A settlement-level perspective of the spatial relationship between economic performance and population change in South Africa between 2001 and 2011

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ABSTRACT

Migration has long been an important phenomenon shaping the demographic profile of South Africa, and migration and labour are often considered to be intrinsically linked. The push–pull theory of migration, which still tends to dominate gravity-based migration modelling as well as academic thinking, is grounded on the assumption that migration is a functional and inevitable outcome of spatial inequality. Economic drivers of migration are most frequently used to explain population movements in the South African context, given, especially, that slow and uneven economic growth, economic disparities, inequality and unemployment persist as some of the country's biggest socio-economic challenges. Urban living holds the promise of employment prospects and improved conditions, and thus the basic premise of many micro-level models of migrant decision-making is that migration occurs with the expectation of being better off in doing so.

The research design of this study set out to empirically investigate the theoretical perspective of the push–pull model of migration from an economic and settlement-based standpoint, and makes novel contributions to the disciplines of Geography, Geographical Information Science, and Urban and Regional Planning. The ultimate aim was to establish a settlement-level perspective of the spatial relationship between economic output (as a measure of economic performance) and working-age population change in South Africa between the Census years of 2001 and 2011. To support the settlement-level analysis scale, special attention was paid to sourcing fine-resolution economic and population datasets covering both the national spatial extent, as well as the ten-year temporal analysis window, and applying advanced GIS methods and techniques to prepare, align, analyse and visualise these datasets. In addition, traditional non-spatial statistical analyses were also employed to measure and quantify the relationship using a correlation-based research approach. Furthermore, the research also proposed a novel way of classifying settlements in South Africa, according to their economic profiles.

Based on the research findings, the study identified eight broad settlement types in South Africa, according to an economically profiled settlement classification typology. Population change in the working-age population was found to have a positive statistically significant association with economic performance at settlement level in South Africa. This relationship proved to be multifaceted, given the complex nature of the South African economic landscape at settlement level, with considerable variability (based on the strength of the relationship) between different settlement types. While none of the settlement types exhibited a very strong relationship between economic performance and population change, several settlement types did indicate a moderate to strong association, while other settlement types were shown to have negligible to weak associations. Furthermore, in certain settlement types, some demographic groups, based on age, gender, employment status, and skill level, were found to have markedly higher associations with the economy than others.

In its empirical contribution towards evidence-based decision-making, especially in the domain of urban and regional planning, the research findings are valuable in helping to support future policy and development

interventions so that development planning can be more successfully targeted and more sensitive to the local South African context, given that South Africa has an intricate history of labour migration, and labour-force participation is a key factor for individuals to improve their socio-economic status.

The study highlights important spatial linkages between economic opportunities and patterns of population change in South Africa, and defines and explores a new perspective of this relationship at settlement level. The results of this study further reinforce the literature, that nuanced and dynamic interplays are evident between the push and pull factors influencing population-change dynamics, in that, on its own, economic performance was not found to be a definitive predictor of population change or migration likelihood at settlement level.

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LIST OF ACRONYMS AND ABBREVIATIONS

AIDS	Acquired immunodeficiency syndrome
AUC	African Union Commission
BBLU	Building Based Land Use
CDE	Centre for Development and Enterprise
COGTA	Department of Cooperative Governance and Traditional Affairs
CSIR	Council for Scientific and Industrial Research
CSP services	Community, Social and Personal services
DEA	Department of Environmental Affairs
DEAT	Department of Environment Affairs and Tourism
DEFF	Department of Environment, Forestry and Fisheries
DF	Dwelling Frame
DoT	Department of Transport
DPRU	Development Policy Research Unit, UCT
DWA	Department of Water Affairs
EA	Enumeration area
EC	Eastern Cape province
Esri	Environmental Systems Research Institute
FES	Friedrich Ebert Stiftung
FS	Free State province
GCRO	Gauteng City-Region Observatory
GDP	Gross Domestic Product
GGP	Gross Geographic Product
GIS	Geographical Information System
GT	Gauteng province
GVA	Gross Value Added
HIV	Human immunodeficiency virus
ID	Unique identifier
IRR	South African Institute for Race Relations
JRC	European Commission Joint Research Centre
km	Kilometre
km/min	Kilometre per minute
KZN	KwaZulu-Natal province
LIM	Limpopo province
LM	Local Municipality

LULC	Land Use/Land Cover
Metros	Metropolitan municipalities
min	Minute
MP	Mpumalanga province
NC	Northern Cape province
NEA	Not economically active
NLC	National Land Cover
No.	Number
NPC	National Planning Commission
NSC	National Senior Certificate
NTC	National Technical Certificate
NW	North West province
OECD	Organisation for Economic Co-operation and Development
R^2	Coefficient of determination
RDP	Reconstruction and Development Programme
r_s	Spearman's rho correlation coefficient
RSA	Government of the Republic of South Africa
SA	South Africa
SACN	South African Cities Network
SBC	SPOT Building Count
SF	Settlement Footprint
SIC	Standard Industrial Classification
SIC 1	Agriculture, forestry and fishing sector
SIC 2	Mining and quarrying sector
SIC 3	Manufacturing sector
SIC 4	Electricity, gas and water supply sector
SIC 5	Construction sector
SIC 6	Wholesale and retail trade, catering and accommodation sector
SIC 7	Transport, storage and communication sector
SIC 8	Finance, insurance, real estate and business services sector
SIC 9	General government and community, social and personal services sector
SP	Sub-place
SPSS	Statistical Package for Social Sciences
Stats SA	Statistics South Africa
TDA	Transport and Urban Development Authority
UCT	University of Cape Town
UDS	Urban Development Strategy

UNCHS	United Nations Centre for Human Settlements
UNDESA	United Nations Department of Economic and Social Affairs
UN-Habitat	United Nations Human Settlement Programme
WC	Western Cape province
WF	Weight factor

1 INTRODUCTION

This chapter provides an overview of the contextual background that motivated this research, namely the relationship between the fluctuating economic performance of towns and cities over time, and its ensuing influence on population-change dynamics in South Africa. In this chapter, the research questions as well as the aims and objectives of the study are presented, and the significance of the study is discussed.

1.1 BACKGROUND

People and the environments in which they live and carry out their lives lie at the heart of urban and regional planning and policy-making. In today's dynamic world, very few people live out their lives in the same place that they were born. Human population distribution refers to the location and spatial patterns of where people are situated, and the study thereof is concerned with how people relate to and interact within their physical and socio-economic contexts. Research in this domain encompasses broader themes that look at population characteristics, patterns and rules, and what stimulates these to change over time and space (Wang & Chen, 2016).

The manner in which people are distributed across both the built-up and natural landscapes can be regarded as a dynamic reflection of the relationship and interaction between populations, development and the environment. The spatial distribution of people is not static. Population change, whether through growth or decline, distribution or composition, is an inevitable process over time and space, which may be influenced by a variety of internal and external factors (Chi & Ventura, 2011). Natural, cultural, developmental, political and geographical forces, together with temporal and spatial influences, continually affect population dynamics and drive population change (National Population Unit, 2001; Entwisle, 2007; Chi & Ventura, 2011; Kaneda & Brenner, 2014). A fundamental understanding of human population distribution and its change-driving factors is essential to understanding the dynamic relationships that exist between humans and their environment, and is vitally important in order for policy-makers to be able to better respond to population changes, and plan for future development, including service and infrastructure provision (Maritz & Kok, 2014; Wang & Chen, 2016).

In understanding how a population may change over time, the main stimulating components are fertility, mortality and migration (Cassen, 1976). Natural population change occurs given the differences between live births and deaths, where a positive difference results in a growing population, and a negative difference in a declining population. Migration, in contrast to natural change, is a multifaceted and dynamic process, and is arguably the most complex component in projecting population change (Demko, Ross & Schnell, 1970; Weeks, 2012). The potential magnitude of the destabilisation effect of migration has prompted some researchers (Cross

& Omoluabi, 2006; Weeks, 2012; Rees, Bell, Kupiszewski, Kupiszewska, Ueffing, Bernard, Charles-Edwards & Stillwell, 2016) to suggest that of the three agents of population change (fertility, migration and mortality), migration could have the greatest short-term impact on society, given that migration (including both internal migration and international migration) can change the demographic size, distribution and composition of population at sub-national level (Maritz & Kok, 2014) far more rapidly than either mortality or fertility (Rees *et al*., 2016).

It is widely accepted that migration is multifaceted, potentially influenced to varying degrees by many factors (Murdock, Hamm, Voss, Fannin & Pecotte, 1991; Li, 2010; Chi & Marcouiller, 2011; Chi & Ventura, 2011; Jones, 2014). Several theories have tried to explain migration processes and their determinants, and it is clear from this literature that people choose to migrate for various reasons, which can be categorised in terms of economic, social, political, cultural, environmental or personal factors, related to what are referred to as the 'push' and 'pull' factors of migration (Lee, 1966). Most migration theories maintain that migration is a response to disequilibrium across space, largely income disparities, but also social inequalities, within a country or between countries (Ravenstein, 1885; 1889; Lee, 1966). People tend to migrate from areas of less development, and therefore fewer opportunities, to areas that they perceive (whether rightly or not) as being more developed, offering more opportunities, and having better potential to satisfy their needs and desires (White & Woods, 1980). Within human migration systems, economic settings are therefore seen as important drivers of change, and macro-economic indicators play a strategically important role as push–pull factors underpinning migration behaviour (Eigelaar-Meets, 2018). However, the relationship between migration and labour markets is complex, and the economic influences on population change, especially in developing countries, are not well understood (Dennett, 2013; Kollamparambil, 2017), although it remains vital for demographers, economists, planners and policy-makers alike whether there are any correlations (Chang, Chu, Deale & Gupta, 2014).

Etzo (2008) notes that the empirical literature has provided strong evidence of the impact of income differentials on migration in the developed world, as outlined by the New Economics of Labour Migration theory (Taylor, 1999). It has often been observed, however, that the nature of African urbanisation is atypical (Kessides, 2006), and may be occurring in the absence of economic growth, or at a disproportionate rate to such growth (White, Mberu & Collinson, 2008). Atkinson (2014) argues that a strong link between labour markets and spatial population patterns exists at a conceptual level, but that in South Africa, this link continues to be poorly understood. Morudu and Du Plessis (2013) note that in terms of migration theory, the populations of municipalities with growing economies are intuitively expected to increase, and those with deteriorating economies would be expected to shrink. However, their findings suggest that in the South African context, the relationship between population size and economic variables is much more complex. For most of South Africa, the synthesis between clusters of people accruing together with agglomerations of economic activity is evident, with the significant exception of the former homeland territories, where continued population growth in the absence of any formal economy contradicts the generally positive relationship observed between population concentration (growth) and economic agglomeration (growth) elsewhere in the country (Geyer, Ngidi & Mans, 2018). Adding to this complexity is the nuanced and dynamic interplay of many other push–pull factors that work together to influence population change and distribution when considered at localised levels (Van Tonder, 2018).

South Africa, which is considered a highly migrant society, has a number of distinct migration corridors (Cross, 2009; Stats SA, 2015a; Gauteng Provincial Government, 2016; DEA, 2016; Mastrorillo, Licker, Bohra-Mishra, Fagiolo, Estes & Oppenheimer, 2016). Social and economic disparities are considered to be key drivers of the internal migration trends observed in the country (Jozi, 2015), and migration choices may often relate to accessing better economic opportunities (De Haan, 2000; National Population Unit, 2001; Kok & Collinson, 2006; Todes, Kok, Wentzel, Van Zyl & Cross, 2010; Mhloyi, Taruberekera & Lemba, 2013; Reed, 2013; Stats SA, 2015a). The recent literature supports the notion that population flows in South Africa are predominantly influenced by economic factors, with increasing migrant flows towards municipalities with better employment opportunities (Eigelaar-Meets, 2018). Deteriorating labour-market conditions and fewer job opportunities in one area relative to another have been observed to lead to greater out-migration, as individuals move to seek employment opportunities elsewhere (Jozi, 2015; Eigelaar-Meets, 2018). The dominant flows of movement taking place in the country are understood to be predominantly rural to urban, especially towards the large metros and cities experiencing economic growth. Where rural areas cannot provide sufficient employment, people opt to venture into towns and cities in search of such opportunities (Mlambo, 2018). In particular, settlements in Gauteng and the Western Cape, characterised by fast-growing economies and mass industrialisation, have become prime destinations for people seeking employment opportunities (Stats SA, 2018a).

1.2 PROBLEM STATEMENT

Unemployment has historically been (and still is) a challenge for South Africa (Kingdon & Knight, 2004a; Stats SA, 2019a), as the promise of work attracts thousands of people to the country's major cities in search of a better life. According to the 2030 population projections by Stats SA (2021), migration rates in South Africa are not expected to slow down. Moreover, these population projections demonstrate the need to plan for at least a 30 % increase (approximately 20 million people) in the total national population by 2050 (Stats SA, 2021). The widespread movement of people within the country, together with large projected population growth, will continue to have major effects on changes in the demand for local services and housing in settlements across the country if not efficiently planned for (Stats SA, 2018a).

The South African National Treasury (2010:54), in a budget policy statement, observes that: *"South Africa[n] cities face substantial challenges, owing largely to the pace of economic growth to date and continued migration from the countryside".* For sustainable growth and development, it is essential that cities and towns properly understand, plan for, and respond to the ever-changing population distribution patterns in the country, as well as the continued growth projected for urban centres (Stats SA, 2018a). There has been growing concern in government about the form and functionality of South Africa's towns and cities (Sinclair-Smith & Turok, 2012). Core departments in national government have been revisiting the effect of their policies on the built environment and considering the possible need for changes (e.g., National Treasury, 2010; National Planning Commission, 2011; SACN, 2011). The emphasis of national policies has been on transport, housing and social infrastructure, and the spatial economy has received less attention. Shifts in the location of investment decisions and employment opportunities nevertheless have a significant influence on the achievement of more equitable and integrated settlements. In South Africa, there is considerable focus on the dynamics of managing space within settlements, and on land use and transport models to analyse the impact of planning decisions at local level. There has been far less exploration of the dynamics between settlements, what drives people to move, and whether it is possible to predict at settlement level which places will grow or decline. Sinclair-Smith and Turok (2012) point out that the lack of reliable data at local level may also partly be symptomatic of neglected urban economic dynamics.

Given the important role that economic activity has played in defining the internal migration patterns within post-apartheid South Africa, together with the strategically important role that macro-economic indicators play as pull factors underpinning migration behaviour in the country, being able to more accurately project changing population trends, based on scientifically informed inferences about how changing economic conditions affect population distribution, is thus critical to being able to plan more strategically for the future service-delivery needs of settlements (De Haan, 2000; Kok & Collinson, 2006; Todes *et al*., 2010; Jozi, 2015; Eigelaar-Meets, 2018). This background forms the underlying motivation for conducting the study.

1.3 RESEARCH QUESTIONS, AIMS AND OBJECTIVES

The research set out to explore, describe and quantify the relationship between economic performance and population change in South Africa, both spatially and statistically, based on historical, spatially explicit time-series data. The research looks specifically at how changes in labour-market conditions and macro-economic factors have influenced population demographic patterns at settlement level.

Research questions:

- What is the relationship between economic performance and population change at settlement level in South Africa?
- Are there variances in the relationship between economic performance and population change between different settlement types and demographic variables, and can trends be identified?

Research aim:

Establish a settlement-level perspective of the spatial relationship between economic performance and population change in South Africa between 2001 and 2011.

Research objectives:

- Objective 1: Establish settlements as the unit of analysis for this study
- Objective 2: Quantify economic performance at settlement level between 2001 and 2011
- Objective 3: Quantify population change at settlement level between 2001 and 2011
- Objective 4: Measure and analyse the relationship between economic performance and population-change dynamics at settlement level in South Africa

1.4 SIGNIFICANCE

It is vitally important to understand the complex phenomenon of population movement so that future policy and development scenarios can be tried and tested before implementation (Stats SA, 2015a). Conceptually, the literature argues that there is a strong link between economic opportunities and spatial population patterns, but in the South African context this link has been poorly understood, and few quantitative studies have been undertaken locally to understand this relationship better (Atkinson, 2014). Evidence-based decision-making is becoming increasingly important for policy-makers so that decisions and policy-making processes are based on sound scientific proof and contribute to ensuring the efficient management of resources, population, and economic and social affairs. Decision-makers across all spheres rely on a strong evidence base, reinforced by the availability of timely, accurate, robust and nuanced data to support their development planning and to ensure better service delivery (Stats SA, 2015a; Wardropa *et al*., 2018).

Population projections at national, provincial and municipal levels are used for a wide range of planning, budgeting and analytical purposes, but in South Africa these data are not available at finer scales, partly since the methods for producing such projections are still in their infancy and very few international examples of spatially explicit projections of the future distribution of population exist to date (Jones, 2014; Van Tonder, 2018). Policy-makers and planners use migration trends and projected population figures to gauge future demand for resources, including basic resources such as food and water, as well as housing, energy and services (Kaneda & Brenner, 2014), but in using provincial or municipal projected figures, it cannot be assumed that all settlements within a particular region will grow (or decline) at the same rate. Population projection data can therefore not be uniformly disaggregated from a national, provincial or municipal level to the human settlements within them, since the various settlements and towns within these administrative demarcations may have different levels of growth and decline.

To support evidence-based decision-making processes that are sensitive to the local South African context, local-level population projections, based on recent historical patterns of internal migration that explicitly take into account the economy as a change-driving factor, are required. There would be great value in beginning to quantify, model and understand the relationship between economic performance and population change in South Africa as it relates to producing more accurate local-level population projections. These could be used not only to alert policy-makers to major economic development trends that could affect population movements, but also to help inform the future economic and social policies of the country (Bouare, 2001–2002; Kaneda & Brenner, 2014).

1.5 ETHICAL CONSIDERATIONS

The research is not considered ethically sensitive since it utilises secondary data that the researcher has permission to use. The researcher has complied with ethical considerations related to using secondary data, including:

- Data were analysed at settlement level and were thus aggregated to the extent that no personal or individual inferences can be made by the research.
- The project researcher and data custodians entered into data-use agreements before using any data for research purposes in this project.
- The primary sources of the data are acknowledged in the research report.
- The data-use conditions of the data custodians were adhered to.
- The analysis and results of the research are accurately and honestly reported.

2 LITERATURE REVIEW: POPULATION-CHANGE DYNAMICS

This chapter explores theories from the literature relating to population-change dynamics, specifically the components of population change, theories of migration, the high-level factors influencing why and where people choose to migrate, the relationship between migration and urbanisation, and the concept of an economic–population nexus.

2.1 AGENTS OF POPULATION CHANGE

In demographic terms, the three main processes affecting population growth at the aggregate level are fertility, mortality and migration. These processes, also referred to as the components of population change, have significant impacts on shaping population change over time (Cassen, 1976). Natural population change occurs according to the differences between live births and deaths. The annual birth and death rates of populations are determined primarily by the levels of fertility and mortality experienced by individuals (Cassen, 1976; Andreev, Kantorová & Bongaarts, 2013). The influence of mortality on population growth is positive if mortality is declining, and negative if mortality is rising. Similarly, the contribution of fertility to population growth is positive if fertility is above replacement level, and negative if fertility is below replacement level. Maintaining fertility at replacement level will lead to population growth stabilisation over time (Preston, Heuveline & Guillot, 2000). With constant mortality and no migration, if fertility overtakes replacement levels, the population will grow indefinitely; similarly, if fertility remains below replacement, the population will eventually decline to zero (Andreev, Kantorová & Bongaarts, 2013).

In brief, fertility patterns are known to be affected by factors such as educational attainment, access to contraception, religion, culture, and national policy and law, to name only a few, while mortality patterns are known to be affected, for example, by changing contexts of health, technological development, outbreaks of disease, nutrition, natural disasters, war and crime (Cassen, 1976).

In addition to natural population growth, the migration of people, both internally from rural areas to cities, as well as across international boundaries, also has an influence on population-change outcomes. In contrast to fertility and mortality, migration is regarded as the most complex and dynamic component of population change. Migration research, in relation to human population and settlement, focuses on understanding what drives the movement of people, and usually refers to a range of patterns associated with shifting individuals or populations (Waugh, 2000; Eigelaar-Meets, 2018).

Technological development and improvements in communication, information and transportation have increasingly stimulated the volume and flow of migration globally (White & Woods, 1980; Wajdi, Adioetomo &

Mulder, 2017), to the extent that migration is more commonly replacing fertility and mortality as the principal demographic process shaping the patterns of contemporary human settlement (Poston & Bouvier, 2010; Bell, Charles-Edwards, Stillwell, Kupiszweski & Kupiszewska, 2015; Rees *et al*., 2016).

