least-important tourism local municipalities are mainly concentrated in arid and remote parts of Northern Cape province. Collectively, the ten least significant tourism spaces account for only 0.2% of total national tourism spend, which suggests that some regions of South Africa have limited potential for tourism development (C. M. Rogerson 2015c). The caveat must be added, however, that ‘tourism potential’ is often equated simply with potential for leisure tourism (or on occasion with a nod to business tourism). Such a narrow definition of tourism potential eschews the importance and dominance of (primarily domestic) VFR travellers in South Africa’s non-metropolitan spaces, more especially in the distressed areas (C. M. Rogerson 2014b, 2015b, 2017c). This said, in certain national tourism strategic documents, the potential significance of leveraging VFR tourism for local development now is acknowledged (Department of Tourism 2017; South African Tourism 2016). Overall, this analysis of the uneven geographical patterns of tourism spend provides a demand-side perspective on the accommodation services sector. The next section provides a supply-side viewpoint on the different forms and geography of accommodation services in South Africa.

### 23.3 The Accommodation Services Sector: An Overview

Over the past 25 years, the development of the accommodation services sector has been an important contributor to the competitiveness of South Africa in the global tourism economy (C. M. Rogerson and J. M. Rogerson 2018). During the colonial and apartheid period, the growth of accommodation services in South Africa was anchored upon a core base of the domestic tourism market (C. M. Rogerson 2011). Since the early 1990s, the sector has matured and diversified its range of product offerings in response to long haul international tourist arrivals, as well as regional tourism from sub-Saharan Africa. In the African context, South Africa provides a ‘good practice’ case study for restructuring and upgrading of the national accommodation services sector following the country’s post-1994 re-entry into the international tourism economy (J. M. Rogerson 2013a, b; J. M. Rogerson and Kotze 2011). As a consequence, tourists in South Africa – domestic or international – can now choose from a menu of

<table>
<thead>
<tr>
<th>Local municipality</th>
<th>Province</th>
<th>2015 share (%)</th>
<th>Total spend (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ntabankulu</td>
<td>Eastern Cape</td>
<td>0.0271</td>
<td>64,099</td>
</tr>
<tr>
<td>Karoo Hoogland</td>
<td>Northern Cape</td>
<td>0.0263</td>
<td>62,250</td>
</tr>
<tr>
<td>Mier</td>
<td>Northern Cape</td>
<td>0.0253</td>
<td>59,953</td>
</tr>
<tr>
<td>Dikgatlong</td>
<td>Northern Cape</td>
<td>0.0246</td>
<td>58,354</td>
</tr>
<tr>
<td>Gariep</td>
<td>Eastern Cape</td>
<td>0.0236</td>
<td>55,880</td>
</tr>
<tr>
<td>Kamiesberg</td>
<td>Northern Cape</td>
<td>0.0227</td>
<td>53,820</td>
</tr>
<tr>
<td>Ezingoleni</td>
<td>KwaZulu-Natal</td>
<td>0.0226</td>
<td>53,456</td>
</tr>
<tr>
<td>Tsantsabane</td>
<td>Northern Cape</td>
<td>0.0220</td>
<td>52,112</td>
</tr>
<tr>
<td>Richtersveld</td>
<td>Northern Cape</td>
<td>0.0218</td>
<td>51,620</td>
</tr>
<tr>
<td>Kareeberg</td>
<td>Northern Cape</td>
<td>0.0215</td>
<td>50,923</td>
</tr>
</tbody>
</table>

Based on unpublished IHS Global Insight data
accommodation options including five star luxury hotels and safari lodges, boutique hotels, limited service hotels, all-suite hotels, guest houses, bed and breakfasts, self-serviced apartments, backpacker hostels and, most recently, Airbnb home stays (Greenberg and Rogerson 2015; J. M. Rogerson 2010, 2011a, b; Visser et al. 2017). It is evident that certain commercial accommodation products target specific markets, such as time share accommodation primarily for the domestic tourism market and backpacker hostels almost exclusively for young international travellers. In addition, many of the high-end luxury hotels and exclusive safari lodges are geared especially to the international tourism market.

Over the past decade a growing number of research investigations have unpacked the characteristics and shifting dynamics of these different segments of commercial accommodation services (e.g. Greenberg and Rogerson 2015; Hay and Visser 2014; Pandy and Rogerson 2013a, b, 2014a, b; J. M. Rogerson 2010, 2011a, b, 2013a, b, c, d, 2014a, b; J. M. Rogerson and C. M. Rogerson 2014; Visser and van Huyssteen 1997, 1999; Visser et al. 2017). The research discloses structural changes in the accommodation services sector and in particular in response to shifting consumer demands and market segmentation. It is also evident that different types of accommodation have a different geographical footprint. Marked differences are observable for example in spatial patterns of nature-based accommodation, time-share resorts, boutique hotels, second homes, backpacker hostels, five star luxury hotels or Airbnb home stays. Outside of the various segments of commercial accommodation, however, there are non-commercial accommodation services which concentrate on (mainly) domestic low-income VFR travellers (C. M. Rogerson 2015b, 2017c, d), but these are not fully mapped out or understood in terms of their geography.

The composite national picture in terms of the provision of accommodation services can be appreciated by examining an index of total bednights spent by tourists in individual destinations (Table 23.3). Total bednights includes all purposes of travel from leisure and business to VFR, with the latter the largest segment and (overwhelmingly in the South African context) dominated by non-commercial forms of accommodation. Accordingly, the data on total bednights must be read as a composite index for both commercial and non-commercial forms of accommodation. The Global Insight data on total bednights shows an expansion in total from 129 million bednights in 2001 to almost 186 million by 2006. By 2015, however, total bednights declined to 171 million, which is explained mainly by the downturn in domestic tourism due to weakened economic circumstances. Of this 2015 total, approximately 63% is accounted for by domestic tourists, including for VFR travel. Analysis undertaken for 2012 data showed the dominance of cities in terms of total bednights. Collectively the 8 metropolitan centres were responsible for 42% of bednights, the country’s 22 secondary cities for 16%, and small towns and rural areas for 42%. However, the small towns and rural areas of South Africa account for a much higher proportion of non-commercial VFR stays than the cities as a whole and metropolitan areas in particular. With their much higher representation of leisure and business travel and of high-end international tourists, the ratio of paid to unpaid accommodation in metropolitan areas is much higher than in small towns and rural areas.

Using total bednights data, Table 23.3 indicates the national picture in terms of the geographical provision of accommodation services for individual destinations. Several points must be noted. First, the overall supply of accommodation services focuses overwhelmingly on the country’s major urban centres of Cape Town, Ekurhuleni, eThekwini (Durban), Johannesburg and Tshwane (Pretoria). Second, the geography of bednights exhibits much lower concentration than tourism spend. As compared to the 53% of total tourism spend in metropolitan areas, only 43% of bednights are accounted for. Although accommodation cost is only one (albeit a major) aspect of total spend, it can be argued that this signals that a relatively higher proportion of bednights are in paid commercial forms than occurs in other parts of the country, most notably in small town and rural destinations which host large numbers of VFR travellers. Finally, outside the metropolitan areas and secondary cities, individual destinations with high total bednights reflect a mix of coastal leisure tourism hubs, areas proximate to protected nature tourism attractions, and deep rural areas characterised by a high proportion of split households which are focal points for VFR travellers (C. M. Rogerson 2017c).

### 23.4 Summary

Tourism geography researchers in South Africa are making significant contributions to an expanding canvas of themes, including biodiversity, climate change, protected areas, and poverty reduction (Visser 2016). In many respects, local tourism geography is a mirror of a broadening foci in international tourism scholarship. Arguably, the case exists for a re-spatialization of local geographical research on tourism. Understanding the shifting spatial landscape of tourism is of critical relevance for national tourism stakeholders and local development planners. The unevenness of tourism spend patterns provides a basis for representing the demand-side of the tourism-accommodation nexus. The supply-side of accommodation services in South Africa encompasses both a commercial and a non-commercial component, the latter linked to VFR travel (C. M. Rogerson 2017d). Future research by geographers must continue to excavate the shifting contemporary landscape of tourism and accommodation.
services, both commercial and non-commercial. In addition, further value can be added to existing scholarship by pursuing historical studies on tourism and accommodation services in South Africa.

Acknowledgements Thanks to Jonathan Rogerson for data analysis, to referees for comments, and to Teddy, Skye and Dawn Norfolk for useful inputs.

References

Department of Tourism (2017) National tourism sector strategy. Department of Tourism, Pretoria 76pp

Table 23.3 Total number of bednights spent in the leading municipalities in 2015

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Province</th>
<th>Settlement type</th>
<th>2015 share (%)</th>
<th>Total bednights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johannesburg</td>
<td>Gauteng</td>
<td>Metropolitan</td>
<td>9.5</td>
<td>16,224,055</td>
</tr>
<tr>
<td>Cape Town</td>
<td>Western Cape</td>
<td>Metropolitan</td>
<td>8.1</td>
<td>13,852,724</td>
</tr>
<tr>
<td>eThekwini</td>
<td>KwaZulu-Natal</td>
<td>Metropolitan</td>
<td>7.8</td>
<td>13,365,580</td>
</tr>
<tr>
<td>Tshwane</td>
<td>Gauteng</td>
<td>Metropolitan</td>
<td>6.3</td>
<td>10,754,400</td>
</tr>
<tr>
<td>Ekurhuleni</td>
<td>Gauteng</td>
<td>Metropolitan</td>
<td>4.9</td>
<td>8,381,711</td>
</tr>
<tr>
<td>Polokwane</td>
<td>Limpopo</td>
<td>Secondary city</td>
<td>2.5</td>
<td>4,246,218</td>
</tr>
<tr>
<td>Mangaung</td>
<td>Free State</td>
<td>Metropolitan</td>
<td>2.3</td>
<td>3,954,844</td>
</tr>
<tr>
<td>Mbombela</td>
<td>Mpumalanga</td>
<td>Secondary city</td>
<td>2.3</td>
<td>3,947,834</td>
</tr>
<tr>
<td>Buffalo City</td>
<td>Eastern Cape</td>
<td>Metropolitan</td>
<td>1.9</td>
<td>3,263,610</td>
</tr>
<tr>
<td>Nelson Mandela Bay</td>
<td>Eastern Cape</td>
<td>Metropolitan</td>
<td>1.8</td>
<td>3,003,091</td>
</tr>
<tr>
<td>Rustenburg</td>
<td>North West</td>
<td>Secondary city</td>
<td>1.1</td>
<td>1,857,811</td>
</tr>
<tr>
<td>Steve Tshwete</td>
<td>Mpumalanga</td>
<td>Secondary city</td>
<td>1.0</td>
<td>1,801,655</td>
</tr>
<tr>
<td>Nkomazi</td>
<td>Mpumalanga</td>
<td>Small town</td>
<td>1.0</td>
<td>1,771,229</td>
</tr>
<tr>
<td>Hibiscus Coast</td>
<td>KwaZulu-Natal</td>
<td>Small town</td>
<td>1.0</td>
<td>1,713,114</td>
</tr>
<tr>
<td>Emalahleni</td>
<td>Mpumalanga</td>
<td>Secondary city</td>
<td>0.9</td>
<td>1,599,867</td>
</tr>
<tr>
<td>Govan Mbeki</td>
<td>Mpumalanga</td>
<td>Secondary city</td>
<td>0.9</td>
<td>1,593,213</td>
</tr>
<tr>
<td>Mogale City</td>
<td>Gauteng</td>
<td>Secondary city</td>
<td>0.9</td>
<td>1,504,224</td>
</tr>
<tr>
<td>Matjhabeng</td>
<td>Free State</td>
<td>Secondary city</td>
<td>0.9</td>
<td>1,490,103</td>
</tr>
<tr>
<td>The Msunduzi</td>
<td>KwaZulu-Natal</td>
<td>Secondary city</td>
<td>0.9</td>
<td>1,469,838</td>
</tr>
<tr>
<td>Makhado</td>
<td>Limpopo</td>
<td>Small town</td>
<td>0.8</td>
<td>1,376,768</td>
</tr>
<tr>
<td>Stellenbosch</td>
<td>Western Cape</td>
<td>Secondary city</td>
<td>0.7</td>
<td>1,265,850</td>
</tr>
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<td>Overstrand</td>
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Based on unpublished IHS Global Insight data
Part III

South Africa and the Contemporary World
South Africa in the Global Political Economy: The BRICS Connection

Pádraig Carmody

Abstract

How has BRICS (Brazil, Russia, India, China, South Africa) impacted on southern African states’ development policy, practice and outcomes? Has BRICS promoted development space and fostered the emergence of developmental states, or has its influence reinforced the neoliberal, extractive nature of most southern African economies? Drawing on interviews with policy analysts and shapers in South Africa, trade data and secondary sources, this chapter explores the BRICS countries’ relations with, and strategies towards, the southern African region, with a particular focus on relations between China and South Africa. The chapter explores the nature and influence of BRICS countries’ engagement in the region and the potential for policy space opened up by this process.

Keywords

BRICS · China · Dependency · Development · Globalisation · South Africa

24.1 Introduction

South Africa is once again, as of 2016–2017, regarded as the largest economy in Africa owing to the recent falls in oil price and the consequent depreciation of the Nigerian naira. However, this is perhaps not the cause for celebration that might be implied. The structure of the South African economy produces both extreme wealth for some and poverty and social exclusion for others. According to recent World Bank statistics, South Africa is the most unequal society in the world (Inequality Datablog 2017). This relates to both the internal structure of the economy and the way in which this is co-produced through interactions with the outside world, for example through competitive displacement of manufacturing and through mineral exports. The challenge of development then relates to restructuring internal patterns of capital flow, and trade and investment relations with the rest of the world to facilitate employment growth, reduced inequality and economic upgrading. In particular, there is a need to reform the current economic structure, which some have characterised as a ‘financialised minerals-energy complex’ (Ashman et al. 2013). Does South Africa’s membership of the BRICS (Brazil, Russia, India, China, South Africa) group facilitate such restructuring and how do we conceptualise the impacts of its membership in the grouping? This chapter explores this question.

24.2 South Africa and BRICS

It is an oft-cited fact that China is now Africa’s single largest trading partner (Ighobor 2013), with South Africa an important nodal point in this relationship. South Africa is now China’s biggest trading partner on the continent, and also South Africa’s biggest export market, accounting for 14% of its total in 2014 (calculated from data from IMF 2016). South Africa accounts for approximately a quarter of China’s total trade with the continent (Yong 2012). What are the broader implications of this geopolitically and geo-economically? There is an increasing ‘strategic coupling’ (Yeung 2016) between (some of) the BRICS nations and South Africa. Trade with BRICS accounts for 20% of South Africa’s total and is growing rapidly (Nkoana-Mashabane 2011). According to the South African Foreign Minister, Maite Nkoana-Mashabane (2011), “our geo-strategic importance and influence is of critical importance to other member states of the BRICS”. However South Africa’s importance to other members of the BRICS varies somewhat. According to the
Indian Consul General in South Africa, Randir Jaiswal, “South Africa is the country which matters in Africa” (interview, 11 August 2014, Johannesburg). As far as he was concerned South Africa was “more than a gateway to Africa”, in the sense of companies investing directly there, and was where companies went to get legal and financial services if they wanted to invest in Mozambique, for example; although Mauritius is also an important service centre for Indian companies on the continent. On the other hand, the Brazilian ambassador to South Africa, Pedro Luiz, argued that for Brazil there were “many more important countries” in Africa in economic terms than South Africa, as bilateral trade between the two was a “not very impressive” US$3.5 billion (interview, 14 August 2014, Pretoria/Tshwane). The ambassador noted however that more than 80 Brazilian companies were operative in Angola, illustrating the different geographies of engagement in the region.

South Africa is however, arguably, the key state in the region as far as China is concerned, and this is particularly significant given its economic weight. China by itself accounts for over two thirds of BRICS’ total economic output (calculated from World Bank 2017a). According to one Chinese academic, the combination of South Africa’s domestic achievements and consequent international reputation and position in Africa afford it “irreplaceable unique advantages” (Linhua n.d., cited in Yong 2012, p. 7), and South Africa joined the BRICS grouping in 2010 at China’s invitation.

Whilst being the biggest in Africa, the South African economy is only a quarter of the size of Russia’s and only a little bit bigger than China’s sixth-richest province or roughly the same size as Beijing’s economy. Thus, South Africa appears an odd member of this BRICS grouping. However, its relative economic weakness may make it open to greater Chinese influence, which may be part of the attraction. By way of example, the South African government repeatedly delayed visas for the Dalai Lama, such that he had to cancel his trips to the country. This led the Nobel Laureate, Archbishop Desmond Tutu, to describe the current government as worse than the apartheid regime for bowing to Chinese pressure. Apparently, the South African government feared that giving the Dalai Lama a visa would damage trade relations with China, on which it is now highly dependent. At the same time, membership of the BRICS group, one of the highest-profile such groupings in the world, allows South Africa to ‘punch above its weight’ in international affairs, giving rise to a confluence of interests, at least amongst political elites.

While South Africa’s inclusion in the BRICS grouping seems anomalous, given the relatively small size of its economy, it also increases the geographical representativeness of the grouping and serves a gateway function into Africa for BRICS powers, particularly China. This has prompted changes in domestic policies. For example, in 2013 the South African Minister of Finance expanded ‘Gateway to Africa’ reforms, specifically referencing BRICS countries (Gordhan 2013). These reforms allowed holding companies for operations in Africa to be set up, which are not subject to South African foreign exchange restrictions.

South Africa thus serves a number of important functions for investors from the BRICS and this, combined with the importance of trade relationships, has reconfigured regional geopolitics. Researchers at the South African Institute of International Affairs noted that some of South Africa’s neighbours feel that South Africa cares more about the BRICS than it does about them (interview with Christopher Wood and Elizabeth Sidaropoulos, 13 August 2014, Johannesburg) – perhaps because it gives South Africa a seat at the ‘top table’ of international relations. This is echoed in a concept document for the BRICS where it states that “Africa is becoming increasingly sceptical of South Africa’s role as it is seen to be pushing its own national interests to the exclusion of those of the African continent” (South African BRICS Think Tank 2017, p. 11). Christopher Woods argued that South Africa serves as an “echo of China” in debates about the continent’s development, while Alden and Schoeman (2013) talk of South Africa institutionalising “a BRICS-oriented foreign policy”. Closer alignment with China reflects a shift from a greater concern with ethics in foreign policy under Nelson Mandela’s presidency, to ‘realpolitik’ subsequently, with South Africa abstaining in 2014 on the United Nations’ vote to refer North Korea to the International Criminal Court, for example.

### 24.3 Chains of Dependency

While some Chinese analysts argue that China and South Africa’s economies are complementary and that the countries have similar outlooks on world affairs, and on the need to reform structures of global governance in particular, it could also be read as reflecting a new dependency (Yong 2012). Indeed a 2012 African National Congress (ANC) discussion document warned of “neo-imperialistic economic relations” being forged (quoted in Alden and Schoeman 2013, p. 116). China is extractive of both value and resources from the South African economy. This is evidenced by the fact that the cost of shipping a container from China to Durban is more than double that on the return journey (Rodrique 2010), where is it primarily lower value, often unprocessed, raw materials which are being transported.

South Africa realises that is “amongst giants” in the BRICS (interview with Dr. Sookal, South African Department
of International Relations and Cooperation, 13 August 2014, Pretoria/Tshwane), but that it has a certain degree of influence which flows from its relative economic size in Africa, its status and consequent geopolitical positionality on the continent, although this also has its limits (Taylor 2011). Part of the attraction of South Africa for China is that it also has established networks of economic and political influence in the sub-region in particular. Thus, while South Africa is increasingly dependent on China, China serves to bolster South Africa’s role in the region, creating chains of dependence.

As the director of the BRICS Secretariat at the South African Department of International Relations and Cooperation noted, all of the BRICS countries have an interest in the African market (interview with Sookal, op. cit.). He explained further that there was room for all to “come in in a coordinated way. We shouldn’t be trampling each other”, perhaps recalling Kautsky’s theory of ‘ultra-imperialism’ where world powers cooperate to exploit weaker countries rather than engaging in war with each other. However, as some have noted, ‘trade is war’ by another means; a sentiment echoed by the head of the South African supermarket group Shoprite/Checkers when he explained that the group’s expansion across the continent was “just like conventional warfare” (Basson in The Economist, quoted in Simon 2001). However, each of the BRICS powers competes economically at the same time as there is geopolitical unity around certain issues such as non-interference in ‘sovereign’ affairs.

“Fear of internal disorder projects itself through China’s global emphasis on maintaining existing patterns of order (however imperfect), upholding the sovereignty and territorial status quo of other states wherever possible. Existing international institutions are tolerable, as they have allowed China’s rise, and the stability they provide in interactions is preferable to the uncertainty of radical reform” (Bevir and Gaskarth 2015, p. 80). Thus, in its international economic relations, the Chinese government plays a two-level game – promoting external neoliberalisation to achieve resource, investment and market access through the World Trade Organisation, for example, whilst also adopting a ‘flexicteitan’ (Carmody 2016) approach domestically and in bilateral relations, ostensibly without conditionality. The ostensible lack of political or economic conditionality is functional in accessing resources and markets as this approach is popular with southern African political elites, who benefit from it and had often resented prior Western conditionality. However, the creation of new transnational alliances or assemblages between South African and BRICS political elites, and sometimes capital, results in a deepening ‘uncertain territoriality’ of many gatekeeper states in the region (Chari 2015).

### 24.4 Re-spacing South Africa in Globalisation and BRICS

The projection and penetration of Chinese and South African state/capital interests into southern Africa represents a form of geo-governance, where power is projected across borders. While there has recently been much written about the importance of African agency in relations with China (for example Mohan and Lampert 2013), the power in these relations are in the networks, in which Chinese actors often play the dominant role (Carmody and Kragelund 2016). This relates to the continuing strong role of government in the economy, and internationalisation of the Chinese developmental state for its own, rather than others’, benefit. Its increasing power is also demonstrated through the establishment of a BRICS development bank (The New Development Bank) in 2015, which is headquartered in China and now has a regional office in South Africa. The announcement of the creation of this bank, and the Asian Infrastructure Investment Bank, took place shortly after the US Congress failed to pass a law which would have changed the shares of voting rights to better reflect economic weight in the International Monetary Fund (Radelet 2015).

Influence is also attained through investment which may, in turn, promote and facilitate expanded trade flows. In 2007, for instance, the Industrial and Commercial Bank of China (the world’s largest company according to Forbes (2016)) bought a multi-billion-dollar stake in the South African-headquartered Standard Bank, which has an extensive branch network across the continent. It was the largest foreign investment in South African history. This intermingling of South African and Chinese-originating capital has its analogue in political coordination between their respective states, the BRICS cooperation mechanism being a prime example. Geo-governance, or coordinated economic and political power projection across borders, in southern Africa is achieved through foreign investment and trade in addition to other modalities. Writing in 2001, David Simon reflected on South Africa’s changing geo-economic positionality and argued that the country did not perform as well on economic or social indicators as many South Africans believed. He also noted the globalisation of many South African conglomerates and their growing influence. What kind of space then is South Africa now?

In colonial times, South Africa served as a regional command and control centre for Great Britain (Carmody 2002). This was the site from which the Cecil Rhodes organized the conquest of what is now Zimbabwe under the auspices of the British South Africa Company, for example. However with the advent of (late) apartheid, South Africa became increasingly economically isolated: “Although some important trade flows between apartheid South Africa and selected
countries to the north continued throughout the period of international sanctions, the increasingly rigorous diplomatic/political, economic and social ostracization of South Africa "promoted both imagined and real isolation" (Simon 2001, p. 337). Immediately after the end of apartheid in South Africa, much of the media and academic narrative around South Africa’s emergence were about its ‘corporate march into Africa’. However, this was only one vector or axis of globalisation. Others include, for example, the rise of the BRICS nations, which is an outcome of the evolution of globalisation and the way in which it has been mediated by different state–society formations. Thus, the temporality of globalisation is as important to its evolution as its spatiality.

It is perhaps often forgotten that globalisation as a phenomenon has also a temporality rather than just a spatiality or sectorality. In the *longue durée*, apartheid and associated sanctions against South Africa might be seen as a relatively anomalous period of the country’s history, even if the racial inequalities which it reinforced continue to have long-lived consequences. Rather, the way in which South Africa was constructed and integrated into the global economy – primarily as a supplier of mineral resources – can be seen to be reasserting itself. However, its reconfiguring and rearticulation with the global economy is now largely through trade and investment networks which increasingly run through China, rather than Great Britain. The precise way in which this rearticulation is occurring is also influenced by neoliberal principles based on the rule or sovereignty of (trans)national capital (Woodley 2015).

As noted above, some have recently written about the emergence of a financialised mineral-energy complex (MEC) in South Africa. When Fine and Rustomjee (1996) developed the concept of the MEC, they were trying to reveal the inner driving dynamics of the South African economy beyond the sectoral contributions to national economic output. They noted at that time that although these sectoral contributions were relatively small, many other sub-sectors of the economy such as branches of manufacturing were heavily related to or reliant upon them. With the restructuring of the South African economy under globalisation there has been a shift towards a service economy. Part of this has to do with the so-called servitisation of manufacturing (Weeks and Benade 2009) where, for example, the outsourcing of services from manufacturers boosts their contribution to gross domestic product. However, the growth of services is part of a secular global trend, with the percentage of global economic output accounted for by services rising from approximately 59% in 1995 to over 68% in 2014 (World Bank 2017b). In the South African case, the growth of the financial services sector has been particularly marked, now accounting for over a fifth of total economic output (StatsSA 2017). In South Africa’s economic heartland of Gauteng, including Johannesburg, services are a key economic driver.

Financialisation and informationalisation are perhaps two of the major meta-trends in the global economy under globalisation. In the South African case, according to Mohamed (2009, p. 3), the policy of economic liberalisation:

> has reduced the influence of the state in the economy and instead placed the largest South African corporations under the control of global financial institutions and the shareholder value movement. The increased influence of the shareholder value movement on South African big business has shifted their attention towards increasing profits in the short-term instead of focusing on long-term productive investments. Most non-services sector investment was in capital intensive MEC sectors where high levels of resource and monopoly rents could be extracted from the economy. Therefore, the major restructuring of South Africa’s major corporations during the 1990s has left the already highly concentrated economy even more concentrated and, unfortunately, more dependent on the MEC, especially for export earnings.

Thus, the rising influence of (some of) the BRICS in South Africa is not the only change in international power relations affecting the country. Rather, there are different channels or axes of globalisation which are reconfiguring South Africa’s relations with the outside world. South Africa’s geopositionality then is being reconfigured by the development of new and revised sets of assemblages with and between ‘inside’ and ‘outside’ actors. Currently existing power configurations, however, do not appear favourable to development in the country (Plaut and Holden 2012). The strain which the nascent social contract in South Africa is under is evidenced by repeated and sometimes violent service delivery protests, xenophobia (Crush et al. 2015) and arguably the extent of crime in the country, although the substantial roll-out of social grants has arguably contributed to greater political and social stability than would otherwise be the case.

### 24.5 Summary

The South African political economy is, in part, defined by a number of interrelated paradoxes. The first of these is the massive, and still heavily racialised, distribution of wealth and poverty which marks the country. The second is its semi-peripheral status in the global political economy which results from its ‘internal’ economic structure. A third point is arguably its inclusion in the BRICS grouping, despite the small size of its economy and recent low rates of economic growth. This membership, it can be argued, enables South Africa to exert pressure for change in the global system which is more favourable for its development. However, as Bond (2016) and Taylor (2016) have shown, the BRICS group does not represent an existential challenge to the existing Western-centred global order. Rather, these countries are being absorbed into it as they seek to modify it for to their
own advantage. Nevertheless, the power of transnational capital is firmly embedded in existing global institutions, predictions of the end of globalisation notwithstanding.

Whilst it is difficult to predict how the South African political economy will evolve, particularly given its recent economic and political travails, the path-dependency established by its mode of integration into the global political economy seems set to continue, membership of the BRICS and new trading relations with China notwithstanding. As the concept document for 2018 South African Chairship of the BRICS notes: “we have unfortunately not succeeded in addressing adequately the scourge of inequality, poverty and unemployment, despite having the largest economy in Africa that boasts sophisticated infrastructure and institutions to rival those of industrialised nations” (South African BRICS Think Tank 2017). This said, the country has also shown itself in the past to be capable of reinventing itself. A future reinvention would likely include more substantial redistribution of the assets and income of the ‘rainbow nation’.

Acknowledgements

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References


Changing Geographies of Immigration to South Africa

Sally Ann Peberdy

Abstract
This chapter explores South Africa’s changing geographies of migration since 1994. It starts by contextualising contemporary patterns of migration using a brief exploration of South Africa’s migration history. This is followed by an explanation of the legislative framework governing migration, immigration and asylum seeking since 1994, identifying how it may have affected migration patterns. The chapter then provides an overview of migrants, immigrants, refugees and asylum seekers in South Africa, including their origins, age and sex profiles, and changing patterns of migration before locating their roles in the economy of the country.

Keywords
Demography · Immigration · Migration · Refugees · SADC region · South Africa

25.1 Introduction
Immigration and migration has become an increasingly contested area in South African public life since 1994. The South African state has retained a strong territorial identity. Migrants and immigrants are increasingly seen as potential threats to the nation-building process and the ability of the state to meet its obligations to citizens. Amongst sections of civil society, not always the poorest and most disadvantaged, attitudes have hardened. This has led to widespread outbreaks of violence against international migrants, notably in 2008, 2013, 2014 and 2015. Low level, but sometimes deadly attacks have continued in between. The targets of public violence are largely black African migrants including entrepreneurs, and to a lesser extent, South Asian and Chinese business owners. Most attacks occur in townships and informal settlements. White immigrants are largely exempt from hostility from the state as well as civil society.

Although political and public rhetoric in South Africa suggests it is one of the most significant destination countries for immigrants and refugees on the continent, data suggest otherwise (Table 25.1). In 2015, only 4.6% of the population was born outside the country, ranking South Africa eleventh out of African countries in the United Nations 2015 revision of Trends in International Migrant Stock (UNDP 2015). However, the total number of people born outside the country does exceed those of some other countries ranked above South Africa, as their national populations are smaller.