2.2 RELEVANT MIGRATION THEORIES

Theories provide analytical frameworks through which to examine social phenomena. Migration and settlement, put simply, are social phenomena with related social drivers, processes, patterns and outcomes. In particular, migration theories help to outline the conceptual understanding of human mobility processes (O'Reilly, 2015).

An orthodox view of migration expects migrants to move from rural areas to more developed towns and cities. The underlying motives for these moves may include considerations that range from economic to social, environmental or cultural (Eigelaar-Meets, 2018). In this light, explanations of migration are commonly grouped into two overarching frameworks, namely, economic theories (following the neo-classical models of migration that place economic determinants of migration at the centre) and non-economic frameworks (Britz, 2002; Moses & Yu, 2009; Eigelaar-Meets, 2018). Economic theories explain and predict migration based on economic stimuli. These theories suggest that the greater the difference in expected income between two regions, the greater the migrant stream between them. Economic conditions are thus seen to exert pushing and pulling forces in predictable directions (Gelderblom, 2006). In sending areas, poverty and unemployment act as the major push factors, while the possibility of employment and improved income are regarded as the major pulling factors drawing people towards a particular destination, provided that the costs of migration can be met (Gelderblom, 2006; O'Reilly, 2015). Non-economic frameworks take into account broader aspects of the decision to migrate, including the migrants' demographic characteristics (e.g., age, gender, race, level of education, marital status, career aspirations and economic standing); spatial aspects influencing the decision to move (e.g., distance and direction); as well as personal subjective factors (Eigelaar-Meets, 2018). In reconciling these frameworks, push and pull factors related to the spatial imbalance of equality can be used to explain a broad range of migration theories that are both economic and non-economic.

2.2.1 The push–pull theory of migration

The push–pull theory of migration, which still dominates much gravity-based migration modelling as well as academic thinking, is grounded on the assumption that migration is a functional and inevitable outcome of spatial inequality (De Haas, 2011). If place B, for instance, becomes more attractive to live in than place A, or if circumstances become disagreeable in place A, people can be expected to move from place A to place B (Gelderblom, 2006). While this is a very simplistic example and in reality may not be as clear cut, this line of reasoning outlines the pulling and pushing forces associated with this classical migration theory.

The push–pull theory of migration was proposed by Ravenstein (1885; 1889) in his influential work entitled 'The laws of migration'. The theory was later revised in Lee's (1966) seminal contribution to the migration literature. The theory combines individual rational choice with the broader structures of rural–urban developmental disequilibrium to explain why people migrate. It argues that the process of migration is neither random nor *ad hoc*, but rather that certain factors act as pushing or pulling forces between places. These factors, the inherent result of spatial inequality, have a motivating effect on an individual's decision to move from one location to another (**Figure 1**) (National Population Unit, 2001; Moses & Yu, 2009; Mhloyi, Taruberekera & Lemba, 2013). In essence, the push–pull model attempts to explain the spatial reward structure, where a decision to move can only occur when one region potentially satisfies an individual more than another region; for example, in the case where urban life seems more economically rewarding compared to the restrictive fiscal realities perhaps found in more rural areas (Gelderblom, 2006; Kok & Collinson, 2006).

Pull factors refer to those elements (tangible and intangible) in either the sending or receiving area that are attractive to the potential migrant. These are the favourable characteristics of a specific place that encourage and attract migrants towards it (**Figure 1**). Migrants responding to pulling forces decide to move to a specific destination because they perceive the conditions there to be more attractive, for example, in terms of better employment prospects, higher wages, access to higher-order services, better education and welfare systems, better infrastructure and housing, access to land, favourable climatic conditions, good environmental and living conditions, political stability and lower crime rates (Lee, 1966; Britz, 2002; De Haas, 2010; King, 2012; Bunea, 2012; Eigelaar-Meets, 2018). Gelderblom (2006) explains that the focus in such cases is on the rewards attached to living in a particular place.

Push factors are more difficult to conceptualise. In a generic sense, they are the characteristics of an area that make it unattractive for an individual to live. Circumstances that act to drive away, or push out, migrants from a particular place include, for example, poor or deteriorating economic conditions, high unemployment, underdevelopment, poverty, low wages, economic and financial decay, high living costs, poor access to basic services, changing community structures, landlessness, poor access to housing, political unrest and influence, ethnic or religious discrimination, crime, unfavourable climate and environmental degradation (Lee, 1966; Britz, 2002; De Haas, 2010; King, 2012; Bunea, 2012; Eigelaar-Meets, 2018). Gelderblom (2006) explains that the focus in such cases is on the factors that make a place undesirable to live.

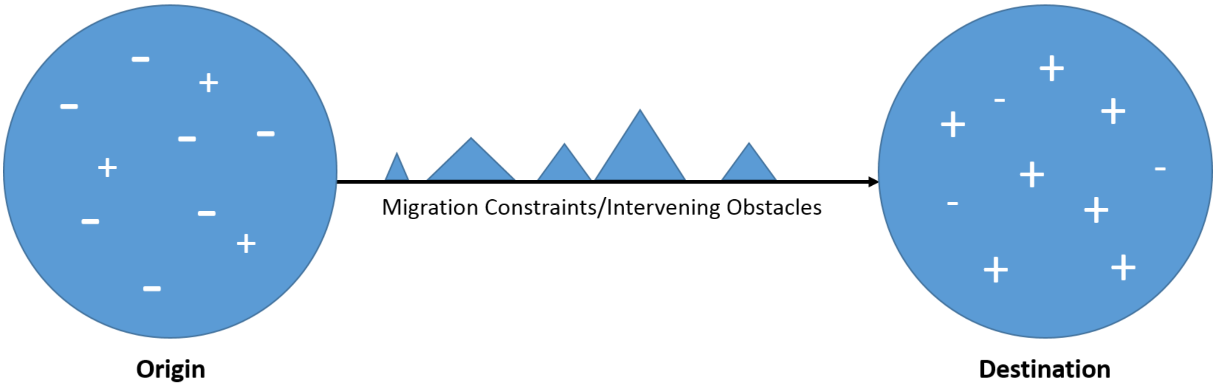


***Figure 1:** Push–pull theory of migration*

Source: Own illustration, based on Lee (1966)

In his attempt to frame the migration process, Lee (1966) distinguished between four overarching factors that aid in determining migration behaviour. These are summarised as follows:

1. The local conditions at the origin that stimulate an individual's decision to move (push factors)
2. The subjective perceived conditions at the destination that make it a more desirable place to live (pull factors)
3. Existing barriers that act as migration constraints
4. A migrant's personal characteristics that act to increase or decrease the propensity to move.

In Lee's framework (1966), existing barriers refer to the intervening obstacles between the origin and destination that may hinder an individual's ability to move (**Figure 1**). These may be in terms of physical obstacles (e.g., mountains, rivers or oceans), distance, costs, immigration laws, language or cultural barriers that further affect an individual's decisions (Wajdi, Adioetomo & Mulder, 2017; Eigelaar-Meets, 2018).

The push–pull model is underpinned by the assumption that anyone could be considered a potential migrant if living conditions elsewhere, especially in relation to the labour market, are better than in the current place of residence, and the potential gain outweighs the cost of migration (Fassmann, Gruber & Németh, 2018). While both push and pull factors exert weight on an individual's decision to move, Ravenstein (1889) suggested that pull factors tend to be more influential in stimulating migration than the counterpart push factors. Typically, people who migrate are attracted by the perception of better opportunities, whether these are employment or income-generating opportunities, education, access to healthcare or social and physical safety; in other words, opportunities to improve their standard of living and that of their family. However, such opportunities and chances only operate as attractors if knowledge about them is accessible in the sending community (Bekker, 2002; Hall, Ebrahim, De Lannoy & Makiwane, 2015).

The push–pull model has been criticised for assuming that migrants are motivated only by rational factors, for oversimplifying migration processes, for being deterministic in nature, and for failing to explain how and why immigration, emigration and return migration may occur simultaneously (Castles, De Haas & Miller, 2014;

Fassmann, Gruber & Németh, 2018). Despite its limitations, Lee's (1966) conceptual framework remains a sound way to understand the motivations underpinning migration decision-making, and thus, conventional push–pull theories have dominated debates on the nexus between population and the economy. Other advantages of Lee's model are its applicability at both the micro and macro levels of analysis, and indirectly its clear linkage to official measurement statistics.

2.3 FACTORS INFLUENCING WHY AND WHERE PEOPLE CHOOSE TO MIGRATE

Migration is determined by the changing spatial characteristics of both the sending and receiving areas. Theorists have long argued that the decision to migrate is a direct response to the spatial imbalance of equality. Etzo (2008) describes migration as a complex phenomenon involving mainly demographic and economic aspects, while most migration theories maintain that migration and settlement are predominantly motivated by economic factors (Poston & Bouvier, 2010). Expanding on this, Jones (2014) suggests that people choose to live in places they deem to be attractive by evaluating the attractiveness of their place of residence and comparing it to other possibilities. Although attractiveness may be a subjective concept, Fassmann, Gruber and Németh (2018) suggest that it can be measured as the sum of those location factors that are perceived as positive, the so-called plus factors, less any negatively perceived factors, or minus factors. **Figure 1** illustrates that the sending and receiving areas have a combination of both push and pull factors, which work in both directions (Moses & Yu, 2009). Gelderblom (2006) explains that a potential migrant may be pushed away from the sending area due to poor employment prospects, for example, but could also be pulled back again by social connections. This contradictory combination of forces may help in understanding why migration is often circular in nature, with the migrant returning home periodically and not committing to the destination area in a permanent fashion.

Bearing in mind what makes a place attractive, population movement choices have been linked to economic factors such as economic opportunity and transportation infrastructure, social factors such as proximity to family and the presence of social amenities, as well as the intangible attachments people have to certain places (Jones, 2014; Eigelaar-Meets, 2018). While numerous authors have suggested various permutations in grouping and categorising migration determinants, the literature generally supports five primary forces that stimulate migration (the so-called 'drivers of migration') at a macro level (Black, Adger, Arnell, Dercon, Geddes & Thomas, 2011). These include: 1) economic and labour-market forces, 2) social forces, 3) political forces, 4) environmental forces and 5) demographic forces (**Figure 2**).

Macro-level factors operate at national and regional levels. They are the real or perceived differences across time and space that influence movement akin to Lee's (1966) conceptualisation of the push–pull factors that influence migration. Black *et al*. (2011) explain that pulling and pushing forces rarely act in isolation, and that the specific outcomes of migration are grounded in the interconnections that develop between places as a result of culture and history, as well as the nature of the interactions between factors, influencing movement patterns at different scales.

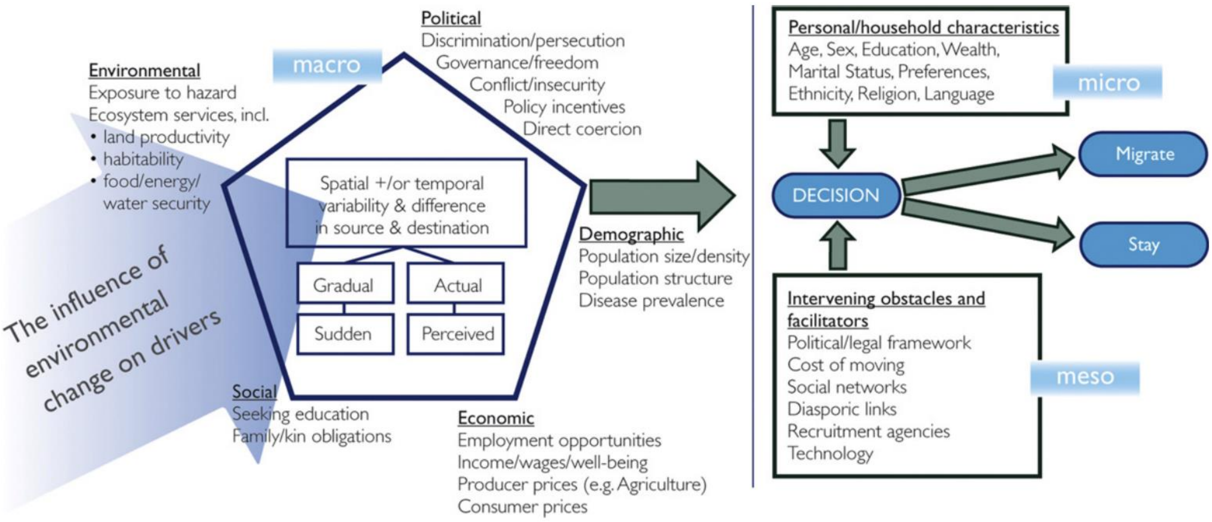


Figure 2: *Conceptual framework for the drivers of migration*
Source: Black *et al*. (2011)

1. Economic and labour-market factors

Economic drivers directly affect both internal and international migration patterns. Economic disparities encourage the movement of skilled labour from developing to developed economies (Piesse, 2014). Scholarly research argues that economic forces have long been, and continue to be, the dominating factors in stimulating migration. Economic factors relate to employment or income-generating opportunities, job prosperity, labour-market standards, income differentials, market growth, and the overall health of the economy between different places. Economic factors may stimulate mobility, but the inverse is also true, where displacement could also be triggered by sudden economic collapse (Black *et al*., 2011). Piesse (2014) notes that if economic conditions are not favourable and appear to be at risk of declining, or further declining, individuals might choose to uproot and move towards regions with better economic prospects. This often results in internal migration, with the movement of people from rural to urban areas.

Economic theory posits that potential migrants will select destinations where they expect to maximise their net economic benefits (Hicks, 1932; Simpson, 2017). As such, economic factors, specifically employment, income levels and differences in income (in their direct ability to affect the net benefits of migration), are typically considered among the more important migration determinants, at least for the working-age population (Chi & Marcouiller, 2011; Simpson, 2017). Black *et al*. (2011) explain that if economic growth is rapid, as has been the case with internal migration to megacities in Asia and increasingly also in the African context, then income differentials are generally the most powerful driver of migration.

Conditions of the labour employment market may also reflect aspects of regional economic prosperity. Labour-market factors are therefore significant, both in promoting out-migration, as well as influencing people's destination choices (Etzo, 2008). Workers in poorer regions move in search of better employment opportunities and higher wages, which are usually found in regions where economic productivity is higher (Simpson, 2017). As Ravenstein (1885) observed, centres of greater commerce and industry tend to absorb more migrants, while longer-distance migrants are likely to be influenced more by relative regional economic prosperity compared to their shorter-distance counterparts.

For most migrants, high economic prosperity equates to more services, activities and opportunities. Furthermore, dynamic centres tend to attract mostly young people, who move out of their family homes in search of education, better employment or income-generating opportunities, and access to healthcare, housing and social security. As such, young people are commonly recognised as the most mobile segment of the population (Hall *et al*., 2015). Migration flows therefore appear to operate out of areas with limited economic opportunities and into those perceived to offer more opportunities, and function to bring population size and economic opportunities into equilibrium at the aggregate level (Chi & Marcouiller, 2011).

2. Social factors

Social drivers related to quality of life include the presence of social amenities, crime and public safety, as well as family links or social networks (including the presence of friends or relatives at the destination locality (i.e., migration networks) (Jones, 2014). Lucas (2015) explains that improved social amenities and greater security can have a direct effect on migrants' decisions through the prospect of a more attractive life in a particular setting. The reverse can also hold true. Examining internal migration in Ghana, Ackah and Medvedev (2010:2) report that *"the probability of migration is higher for younger and more educated individuals, but communities with higher levels of literacy, higher rates of subsidised medical care, and better access to water and sanitation are less likely to produce migrants*". Social factors can also include educational and training opportunities, family or cultural expectations, and cultural practices such as inheritance or marriage (Black *et al*., 2011).

3. Political factors

Political drivers of migration can include conflict, discrimination, insecurity and persecution, as well as wider influences such as political manipulation, enforced relocation and land ownership (Black *et al*., 2011). Government-led policies have also acted to stimulate people to relocate; for example, policies to create growth hubs or stimulate new urban developments can act as pull factors encouraging migration, while planning policies for rural land management may act in reverse, pushing people to relocate.

4. Environmental factors

Environmental factors are increasingly being recognised as a contributing factor in both internal and international migration (Laczko & Aghazarm, 2009). Environmental drivers may relate to the quality of the natural environment (e.g., climate or air quality), natural amenities, exposure to natural threats or the diminishment of ecosystem services (e.g., those that provide food and water) (Black *et al*., 2011). Adverse environmental conditions have been shown to induce migration as an adaptation strategy (McLeman & Smit, 2006). Climate change is perhaps the most serious of the environmental factors that drive out-migration, given its potential to intensify and exacerbate the impacts of economic, social and political push factors (Black *et al*., 2011).

5. Demographic factors

At a macro scale, demographic drivers of migration include the size and structure of populations in sending regions. Demographic factors interact with other drivers of migration, particularly economic forces. Black *et al*. (2011:S6) explain that *"it is not the presence of large numbers of people in a region per se that will trigger out-migration, but rather the presence of large numbers without, for example, access to employment or livelihood opportunities"*.

2.4 MIGRATION AND URBANISATION

The world is becoming increasingly urban, to the extent that "*the twenty-first century has been referred to as the first 'urban' or 'metropolitan' century*" (Avis, 2016:4). Urbanisation is increasingly being acknowledged as a pertinent issue, as towns and cities become not just the dominant living environment of humanity, but also "the *engine-rooms of human development*" (UNCHS, 2012 in Wray, Musango, Damon & Cheruiyot, 2013:5). Historically, economic development has been accompanied by demographic transition. As economic functions in industrially developed countries have increasingly been centralised in cities, migration has been key to the urbanisation process and rural depopulation (Britz, 2002; Weeks, 2012).

Globally, and especially in developing countries, there have been dramatic increases in people moving to urban areas. Factors that attract people to urban settlements include opportunities for economic stability, employment, education and access to services, social support and healthcare (DEAT, 2006). Although the land footprint area of cities, towns and settlements covers only a tiny fraction of the Earth's surface (estimated to be less than 1 %) (Harrison & Pearce, 2000; Schneider, Friedl & Potere, 2009), urban areas form the hubs of the vast majority of all human activity, accounting for 70–90 % of all economic activity (Schneider, Friedl & Potere, 2009), and more than half of the total global population (55 % in 2018) (UNDESA, 2018). Furthermore, UNDESA (2018) projects the global urban population as increasing to 68 % of the total population by 2050. The global urbanisation rate, however, disguises important distinctions in the urbanisation rates across different geographical regions. In the developed world, the era of rapid urbanisation has already passed, in sharp contrast to the proportion of urban dwellers in developing countries (Bekker, 2006). Based on 2018 estimates (UNDESA, 2018), populations in Africa are still predominantly rural, with only 43 % living in urban areas (well below the global average), while South Africa's urban population (66 % of the total national population) is significantly higher than both the African and global averages, making it one of the most urbanised countries on the continent (Bakker, Parsons & Rauch, 2016).

Turok (2014) explains that the structure of urban centres is made up of four pillars, namely economic development centres (e.g., business and industrial sites), housing provision (e.g., government housing, private residential areas or informal settlements), public transport networks (e.g., road networks) and infrastructure networks (e.g., water and sanitation infrastructure). An increase in population and urbanisation, if not planned for, leads to development pressures that commonly result in serious social issues such as poverty, under-serviced settlements, informal housing and land degradation. For those who must plan for, manage and react to this growth, the fast rate of urbanisation and rising migration to cities bring risks, challenges and opportunities for both migrant communities and the governments concerned (Avis, 2016). Towns and cities often have only limited capacity to plan and cater for increasing migrant populations, by providing access to land, housing, employment and basic services. This has led to the largely negative policy position of government and city authorities in relation to migrants (White, Uljee & Engelen, 2012; Awumbila, 2017). Globally, increased migration to urban centres is unavoidable given the realities of slow and uneven regional and national economic growth, as well as ecological and political instability (McCatty, 2004; Skeldon, 2013). Cities are known to be attractive destinations for migrants because of their role as economic engines and job baskets, and if economic growth is rapid, then income differentials tend to be a powerful driver of migration. There is thus growing interest, both locally and internationally, in finding ways to predict the spatial manifestations of growth in towns and cities and to incorporate this knowledge into spatial planning processes and development frameworks that are inclusive and sustainable (White, Uljee & Engelen, 2012).

2.5 THE ECONOMIC–POPULATION NEXUS

Society stimulates continuous interactions between population and economic aspects. A heuristic model linking population and economic dynamics, the economic–population nexus, is illustrated in **Figure 3**. It sets out bidirectional and continuous impacts of the economy upon population, and vice versa, both directly and indirectly, and at macro and micro levels. Economic aspects include economic size, growth and structure, as well as economic processes and macro- and micro-economic dynamics affecting economic performance. Population aspects include demographic characteristics such a population size, growth, structure as well as population processes. Interactions at the interface of population and economic dynamics, the population–economic nexus, include the size of the economically active population as well as the level at which the population benefits from economic growth (Van Aardt, 2008).

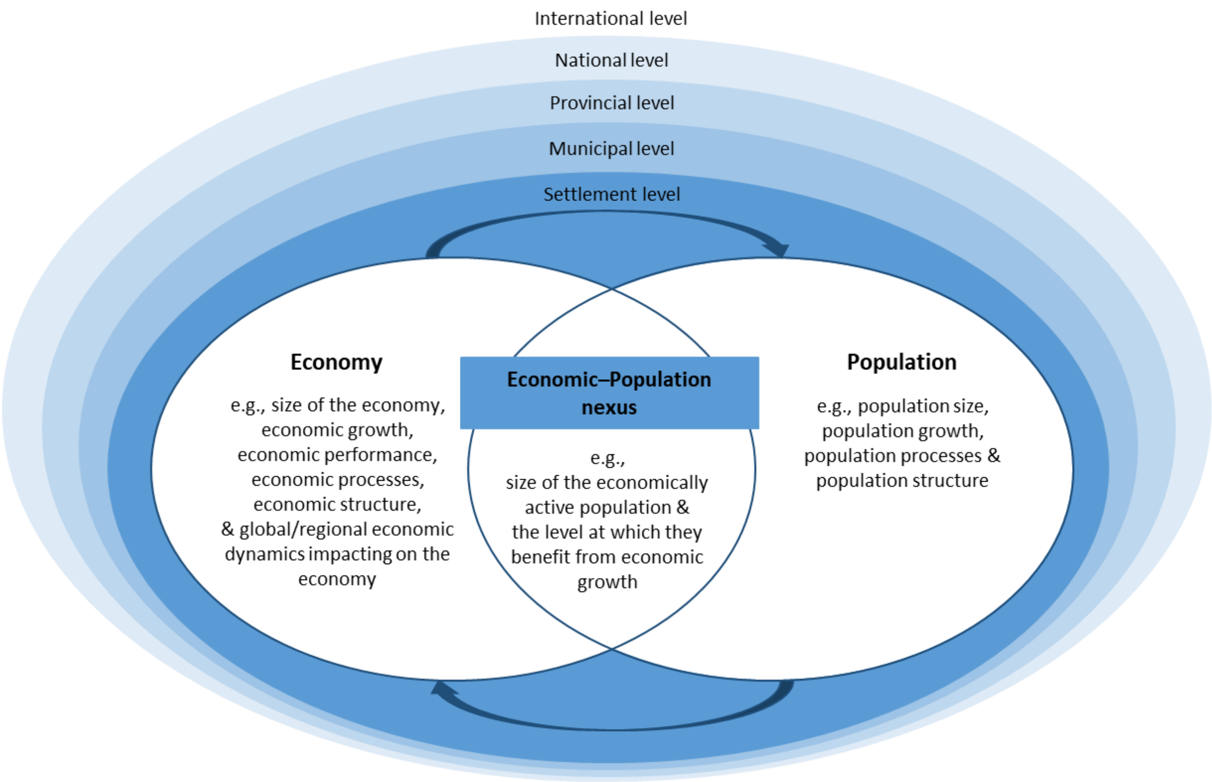


Figure 3: *Heuristic model linking population and economic dynamics*
Source: Own illustration, adapted from Van Aardt (2008)

Looking specifically at the interaction between economic performance and population change, most migration theories maintain that migration is motivated by economic factors (Etzo, 2008; Poston & Bouvier, 2010). Migration may be triggered by uneven economic development, inter-regional differences and disparities in living standards (Kainth, 2010). It can even be said that at regional and national levels, the efficient functioning of the economy is supported through migration by stimulating the movement of people, skills and knowledge (Blanchard, Katz, Hall & Eichengreen, 1992, in Bernard & Bell, 2018).

The territorial dynamics of the Zambian Copperbelt are used as an illustrative example of the power that economic shifts (both development and downscaling) can have on internal migration dynamics (**Figure 4**). Until the 1980s, Zambia epitomised the urbanisation process in African, largely due to its vibrant mining industry, which stimulated rapid economic growth. Migrants flocked to Copperbelt Province for employment on the mines and related activities, and the population in this area grew rapidly. The crash in copper prices during the 1990s led to the shutting down of mines, a process that induced reverse migration flows from urban centres along the Copperbelt back towards the rural areas to eke out a subsistence existence. The downturn in growth rates and reversal of urbanisation occurred mainly in the Copperbelt Province, but other urban centres in Zambia showed similar trends (Girard & Chapoto, 2017; Potts, 2005).

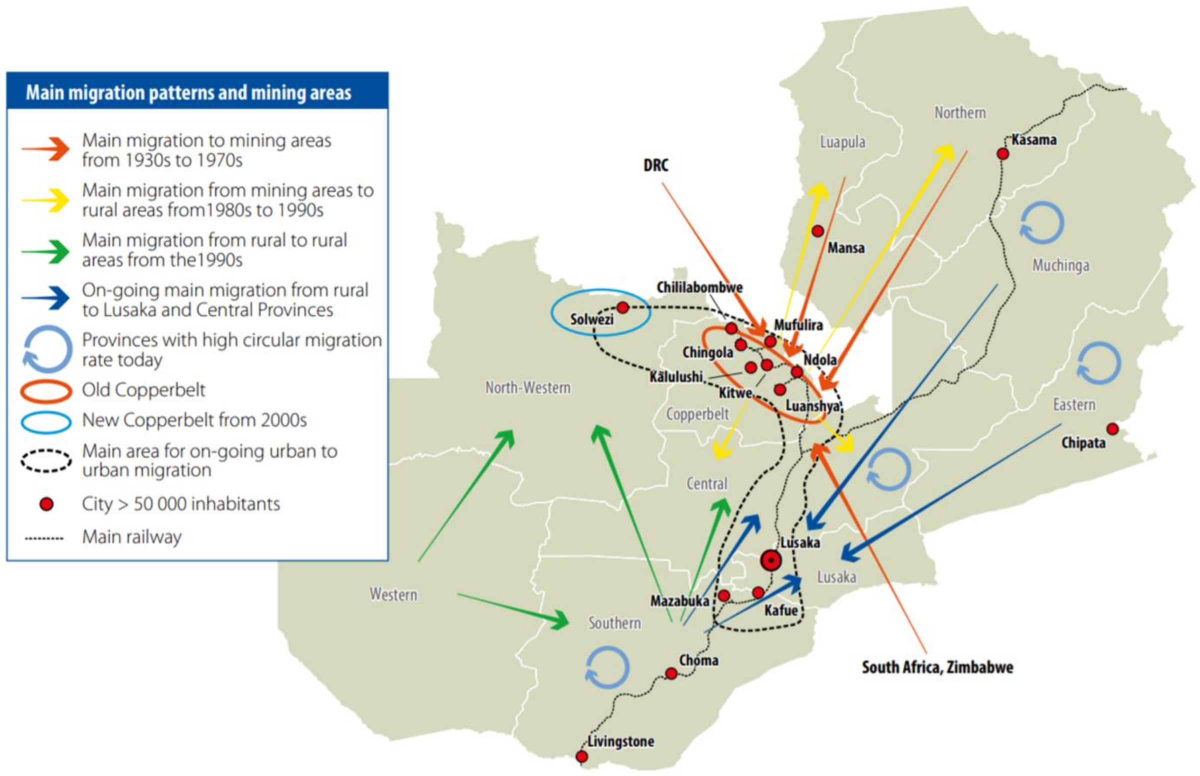


Figure 4: *Migration dynamics along the Zambian Copperbelt since the 1930s*
Source: Girard and Chapoto (2017)

2.6 CONCLUSION

At the aggregate level, the agents driving population growth or decline are natural change (according to the differences between fertility and mortality) and net migration (the result of direct population movement). Many theories have tried to explain migration processes and their determinants, and are commonly grouped into two overarching frameworks, namely, economic theories and non-economic theories. Conventional push–pull theories have dominated debates on the nexus between population and the economy, according to which the reasons for migration are determined by pushing and pulling factors that encourage people to move. These include economic drivers such as employment opportunities and economic stability (Stats SA, 2019b), which have long played a key role in urbanisation. People migrating to urban centres often come from economically stagnant rural areas with limited prospects. Thus, towns and cities are known to be attractive destinations for migrants because of their role as economic engines and job baskets.

3 LITERATURE REVIEW: INTERACTIONS BETWEEN POPULATION AND THE ECONOMY IN THE SOUTH AFRICAN CONTEXT

This chapter explores literature theory related to interactions between population and the economy in the local South African context. The chapter is structured as follows: **Section 3.1** discusses the changing population dynamics of South Africa and reviews the literature on migration trends in the country. **Section 3.2** sets out the changing economic dynamics of South Africa, looking specifically at labour-market trends and the state welfare system. Lastly, **Section 3.3** sets out to better understand settlements in the local context.

3.1 CHANGING POPULATION DYNAMICS OF SOUTH AFRICA

Population changes at national and sub-national levels are influenced by natural growth rates and migration over time. The population size of South Africa has increased substantially, from 40.58 million in 1996 to 51.77 million in 2011, and is estimated to reach 59.62 million people with the latest mid-year population estimates by Stats SA (which uses the latest available data on fertility and mortality to estimate the size of the population) (Stats SA, 2012a; Stats SA, 2020). While Van Aardt (2008) notes that the South African population has shown rapid and increasing growth over the last century, there is an indicative trend in the last three decades of the growth rate gradually slowing down and levelling off. Data for the period 1996–2001 indicate that during this period, an average annual population growth rate of 2.08 % was realised, from a national population of 40.58 million in 1996 to 44.81 million in 2001. Annual population growth rates since 2001 have been substantially lower, at roughly 1.57 % per annum between 2001 and 2011, and 1.67 % between 2011 and 2020 (Stats SA, 2012a; Stats SA, 2020). This year-on-year trend of declining population growth rates may be driven largely by declining fertility rates as well as the demographic impact of HIV/AIDS on mortality and fertility levels (Van Aardt, 2008). Natural increase is still considered to be the main contributor to urban growth in Africa, while migration, as the third agent of population change, has also been identified as contributing to urban growth, albeit at a lower rate (Potts, 2012), with significant implications that are not only demographic but also political, economic and social (Stats SA, 2018a).

In South Africa, populations tend to be dynamic, and population mobility is high (Stats SA, 2019b). The migration of individuals and families, both within and across national borders, has thus long been commonplace. Mastrorillo *et al*. (2016) estimate that between 2007 and 2011, approximately 2.3 million people (i.e., about 4.5 % of the total national population) moved at a municipal district scale. These movements constantly influence the population structure of provinces and municipalities (Stats SA, 2018a).

South Africa's apartheid legacy has ongoing relevance for the development trajectory and trends witnessed in the state (Stats SA, 2019b). The current (post-apartheid) migration and urbanisation trends therefore need to be framed within the proper historical context. During the colonial and apartheid eras, government policies and land use planning enforced racial segregation, restricting the free movement of certain racial groups in South Africa by law. This institutional system of racial segregation effectively created areas of 'forced' settlement in the former homeland territories, most of which were (and still are) characterised by their limited economic base, unacceptably high rates of unemployment, and predominantly rural settings (Kwenda, Ntuli & Mudiriza, 2020). The migrant labour system, which became associated with the former homeland territories and played a crucial part in the economic development of the country, saw unskilled and semi-skilled male migrant labour drawn from these regions[1] for work in sectors such as mining, agriculture and manufacturing (Parshotam & Ncube, 2017; Stats SA, 2019b). This migrant labour system was closely regulated and accompanied by influx-control legislation, inhibiting the urbanward migration of black African people until the mid-1980s, when restrictions on African urbanisation began to break down, and were finally abolished with the democratisation of the country in 1994 (Todes *et al*., 2010; Maritz & Kok, 2014). Until 1994, South Africa's urban transition and corresponding patterns of migration were largely shaped by the apartheid system and the preceding colonial period, and new patterns of internal and international migration have since emerged (Stats SA, 2019b).

3.1.1 Internal migration determinants and trends

In contemporary South Africa, migration as a conceptual term is typically understood to reflect the major societal changes caused by the movement of people from rural to urban areas, and is hence synonymous with the urbanisation process (Bekker, 2002; Moses & Yu, 2009). Migration since 1994 has largely been urbanward, but significant flows of people from urban to urban areas (signified by very large flows of people moving between city regions as well as within a city region) have also been observed (Pieterse, Van Huyssteen, Maritz, Mans & Van Niekerk, 2014). In analysing the destination types of inter-municipality migration, Todes *et al.* (2010) found that in most inter-municipality migration, migrants tend to move towards settlement types that are similar to their place of origin.

Placing the emphasis on the sending and receiving areas and the reasons for moving, rather than on migrants themselves, Bekker (2001:1) conceptualises migration as *"the movement of [individuals or] households from relatively poorer regions – the sending areas – to relatively better-off regions – the receiving areas – thereby enhancing the … chances of improved access to resources"*. In a state where unemployment persists as one of the biggest socio-economic challenges, economically driven migration is often a livelihood strategy. For youth coming from rural areas especially, migration could be a collective strategic decision that serves to benefit both the migrant and the household, improving the socio-economic positions of both through remittances. Thus,

[1] The Transkei, Bophuthatswana, Ciskei, Venda, Gazankulu, KaNgwane, KwaNdebele, KwaZulu, Lebowa and QwaQwa homelands of the former apartheid government.

economic theories of migration are most frequently used in the South African context to explain population movement in terms of the rational decision-making processes undertaken by both individuals and households (e.g., **Figure 5**) (Stats SA, 2019c).

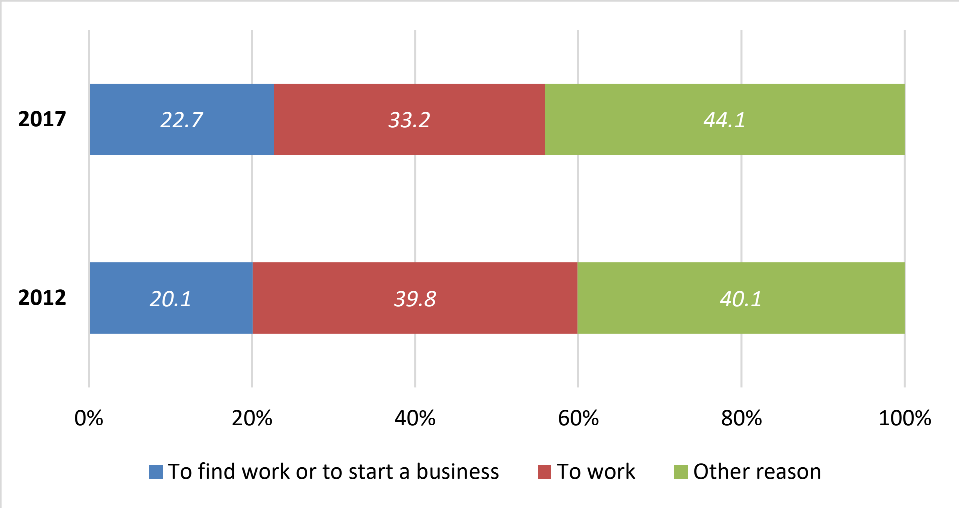


***Figure 5**: Reasons for migration within South Africa, 2012 and 2017*

Source: Adapted from Stats SA (2019c), based on Labour Force Survey data

By its nature, the push–pull factors of migration entail that people move for economic stability (Stats SA, 2019b). The overall migration trends in South Africa confirm the push and pull dynamics of Lee's (1966) theory of migration. In rural areas, poverty, economic hardship, adverse living conditions and lack of the critical infrastructure needed for rapid development act as push factors, fuelling relocation (Mlambo, 2018). The promise of improved livelihoods draws people from rural areas to the cities. Importantly, ill-informed perceptions of financial benefit in terms of the availability of employment opportunities in urban areas may drive migration, even when such opportunities are only apparent rather than real, which, in turn, can lead to public antagonism towards migration (OECD, 2014).

Labour-market conditions are generally most favourable in metropolitan areas. The growing economic strength and industrialisation of these urban areas, and opportunities for study and improved quality of life, especially in Gauteng and the Western Cape, influence their attractiveness to migrants, making these provinces, and the affluent cities within them, top destinations for migrants (Von Fintel, 2007; Stats SA, 2015a; Mastrorillo *et al*., 2016; SACN, 2016; Stats SA, 2018a; Stats SA, 2020). The strength of the Western Cape's growing economy is further illustrated, in part, by its consistent ability to provide employment to slightly more than half of the economically active population despite increases in population size (Eigelaar-Meets, 2018). Comparing the labour-force conditions of these provinces with financially embattled provinces such as KwaZulu-Natal, the Eastern Cape and Limpopo sheds light on the push factors stimulating out-migration from these more rural provinces, as well as the pull factors of the more urban receiving provinces (Bekker, 2002; Pekane, 2018).

Of all nine provinces, Gauteng (which incorporates the three metropolitan areas of Johannesburg, Tshwane and Ekurhuleni) is the biggest contributor to national economic output (approximately 32 %), followed closely by the City of Cape Town and eThekwini metropolitan municipalities which jointly contribute approximately 20 % of national output (SACN, 2011; IIED, 2012). Consequently, employment opportunities and earnings are also concentrated in these more economically productive metropolitan areas, making them the most attractive destinations for migrants (SACN, 2011; Stats SA, 2015a). Further testimony to this are the findings of Mastrorillo *et al*. (2016) and Von Fintel and Moses (2017), who determined (respectively) that roughly half of all domestic migrants are absorbed by only five of the country's metropolitans, three of them in Gauteng, and that the province attracted 41 % of inter-municipality migrants in 2011.

In general, the movement of people towards provinces and cities experiencing economic growth is an important trend in the development trajectory of the country (Todes *et al*., 2010; Eigelaar-Meets, 2018). There has similarly been a move away from economically declining regions, and Cross (2009) notes that economic downturn and deteriorating economic conditions have been key drivers of out-migration in South Africa. In general, rural–urban migration is characterised by four main corridors, mainly from Limpopo, Mpumalanga, the Free State and northern KwaZulu-Natal flowing into Gauteng, and from southern KwaZulu-Natal and the Eastern Cape (especially the Transkei and Ciskei former homeland regions) flowing into the Western Cape (Cross, 2009; Atkinson, 2014).

The literature motivates that the movement of people to large urban areas is primarily driven by employment opportunities. South Africa's unemployment rate is one of the highest in the world, however; national unemployment consistently measures above 20 %, increasing gradually from 23.2 % in 2008 to 27.1 % in 2018 (Stats SA, 2019a). Equally alarming are national youth unemployment figures, with Statistics South Africa (Stats SA) estimating that 50 % of young people aged 15–34 years are unemployed in terms of the broad definition[2] (Stats SA, 2018b). Duff and Fryer (2005) explain that the unemployment problem in rural areas and among the youth is exacerbated by a general lack of skills, low levels of schooling and a poor education system, lack of work experience, limited opportunities for entrepreneurship and low social capital, all of which act to encourage youth migration into urban areas, but may not support migrants in actually fulfilling their employment aspirations.

In this light, several authors argue that population movement may not always be opportunity-driven as the usual assumptions would imply, but that in the local context, prevailing levels of unemployment, poor employment prospects and the critical scarcity of jobs may in fact force some migrants to move with other goals in mind. Bekker (2002) proposes that a 'secondary engine' fuelling migration in South Africa may be the search for improved living conditions, including both social and economic infrastructure (including education, healthcare, housing, basic services and transport), which typically comes into play when poverty in the sending region acts

[2] The broad definition includes those who have given up looking for work.

as a major push factor, even when employment opportunities are limited or non-existent in receiving areas. Collinson (2010) points out that rural villages may thus experience net population losses to nearby towns, expressly for accessing improved services, and that this pattern of settlement change seems to be associated with step migration, as out-migrants choose to leave their rural homes for larger places (but not necessarily the largest), thus reducing the extent of social and economic change accompanying the move. This sentiment is shared by Cross (2001), who agrees that for some unemployed migrants from rural areas, there may be little advantage in moving to the city to look for work. The availability of, and access to, land, housing and services in small towns may thus be viewed by some as 'second-best', a so-called 'substitute goal' (Atkinson, 2014; DEA, 2016). This confirms, among other things, the suggestion by Marais and Krige (2000) that the availability of housing in some small towns has encouraged movement in the absence of economic growth. Another local study by Pekane (2018) found that out-migrants move to destinations that provide comparatively better access to services than their place of origin.