It is impossible to know exactly how many foreigners are living in South Africa at any one time as official data can be difficult to interpret. Furthermore, there is no way of knowing how many irregular migrants live in the country and how many have been counted in the Census or other national surveys. Estimates are in the range of 1–2 million. Census 2011 found 2,188,872 people (4.2% of the population) were born outside South Africa compared to 1,578,541 (2.8%) in the Community Survey 2016 (StatsSA 2016a, p.25). Thus the 2016 Community Survey shows an unexplained decline in the number and proportion of people born outside the country, since 2011. Possible explanations for the discrepancy include errors in non-sampling and sampling in the Community Survey (StatsSA 2016a, p.28), the impact of ongoing violent xenophobic attacks pushing migrants home, the dramatic fall in the value of the rand in 2015–2016 reducing the value of earning rand, the strengthening of the economies of some sending countries, and emigration of European and other permanent residents. The decline applies to all provinces.

Since 1994, there has been a significant increase in the movement of people into and out of South Africa, particularly from neighbouring states and the rest of the Southern Africa Development Community (SADC) countries. Many of the people entering stay for only a day or less. The
Department of Home Affairs (DHA) counts the number of times the border is crossed, i.e., the country is entered. The annual number of border crossings by non-South Africans rose from 1 million in 1990 to over 7.5 million in 2005 (Table 25.2), peaking at over 15 million in 2013, since when they have declined slightly (StatsSA 2016b, p.23). SADC nationals comprise almost 90% of movement through land borders (DHA 2016, p.26). Lesotho nationals (a country with a population of 2.5 million) comprise 22% of all border crossings, illustrating the high rates of movement from some countries, its short-term nature, and the problems of using these data to measure anything other than border movements. However, the significant increase in movement into and out of South Africa may fuel perceptions that there are more migrants in South Africa than there really are.

This chapter will explore South Africa’s changing geographies of migration since 1994. It starts with a brief exploration of South Africa’s migration history, followed by an explanation of the legislative framework governing migration, immigration and asylum seeking since 1994. The chapter then provides an overview of migrants, immigrants, refugees and asylum seekers in South Africa before locating their role in the economy of the country. The chapter largely draws on data from Census 2001 and 2011, the 2016 Community Survey, Statistics South Africa (StatsSA) tourism and migration reports as well as the 2016 Green Paper on international migration. This is supplemented by data from the Gauteng City-Region Observatory (GCRO) 2015 Quality of Life Survey.

### 25.2 Contextualising Contemporary Migration Patterns

Although there has been a massive increase in the movement of people into South Africa (often only for short, even one-day visits), as well as an increase in migration and immigration, at times it seems as if international migration from Africa only started after 1994. Yet the movement and migration of black Africans in the area now known as South Africa started long before the arrival of the first white settlers under the leadership of Jan van Riebeck in 1642, and continued long after their arrival. Many ethnic groups in South Africa have links with others in the region and not just because of the imposition of colonial national borders. Wars, particularly at the time of Shaka Zulu, pushed people northwards. The formation of the Union of South Africa in 1910 saw the development of racially exclusionary immigration legislation, which only allowed white migration and immigration (Immigrants Regulation Act of 1913) (Peberdy 2009). As immigration to South Africa in the twentieth century meant white immigration, this has led to the assumption that an obviously racist white South African state allowed in any and all white immigrants and kept out all black immigrants. Yet this assumption elides over the exclusion of successive groups of white immigrants (Peberdy 2009). More importantly, it masks the long history of state-sanctioned black African temporary migration from southern Africa to the mines and commercial farms of South Africa, as well as the tacit sanctioning by the state of ‘clandestine’, or undocumented migration from southern Africa (Jeeves and Crush 1997; Peberdy 1998, 2009). Owing to territorially expansionist aims, black African nationals of Botswana, Lesotho and Swaziland could move freely into South Africa until 1963, although they were subject to segregationist and
Table 25.3 Black population born outside South Africa in censuses, 1911–1991

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<td>1960</td>
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<td>1970</td>
<td>516,043</td>
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<tr>
<td>1980</td>
<td>677,160</td>
</tr>
<tr>
<td>1985</td>
<td>315,482</td>
</tr>
<tr>
<td>1991</td>
<td>920,913</td>
</tr>
</tbody>
</table>

Source: Peberdy (2009)

Note: No explanation is provided for the low figure in 1985, while Census 1991 used creative means to project populations in informal settlements

apartheid restrictions on movement and settlement once inside the country. From the 1920s until at least the mid-1960s, undocumented migration of black Africans was allowed and sanctioned through agreements between South Africa, Portuguese East Africa and Southern Rhodesia (Katzellenbogen 1982; Peberdy 1998, 2009). Thus, the attitude of the colonial and apartheid South African state to black African migration from the region “veered between encouragement, acceptance, ambivalence and rarely hostility” (Peberdy 2009, p.145).

By the 1960s, black African migrants from the region were entrenched in every sector of South Africa’s labour force, leading to concerns over the number of Africans in the country. In 1961 the Froneman Commission, appointed to inquire into ‘foreign Bantu in the Republic’, estimated there were 836,000 ‘foreign-born’ Africans in South Africa of whom 420,000 were in rural areas and 53,281 were registered as working in urban areas (Froneman Commission 1962, p.165). Most of these were from southern Africa. The number of black southern Africans living in the country (at least in urban areas) appears to have declined from the 1970s onwards (Table 25.3), possibly owing to political changes including independence in their home countries and growing tensions between South Africa and neighbouring states (Peberdy 1998, 2009). However, war and drought in Mozambique led to the arrival of an estimated 350,000 Mozambicans in the 1980s and 1990s (Dolan 1995; Johnston 2001; Peberdy 1998). Migration from southern African countries extending as far as Malawi (with a small number of Africans from farther north) has been a feature of migration to South Africa since the late 1800s. They have lived in South Africa as contract workers, as undocumented migrants and immigrants and as unrecognised asylum seekers. Most have lived as circular migrants, retaining homes and families in their countries of birth, although some may have developed other family ties in South Africa as well.

White immigrants and migrants formed the bulk of new arrivals until 1994 owing to the racist immigration laws which made entry for most easy. At times, particularly after the formation of the Republic of South Africa in 1961, the state introduced schemes to encourage white immigrants to move to South Africa which included active recruitment and financial incentives. Immigration laws were often waived for white settlers arriving from newly independent African states (Peberdy 2009). Since 1994, white immigrants and migrants continue to arrive, but in small numbers, while white South Africans and permanent residents comprise the bulk of emigrants.

Indian and Chinese migration to the country (mostly through indentured labour schemes) started in the late 1800s. Indian immigration, both ‘free’ and indentured, was effectively stopped by the introduction of the 1913 Immigrants Regulation Act after the formation of the Union. Some still entered for family reunification purposes, while indentured labourers already in South Africa were encouraged to stay (Peberdy 2009). Indians who arrived in the late 1800s and 1900s and their descendants still comprise a significant proportion of the population of some towns, cities and provinces, particularly in KwaZulu-Natal. The Indian population has been supplemented by new arrivals from the Indian subcontinent since 1994. Chinese immigration was essentially stopped before the formation of the Union of South Africa in 1910, but resumed in the 1970s and 1990s when small numbers of Taiwanese settled as the apartheid state developed economic ties with Taiwan (Peberdy 2009). This population has been supplemented by arrivals from mainland China since 1994.

25.3 Legislative Framework

25.3.1 Migration and Immigration

Foreigners can live in South Africa as immigrants (permanent residents), migrants (temporary residents and contract workers), or asylum seekers who are classified as refugees when their applications are approved. The process of immigration legislative and policy reform since 1994 has been slow and marked by continuity with the past rather than change, in that immigration policy has been mostly exclusionary, retaining a protectionist and territorial vision. The post-apartheid government inherited the Aliens Control Act of 1991, which has been called one of the “dying Acts of apartheid” (Peberdy and Crush 1998). This essentially exclusionary Act regulated migration and immigration to the country until 2002.

The 1991 Aliens Control Act was amended in 1995 ‘to improve control’ over immigration. The amended Act placed
greater emphasis on the skills and qualifications of potential immigrants and the DHA stated that “no one in the unskilled and semi-skilled categories” would be accepted as an immigrant (DHA 1998). A new Immigration Act was enacted in 2002 and amended in 2004. This Act indicated a more open approach to immigration. The objective of the more inclusionary approach was to “approve immigration applications in the context of South Africa’s skills and investment needs” (DHA 2005, p.35). It maintained the privileged access of the mining houses and commercial agricultural sector to contract labour and seasonal workers. Bilateral agreements governing contract labour for the mines from neighbouring states which have barely changed since the mid-1900s (or even earlier for some) remained in place (Crush et al. 2007). Unlike most work permit holders, contract workers have no access to the immigration system except through marriage and are not allowed to bring their families with them. Arrangements are also in place through regulations to allow the entry of seasonal farm workers (mainly from Lesotho, Mozambique and Zimbabwe).

The Immigration Act of 2002 as amended in 2004 presently governs migration to South Africa. Further amendments and regulations were introduced in 2014, reflecting a shift back to a more restrictive policy. A Green Paper on International Migration was published in 2016 (DHA 2016). Proposed changes to immigration policy in many ways revert to the Aliens Control Act of 1991. However, there are proposals to introduce a form of guest worker (or contract labour) scheme to enable unskilled and semi-skilled workers from the region to enter and work.

Nationals of two SADC countries have been eligible for specific temporary residence permits. To relieve pressure on the asylum system and to regularise irregular migrants, in 2009, Zimbabwean nationals already in South Africa could apply for a renewable special temporary residence permit allowing them to work. Recognizing the strong connections between Lesotho and South Africa and the large volume of traffic for short visits, until 2010, Basotho nationals could hold six-month concession permits. Indicating a shift in policy and pragmatism, the equivalent of the Zimbabwe special dispensation permit was extended to Lesotho nationals in 2016.

25.3.2 Forced Migration, Asylum Seekers and Refugees

There was no refugee legislation in existence in 1994. The apartheid state did not recognise asylum seekers and refugees. It was however, willing to take white people leaving de-colonising countries on the continent without question, often when they did not meet the terms of immigration legislation (Peberdy 2009). The apartheid government came to an agreement with the United Nations High Commissioner for Refugees (UNHCR) in 1993, and from that date until the passing of refugee legislation in 1998, newly arriving asylum seekers and refugees were issued with special permits under the Aliens Control Act of 1991. After 1994, South Africa became a signatory to the United Nations 1951 Convention on the Status of Refugees and its 1967 Protocol as well as the 1969 OAU Convention Governing the Specific Aspects of Refugee Problems in Africa.

Less controversial than proposed changes to the immigration regime, the Refugees Act was passed in 1998 (Act No. 130). It was amended in 2008 by the Refugees Amendment Act (Act No. 33) which made changes to the refugee determination procedures and aligned the process more closely with international instruments. It was then again amended in 2011. Although the amended 2008 Act sets out provisions for claiming asylum, the administration of the Act has been problematic. The sometimes lengthy adjudication process has left the system open to abuse. Notwithstanding problems in its administration and implementation, the Act has afforded protection to asylum seekers in South Africa. It has given asylum seekers and refugees the right to work, study and access medical treatment as if they were South African nationals. However, the policy framework has become less accommodating in the 2010s with the closure of refugee reception centres where applications are made, in an attempt to make all refugees make their claims at Musina in the far north of the country. Proposals for refugees in the 2016 Green Paper on international migration include setting up ‘reception centres’ (read: detention centres) on the borders where asylum seekers would be held until their claims for refugee status have been processed (DHA 2016).

25.3.3 Regional Obligations

Although immigration legislation, policy and practice remain largely exclusionary, the post-apartheid government recognised the racially exclusionary apartheid migration practices and the continued existence of colonial boundaries (Peberdy 2009). To this end, it introduced four measures to redress these issues. First, bilateral agreements established ‘border control areas’ along certain parts of the border. These allow residents living within a specified distance of the border to move freely within specified areas on either side of the border without having to pass through immigration control. Second, three different ‘amnesties’ were introduced for SADC nationals. In 1995, mineworkers who had worked on the mines since 1986 and who had voted in the 1994 elections could apply for permanent residence (Crush and Williams 1999). Just over 51,000 mineworkers (half of those eligible) got permanent residence through this process (Crush and Williams 1999, p.6). The second, for undocu-
mented SADC nationals who met certain conditions, ran from 1996 and gave permanent residence to almost 125,000 applicants (ibid., pp.6–7). The third amnesty ran from 1999 to 2000 and was for Mozambican refugees who had arrived in South Africa between January 1985 and December 1992 (Johnston 2001). This last amnesty gave approximately 90,000 Mozambicans permanent residence (ibid., p.33).

South Africa is a member of both the African Union and the SADC. Among the founding principles of both institutions is the promotion of the free movement of people. The SADC has gone through a tortuous process leading to the adoption of the Facilitation of Movement of People Protocol in 2005 (Oucho and Crush 2001; Peberdy and Crush 2007). It has been adopted by nine countries but still had not been ratified by 2017. Although its aim is to facilitate movement, the Protocol will only allow SADC nationals visa-free entry to another SADC country for 90 days per year. Entry for work, study or permanent residence purposes will remain subject to national legislation.

The creation of border zones and the amnesties, while inclusionary measures, were more about acknowledging the apartheid past and drawing a line for future exclusion (Peberdy 2009). The special permits issued to Lesotho and Zimbabwean nationals are pragmatic measures. The legislative framework remains unfriendly to unskilled and semi-skilled migrants from the region, the rest of the continent and the world.

25.4 Who Are International Migrants and Where Are They Born Outside of South Africa?

25.4.1 Origins, Sex and Age

The population born outside South Africa is overwhelmingly African. In 2011, four out of five people born outside South Africa (82%) were born in the SADC and 7% in the rest of Africa outside the SADC (Table 25.4). This represents a significant shift in the origins of the population born outside South Africa since 2001 when just over two thirds of the foreign-born population were from the SADC. The long history of white immigration can be seen in 2001 when almost a quarter of people born outside South Africa were from the UK and Europe, but only 5% were in 2011. The years 2001 to 2011 have also seen a growth in migration from the rest of Africa outside SADC and East and South Asia. In 2011, the top five countries of origin of the foreign-born population were Zimbabwe (38%), Mozambique (22%), Lesotho (9%), Malawi (5%) and the UK (5%) (StatsSA 2016a, p.26).

Men outnumber women amongst migrants. However, as across the world, migration streams to South Africa are increasingly feminised. Census 2011 found 60% of people born outside South Africa were male; this is similar to results in the Community Survey 2016 (of 58%) (StatsSA 2011, 2016a, p.25). The age distribution of the cross-border migrant and South African populations differs significantly (Table 25.5). Migrants are more likely to be of working age, and a significantly smaller proportion is aged under 19 years. A higher proportion of those born outside South Africa are aged over 50 years. This may in part reflect the in-migration of white immigrants during the apartheid years who have longer life-expectancies than the black population.

25.4.2 Distribution of Foreign-Born Populations

People born outside South Africa are not distributed equally across the country. There are differences between inter- and intra-provincial distributions, and significant differences between and within cities. The highest concentrations of foreign-born migrants are found in Gauteng (Table 25.5). Similarly, the highest proportions of cross-border migrants are found in the three of the five major metropolitan areas in South Africa located in Gauteng: Johannesburg, Ekurhuleni and Tshwane (Fig. 25.1).

Variations can also be found on smaller scales. Mining areas are home to significant proportions of cross-border migrants. Thus, in Gauteng in 2011, the highest concentration of cross-border migrants (17%) was found in the mining...
municipality of Westonaria (StatsSA 2011) (Fig. 25.2). High concentrations can also be found in wards in inner-city areas, particularly in Johannesburg, Tshwane, Ekurhuleni, Cape Town and Ethekwini. Black regional migrants have always lived in township areas (in part because of apartheid restrictions on movement). Census data indicate that there has been increasing movement of migrants, immigrants, refugees and asylum seekers into townships and informal settlements. For example, the proportion of the population born outside South Africa in Soweto rose from 1% in 2001 to 5% in 2011 (StatsSA 2001, 2011).

25.5 Changing Geographies of Migration

While there are continuities with the past in patterns of cross border migration to South Africa since 1994, there have also been significant changes which include:

- the entry of migrants, asylum seekers and refugees from the rest of the continent outside the SADC as well as from farther afield;
- a fall in the number of contract mineworkers;
- until 2000 and since 2005, significant falls in the number of people granted permanent residence through normal channels (notwithstanding those granted permanent residence in the amnesties);
- since 2000, a significant but unknown increase in the number of Zimbabweans entering the country; and
- increased movement of visitors and business people (mainly small scale cross border traders) from southern Africa.

The shifts in the origins of migrants, immigrants, refugees and asylum seekers in part reflect political and economic changes in various countries of origin as well as within South Africa. Other changes reflect shifts in the immigration policy and practice of the South African state.

### Table 25.6 Provincial population born outside South Africa (%), 2011 and 2016

<table>
<thead>
<tr>
<th>Province</th>
<th>2011</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Cape</td>
<td>1.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Free State</td>
<td>2.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Gauteng</td>
<td>9.5</td>
<td>6.0</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>1.7</td>
<td>0.8</td>
</tr>
<tr>
<td>Limpopo</td>
<td>3.0</td>
<td>2.3</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>3.7</td>
<td>2.6</td>
</tr>
<tr>
<td>North West</td>
<td>4.4</td>
<td>3.3</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>1.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Western Cape</td>
<td>4.5</td>
<td>3.1</td>
</tr>
<tr>
<td>South Africa</td>
<td><strong>4.4</strong></td>
<td><strong>2.9</strong></td>
</tr>
</tbody>
</table>

Source: StatsSA (2011, 2016a, p.29)
25.5.1 Temporary Residents

Temporary residents may be in South Africa for a multitude of reasons, including visiting family and friends or other forms of leisure, work, study, business or trading and for medical treatment. Between June 2014 and January 2016, 124,453 temporary residence applications were approved (DHA 2016, p.28). Almost a quarter were for relatives (including spouses) led by nationals of Bangladesh, Nigeria and Pakistan. Study permits comprised 18%. Students were most likely to be from Zimbabwe (20%), Nigeria (15%), the Democratic Republic of Congo (DRC) (9%) and Angola (6%) (DHA 2016, p.28). Noting that some nationals do not have to apply for visitors permits, 14% were for visitors. The remaining 44% of temporary permits issued will largely have been work permits but will also have included business and medical permits. Between 2010 and 2013, 65% of work permit applications came from China, Zimbabwe, India, Pakistan and Nigeria (DHA 2016, p.27). It is difficult to know how many people are in South Africa on temporary work and study permits at any one time as they are usually issued for the duration of contracts or study. Over 300,000 Zimbabweans have been issued special dispensation permits since April 2009 (allowing them to work if they want) (DHA 2016, p.61). Small-scale or informal-sector cross-border traders who comprise a significant proportion of traffic through South Africa’s border posts do not qualify for business permits and so usually enter on visitors permits.

25.5.2 Permanent Residents

Permanent residents are people granted the right to stay indefinitely in South Africa and live as citizens, but without the right to vote (since the 1994 elections). There is no way...
of knowing how many permanent residents are in the country at any one time. Initially, post-1994 immigration policy and practice led to a dramatic fall in the number of approved applications (Table 25.7). The change in policy and legislation in 2002 and clearing of an administrative backlog led to a significant increase in approved applications between 2002 and 2005. However, a change in leadership in the DHA led to a fall in approved applications from 2007. By 2005, almost half of new permanent residents were Africans. Their numbers were supplemented by the approximately 265,000 SADC nationals granted permanent residence in three amnesties of 1995, 1996 and 1999–2000 for mineworkers, SADC nationals and Mozambicans.

Between 2014 and 2016, 30,098 applications for permanent residence were received (DHA 2016, p.28). The majority were for family members (33% spousal and 26% dependents or relatives) of permanent residents or citizens (DHA 2016, p.28). Applications for work-related reasons comprised 26% (19% worker and 7% special skills) while 3% were for business reasons (DHA 2016, p.29). Applications from Zimbabwe, China, India, Nigeria and Pakistan comprised 68% of all applications in this period (DHA 2016, p.29).

### 25.5.3 Contract Mine and Agricultural Labour

For most of its history, mineworkers from the southern African region, particularly Lesotho and Mozambique, made up over half of the labour force of the gold mining industry on which the economy of South Africa has been based (Crush et al. 1999). From the early to late-1900s, significant numbers of Malawian and Swazi nationals were also employed in the mines alongside some Batswana and Zimbabweans. Mining houses continue to have preferential access to contract labour as regulations and bilateral agreements initiated in the early 1900s persist. However, despite their contributions, retrenchments in the gold mines led to a massive drop in employment of foreign contract workers in the late 1990s and early 2000s. Although South Africans were heavily affected in the early years of retrenchments, they have been more likely to be employed with the growth in employment in the 2000s (Table 25.8). Basotho mineworkers have been most heavily affected (Table 25.8). In 2006, foreign mineworkers formed the lowest proportion of the workforce in the gold mines ever (Crush et al. 2007). SADC nationals, particularly from Mozambique and Lesotho, are also employed in platinum and other mines. According to Budlender (2014) as cited by the DHA (2016, p. 27), people born outside South Africa comprised only 8% of all people employed across all mines (not just gold mines).

Black Africans from the region have entered as contract and seasonal workers on commercial farms since the late 1800s (Jeeves and Crush 1997). Numbers of contract and seasonal agricultural workers are hard to find. Regulations

### Table 25.7 Approved applications for permanent residence, 1990–2011

<table>
<thead>
<tr>
<th>Year</th>
<th>Applications approved</th>
<th>African applications approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990–94</td>
<td>51,786</td>
<td>8,228</td>
</tr>
<tr>
<td>1995</td>
<td>5,064</td>
<td>1,343</td>
</tr>
<tr>
<td>1996</td>
<td>5,407</td>
<td>1,601</td>
</tr>
<tr>
<td>1997</td>
<td>4,102</td>
<td>1,281</td>
</tr>
<tr>
<td>1998</td>
<td>4,371</td>
<td>1,169</td>
</tr>
<tr>
<td>1999</td>
<td>3,669</td>
<td>980</td>
</tr>
<tr>
<td>2000</td>
<td>3,053</td>
<td>831</td>
</tr>
<tr>
<td>2001</td>
<td>4,832</td>
<td>1,584</td>
</tr>
<tr>
<td>2002</td>
<td>6,545</td>
<td>2,472</td>
</tr>
<tr>
<td>2003</td>
<td>10,578</td>
<td>4,961</td>
</tr>
<tr>
<td>2004</td>
<td>10,714</td>
<td>5,235</td>
</tr>
<tr>
<td>2005</td>
<td>17,771</td>
<td>n/a</td>
</tr>
<tr>
<td>2006</td>
<td>2,136</td>
<td>n/a</td>
</tr>
<tr>
<td>2007</td>
<td>9,235</td>
<td>n/a</td>
</tr>
<tr>
<td>2008</td>
<td>3,817</td>
<td>n/a</td>
</tr>
<tr>
<td>2009</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>2010</td>
<td>4,083</td>
<td>n/a</td>
</tr>
<tr>
<td>2011</td>
<td>5,476</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Source: Crush et al. 2007, p. 19; Peberdy 2016

### Table 25.8 Mine labour employment on the gold mines, 1990–2006

<table>
<thead>
<tr>
<th>Year</th>
<th>South Africa</th>
<th>Botswana</th>
<th>Lesotho</th>
<th>Mozambique</th>
<th>Swaziland</th>
<th>% foreign</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>199,810</td>
<td>14,609</td>
<td>99,707</td>
<td>44,590</td>
<td>17,757</td>
<td>47</td>
<td>376,473</td>
</tr>
<tr>
<td>1995</td>
<td>122,562</td>
<td>10,961</td>
<td>87,935</td>
<td>55,140</td>
<td>15,304</td>
<td>58</td>
<td>291,902</td>
</tr>
<tr>
<td>1999</td>
<td>99,387</td>
<td>6,413</td>
<td>52,188</td>
<td>46,537</td>
<td>9,307</td>
<td>54</td>
<td>213,832</td>
</tr>
<tr>
<td>2000</td>
<td>99,575</td>
<td>6,494</td>
<td>58,224</td>
<td>57,034</td>
<td>9,360</td>
<td>57</td>
<td>230,687</td>
</tr>
<tr>
<td>2001</td>
<td>99,560</td>
<td>4,763</td>
<td>49,483</td>
<td>45,900</td>
<td>7,841</td>
<td>52</td>
<td>207,547</td>
</tr>
<tr>
<td>2002</td>
<td>116,554</td>
<td>4,227</td>
<td>54,157</td>
<td>51,355</td>
<td>8,698</td>
<td>50</td>
<td>234,991</td>
</tr>
<tr>
<td>2003</td>
<td>113,545</td>
<td>4,204</td>
<td>54,479</td>
<td>53,829</td>
<td>7,970</td>
<td>51</td>
<td>234,027</td>
</tr>
<tr>
<td>2004</td>
<td>121,369</td>
<td>3,924</td>
<td>48,962</td>
<td>48,918</td>
<td>7,598</td>
<td>47</td>
<td>230,771</td>
</tr>
<tr>
<td>2005</td>
<td>133,178</td>
<td>3,264</td>
<td>46,049</td>
<td>46,975</td>
<td>6,993</td>
<td>43</td>
<td>236,459</td>
</tr>
<tr>
<td>2006</td>
<td>164,989</td>
<td>2,992</td>
<td>46,082</td>
<td>46,707</td>
<td>7,124</td>
<td>38</td>
<td>267,894</td>
</tr>
</tbody>
</table>

Source: TEBA see also Crush et al. (2007)
and arrangements dating back to the apartheid era have persisted into the 2000s, allowing seasonal farmworkers from neighbouring states to be regularised after their arrival in South Africa, but only for the duration of the season (Crush et al. 2007; Jeeves and Crush 1997). The regulatory system allows labour brokers to employ and regularise the stay of seasonal farmworkers (Misago 2009). Although most are employed in the provinces on the national borders, non-national seasonal workers are also found working on fruit farms in the Western Cape.

25.5.4 Asylum Seekers and Refugees

In 2015, there were 96,971 refugees and 78,339 asylum seekers with active permits living in South Africa. One of the most significant changes in patterns of migration seen since 1994 has been the arrival of asylum seekers and refugees from the rest of the continent as well as from overseas. According to unpublished DHA data, around 150,000 claims for asylum were received by the DHA between 1994 and 2004. In 2013, 70,010 claims for asylum were made and in 2014, 71,914 (DHA 2016, pp.30–31). Between 1994 and 2004, 26,900 people were granted refugee status and by January 2012 there were 65,300 people with refugee status in South Africa (UNHCR 2013, p.2). In total, 1,061,812 people were issued with asylum seeker permits by 2015. Of those not awarded refugee status, most will have been refused, others will have left the country or changed to other forms of permits, for instance special dispensation permits.

The dominant claimant-generating countries between 1994 and 2001 were Angola, Burundi, DRC and Somalia. By 2006, Zimbabwe became the largest source of asylum claims, comprising over a third of all claims. However, in 2012 the top five countries of origin of asylum seekers were Somalia, DRC, Angola, Ethiopia and Burundi (UNHCR 2013, p.2). The introduction of special permits for Zimbabweans in 2009 is likely to have provided an alternative to the asylum system for these nationals. By 2015, Zimbabwe again led the top five countries of origin of asylum seekers followed by Ethiopia, DRC, Nigeria and Bangladesh.

25.6 Employment and Income

The participation of international migrants and immigrants in the economy has increasingly been part of public debates on migration, and has been used by both state officials and civil society as justification for xenophobic attitudes and attacks. However, nationally, international migrants comprise less than 10% of employees in any sector (Table 25.9). In 2011, international migrants were slightly less likely to be unemployed than South African nationals. However, in Gauteng in 2015 they were equally likely to be unemployed (GCRO 2015a).

Trade provides incomes to almost a third (30%) of international migrants (Table 25.9). A 2015 representative survey of the population in Gauteng found international migrants were more likely than South Africans to be employed in private households, construction, agriculture, mining, retail and community services (GCRO 2015a). South Africans were more likely to employed in the manufacturing, financial, transport and public sectors. Many people involved in trade are self-employed. The 2015 survey in Gauteng found that international migrants (16%) were significantly more likely than South Africans (7%) to own a business (GCRO 2015a). A 2014 survey of informal sector entrepreneurs in Gauteng found that international migrants were more likely to employ people and employ more people than South Africans in their informal businesses (Peberdy 2016). The presence of international migrants, particularly SADC nationals, also contributes to regional small-scale cross-border trade as they often provide a base from which cross-border traders buy goods for their businesses in their home countries when they visit South Africa. A 2014 survey found this business contributed billions of rand annually to the retail and wholesale economy of Johannesburg (GCRO 2015b).

It is often asserted that international migrants undercut the wages of South African workers to secure employment. However, the 2015 survey of Gauteng residents does not support this assertion (Fig. 25.3).

Table 25.9 Employment of migrants by sector (%) in 2012

<table>
<thead>
<tr>
<th>Sector</th>
<th>Proportion of migrant population in sector (%)</th>
<th>Migrants as a proportion of population in sector (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade</td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td>Services</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Construction</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Private households</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Financial</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Agriculture</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Transport</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Mining</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: DHA 2016, p.27 (from Budlender 2014 using QLFS 2012 data)
**25.7 Discussion and Summary**

Although South Africa has a long history of migration from Africa, Europe, India and China dating back to the 1800s and before, there have been significant changes in patterns of migration since 1994. These include growth in the numbers of migrants, particularly from the rest of the SADC and Africa outside of the SADC, as well as to a lesser extent from South Asia and China. Political and economic crises, and their resolutions, as well as the development of new economic and political ties, have led to changes in the dominant countries of origin. Thus, since the 2000s, Zimbabwe has become a significant source of migrants, immigrants and asylum seekers. Immigration from East Asia has shifted from Taiwan to China, reflecting changes in economic and political links. Similarly, immigration from South Asia has increased.