3.1.1.1 Types of internal migration

Within the developmental context of South Africa, distinguishing between different kinds of migration is useful (Moses & Yu, 2009). Three forms of migration are commonly identified in South African analysis: circulatory or temporary migration, oscillating migration and step-wise migration. All three forms are closely related to urbanisation and to the fact that perceived employment opportunities and associated income dominate an individual's decision to move, for how long and where to (Bekker, 2002).

The trend towards temporary or circular migration sees migrants maintaining connections with their rural roots, and continuing to send back remittances to their relatives in the rural areas following a move to the city. Atkinson (2014) explains that migrants moving away from former homelands to erstwhile 'white South African towns' may still have resources available to them in the rural areas, such as land or a house. However, their need for social services, as well as their desire for a job in the formal sector, may encourage them to leave their rural roots (possibly leaving some family members behind as a fall-back position). In such cases, migrants may periodically return to their rural places of origin; and ultimately return in retirement or due to ill health (Clark, Collinson, Kahn, Drullinger & Tollman, 2007).

Oscillating migration typically refers to back-and-forth labour-related migration between rural areas and economic nodes. It is often associated with the need for unskilled temporary seasonal workers in areas with intensive agriculture such as horticultural crops, where small farms are located near towns, or in locations where workforces can more easily be transported to and from their residential villages (Atkinson, 2014). Typical areas include the agricultural sector of the Western Cape, the horticultural areas of the eastern Free State, the wine-growing areas of the Northern Cape, and the intensive vegetable-growing areas in Mpumalanga.

Step-wise or gravity-flow migration refers to permanent migration towards urban places, and is characterised by flows of people from rural areas to neighbouring smaller towns, and subsequently to cities and larger metropoles. This is a common trend in South Africa, where demographic flows are commonly into the peri-urban areas of metros (an increasingly important trend in some parts of KwaZulu-Natal, Gauteng and the Western Cape) and into secondary cities. Secondary cities have experienced the most rapid increases from in-migration, although the largest flows of people still gravitate to the metros (Cross, 2009; Todes *et al.*, 2010; Reed, 2013).

3.1.1.2 Characteristics of migrants

Regardless of spatial inequalities, some specific groups of people are more inclined to migrate than others. The characteristics of potential migrants have long been a central part of explaining who migrates and who does not. In short, Lee (1966) observed two enduring generalisations about migration: firstly that migration is selective in that not everyone migrates, and secondly that people are more likely to migrate at certain stages of the life cycle than at others.

It is well established that migrants are a distinct group with respect to a number of characteristics (Bernard & Bell, 2018). In local studies, the typical variables included in migration analysis have included age, gender, race, marital status, household composition, level of education and employment status. While these demographic variables may be somewhat limited in their focus, they have proved robust enough to form a framework for studying migration and migrants. More rigorous studies have bolstered their analysis with qualitative data on factors such as attitudes (see Kok & Collinson, 2006).

Kok, O'Donovan, Bouare and Van Zyl (2003) and others have studied migrant selectivity in South African migration and found that the likelihood of becoming a migrant is inversely related to age, that it increases with income and education, is higher in Gauteng and the Western Cape, and is influenced by whether the origin is urban or rural. These demographic variables are discussed in more detail below in relation to South African migrants.

I. Age

In South Africa, the demographic composition of migrants is influenced by the selective nature of migration, particularly age selectivity (Moses & Yu, 2009). When decomposing migration probabilities by age, migration patterns in South Africa are highly age selective, with movement trends favouring working-age people who comprise the largest majority of all migrants (Oosthuizen & Naidoo, 2004; Mastrorillo *et al*., 2016). In addition, research has shown that young adults (i.e., youth) (up to the age of 35) tend to be most likely to migrate, especially in search of jobs (Van der Berg *et al.*, 2002). Children between the ages of 10 and 17 years, as well as elderly people, tend to be less migratory than persons in the working-age group (18–64 years) as well as very young children (Kok *et al*., 2003; Stats SA, 2015a). These trends see sending areas typically losing their young adult populations, which not only leaves rural areas with an aged and vulnerable population, but also exacerbates unemployment in urban areas where competition for scarce work is rife (Mbatha & Roodt, 2014).

II. Gender

Historically, South African migration has had a strong gender bias (Oosthuizen & Naidoo, 2004), due to the traditional division of work into waged labour for males and household production functions for females (Posel, 2004; Moses & Yu, 2009). Men typically migrated to fill labour-intensive positions in the mining regions in the northern parts of South Africa (Posel, 2004; Moses & Yu, 2009). Todes (2001) points out the importance of cultural and institutional barriers in explaining lower rates of migration for women, who faced enforced immobility in the past.

Men, as the main household earners, tend to be more migratory than women, especially over long distances, as males are recruited for laborious and arduous tasks in agriculture and mining (National Research Council, 1993; Moses & Yu, 2009). Britz (2002) explains that more unmarried young males migrate to areas where mining, agriculture, forestry and heavy industries are prevalent, while services and administration have tended to attract more females.

The impact of historical migration flows on regional female-to-male sex ratios is still evident, as shown by Von Fintel and Moses (2017). Most municipalities in the former homelands have substantially more prime-aged (20–39-year-old) women than men (Von Fintel & Moses, 2017). In contrast, the metropolitan municipalities in the Western Cape and Gauteng, which are also the dominant migrant-receiving municipalities, have more prime-aged men than women, an observation that Von Fintel and Moses (2017) note as being indicative of the heavily gendered cumulative impact of migration and settlement in South Africa's economic centres. This is corroborated by Oosthuizen and Naidoo (2004), who found that in Gauteng, working-age male in-migrants between the ages of 15 and 64 years outnumber females by 111 to 100, pointing to the historical and continued demand for labour in heavy industry and mining in the province.

There is, however, lack of consensus whether South African migration patterns demonstrate a gender bias. Stats SA (2015a) asserts that *"there is no gender selectivity worth mentioning in South African internal migration"*. Kok *et al*. (2003) warn against explaining observed general male dominance in migration on any theoretical grounds, and caution that *"[a]lthough it has been shown earlier that men are generally more migratory than women in most age categories … the general difference is insignificant".* Collinson (2010) notes that since the onset of democracy, one of the main changes in migration patterns has been that both younger men and women in the 20–25 age bracket are increasingly likely to migrate. Within contemporary South Africa, women are increasingly moving to urban areas to access employment opportunities (Posel & Casale, 2003; Collinson, Kok & Garenne, 2006).

Von Fintel and Moses (2017) found that male and female migrants might be incentivised differently. In their view, women do not move only to seek livelihoods from the job market, which does not serve them as well as men, but they also follow service provision in more developed areas, and motivated and educated young women may migrate to gain more freedom from traditional rural society and gendered power relations.

III. Race

In South Africa, the importance of race as a descriptive variable for migrant characteristics is rooted in the apartheid legacy. Moses and Yu (2009) note that traditionally, the racial groups most likely to migrate were black Africans and whites.

In analysing the characteristics of the ten largest migration streams in contemporary South Africa, Stats SA (2015b) found that while black African migrants are more dominant (in absolute terms) in most of the reported streams, the dominance of white migrants in the Western Cape-to-Gauteng stream, and Indian/Asian migrants in the KwaZulu-Natal-to-Gauteng stream, should not be overlooked. Coloured persons are the least migratory population group in the country (Stats SA, 2015a; Mastrorillo *et al*., 2016). Oosthuizen and Naidoo (2004) found similar trends in their investigation of race in-migration patterns to Gauteng: blacks representing just more than three-quarters of in-migrants to Gauteng, whites comprising just less than one-fifth of migrants, and coloureds and Indians/Asians accounting for the remaining 5 % of in-migrants.

IV. Education

Education plays a dual role in stimulating mobility, either to seek a better education, or to pursue employment opportunities that open up due to education or occupation (Britz, 2002; Stats SA, 2015a). According to Grogger and Hanson (2011), two prominent features of labour movements are related to level of education: firstly, the more educated are more likely to migrate (exemplifying positive selection of migrants) and, secondly, more-educated migrants are more likely to settle in a destination with high rewards for skill (exemplifying positive sorting with respect to destination). The positive relationship between migration and education has been confirmed in South Africa, with migrants generally having higher educational attainment than non-migrants (Stats SA, 2015a; Mastrorillo *et al*., 2016). Mastrorillo *et al.* (2016) found that migrants with secondary or university education accounted for the largest share of internal migrants (about 86 %), while Stats SA (2015b) found that a higher level of education attainment is associated with a 2.9 % increase in migration probability.

Education factors were also shown to be relevant in migration destination preferences. In South Africa, educated migrants favour urban areas and higher-wage districts, while uneducated migrants gravitate towards wage employment in industry, mining and agriculture (National Research Council, 1993; Choe & Chrite. 2014). Another selection factor among South African migrants is occupation (Moses & Yu, 2009). Skilled persons, or those with some education or potential for skills development and training, tend to prefer urban-to-urban or rural-to-urban migration, while the unskilled and poorly educated are dominant in rural-to-rural migration (National Research Council, 1993).

V. Employment status

In the South African context, Stats SA (2015a) found that employed migrants are predominant in only two of the five main inter-provincial migration streams, namely KwaZulu-Natal-to-Gauteng, and Gauteng-to-Western Cape; unemployed migrants tend to dominate in the three other streams, namely Limpopo-to-Gauteng, Mpumalanga-to-Gauteng and Eastern Cape-to-Western Cape. Employed migrants also tend to be more readily absorbed into the formal employment market at their destination, but only in the case of the Gauteng-to-Western Cape migration stream are migrants *less* likely to have no income at the destination than inter-provincial migrants elsewhere (Stats SA, 2015a).

3.1.2 International migration trends

South Africa's international migration trends over the past two decades have been characterised largely by the brain drain (high levels of emigration of highly skilled people from South Africa), together with high levels of immigration into South Africa from within the southern African region (Van Aardt, 2008). While international migration is not a focus of this study, the high-level trends are briefly discussed in this section, given their economic and social impacts.

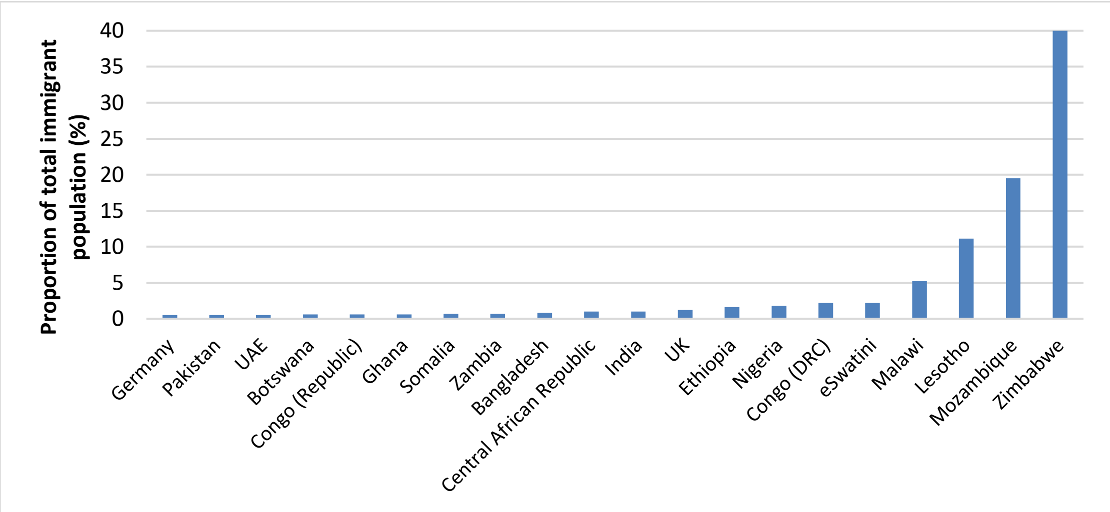


***Figure 6:** Proportion of total immigrant population within South Africa, 2016*

Source: Own illustration using Stats SA (2017) data

Figure 6 illustrates the proportion of immigrants to South Africa from different countries. These statistics are based on immigration statistics by Stats SA and do not necessarily include undocumented or illegal cross-border migrants. South Africa's history and position as a regional economic powerhouse make it a major destination for immigrants from the region and further afield (OECD/ILO, 2018). International migration into South Africa is stimulated largely by poverty, deteriorating economic conditions and political instability in neighbouring countries. According to Stats SA (2017), the largest immigrant populations within South Africa are from neighbouring countries (**Figure 6**). The majority of these migrants comprise *"politically persecuted refugees,* *economic migrants (from professionals to unskilled persons), humanitarian migrants (including unaccompanied children), traders, shoppers and transit migrants"* (Polzer, 2008). Current international migration trends in South Africa indicate that the bulk of migrants are concentrated in the urban areas of Gauteng (46.8 %) and the Western Cape (13.4 %) (Stats SA, 2007a).

South Africa is also a significant contributor to international migrant statistics, and is known for the emigration of its citizens to more developed countries such as the United Kingdom, Australia, New Zealand, Canada and the USA – the five traditional English-speaking immigration countries for emigrants from South Africa (**Figure 7**) (Kaplan & Höppli, 2017). The vast majority of these emigrants are considered to be highly qualified professionals, resulting in a net emigration loss of highly skilled people (known as the 'brain drain').

The extent of the brain drain is difficult to measure due to a lack of reliable data on the extent of South African skilled emigration. Based on immigration statistics from 31 countries (the traditional five immigration countries, 25 other OECD countries and the United Arab Emirates), it is estimated that the net immigration of South African-born emigrants to such countries between 2000 and 2013 was approximately 767,000 people, with roughly 77 % living in the five traditional English-speaking immigration countries (**Figure 7**) (Kaplan & Höppli, 2017).

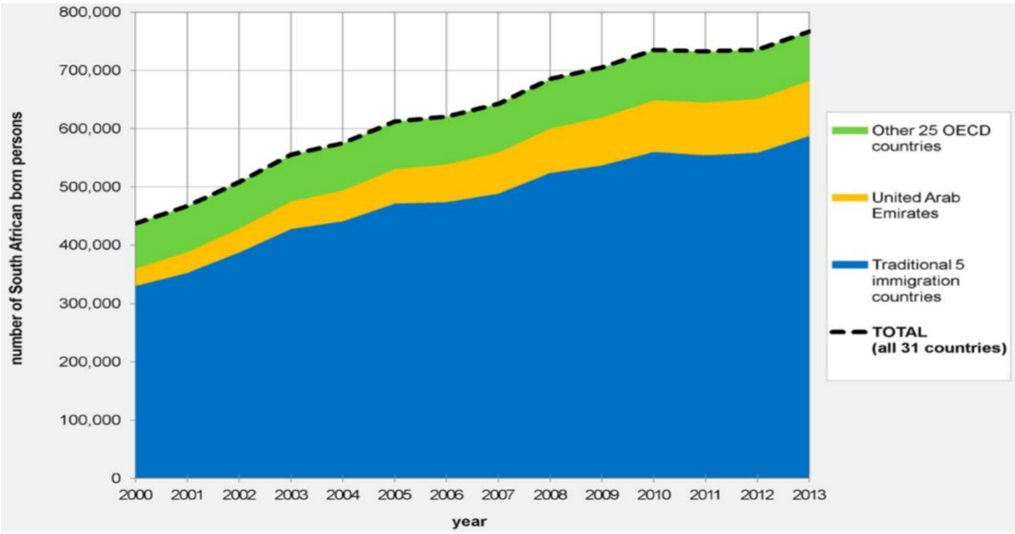


***Figure 7:** Development of total stock of South African-born persons living abroad (emigrants), 2000–2013*
Source: Kaplan and Höppli (2017)

3.2 CHANGING ECONOMIC DYNAMICS OF SOUTH AFRICA

South Africa has made significant advances in economic and social development over the last 25 years. Ranked as an 'upper middle-income country' by the World Bank, South Africa boasts the most developed, diversified and technologically advanced economy in Africa, ranking among the 30th largest in the world, and one of the three largest on the African continent (InvestSA, 2018). Yet the economy faces important structural challenges, arguably the three biggest being high unemployment, low labour-force participation and high inequality, all three of which are at extreme levels by international comparative standards (Bhorat & Rooney, 2017; Western Cape Provincial Treasury, 2018). Between 2004 and 2008, South Africa experienced large economic growth due to the stable micro-economic environment and a global boom in commodities (**Figure 8**) (The Presidency, 2014), although Musvoto (2014) cautions against assuming that economic growth equates to economic opportunities.

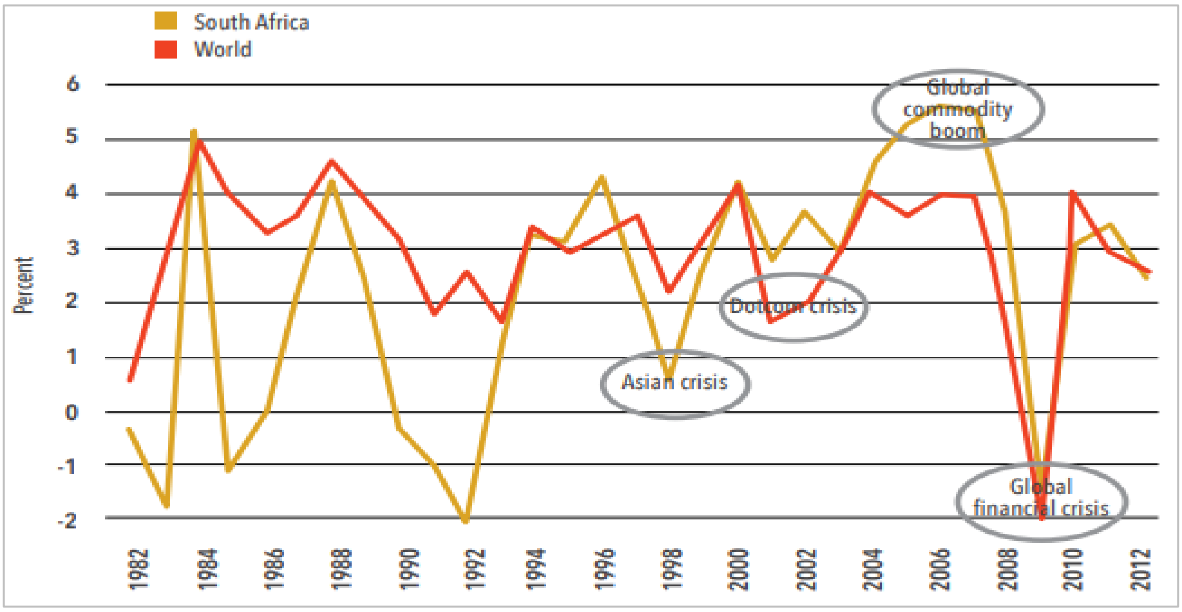


Figure 8: *South African GDP compared to world GDP growth, 1982–2012*

Source: The Presidency (2014)

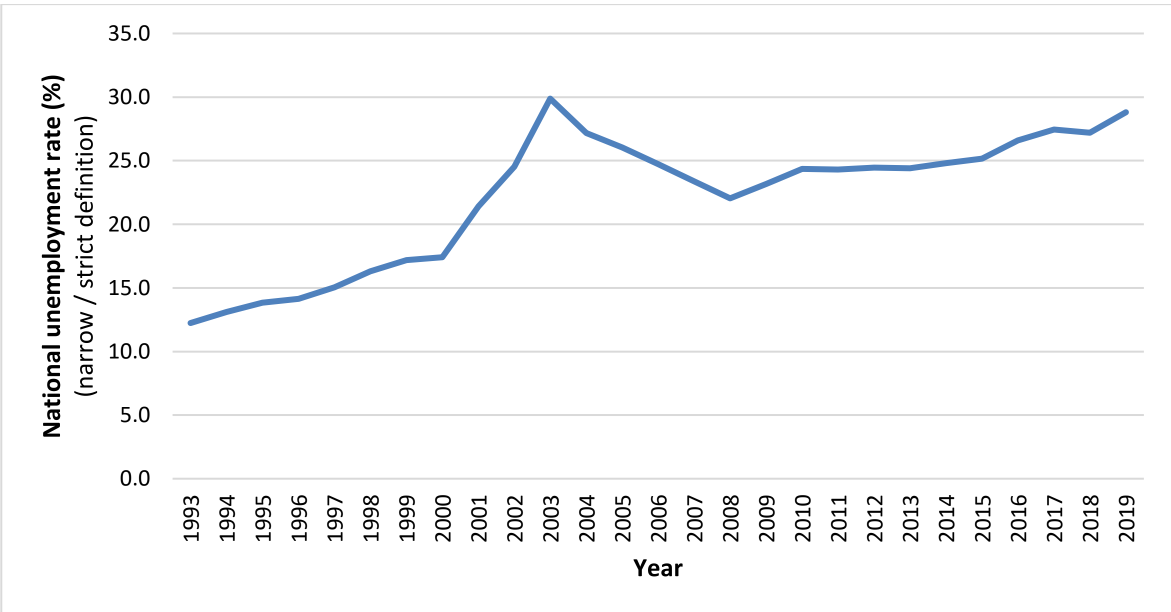


Figure 9: *National unemployment rates, 1993–2019*

Source: Own illustration using Quantec (2020a) data

The standard labour-force approach provides two definitions of unemployment: a 'strict' or 'narrow' definition which includes only active job seekers; and an 'expanded' or 'broad' definition which includes the non-searching unemployed as well (Nattrass, 2002). While any employment estimates in South Africa are fraught with difficulties and should be used with care (Quantec, 2020a), Geyer, Coetzee, Du Plessis, Donaldson and Nijkamp (2011) note the trend that increasing rural-to-urban migration rates since the democratisation of the state were accompanied by rising unemployment rates, with the highest rate of 41 % being recorded in 2002 according to the expanded or broad definition, and 30 % according to the strict or narrow definition (Stats SA, 2003) (**Figure 9**). Geyer *et al*. (2011) highlight that in the context of increasing rural-to-urban migration, as well as international migration, a large proportion of people may be finding employment in the informal sector. In economic terms, unemployment is a serious concern, affecting economic production, social stability and welfare, eroding human capital and contributing to increased crime (Kingdon & Knight, 2004b; 2007).

3.2.1 Overview of economic and labour-market trends

While the South African economy has traditionally been rooted in the primary sector – the result of a wealth of mineral resources and favourable agrarian conditions – recent decades have seen a structural shift in output. Bhorat and Rooney (2017) explain that in broad terms, there has been a shift away from tradable commodity goods sectors, such as agriculture, mining and manufacturing, towards non-tradable service-led sectors, especially financial services (**Figure 10**). They argue that the changing dynamics in sectoral trends over the last two decades indicate that South Africa has become a service-producing economy, and that South Africa's economic development trajectory will depend increasingly on intensive use of services.

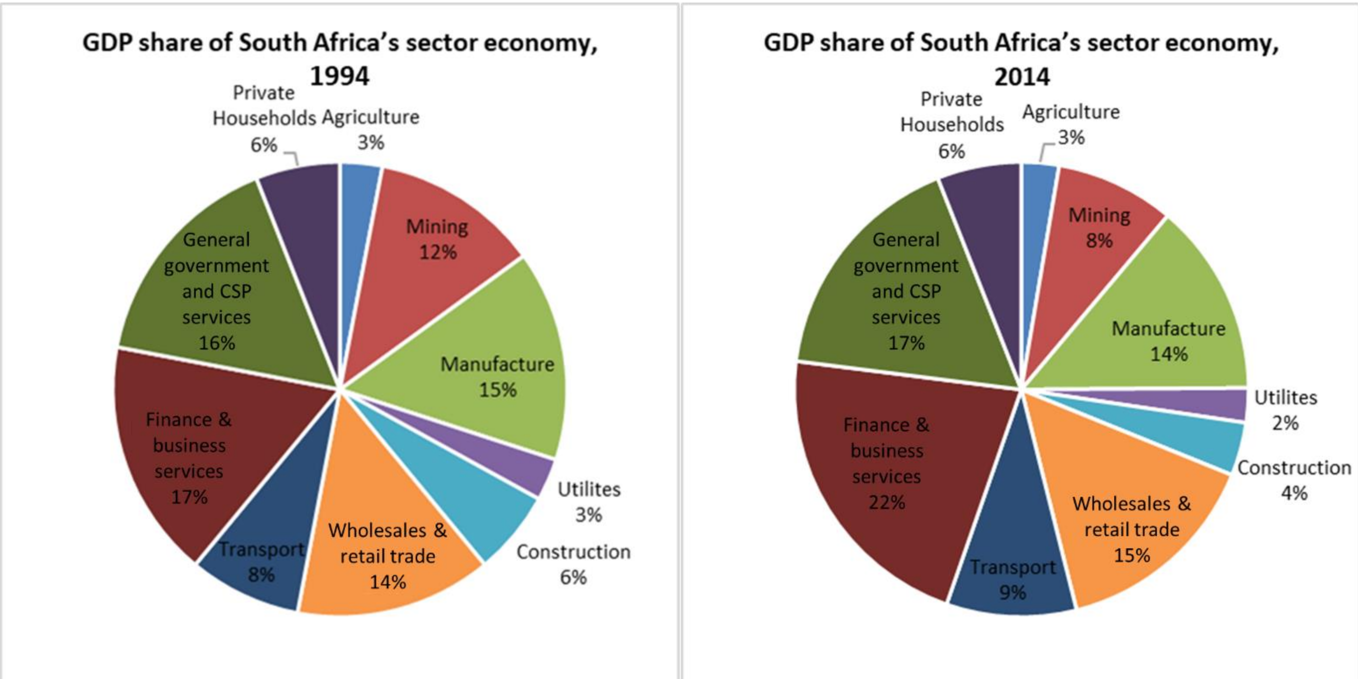


Figure 10: *GDP share of South Africa's national economy per sector, 1994 and 2014*

Source: Own illustration based on Bhorat, Naidoo, Oosthuizen and Pillay (2016)

Labour-market measures are critical in determining and monitoring the health of an economy. South Africa's labour market is characterised by endemic unemployment, accompanied by chronically widespread poverty and inequality. Consensus regarding this dire situation is that exclusion from the labour market is the central socio-economic problem facing the country (Bhorat & Rooney, 2017).

In the post-apartheid period, South Africa's economy has struggled to sustain rapid growth rates over extended periods (**Figure 8**), and has thus been unable to generate sufficient employment opportunities for the ever-growing numbers of young work seekers (**Figure 9**) (Western Cape Provincial Treasury, 2018). Over the last two decades, national unemployment rates have consistently measured above 20 % (**Figure 9**), while youth and unskilled rural dwellers suffer even higher unemployment. In the long term, high unemployment is associated with social insecurity and low economic growth, and it is widely accepted that the effects of unemployment manifest as other socio-economic problems, including crime, poverty, alcoholism, HIV/AIDS, as well as poor educational outcomes and low skill levels (Bhorat *et al*., 2016; CSIR, 2015b). Low labour-market participation also places a burden on the state, as well as on society, in having to support and sustain those not working. Together with youth unemployment, rural unemployment is a huge problem in South Africa, particularly in the former homeland regions in rural KwaZulu-Natal and the Eastern Cape, where as many as 50 % of people are unemployed (according to the broad definition), while most other rural areas in the country have unemployment rates approaching those levels (Roodt, 2019).

At an aggregate level, unemployment is the direct result of labour supply outstripping demand. Over-saturation of certain skills can also contribute to unemployment rates, where in South Africa, labour supply is dominated by a semi- to low-skilled workforce (Bhorat *et al*., 2016). The transition from a commodity-led to a service-led economy is causing a loss of low-skill jobs, while the emerging 'information economy' demands a highly skilled, and in turn highly educated, workforce (McLafferty, 2001).

A large body of literature has tried to explain the high unemployment rate in South Africa; Fourie (2012) provides an overview. Aliber, Baipheti and Jacobs (2007), and Ferrer (2013) note that employment on commercial farms has shown a significant decline (as much as 37.9 %) over the long term. Industrial downscaling (especially in the mining industry, but also in the textile-manufacturing and agriculture industries) is another contributory factor to changing employment dynamics (National Population Unit, 2001; CDE, 2005; Todes *et al.*, 2010) (**Figure 11**). Kingdon and Knight (2009) explain that a large increase in the supply of labour followed the abolition of apartheid, predominantly the influx of low-skilled labour from the former homeland regions into towns and cities, while demand for labour stagnated. The disparity between the demand for, and supply of, skills is also argued to be an important driver of soaring unemployment rates, where skills-biased technical change and decline in mining and agriculture reduce the demand for low-skilled workers (Banerjee, Galiani, Levinsohn, McLaren & Woolard, 2008). Furthermore, Duff and Fryer (2005) note that a lack of skills, low levels of education, lack of work experience and low social capital exacerbate the unemployment problem in rural areas, especially among the youth.

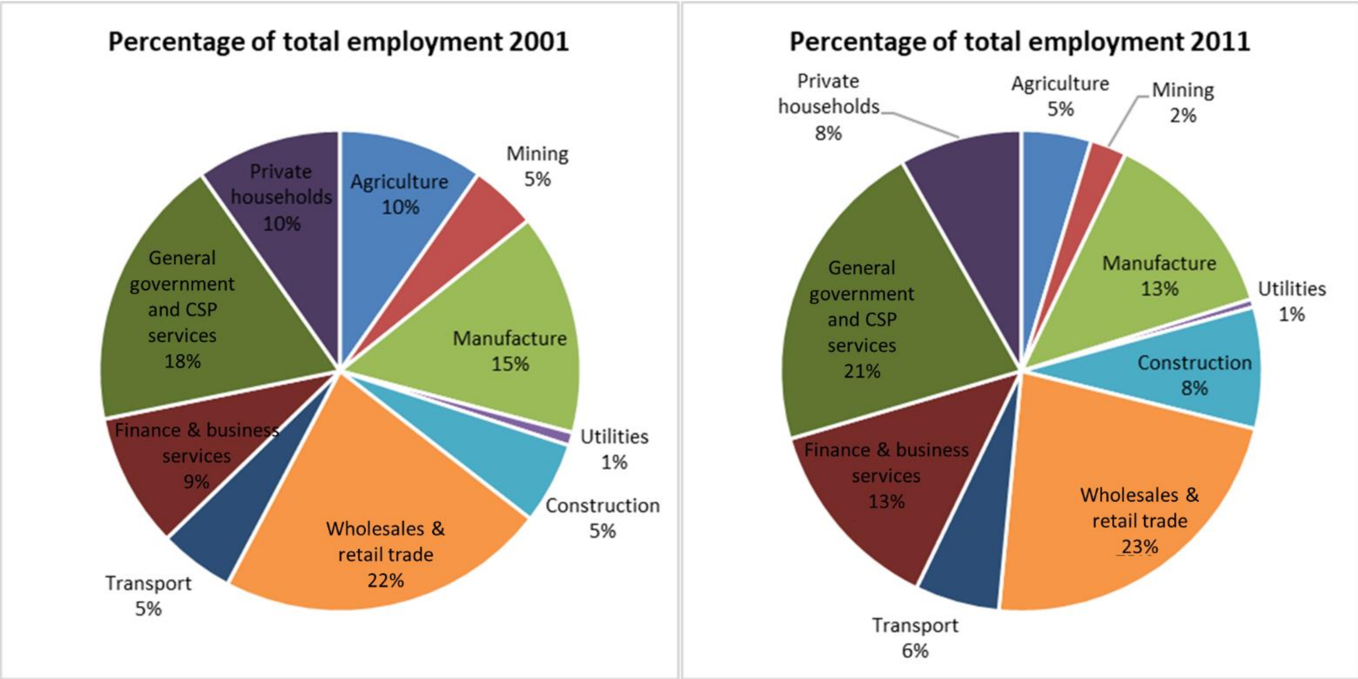


Figure 11: *Sectoral composition of national employment, 2001 and 2011*

Source: Own calculations using Stats SA (2002; 2011a) data

3.2.2 Employment sectors and labour-market segmentation

Changing economic conditions affect the various sectors of employment and segments of the labour market differently. It is therefore useful to classify these in the context of the South African economy. Decomposing the sectors of employment in the South African labour force, Van der Berg (1992) in Dieden (2004) identifies three groups based on the extent to which workers and dependants *"participate in the modern consumer economy"*:

- Core economy sectors: Manufacturing, government, other industry and services
- Marginal modern economy: Commercial agriculture, domestic services, mining
- Peripheral economy: Subsistence agriculture, informal sector.

Makgetla (2004) in Altman (2005) segments the South African labour market that emerged from the apartheid system as follows:

- Highly skilled professionals at the top end of the formal sector, predominantly professionals and managers
- Less skilled workers at the lower end of the formal sector, administrative and technical workers
- Public sector civil servants in the health, education and security sectors
- Segments defined by colonial labour relations, consisting of:
    - Mining and agricultural workers at the bottom end of the formal sector
    - Unskilled workers in the public sector at the bottom end of the formal sector
    - Domestic workers employed in private households

- Informal and agricultural subsistence workers in the former homelands
- Unpaid production and reproductive workers, consisting mostly of women and children.

3.2.3 Spatial distribution of economic activity in South Africa

The South African economy is characterised by spatial inequality, with the location and distribution of significant and dynamic economic activity heavily concentrated in a few core cities and city regions (Krugell, 2005) (**Figure 12**, **Figure 13** and **Figure 14**)[3]. According to the National Spatial Development Perspective, South Africa has 26 areas of core economic concentration, which play an important role in integrating South Africa into the regional and global economy (The Presidency, 2007). The historical dominance of South Africa's six largest cities remains largely unaltered, their importance and the consequent spatial economic inequality explained by patterns of trade, mineral extraction, climate and culture, along with apartheid's social engineering and the recent transformation of local governments (Krugell, 2005).

[3] In these maps, and throughout the report, the settlement naming convention was to use the most current official place names, including any changes after either the 2001 or 2011 censuses. **Table 49** and **Table 50** in **Appendix F** set out the old and equivalent new names of settlements and countries referred to in this report.

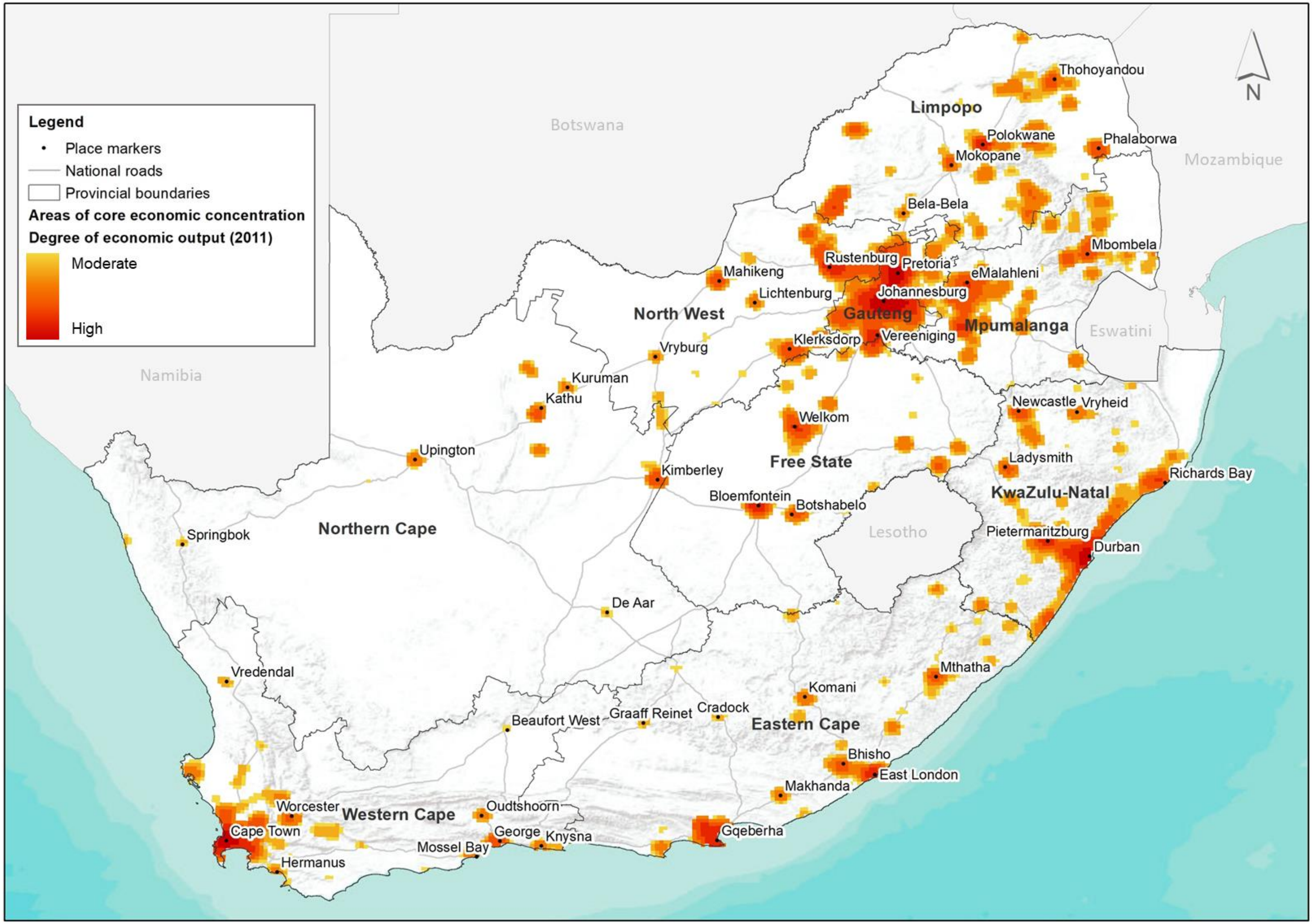


Figure 12: Areas of core economic concentration

Source: Own illustration using CSIR (2020a) data

Most of South Africa's cities and towns produce very little in terms of economic output. This is most apparent in the spatial concentrations of the economic activity and the rural–urban divide (Naude, Krugell & Serumaga-Zake, 2002). The foremost economic centres of the country include the eight metropolitan areas, with a strong node stretching from the Middelburg/eMalahleni conurbation in the east, through the Gauteng city region, to the Rustenburg/Brits area in the west. Further areas of high economic activity include the major secondary cities and their surrounding areas, the coastal areas of KwaZulu-Natal, and the mineral extraction zones in Limpopo and the Northern Cape (The Presidency, 2007). In terms of spatial distribution, these densely populated core economic nodes are largely concentrated in the northern and eastern parts of the country – the division being an imaginary line that stretches from Upington in the north, through Kimberley and Bloemfontein, to Durban on the south coast, with some additional concentrations along the coastlines of the Western and Eastern Cape (The Presidency, 2007) (**Figure 12**). While these core areas share similar characteristics, they are not homogeneous entities (**Figure 13** and **Figure 14**).