Changes to the legislative framework governing migration, immigration and asylum seeking have also led to changing patterns of migration. Since 1994, race has no longer been a barrier to entry to South Africa. Anyone can apply for permanent or temporary residence permits. Recognition of racially-exclusionary immigration legislation and practices by the post-apartheid state has given over 265,000 SADC nationals already resident in South Africa permanent residence. Thousands of others have been given the opportunity to visit South Africa legally, passing through border posts with travel documents to visit friends and family, to shop and to trade. Special permits for Zimbabwean and Lesotho nationals allow them entry to South Africa under particular terms and conditions and enable them to work. New refugee legislation has allowed asylum seekers from the rest of Africa and further afield the opportunity to seek refuge in South Africa. Yet the history of South Africa and the number of people born in the rest of the continent suggest that although the rate of movement of black African cross-border migrants and visitors across South Africa’s borders (in both directions) has increased, this does not amount to the influx and flooding that is so often imagined. The mining houses and commercial agricultural sector still retain their privileged access to unskilled and semi-skilled labour from the region. The proposals in the 2016 Green Paper indicate a change in policy which may extend access to some unskilled and semi-skilled SADC nationals, under what appear to be similar conditions (DHA 2016). Otherwise, the proposed policy changes appear to introduce more restrictive access for migrants and immigrants and will significantly change access and reduce the rights of asylum seekers including their rights to freedom of movement, to study and to work.

Employment data indicate that international migrants do not dominate any single sector of the economy, forming less than 10% of the workforce in any sector. Nor do the data indicate that they undercut the wages of South African workers. They do, however, play a significant role in the informal sector as business owners (and employers). The presence of a migrant community also provides a base for small scale informal-sector cross-border traders to operate from when they come to South Africa to buy goods. Their presence also contributes to the tourism sector when they receive visits from family and friends.

Although there has been a significant increase in the numbers and to a lesser extent the proportion of people born outside South Africa since 1994, it does not necessarily warrant the language of ‘flooding’ that permeates many debates. Compared to other (often poorer) countries on the continent, the proportion of the population born outside the country is relatively low. The distribution of international migrants across the country is also uneven. Concentrations found in certain neighbourhoods, particularly in inner cities may lead to the perception that the numbers of international migrants in the country is higher than it really is. Furthermore, the movement of international migrants in greater numbers into townships and areas where few lived previously may fuel these perceptions as people see changes in their neighbourhoods.
The commitment of the state to diversity and respect for human rights is there to see. However, the inclusive vision seems only to see those with skills and large bank accounts, or unskilled and semi-skilled workers who will continue to contribute to the mining and agricultural sectors. Immigration legislation, policy and practices remain largely exclusionary except for skilled professionals. The language around the introduction of immigration and refugee legislation as well as policing measures, contribute to exclusionary constructions of South African nationhood.

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Geographies and Geographers of Post-Apartheid Poverty

Siân Butcher

Abstract
Poverty in South Africa is much higher than in other middle-income countries, alongside persistently high levels of inequality. Scholars, policymakers and activists have sought to understand these dynamics, and post-apartheid South Africa has become a popular site for studying poverty and inequality, yet knowledge about poverty is still contentious. This chapter is about post-apartheid ‘poverty knowledge’ rather than only about poverty itself. It is particularly interested in how geographers in South Africa engage in and contribute to poverty knowledge. The chapter examines different approaches to the meaning and measurement of poverty, its changing spatialities and multiple drivers. It then surveys geographers’ assessments of post-apartheid anti-poverty policies and programmes in South Africa, their politics, and people’s own strategies in the face of poverty’s disempowerments.

Keywords
Inequality · Knowledge production · Poverty · Society · State

26.1 Introduction

During structural adjustment’s ‘lost 1980s’, geographer Anthony O’Connor could start his book Poverty in Africa with the trope “To think of Africa is to think of poverty” (O’Connor 1991, p.1). To think of South Africa is something else: deep poverty “alongside great affluence” (Seekings and Nattrass 2015, p. 4), both of which are starkly racialised through a state-organised system of racial discrimination and racial capitalism (Bundy 2016). Scholars have used the social laboratory of South Africa to see how the new democratic state will deal with this conundrum in the throes of late capitalism. Internationally, the booming 2000s was the anti-poverty decade: the first Millennium Development Goal to ‘end poverty in all its forms everywhere’ by 2015 was set out at this time (Sachs 2006), and a burgeoning poverty industry pumped out microcredit (Roy 2010), while new welfare states in the global South experimented with cash transfers (Ferguson 2015).

Geographers have been amongst many scholars researching post-apartheid poverty. Most have produced ‘poverty knowledge’ (cf. Davie 2015) for applied purposes or in co-production with communities, activists and local municipalities; what Oldfield and Patel (2016) call ‘engaging geographies’. These engaging geographies have generally been less focused on measuring and defining poverty than in analysing its contemporary dynamics in lived space and responses by both state and society. Much of the geographic scholarship reviewed here would not explicitly consider itself ‘poverty knowledge’, but rather dealing with specific issues such as housing, access to basic services, food security, etc.

The first three sections of this chapter discuss how to define, measure and explain poverty, mainly based on scholarship from economics and sociology. The penultimate sections draw more heavily on geographical scholarship (limited to literature written in English and privileging locally-based scholars) to discuss state interventions with respect to poverty and subaltern strategies that shape and contest these interventions. The chapter concludes with possible future directions towards more relational geographical poverty studies.
26.2 Conceptualising and Measuring Post-apartheid Poverty

Poverty’s definitions and measurements are dynamic, contextually specific and socially constructed and contested. Since 2008, South Africa’s national statistical agency, Statistics South Africa (StatsSA), has relied on three poverty lines to distinguish ‘the poor’ from ‘the not poor’ (StatsSA 2017a). The food poverty line (FPL), lower bound poverty line (LBGPL), and upper bound poverty line (UBGPL) are absolute money-metric poverty lines calculated by individuals’ monthly expenditure for subsistence (Budlender et al. 2015). These lines do not measure household income, general well-being or relative status in society, nor are they indicators of a ‘living wage’.

The FPL is a measure of the amount needed per person per month to buy enough food to survive, and thus measures bare minimum expenditure or those in extreme poverty (Budlender et al. 2015). This has increased from R219/person/month in 2006 to R531/person/month in 2017 (StatsSA 2017a). To this survivalist expenditure, the other two poverty lines add the crucial ‘non-food expenditures’ of those individuals (Budlender et al. 2015). The UBGPL has thus increased from R575/person/month in 2006 to R1139/person/month in 2017. All three measures rely on Ravillion’s ‘Cost of Basic Needs’ methodology.

Producing these poverty lines requires extensive data on household expenditure. Under apartheid, such data were only collected partially or not at all for black households. Filling the ‘poverty data gap’ has thus been an explicit goal of the post-apartheid state. In 1996 was the first universal census, with the next in 2001 (Christopher 2009) and 2011. In 1993 was the first national Income and Expenditure Survey (IES) to include all South Africans across race and province. The IES was repeated in 2005/2006 and 2010/2011 along with Living Conditions Surveys (LCS) in 2008/2009 and 2014/2015 (Budlender et al. 2015). These national-level surveys have also been supplemented by Quality of Life surveys and Income Dynamics Surveys carried out in different provinces and cities.

The first universal IES in 1993 used income measures and showed that almost half the population lived in poverty, rising to two-thirds in the Eastern Cape and now-Limpopo (Seekings and Nattrass 2015). Despite a significant reduction in poverty headcounts between 2006 and 2011, these values have remained relatively static. In 2015, 55% of the population fell below the UBGPL, equivalent to more than 30.4 million people, and is an increase from 2011’s low of 53% (Table 26.1). This increase has been disproportionately borne by black and coloured people, and particularly black women (StatsSA 2017a) (Fig. 26.1). Better poverty measurement does not automatically reduce poverty (du Toit 2011), and more data do not necessarily yield greater clarity (Bundy 2016). For example, which poverty line to use and how to calculate them is debated. The LBGPL is the preferred measure for government’s poverty reduction targets (StatsSA 2017a), and the National Development Plan’s aim is to reduce the proportion of the population living in poverty to zero by 2030 (StatsSA 2017a). No specific government target exists for the UBGPL. Further, leading economists argue for abandoning the confusing LBGPL in preference of the UBGPL, which itself underestimates poverty (for methodological rather than political reasons, they note). Budlender et al. (2015) calculate that closer to 63% of South Africans fall below the UBGPL, rather than StatsSA’s 55%.

The FPL’s conservative notion of what constitutes a nutritious food basket has also been questioned (du Toit 2011; Ledger 2017). The non-profit organisation PACSA (Pietermaritzburg Agency for Community Social Action) argued that to nutritiously feed a family of seven in 2017, a minimum monthly food expenditure of R4125 would be needed, rather than StatsSA’s R3717. However, in practice they found that low income households spend far less than that (approximately R1912/month) to free up money for other costs (debt repayment, insurance, transport, education, etc.) (PACSA 2017). Thus, more subjective definitions of poverty, along with cost-of-living and relative poverty lines, could better reflect the socially-determined nature of what constitutes poverty in particular contexts (Budlender et al. 2015). For example, the commodification of land and services in urban areas means that lower levels of absolute poverty can be experienced in more extreme ways (cf. Parnell 2005). In 2015, South Africa’s urban households spent four times that of rural households, mostly on housing and utilities costs, while rural households proportionally spent almost twice as much on food (StatsSA 2017a).

Other viewpoints on measuring poverty also exist. Multidimensional definitions recognise the multi-causal nature of poverty (Mushongera et al. 2017; Parnell and

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Source: StatsSA (2017a, p. 14)
Robinson 2012) and go beyond income and consumption to include assets, access to services, health and education, amongst others. StatsSA’s South African Multidimensional Poverty Index (SAMPI) seeks to capture this by combining census data across a range of equally-weighted variables measuring health, education, living standards and employment, to create a composite score (StatsSA 2014) (Fig. 26.2). The most recent SAMPI found that while money-metric poverty has risen, multidimensional poverty nationally has continued to decline since 2001, but more slowly since 2011. In South Africa, 25% of individuals are considered multidimensionally poor, as opposed to 55% income-poor (David et al. 2018).

The multidimensional definition approach has been critiqued for softening poverty counts, justifying reduced social expenditures and omitting structural and political issues (cf. Davie 2015). Given the limitations of money-metric and multidimensional measures of poverty, alternative concepts have been pursued. These include deprivation (Burger et al. 2017), vulnerability (Reid and Vogel 2006), quality of life and marginalisation (Culwick 2016), social polarisation (Lohnert et al. 1998; Lemanski 2007; Borel-Saladin and

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**Fig. 26.1** Proportion of population living below the lower-bound poverty line (LBPL) by sex and population group (2011 and 2015). (Source: StatsSA 2017a)

**Fig. 26.2** Contribution of weighted indicators to South African Multidimensional Poverty Index (SAMPI) 2001 and 2011 at national level. (Adapted from StatsSA 2014)
Crankshaw 2009; Lombard and Crankshaw 2017), social exclusion (Adato et al. 2006), or its corollary ‘adverse incorporation’ which explores how disempowerment occurs through forms of inclusion rather than exclusion (du Toit 2004; Hickey and du Toit 2013). For poverty scholar Andries du Toit (2010) “the proper subject for poverty research is inequality”, especially in South Africa which tops the World Bank’s inequality estimates. Using either income or expenditure-based measures, inequality has increased and remained stubbornly high over the last decade. In 2015, South Africa’s Gini coefficient was 0.68 (income-based) or 0.64 (expenditure-based) (StatsSA 2017a). However, while inequality has begun to deracialise (Leibbrandt et al. 2011), poverty and wealth have not.

26.3 Spatialities of Post-apartheid Poverty

The demography and geography of post-apartheid poverty in South Africa are both chronically familiar and dynamic. The most vulnerable to income poverty are black women, children, those without education, and populations living in rural areas, especially the two former homelands of the Eastern Cape and Limpopo (StatsSA 2017a). In 2015, 72–73% of individuals in these two provinces fell below the UBPL, as opposed to 33–36% for the richer provinces of Gauteng and the Western Cape (StatsSA 2017a). Poverty thus ‘still bears the strong racial markers of apartheid’ (Leibbrandt et al. 2011) and the ‘bitter harvest of the Bantustans’ (Ramutsindela 2001).

More multidimensional measures show poverty headcounts declining in former homelands from 2001 to 2016 (StatsSA 2017a) but this is balanced against increased poverty in an increasingly urbanising population (Leibbrandt et al. 2010). According to StatsSA (2017a), urban areas have substantially lower poverty headcounts than rural areas, with 40.6% of urban residents living below the UBPL in 2015 as opposed to 81.3% in rural areas. For UN Habitat (2011) on the other hand, 61% of South Africa’s urban residents live in poverty, while only 39% of rural residents do. The underestimation of urban poverty across the developing world – largely through undercounting ‘slum’ households – is not uncommon (Lucci et al. 2016). Other scholars argue that “[t]here is no watertight line between urban and rural poverty” given Southern Africa’s history of forced labour migration (Bundy 2016, p. 16) and circular migration since (Potts 2010). More recent work analyses municipal-scale poverty and inequality, finding great disparities between the richest and poorest municipalities in terms of household income, but with similarly high inequality in both (David et al. 2018). In Gauteng for example, Quality of Life scores are highest in central areas within municipalities, whereas they decrease in more peripheral areas (Culwick 2016) (Fig. 26.3). Within municipalities, there is spatial unevenness with, for example, the growth of inequality or social differentiation within townships such as Soweto (Beall et al. 2002; Everatt 2015).

At neighbourhood or household scales, studies by geographers of ‘spaces of vulnerability’ (Watts and Bohle 1993) show the qualitative impacts of socio-spatial factors on poverty. Black female-headed households experience the greatest burden of poverty and ill health (Goebel et al. 2010). Other vulnerable populations include people with HIV/AIDS, migrants (Amisi et al. 2011; Crush et al. 2015; Moyo et al. 2016) and informal settlement residents who face higher unemployment and inferior services as well as greater risks from fires, floods and violence (Drivdal 2016; Hunter 2010a; Meth 2017; Zweig 2016). Geographers have also investigated the lived experiences of poverty in small towns (Zweig 2015), commercial farms (Moseley 2007) and in small-scale farming areas (Kepe and Tessaro 2014; Makhanya and Ngidi 1999; Reid and Vogel 2006).

26.4 Production and Reproduction of Poverty

Recently, StatsSA (2017a, p. 18) announced that “the country has lost ground in the war on poverty”. While the systemic drivers behind this are multiple, for many economists the labour market is primary because it strongly determines wage levels and unemployment rates (Leibbrandt et al. 2011). In mid-2017, South Africa’s unemployment levels were at their highest since September 2003 with 36.4% unemployed, and 38.6% of those under 34 years old (Menon 2017). These statistics also do not capture the working poor. In 2015, the median monthly wage was R3100: R2900/month for black workers (as compared to R12000/month for white workers) (StatsSA 2015).

For liberal scholars, these labour market trends are driven by low economic growth, educational inequalities, pro-union policies, and a relatively small informal sector (Seekings and Nattrass 2015). For more radical scholars, South Africa’s untransformed wage regime and unemployment are functions of a capitalist economy historically set up for the white minority and structured by racialised wage inequalities, coupled with economic restructuring and ‘jobless growth’ since the 1970s (Bundy 2016). These trends have been exacerbated by the global economic crisis and neoliberal post-apartheid policies favouring elite empowerment, privatisation, commodification and credit, rather than investment in productive activities (Ashman et al. 2011; Barchiesi 2011; Bond 2013a, b; Maharaj et al. 2011; Marais 2011; Narshiah 2002). However, poverty is not only the outcome of neoliberal economic policies (Parnell and Robinson 2012) or the labour market.
Colonialism and apartheid deeply shaped the extreme uneven development of South Africa’s space economy (Bond and Ruiters 2017), and the raced and gendered inequalities in both its distributional and redistributinal regimes (Seekings and Nattrass 2015). These regimes may have been deracialised with the end of apartheid but not fundamentally changed, and so these inequalities continue to be reproduced (Seekings and Nattrass 2005). The articulation of space and class with these raced and gendered inequalities shape how processes such as investment and privatisation happen (Samson 2010) with patterns of investment concentrated in the same historical cores (David et al. 2018). The racialised disposessions of the last three centuries radically undercut black wealth (Kepe 2009) and continue to reduce safety nets in the face of economic precarity (du Toit and Neves 2014; Hart 2002).

At the urban scale, the form of the apartheid city itself produced and continues to reproduce poverty and inequality after apartheid (Harrison et al. 2015; Lemanski and Marx 2015). Racial segregation and forced removals left a deeply entrenched legacy of spatial mismatch between jobs and housing (SERI 2016), and highly unequal access to services and infrastructure. Some geographers argue that urban inequalities in service provision have deepened under post-apartheid policies of cost recovery (McDonald 2008; Smith and Hanson 2003) and urban global competitiveness (Lemanski 2007). Others see the role of the local state as more progressive but with its developmental mandates only partially and contingently realised (Parnell and Robinson 2012), with difficulties in coordinating and implementing policy and managing partnerships (National Planning Commission 2012). An extended criticism blames the lack of progress on corruption and, at worse, state capture by private interests (Bhorat et al. 2017). Rising anti-poor inflation since the mid-2000s (Finn et al. 2014) has also impacted on poverty in different sectors. Studies have investigated people’s experiences of energy poverty (Baker et al. 2014; SEA 2014), transport poverty (Lucas 2011), and food poverty (Crush and Caesar 2014; Frayne et al. 2014). The latter has become more acute in a wider southern African context of growing supermarket power (Peyton et al. 2015), deagrarianisation (Bryceson 2004; Connor and Mtwana 2018), stalled or elite-captured land reform (Hall and Kepe 2017; Kepe and Tessaro 2014), and climate change (Simatele and Simatele 2015).
26.5 Addressing Poverty

26.5.1 The Government of Poverty

Expanding the welfare regime or ‘social wage’ has been more successful than job creation in reducing post-apartheid poverty (Seekings and Nattrass 2015). With respect to total public spending, 60% goes towards the social wage in one form or another (StatsSA 2017a) and is largely managed at the national and provincial levels, with increasing devolution to the local level. The social wage includes items such as Reconstruction and Development Programme (RDP) housing, social protection though payment of old-age and child support grants, free primary health care, no-fee paying schools, and provision of basic services (water, electricity and sanitation) for free to poor households (StatsSA 2017a). These elements of the social wage have significant implications for addressing different aspects of poverty, but many complicating factors exist. The following section discusses three core parts of the social wage before considering job creation interventions.

The leading anti-poverty strategy at the national scale is the means-tested cash transfer programme, which now reach one in three South Africans and is often the only thing standing between households and deep poverty (Bhorat and Cassim 2014), especially in rural households (Thornton 2008). One of the largest social assistance programmes in the world, South Africa has led the charge in what anthropologist James Ferguson (2015) calls new forms of ‘social citizenship’ from ‘new welfare states’ in the South. These pension, child support and disability grants have measurably improved school attendance, health and nutrition (Leibbrandt et al. 2010). They have also been found to aid household investment expenditure and job searching (Bhorat and Cassim 2014). Social grants also work to reduce income inequality within the wider population; without them, South Africa’s Gini coefficient would be even higher at 0.74 (Bhorat and Cassim 2014). They constitute an explicit form of redistribution from the wealthy to the poor, its R160 billion budget funded by taxation. However, some scholars argue that grants are fiscally unsustainable; others that they do not offer enough, or anything to chronically unemployed young men (Bundy 2016). For example, 26% of grant-receiving households in Gauteng in 2015 still reported skipping meals (Mushongera et al. 2017): the largest grant’s R1600/month is not near the R4125/month required for a nutritious household food basket (PACSA 2017). Grants have also been implicated in new forms of exploitation through biometric surveillance and cross-marketing of airtime, loans and insurance, with social grants as collateral (Breckenridge 2005; Torkelson 2017; Webb 2016).

Another element of the social wage has been the 4.3 million RDP houses delivered since 1994 (DHS 2016). This has sought to combat the housing backlog; to create a class of homeowners with assets to enable social mobility (Adato et al. 2006; Charlton and Kihato 2006; Lemanski 2011); and provide a means to close the service gap, as housing and infrastructure are often bundled together (Schensul 2008). Its quantitative successes aside, RDP housing has not delivered as expected because their locations in peripheral areas on the cheapest land available has exacerbated exclusions of apartheid urbanism, from economic activities, quality services and urban life (Huchzermeyer 2005). Many perceive its allocation process to be corrupt (Rubin 2011). Rather than offering mortgageable paths to social mobility (Pillay 2008), they have provided livelihood opportunities through backyard landlording (Lemanski 2009; Shapurjee and Charlton 2013). The RDP approach also emphasises formalisation to the detriment of more creative and incremental approaches to already-existing informality in the housing sector (Huchzermeyer and Karam 2007). The wish to abolish informality still tends to dominate state thinking, despite in situ upgrading provisions within the newer housing policy, Breaking New Ground (Ballard and Rubin 2017). However, informal settlement upgrading can also create exclusions through, for example, the destruction of tenure security and social networks (Massey 2017; Patel 2013). Yet despite its problems, RDP housing remains a core demand of the poor (Charlton 2013).

Improving access to basic services has been another key poverty-alleviation strategy. Provided by municipalities with funding topped up by national transfers, statistics show relative success in rolling out electricity and piped water, much less so water-borne sanitation (Fig. 26.4). To qualify for a minimal package of free basic services (FBS) one has to provide documentary evidence of ‘indigence’ in line with a municipality’s definitions and means-testing (COGTA 2018). In Johannesburg, for example, households earning less than R5308/month qualify for FBS. Nationally, Treasury provides FBS funding to municipalities for households earning up to R2300/month (recently recalculated from R800/month/household where it sat for more than a decade) (National Treasury 2016). While this should allow 60% of South African households access to FBS, access has been much lower in practice, with wide variation in indigence criteria and registration levels across municipalities, as well as uneven monitoring and spending (SERI 2013). There remains great socio-spatial unevenness in basic service provision across municipalities (Palmer et al. 2017). The highest levels of servicing are in the richest and most urbanised provinces of Western Cape and Gauteng. Residents of rural municipalities are, according to the most recent Community...
Survey, the least satisfied with the services they receive (StatsSA 2017b). Increasingly common ‘service delivery protests’ at the neighbourhood scale since 2005 (from 10 recorded protests in 2004 to a peak of 191 in 2014 (Municipal IQ 2017)) point to the challenges of municipal capacity, the inadequacies of minimum and/or free services, particularly for large households (SERI 2013), as well as tensions within local politics and with foreign migrants (von Holdt et al. 2011).

The commodification of basic services has been of particular concern to geographers, documenting the cost recovery efforts of municipalities through technologies such as water meters and electricity disconnections, and struggles against commodification (Mahlanza et al. 2016; McDonald and Pape 2002; McDonald and Ruiters 2012; Peters and Oldfield 2005; Smith and Vawda 2003). More contradictory imperatives within these programmes have also been discussed, such as cost recovery combined with debt moratoriums and cross-subsidisation, privatisation combined with public investment, and new forms of citizenship emerging around service delivery (Jaglin 2008; Oldfield and Stokke 2007; Parnell and Robinson 2012; Wafer 2012).

It is at the local scale that these contradictions and contestations emerge most clearly (Hart 2014), and around a range of developmental responsibilities including service and infrastructure provision, participatory spatial planning, and pro-poor economic development (Palmer et al. 2017; van Donk et al. 2008). However, there is significant uneven capacity between local governments. Within municipalities, the ‘infrastructural power’ of the state varies with respect to other local actors (Schensul 2008). In Durban, for example, the state only successfully enacted its investment in public housing construction in buffer zones where it was the main actor (Schensul 2008). State attempts at township renewal have been mixed (Donaldson and du Plessis 2013; Kotze and Mathola 2012; Rabe et al. 2015; Siyongwana and Chanza 2017). Most infrastructural and post-apartheid spatial change has been the product of private sector operations and private household actions (Harrison and Todes 2015). Along with delivering parts of the social wage, local government has also been tasked with job creation through local economic development since the 1990s (Rogerson 2011), although there are more recent shifts towards regional economic development (Houghton 2016). In the metros, local economic development has sought to build urban competitiveness, for example through mega-events, with limited effects on poverty reduction (Gunter 2011; Hiller 2000; Houghton 2016; Maharaj 2011; Pillay and Bass 2008). Cape Town was the first metro to institutionalise pro-poor local economic development in the mid-2000s through an extended public works programme (Parnell et al. 2005). Some of these public works programmes have created new exclusions through very low wage jobs, kept outside the ambit of organised labour (Samson 2007). Simultaneously, local governments have had contradictory approaches to ‘informal’ employment, a core element of economic activity for poorer residents. In Johannesburg, for example, the concurrent celebration and eviction of informal traders have been recurrent themes (Bénit-Gbadou 2016; Rogerson 2016). In small towns, tourism and small, medium and micro enterprises have been important means of economic development. General analysis finds local economic development outcomes to be modest to disappointing and always uneven, contingent on local government capacity (Rogerson 2011) and sometimes exacerbating existing inequalities (Irvine et al. 2016).
26.5.2 Subaltern Strategies

State attempts to address poverty have not been passively accepted by ‘the poors’ (Desai 2002), despite often being called ‘beneficiaries’. At the same time, people continue to have high expectations of the state (Bénit-Gbaffou and Oldfield 2011), and the state remains central to South Africans’ imaginaries of a better future. Several geographers have examined this state–society interface, and how people respond to and often drive developmental interventions (Oldfield 2000).

Ballard (2015) distinguishes between two distinct but overlapping forms of ‘development by the poor’: organised mobilization, and everyday encroachment. Of the former, service delivery protests and social movements around land, housing, basic services, education and living wages are the most visible (Alexander 2010; Ballard et al. 2006). Another direct tactic is using the courts and the law to make claims on the state to both fulfill its mandate (e.g. deliver housing or protect informal workers) but also to halt anti-poor measures such as evictions, demolition and privatisation of urban commons (Oldfield and Stokke 2007; Rubin 2014; Samson 2017). The poor also engage local political parties and participatory spaces (both invented and invited) to access the state (Bénit-Gbaffou 2011, 2012), which may be able to enact change and create communities in the process, but which can also create networks of patronage and community gatekeepers (Bénit-Gbaffou and Katsaura 2014). More often, people engage in an everyday politics of waiting on the state or ‘living in the meanwhile’ (Oldfield and Greyling 2015), which requires living in the ‘grey spaces’ of legality through insurgencies of a quieter kind. These ‘grey’ strategies could include backyard and shack dwelling in ‘urban estuaries’ or inner-city squatting to access services and the city (Landau 2014; Wilhelm-Solomon 2017); working as informal traders, sometimes cross-border (Moyo et al. 2016; Peberdy 2000); creating order within ‘informal’ work, such as a shift system on a garbage dump regulated by citizenship (Samson 2015); or finding a sugar daddy within South Africa’s changing political economy of sex (Hunter 2015).

People also employ more mundane poverty-alleviating practices, such as increasing or decreasing household size to share or protect resources (Mosoetsa 2011), combining formal and informal food sources (Battersby et al. 2016) and cultivating home gardens (Connor and Mtwana 2018), accessing credit (James 2014), moving to access new opportunities and services, and making use of household and kinship networks across internal and transnational boundaries to diversify livelihood strategies and create new routes along which remittances, people, things and food flow (Crush 2012; du Toit and Neves 2014), and busing children to better-quality schools to ensure future social mobility (Hunter 2010b).

26.6 Future Directions in South African Geographical Poverty Knowledge

Two significant directions for future geographical work on the issue of poverty in South Africa are identified. First, the recent ‘relational turn’ in geographical poverty studies argues that the poor cannot be examined in isolation without also investigating more affluent Others and their interrelationships (Ballard 2004; Elwood et al. 2016; Visser 2013). The middle class and experts have powerfully shaped how we see and act on poverty (Lawson et al. 2012) – in South Africa, the ‘sanitation syndrome’ and ‘poor white problem’ are two historic examples of this. Second, Ananya Roy (2016) has called for more attention both to ‘active relations of impoverishment’ as well as the discursive (not just material) production of poverty as a problem. Here, institutional investigations of the ‘bureaucracies of poverty’ and ‘networks of poverty expertise’ would be useful starting points (Roy and Crane 2015), as would studying the business of poverty including ‘poverty capital’ (Roy 2010) or ‘social finance’ (Rosenman 2017), the new instruments and markets that make good off the ‘bottom billion’.

These relational and institutional geographies of poverty offer productive avenues for future research, in ways that may help supplement an understanding of “the social processes and social relationships that constitute [poverty]” (du Toit 2011, pp. 5–6) and the production of poverty ‘problems’. Such understandings can also help develop less telescopic interventions to address poverty and inequality.

26.7 Summary

This chapter surveyed the unsettled terrain of post-apartheid poverty studies, paying particular attention to geographers’ contributions to this debate. The different ways in which poverty can be potentially measured are contested, but can include absolute poverty lines versus multidimensional measures. The durable yet changing spatialities of post-apartheid poverty have different characters in different municipalities and between urban and rural settings, and emerge as a function both of the racialised inherited structure and history of South Africa’s economic development, and because of the unevenness of contemporary development processes and priorities. The role of the state in poverty alleviation strategies, enacted through the social wage (grants, housing and basic services) and local economic development, is also uneven and does not always lead to desired or sustained outcomes in terms of different poverty measures. In turn, people shape, contest, and work within and between these state interventions with anti-poverty strategies of their own.
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Revamping Local Economic Development Policy in South Africa

Christian M. Rogerson

Abstract

Over the past 25 years, local economic development (LED) issues have been of pressing concern in South Africa. The objective of this chapter is to interpret emerging frameworks and platforms for revamping and redirecting LED in South Africa. The international evidence and debates around LED, particularly in the global South, provide a compelling case for continued efforts to strengthen LED activities rather than revert to top-down policies that have demonstrably failed to deal with local challenges across nearly all of the global South. In South Africa, a major institutional actor in changing LED frameworks is the national Department of Science and Technology (DST). The growing influence of DST thinking on LED policy in South Africa is marked with the release in 2017 of the latest iteration of the National Framework for Local Economic Development, which asserts the centrality of innovation and the imperative to create innovation-driven local economies.

Keywords

Global South · Innovation · Innovation-driven local economies · Local economic development · South Africa

27.1 Introduction

Local economic development (LED) issues have galvanized widespread attention from South African geographies in recent years (e.g. Harmer and Rogerson 2017; Leonard 2016; Nel 2001; Nel and Rogerson 2005, 2016a, b; Rogerson 2002, 2006, 2009, 2010a, b, 2011, 2012, 2014; Rogerson and Rogerson 2010a, 2011, 2012, 2014; Rogerson and van der Merwe 2016). Addressing the Commonwealth Local Government Forum in June 2016, Minister Des Van Rooyen emphasized the vital potential for LED to contribute towards “igniting sustainable and people centred socio-economic development in sub-Saharan Africa” (Department of Cooperative Governance 2016). Indeed, South Africa’s minister with responsibility for LED stated that it “is increasingly being identified as the strategic enabler for national economic and development objectives” in particular of South Africa’s National Development Plan (Department of Cooperative Governance 2016). Furthermore, LED “can serve as an important catalytic instrument to create the necessary broad partnerships and conditions for economic development that can generate better and high quality service delivery, decent jobs, participation and empowerment of communities, women, youth and vulnerable groups” (ibid.).

For nearly 20 years, South African localities, with the support of national government, have actively pursued LED in an effort both to achieve post-apartheid socioeconomic redress and to promote economic development (Nel and Rogerson 2005, 2016a, b). With varying degrees of commitment, LED has been anchored on the principle of ‘developmental local government’ which was introduced in 1998 (Nel 2001). Legally, all local authorities are mandated to implement LED strategies which mostly assume a pro-poor focus, with the exception of the larger cities where market-based support is more in evidence (Nel and Rogerson 2016a; Rogerson 2010a). Notwithstanding the concerted efforts put into LED interventions, the existence of capacity and budget constraints, widespread corruption linked to state capture, low project success levels, the politicization of development, the targeting of unsustainable community-based interventions and ultimately the challenge of attempting to coerce market-based forces to operate in areas with the limited prospects of profitability, have resulted in a lacklustre series of outcomes (Nel et al. 2009; Nel and Rogerson 2016b).

Although South Africa is regarded as somewhat of a world leader in terms of the establishment of LED policy and strategy, it would be difficult to argue that results have made
a significant difference in all local communities (Nel et al. 2009; Rogerson and Nel 2016a, b), and thus fresh thinking is required to reinvigorate the landscape of LED and its national framework (Ndabeni et al. 2016). It is against such a backdrop that this chapter examines the revamping of LED policy in South Africa. The challenge has been to revise policy to impact most especially upon economic and social development in the country’s marginalized spaces or distressed areas (Rogerson and Nel 2016a, b).

27.2 International Context

Local and regional development is an international challenge and policy trajectories across the global North and South exhibit aspects of both convergent and divergent tendencies (Bagley et al. 2016; Pike et al. 2014, 2015, 2017; Rogerson and Rogerson 2010b). Pike et al. (2014) apply the term ‘vari-egation’ to capture the variety of meanings and experiences of LED. LED planning initially emerged in Europe and spread to other advanced economies, and then to late-developing economies in sub-Saharan Africa, Asia and Latin America. In Mexico and Brazil, LED strategies have surged over the past decade (Barberia and Biderman 2010; Palavicini Corona 2015). In South Asia, a recent review demonstrates that LED is a significant driver of context-specific and inclusive sustainable development in the region (Okapi Research 2015). For southern Africa, the Commonwealth Local Government Forum (2016) stresses that LED has evolved as “a multi-sector, multi-actor approach to addressing development priorities at the local level” which strengthens local government processes and offers a comprehensive framework for integrating and ‘localizing’ United Nations Sustainable Development Goals (SDGs) (Commonwealth Local Government Forum 2015, 2016; Slack 2015). The core message is that the SDGs should be “locally owned, inclusive and ‘leave no one behind’” (Slack 2015, p. 5). Indeed, this signals an important shift “from a wholly top-down approach to a more bottom-up approach which recognizes the importance of local contexts and environments” (Okapi Research 2015, p. 2) and more broadly of the potential for local government to be an implementing partner of the SDGs.

LED thus has surfaced globally as a vital planning approach to local economies (Pike et al. 2015). LED strategies are growth and development interventions that should be ‘place aware’ and take cognizance of different factors that can influence the potential returns of intervention (Barca et al. 2012; Rodriguez-Pose and Wilkie 2017; Rogerson 2014). The popularity of LED approaches is attributed by Palavacini Corona (2012, p. 9) to “what has been perceived as a failure of top-down strategies” to address local needs as well as to tackle local economic problems and challenges. Arguably, over past decades globalization has reconfigured planning approaches towards local and regional development as localities have been forced to react to changing global conditions (Pike et al. 2006, 2011, 2017; Rodríguez-Pose 2008; Rodríguez-Pose and Wilkie 2017). The growth of LED approaches can also be associated with the global trend towards decentralization of powers and responsibilities from national to sub-national tiers of government (Rodríguez-Pose 2008). For Latin America, decentralization has “contributed to the emergence of LED strategies across the continent as locally elected governments are closer to the people whose quality of life is to be improved” (Palavacini Corona 2012, p. 47). In Mexico, Palavacini Corona (2015, p. 1) draws attention to the changed constitutional context which has wrought a more propitious environment for LED, such that “the constitutive formal institutional setting has allowed and, at some degree, stimulated municipalities to plan and execute local economic development actions”. For Brazil, Barberia and Biderman (2010, p. 956) confirm that decentralization “has been a particularly important driver for the surge in locally-targeted development programs”.

Tomaney et al. (2011) maintain that the underlying principle is that tackling under-utilized potential and reducing social exclusion may be best achieved by using place-based policies to maximise the growth potential of each locality or region. The consensus is that the pervasive forces of globalization and the expanding integration of the global economy accord LED strategies “a bigger role to play in international development” (Rodríguez-Pose 2008, p. 24). Given the context of unfolding events re-configuring the global economy, several scholars point out the increased significance of local development policies (Palavicini Corona 2012, 2015; Pike et al. 2011; Rodríguez-Pose and Tijmstra 2009). Localities are perceived as the most adequate spaces to address global challenges including those emerging from the 2008 financial crisis, Brexit or the recent rise of isolationism in the USA (Palavicini Corona 2012; Tomaney et al. 2011). Pike et al. (2015, p. 2) point out the shifts in policy approaches occasioned by the changing global economy: “Before the global financial crisis of 2008/09 free markets and globalization were associated with relatively high levels of economic growth and the expansion of a new middle class in emerging economies... In the aftermath of the Great Recession, a new normal of low global growth has created fresh challenges”. During periods of political and economic turmoil local development becomes “an urgent priority” (Pike et al. 2017). The Commonwealth Local Government Forum (2016, p. 22) asserts that:

As the world moves more and more to an integrated global community, local areas are increasingly vulnerable to the impact of global shocks, be these economic downturns, climate change, migration/refugees, demographic shifts, energy shortages etc. Local economic development can help reinforce territories
Although LED strategies are widely recommended by a range of international development organisations, one of the most problematic issues is that of monitoring and evaluating the success/failure of such interventions. Notwithstanding “the multitude of LED initiatives across the developed and the emerging world, there is precious little evidence showing whether LED strategies do really make a difference for economic and social development” (Palavicini Corona 2012, p. 192).

Most commonly, LED analysts and practitioners have resorted to describe ‘best practice’ case studies which has caused “an overwhelming dominance of single-case inductive approaches to the study of LED strategies” (Rodríguez-Pose and Palavicini Corona 2013, p. 303). Until recently, systematic quantitative analyses of how local authorities’-implement LED have fared has been “virtually inexistent” (Palavicini Corona 2012, p. 192). Arguably, there is a “significant dearth of analyses undertaking a systematic monitoring of a large number of LED strategies” (Rodríguez-Pose and Palavicini Corona 2013, p. 303). The evaluation of LED policy and practice often “has been constrained to the lushest trees, disregarding the multitude of small and generally poorly documented attempts to try to implement the bottom-up approach across the world” (Palavicini Corona 2012, p. 10).

A pressing question is whether LED strategies ‘make a difference’ beyond those well-documented examples such as Silicon Valley, Bangalore, the Third Italy, and Baden-Wurttemburg (Rodríguez-Pose and Wilkie 2017). This gap has been addressed through analysis of the performance of LED practice in 898 municipalities in Mexico (Palavicini Corona 2012, 2015; Rodríguez-Pose and Palavicini Corona 2013). The results demonstrate that “pursuing or even thinking about LED strategies has paid off for local authorities in Mexico in the last two decades” (Rodríguez-Pose and Palavicini Corona 2013, p. 313). One issue not explicitly discussed was the role of innovation and local innovation systems. However, many studies across the global North and South flag the role of innovation in local and regional revival (e.g. Barberia and Biderman 2010). Arguably, in recent times, innovation has become a fundamental base for regional and local economic development policy (Kourtit et al. 2011). In particular, for marginalized regions in the global South, local innovation can drive economic catch-up and local growth (Ndabeni et al. 2016). The next section gives an overview of the key South African LED policy documents aligned to changing directions of Science, Technology and Innovation (STI) policies. It is argued that a major institutional actor in changing LED frameworks in South Africa has been the interventions of the national Department of Science and Technology (DST).

27.3 Changing South African Policy Frameworks

In South Africa, the context for aligning LED with STI policies is grounded in analysis of several documents, most notably the National Development Plan 2030 and the successive Industrial Policy Action Plans issued by the Department of Trade and Industry. The National Development Plan (NDP) 2030, which was released in 2012 by the National Planning Commission (2012), is viewed as taking a neoliberal outlook especially when compared to the developmental state approach of the earlier New Growth Path (NGP) (Rogerson 2014). The NDP stresses a more inclusive and dynamic economy in which the benefits are shared more equally. The vision of the NDP firmly asserts the centrality of STI for national development in South Africa (National Planning Commission 2012). Among the objectives of the NDP include increasing the size and effectiveness of the innovation system. The NDP observes that developments in STI are fundamentally impacting the way that people live, connect, communicate and transact, with implications for trajectories of economic growth and development. For achieving equitable economic growth, the role and contribution of STI is viewed as crucial, especially where technological and scientific innovations underpin economic advances, improvements in health systems, education and infrastructure. The NDP also acknowledges that investment in STIs can differentiate between those countries able to tackle poverty effectively by growing and developing their economies, and those that cannot. The NDP makes clear that the extent to which global South countries can emerge as economic powerhouses is contingent in part upon their capacity to grasp and apply STIs, and to use them creatively.

STI is also acknowledged as vital to support industrial policy interventions through the Industrial Policy Action Plan (IPAP). Among core objectives are to facilitate a programme of economic diversification, ensure the long-term intensification of South Africa’s industrial base, galvanize a labour-absorbing industrialisation path, and to move towards a knowledge economy beyond 2014. The IPAP was identified as a key anchor for achieving the goals of the NDP, and towards an equitable society. The first IPAP was produced in 2008 and the most current version for 2016/2017–2018/2019 is the eighth iteration (DTI 2016). The IPAP is now described as “an accepted strategic compass for industrial development which guides government departments in their policy formulation” (DTI 2016, p. 6). In the current IPAP, re-industrialisation remains a core focus and much emphasis is given to overcoming constraints to manufacturing-led, value-added growth, with particular emphasis to labour absorbing sectors, including agro-processing as well as clothing and textiles. This is the essential basis for arguing “the pressing need for structural change in the economy” in...
order to break away from commodity dependence and instead to shift towards a more diversified economic base “in which increasing value addition and export-intensity come to define South Africa’s growth trajectory” (DTI 2016, p. 1).

One consistent theme across several recent iterations of IPAP is the significance attached to the role of STI (DTI 2016). The central focus for DTI is upon leveraging STI to support industrial growth and development. South Africa’s STI policy package, as articulated in the White Paper on Science and Technology, the National Research and Development Strategy as well as the Ten Year Innovation Plan, affords “a sound basis for further improvement and up-scaling of the country’s industrial development interventions” (DTI 2016, p. 69). Arguably, for DTI its particular synergies with STI are with formalised research and development (R & D). It maintains that the “development and leveraging of STI is ideally achieved through partnerships between government, academia (including science councils) and industry (large, medium and SMMEs)” (DTI 2016, p. 72). However, the IPAP also states that “innovation does not stem solely from formalised R & D” (DTI 2016, p. 71).

STI and innovation are traditional core domains of the Department of Science and Technology and its predecessors. In 1996, the national Department of Arts, Culture, Science and Technology launched the White Paper on Science and Technology which has been described as “a necessary and progressive document that aimed to change the thinking about innovation in South Africa and restructure the country’s National System of Innovation (NSI)” (Hart et al. 2015, p. 1). The White Paper sought to address the deficiencies of a fragmented and ailing NSI which was viewed as “neither coordinated within itself nor with national goals” (DACST 1996). At a time of South Africa’s increasing reintegration into the global economy, the White Paper acknowledged a need for “increased co-ordination of innovation policies and strategies in response to the complex challenges generated by global social and economic changes” (DACST 1996). According to Minister Ngubane, the vision in the White Paper was “one where South Africa uses S & T to become economically competitive on a global scale, and on the other hand, to provide essential services, infrastructure and health care for all South Africans”. This was best done “by embedding our S & T strategies within a larger drive towards achieving a winning National System of Innovation” (DACST 1996). No mention was made at this time of linkages to LED activities.

Marais and Pienaar (2010) contend that the 1996 White Paper set out the parameters for STI policy and systems for almost 20 years. It was aligned to the immediate priorities of the post-apartheid government as set out in the Reconstruction and Development Programme and the macro-economic environment of the neoliberal Growth and Development Strategy (DACST 1996). The policy directions in the White Paper were conditioned largely by the experiences of innovation systems in other regions, particularly North America and western Europe, as well as emerging economies of Latin America and Asia (Hart et al. 2015). The policy emphasis was upon reconfiguring the country’s relatively dysfunctional industrial strategy away from labour-intensive commodity production and the military-industrial complex. As STI was recognised as an important enabler of national growth and development, the DST objective was to harness science to develop technologies and innovations to drive growth and competitiveness in national priority sectors. In terms of the role of innovation in development and of associated policy approaches, South Africa is a good example of debates in the global South about such issues (Ndabeni et al. 2016). Evidenced by various policies and strategic plans, much work around innovation in South Africa replicated global trends and mostly concentrated on the formal sector, urban areas, and techno-scientific innovation (Links et al. 2014). Key national STI policies deliberately aimed to drive the economy’s transformation to a knowledge-based economy, using a NSI approach (Blankley and Booyens 2010; Kruss and Lorentzen 2011).

A number of studies argued that the NSI policy focus was problematic, however, in particular, that policies “appear to be far from inclusive and do not have any pro-poor or informal focus” (Links et al. 2014, p. 179). Lorentzen (2011) contends that the poor hardly feature in innovation debates in post-apartheid South Africa. Phiri et al. (2016) aver that whilst South Africa’s NSI aims to address the challenges of an unequal society, its efforts to promote innovation have mainly failed to incorporate the majority population into the formal skills-intensive sectors of the economy. For Hart et al. (2012, p. 31), the NSI was “too formal” and with a desire to focus on global challenges through the application of European models of innovation and innovation thinking.

It is within this changing landscape and imperative for a pro-poor focus on innovation that the DST acknowledged the challenges with its existing STI institutional arrangements, and undertook a substantive rethink of policy directions (Mjwara 2016; Ntuli 2016). One manifestation was DST’s strategy document Innovation for Local Economic Development (ILED) in 2015, which marked the entry of the DST into the LED policy space. In her 2015/2016 budget speech, Minister Naledi Pandor announced that “Innovation is increasingly critical for local economic development” (Pandor 2016, p. 3). As discussed by Ndabeni et al. (2016), the ILED policy targets LED support initiatives particularly in South Africa’s marginalised rural areas. The DST policy document concedes that the existing NSI is not responding adequately to issues of inequality and poverty reduction. In addition, there is a disconnect between the NSI and sub-national tiers of government. Critically important to the ILED agenda is to address spatial patterns which historically
exclude large swathes of the country’s poor from the benefits of economic development (Ndabeni et al. 2016).

The ILED approach is underpinned by innovation systems theory and production systems (Ndabeni 2017; Ndabeni et al. 2016). The former perspective advances that innovation emerges within a context (system) in which a range of actors interact and synergise different types of knowledge, and stresses the centrality of networking, interactive learning and collaboration. The latter focus centres on the role of local clusters in production systems. Informing the ILED approach is acknowledgement that whilst innovation can assist in poverty alleviation, the exclusive focus upon innovations that are outputs of a formal scientific, technological and production approach must be questioned (Ndabeni 2017). Instead, a broadened focus on innovation is required. This opens up the national policy landscape to recognise the potential value of ‘grassroots innovations’ and how these might be leveraged for socioeconomic development (DST 2015).

ILED is introduced to nurture “more equitable local systems of innovation” and thereby to enhance the performance of the NSI (Ndabeni 2017, p. 3). The core objective of ILED is “to contribute towards inclusive development by strengthening local systems of innovation and production that can support the creation of sustainable employment creation, wealth creation and elimination of poverty” (DST 2015, p. 12). According to Ndabeni (2017, p. 4) its premise is that “solutions that emanate from the local system of innovation are more relevant to solving local and regional problems of social exclusion, inequality and unemployment”. Three major goals are identified: (1) to strengthen local innovation systems, (2) to build local knowledge infrastructure, local innovation spaces and human capacity to harness local innovation, and (3) to unlock economic value through launching catalytic interventions to unlock economic value inherent in localities in high potential sectors along the entire value chain and thereby introducing broader economic change (Ndabeni et al. 2016; Ntuli 2016). The need to strengthen local innovation systems places a premium on understanding and enhancing the synergies and dynamics of networks of local agents involved in the generation, diffusion, and utilisation of technology, knowledge and innovative solutions for local economic activities. At the heart of the emerging DST approach is building local capability in science and technology; advancing local industries through the exploitation of technology and innovation in respect of for example agriculture, agro-processing or aquaculture; and establishing an STI legislative environment that is conducive to the promotion of local innovation and production systems (Ndabeni 2017; Ntuli 2016).

The expanding influence of DST thinking on redirecting LED policy in South Africa is marked by the release in 2017 of the latest iteration of the National Framework for Local Economic Development. This revised framework asserts the centrality of innovation. The vision for LED policy is now to forge “innovative, competitive, inclusive local economies that maximize local opportunities, address local needs, and contribute to national development objectives” (Walaza 2017, p. 6). Several framework objectives are set forth including supporting the potential of local economies and “to launch a more effective fight against poverty, inequality and unemployment through the development of innovative and inclusive and competitive local economies” (Walaza 2017, p. 12). The significance of catalyzing “innovation-driven economic growth” is re-iterated in the crosscutting principles adopted in the framework. Finally, embedding of innovation into South African policy frameworks for LED is demonstrated by the six pillars of the National Framework for Local Economic Development, which are: building diverse and innovation-driven local economies; developing inclusive local economies; enterprise development and support; developing learning and skillful economies; economic governance and infrastructure; and strengthening local innovation systems.

### 27.4 Summary

The South African experience of LED must be seen as part of a global trend towards asserting the significance of place-based local development strategies. Despite efforts by both national and subnational tiers of government, the practice of LED in South Africa has been disappointing and, in particular, impacts on marginalized communities are hard to see (Nel and Rogerson 2016b). This said, international evidence and debates around LED, particularly in the global South, provide a compelling case for strengthening LED activities rather than revert to top-down policies that have demonstrably failed across nearly all of the global South (Rodríguez-Pose and Wilkie 2017). The international experience shows that LED policies and practices have to be adaptable to shifting contexts (Pike et al. 2015; Rodríguez-Pose and Wilkie 2017).

LED policies in South Africa have been reframed (Rogerson 2014) in response to the NDP and successive iterations of IPAP. Both of these policy frameworks consistently recognize the centrality of STI and of the activities of the DST towards more inclusive and pro-poor innovation (Mjwara 2016). One manifestation has been the LED policy framework and correspondingly DST’s entry into the policy space of LED. Essential outcomes sought from the implementation of ILED are: (1) innovation-driven LED; (2) increased investment and incorporation of STI in LED in order to address problems of unemployment, inequality and poverty in spatially marginalized communities; and (3) the integration of Local Innovation Systems in LED planning (Ntuli 2016). Further micro-level research is required to
interpret the nature and dynamics of local innovation systems and networking behavior in South Africa (Booyens et al. 2017).

The evolving ILED strategy marks a major departure with traditional STI development approaches. In its pro-poor focus, this approach represents a potential new benchmark for LED planning in the global South (Ndabeni et al. 2016) and is incorporated into the 2017 National Framework for LED. A future research challenge for geographers will be to critically investigate the practice and impact of this policy framework for LED, and in particular the extent to which it can ignite sustainable and people-centred socioeconomic development in South Africa.

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Connecting South Africa: ICTs, Uneven Development and Poverty Debates

Mohammad Amir Anwar

Abstract

Much has been written about information and communication technology (ICT) and its development potential in areas such as poverty reduction. Debates are framed around technocentric visions of development. This discourse on ICT-for-development (ICT4D) has opened the way for academic and policy debates surrounding ICT’s potential for development in Africa. By critically engaging with these debates, this chapter entangles key issues around ICT4D on the African continent to show how ICT might be implicated in uneven development. It then adopts the lens of South Africa to cover some ICT and poverty debates and shows that ICT is critical for development in South Africa, particularly at the individual level. The development policy prescription of the current South African government is heavily implicated towards this neoliberal line of thinking. Overall, there remains a need for further research to address how ICT can enable a change in the structural dynamics in the country that are key to poverty and inequality reduction.

Keywords

Africa · Development · ICT4D · Neoliberalism · Poverty reduction · South Africa

28.1 Introduction

There is a growing body of research on the potential for information and communication technologies (ICTs) to bring about a revolutionary change and development in Africa (Adera et al. 2014; Attwood et al. 2013; Foster and Heeks 2013; Gillwald 2010; Mascarenhas 2010; Obijiofor 2009; Ponelis and Holmner 2015; Ssuuna 2014). ICTs have been linked with development such that a new field of ICT-for-development (ICT4D) has emerged (Heeks 2006), generally built around the idea that ICTs are means to deliver sustainable development. The World Bank (2009, 2016) argues that African countries should improve their connectivity-enhancing infrastructure (including digital technologies) at global, regional and local levels in order to make development more inclusive, efficient, and innovative. As a result, many African countries have adopted national ICT policies and sought to achieve various development objectives (such as employment generation, poverty reduction, education and health care). South Africa is one such example.

The South African case is instructive because the country has a long history of adopting economic policies (both during the apartheid regime and the post-apartheid era) that have produced spatially uneven development (Ashman et al. 2011; Bond 2014; Carmody 2002; Narshah 2002; Williams and Taylor 2000). Currently, South Africa has one of the highest youth unemployment rates (estimated at 52%) and widening income inequality (World Bank 2015). Suffice to say that the current socioeconomic crisis in South Africa can be best understood as a continuing economic legacy of apartheid, built on the branding of neoliberalism by the policymaking elite and domestic businesses of South Africa, as a driver for economic development (Ashman et al. 2011; Bond 2014).

The South African government has placed great reliability, for future economic development, on ICTs and its related activities. Indeed, the National Development Plan 2030 for South Africa states that “by 2030, ICT will underpin the development of a dynamic and connected information society and a vibrant knowledge economy that is more inclusive and prosperous” (Republic of South Africa 2011, p.170). It is argued in this chapter that there is considerable controversy about the role of ICTs in development and of its impacts for South Africa. The increasing reliance of the South African government on ICTs and connectivity for development sug-
gests a strategy that is aligned with that of the World Bank. Indeed, the government’s approach towards the growth and diffusion of ICTs can be characterised as its search for a technological fix for promoting local economic development, including poverty alleviation (Rogerson and Rogerson 2010). However, the contradiction at the heart of the ICT4D discourse is that while ICTs – if suitably managed – can open the possibility of economic development and poverty impacts, they also pose several risks. It is the contention in this chapter that while ICTs can play an important role in South Africa, the policy prescriptions of the government and development organisations ignore many of the fundamental challenges. These are associated with ICTs inability to change the structural dynamics through which the African region is implicated in the world economy.

The next section of the chapter outlines some of the major debates on ICTs role in development in general, and in the context of the African continent, particularly focusing on South Africa. The objective is to present this new burgeoning area of research and to identify pitfalls, which could be a useful path to follow for future research. Arguably, there is a need for a clear research agenda that goes beyond stylised debates and clichés about ICTs’ transformative roles in African development. ‘How can ICTs create new sustainable employment opportunities for the unemployed which will enable income generation and subsequent poverty reduction’ should be one of the more pressing questions. In the third section, the focus turns to South Africa and situates the debates around ICTs in the context of neoliberalism as dominant policy initiative that has driven the agenda of ICTs growth and diffusion. This is critical for ICTs contribution towards uneven development in the country and amplifying the already existing socioeconomic inequalities. Unfortunately, the current direction of ICT policy in South Africa is a continuation of neoliberalism. The chapter closes with some policy reflections on avenues on which the government of South Africa could focus in order to make sure that ICTs contribute towards a more prosperous and egalitarian society.

28.2 Debates on ICT4D in Africa: Hypes, Hopes and Realities

The ICT4D discourse has created powerful imaginaries of ICTs’ potential for development in Africa (Murphy and Carmody 2015). Some well-known examples are in The Economist and Time magazine, both of which published a front page cover titled ‘Africa Rising’ (Perry 2012; The Economist 2011). In recent years, major international organisations and other institutions such as the World Bank (2009), African Development Bank (2012), Rockefeller Foundation (2014) and World Economic Forum (2016) have also contributed to this discourse. This is best summarised by this statement of the former Secretary General of International Telecommunications Union (ITU), Dr. Hamadoun Touré (2013):

ICTs are truly transformational. With the power of technology, we can educate every African citizen, right across the continent. With the power of technology, we can open new opportunities and create new well-paid jobs for our people. With the power of technology, we can deliver healthcare services to every African citizen, even in the remotest villages. And with the power of technology we can empower African women and leverage the fantastic energy and passion of young Africans. This is not just a pipe-dream: this is real.

The arrival of the fibre-optic undersea cable in 2009 to the eastern coast of Africa was hailed by SeaCom, the company backing these cables, as a “revolution” (George Kahama, the Chairman of Seacom Tanzania, quoted in SEACOM live 2009) now that “Africa is connected to the world” (quoted from Graham and Mann 2013, p.2). That said, Africa was already connected to the world capitalist economy, albeit on structural terms which favoured rich countries. The old forms of connectivity of the African continent with the rest of the world produced various forms of historical exploitation and underdevelopment (Carmody 2010). For many observers, the danger is that the new ICT-driven connectivities can amplify those existing economic, political and social inequalities (Fuchs and Horak 2008) rather than create a level playing field, as argued by Friedman (2006). In other words, changing connectivities can reinforce the production of spatially uneven development, the very process that the World Bank (2016) thinks is inevitable but key for the future economic development of the African continent.

Despite this hype surrounding ICTs and their role in Africa, the evidence of ICTs’ transformative potential for African development is inconclusive at best (Friederici et al. 2017). Murphy and Carmody (2015, p.xv) maintain that the ICT-4D literature in relation to Africa often lacks “geographic contextualization, theoretical grounding, and/or inter-study comparability or transferability”. Arguably, ICTs and connectivity are found to have variegated effects on development, with more evidence available from high-income countries than middle- and low-income countries (Friederici et al. 2017). Nevertheless, grand visions of the power of ICTs and resultant connectivities on economic development are recreated, encouraging African economies to integrate into the global production networks (Coe and Yeung 2015) often to their detriment (Murphy and Carmody 2015). Despite modern communication networks, the cost of broadband across Africa still remains very high (see Fig. 28.1).

Notwithstanding these comments, the rhetoric of ICT4D has been adopted by national economies on the African continent without much critical appraisal, and is present in a wide range of national policy documents, including in South Africa.
Africa. Here it is argued that the South African government has tried to rebrand neoliberalism into its new development policies particularly in the ICTs sector, largely driven by recent (under)development debates. This is discussed in the next two sections.

28.3 ICTs and Development Debate from South Africa

For many years the ICTs and affiliated sectors remained under the radar while the ‘mineral–energy complex’ (Ashman et al. 2011) dominated policymaking circles in South Africa. This has now shifted as the information economy sectors have been granted higher priority in the South African government’s current and future economic policies (Republic of South Africa 2014). This change in the policy discourse has been supported by a wealth of theoretical and empirical advances in ICT4D research which tackles the issue of development from a variety of geographical, socio-political and economic contexts (e.g. Adera and May 2011; Avgerou 1998; Chacko 2005; Chib et al. 2015; Donner 2006, 2008; Duncombe and Heeks 2002; Elder et al. 2013; Foster and Heeks 2013; Gillwald 2010; Heeks 2002, 2006; Oshikoya and Hussain 1998; Ponelis and Holmner 2015). These studies adopt different conceptual and methodological approaches to understand links between ICTs and poverty in different geographical contexts (May and Diga 2015; Murphy and Carmody 2015). More importantly, there is a burgeoning research base highlighting relationships between ICTs and development in the South African context (Adera et al. 2014; Anwar et al. 2014; Attwood et al. 2013; Blankley and Booyens 2010; Bornman 2016; Cross and Adam 2007; Rey-Moreno et al. 2016).