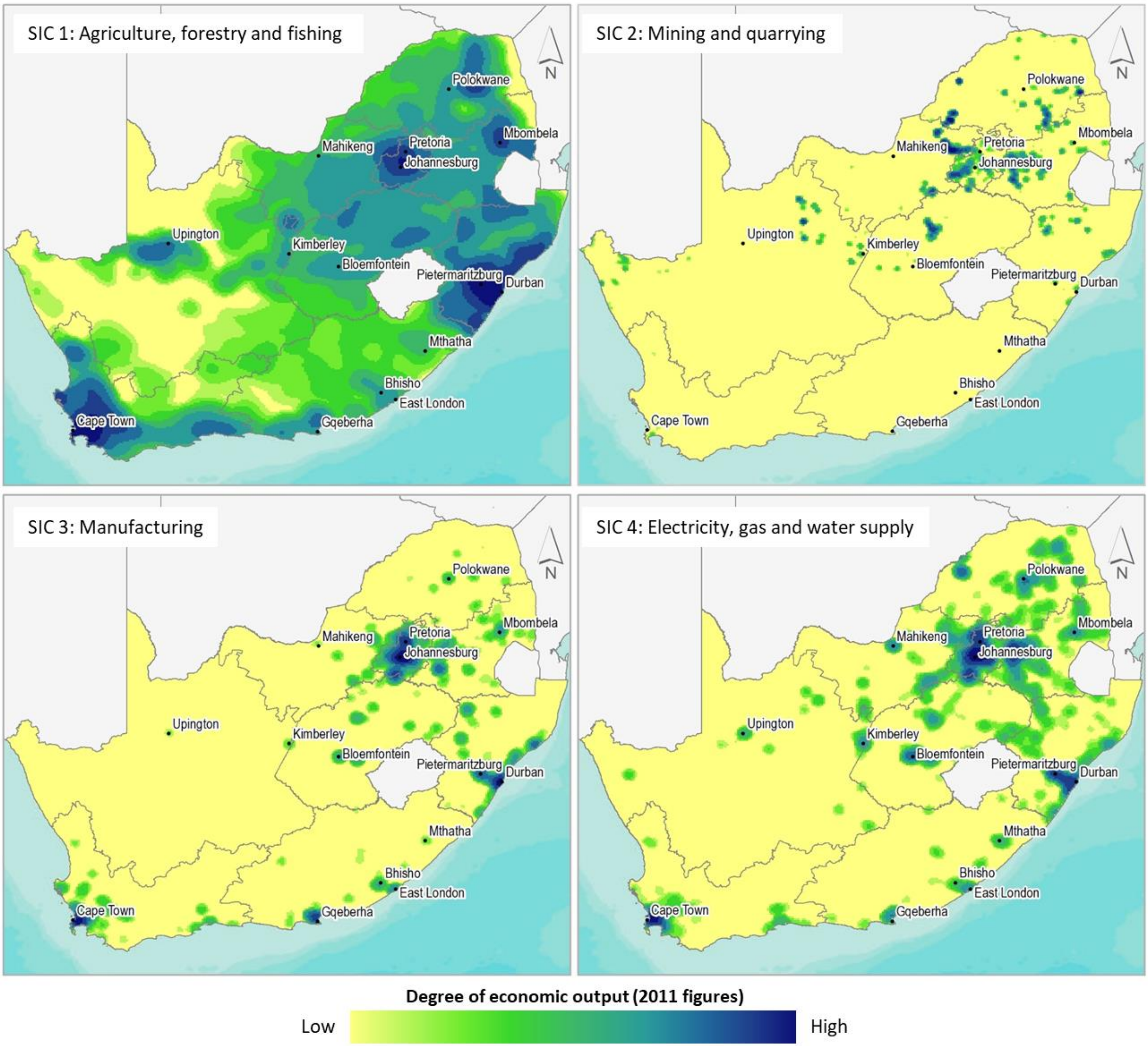


Figure 13: *Spatial distribution and concentration of economic output per primary and secondary sector activities*

Source: Own illustration using CSIR (2020a) data

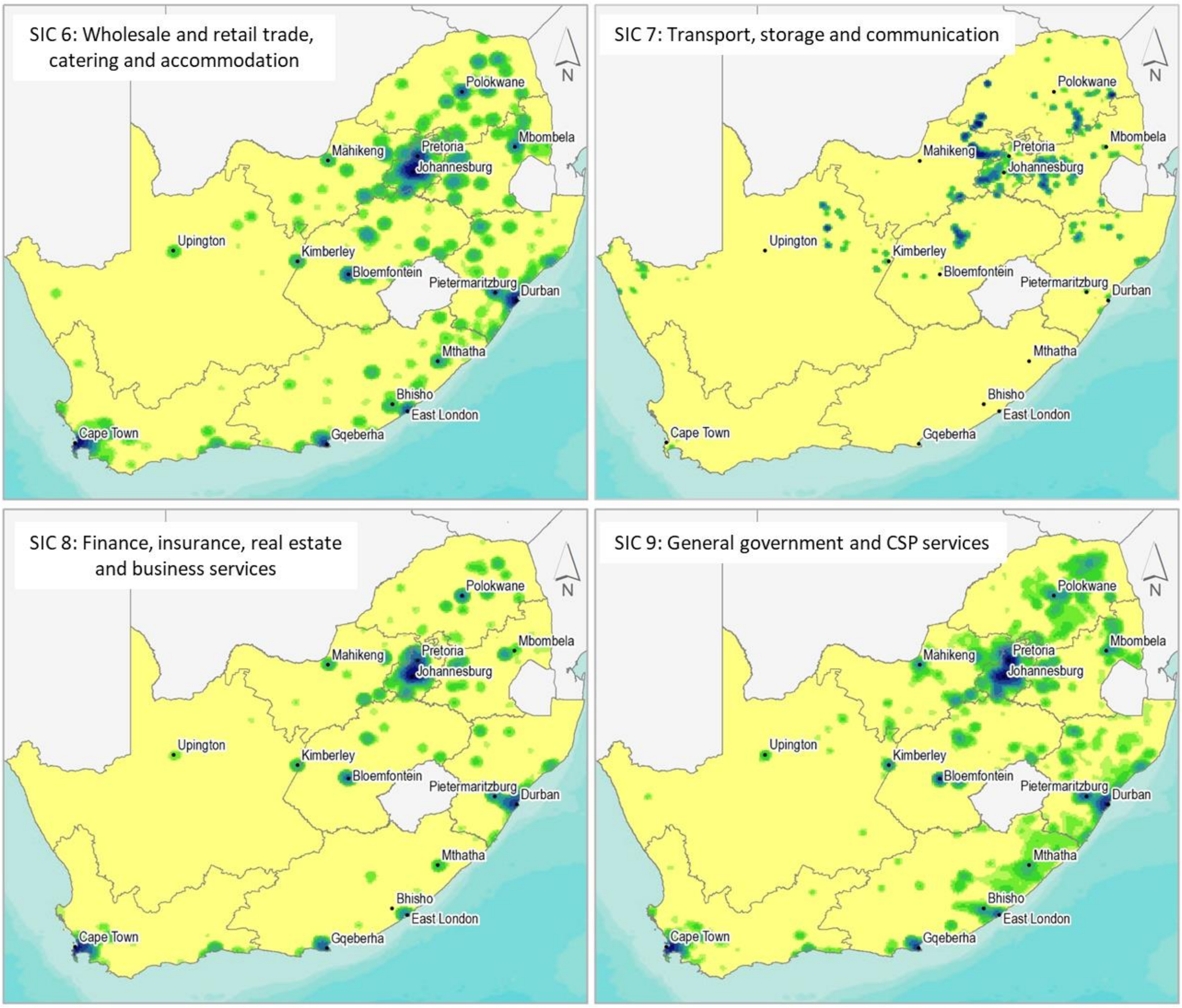


Figure 14: *Spatial distribution and concentration of economic output per tertiary sector activities*

Source: Own illustration using CSIR (2020a) data

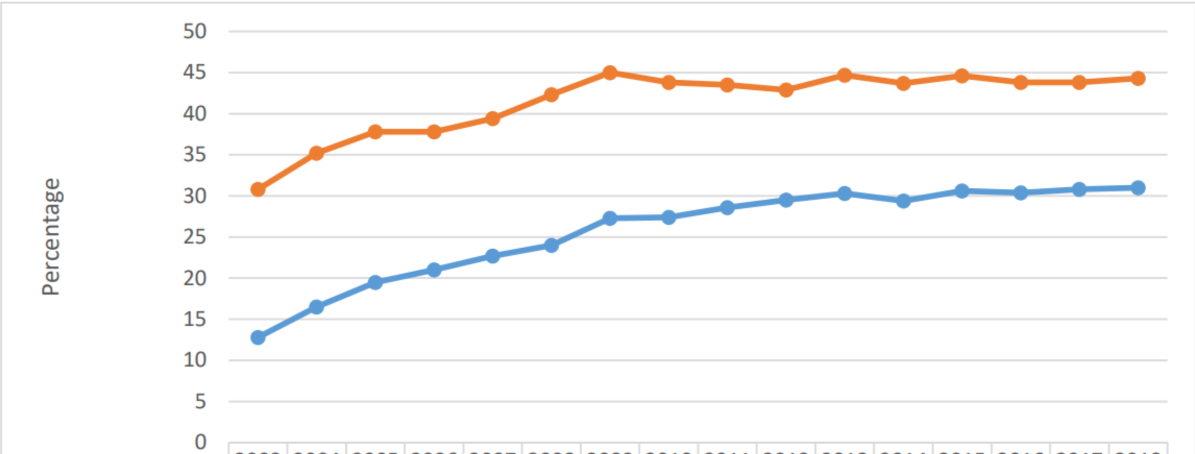
3.2.4 Welfare dynamics and social grant dependency

Income (individual) refers to money (or some equivalent value) received by an individual to support their livelihood, normally on a regular basis (Stats SA, 2012b). In general, income can be decomposed into five main sources (Stats SA, 2019a), namely, labour-market income, social grants, remittances or allowances from outside the household, in-kind income and other income (e.g., investments, interests, dividends, shares).

While labour-market income has consistently constituted the largest share of overall household income nationally (roughly 71 % between 2011 and 2015), social grants and remittances continue to play a crucial role in reducing the income inequality gap for a large proportion of the population (Stats SA, 2019a). Given that the percentage of the population receiving grants exceeds the employed percentage, South Africa is proportionally one of the biggest welfare states in the world (IRR, 2017).

South Africa's social welfare system serves to alleviate poverty and inequality by providing grants and social services to vulnerable groups (National Treasury, 2019). According to Stats SA (2019a), social grants contributed on average 5.4 % to overall household income in 2015. Additionally, Stats SA (2019a) reports that in 2018, grants were the second most important source of livelihood (45.2 %) for households after labour-market income (salaries and wages) (64.8 %), and constituted the main source of income for almost 20.0 % of households nationally. This was particularly true in the poorer provinces where a larger percentage of households (35.0 % in the Eastern Cape, 30.4 % in Limpopo and 29.8 % in the Northern Cape) rely on grants as their main source of livelihood (Stats SA, 2019a).

The South African Social Security Agency (SASSA) administers seven long-term grants on behalf of the national government. Together with grant-specific requirements, eligibility for each grant is dependent on an income-based means test (RSA, 2019). The number of people receiving social grants has increased markedly over the last 20 years (**Figure 15**) (Stats SA, 2019a). According to findings from the IRR South Africa Survey, in 2001 there were just under 12.5 million in employment and roughly 4 million people receiving social grants. Between 2001 and 2016, the number of people receiving grants increased by over 300 %, while those with jobs increased by only 24 % (IRR, 2017). By 2018, there were almost 18 million grant recipients, accounting for 31 % of persons and 44.3 % of households nationally who received one or more grants (**Figure 15**) (Stats SA, 2019a). National Treasury's 2019 Budget Review (2019) reports that total national grant spending in 2018/19 amounted to R162.6 billion, supporting 17.9 million beneficiaries, and that social grant coverage was growing by 2 % annually.



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Persons	12,8	16,5	19,5	21,0	22,7	24,0	27,3	27,4	28,6	29,5	30,3	29,4	30,6	30,4	30,8	31,0
Households	30,8	35,2	37,8	37,8	39,4	42,3	45,0	43,8	43,5	42,9	44,7	43,7	44,6	43,8	43,8	44,3

Figure 15: *Percentage of households and individuals who benefited from social grants, 2003–2018*
Source: Stats SA (2019c)

While the amounts paid have increased significantly in real terms since 2002 with the increase in total recipients, the coverage of the child support grant has also expanded, from all children below the age of seven years to all children under the age of 18 years (South African Government, 2019). In terms of the number of grant recipients and the proportion by type of grant (2017 figures), the vast majority are made up of child support grants (75 %), followed by old age grants (18 %) and disability grants (6 %) (Stats SA, 2018c). The distribution of these grants is split evenly between males and females, with the exception of old age grants where female recipients outnumbered male recipients by two to one (Stats SA, 2018c).

3.3 SOUTH AFRICAN SETTLEMENT DYNAMICS

Settlements are essentially systems, representing places where people live and interact, both socially and economically. Towns and cities are not dormant; they can be regarded as the physical, technical and social expression of the dominant, though changing, cultural and economic processes of their population over time (CSIR, 2002).

Importantly, settlements have different roles to play within their local economy (Swinney, McDonald & Ramuni, 2018). Metropolitan cities and municipalities are regarded as the economic powerhouses and growth engines of the country, with spatially dense economies that are able to provide access to higher-order goods and services. Larger and more organised (formal or proclaimed) settlements also have governance and management functions administered through elected representatives or traditional structures (DEAT, 2006). The sheer demographic size and infrastructural resources of metropolitan regions allow them to forge ahead as they maintain economic momentum. In contrast, small to medium-sized towns and cities tend to be more individually unique in terms of their economic base (for example tourism, manufacturing, agriculture or mining), with very different economic fortunes, ranging from growth to stagnation or deterioration (Atkinson, 2008). Small to medium-sized towns and cities differ significantly with respect to both their economic base and economic prospects, as well with the degree of goods and services they are able to provide.

Settlements are central to local and national efforts to address the multitude of challenges facing sustainable development (CSIR, 2002). With the socio-political overlay of settlement engineering in South Africa, the pattern of human settlement is complex and multifaceted (DEAT, 2006). According to Bunce (1982), settlements can be categorised or classified by considering a number of factors such as groupings of buildings, morphology, location, size or function. Since settlements constitute the pivotal unit of spatial organisation for this study, an overview of South African settlement dynamics is warranted.

3.3.1 Established settlement classification typologies

Settlement classification typologies have been developed by a number of government departments and organisations for the purposes of spatial analysis, profiling and grouping settlements based on characteristics such as formality, size, location, functional role and spatial hierarchy. In addition, settlements have also been differentiated according to their 'urban' or 'rural' characteristics. Settlement and housing typologies have sometimes even been used together, partly because it is often difficult to separate these two elements. Based on the range of very diverse settlement patterns, cities and towns can be divided into various settlement typologies. The literature, however, identifies a gap in the absence of any economic-based settlement typology that profiles settlements based on their core economic activities. The Department of Cooperative Governance and Traditional Affairs (COGTA) (2016) points out, though, that regardless of the typology used, similar settlement patterns emerge, stressing the importance of the different settlement contexts and their contributions to the economy.

3.3.1.1 Dimensional typologies

Settlement size, both in terms of population and economy, plays an important role in the long-term sustainability of settlements, and influences a number of drivers and pressures in different ways. Size is thus a useful and well-established way of classifying settlements (e.g., **Figure 16**). In 1995, the South African Urban Development Strategy (UDS) (RSA, 1995) categorised cities according to four size classes: large metropolitan areas (> 2,000,000 people), large cities (500,000–2,000,000 people), medium-sized cities and large towns (100,000–500,000 people), and medium-sized towns (50,000–100,000 people). Given the urban focus of the UDS, its classification did not extend to rural settlement types. The White Paper on Local Government (RSA, 1998) officially extended the previous narrow interpretation of settlement types to include rural settlements (rural villages of varying sizes). Subsequent studies on human settlements have further expanded the settlement typology: small towns (fewer than 50,000 people); displaced urban settlements or dense rural areas (variable in size, but usually having more than 50,000 people) (CSIR, 2002); large rural villages (5000–50,000 people); and small rural villages and scattered settlements (fewer than 5000 people) (CSIR, 1999).

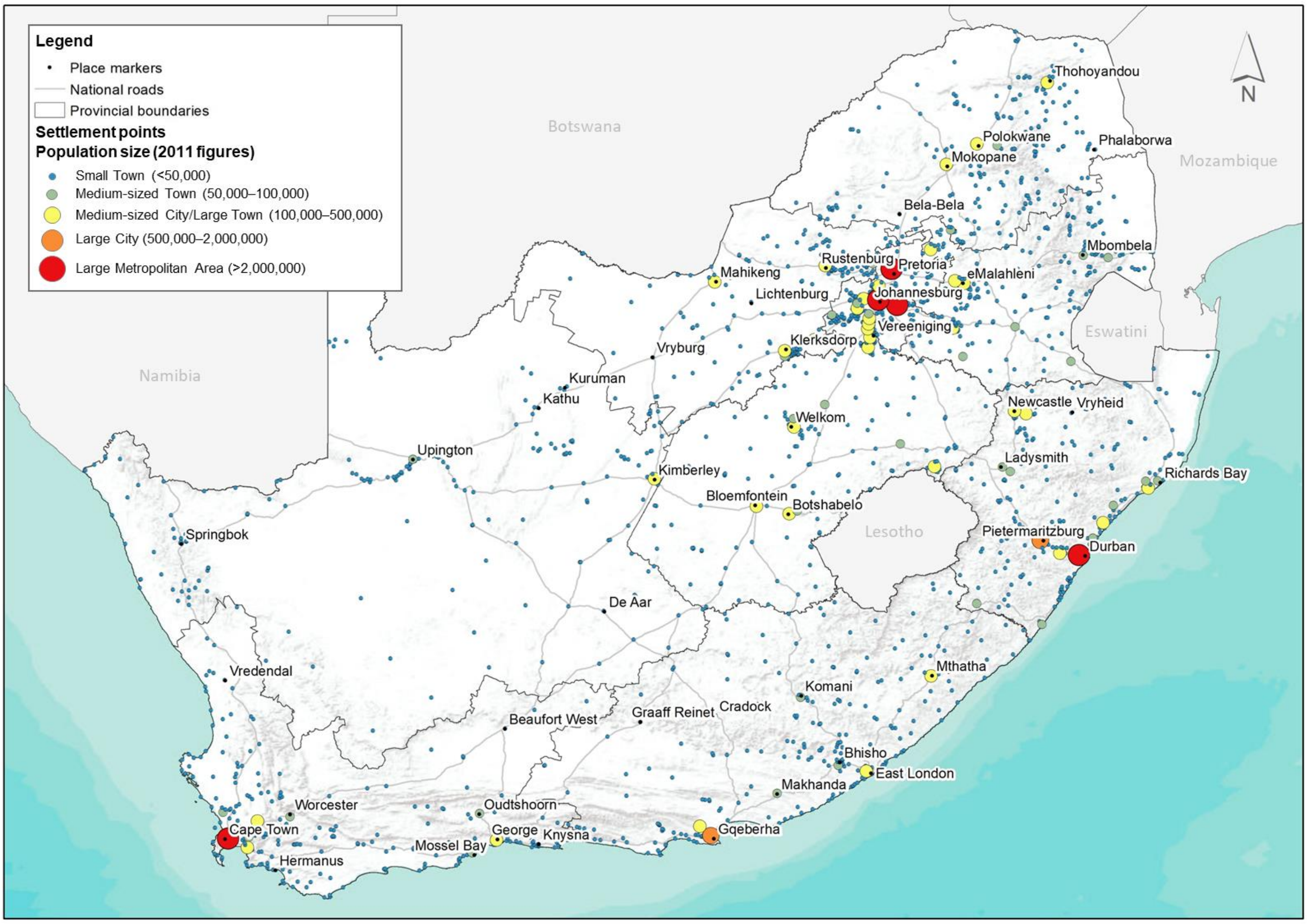


Figure 16: Distribution of South African settlements, classified according to population size

Source: Own illustration using CSIR data

3.3.1.2 Geographical typologies

The geographical location and distribution of settlements have also been incorporated into South Africa's settlement typology based on their relative location within and adjacent to urban cores (areas of relative population and economic concentration). Due to the apartheid legacy, these locational typologies also tend to have more clearly defined economic divisions, whether they are in the core of cities, on the fringe or periphery, or at some distance from them; for example, Palmer (1997, in CSIR, 2002) used a simplified settlement typology consisting of urban core, urban fringe, dense rural, villages, scattered settlements and farms. This geographical typology was later refined to comprise four broad categories, namely, urban core, urban fringe, displaced urban and/or dense rural, and rural (CSIR, 1999), and later further developed to include different settlement types (sub-types) under each category (CSIR, 2002). Similar to these aforementioned categories of area, Harrison and Todes (2013) more recently proposed a slight variation, classifying areas, and the settlements within them, as inner core, outer core, semi-periphery, periphery, and deep periphery (as illustrated in **Figure 17**)[4].

[4] **Table 49** and **Table 50** in **Appendix F** set out the old and equivalent new names of settlements and countries.