Attwood et al. (2013, 2014) conducted grounded research under the participatory action project Community-based Learning, ICTs and Quality-of-life (CLIQ) to study the impacts of computer training programmes and telecentre usage among rural communities in KwaZulu-Natal. Results show that the majority of participants, who acquired new computer skills, noted positive improvements in their quality of life. This was higher for individuals with improved participation rates and who experienced better implemented training programmes. The research also highlighted other major benefits mentioned by participants, including increased self-empowerment, self-esteem, happiness, confidence, widening of social circles and interaction, attainment of computer skills, free use of computers, greater knowledge of the world

Fig. 28.1 Broadband affordability (Source: Graham and De Sabbata 2014, licensed under Creative Commons, CC BY 3.0)
or increased access to information. However, these telecentres have internal political contexts, and differences can exist across these centres in terms of empowerment (Braathen et al. 2012). Nonetheless, research is beginning to show that ICTs have become important development tools both in the African and South African contexts with respect to people’s various goals and aspirations, and that the Government of South Africa needs to incorporate ICTs in their development policies, particularly from a poverty and inequality reduction perspective (Adera et al. 2014; Chib et al. 2015). Having said that, the positive relationship between ICTs and poverty reduction in South Africa (and in other African countries) is more complex. Digital communication tools and services still remain unaffordable to the majority of the poor especially in rural areas (Gillwald 2012; Rey-Moreno et al. 2016). This fact denies them the equal opportunity to participate meaningfully in the information economy, as compared to richer urban socioeconomic groups (mainly white people but also some affluent black people). While the penetration of ICTs has increased in rural areas of South Africa, this has also resulted in rural communities spending a high proportion of disposable income on airtime (Rey-Moreno et al. 2016). For example, Duncan (2013) found, in their sample of rural households in South Africa with earnings between R300 and R5000/month, respondents were spending roughly 26% of their income on buying cell phones and airtime, largely due to highly expensive telecommunication services. It is here that public telecentres in South Africa are of great utility, albeit with limited roles in improving livelihood chances, income generation and poverty reduction. Attwood et al. (2013) discuss telecentres’ role in provision and access of ICTs in rural areas of South Africa, but do not fully show that telecentres improve participants’ quality of life. This is because their research was based on subjective evaluations of wellbeing measured in terms of expansion of respondents’ personal choices and freedoms, as argued by Sen’s (2001) ‘capabilities approach’. This is bound to generate varied responses with no sense of causality between usage and access to ICTs and participant wellbeing. For example, one of their participants expressed that her quality of life declined despite getting a job, because her father died. In addition, their research overlooked the structures of class power and how ICTs might be able to alter current sociopolitical and economic structures. Nonetheless, their study acknowledges that there are limitations to ICTs’ impacts on poverty reduction and economic development in the South African context.

Overall, there is a lack of systematic studies that connect ICTs to poverty reduction in the South African context, particularly those that address the structural problems of how the domestic political economy continues to produce both poverty and inequality. In other geographical contexts, many studies that attempt to put a positive spin on the links between ICTs and poverty reduction are more descriptive than analytical (e.g. Adeya 2002; Morales-Gómez and Melesse 1998), with literature reviews confirming the continued reproduction of the discourse (Friederici et al. 2017; Moodley 2005). Other researchers have highlighted that ICTs in many African countries, especially mobile phones, merely maintain social interactions or networks rather than effect wider economic changes at micro or macro levels (Murphy and Carmody 2015). In light of this evidence, where do South Africa’s policies to incorporate ICTs into its development plan fit in?

28.4 ICTs and Rebranding of Neoliberal Discourse in South Africa

During the early 2000s, a number of reports and working papers were commissioned by the South African government to identify the role of ICTs in the country’s development. The National Development Plan 2011 expanded on ICTs’ role in development interventions in several key areas: employment creation, education, infrastructure, spatial divide, public services, corruption, and social integration (Republic of South Africa 2011). The National ICT Policy White Paper 2016 later became the South African government’s formal document for policy position on these issues (Republic of South Africa 2016). Although these policies are ambitious in scope, they are rooted in the neoliberal economic framework that has characterised policy development and implementation since the fall of apartheid.

The South African government’s position on ICTs and their role in economic development is consistent with that of the World Bank and the ICT4D discourse. The World Bank, in its report on ICTs for Greater Development Impact, argued that “ICTs have great promise to reduce poverty, increase productivity, boost economic growth, and improve accountability and governance” (World Bank 2012, p.v). The South African government took a similar stance in one of its preparatory documents on the ICT policy:

Over the past three decades the world has accepted the transformative power of ICTs… The International Telecommunication Union (ITU) estimates that a 10% increase in broadband penetration will result in an increase of up to 1.38% in the Gross Domestic Product (GDP). This will create jobs. The implementation of e-government, e-commerce and online transactions will improve service delivery and open new avenues for the end-user equipment manufacturing sector. Therefore, a coordinated roll-out of ICTs promises a realistic opportunity to bridge the digital divide and help deal with the inequalities and unequal access to services in the country. (Republic of South Africa 2014, p.2)

There are several elements of South Africa’s current ICT policy that are positive developments but overall it remains highly contentious and contradictory. For example, the White Paper states that “increased access to communications tech-
nologies, in particular, broadband, and the services and content carried on ICT networks, is acknowledged as an important means of promoting growth” (Republic of South Africa 2016, p.10). A report by Statistics South Africa estimated that ICTs sectors contributed roughly 3% to GDP in South Africa in 2014 (StatsSA 2017). While there is some evidence of a correlation between ICT penetration and economic growth (Röller and Waverman 2001), the issue of causality is not clear (Gillwald 2010). The problem is further complicated by the fact that economic growth alone does not lead to poverty alleviation. South African policymakers need to ensure that economic growth is multidimensional and inclusive, so that benefits reach the poor and marginalised.

South Africa imported roughly US$9.6 billion-worth of ICT products (both goods and services) but exported only US$2.3 billion in 2014 (StatsSA 2017). Future policy interventions must address the country’s dependence on ICTs related imports. While most of the mobile phone market in Africa is dominated by foreign products, a local South African company (Onyx) is hoping to launch locally-assembled smart phones within the country (its component parts will still be imported) (CNN 2017). Such initiatives may help generate jobs in the country. However, the question of job creation is one of the most problematic aspects of the South African political economy, and the expectation that the ICT sector is able to generate jobs on a scale that will alter the income distribution structure of the country is farfetched.

The World Bank (2015) confirmed that while job creation in South Africa is slowing since 2000, total employment in the country is becoming more skills-intensive. Since the 2000s, there has been growth in capital-intensive segments of the economy (finance and information technology), while labour-absorptive sectors such as industrial manufacturing have declined. This means that much of the jobs generated in South Africa cater to the high-skilled workforce, who mainly reside in urban areas. As such, in post-apartheid South Africa, the majority of the poor have experienced job losses while the growth of the information economy mainly benefits elites (Bond 2014; Carmody 2002). This results in limited opportunities for the unskilled and semi-skilled workforce in both the formal and informal sectors. Thus, instead of altering the power structure in the country, ICTs may be amplifying already existing socioeconomic inequalities, as most beneficiaries (affluent white people or the emerging black elite) enjoy better access to education and have skills that can be absorbed into new sectors of the economy. This is not to say that no benefits are derived from the changing economic structure of the national economy for the unemployed poor. Harambee, a youth employment accelerator programme, which connects job seekers to employers, is helping unemployed youth (mainly black people) to find entry-level jobs in retail, hospitality, financial services, and business process outsourcing.

Furthermore, the government of South Africa aims to make ICT tools and services (such as computers, laptops, mobile phones, e-government, e-commerce, e-post, e-finance) accessible to all its population by, for example, leveraging ICTs into its postal services. This entails maximising the benefits and impact of the current infrastructure through the introduction of new ICT services and products (Republic of South Africa 2016). This is a welcome addition to expand the reach of digital technologies and services, enabling a greater degree of local participation in democracy and enhancing the rural population’s ability to make significant changes to their life circumstances. However, it is critical for the state to ensure that ICT services are made affordable and easily accessible to the poor and in remote areas. South Africa has seen a marked increase in mobile phone service access among its population, but these services are unevenly distributed and expensive, a result of the duopoly market (Gillwald 2012). In a free market scenario, the dangers of consolidation and dominance of few big players (monopolies, duopolies and cartels), particularly in the ICTs sector, can result in poor quality services and extractive rents (Gillwald 2012). Here, the South African state should ensure that public-private partnership is encouraged for the provision of services and to encourage healthy competition that ensures better services at affordable prices.

One of the main criticisms of the National Development Plan 2030 was that it did not go far enough to make ICTs a priority in broader economic development planning (Gillwald 2012). One of the most problematic aspects of the new direction taken by policymakers is the continued dependency on neoliberal policy approaches by the political elite. Some industry experts and commentators have even hailed the National Development Plan 2030 for its ‘free market’ position (cf. Gillwald 2012). The South African government maintains that markets and the private sector are key to the successful growth of ICT sectors in order for them to impact on the delivery of infrastructure and services. This debate should focus on the role of state and the market, rather than state vs the market. To reverse the adverse policy outcomes of the post-apartheid era, the idea of free markets and direct state ownership of services must be reworked to adopt a more evidence-based approach for the ICT sector (Gillwald 2012).

There is also a need for new research that deals with both macro- and micro-levels of analysis, focusing on how ICT tools and service provision among poor and marginalised societies can generate wider benefits. Unfortunately, there is little data on this issue and it is premature to conclude that “the quality of life of the poor people has improved” based on their access to and usage of ICTs (Gillwald 2010, p.81). The danger of South African society slipping into further socioeconomic gaps is quite real, if the proliferation and diffusion of ICTs are not managed effectively. The current plan-
ning position of the South African government with regards to ICTs is to improve domestic connectivity and infrastructure provision for the flows of information and services. This has various consequences whereby flows of economic values will increase, but not necessarily the creation of new values that benefit its citizens.

28.5 Summary

South Africa has been going through one of its worst political-economic crises since the end of apartheid. As a result, the South African policy makers have embarked on a bold vision of development with a renewed focus on ICTs. The South African government’s ideological underpinning on ICT is that it would ‘level the playing field’ (Friedman 2006) where the country can compete and reap the benefits of new forms of globalisation enabled by changing connectivities. This current planning discourse fits with the emerging discourse on positive links between ICTs and development. Mainstream literature suggests greater adoption of ICTs can enable the population to participate in the information economy, thus affording them potential improvements in their quality of life. There are also arguments that improving digital connectivity across the country and in various business sectors can also contribute towards economic growth. Yet, the transformative potential of ICTs for the poor and marginalised through employment and poverty reduction is less clear.

The availability of paid employment opportunities represents one of the most significant development interventions, but development is itself a broad term with multiple meanings and conceptualisations (Peet and Hartwick 2009). Seers (1963) argues that when unemployment, poverty and inequality decrease, then development takes place. Paid jobs enable individuals and social groups to support their families, access education and health care, and improve their societal position and general wellbeing (Erez and Earley 1993; Gallie 2009; Green 2006; Hanson and Pratt 1995).

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Connecting South Africa: ICTs, Uneven Development and Poverty Debates


Republic of South Africa (2016) National integrated ICT policy white paper. Department of Telecommunications and Postal Services, Pretoria. 177pp


Innovation in a Changing South Africa:
Extant Debates and Critical Reflections

Irma Booyens and Tim G. B. Hart

Abstract
Economic and social imperatives of innovation are increasingly becoming intertwined and important, especially in the global South. While South Africa has a nucleus of innovating enterprises, key challenges with respect to poverty and underdevelopment remain. During recent decades, South Africa has experienced a marked decline in the traditional and employment-intensive sectors along with growth in service sectors. However, growth in low-productivity service sectors accounts for most employment growth. It is noted that regional innovation networks are scarce and predominantly found in major cities. A decline in the traditional employment-intensive and largely rural-based sectors of mining and agriculture, along with attempts to redress the socio-economic consequences of apartheid, resulted in a policy emphasis on innovation in distressed rural areas to enhance local economic development and public service delivery. It is concluded that skewed spatial patterns of innovation, as well as research and policy foci in relation to innovation, emerge.

Keywords
Basic public services · Economic competitiveness · Local economic development · Social innovation · South Africa

29.1 Introduction
Innovation is considered significant for achieving economic competitiveness in a global economy and to stimulate economic catch-up in emerging markets. South Africa, like other middle-income countries, has adopted knowledge-based policies to foster economic growth (Kruss and Lorentzen 2011; Wild 2015). A key criticism regarding the adoption of policies emanating from countries in the global North is that the assumptions and policy precepts of adopting neoclassical economic theory to emerging markets are questionable and sometimes incorrect (Todaro and Smith 2003). This situation exists because the structure and organisation of such emerging economies differ from highly developed economies. In addition, innovation capabilities depend on the quality of institutions hinging on the control of corruption, rule of law, and government effectiveness and accountability, which often constrained in the South (Rodríguez-Pose and Di Cataldo 2015). Furthermore, it should be recognised that economic growth does not necessarily contribute to poverty alleviation and the reduction of inequalities, as Hart et al. (2012, p.28) assert: “We are all too familiar with the fact that the neoliberal idea of the ‘trickle-down effect’ makes no real contribution to overall social well-being”. It is argued that the current growth-oriented path of knowledge-based economies, rooted in the notion of free competition, is insufficient in terms of promoting long-term human development, livelihood resilience and social stability (Lin 2007; Marcelle 2012).

One way of addressing these challenges has been to focus on innovations producing social benefits or outcomes. However, this dimension of innovation is neglected in economic-orientated innovation literature, despite the rapid growth of innovation studies in recent decades (Lorentzen 2011). While Science, Technology and Innovation (STI) policies in South Africa support knowledge creation and human capacity development for world-class Research and Development (R&D) aimed at enhancing the country’s
competitiveness, a dual vision which includes a policy emphasis on innovation aimed at achieving social benefits and poverty alleviation is apparent (Wild 2015). Hart et al. (2015, p.2) observe that the South African White Paper on Science and Technology earmarks the “vulnerable sectors of society, particularly the poor and unemployed” as beneficiaries of STI. The emerging policy intention is to spread the benefits of innovation to address the needs of poor and marginalised groups. This innovation undertaken for the poor and also by the poor is, in the South African policy environment, referred to as Innovation for Inclusive Development (IID) (Petersen et al. 2016). This aspect of South African policy is a reflection of a distinct trajectory of innovation in the global South, which highlights the role of STI to address challenges particularly related to enhancing access to basic public services of health care and education, and ensuring food security (AU 2014; OECD 2015). Although the developmental agenda of innovation is not new, a focus on innovation for creating employment, stimulating Local Economic Development (LED), addressing basic needs by improving public services and ensuring other social benefits, especially for the poor, is increasingly gaining traction within academic and policy environments in South Africa (Houghton 2016; Ndabeni et al. 2016; Rogerson and Nel 2016). The Department of Science and Technology (DST) is a key facilitator of this work since it funds projects and develops strategies as part of an IID agenda, which includes stimulating closer collaboration between actors in the National System of Innovation (NSI) – government agencies, universities and science councils, private sector enterprises and communities. The IID strategy attempts to foster needs-based ideologies of including innovations into development implementation. However, early drafts of this strategy overlook the innovations and experiments conducted by the poor (Petersen et al. 2016). Cartwright et al. (2009) estimate that such ‘informal’ innovators account for more than a third of innovations taking place in certain South African provinces and economic sectors. Nonetheless, innovation by the poor and within informal settings remains under-theorised and under-researched in South Africa (Kruss et al. 2017); thus while we recognise its importance, it is not discussed in this chapter.

In this chapter, we outline extant innovation debates and evidence with respect to enhancing competitiveness and achieving social outcomes, although we maintain that innovation in both cases remains under-researched in the local context. To manage multiple definitions of innovation, we retain focus on current innovations with economic and social imperatives as manifested in South Africa, without being drawn into ongoing debates about concepts and definitions. The next two sections focus on innovation for a competitive economy and innovation for realising social outcomes respectively. In each of these sections we present conceptual considerations and perspectives, evidence of contemporary changes, and critical reflections pertaining to policy responses. The final section provides a summary and delineates potential foci for future research.

29.2 Service Growth, Innovation Performance and Its Geography in South Africa: An Economic Perspective

29.2.1 Theoretical Considerations

The importance of innovation for economic competitiveness is well-established within economic theory. New economic growth theories posit that innovation is an endogenous, evolutionary process that requires knowledge as an input for enhancing productivity and long-term economic progress (Aghion and Howitt 1998). Neo-Schumpeterian evolutionary economic theory, based on the theories of Joseph Schumpeter, links innovation to economic development by arguing that economic growth is driven by the emergence and continual practice of innovation centred on new and more viable solutions, rather than on ‘old ways of doing things’ (Fagerberg 2003). Innovation practice is regarded as essential to the efficiency of firms and industries, fully endogenised and fundamentally linked to entrepreneurship and productivity growth (Baumol 2011). In this context, innovation is the introduction of new and improved products, processes, organisational procedures and marketing methods that allows firms “to override the pre-existing conditions of markets and industries, and to grow and gain market shares at the expense of non-innovating firms” (Cainelli et al. 2006, p.437). The emphasis is on the profit-orientated economic imperative of innovation operating in a free-market environment, driven by private sector enterprises. On a larger scale, innovation by private enterprises collectively stimulates economic opportunities and growth within settings such as cities, regions and nations (Fagerberg 2013). From an evolutionary economic geography perspective, competitiveness of firms and regions is enhanced through the cumulative effects of past learning, knowledge acquisition, innovation and technology adoption (Fagerberg 2003; van Eggeraat and Kogler 2013). At the same time, failure to innovate, keep up with technology, and stay competitive increases the risk of firms being locked into outdated and unproductive technologies, products or operations which ultimately incurs irreversible losses to firms, and also to regions not embracing change (Brooder 2014). This has implications for firms and regions in the South that want to accelerate economic catch-up, but which do not necessarily have capabilities or resources to innovate beyond adopting the innovations of others.
29.2.2 Economic and Innovation Performance

A number of observers highlight that the most striking feature of South Africa’s economic performance in recent decades is the sustained rise of the tertiary sector which has performed well in terms of output, export expansion, employment growth, and technological progress since the mid-1990s (Bhorat et al. 2016; Du Plessis and Smit 2007; Fourie 2011; Manyeka 2014). The expansion of services, both in relative and absolute terms, coincided with economic reforms since democratic change in 1994. Previously, under apartheid, government intervention, import substitution, stabilisation policies, price controls and regulation of markets characterised the economy (Calitz 2002). Structural economic reform and liberalisation in South Africa gained momentum after 1994, marked by a gradual shift to a market-based economic system (Calitz 2002). The recovery and growth of the economy from the 1990s to around 2010 (after which signs of decline started to emerge) is best explained by total productivity growth arising from international trade openness; increased competition at sectoral level; a significant period of increased economic and political stability; lower interest rates; and the systematic rise of the service sector (Bhorat et al. 2016; Du Plessis and Smit 2007).

Figure 29.1 provides the composition of Gross Domestic Product (GDP) in selected countries. The size of South Africa’s service sector is comparable to countries such as Hungary or Turkey. With regard to the Brazil, Russia, India, China and South Africa (BRICS) countries, South Africa has the second largest service sector after Brazil. The relatively large share and character of South Africa’s service sector is atypical for a middle-income country (Fedderke 2014; Kahn and Hounwanou 2008). This raises concerns about jobless growth in the economy where low-productivity service sectors, like the sizeable and growing wholesale and retail trade sector, are responsible for the bulk of employment growth since 2000 (Fedderke 2014). Equally, the contributions of traditional labour-intensive sectors of the economy, such as agriculture, mining and manufacturing, to GDP output and employment, have dwindled consistently over the last 40 years (see Booyens 2016). In terms of economic growth and technological progress, financial and business services stand out as the strongest performers, yet employment in high-productivity service sectors like the communications, finance and insurance sectors is low in comparison to other emerging markets (Bhorat et al. 2016). Furthermore, growth in government services account for almost a third of employment growth in the service sector from 2000 to 2014 (Bhorat et al. 2016).

In terms of South Africa’s innovation outlook, the OECD (2007) observes that the country has a nucleus of innovating enterprises. However, innovation in South Africa is largely

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**Fig. 29.1** Composition of GDP in % (Value added of major activity groups as share of total industry value added) in selected countries. (Source: authors’ calculations from OECD 2011)
incremental, i.e. improvements or adaptions rather than new creations or cutting-edge technologies (Booyens 2016; Buys 2013). Nonetheless, it is argued that incremental innovation is collectively significant for economic progress, social development and not least survival in a locale (Brouder 2014; Hayter and Le Heron 2002). In light of this, it is emphasised that STI policies in the country largely focus on technoscientific innovation, i.e. innovation in certain ‘high-tech’ industrial sectors such as biotechnology and pharmaceuticals, space science, defence, energy, and the automotive industries among others; while ignoring non-technological, incremental and service innovations (Booyens 2016; Buys 2013; Manzini 2015). Even so, service sectors are considered to be dynamic in terms of R&D and innovation (Kahn and Hounwanou 2008). The total innovation rate of services is comparable to innovation in manufacturing. The sector of financial and business services, which includes software development, is one of the best performers in terms of innovation and contributes most to business expenditure on R&D (HSRC and DST 2011, 2017). By comparison, during the period 2014–2015, R&D spending in mining and quarrying declined by 20% and remained low in agriculture, forestry and fishing (HSRC and DST 2017).

29.2.3 Geographical Patterns

Geographical patterns in relation to knowledge-based economic activities show that these are concentrated in the wealthier, urban regions of South Africa (Bhorat et al. 2016; SACN 2016). Service growth is also concentrated in these cities. Overall, the Gauteng province and Cape Town city-region exhibit higher rates of economic growth than the rest of the country, with higher employment rates, superior infrastructure, and a more sectorally diverse workforce (Lorentzen et al. 2009; Rogerson 2018; SACN 2016). Gauteng has the highest degree of specialisation and diversity of economic activities. Gauteng’s cities and Cape Town spend the most in terms of R&D, are dynamic in terms of innovation, have the most highly skilled human capital, produce the most scientific and engineering articles and register the most patents in comparison to other cities in South Africa (Lorentzen et al. 2009; SACN 2016). Lorentzen (2008) observes that regional innovation systems consisting of a network of private sector firms, government agencies, research-based organisation and other actors, exist to a limited extent in both Gauteng and the Western Cape, but are not well developed elsewhere in South Africa.

These patterns are in contrast to small town and rural decline, in the light of increased urbanisation, and exacerbate issues around unemployment and inequality in South Africa which remain critical (Bhorat et al. 2014; SACN 2016). Decline and job losses in labour-intensive sectors, such as mining and agriculture, are felt most acutely in small towns and rural areas, where few viable economic activities remain, and where poverty-associated socio-economic consequences are most pronounced (Hoogendoorn and Visser 2016; Marais et al. 2017). Recent debates highlight the importance of innovation to reframe place-based economic development in South Africa. In particular, innovation for LED is an area of policy reform that is rethinking the role and functioning of LED in South Africa (Rogerson and Nel 2016). There is also an emphasis on innovation in under-developed and distressed areas to not only enhance LED but also basic public service delivery (Ramoroka et al. 2017; Rogerson and Nel 2016). Innovation across the spectrum is of significance whether it is of new or improved products, services, processes, marketing methods, organisational procedures or environmental practices implemented by a variety of agents including private firms, government and non-governmental organisations (NGOs). Various authors underscore the need for innovation to enhance pro-poor benefits (Hart et al. 2014) and inclusive development (Houghton 2016; Ndabeni et al. 2016), leading to debates about innovation for social imperatives.

29.3 Innovation for Achieving Social Outcomes

29.3.1 Conceptual Considerations

Internationally there are multiple interpretations of what innovation with social outcomes, often referred to as social innovation, entails (see Edwards-Schachter and Wallace 2015; Murray et al. 2010). The thinking behind social innovation is primarily welfarist and conscionable. Consequently, products that assist and improve the economic, social and physical wellbeing of the destitute now and in the future, and intend to protect our world for future generations, are the most prevalent. These products are often combined. For instance, we see solar, wind driven or biodigester-based energy production for lighting, cooking and heating in low cost housing. This means that environmentally-friendly innovations are often included along with welfare and social development type innovations within a broader sustainable development agenda (Booyens and Rogerson 2016).

Hart et al. (2015) note that two other meanings of social innovation dominate. The first focuses on the arrangement or organisation of people and artefacts within economic, social or cultural environments, and can include trade unions, saving and credit groups, work parties, job sharing and even neighbourhood watch committees. The second is populist in orientation and demands that any goods, services or social arrangements must include the social actors who require these goods, services and arrangements. Furthermore, this second category of social innovation must aim at the broad
transformation (as opposed to simple reform) of the existing innovation system structure, which is elitist and determined by hierarchies of knowledge (YF/SIX 2010). In South Africa, Phiri et al. (2016) considers social innovation to refer to innovation for and by the poor which largely concurs with this populist orientation. A further consideration relates to the observation that the ‘public good’ characteristic of innovation is generally neglected. Ramoroka et al. (2017, p.7) maintain that “In the domain of STI, the functions of government entities have evolved from simple administration and policy oversight to the [organisation, identification and support for the] incorporation of innovation and new technologies in the delivery of public goods and basic services to communities”. The role of government includes the fostering of innovation aimed at achieving particular social developmental outcomes, such as enhancing social cohesion, equality, poverty reduction, wealth redistribution, job creation, environmental protection, safety and security, and education and health care (Bloch and Bugge 2013). In this regard, innovation can be considered a ‘public good’ – the intended outcome of innovation by government agencies (Ramoroka et al. 2017). Innovation in the public sector which has social imperatives is central to emerging LED policy responses in South Africa (DST 2015).

29.3.2 Empirical Evidence and Spatial Considerations

Social innovation research and policy development in South Africa has a brief history and is primarily driven by the public sector. A significant development is the Innovation Partnership for Rural Development Programme (IPRDP), convened in 2011 by the DST, as a means of introducing available innovations/technologies into the 27 distressed districts initially targeted by the Department of Rural Development and Land Reform. The prerogative to use STI as a driver to rejuvenate rural development in South Africa is evidenced by individuals, NGOs and public agencies engaging in innovation with social and environmental benefits (see Booyens and Rogerson 2016; Hart et al. 2012, 2015). Most extant research in this area has focused on rural locales. Hart et al. (2012, 2015) found that social innovations are mainly welfare-oriented, which occasionally include an economic component. They note that social innovations typically are confined to technical products with a social service orientation but do not necessarily involve users’ input into design (e.g. solar geysers, latrines and multi-purpose service centres), unless they are initiated by the poor or concerned local entrepreneurs (e.g. savings schemes and care groups for vulnerable adults and children). Further research foci in rural South Africa are innovations aiming to improve health care, agriculture, education, Information and Communication Technologies (ICT) access, organisational reform and basic public services (Hart et al. 2014; Kraemer-Mbula et al. 2015; Ndabeni et al. 2016; Ramoroka et al. 2017).

The IPRDP has been instrumental in demonstrating innovations to improve basic public service delivery in distressed, rural districts. The programme fosters the introduction of innovations, mostly in the form of technologies developed by South African science councils and university partnerships, into a selection of these districts (see Fig. 29.2) to bolster existing basic services, such as energy, water and sanitation, as opposed to providing new services or addressing backlogs. Innovations include internet and web-based platforms for water problem reporting and tracking, low cost mini-water purifiers (Fig. 29.3), mini-hydroelectric plants, geyser management through mobile phones (smart geysers), low water consumption flush toilets (Fig. 29.4) and improved waste water purification pond systems, including the introduction of newly developed algae to increase agricultural irrigation and provide high protein fodder. The algae example illustrates the connection between social services and economic opportunities. The demonstration of these technologies is being evaluated and this includes an assessment of their impact on host communities. Another component of the IPRDP is a research programme to identify innovations in local areas, develop a tool to assess these, and to work with the local municipalities to ensure that they can identify suitable innovative interventions to promote service delivery and LED. This project is known as the Rural Innovation Toolbox (RIAT) and is currently being implemented in eight of the distressed districts (see Fig. 29.2). The key observation is that the IPRDP policy focus is heavily skewed towards districts where the former homelands are based, to redress the spatial legacy of apartheid, but with no social or service delivery innovation interventions in poor metropolitan areas. A third element of the IPRDP, not discussed in detail here, is the development of an Innovation Maturity Index which assesses the capabilities of local municipal organisations and staff to learn, implement innovations and share knowledge in relation to improving public service delivery (see Mhula Links et al. 2017). Understanding innovation maturity, in relation to capabilities and organisational culture of public sector officials and their local councils, is essential to evaluate the feasibility of such policy interventions and inform the support mechanisms required.

Critical observations in relation to extant research and policy on innovation with social benefits in South Africa are that STI is increasingly seen as the driving force for LED in rural locales. It is observed that the approach is regarded by policymakers as a panacea for a myriad of developmental challenges manifested in rural settings. It is uncertain, however, whether innovation is a viable catalyst for rejuvenating rural LED, especially considering that highly skilled human resources, access to financial resources and strong institutions
are required to drive innovation (see Rodríguez-Pose and Di Cataldo 2015). In South Africa, this hampers innovation both at the national and local levels, particularly in small centres and rural areas, which have limited access to financial resources, skilled and experienced human resources, and systems to ensure good governance and the control of corruption (Hart et al. 2014; Jacobs and Hart 2012; Ndabeni et al. 2016; Rogerson 2014). A further reflection relates to the challenges observed in implementation of IPRDP technology demonstrations. Such challenges include constraints in relation to the environmental terrain, distances between rural villages and existing sources of government-supplied water, practicalities around energy provision, and non-existent ICT infrastructure in areas where ‘smart’ technologies are integral to service delivery innovations. These circumstances are compounded by the lack of financial resources and commitment on the part of certain local councils. Thus, it is not clear whether the demonstrated innovations are feasible solutions to sustained service delivery on a large scale, as many are only once-off projects (see Hart 2016; Wild 2015).

29.4 Summary and Future Research Directions

South Africa’s economic performance over recent decades is characterised by unbalanced growth that resulted in the expansion of the services sector, exemplified by largely jobless and low productivity growth. While jobs in the trade and tourism sectors provide opportunities for persons with low-level skills, in the light of losses in other labour-intensive sectors, growth in low productivity services impacts negatively on the overall performance of the economy. This

Fig. 29.2 The geographic spread of IPRDP initiatives, i.e. RIAT and STI-related basic service deliveries. Note the districts shown are those earmarked for intervention but that there are places where some interventions have not been rolled out as planned. (Source: EPD, HSRC)
service sector growth is unusual for an emerging, middle-income country. Therefore, more energetic efforts are needed to stimulate innovation, employment creation and growth in appropriate ‘industrial’ sectors to avoid a low-level economic growth trap. The SACN (2016, p.97) suggests that “manufacturing, in particular high value-added automotive, industrial machinery and equipment, and chemical industries, still holds considerable opportunity for growth and employment, given improvements in innovation and productivity”.

However, there is much that is not known about innovation in South Africa. Geography matters: it is difficult to accurately disaggregate innovation by province or place, and thus there is a lack of regional and sectoral analysis. A further reflection is that innovation policy remains focussed on the NSI. We argue that the role of regions is not well understood, which results in under-developed regional innovation policies coupled with limited evidence of functioning regional or local innovation systems or networks (see Booyens 2016; Buys 2013; Ramoroka et al. 2014). Further investigation into the nature, characteristics and actors of innovation networks at the local and regional levels is therefore warranted.

Fig. 29.3 Beneficiary (left) showing cleaned water using the filter (right) compared to the water accessed from the Olifants River, which is the main water source of the village in the Capricorn district, Limpopo. (Source: EPD, HSRC)

Fig. 29.4 Toilet facilities. (a) A pour flush installation in the Eastern Cape, (b) instructions for use, (c) an old pit latrine
Internationally, the notion of innovation for competitiveness dominates, and debates around the importance of innovation for ensuring social resilience remain marginal. While a similar situation prevails in South Africa, there has been notable policy support for innovation with social outcomes. However, service innovation remains underestimated and under-researched, despite its strong economic performance in recent years. Focused research is needed to measure and understand the nature of service innovation in South Africa. Nonetheless, innovation is needed to rejuvenate high-value and labour-intensive sectors, like manufacturing, to ensure comparative competitiveness in South Africa. While service growth and innovation is centred in Cape Town and urban Gauteng, extant research and policy predominantly focus on innovation in rural settings and for the benefit of the rural poor. The latter emphasis is a policy response to the observations that urban-based firms, organisations and actors dominate the NSI in South Africa and that rural areas are historically neglected. However, the poor and under-developed urban areas are accordingly currently ignored. With regard to applying an innovation lens to LED, we propose an emphasis on STI to create new and improved products, services, and processes to catalyse new economic opportunities, stimulate entrepreneurship and improve basic public service delivery in rural areas, small towns and cities. Several questions emerge with regard to such proposals, which require further interrogation. Pertinent questions include: What should be the role of government in support of innovation for LED, beyond a project-focused modus operandi? Does the capacity for this support exist at local government level and how can it be enhanced? Is the innovation for LED viable to bring new opportunities to rural areas and small towns in particular, given the prevailing resource (human and financial) and support constraints? Would this differ from urban areas in building competitive, creative and resilient cities that also provide comprehensive basic service delivery?

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Towards a Broader Conceptualisation of Environmental Justice in South Africa

Llewellyn Leonard

Abstract
In contemporary South Africa, environmental justice is a critical question for geographers. It is argued in this chapter that whilst new civil society leadership has emerged to address environmental justice concerns in the post-apartheid period, these have not been effective in formulating an emerging ‘environmental justice framework’ by way of a coherent ideology to collectively address social and environmental risks for more effective civil society actions against macroeconomic risks. This chapter explores selected case studies to examine how leadership in social and environmental struggles has unfolded, and for joint actions. Results indicate that leadership for an emerging environmental justice framework is restricted by individualised and self-interested leaderships, undermining engagement for collective actions both within and across the social and environmental arenas. It is observed that leadership will be vital in advancing local struggles, and also ensuring expansion and connection of struggles beyond localities, but will require negotiation between leaderships on convergence.

Keywords
Environmental justice · Civil society · Leadership · Neoliberalism · Social movements

30.1 Introduction
In contemporary South Africa, environmental justice is a critical question for geographers. The goal in this chapter is to examine issues surrounding the emergence of an environmental justice framework (EJF) by way of leadership to bring together the diversity of social and environmental struggles (Cock 2004a, b; Death 2014; McDonald 2002). An EJF aims to address environmental and societal risks collectively to respond to the emerging environmental justice dilemma, discussed below. Environmental risks include exposure of mostly low-income communities to chemical industries, waste disposal sites and oil refineries to name a few, which deteriorates local environments and health (Roberts 2003). These environmental risks are generally coupled with social risks such as poor housing, and reduced waste, water and sanitation facilities (Leonard and Pelling 2010a). The neoliberal programmes of the post-apartheid government have continued (as during apartheid) to ignore the unequal geographical distribution of social and environmental risks (Ballard et al. 2005; Bond 2004, 2005). Due to rising inequality between the rich and the poor (Orthofer 2016), research into social justice and livelihood issues has taken centre stage, with limited research engagement on environmental risks issues (Leonard 2011; Leonard and Pelling 2010a, b), and services such as water, electricity and housing have been more of a priority for people (Naidoo and Veriava 2003). This said, South Africa is not progressive in linking social and environmental concerns into a coherent ideology for an emergent EJF (Cock 2004b) since the mobilizing issues are health and rights and not environmental justice per se (Cock 2004a). For South Africa, what then is the potential for civil society leaderships to work jointly and formulate an EJF to address risks for more effective civil society actions against macroeconomic risks? This can be achieved by linking environmental justice to broader political, social and economic issues. Before proceeding, it is important to clarify what is understood by the terms leadership, civil society and environmental justice. In this analysis, leadership (against macroeconomic risks) is understood as providing guidance to and projecting the will of constituencies, including forming relationships with other leaders and people for collective resolutions (Leonard 2011). Two theoretical outlines for leadership are used: local civil society leadership (e.g. local leaders and
representatives) residing within the affected region, and external civil society leadership (e.g. non-governmental organizations (NGOs), academics) who provide support to local social actors (Leonard and Pelling 2010a). Civil society seeks to create political space for the grassroots to shape the rules of specific policies and social structures that hinder aspects of their social life (Leonard 2014).

Environmental justice is variously understood by its subject of study, political orientation and mode of analysis (Agyeman and Evans 2004). It has been understood as questioning why the marginalised reside in vulnerable environments (Dobson 1998), as uniting the trepidations of both the environmental and civil rights movements (Camacho 1998), and as not affixed in scientific discourse but necessitating ethical investigation of environmental decision-making (Bullard 1994). More contemporary considerations of environmental justice have been understood as integrating environmental issues into the wider intellectual and institutional framework of human rights and democratic accountability (McDonald 2002); and as non-racial discrimination in environmental policymaking and enforcement, and the non-deliberate siting of environmental risks within specific ethnic communities (Rhodes 2003). These various definitions of environmental justice need to be seen as complementary. This chapter explores how leaderships within the social and environmental struggles have unfolded and with reference to their joint actions. It examines literature on social and environmental struggles as well as empirical material which includes interviews and correspondence conducted by the author with civil society leaders in Dakar, Senegal, in 2011 during the World Social Forum, to understand how leaders deal with grassroots concerns against injustices. The discussion also draws on interviews conducted in 2016 in St Lucia, KwaZulu-Natal, South Africa, to understand civil society leadership opposition to mining development. Common elements and differences are examined within and across the social and environmental struggles presented, in order to understand the nature of civil society leadership and the potential for formulation of an EJF.

30.2 Leadership and Environmental Justice

Leadership has been shown to be crucial for the emergence of an EJF. In the United States in the early 1980s, the success of the environmental justice movement and its leadership was in linking environment, labour and social justice into a master frame to communicate claims, as well as to clarify goals and grievances which forged a powerful environmental justice paradigm (Agyeman et al. 2002; Checker 2002). Similarly, a coalition between environmental and social justice leaderships in Europe against neoliberalism has had mutual benefits (Death 2014). European new social movements have always challenged neoliberal ideologies, whilst criticising hierarchical power structures, inequality and environmental destruction inflicted due to profit (Dagkas and Tsoukala 2011). Thus, environmental justice as an overarching framework can create a discourse to bring together social and environmental activists and employ joint strategies and tactics to address risks collectively.

Unlike the United States and European movements, there are important distinctions in the South African adoption of environmental justice by leaders. For example, in South Africa, this included an emphasis against oppression driven by majority interests, whereas in the United States the leadership emphasis has been on minority interests concentrated in environmental racism (Leonard 2009). Unfortunately, the transition to democracy in South Africa resulted in a loss of civil society leadership to assist in spearheading environmental justice. Many civil society leaders moved into government and corporate structures, creating a calamitous situation in the civil society sector (Leonard 2011). Although 1992 witnessed the formation of a national umbrella organisation called the Environmental Justice Networking Forum (EJNF), to harmonise activities between the social and environmental arenas (McDonald 2002), in 1998 it experienced deterioration when growth led to structural strains which became racialised. It experienced a change from a largely white organisation to a strongly black-led organisation. In 2004, EJNF reduced from 600 to about 400 member organisations (Cock 2004a) and is now no longer operational (Leonard 2011). Thus, a re-examination of the potential of contemporary civil society leadership (as one issue in the range of research matters around environmental justice) in addressing risk collectively is important for the progression of South African environmental justice.

30.3 Exploring Social and Environmental Risks in South Africa

Bond (2005) has previously highlighted the fragmentation of social and environmental issues in South Africa. In 2007, Durban was igniting with protest: informal traders against municipal restrictions (with more than 500 arrests in 1 day); fishermen removed from docks by forces of gentrification; various community groups infuriated about slum conditions and/or pollution; students against financial exclusions; and public sector trade unions striking for decent wages. The misfortune of that moment and many others was the failure to link up the leaderships and their collective causes. Although civil society has the potential to act against macro-economic risks, civil society actions can also be uncoordinated (Leonard 2012; Leonard and Pelling 2010a, b) thus limiting the potential to achieve an EJF. For example,
30.4 Leaderships Within the Social Arena

In this section, leaderships within the social justice arena surrounding housing, land and electricity are explored, before examining leadership coordination of struggles within the environmental arena. The leadership examples mentioned do not cover all struggles; rather a general overview is provided of some of the most important and wide ranging struggles in post-apartheid South Africa, coupled with some site specific cases.

30.4.1 Abahlali baseMjondolo (AbM) Movement: Struggle for Housing and Land

There are misconstrued ways in which some external civil society leaderships (e.g. academics) have engaged with poor communities’ struggles, creating unequal power relations (Bohmke 2010; Desai 2003; Leonard 2009; Madlingozi 2007; Walsh 2008). AbM is a shack dwellers’ movement fighting primarily for housing and land. Although it is located in the informal settlement of Kennedy Road, Durban (KwaZulu-Natal Province), comprising of approximately 7000 residents, it is a national movement and represents the largest organisation of the poor in post-apartheid South Africa organising against the state. Walsh (2008) notes how AbM had been the source of a great deal of academic writing since its formation in November 2005. Some academic/activist leaders were criticised by the AbM for writing about the movement without having a direct relationship with it, which led to the informal settlement disengaging from networking with academic leaders (Leonard 2012). As S’bu Zikode, leader of the AbM noted, “people want to be doctors and professors out of this poverty” (Leonard 2012). It is useful to reference the work of Cresswell and Spandler (2012) and their reference to Antonio Gramsci’s contrast between the ‘traditional’ and ‘organic’ intellectual. The former views social movements as objects of research to be observed and explained, while the latter is located within social movements, producing knowledge for the movement (and not about it and of it). According to Desai (2003) and Fuller (2004), the challenge for academic leaders is how to support the poor without becoming gatekeepers. Nevertheless, despite some good progress from the AbM leadership in fighting state repression such as the winning of a court case in 2016 against two ward ANC councillors for victimisation against AbM members (AbM 2016), internal leadership conflict has beset the movement. In 2009, there was mistrust between AbM members and leaders over how the movement decided on its priorities (AbM 2014a). At an Annual General Meeting in 2010, internal conflicts emerged especially after the election of the new Secretary General, who was alleged to have not respected the democratic processes and directive of the AbM (e.g. engaging with outside communities and giving direction without consent of the AbM). This caused splintering within the movement. Some leaders also garnered fame via social media. Further internal fracturing also resulted when a global human rights establishment offered security support to the AbM as some leaders received death threats after openly speaking against government actions and the problems the movement confronted. However, support was only offered to two leaders for safe houses, whilst another two members who also received death threats did not receive protection (AbM 2014b). These internal conflicts moved the movement away from acting more effectively and collectively against injustices.

30.4.2 Soweto Electricity Crisis Committee (SECC): The Struggle Against Electricity Disconnections

Despite the SECC being one of the notable emerging social movements under the umbrella of the Anti-Privatisation Forum (APF) to respond to electricity disconnections, pressures and divisions have followed this movement. According to Egan and Wafer (2004), the founders of the SECC had preserved influence in the leadership structure, with no direct communication with grassroots at the branch levels in Soweto. Leaders did not reflect the concerns of older women and did not engage youths in SECC issues. Divisions existed between the ‘political’ leadership and the ‘de-politicised’ branches of the SECC. Desmond D’Sa, leader of the South Durban Community Environmental Alliance, noted with regard to South African civil society leadership generally (personal interview 2011):

[C]ivil society is fragmented and because of the fragmentation, it leads to individuals taking the lead […] they are accountable to nobody […] people [at grassroots] taking the lead […] does not happen […] more women need to be at the forefront …
According to Wafer (2008), the SECC leaders have maintained a national and international profile, whilst the branch members share local experiences. Thus, the two scales are separately articulated, networked and politically resourced in contesting state policy. Several branches of the APF walked out of an SECC Annual General Meeting in 2005, citing concerns with centralised leadership. As Madlingozi (2007) notes, a number of prominent leaders of various post-apartheid social movements have exhibited similar views of centralised leadership. The opinion within SECC is also divided on whether to contest local government elections (Wafer 2008), and with the SECC leadership not discussing with branches how neoliberalism affects people’s daily lives (Egan and Wafer 2004). All of these have limited the ability for coordination and coherent actions within the SECC, and for linking up with other social and environmental struggles.

30.5 Environmental Risk Struggles

Unlike the social justice arena, there has not been the emergence of a specific movement to address environmental risks. The case studies below represent specific examples (in urban and rural settings) of how leaders have addressed environmental risks.

30.5.1 Leadership Against Industrial Risks in the South Durban Basin

The South Durban Basin has a history of civic struggle with local communities engaging with the local state and industry to address industrial risks for environmental justice (Charl 2008; Scott and Barnett 2009). South Durban is heavily industrialised and is one of the most polluted areas in southern Africa (Nriagu et al. 1999). Although community leaders have acted against environmental risks, fragmentation amongst leaders has also resulted in divergent actions and strategies. For example, Leonard (2013) examined the ability of civil society leaders in Durban to champion environmental justice. This highlights that new leaders since the transition to democracy were unable to bring local collective action (often due to human and financial resource constraints); individualized approaches existed between some civic leaders for political and financial gain; and there was mistrust caused by some leaders accepting industrial funding. This prevented inter-organizational collaboration between local leaders, including the potential formation of joint constituency engagements. Similarly, within the South Durban Basin, Leonard and Pelling (2010a) examined civil society’s response to industrial groundwater contamination by the German multinational Bayer (now known as Lanxess). In November 2004, Bayer announced the contamination of local groundwater supplies in Merebank, south Durban, with hexavalent chromium. There was mixed engagement amongst local community actors in networking and organising effectively in response to the groundwater contamination. Some community leaders did not engage collectively or with local residents to inform the task team process. Other local leaders relied on a formal technical task team process, including using external technical expertise from NGOs, academics and scientists, and failed to mobilise residents for protest who were vulnerable to environmental risks.

There have also been attempts to analyse the ability of civil society actors and communities to challenge environmental risks in Durban by way of mobilisation and protest action. Case studies include the Mondi incinerator campaign in south Durban dealing with civil society action to halt further air pollution; the Bayer campaign in south Durban dealing with civil society’s response to contamination of local groundwater supply (as above); and the Bisasar landfill in the Clare Estate, Durban, dealing with civil society’s response to a solid waste disposal site (i.e. middle class residents fighting landfill closure and informal shack dwellers living off the landfill) (Leonard and Pelling 2010b). Such mobilisation and protests are best understood in relation to the socioeconomic and political positioning of individuals and organisations. The case studies also highlight competing priorities for individuals seeking to meet basic needs and the economic dependence of community workers on individual industries (such as in Mondi) which reinforced a lack of collective actions, suggesting a wider interpretation of environmental justice to combine the social and environmental struggles.

Industrial contributions to some leadership situations (such as in the Mondi case) has weakened capacity for combined community actions. The living reliance of informal residents on the landfill in the Clare Estate also reduced the willingness of the informal leadership to engage with other stakeholders in joint actions against risks. Additionally, civil society leadership and external actors engaging in climate change work did not consult with the informal settlement. As S’bu Zikode noted (cited in Patel 2000), “We invite them to the presentation here in the [informal settlement community] hall so that we can be together. They didn’t come. They have their meetings in places we can’t go to. They don’t invite us but they always represent us.” Generally, leaders engaging in technical/legal processes weakened engagement with those affected (e.g. the Mondi case where local leaders and legal and technical experts took provincial government to court), which displaced community mobilisation. The Bisasar case observed the formal leader engaging in a technical and legal process with the World Bank; and the Bayer case witnessed local leaders engaging in a formal technical task team process.
30.5.2 Leadership Against Mining in St. Lucia, KwaZulu-Natal

In addition to leadership actions within local communities in urban areas, there are also instances of leadership fragmentation within local communities in rural areas. For example, like many areas across the country, mining development in KwaZulu-Natal is being conducted by mining company Ibutho Coal, for the proposed anthracite ‘Fuleni’ coal mine. The proposed mine location is on the southeastern border of the Hluhluwe-iMfolozi game reserve in Zululand. Although there has been strong local community opposition, a local resident, who is a Ocilwane community activist and leader of the anti-mining struggle, noted divisions between local residents and some traditional leaders which allowed mining development in the area without community consultation (personal interview, 29 June 2016):

I said they [traditional leaders] can’t just do that [allow coal mining in our area] without our consent…that’s where the problem started, then I got some threats from our traditional leaders to say who am I to ask those questions because they are the owners of the place…I said no you don’t own the place…wherever we build our houses we own it so you can’t tell us what to do…we blacks we have cultures and we respect our families and so if you bury someone at a place you must let them rest in peace there and so if someone says they are gonna come and dig them up because they looking for coal…no one can come and tell us what to do in our own place…our Chief’s son was supporting the Ibutho Coal Mine Company…Some [community members] said it seems like we don’t have a chief because he is supposed to be here defending us…

Divisions between local residents and traditional authorities therefore made it more difficult to oppose mining development in the area. As a Ocilwane resident and community activist, noted, difficulties fighting the mining development arose due to internal conflicts within the community with certain traditional authorities (personal interview, 29 June 2016):

So his [Chief’s] son and the board of councils are for the mine to carry on. They are the ones who are making it so difficult for us [the local community] to fight this battle because the first time we met them they were already moving with the mining company group…and now we had to fight against them and the mining company…

Thus, as a result of these local complexities in fighting mining development, joint networking and support between social and environmental activists has not taken place. Within this context, one can refer to Peet and Watts (2004), who question how populist language can be used to articulate between different people, and how this can address environmental justice.

30.6 Summary

The emergence of new civil society leadership in post-apartheid South Africa has not necessarily resulted in joint actions within and between the social and environmental communities, or their struggles for the formulation of an emerging ‘environmental justice framework’ to address macroeconomic risks. The importance of engaging in environmental justice is vital for geographers whose work revolves around understanding environmental change and the interactions between society and the environment. How leaders engage for environmental justice has implications for how industrial risks are addressed in society, which in turn has implications for the environment.

In the social arena, external actors have not adequately supported local civil society in its struggles. For example, personality clashes and divergent ideologies can take place between individuals (Walsh 2008). Internal civil society conflict and divisions have also not assisted in coherent actions to address risks. Nonetheless, leadership is vital in advancing local struggles, in engaging local members and serving the needs of constituencies, and to also ensure formulation of an environmental justice framework. The challenge for leaders is to engage with others within the social and environmental arenas, and communicate to those affected on the interconnections between social and environmental risks. According to Madlingozi (2007), there is a need for communities and social movements to link with others to collectively challenge the system and provide alternatives to capitalism. This will not be easy and will require negotiation between leadership. As Appolis (2004 in Naidoo and Veriava 2004) notes for South African social movements, “I think there is a real basis for working together as social movements […] But […] we have not been able to translate that kind of common identity into real co-operation around solidarity work […] we are going to have to go through lots of processes of common struggles, victories, defeats […] for us to get together.”

References


Geological and Environmental Hazards in South Africa

Jasper Knight

Abstract
Hazardous events can have a variety of origins, but their varied impacts on both physical and human environments represent one of the most significant challenges for resource management and sustainable development in South Africa, and sub-Saharan Africa more broadly. This chapter summarises the different types of geological and environmental hazards affecting South Africa, their causes and controls, and then uses case studies to describe the nature and impacts of some selected recent hazard events. Finally, the chapter considers the future prospects for hazard types in South Africa, in the context of global warming, depleting ecological resources and urbanisation. It is in this integrated and cross-disciplinary context that different hazard impacts can be best evaluated and managed.

Keywords
Climate change · Disasters · Environmental hazards · Geomorphological processes · Sustainability · Vulnerability

31.1 Introduction
A hazard can be defined as any individual event or process that has potential to lead to loss or harm. Geological and environmental hazards are those events that arise from the workings of the natural environment, and as such they can be termed natural hazards. However, the term natural hazards is somewhat of a misnomer, as it could be argued that human activity has now impacted on almost all workings of the natural environment, and thus that all natural hazards are now substantially modified by human actions, either directly or indirectly (Bokwa 2013; Steffen et al. 2007). Geological and geomorphological hazards (contrasted to the term geohazards) are those that are related the operation of physical processes and/or events taking place on or within the Earth’s surface that have their origins in geological or geomorphological processes (Berger 2006). Environmental hazards are subtly different, because they include broader disturbance events taking place in different environments more generally, and affecting multiple elements of different environments. Environmental hazards are commonly those that relate to ecosystems and the hydrological cycle, and disturbance of the land surface. Commonly (but not always), geological hazards have a quick onset and environmental hazards have a slow onset. The most common geohazards and environmental hazards found globally, with particular examples from South Africa, are listed in Table 31.1. For simplicity, Table 31.1 distinguishes between different hazard types, but in many instances they are genetically related as an event cascade, or where the operation of one hazard increases the likelihood of another. For example, earthquakes commonly lead to landslides and debris flows (geological hazards). River floods caused by high rainfall can lead directly to soil erosion, water contamination and disruption of infrastructure; these can lead in turn to increased disease, poverty and societal vulnerability. There are of course many interconnections between different hazard types, and the different terms used for these hazard types unfortunately tend to conceal these interconnections. This may, in turn, undermine the efforts of managers and decision-makers to deal with the wide ranging impacts that hazards can have upon the physical and human environments.

Analysis of hazard types, their causes, risks and risk reduction strategies in South Africa, is also set within a wider international context. A key element includes the Sendai Framework for Disaster Risk Reduction (the latest version covering the time period 2015–2030). In South Africa, the National Disaster Management Centre (NDMC) deals specifically with coordination of hazards and disasters on
national and provincial scales. The South African Risk and Vulnerability Atlas (SARV A 2008), developed in part by the NDMC, was an attempt to communicate the idea of risk and community vulnerability from different hazards to a wider audience. The atlas deals with risk factors of the physical and human environments that can lead to negative hazard impacts, and deals with issues of water resources, agriculture, coasts, biodiversity, and human health. In this context, geological and environmental hazards are the events that lead to potential disaster risk, and are thus explored in this chapter.

### 31.2 Hazards in South Africa

South Africa and sub-Saharan Africa more generally are particularly vulnerable to different hazard types, for a number of reasons (e.g. Alcántara-Ayala 2002). (1) The topography and relief of the land surface in South Africa vary spatially, with mountains and steep escarpments in some places and flat coastal plains in others. Geological hazards such as landslides and rockfalls are more likely in areas of high relief (Table 31.1). South Africa broadly has a semi-arid climate.
and this therefore makes it sensitive to variations of precipitation, over different time scales (annual total, seasonal and event-scale). Precipitation also varies spatially, with different climate systems affecting the eastern and western parts of the country. Eastern areas are more likely to be affected by floods, and western areas by droughts. Such variations in precipitation also have associated negative impacts on agriculture and biodiversity, potable water availability, water quality, hydroelectric power production, sanitation and human health, food security and food prices, amongst others. (2) As a developing world country, South Africa has a high dependency on agriculture as part of its mixed economy, and in rural areas subsistence agriculture is vital for smallholder farmers. The dependence of many rural communities on agriculture makes them particularly vulnerable to climate changes and hydrological hazards. (3) South Africa’s population is in many cases poor, lacking political leverage, has low resilience and high vulnerability, has low social mobility, low education status, and is in some cases strongly gendered such that women (and indeed other groups) are disproportionately disadvantaged and thus more vulnerable to the effects of hazards (e.g. Akerkar and Fordham 2017). (4) South African society and governance has generally low adaptive capacity, and has low infrastructural resilience, to help cope with hazards and disasters. This has impacted on the capacity of national and regional governments, and other agencies and institutions, to respond effectively to hazards while they are in operation, and to plan for future events. National government and institutions have most influence on disaster management, but managing the impacts and reducing hazard risk is enacted mainly at the local level. Further discussion on disasters and risk management in South Africa is given in the chapter by Culwick.

### 31.3 Examples of Hazard Types in South Africa

Table 31.1 lists a range of geohazard and environmental hazard types, and examples from South Africa (where appropriate). Several examples of hazards are now described in more detail, illustrating the range of impacts on human and physical environments, and their interlinkages.

#### 31.3.1 Floods as Climatic Hazards

Floods are a common hazard in South Africa. Apart from urban flash-flooding and coastal storm surges, the most widespread occurrences of floods result from high event-scale precipitation, in particular on the eastern side of the country, with incoming Indian Ocean cyclones during the austral summer (Alexander 1995). Many recent tropical cyclones have had significant negative impacts on both physical and human environments in northeast South Africa and adjacent areas of Zimbabwe and Mozambique. For example, Tropical Cyclone Dineo (February 2017) was a Category III Tropical Cyclone, and made landfall over southern Mozambique with sustained wind speeds of over 100 km/h and rainfall of <110 mm/day. In this region, official government figures report that 112,207 households and 548,566 people were affected, 33,014 houses were totally destroyed, and 7 deaths were incurred. High rainfall resulted in flooding from the Limpopo River, affecting surrounding communities and agricultural land (IFRC 2017). Previous tropical cyclones of a similar size have also caused significant damage and loss of life in this region, such as those in 2000 that claimed 800 victims in southern Mozambique, and 100 victims in 2015.

Instrumented flood hazard data are available from rivers in South Africa that show very clearly flood responses by different river systems. For example, the Sabie River has its source in high-precipitation areas of the Eastern Escarpment of South Africa, flowing eastward through the semiarid Lowveld to join the Incomati River system into the Indian Ocean. An extreme flood on the Sabie River (~7000 m$^3$ s$^{-1}$) took place in January 2012 following landfall of Tropical Cyclone Dando, and resulted in substantial net erosion along middle reaches of the river (Heritage et al. 2015). The Crocodile River, following the same direction as the Sabie and located in the same climate region, has experienced repeated seasonal flooding over the last decade, in particular in January of 2006, 2009 (Jan/Feb), 2011, 2012 and 2013, corresponding to high rainfall periods (Fig. 31.1). In February 2009, high rainfall resulted in high river discharge, with peak daily rainfall reaching 184 mm on 3 February within the Crocodile catchment. On 5 February 2009, the provincial government issued a flood alert for low lying areas. Communities and road users were warned to be careful when travelling. The floods caused extensive damage in communities and to infrastructure (Fig. 31.2a). In January 2012, seasonal flooding also took place along the Crocodile River. The highest peak daily rainfall was 210 mm (on 17 January 2012) (Fig. 31.1). A flood alert was issued on 19 January 2012 for residents in low lying areas (Fig. 31.2b). This flood resulted in significant erosion within the river system which caused the uprooting and transport of vegetation, and damage to infrastructure (Fig. 31.3). Economic impacts on the tourism sector were estimated at R58 million (Fitchett et al. 2016). Although most floods along river valleys or in lowlands are associated with high rainfall within river catchments, lower rainfall values over longer time periods can also lead to increased flood risk. Likewise, coastal flooding can take place without high rainfall being received. Despite these other situations that lead to flood hazards, climate model outcomes for South Africa projected to 2100 suggest that future rainfall will increase by 85–303 mm per year by 2100, the
The majority of which will fall during the austral summer months. The number of rain events is expected to increase, which may increase the likelihood of flood events, and increase streamflow variability (Schulze 2011).

### 31.3.2 Landslides and Other Land Surface Instabilities as Geological Hazards

In South Africa, landslides and other mass movements are concentrated in areas of steep and therefore unstable land surface slopes, and in particular in areas along the Great Escarpment edge in KwaZulu-Natal and Mpumalanga, and along the Cape Fold Belt mountains (Botha et al. 2016). Landslides and related instabilities such as rockfall, colluvial slope processes and soil erosion are known to have taken place throughout the Pleistocene and Holocene (Romer and Ferentinou 2016; Singh et al. 2008). A recent review by Botha et al. (2016) highlights the relationships between soil erosion due to land use change, colluvium deposition, and climate; examples of different types of land surface instabilities are shown in Fig. 31.4. More recently, studies have used remote sensing to map and monitor changes in the land surface environment, including the distribution of landslides (Diop et al. 2010) and gullies formed by soil erosion (Mararakanye and Le Roux 2012).

Thomas and van Schalkwyk (1993) described some of the varied impacts of slope failure caused by high rainfall and
flooding in KwaZulu-Natal Province. For example, after storms in 1987–1988, 223 different slope failures were recorded on river valley sides in KwaZulu-Natal, largely associated with high rainfall and surface destabilisation but also due to river meander undercutting. Many of these failures took place in association with inappropriate geoengineering activities, including oversteepened and undrained slopes, blocked culverts, and along railway cuttings and embankments. Failure of river bridges took place by loss of structural integrity of surrounding rocks (17 cases directly, 16 cases indirectly), changes of river course (3 cases) or failure of bridge foundations (13 cases). Impacts of these slope failures included substantial structural damage to houses and roads especially around Durban where weathering of Natal Group sandstones results in cohesionless soils. Bell and Maud (2000) analysed the incidents of landslide failures around Durban associated with the 1987–1988 storms, and showed that small-scale landslides are likely to take place when event-scale rainfall exceeds 12% of mean annual rainfall, and major landslides where rainfall is over 20% of mean annual values.