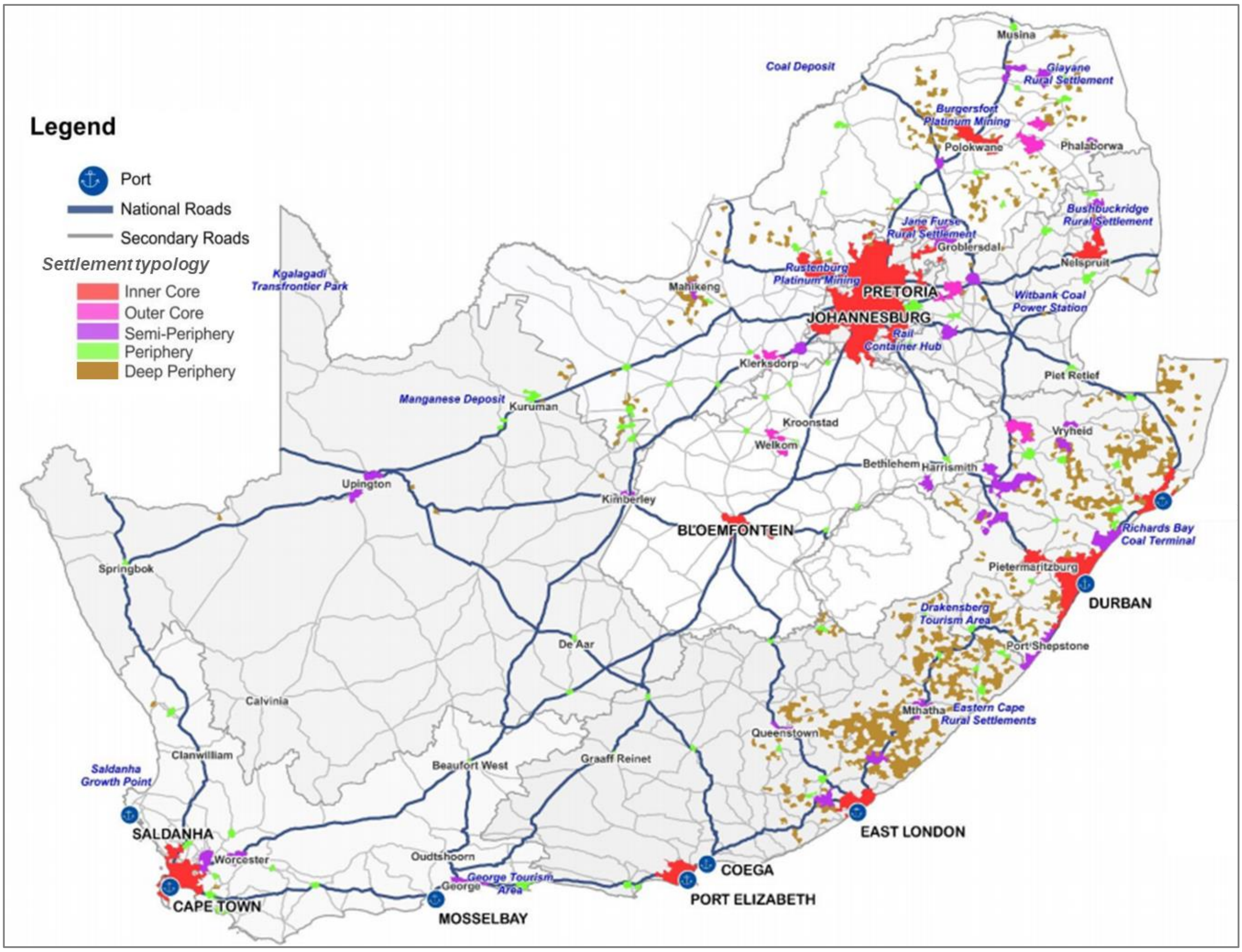


Figure 17: *Distribution of South African settlements, classified according to geographic location*

Source: DoT (2017), based on Harrison and Todes (2013) data

3.3.1.3 Formal–Traditional versus Urban–Rural settlement typologies

There is general consensus that two broad types of settlement exist in South Arica, namely formal and traditional settlements. Formal settlements are those settlements created through formal town establishment, as set out by the legal land-tenure framework. These settlements are generally characterised by the planned provision of services and infrastructure (DEAT, 2006). Traditional settlements are unplanned settlements that developed as people settled in traditional authority areas (DEAT, 2006).

The rural–urban divide in South Africa is the product of long-term economic and demographic trends (Arndt, Davies & Thurlow, 2018). Although many of the aforementioned typologies in the South African context differentiate between urban and rural to some extent, the definitions of 'urban' and 'rural' in South Africa remain unresolved (RSA, 1998). While the literature acknowledges the need to move towards a more common categorisation of settlement types, the classification of settlements along a rigid rural–urban divide is not straightforward, especially in borderline conditions where settlements often exhibit both urban and rural features (COGTA, 2016).

In reality, there is seldom a sharp division between types of areas, but rather a rural–urban spatial continuum (COGTA, 2016). In the literature, there have been various attempts to develop a classification system to account for this continuum. Collinson, Tollman and Kahn (2007), for example, developed a settlement-type transition matrix and proposed the following categorisations:

- Metropolitan formal (metropolitan urban areas), including townships joined to metropolitan areas
- Secondary urban, including other non-metropolitan urban formal areas such as secondary and tertiary towns, as well as many townships
- Informal urban (informal settlements), often located on the peri-urban fringe
- Commercial agriculture, including rural industry settlements
- Former homelands.

Atkinson (2014), building upon the work of Collinson, Tollman and Kahn (2007), points out that 'former homelands' are a highly simplified category since they demonstrate the rural–urban continuum, including formal 'dormitory townships' or 'dense rural settlements' (but without any economically functional core), small towns, agricultural villages and small farms. As a means of illustrating the rural–urban spatial continuum and incorporating more strongly the informal and semi-urban aspects of urban classification, the Department of Housing (2002 in DEAT, 2006), for example, used settlement and housing typologies together, along with the intensity and diversity of economic activities (**Figure 18**)[5].

[5] **Table 49** and **Table 50** in **Appendix F** set out the old and equivalent new names of settlements and countries.

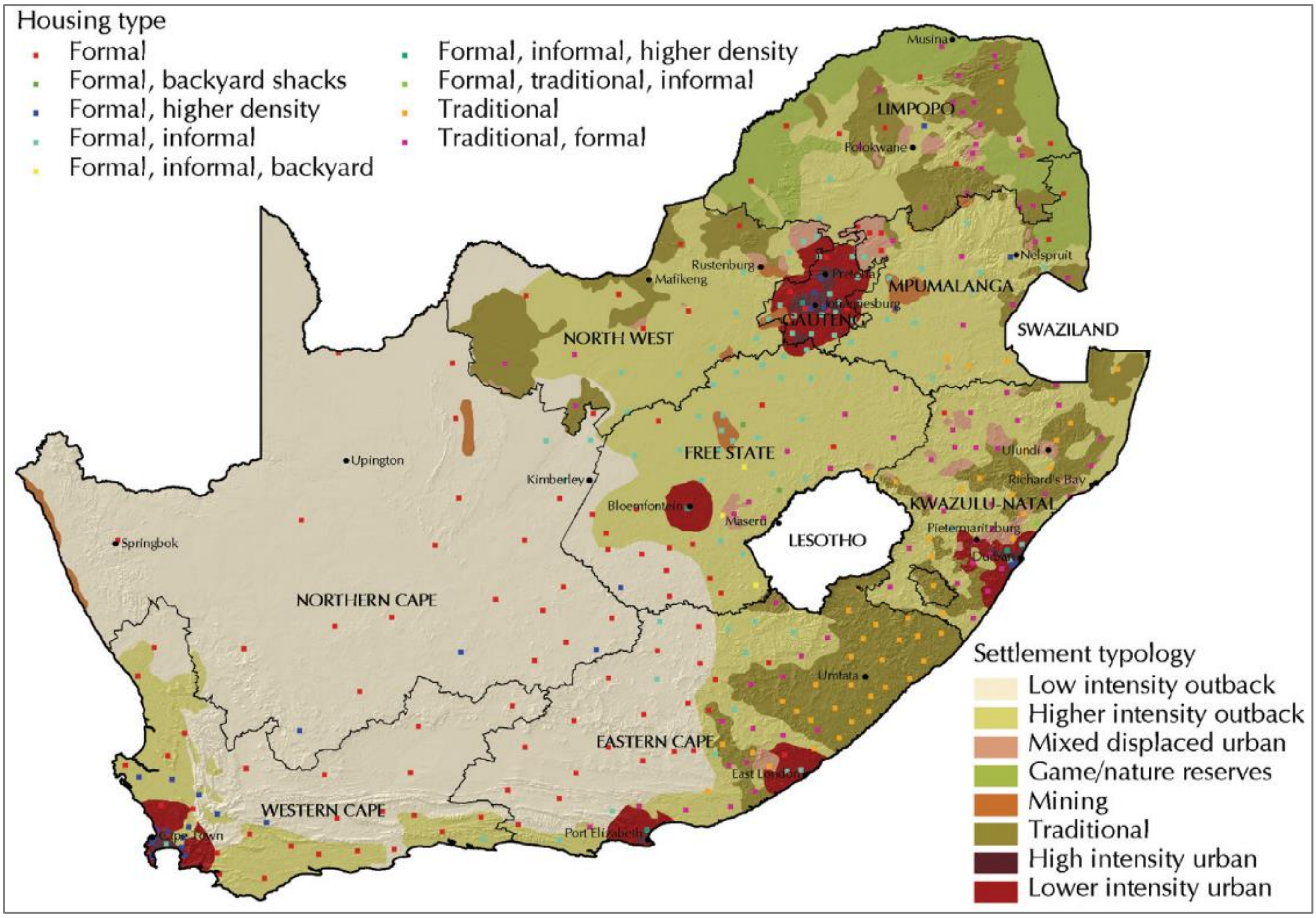


__Figure 18:__ Distribution of South African settlements, classified according to dominant housing type and intensity of economic activities

Source: Department of Housing (2002, in DEAT, 2006)

3.3.1.4 Functional typologies

In recent years, there has been a shift among policy-makers in recognising that the national economy comprises a multitude of smaller local economies across the country. Functional settlement typologies aim to identify regional-scale settlement patterns and trends based on functionally linked service nodes. The SA Functional Town Typology is a spatial mesozone[6]-based dataset developed by the CSIR to provide a fine-grained overview of the functional town and settlement areas of South Africa. The typology has been developed and refined over a period of 15 years for the express purpose of exploring settlement dynamics at regional and national scales by identifying functionally linked areas (Van Huyssteen, Biermann, Naudé & Le Roux, 2009; CSIR, 2018a). The typology describes eight town types in South Africa, based not only on size, but also on their functional role as

[6] The mesozone set (SA CSIR Mesozone 2018v1 dataset) is a demarcation of South Africa into a complete grid of 25,000 spatial units (CSIR, 2018a). Mesozones are not uniform in shape, but are aimed to be approximately the same size (~50 km^2).

service nodes (for government and economic service provision) within the broader network of settlements in South Africa (Van Huyssteen *et al*., 2009; CSIR, 2018a) (**Figure 19**).

The SA Functional Town Typology dataset enables population and economy variables to be calculated from a functional town-level perspective. It also enables temporal and spatial comparison of settlements at regional scale, independent of municipal boundary demarcation. This dataset further profiles functional town areas according to their hierarchical standing in South Africa's built environment (CSIR, 2018a).

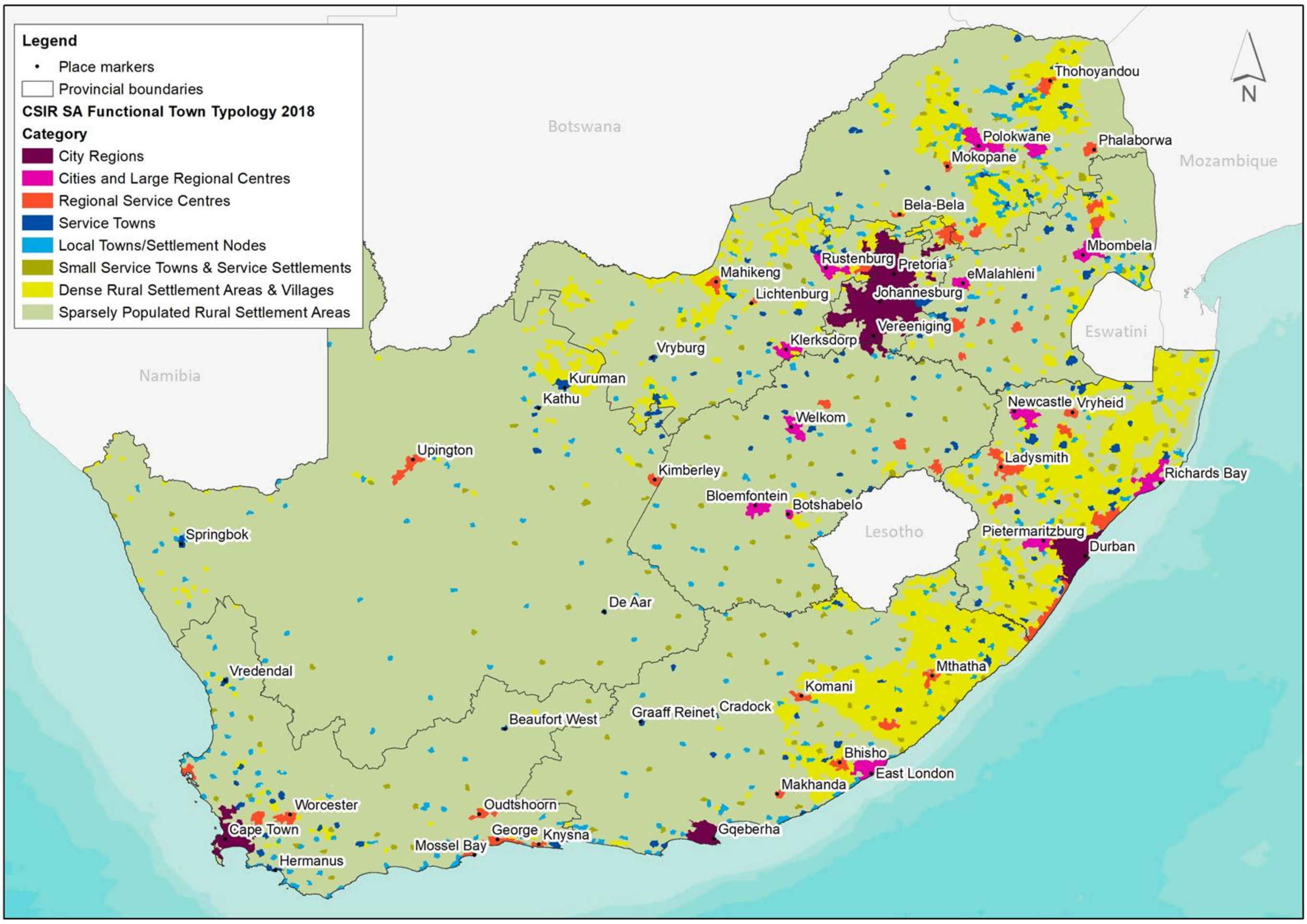


Figure 19: Distribution of South African settlements, classified according to the SA Functional Town Typology
Source: Own illustration using CSIR (2018a) data

3.3.2 Understanding townships in the South African geographical landscape

Townships feature prominently in the South African settlement landscape, given that more than 40 % of the national urban population lives in townships (FinMark Trust, 2004); they thus form a substantial part of the canvas for examining economic–population relationships. Some background to the role of townships in settlement dynamics in South Africa is therefore warranted.

In the South African context, townships refer to the underdeveloped, usually but not exclusively urban, residential areas that during apartheid were reserved for non-white communities living near to or working in racially segregated towns. These townships, now commonplace in the South African geographical landscape, were inspired by colonial town planning and were planned and built some distance outside of colonial towns in order to house the African working class (Pernegger & Godehart, 2007). Municipalities tended to build townships at the periphery, often separated from the city by a green belt or geographical divide, and generally linked to the city centre and industrial areas by a single road and possibly a railway line. Due to the historic social compression in apartheid townships, old established townships across the country have become socially, culturally and economically diverse, but socio-economic data show clearly that the majority of township residents are poor, and that unemployment rates are very high (Pernegger & Godehart, 2007).

The location of many townships at the periphery, together with their limited transport linkages to cities, is reportedly the most negative aspect of spatial exclusion (Pernegger & Godehart, 2007). Increasingly, however, the spatial relationships that modern-day townships have with the cities and towns with which they are associated are dependent on the patterns and direction of urban and economic growth. In many metropolitan areas, for example, cities have expanded to the extent that many pre-apartheid townships are no longer at the peripheries (Pernegger & Godehart, 2007). For example, Alexandra in Johannesburg and Duncan Village in East London are today favourably located in relation to the prevailing economic opportunities.

Apart from the physical expansion of cities, new economic activity nodes in large cities have developed outside the historic central business districts, or the central hub of economic activity may have shifted; as a result, most South African cities today are multi-nodal. These evolving urban dynamics have affected different townships in different ways. Many townships, especially those built in the 1970s–1980s, now find themselves close to new economic nodes (for example, Inanda, Ntuzuma and KwaMashu in eThekwini, and Alexandra in the City of Johannesburg), while others such as Shoshanguve in the City of Tshwane, Mdantsane in Buffalo City, and Botshabelo in Mangaung, are still far from economic opportunities (Pernegger & Godehart, 2007).

Proximity to areas of economic growth has not necessarily resulted in integration or in obvious developmental benefits for townships. Most township economies are marginal and undiversified, with few (if any) formal jobs, resulting in residents commuting to economic nodes and affluent suburban areas for work. An example is Soweto, which, despite housing 43 % of Johannesburg's population, contributes only 5 % to the city's Gross Geographic Product. Well-located townships tend to suffer from overcrowding, since townships remain destinations of choice for aspiring rural-to-urban migrants wanting a foothold in the urban job market, but not being able to afford housing in more affluent areas (Pernegger & Godehart, 2007; Cross, 2013; Mahajan, 2014; Moselakgomo, Mokonyama & Okonta, 2017). Townships in most towns and especially large cities tend to be connected to the broader economy of the town or city through the mobility of factors of production such as labour and capital, as well as through markets for goods and services.

Due to the spatial divide between the places where people interface with the economy and the places where they live, many workers are likely to travel long distances between work and home and incur significant transport costs. Townships and informal settlements closer to economic nodes tend to function as entry points into the labour markets for young migrants with limited housing needs, while more distant townships and informal settlements may attract established households with more substantial housing needs, whose members may already have found employment or have a stronger income cushion from family sources or government grants (Cross, 2013; Mahajan, 2014).

3.3.3 Assessing the spatial dynamics and locations of economic activities at settlement level

Primary sector industry has strongly influenced the population settlement and mobility trends in South Africa. The pattern of mineral deposits across the country initiated rapid urbanisation in often remote and underdeveloped farming areas, and many South African towns owe their existence to gold mining (Musvoto, 2014). The focus of economic activity within urban areas tends to be skills-intensive and service-based, while rural regions tend to have larger primary sector economies and to be more focused in agrarian areas than urban built-up areas. For example, due to the geospatial sources of raw materials, primary sector economic activity (especially agriculture and mining) typically occurs outside of the core built-up areas of a settlement, within the urban–rural interface and surrounding rural hinterlands, on cultivatable land or mining locations (Atkinson, 2008; Musvoto, 2014; Mercandalli & Losch, 2017).

Small and medium-sized towns are increasingly being recognised as central nodes for primary sector activity in the surrounding area, acting as anchor points that support primary sector production by housing the labour involved in that activity, and serving as markets for goods and services. A trend in the local agricultural and mining sectors over the last two decades has been the considerable movement towards off-farm or off-mine labour; primary sector producers are increasingly appointing permanent workers on an off-site basis, with employees meeting their housing needs in settlements around the farm or mine (**Figure 20**, **Figure 21** and **Figure 22**) (De Satge, 2017; Pelders & Nelson, 2019). Factors that have stimulated this trend include migrants wanting closer proximity to services, and choosing to settle in local townships, possibly with their families, where social life is freer, rather than living in shared hostel accommodation (Visser & Ferrer, 2015; Pelders & Nelson, 2019).

Over the last 20 years, small to medium-sized towns have experienced a minor demographic revolution due to the widespread migration away from the former homelands, as well as the rapid in-migration of farm workers, as a result of changing economic and labour conditions in commercial farming. Many farm workers have moved off farms where they previously used to reside, either voluntarily or forcibly, to nearby towns and cities (**Figure 20** and **Figure 21**) (Sithole, 2005; De Satge, 2017). Data in this regard are limited, but in a survey of farm workers in the Western Cape, for example, De Satge (2017) found that 53 % of farm workers were not living on the farms where they were employed, and their reasons and conditions for moving off farms are illustrated in **Figure 21**.

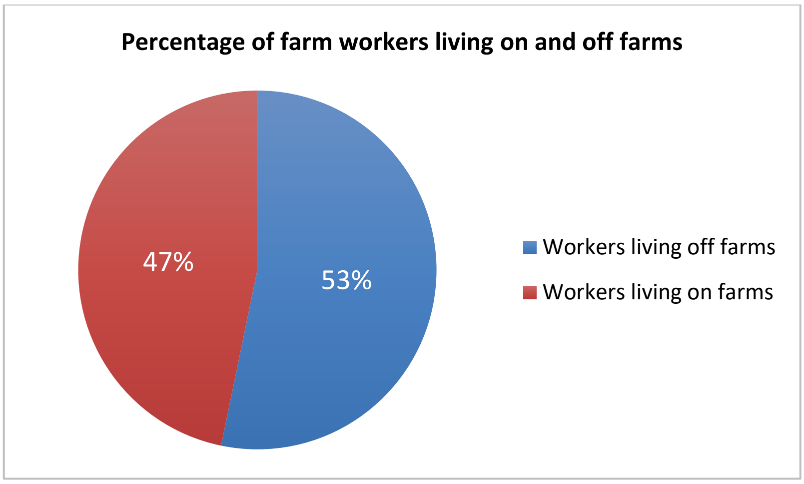


Figure 20: *Residence of farm workers in South Africa*

Source: De Satge (2017)

Figure 21: *Reasons for farm workers moving off farms*

Source: De Satge (2017)

Many of the government-provided social services on farms, such as farm schools and clinics, have declined or disappeared completely, prompting further exodus (Visser & Ferrer, 2015). Other factors in the expansion of rural towns include their role as centres of economic growth and (seasonal) employment, in-migration from other parts of the country, and the persistent evictions of farm workers (Visser & Ferrer, 2015). Atkinson (2014) explains that in small agricultural towns, the continuing need for unskilled and often temporary workers has led to rapid in-migration of workers from rural areas, which may be either circular or permanent. Some of these unskilled labourers manage to secure employment in towns or on nearby farms, but in towns with stagnating or declining formal sectors, this in-migration further contributes to high unemployment rates. While some of these individuals and families may attempt informal economic activities, others subsist on a combination of social grants and subsistence farming in urban townships or squatter areas.