31.3.3 Mining Impacts as Environmental Hazards

Mining for gold and other resources extracted from rocks of the Witwatersrand Basin, northern South Africa, has resulted

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**Fig. 31.2** (a) Extract from a news report on the February 2009 flood along the Crocodile River (Source: iol. News 2009). (b) Extract from a media briefing by the Department of Water Affairs on the January 2012 flood. (Source: Mpumalanga Provincial Government website 2012. Figure adapted from Sauka 2016)
Fig. 31.3 Geomorphology and flood impacts on semi-arid rivers, northeast South Africa. (a, b) Sabie River between flood events, showing (a) sand bars amid bedrock outcrops, (b) shifting sand bars present within and alongside the active channel; (c) Sabie River in flood, where the river level is higher than bridge level (water flow from left to right), (d) same as (c), with more turbulent water flowing over a submerged bridge, with erosion on the down-flow side. Note the dirty colour of the water, which reflects the high sediment transport load, and the woody debris swept to either side of the channel. (e) flood marker on the Klaserie River, north of the Sabie. Note the woody debris trapped 4 m above the land surface in the branches of a tree (red arrow). This indicates the height of the flood. (f) flood impacts along the Sabie, including bank erosion and undercutting of settlements and agricultural land. (Photos a, b, e: Jasper Knight, c, d, f: Wikimedia Commons)
in a range of different geological and environmental hazards. This includes formation of karstic sinkholes and collapse features (largely due to groundwater lowering), induced seismicity, particulate dust pollution, carbon monoxide and methane emissions, uncontrolled fires, and respiratory conditions such as silicosis amongst miners and in local communities (McCulloch 2009; Utembe et al. 2015). These different hazards operate over different spatial and temporal scales and thus their potential impacts on physical and human environments vary substantially. Acid mine drainage (AMD) is a common environmental hazard associated with mining. The chemical processing of mined ore, in order to extract metalliferous minerals, can result in high concentrations of mercury, arsenic, cyanide and other components in waste sediments and water. Contaminated waste water is often contained within storage ponds or bio-filtered through wetlands on site, but may be lost through river outflow or by seepage into groundwater. Groundwater contamination is significant because it can spread underground for long distances, and affect potable water supplies. In addition, rainwater oxidation of pyrites within mine tailings dumps forms sulphuric acid which can cause the dissolution and transport of metals through the profile and into rivers, ponds and groundwater (McCarthy 2011). The result of this AMD is very low water pH, high sulphate concentration, low Eh, and high electrical conductivity (Tutu et al. 2008). In river water, some metals are taken up in riparian vegetation, by the process of bioremediation, but contaminated water has a variety of negative impacts for environmental, biological and human health, largely by increasing toxicity levels within living tissue (Utembe et al. 2015). Furthermore, environmental degradation and contamination of land and water in mining regions negatively impact on the socioeconomic resilience of local communities, making them more vulnerable to be affected by future events (Naidoo 2015).
31.4 Discussion

Geological and environmental hazards that are common in South Africa have different origins, triggers, controls and dynamics, operate over different spatial and temporal scales, affect different environments, and have different types of impacts. These characteristics make it difficult to develop an overarching strategy to (1) monitor or evaluate potential hazards, or (2) deal with the varied potential impacts of hazards on human or physical environments. Furthermore, ongoing climate change is starting to have – and will increasingly do so in future – a role in amplifying the human and physical risk factors that contribute to greater vulnerability (Alcántara-Ayala 2002). Climate change scenarios for South Africa broadly suggest an increase of mean annual temperatures by 2–3 °C by 2100 (relative to the 1975–2005 mean), in particular with a warmer winter season (Li et al. 2013). For precipitation, most climate models predict wetter spring and summer seasons for the eastern interior of the country for the same time period, but drier elsewhere. Winter and in particular autumn seasons are predicted to become drier to 2100. The net effect is thus one of increased seasonality of rainfall by 2100, but its impact on annual precipitation totals is not clear, with some models predicting a net increase but most models a net decrease (Li et al. 2013). The models also suggest significant winter drying in the Western Cape region which lies within the winter rainfall zone. Although these model projections have been considered with respect to water resource availability and agriculture (Odiyo et al. 2015; Tadross et al. 2009), their implications for hazard types, magnitude, frequency and location are largely unknown. For example, changes in rainfall seasonality may lead to seasonal dryness and increased drought risk, whereas increased event-scale rain intensity may lead to increased flash-flooding. Such details are not captured by climate models and are thus an important area of future research.

A further confounding factor in hazard impact management is the role of the human environment. Many studies show that in developing world countries, different socioeconomic, educational, political and cultural factors can contribute to high vulnerability to be affected by different types of hazards (e.g. Adger et al. 2003; Shiferawa et al. 2014). In South Africa, there is also high socioeconomic and political inequality, which further disadvantages poor communities by weakening their adaptive capacity to climate change and climatic hazards in particular (Ziervogel et al. 2014). Thus, considering the physical causes or spatial/temporal patterns of hazards alone may not sufficiently capture their potential to impact human activity, either directly or indirectly. Projected increases in hazard frequency and/or magnitude due to climate change (e.g. Alfieri et al. 2017) can contribute to long-term environmental degradation and thus compromise sustainable development (Biggs et al. 2015). Understanding of the causes and effects of different hazards, and managing these effectively, therefore underpins national strategic development goals over the next decades and beyond.

31.5 Summary

Different hazard types and their varied impacts can act to have a multiplier effect on already-vulnerable communities in South Africa. Climatic hazards are already increasing in frequency and magnitude due to global warming, and this is likely to have significant secondary hazard impacts in South Africa through changing precipitation patterns, influencing future water and food security and environmental degradation. Although some hazards are better understood than others in terms of their forcing mechanisms and controls, it is still unclear how different hazards are interconnected or their relationships to human activity. This is an important area of future research for hazards and disaster risk in South Africa.

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Disasters and Disaster Risk Management in South Africa

Christina Culwick

Abstract

The connection between sustainable development and disaster risk reduction is widely accepted. Rapid urbanisation and climate change are both likely to increase the frequency and intensity of disasters, with the urban poor in the Global South at greatest risk. South Africa faces the dual challenge of addressing post-apartheid developmental challenges and increasing disaster risk from climate change and urbanisation. Despite this challenge, South Africa’s disaster risk reduction legislation is globally praised for its strong focus on proactive risk reduction rather than disaster response and recovery. Disaster risk management includes developing an understanding of hazards, reducing disaster risk, and developing capacity to cope with disaster impacts. This chapter uses case studies from South Africa to present the context of natural disasters and how disaster risk management is evolving. It explores how disaster risk management in South Africa can be enhanced through learning from past disasters, ‘building back better’, anticipating and preparing for future disasters, mobilising community-based adaptations, and using mobile technology and social media.

Keywords

Climate change · Disaster risk reduction · Everyday risk accumulation · Sustainable development · Urban environments

32.1 Introduction

In recent years, the number of disasters reported around the world has increased (UNISDR 2015). This increase has been attributed to changes in climate as well as general population and specifically urban growth. The damage and losses caused by disasters can undermine efforts towards achieving sustainable development. Thus, managing disasters is critical for achieving sustainable development, particularly in developing countries (the Global South). In addition to this, the growing acceptance of climate change and the associated increase in expected disasters has further strengthened the commitment to building resilience to disasters. This commitment is reflected across recent global agreements, in particular the Paris Climate Agreement (2015), the 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction (2015–2030). The coherence across these different agreements highlights the interconnectedness of climate change, sustainable development and disaster risk reduction. This chapter explores the context of natural disasters and how disaster risk management is evolving, with a particular focus on South Africa.

32.2 Disasters and Disaster Risk Management

A ‘disaster’ is an event that disrupts the functioning of a community and causes or threatens to cause, social, environmental, economic or material losses that exceed the ability of the affected community to cope with the event’s impacts (Holloway 2003; RSA 2003). Disasters can range from slow-onset occurrences, such as droughts, to rapid onset events, such as flash floods. They can also be extreme events at a city or regional scale or everyday localised disasters. While disasters can result from natural or human-induced hazards (Chapter 31), natural disasters, and climate-related disasters in particular, account for the majority of reported disasters.
worldwide (Department of Environmental Affairs 2017). This chapter thus focuses on natural disasters, and specifically those most prevalent in South Africa.

It is important to note that the mere occurrence of a hazard, such as a drought or a flood, does not necessarily lead to a disaster. A disaster occurs when a hazard affects a community that is vulnerable to that particular hazard and where the community has insufficient coping capacity to deal with the impacts of the hazard (Pharoah et al. 2015; van Riet 2009). Vulnerability and coping capacity are functions of social, economic, governance and environmental factors. Wisner (2017) explores how factors unrelated to volcanic eruptions in Nyiragongo, Democratic Republic of Congo, such as political unrest, lack of democratic institutions, cholera outbreaks, poor healthcare facilities and ineffective land use control mechanisms have amplified the affected communities’ vulnerability to volcanic eruptions. Disaster impacts are also influenced by the extent to which the community has been affected by disasters in the past, and their ability to learn from previous experience both before and in the aftermath of a disaster (Cutter et al. 2008).

There is a growing focus on the accumulation of everyday risk factors that increase the severity of a disaster. Figure 32.1 provides a stark example of two adjacent housing developments on either side of the Kleinjukskei River in northern Johannesburg, Gauteng. While the two communities have nearly identical exposure to hazards, their respective disaster vulnerability is vastly different. The residents in Cedar Creek Estate (right) are wealthy and have well-constructed houses with basic services and good roads, and residents of this community are likely to have access to insurance and personal transport, all of which increase their coping capacity and reduce their vulnerability. By contrast, residents in Msawawa informal settlement (left) have generally low income and live in informal housing. In addition to poverty and limited income and assets, poor quality housing, lack of basic infrastructure, services and waste removal, high population density, and poor and narrow roads are some of the everyday risk factors that accumulate and exacerbate their disaster risk. Research shows that everyday hazards and disasters are responsible for the greatest damage and losses in urban Africa, but despite this, many of these disasters are too small to be recorded or to trigger national responses or meet the minimum criteria of international databases (Adelekan et al. 2015).

Fig. 32.1 Msawawa informal settlement (left) and Cedar Creek Estate (right) on either side of the Kleinjukskei River in northern Johannesburg, Gauteng. (Photo: Christina Culwick)
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32.2.1 Disasters in Cities in the Global South

Cities are considered highly vulnerable to disasters due to a range of factors including high population densities, and the concentration of buildings, infrastructure and social amenities that stand to be damaged by disasters. Urban developments such as roads, concrete surfaces and built up areas have changed the natural landscape, and these changes affect how heat is absorbed and how water flows through cities (Bull-Kamanga et al. 2003). Hard surfaces prevent rain from being absorbed into the ground, thus increasing the likelihood of floods, and artificial surfaces absorb more heat than vegetation does, making cities hotter than rural areas (a process known as the ‘urban heat island effect’), and exacerbating heat-related disaster risks. Poor urban planning can further deepen vulnerability to disasters by allowing development in high-risk areas. Figure 32.2 of Lenasia, Johannesburg, provides an example of this where houses were built on a floodplain, thus exposing residents to increased flood risk. In the southern area on the map, the houses (black blocks) have been built over a natural river (blue line) and within both the 2- and 5-year flood lines (dark and medium red respectively). This area is flood prone and it has been affected by numerous recent floods, some resulting in fatalities (eNCA.com 2017; City of Joburg 2017; News24.com 2014).

Despite the negative consequences of urban development, cities provide critical infrastructure and amenities such as emergency services and healthcare facilities that are invaluable in the event of a disaster. Cities thus simultaneously contribute to disaster risk whilst also providing necessary coping capacity. Urbanisation is occurring fastest in cities in the Global South and many of these cities are unable to keep pace with the demand for housing, infrastructure and services. In addition to typical urban risk factors (described above), the proliferation of informal houses, inadequate infrastructure and poor access to basic services further increase risks to health and wellbeing. Because of high population density in Southern cities, disasters tend to result in greater numbers of fatalities and damage than equivalent events in the Global North (El-Masri and Tipple 2002; Seneviratne et al. 2010). Climate change is expected to expose even more people to climate hazards in the Global South, thus further worsening disaster risk (Adelekan et al. 2015).

Fig. 32.2  Urban development within flood zones in Lenasia, Johannesburg. (Map produced courtesy of Khanyile and Maree, 2017)
Disaster risk is not evenly distributed across cities, with the urban poor widely considered most vulnerable. However, income is not the only factor influencing vulnerability and low coping capacity. Van Riet (2016) flags that the recovery time for people living in social housing is much shorter than those living in informal housing, despite similar income and employment statuses. Informal settlements are particularly at risk from disasters because they are densely concentrated, which can allow fires to spread quickly. Further, new houses or developments can block escape routes and limit access for emergency vehicles. People in informal settlements have limited access to urban services and amenities, and they are often located in marginal or vulnerable areas (e.g. flood-plains, steep hillsides and near waste dumps) (Douglas et al. 2008; O’Brien and Leichenko 2000; Vogel 1996). The poor also have fewer resources and lower coping capacity than wealthier communities who typically have greater access to transport, communication technology and insurance, and have higher education and adaptive capacity as a result (Salami et al. 2017).

### 32.2.2 Disaster Risk Management

Disaster risk management includes building an understanding of hazards, reducing disaster risk, and developing the capacity to cope with disaster impacts. Disaster risk reduction both locally in South Africa and globally is strongly guided by policy, and is explicitly linked to commitments to achieving sustainable development and reducing climate change impacts. In fact, disaster risk reduction is considered a precondition for achieving sustainable development, and in particular sustainable urban development (Department of Environmental Affairs 2017; UNISDR 2015). The Sendai Framework for Disaster Risk Reduction (2015–2030) is a global policy agenda which was signed in 2015 by 187 states, including South Africa. It provides a set of goals and actions to guide what should be done to reduce the impact of disasters and to build resilience to future hazards (UNISDR 2015). The Framework explicitly draws connections between poverty alleviation, sustainable development and disaster risk reduction (Aitsi-Selmi et al. 2015). Cities in the Global South face the double burden of addressing poverty and development whilst also managing disaster risk, and thus it is important to find ways to achieve these objectives at the same time (Adelekan et al. 2015; UNISDR 2015).

The Framework also emphasises the importance of collaboration and coordination between government departments, agencies and non-government actors including communities. Data and research, including community and indigenous knowledge, are identified as critical for developing policies and plans to reduce disaster risk. It further emphasises the cost-effectiveness of proactively managing disasters to prevent rather than merely recovery from disasters. Land use policy and management, and in particular the use of ecosystem-based approaches to land management, are identified as important tools in limiting the impacts of natural hazards. Many of these actions require the necessary finances to be made available to include consideration of disaster risk reduction in development plans and projects (UNISDR 2015). The traditional approaches to disaster management have focused on technical solutions such as monitoring hazards, building infrastructure and developing early warning systems. While these actions are important, they ignore everyday risks and how these can compound each other in complex and sometimes unpredictable ways (Bull-Kamanga et al. 2003). Thus, it is also important to incorporate non-technical solutions and community-based adaptation strategies.

### 32.3 South Africa’s Disaster and Disaster Risk Reduction Context

South Africa has a semiarid climate that can be highly variable. This makes the country prone to a range of natural hazards including droughts, intense storms and floods (Department of Environmental Affairs 2017). In the past few years, the country has faced a range of disasters that have caused significant damage and loss, including widespread flooding in Limpopo Province (McDonald 2013), wildfires in Knysna, Western Cape (Gosling 2017), and a multi-year countrywide drought that affected the Western Cape most acutely (Ziervogel 2017). In addition to South Africa’s natural climate variability, the existing disaster risk is likely to be exacerbated by climate change. Between 1931 and 2015, South Africa’s average temperatures have risen at double the rate of the global increase. The country also experienced an increase in extreme daily rainfall events, which is linked to these temperature changes. South Africa’s warming is likely to continue at a similar rate even if greenhouse gas emissions are significantly reduced (Department of Environmental Affairs 2017). Climate change models project that if greenhouse gas emissions are not reduced significantly (low mitigation), South Africa will experience a drastic increase in heat waves and will become generally drier. There will be a likely increase in extreme thunderstorms (Department of Environmental Affairs 2017). Higher temperatures and drier conditions will worsen drought and wildfire risks, and the changes in extreme rainfall events will increase flood and storm risk. The South African national government has identified drought, flood and wildfires as priority hazards for disaster risk reduction, but has also flagged that lightning, heatwaves, hail, wind and sea-level rise also pose significant threats (Department of Environmental Affairs 2017).
These natural climate risks are exacerbated by South Africa’s high levels of poverty and inequality, rapid urban growth, and the lingering social and spatial impacts of apartheid. In addition to meeting the growing demand for services and infrastructure, South Africa faces the challenge of ensuring that people who were underserved during apartheid now receive adequate levels of service. The national government has identified informal settlements as priority focus areas because they are likely to be where future population growth concentrates, and they are also where everyday risk accumulation is most acute. Despite the significant benefits of ensuring people have access to adequate housing (van Riet 2016), there are persistent reports of social housing being built within low-lying, flood-prone areas and not built to a quality that will withstand hazards, thus placing poor people at greater risk of disasters (Deklerk 2011; Koza 2017; van Riet 2016). The immediate pressure to provide housing and basic services to a significant number of people has overshadowed the longer-term imperatives of building ‘disaster proof’ developments (Pharoah et al. 2016).

Disaster risk reduction in South Africa is strongly guided by legislation. The Disaster Management Act (2002) lays the foundation for disaster risk reduction in the country, and the National Disaster Management Framework (2005) provides details on the development and implementation of the Act for all levels of government. The Disaster Management Amendment Act (2015) was recently adopted to update the 2002 Disaster Management Act with new commitments including climate change adaptation, and adjustments to minimise some of the challenges that were experienced in implementing the original Act. These changes encourage the government to incorporate climate change projections into disaster risk management. The City of Cape Town, for example, has used climate change projects to update strategic planning in the Salt River catchment to minimise future flood risk (Ziervogel 2017).

South Africa’s disaster risk reduction legislation is considered progressive across the world because of the strong emphasis on prevention, mitigation and preparation, rather than purely response and recovery (Botha et al. 2011). Despite this, the dominant approach to disaster management in the country has been reactive rather than proactive. This approach has resulted from a range of factors. Some things that contribute to disaster risk, including everyday risks (e.g. healthcare, housing, roads), are beyond the mandate of disaster risk departments. It is thus easier for disaster management departments to focus their attention on those elements where they have control, namely disaster response. There are also financial trade-offs between building houses and infrastructure to meet the scale of the current demand, and the additional cost-burden of ensuring that these developments are resilient to disasters (Pharoah et al. 2016). Disaster risk is often seen as an added bonus if there is additional funding available, but is often excluded because it is perceived as expensive.

Despite these challenges, there is a renewed commitment in South Africa to ‘no regret’ interventions that work to minimise disaster risk and the associated unexpected costs arising from disaster response and recovery. This commitment includes ensuring that low-cost housing is built according to disaster management principles (Department of Environmental Affairs 2017). While this approach may cost more initially, developments that can withstand the worst-case scenarios will reduce long-term costs and impacts if a disaster occurs. This approach relies on identifying high-risk areas and applying effective land use planning to ensure that there are no new developments in these areas (Department of Environmental Affairs 2017). While it may be cheaper to anticipate risk than to rebuild after a disaster, political will is often stronger in post-disaster response than in pre-emptive development planning (Cutter et al. 2015).

### 32.4 Enhancing Disaster Risk Management

Enhancing disaster risk reduction requires a better understanding of disasters. Understanding future risks and past impacts can guide plans to reduce disaster risk and increase coping capacity in the event of a disaster. The following sections focus on important considerations for each of these objectives.

#### 32.4.1 Developing a Better Understanding of Disaster Risk and Impacts

A range of models has been developed to assist with understanding the interconnections between the factors that can lead to or exacerbate disasters. Whilst these models can be very useful in helping develop strategies and assess risks, models at a city scale by necessity provide broad-scale assessments, thus losing information regarding community-scale risks. Despite the importance of individual risk accumulation for disaster risk, it is not feasible for government to gather and monitor this level of detail. The case of flooding in Touws River, Western Cape, shows how social issues such as drug abuse and unplanned pregnancies, in addition to broad institutional changes, economic decline and environmental changes, significantly increased individual flood risk (Zweig and Pharoah 2017). Gaps in data also create problems for effective disaster risk reduction. For example, a recent report identified that some of the worst affected towns in a recent spate of flooding in the Western Cape are located outside the range of the current weather radars (Pharoah et al. 2016). This meant that heightened flood risk could not be identified and warnings could not be communicated to
those who faced the greatest risk. This highlights the importance of improving data collection as part of anticipating disasters.

Assessing the impact of past disasters is important for managing post-disaster recovery and rehabilitation, but also for identifying areas of highest risk and limited coping capacity. However, the total impact of disasters can be difficult to assess, especially at the individual and household levels. Gathering disaster impact data is typically used to guide disaster aid and recovery efforts. Recent legislation has tightened the requirements for those who can access disaster recovery funds, which has had the unintended consequence of reducing the quality of disaster impact data (Pharoah et al. 2016). Incentives such as insurance and financial aid influence the type and quality of disaster impact data that are gathered. It is thus unsurprising that data are poorest in informal settlements, where few people have insurance or other incentives to report their disaster-related losses or damages.

These data challenges highlight the need to draw data from a range of sources including scientific, government and community knowledge. South African disaster risk legislation has highlighted the importance of including indigenous and community knowledge into planning and decision-making. Van Riet (2016) shows that despite common perception, the poor and those living in disaster-prone areas are highly knowledgeable on the drivers of disaster and are often very creative with potential risk reduction measures, but can lack the financial or material resources to carry out their ideas.

32.4.2 Improving Disaster Responses

Understanding what drives changes in a system can help inform where strengths and weaknesses lie and where adaptive capacity can be developed. Effective disaster risk reduction requires learning from the past, ‘building back better’, and anticipating future risks (Folke 2006; Pelling 2003; UNISDR 2015).

32.4.2.1 Learning from the Past

Learning from past disasters can help minimise risk and also prepare for future disasters. For example, a recent report found that the worst flooding between 2003 and 2014 in the Western Cape did not occur in the rainy season, but rather in the dry summer months. This counterintuitive finding challenges the existing focus of flood preparation for the rainy season and suggests that stormwater maintenance should instead be continued throughout the year (Pharoah et al. 2016). Past disasters can also help to identify who and what are vulnerable and where coping capacity needs to be improved. In 2013, a hospital in Somerset West, Western Cape, was evacuated because of extensive flooding. This showed the vulnerability of healthcare facilities more generally, and subsequently, plans have been made to minimise this vulnerability and to enhance the ability of all healthcare facilities in the province to deal with disasters (Pharoah et al. 2016).

Although past experience is an important way to help prepare for the future, too much reliance on past trends as indicators of future risk can exacerbate disaster impacts, particularly because climate change is projected to increase the frequency and intensity of extreme events. An example is the recent drought in the City of Cape Town. After two consecutive years of below-average rains, based on past records, the likelihood of a third dry year was deemed to be very low. The city thus decided not to take aggressive action to address the drought conditions because of the high cost and perceived low risk of this step. However, the following rainy season was drier than hoped and the city’s delayed drought alleviation action has exacerbated the drought. Figure 32.3 shows the drought-affected Berg River Dam in the Western Cape in 2016, the second of three consecutive years of below-average rainfall.

32.4.2.2 ‘Building Back Better’

‘Building back better’ is a key principle for developing resilience in post-disaster areas. Ecosystem-based adaptation has emerged both locally and globally as an approach towards disaster risk reduction. Ecosystem-based adaptation incorporates ecological systems such as trees, grasses, wetlands, green open spaces, planted pavements (bioswales) and green roofs to help reduce the impacts of disasters and climate change. For example, ecological systems can help reduce heatwave impacts by providing shade and reducing urban heat island effects. They can also minimise flooding by slowing the flow of stormwater and allowing water to sink into the ground. Ecosystem-based adaptation principles were adopted in a flood relief scheme in Atlasville, Ekurhuleni, Gauteng. Figure 32.4 shows the Atlas Spruit riverbed and floodplain which was deliberately designed to support stormwater infrastructure using the natural ability of the river to reduce flooding. This scheme not only reduced flood risk, it also improved the public park and increased biodiversity within the riverbed. While ecosystem-based adaptation is not a panacea for disaster risk reduction, it provides an opportunity to achieve developmental and risk management objectives.

32.4.2.3 Building Capacity to Anticipate and Respond

The growing risk of disasters places importance on the role of anticipating disasters, and in reassessing what is ‘normal’. Climate change will likely increase the frequency of extreme events and thus design standards and preparation need to
take these changes into account. For example, design standards for urban development may need to change to accommodate larger flood events, because in the future what is currently a ‘one in 100-year flood’ will likely occur more frequently than in the past.

Advancement in mobile technologies and development of social media provide significant opportunities to enhance how disaster warnings are communicated. The high level of mobile phone penetration in South Africa, together with innovations in mobile phone communications, provide real opportunities to enable targeted early disaster warnings via text message. Figure 32.5 provides an example of how the City of Johannesburg has used permanent signage to warn people about a permanent flash flooding hotspot in Diepsloot, in a range of languages. The City also uses social media platforms such as Twitter to warn residents of emerging disaster risks, such as flooding in Lenasia. However, sole reliance on technology may exclude the poorest groups who cannot easily access the internet or mobile technology, but who are likely to face the highest disaster risk.

32.4.2.4 Role of Local Community-Based Adaptation

Because risk assessments and disaster risk reduction measures cannot target individual and household-scale risk factors, communities play an important role in enhancing disaster risk reduction at this scale. Policies have been developed to exploit local and indigenous knowledge in informing disaster risk strategies. Communities can also build coping capacity by working together to share disaster risk information as well as ways to reduce risk. Local communities can fill gaps in knowledge where formal disaster risk data are absent (Satterthwaite 2017). If unified, community capacity can strengthen the political voice of a community and compel the local municipality to take their local disaster risks seriously (Fatti and Patel 2013). This is particularly important for marginalised groups who tend to be at greatest risk of disasters, and who are further disadvantaged by their limited ability to mobilise government action.

The FLOW programme in the Bergrivier municipality, Western Cape, provides an example of how community
capacity to manage both everyday risk accumulation and extreme natural disasters was enhanced. This involved an extended 2-year training and mentorship programme with youth in the municipality. After the programme, the community had engaged meaningfully with a range of factors that contribute to their risk profile: they developed skills and locally-specific knowledge (such as mapping their local water and sewage systems) that empowered them to minimise risk and also built capacity to adapt to changes and disaster risk. This type of embedded community engagement is likely to support and sustain long-term benefits for the municipality (Ziervogel et al. 2016). This is a model that could be replicated elsewhere in South Africa.

32.5 Summary

Disasters undermine progress towards sustainable development, thus understanding and managing disaster risk is important. Cities face the highest risk from disasters because urban development constrains the ability of natural systems to absorb the impacts of disasters, and high population density increases the number of people exposed to hazards. Cities in the Global South face the highest disaster risk because of the intersection of developmental challenges and high population densities. South Africa confronts the dual challenge of addressing post-apartheid developmental challenges and increasing disaster risk from climate change and urbanisation. South African disaster risk reduction strategies have identified people living in informal settlements as an important focus because their everyday risk accumulation and high exposure to hazards makes them particularly vulnerable to disasters. Despite these challenges, if South Africa can implement its globally-esteemed disaster risk legislation effectively, the country stands to be a global leader in disaster risk reduction in the face of multifaceted disaster risk drivers. This will require collaboration and coordination across and within different levels of government, and between government and local communities, as well as the adoption of ecosystem-based adaptation, innovative data collection, mobile technologies and community-based adaptation to minimise everyday risk accumulation and reduce overall disaster risk.

References


Department of Environmental Affairs (2017) South Africa’s Third National Communication under the United Nations Framework Convention on Climate Change (Draft). Department of Environmental Affairs, Pretoria, p 752


Fig. 32.5 Flood warnings issued by the City of Johannesburg. (a) Permanent signage near a flash flood hotspot in Diepsloot (Photo: Christina Culwick); (b) Tweet from the official City of Johannesburg Twitter account warning of flooding conditions in Lenasia, 30 December 2017 (City of Joburg 2017)
for Disaster and Risk Reduction, Department of Geography and Environmental Studies, Stellenbosch University, Stellenbosch, 28pp
Republic of South Africa (RSA) (2002) Disaster Management Act
Republic of South Africa (RSA) (2015) Disaster Management Amendment Act
South Africa’s Future Climate: Trends and Projections

Mark R. Jury

Abstract

The climate of South Africa is analyzed for trends and variability using observations 1980–2016 and IPCC-validated model-simulations up to 2050, as atmospheric greenhouse gas concentrations rise. Results show that air temperatures have increased by 0.02 °C/year in this time period, and may warm more quickly by 0.03 °C/year in future. The South Atlantic anticyclone is moving poleward and causing more southeasterly winds, so the pre-existing moist-east/dry-west weather pattern across South Africa is accentuated. Observed rainfall shows little overall trend except near Cape Town where drier conditions correspond with enhanced coastal upwelling. Model projections for rainfall to 2050 show slight decreasing trends, except for the eastern coastal plains. Cycles of droughts and floods that affect water resources are expected to continue and this variability may overshadow the gradual and long-term effects of climate change in South Africa.

Keywords

Climate change · Climate models · Extreme weather events · Meteorology · Ocean circulation · Weather patterns

33.1 Introduction

South Africa’s high elevation and subtropical latitude impart a semiarid climate with a distinct annual cycle. Easterly winds from November to March draw humid air from the warm southwest Indian Ocean and its Agulhas Current. Westerly winds from April to October bring dry air from the cool South Atlantic Ocean and its Benguela Current. The eastern half of the country receives ample rainfall except when drought occurs during the Pacific El Niño (Dieppois et al. 2015). The resulting fluctuating availability of water resources induces multi-billion Rand swings in South Africa’s agricultural sector (Jury 2002). Alongside the Pacific El Niño influence, sea surface temperatures over the tropical Atlantic and Indian Oceans (Reason et al. 2006) and local vegetation cover and air chemistry alter the water cycle and radiation budget (Hobbs 2000). The western half of South Africa is also vulnerable to encroachment by the Kalahari Desert (Tyson and Preston-Whyte 2000). Thus, understanding and anticipating future climate changes can help management of sustainable crop yields, fishery resources, and divert negative impacts that climate change and variability can have on the physical and human environments. The scientific tools and knowledge of the climate system have matured such that climate trends can be well documented and simulated, and reasonably well extrapolated or projected.

Understanding trends in past and future climate can assist resource management and underpin strategic planning for sustainable development. Past research has found trends of ~0.02 °C/year in observed temperature (Kruger and Shongwe 2004; Morishima and Akasaka 2010) consistent with global averages, but trends in rainfall are often described as minimal or ‘patchy’ (MacKellar et al. 2014; Tadross et al. 2005) due to both its uncertain sign (positive or negative) and spatial variability. The main objective of this chapter is to analyze the patterns and rates of change in past observed and future projected climate over South Africa, to 2050.

33.2 Data and Methods

South Africa is well endowed with weather observations (Fig. 33.1a) and ship reports, supplemented by global satellites since 1980. These climate inputs feed into data
assimilation systems that provide the gridded products employed here. During the 35 year period (1980–2015), global greenhouse gases have risen by 2 ppm/year. Industrial emissions of greenhouse gases in South Africa now exceed 600 M T/year (Bekker et al. 2008), and agricultural emissions of greenhouse gases from Africa as a whole exceed 1350 M T/year (Semazzi and Song 2001; Sinha et al. 2003).

The data used here to establish climatic trends (abbreviations listed in Table 33.1) include CRU3 temperature (Mitchell and Jones 2005), GPCP2 rainfall (Adler et al. 2003; Huffman et al. 2009), NCEP atmosphere re-analyses (Kanamitsu et al. 2002), and NOAA sea surface temperature (SST) data (Reynolds et al. 2007). These global datasets have been carefully assembled, quality-controlled and validated as outlined in Harris et al. (2014). Annual averages were subjected to linear regression, as in earlier work (Jury 2013), to determine the trend (or slope) over the period 1980–2016. These results are then spatially mapped over South Africa and adjacent seas (over the spatial domain 35–22°S, 16–33°E).

To understand the future climate, outputs from the 25-model CMIP5 ensemble-average using the medium-value Representative Concentration Pathway (RCP) 6.0 greenhouse gas forcing (van Vuuren et al. 2011) was analyzed for the period 1980–2050, based on the procedure used by the Intergovernmental Panel for Climate Change (IPCC). For

Fig. 33.1 Linear trend 1980–2015 in: (a) CRU3 surface air temperatures (°C/year), with weather stations (grey squares) and dashed sub-area for time series, (b) GPCP2 rainfall (mm/day/year) and elevation contours, (c) NOAA sea surface temperature (°C/year) with place names, (d) NCEP 1000–850 hPa wind vectors (m s⁻¹/year). Areas of weak trend are shaded neutral or have small vectors.
Table 33.1 Datasets used in the 1980+ trend analysis

<table>
<thead>
<tr>
<th>Model name</th>
<th>Model name</th>
<th>Spatial resolution (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMIP5</td>
<td>Coupled Model Inter-comparison Project v5 (IPCC validated)</td>
<td>110–220</td>
</tr>
<tr>
<td>CRU3</td>
<td>Climate Research Unit v3 (UEA, Temperature)</td>
<td>50</td>
</tr>
<tr>
<td>GPCP2</td>
<td>Global Precipitation Climatology Project v2</td>
<td>100–250</td>
</tr>
<tr>
<td>HADLEY2</td>
<td>Hadley v2 coupled GEM – earth system model</td>
<td>180</td>
</tr>
<tr>
<td>NCEP</td>
<td>National Center for Environmental Prediction v2 Reanalysis</td>
<td>180</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration land and sea surface temperature</td>
<td>5–25</td>
</tr>
</tbody>
</table>

References are listed in text and indicate the input data and interpolation systems.

33.3 Results

33.3.1 Observed Trend Maps

Surface air temperatures display overall increases of >0.02 °C/year (Fig. 33.1a) over recent decades (1980–2016). The rate of warming is greater over the northern part of South Africa and in the west near Cape Town, consistent with Kruger and Shongwe (2004). Trends are slightly weaker in the area of the Free State/Eastern Cape provinces between Bloemfontein and Port Elizabeth, due to the circulation trends described below. Observed rainfall trends (Fig. 33.1b) show little change over this time period, however there is an underlying pattern of slightly wetter conditions in a NW-axis across the interior, and drier conditions over the east and southwest coasts. Offshore, the SST is warming rapidly in the shelf-edge Agulhas current (by 0.03 °C/year; Fig. 33.1c), consistent with Rouault et al. (2010). In contrast, inshore waters west of Port Elizabeth exhibit coastal upwelling and cooler SST in this period.

Atmospheric circulation (Fig. 33.1d) shows a trend of easterly winds that is related to the South Atlantic high pressure cell. The easterly trends spiral around a cyclonic centre over the Western Cape and continue over Namibia producing offshore air flow. In the latitude band ~30°S over the Kalahari plateau, westerlies have increased in strength. There is also a trend towards offshore easterly flow over the Western Cape that contributes to warm and dry weather in this area. Over the Eastern Cape coast the surface wind trends are onshore, so temperature trends are suppressed and rainfall is increased. The anticyclonic ridge associated with the South Atlantic high is shifting poleward, deflecting rain-bearing winter storms, so summer climatic conditions exist for a longer period than before.

33.3.2 Temporal Features and Projections

The annual cycle of temperature and rainfall (Fig. 33.2a, b) in observations (1980–2016) and IPCC-validated model simulations indicates that the models over-predict wet conditions in South Africa (likely due to coarse model resolution, which overemphasizes the effect of the Drakensberg mountains), but the observed temperatures lie between the simulated and projected CMIP5 annual cycle. Temperatures increase ~1 °C/ rather evenly across the seasons in both the observed and modelled datasets. The annual cycle of rainfall shows a decrease in February, but otherwise little change.

Area-averaged time series (Fig. 33.2c, d) demonstrate that fluctuations in observed rainfall tend to overshadow the longer-term trends, largely due to El Niño-induced drought (Dieppois et al. 2015). The model projection under a gradual doubling of greenhouse gases in the period 1980–2050 shows a warming rate of 0.028 °C/year, while area-averaged rainfall trends are downward (the trend covers 12% of total variance, r²). It is evident that the slope in past observations is close to the model projections, when averaged over most of South Africa.

33.3.3 Extreme Events

Examples of spatial patterns of a recent warm spell and wet spell are given in Fig. 33.3a, b. In the warm spell, land surface temperatures in January 2015 reached 60 °C in the Kalahari, affecting cities like Bloemfontein. In the wet spell, heavy rainfall in January 2010 was concentrated in the area between Johannesburg and Durban (>150 mm/day). The Hadley v2 model projected changes in warm spells and wet spells up to 2050 (Fig. 33.3c, d) suggest an increase in the...
former over the Kalahari (>1 day/year) and the latter east of the Drakensberg. The 2013 IPCC report (Collins et al. 2013) confirms this spatial pattern trend toward wet-east/dry-west, corresponding with the windward/leeward effect of increasing easterly winds.

### 33.4 Climate Drivers and Impacts

As the South Atlantic high pressure cell shifts and expands poleward, it deflects winter storms and draws the Benguela ecosystem and its coastal upwelling to the southwestern Cape. The high pressure cell also drives air-flow onto the southeast coast, keeping temperatures steady on the south coast near Port Elizabeth, despite warming of the offshore Agulhas Current. Surface air pressure trends across the southern hemisphere (Fig. 33.4a, b) reveal that the poleward shift of subtropical anticyclones is seen on a global scale, and is expected to continue in future (Collins et al. 2013).

One key impact of climate change is a rise in sea level that contributes to coastal erosion in South Africa. This global effect is accelerating (Fig. 33.4c) due to thermal expansion of tropical waters and the melting of polar ice over Greenland and Antarctica. The rate of sea-level rise has changed from 0.2 cm/year in the past to >0.5 cm/year in future, so by 2050 a sea surface height 1 m above the 1980 level is likely. Coastal development will face problems especially during wave-driven storm surges (Fig. 33.4c inset) that can occur throughout the year.

Climate change may accelerate the hydrological cycle and consequently evaporation (Collins et al. 2013). Temporal fluctuations in the water balance over South Africa (Fig. 33.5a) show a net surplus in the 1970s and net deficit in the 1980s and early 1990s. Prolonged drought in 2015 affected many parts of South Africa, leading to water restrictions in Cape Town and Zululand. Drought and flood cycles, as projected by the Hadley v2 model, will continue and without much change in amplitude. The trend map for river runoff projected by the CMIP5 model ensemble-average (Fig. 33.5b) suggests a deficit on the Highveld and surplus in KwaZulu-Natal regions. The model projections show little change in the Western Cape, where runoff is already rather small. One of the reasons why climate change may benefit the Tugela River instead of the Vaal River is that intensifying easterly winds bringing moisture from the southwest Indian Ocean are ‘shallow’ and deposit their rainfall east (rather than west) of the Drakensberg escarpment (Fig. 33.5c). Plans for future development may be constrained by the expected eastward shift of water resources.
Past observations in the period 1980–2016 and model-simulations up to 2050 suggest that the rate of warming will accelerate from 0.02 to 0.03 °C/year. Poleward expansion of the subtropical ridge and attendant southeasterly flow is expected to accentuate the pre-existing moist-east/dry-west climate of South Africa. Although rainfall shows little overall trend, drier conditions near Cape Town, reduced runoff into the Vaal River, and increased flood frequency over KwaZulu-Natal suggest the need for improved water transfers and weather forecasts. Cycles of droughts and floods are expected to continue and may overshadow the gradual effects of climate change. Greenhouse gas emissions can be reduced whilst still growing South Africa’s five-trillion Rand economy (in 2015 values). This might be done by (1) realizing the problem, (2) applying technological innovation, (3) adapting where necessary (i.e. moving settlements and infrastructure to higher ground), and (4) mitigating the adverse effects of climate change. Improved summer rainfall forecasts have already reduced the impacts of drought and flood (Landman et al. 2017; Ziervogel et al. 2014). Renewable energy resources are becoming increasingly competitive, and South Africa has opportunities to tap the potential of wind, marine and solar energy. Water resources are well-engineered, but ongoing municipal-level maintenance of water infrastructure is a key priority. Global warming also coincides with a growing local population: maintaining South Africa’s water quality could be more challenging than water quantity.

Fig. 33.3 Maps illustrating (a) satellite surface temperature during the warm spell 17–24 January 2015, (b) satellite rainfall during the wet spell of 21–31 January 2010, (c) Hadley v2 model projected change in the duration of warm spells (>40 °C), and (d) Hadley v2 model projected change in the occurrence of wet spells (>20 mm/day) up to 2050

33.5 Summary

Past observations in the period 1980–2016 and model-simulations up to 2050 suggest that the rate of warming will accelerate from 0.02 to 0.03 °C/year. Poleward expansion of the subtropical ridge and attendant southeasterly flow is expected to accentuate the pre-existing moist-east/dry-west climate of South Africa. Although rainfall shows little overall trend, drier conditions near Cape Town, reduced runoff into the Vaal River, and increased flood frequency over KwaZulu-Natal suggest the need for improved water transfers and weather forecasts. Cycles of droughts and floods are expected to continue and may overshadow the gradual effects of climate change. Greenhouse gas emissions can be reduced whilst still growing South Africa’s five-trillion Rand economy (in 2015 values). This might be done by (1) realizing the problem, (2) applying technological innovation, (3) adapting where necessary (i.e. moving settlements and infrastructure to higher ground), and (4) mitigating the adverse effects of climate change. Improved summer rainfall forecasts have already reduced the impacts of drought and flood (Landman et al. 2017; Ziervogel et al. 2014). Renewable energy resources are becoming increasingly competitive, and South Africa has opportunities to tap the potential of wind, marine and solar energy. Water resources are well-engineered, but ongoing municipal-level maintenance of water infrastructure is a key priority. Global warming also coincides with a growing local population: maintaining South Africa’s water quality could be more challenging than water quantity.
Fig. 33.4  South polar maps illustrating the trend of surface air pressure (a) ECMWF observed 1980–2016, (b) RCP6.0 CMIP5 ensemble 1980–2050 (hPa/year), (c) sea height observed by AVISO satellite and projected by Hadley v2 model, averaged around South Africa. Inset is the observed mean wave height (m) that corresponds with coastal storm surges.
Fig. 33.5  (a) Area-averaged time series of CRU3 observed and Hadley v2 model-simulated changes in the surface water balance (Precip-Evap), (b) RCP6.0 CMIP5 ensemble 1980–2050 projected changes in runoff (mm/year × 10⁻³), indicating more flow into the Tugela River and less into the Vaal River, (c) mean zonal section of specific humidity (shaded blue) and wind circulation on 28°S (largest vector = 10 m s⁻¹); icons suggest changes in future; topography profile overlain
Acknowledgements  SA Dept of Education SAPSE funding support is acknowledged. Some data were extracted and analyzed from websites: IRI Climate Library, KNMI Climate Explorer and APDRC Hawaii. The SA Weather Service and Dept of Water Affairs are recognized for ongoing maintenance of a sophisticated observing network.

References


New Perspectives on the Discipline of Geography in South Africa

Jasper Knight

Abstract

Geography research and teaching have a long history in South Africa, and Geographers are well placed to engage with issues affecting South Africa in the twenty-first century, including climate change, resource scarcity, poverty reduction and sustainable development. Although different research topics have been investigated previously, others represent some new areas of departure for research in physical and/or human geography, and opportunities for future research growth in South Africa. This chapter identifies and discusses the significance of some of these new topic areas for South African Geography, and the application of such research to address twenty-first century local to global issues.

Keywords

Applications · Development · Heritage · Sustainability · Universities

34.1 Introduction

Geography as a discipline has existed in South African universities for just over 100 years. It was first taught as a university-level topic from 1914 at what is now Stellenbosch University, with the first lecturer in Geography appointed in 1917 at what is now University of the Witwatersrand (Ballard et al. 2016). The context of the discipline in South Africa today is somewhat different to other areas of the world, because of South Africa’s recent historical trajectories of development in the apartheid and post-apartheid eras. These have a strong geographical element because of the impacts of policy and planning in these eras on both contemporary and ongoing demographic and socioeconomic patterns, cultural values and identities, spatial planning and urban/rural development (Christopher 2001; Lemon 2004; Maharaj and Narsiah 2002). Examining the spatial and temporal dimensions of these policies, and their impacts, has long been of concern to Geographers in South Africa, and from different perspectives (e.g. Adam and Moodley 1993; Christopher 2006; Harrison and Zack 2014; Horn 2005; Krige 2001; Myers 2014). Moreover, research in different areas of Geography has helped inform policy and practice in areas such as urban planning, sustainability, resource conservation, energy and transport, food security, water management, protected area management, heritage and conservation. Thus, Geography offers new ways of viewing the past and present in South Africa, and with an application to informing the future. It also specifically integrates aspects of human and physical environments and their connections over different spatial and temporal scales. Such a focus is of particular relevance to South Africa where human evolution and development of the palaeontological, palaeoanthropological and archaeological record has taken place in concert with the physical environment during the Quaternary and Holocene (Knight et al. 2016).

Geography as a discipline therefore offers a framework for wide-ranging narratives on South Africa, its peoples, landscapes and resources. This chapter aims to reflect on some emerging global themes in geographical research and potential areas of future application of these themes to a South African context. The themes discussed are illustrative rather than all-inclusive, and are proposed to generate discussion rather than setting a future research agenda. They highlight, however, important ways in which Geography can be applied to address contemporary problems in South Africa, and the continued relevance of the discipline to the contemporary world.
34.2 Identifying and Dealing with the Future

Although dealing with data from the past and present, Geographers can employ the principle of uniformitarianism to make predictions about the future. Spatial modelling tools such as climate, land surface process, biophysical and hydrological models have been commonly used in this regard, in addition to spatial datasets based on remote sensing and GIS data (Mutanga et al. 2016; Nativi et al. 2015). These models can identify probabilistic outcomes based on different input datasets and with reference to past systems' behaviours. Less certain however are predictions based on narrative scenarios that express cultures, aspirations and values, and thus are more closely related to human geography topics. Three different approaches potentially useful to both physical and human geography topic areas in a South African context are now described.

34.2.1 Future Studies

The discipline of Future Studies (or Futurology) focuses on the prediction of potential integrated futures and often on a global scale. Thus, approaches in Future Studies emphasise different philosophical worldviews that describe the interconnectedness of different world systems (including the physical world) and human societies (Robb 1985). Future Studies tends to take the optimistic viewpoint that many different future scenarios exist and that which pathway is followed is strongly a matter of choice, and that memory, history and causality do not determine any future pathway (Zeitlyn 2015). This viewpoint sees the future as not a deterministic linear path that has been set as a result of past events, but puts human aspirations, technology harnessed for good, and societal cooperation as key elements of future global scenarios. Some studies in this discipline thus focus on social dynamics (e.g. Tonn and Ogle 2002; Vanolo 2016), whereas others are more concerned with identifying and managing potential societal and environmental threats (Coates 2009; Gurå and Ranchhod 2016). Morgan (2015) discusses the subdiscipline of ‘environmental futurology’ and the key role of Geographers in developing this debate. Although this highlights the importance of predictions of future patterns, processes and development constraints that are of clear relevance to South Africa (e.g. Cameron and Katzschner 2017; van der Voorn et al. 2012), Future Studies are not well developed in South Africa at all (Spies 1994). This is clearly important when it comes to better predicting future societal and environmental threats and opportunities.

34.2.2 Foresight Studies

The term foresight has been used in the last decade, mainly by think-tanks and public policy units and in particular in Europe, to identify future strategic and planned outcomes. Foresight Studies are therefore focused on the development of government policy and strategies, and by policymakers and special advisors, rather than by academics. Foresight Studies and Future Studies thus address similar issues but from different perspectives. Activities involved in Foresight Studies include horizon scanning and scenario planning (Cook et al. 2014). The former involves identifying potential risks or threats, or emerging opportunities. The latter involves strategies devised to address the longitudinal evolution of policy and society that culminates in these future outcomes. Foresight Studies therefore focus on (1) identifying future scenarios through modelling or forecasting, (2) planning for managing the properties or situations associated with these scenarios including identifying priorities, and (3) identifying and building networks, by which information can be collected and shared. The latter is closely connected to the Delphi process of professional evaluations by experts on specific topics. Outcomes of Foresight Studies are most commonly policy documents or NGO grey literature reports (e.g. UK Government Office for Science 2011). The process of foresight analysis is now starting to be applied in academic contexts, focusing in particular on managing environmental resources (e.g. Bengston et al. 2012; Prior et al. 2013). It is notable that government agencies and NGOs in South Africa have not explicitly engaged in Foresight Studies (Adam and Moodley 1993).

34.2.3 Anticipatory History

An alternative conceptual approach to viewing future landscape–human relationships in the Anthropocene is that of ‘anticipatory history’, a viewpoint that considers how artefacts within the landscape (landforms, buildings, archaeology) change over time and the ways in which narratives on conservation and management change are superseded or become redundant in the light of such changes (DeSilvey 2012; DeSilvey and Edensor 2012). The imprint of an anticipatory history in the landscape is the landscape palimpsest, by which different ‘layers’ of the history of evolution of the landscape are overlain over time, representing different phases of landscape evolution (Knight 2012). In this way, elements of old landscapes can be preserved, as windows into past environmental conditions or as cultural relics. The concept of an anticipatory history explicitly considers landscapes as transient phenomena, reflecting the ongoing dialogue between past and present, physical and non-physical,
human and non-human (Knight and Harrison 2013). Anticipatory history also speaks to the ways in which local communities and actors respond to their environment and its changes. Thus, a key element in this narrative is the role of memory (both of landscape and of people). Memory and identity are of critical importance in many spheres of life in South Africa especially in a post-apartheid context. Monuments and memorials in the landscape represent the intersection of memory, identity and sense of place, and relate to the physical context or landscape setting of such memories. Several studies have considered the role of monuments and memorials in South Africa in creating, upholding or modifying memory and identity (Knight and Passmore 2018; Marschall 2006a, b, 2008; Meskell and Scheermeyer 2008). Many locations in South Africa can therefore be considered as ‘memoryscapes’, where issues of presence-absence and shifting narratives of power are enacted (e.g. Maddrell 2013; Till and Kuusisto-Arponen 2015). In the context of anticipatory history, DeSilvey et al. (2011, p. 15) state: “Those who make decisions about landscape futures need to be sensitive to how people know the past in place – the dense weave of individual memories, shared experiences, and personally significant landmarks that makes up our understanding of where we are, and where we have been”. Such an integrated approach to people and landscapes, past and present, may be usefully developed by Geographers in South Africa.

34.3 Engaging with Future Worlds:
Geographical Issues in Twenty-First Century South Africa

There are several generic thematic areas of relevance to developing future geographical research in South Africa over the next decades. Some of these areas are now briefly described.

34.3.1 Big Data, Smart Worlds

‘Big data’ refers to large-scale datasets of different types, most commonly digitally collected in an automated way, that have been stored or archived (typically in a cloud) and potentially available for use or analysis by others. Big Data datasets of relevance to Geography can include ecological, climate, remote sensing and GIS datasets. There has been some discussion of the implications of Big Data for research in Geography (Kwan 2016; Miller and Goodchild 2015; Nativi et al. 2015), including who generates, owns and manages such data (Salmond et al. 2017). Advances in remote sensing, network telemetry and spatial and environmental modelling (though both software and hardware development) now mean that the Earth’s surface can be monitored in real time, producing unprecedented volumes of raw data (Hampton et al. 2013; Nativi et al. 2015; Vitolo et al. 2015). Data analysis remains a challenge, however. The use of GIS and remote sensing datasets for environmental monitoring is an area of research strength in South Africa (see review in Mutanga et al. 2016) and, further, there are opportunities to develop these methods into other areas of land surface process and hydrological monitoring and modelling. These spatial datasets can also be used in an epidemiological context for modelling future patterns of environmental change, which may include spread of alien species, hazards, pollutants, health and poverty. Thus, analysis of Big Data datasets can be applied to identify better and more efficient ways of delivering environmental management, resource management, and goods and services. An emerging outcome of Big Data represents analysis of the spatial and temporal data from the Internet of Things, which includes the operations undertaken by mobile devices, sensors, internet-connected electronics, telemetric networks of roads, pipelines, railways and energy systems, healthcare devices, etc. These data types have rarely been exploited by South African Geographers.

An emerging research field in the Internet of Things is the intersection between people and their digital environments – what Sumartojo et al. (2016) call ‘datafied spaces’ – including biomonitoring, tracking and surveillance (Leszczynski 2015; Thatcher 2017). An important research theme is human interaction with the smart city, in which telemetric and digital networks can monitor real-time patterns of traffic, energy/water usage, microclimate, and data/information/communication flows, and can also influence patterns of human behaviour by manipulating the workings of these infrastructure systems. Thus, citizens become active data agents, termed ‘posthuman agency’ by Rose (2017). These interactions between people and datafied spaces are not well known from South Africa (Watson 2014). However, these new types of anthropogenic spaces and human–electronic interactions offer new perspectives on human–environment relationships (Roche 2017).

34.3.2 Predicting and Managing Change

South Africa, located in a semi-arid climatic setting, is sensitive to ongoing global warming which is likely to amplify already existing issues of food and water insecurity (Kang et al. 2009; Zinyengere et al. 2013). Being able to predict and manage future outcomes requires (1) an understanding of what is happening at present and why, and then (2), based on this understanding, development of models to describe future trajectories of change based on past behaviour. In order to achieve such an outcome, baseline monitoring is needed for human and physical systems, but this is generally lacking in
South Africa where data are spatially sparse and often not collected over long time scales (O’Connor 2010). As a result, an approach commonly taken is to extrapolate across space and/or time. For the physical landscape, this approach is problematic because of significant variations in relief across the country which mean there are microclimate effects, and non-uniform spatial patterns of soils, vegetation etc. Predictions of future climate have used such an extrapolation approach across both space and time. For example, CMIP5 and CORDEX AFRICA ensemble climate models have used statistically-downscaled regional climate models (RCMs) to predict future climate patterns of relevance to resource management, such as river flood risk, water resource management and sustainable food production (Graham et al. 2011; Zinyengere et al. 2013). Li et al. (2015) used RegCM4 (an RCM) projections linked to a large-scale hydrological model to examine temperature, precipitation and potential evapotranspiration changes in southern Africa to 2029. Results from this approach show significant spatial variations, with summer and total annual precipitation increases in coastal southeast Africa, increased summer aridity in central areas, but no change in winter rainfall in central areas and on western coasts. All areas will see increases in temperatures, in particular during summer in central inland areas, but with little change on western coastal fringes especially during winter. Eastern coastal fringes have highest increases (1.8–2.0 °C) in all seasons. Such model outputs can provide boundary conditions for future environmental and resource management strategies, but there are potentially large uncertainties that are not well quantified. Predicting and managing change in the human environment in South Africa is framed by the relationships between government (top-down policy-driven, sometimes lacking in strategy) and people (bottom-up, community-based, diverse and shifting). Although some studies have examined the changing nature of this relationship (Khosa 2002; Maharaj and Narsiah 2002), a theme now emerging is that of transdisciplinarity, in which governments and people at different levels work to address single yet complex issues such as housing, poverty and environmental degradation, and often in urban contexts (Goebel et al. 2010; Vogel et al. 2016). This has been a major concern of post-apartheid human geography research. This speaks to both evaluating the impacts of change, and managing this process to support sustainable development (Le Roux and Augustijn 2017; McLennan et al. 2016; Parnell et al. 2007).

### 34.3.3 Valuing Heritage and Culture

Despite the evident diversity of the ‘rainbow nation’, Geographers have not been very active in investigating heritage and culture in South Africa, and many of these areas which are of concern to Geographers elsewhere in the world have been more readily investigated by anthropologists and sociologists in South Africa. This may be because issues of language, culture, identity and ritual are more commonly mixed with contemporary geographical issues in South Africa, as compared to elsewhere. Culture and heritage issues in South Africa are notably politicized and racialized (e.g. Wells 2014), which provide a different and more contested context to such studies, as compared to elsewhere. Apart from the meaning and significance of monuments, memorials and the built environment (Herwitz 2011; Marschall 2006b, 2008), non-material expressions of identity (values, places, language) are now being discussed in the literature (Christopher 2006; Mavungu 2012; Meiring 2008) and with respect to issues such as heritage tourism (Rogerson and van der Merwe 2016).

### 34.3.4 Integrated Environmental Thinking

A key contemporary research and management theme, including in South Africa, is sustainability and sustainable development (Cilliers et al. 2014; O’Riordan et al. 2000; Patel 2014; Shackleton et al. 2011). However, this concept and its applications are not well understood by policymakers and planners (Knight 2015). Several issues relevant to South Africa are conflated into the idea of sustainable development, including urban greening, food gardens and food systems, sustainable public transport systems, and water systems and connectivity. Thus far, most of the discussion of sustainability issues has been focused on urban settings (e.g. Battersby 2013; Koop and van Leeuwen 2017; Myers 2008) and rural environments have largely been ignored despite the importance of rural communities in issues such as economic development, education, sanitation and food. In the context of ongoing climate change and increased resource use, ensuring food and water security requires integrated environmental thinking based on (1) an understanding of the workings of environmental systems (soils, climate, water), (2) accurate models and projections of future behaviour (supply–demand systems), and (3) managing future resource availability through enacting policies and strategies. Elements of these three sequential components have been examined from different perspectives (e.g. Pijpers 2014; Tait and Morris 2000), but there is a lack of integration of these different elements in order to address specific policy goals or to solve practical issues (Cameron and Katzschner 2017; van der Voorn et al. 2012). This is an important future priority for South African Geographers to address. Likewise, discussion of environmental justice, which can be enacted through equitable sustainable development, has not fed through into policy and planning, although some issues of social justice have done so (Myers 2008; Patel 2014).
34.4 Discussion: Whither Geography in South Africa?

Geography, representing the intersection of physical and human environments and their past, present and future relationships, has a unique disciplinary and applied focus. The discipline of Geography has, in South Africa, an unrivalled opportunity to address contemporary issues at the national scale and beyond, around which future research on twenty-first century issues can be focused. The discipline has huge potential to address nationally-important agendas of inequality, decolonization, poverty reduction, food and water security, sustainable development, transport, energy, biodiversity, climate hazard mitigation, ecotourism, risk management, social and environmental justice, bioremediation and environmental degradation, amongst others. However, despite these opportunities, Geography research overall in South Africa remains weak in terms of quantity, quality and impact, despite some areas of excellence. The reasons for this situation, and its solutions, are not immediately apparent (Hammett 2012), but there is an overarching problem in addressing both the local post-apartheid agenda and making research relevant to the global geographical community (Knight 2018). Negotiating between these different drivers, building links between theory and application, human and physical, are issues that Geographers in the twenty-first century must address to government, industry and communities. In addition, diversifying the academy in the context of transformation is also a priority.

34.5 Summary

Geographical research in South Africa has focused on some different areas of physical and human geography, but many other research areas of relevance to South Africa in the twenty-first century are not well developed. This chapter identifies examples of these upcoming research areas, in both pure and applied research topics, and presents some discussion on sophisticated ways of understanding physical and human environments and their intersections. Future research trajectories in South Africa over coming decades may address some of these issues.

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Belated correction received from the corresponding author, Christina Culwick, of Chapter 32 in regards to the expansion of affiliation. The correct affiliation has now been added in the Table of Contents and in the chapter which reads as follows:

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