In the local mining industry, a similar trend is noted, with a majority of mine workers opting not to live in mining-provided housing, but rather choosing other forms of accommodation provided in towns or rural areas around the mine, including shacks, backrooms, government housing schemes, rented rooms or houses, or their own homes (**Figure 22**) (Pelders & Nelson, 2019).

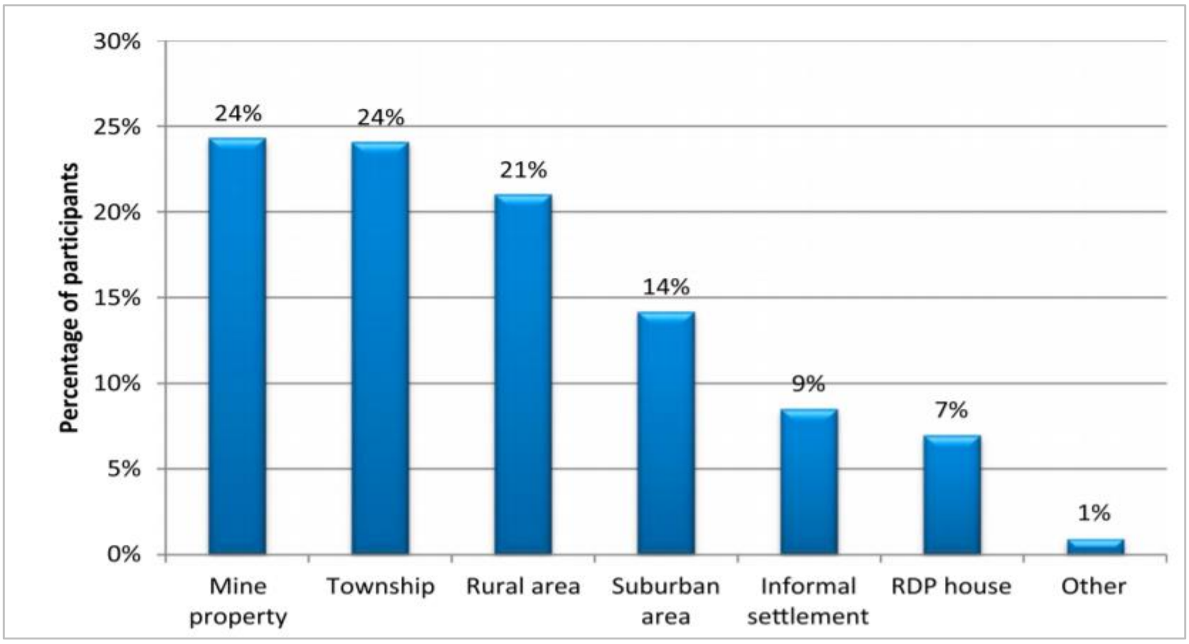


Figure 22: *Residence for mineworkers in South Africa*
Source: Pelders and Nelson (2019)

3.4 Conclusion

Inequality is deeply entrenched within South Africa's development landscape. The need to address socio-economic inequalities has been a key element of the evolving post-apartheid planning and policy framework of the country (Maritz, Van Huyssteen, Le Roux, Pieterse, Ndaba, Mans & Ngidi, 2016). Despite positive development policies and planning in the post-apartheid era (see National Planning Commission, 2012; COGTA, 2016; The Presidency, 2018), glaring social deprivation and spatial inequalities continue to persist. There has been little change in the spatial structure of South Africa's socio-economic landscape in the last three decades, characterised by stark social and income inequalities. In this context, migration remains a significant aspect of the national labour system, patterns of which tend to confirm the push and pull dynamics of Lee's (1966) theory of migration, as rural residents attempt to break into the labour economy of more urbanised settlements (Bouare, 2001–2002; Atkinson, 2014).

4 METHODOLOGY

This chapter outlines the conceptual framework of the research, discussing in detail the rationale for the research design and analysing the workflows for each of the four research objectives.

4.1 QUANTIFYING THE INTERACTIONS OF POPULATION AND ECONOMY

The study of the interaction dynamics between the economy and demographics is not a new research area. Philosophically speaking, the relationships are mutually reinforcing in that population dynamics have consequences that play out in the economy, and in turn, economic performance has demographic outcomes. The interplay of these dynamics makes these relationships a complex domain. Cassen (1976) explains that in any study exploring the spatial dynamics and interactions of population and the economy (cross-sectional, across time or space), the data being correlated bear the influence of population change on the economic outcomes, and of economic change on population outcomes. However, a large number of other factors affect the growth of both the economy and population (as discussed in Chapter 2), and the magnitude of their effects may overshadow the mutual influences of population and economic growth if the analytical scope is too wide (Cassen, 1976).

The widespread literature exploring the association between some measure of economics and demographics spans several diverse disciplines, including economics, geography, sociology, and urban and regional planning, although the vast majority of empirical literature falls within the domain of economics. Economists examining the correlation between economic growth and population growth have generally failed to clarify their two-way inter-relationships. From an economic perspective, population growth is generally thought to cause economic growth, while from a demographic perspective, it is also possible that economic growth causes population growth (Huang & Xie, 2013). McNicoll (1984) stresses the causal effect of economic growth on population growth, namely, that strong economic growth frequently causes population growth either through increased birth rates or migration. Thus, research in this domain can generally be classified according to these two lines of enquiry. Demographic–economic studies are concerned with the classic question of the economic impact of population, and generally consider the broader effects of the size and growth rate of the population, and its effect on economic outcomes. This line of enquiry has gained significantly more attention along with the population explosion, and a vast majority of studies fall into this category (e.g., Yao, Kinugasa & Hamori, 2013). Considerably fewer studies have set out to explore the opposite relationship, which considers the demographic effects of economic growth or decline. While Cassen (1976) points out that there is much to be gained from research on economic development paying more attention to the population dimension, lamentably, research on changes in income distribution over time, for example, as one of the basic indicators of economic change, consistently lacks demographic insight.

The methodological approaches to these opposite lines of enquiry differ from the outset in various ways, but most fundamentally in the choice of the independent variable; as a result, the literature contains a multifaceted mixture of theoretical and empirical approaches using vastly different statistical variables, units of analysis and analytical techniques, and the findings are unsurprisingly diverse.

DaVanzo (1982) identified several commonly used empirical methods for analysing the determinants of migration, namely, cross-tabulations, multivariate analysis with dichotomous dependent variables (when the time interval over which migration is being measured is fixed) and hazard models (a set of statistical techniques for analysing longitudinal data). Regardless of method, critical decisions include defining the dependent variable and specifying the explanatory variables.

In measuring the relationship between two factors, empirical statistical analysis is often applied. Correlation is a bivariate statistical analysis method often employed to evaluate the strength of the relationship between two quantitative variables (Babbie, 2009). The literature highlights the importance of distinguishing between correlation and causality (Borrowman, 2014). Correlation is the existence of a mutual relationship or connection between two or more processes or phenomena that tend to vary, be associated, or occur together in a way that cannot be explained on the basis of chance alone (Aitken, 1957; Croxton, Cowden & Klein, 1967). Causality (also referred to as cause and effect) is the rational relationship between two processes, the first of which (the cause) is partially or fully responsible for the second (the effect), while the effect is partially or fully dependent on the cause. Without correlation, causality cannot exist, although correlation does not necessarily imply the existence of causality (Bunge, 1959).

Empirical research studies investigating the correlation between a measure of agglomeration (e.g., city size or density) and a measure of economic development (e.g., growth in output or average income) have observed the development effects of urbanisation and the magnitude of agglomeration economies to be variable (Turok & McGranahan, 2013). According to Turok and McGranahan (2013:469), "*from the perspective of economic growth, the key outcome of agglomeration that should be measured is productivity [as] the single most important determinant of growth in economic output and income*". However, statistics on productivity tend to be unavailable or unreliable at local levels (Turok & McGranahan, 2013), and existing studies have thus tended to focus on the national level.

Conventional causality tests, such as the Granger causality test (a statistical hypothesis test for determining whether one time series is useful in forecasting another) (Granger, 1969), have been applied in several studies related to the economy and population. These studies use national-level panel data to model the causal link between economic growth and population growth between countries (e.g., Thornton, 2001; Huang & Xie, 2013; Chang *et al*., 2014).

Other empirical migration studies have adopted a traditional gravity model (Anderson, 2010) to examine the push and pull forces of places that drive the in- and out-movement and settlement of people. Ravenstein pioneered the use of gravity for migration patterns in 19th century Britain (Ravenstein, 1889). Rodrigue, Comtois and Slack (2009:216) explain that the gravity model of migration, derived from Newton's law of gravitation, is used to predict the degree of migration interaction between two places. A number of studies have acknowledged gravity models as a prime tool for empirical analysis of population growth modelling, with gravity models being applied to summarise the spatial distribution of the population of an area over time (Simini, González, Maritan & Barabási, 2012; Jones & O'Neill, 2013; Pueyo, Zuniga, Jover & Calvo, 2013; McKee, Rose, Bright, Huynh & Bhaduri, 2015; Le Roux*,* Makhanya, Arnold, Van Tonder, Wools & Mans*,* 2018).

Gravity models put emphasis on distinguishing between the autonomous benefits of relocation, or conversely, the role that overall economic activity and other variables have in determining migration and settlement flows (Von Fintel & Moses, 2017). The parameters of such models are derived using ordinary least squares regression, a method for estimating the unknown parameters in a linear regression model. Regression is used to test the specific influence of suspected population movement drivers. Bouare (2001–2002) used a modified gravity model to investigate the determinants of internal migration in South Africa. The study showed that a modified gravity model, using relative GDP, relative unemployment, relative number of reported crimes, and kinship as independent variables explained between 34 % and 91 % of internal migration in South Africa at provincial level. Bouare used the logarithm of each variable in relative form (i.e., the ratio of variable x between province y and province z) to capture the incentive for moving from one province to another. A more recent study that looked at modelling internal migration in South Africa was that of Jozi (2015), who found a strong relationship between internal migration and economics, demographics and living conditions in South Africa by using an array of global and local modelling techniques. One of the conclusions of Jozi's study was that not all models were optimally suited to studying migration; in particular, that it is not advisable to use gravity modelling for migration flows utilising count response data.

Studies in the field of internal migration have tended to explore population movement dynamics at finer sub-national scales, whether at provincial or municipal levels. Both the Bouare (2001–2002) and Jozi (2015) studies looked at population movement predictors at the macro, provincial and district levels. No studies at settlement level were found in the research literature.

4.2 CONCEPTUAL FRAMEWORK

The conceptual framework of this study is grounded in the theoretical perspective of the push–pull model of migration, according to which migration is driven primarily by the pulling force of labour markets and the economic opportunities and livelihood prospects they provide. An assumption of this study is thus that migration-induced population change at settlement level is responsive to economic change. **Figure 23** sets out the conceptual framework for the study, according to which economic performance, as a factor prompting population movement, stimulates inter-settlement migration and mobility, resulting in population growth or decline. This study investigated this process as it pertains to the working-age population of settlements.

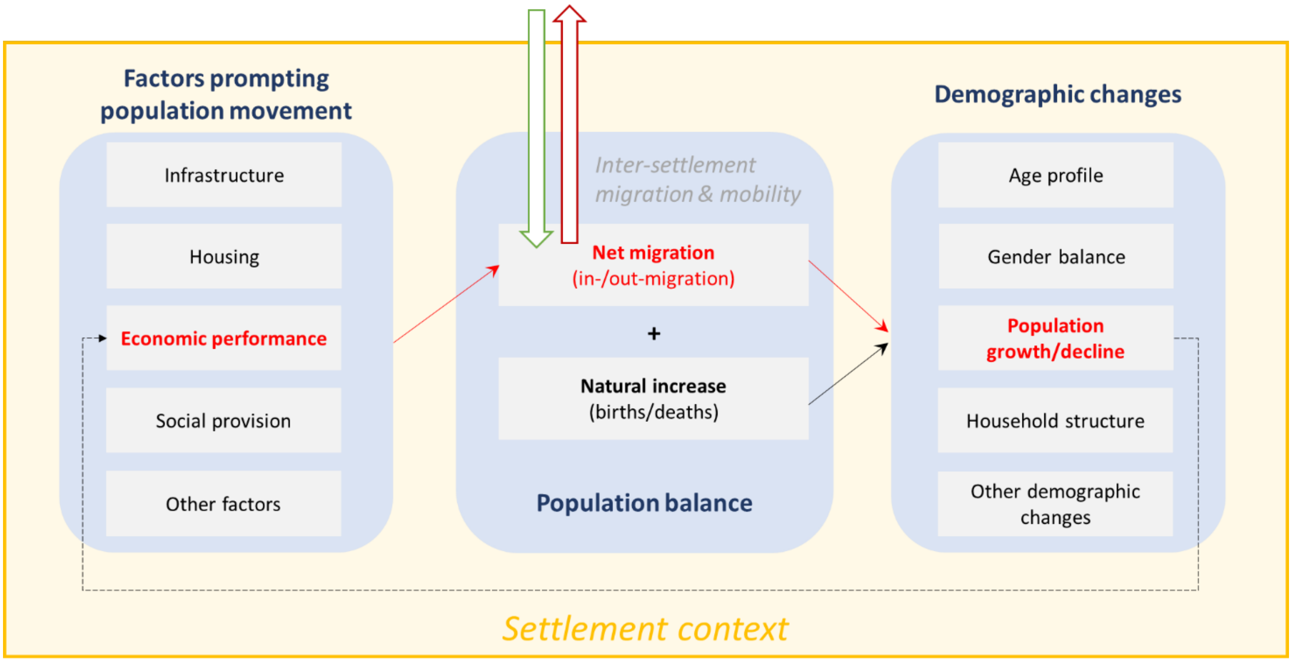


Figure 23: *Conceptual framework*

Within the ambit of this study, several concepts fundamental to the discourse need to be conceptualised and defined (**Table 1**).

Table 1: *Conceptual constructs*

Conceptual construct	Definition
Settlements	The places where people live and interact, both socially and economically. In this study, a settlement refers to a single continuous built-up area.
Economic performance	The measure of how well a settlement's economy is functioning in relation to a number of economic metrics. Economic growth (or growth in economic output) is one such metric of economic performance.
Economic change	The difference in the size of a settlement's total economic output, calculated between two time intervals.
Migration	Inter-settlement population movement involving a change of residence.
Population balance	The balance between the number of births, deaths, in-migrants and out-migrants within a settlement's population. In other words, a settlement's total population (given increasing and decreasing factors) at a particular time.
Population change	The difference in the size of a settlement's population, calculated between two time intervals.

Source: Own definitions

4.3 SCOPE OF WORK

This research set out to better understand the relationship between economic performance and population change, according to the push–pull theory of migration. It aimed to determine whether the economy could confidently act as a predictor of population change in South Africa, specifically at a localised settlement level. In order to quantitatively explore this relationship, a ten-year reference period, 2001–2011 (the years of the most recent National Censuses), was employed to calculate and analyse the changing dynamics between settlement-level economic performance and population change.

4.4 DATA-HANDLING METHODOLOGY

The data-handling methodology of the project involved the sourcing, cleaning and storage, validation, and advanced spatial analysis of GIS vector and raster data. The project required several datasets to meet the analytical requirements of the research objectives. Data sourcing entailed the accumulation of these datasets, including fine-scale spatial datasets for both the economy and population for 2001 and 2011. These datasets were sourced from the CSIR[7] and Stats SA[8] respectively. Supporting datasets, such as the Settlement Footprint data frame, were also obtained.

Table 2 outlines the main datasets that were sourced for the purposes of this research, including a short description of the dataset and the data custodian or source. More detailed explanations of the spatial datasets used in this research are provided in **Table 4** and **Table 7**, in **Section 4.5.2** and **Section 4.5.3** respectively.

Table 2: *Overview of main datasets sourced for this study*

Dataset	Description	Source
SA downscaled sector-based GVA database	Point-based sectoral GVA production (2001 and 2011) (as a measure of economic performance)	CSIR (2020a)
SA National Population Census	Population Census (2001 and 2011)	Stats SA
SA Settlement Footprint data frame	Spatial demarcation of built-up areas	CSIR (2018b)

To support the calculations of economic–population spatial and temporal change as outlined in the research objectives, the datasets for both 2001 and 2011 were spatially aligned to the settlement footprint demarcation,

[7] The CSIR is South Africa's national scientific research and development organisation, mandated to conduct directed research and technological innovation for industrial and scientific development.
[8] Stats SA is the national statistical service of South Africa, mandated to conduct demographic, economic and social censuses and surveys, and to produce official statistics.

which constituted the spatial unit of the research analysis. As part of the research analysis methodology, these data were processed using a combination of GIS, database, spreadsheet and statistical software platforms. The full analysis methodology is explained below, under a separate heading for each objective.

4.5 RESEARCH DESIGN

The research design is quantitative in that it aims to measure and quantify the relationship between economic performance and population change in South Africa at settlement level. To support the settlement-level analysis scale, special focus was placed on sourcing fine-scale spatial datasets for the economy and population covering the ten-year analysis window (2001–2011), and applying advanced GIS methods and techniques to prepare, align, analyse and visualise the data from these datasets.

In addition, 'traditional' non-spatial statistics were employed to measure and statistically quantify the relationship between economic activity and local population change, using a correlation-based research approach. Research studies employing correlation and regression-based analysis aim to predict the value of a dependent variable based on the known value of the independent variable, assuming a consistent statistical relationship between the two variables. In this research, the independent variable relates to the economic performance of a settlement between the reference years 2001 and 2011. The dependent variable is then the change in settlement-level population (population change) over the same ten-year period.

The research design for the data analysis, as set out in **Figure 24**, comprised a task-based approach to address the respective objectives of this study. The research design methodology is further discussed under the individual headings of each of these objectives.

OBJECTIVE 1

Establish settlements as the unit of analysis for this study

TASK 1.1: Source the availability and assess the suitability of spatial datasets demarcating settlements in South Africa

TASK 1.2: Consider the implications of the settlement-level context in analysing the relationship between economic performance and population change

OBJECTIVE 2

Quantify economic performance at settlement level between 2001 and 2011

TASK 2.1: Select economic variables and source, clean and prepare data

TASK 2.2: Calculate settlement-level economic performance and change between 2001 and 2011

TASK 2.3: Profile South African settlements according to economic criteria

TASK 2.4: Analyse settlement-level economic performance and change between 2001 and 2011

OBJECTIVE 3

Quantify population change at settlement level between 2001 and 2011

TASK 3.1: Select key socio-economic variables for analysis and source, clean and prepare data

TASK 3.2: Align census sub-place and settlement footprint spatial datasets

TASK 3.3: Calculate settlement-level population change between 2001 and 2011

TASK 3.4: Analyse settlement-level population change between 2001 and 2011

OBJECTIVE 4

Measure and analyse the relationship between economic performance and population change dynamics at settlement level in South Africa

TASK 4.1: Combine output datasets from Objective 2 and Objective 3

TASK 4.2: Statistically measure, through correlation analysis, the relationship between economic performance and population change dynamics at settlement level in South Africa

TASK 4.3: Test the correlation analysis for significance and strength

Figure 24: *Research design*

4.5.1 Objective 1: Establish settlements as the unit of analysis for this study

I. Objective

The aim of Objective 1 was to establish settlements as the unit of analysis for this study by, firstly, scoping, sourcing and assessing suitable datasets and, secondly, considering and documenting the implications of the settlement-level context for the study analysis.

II. Overview of process for meeting Objective 1

A two-stage process was followed in order to meet the outcomes of Objective 1, as illustrated in **Figure 25**.

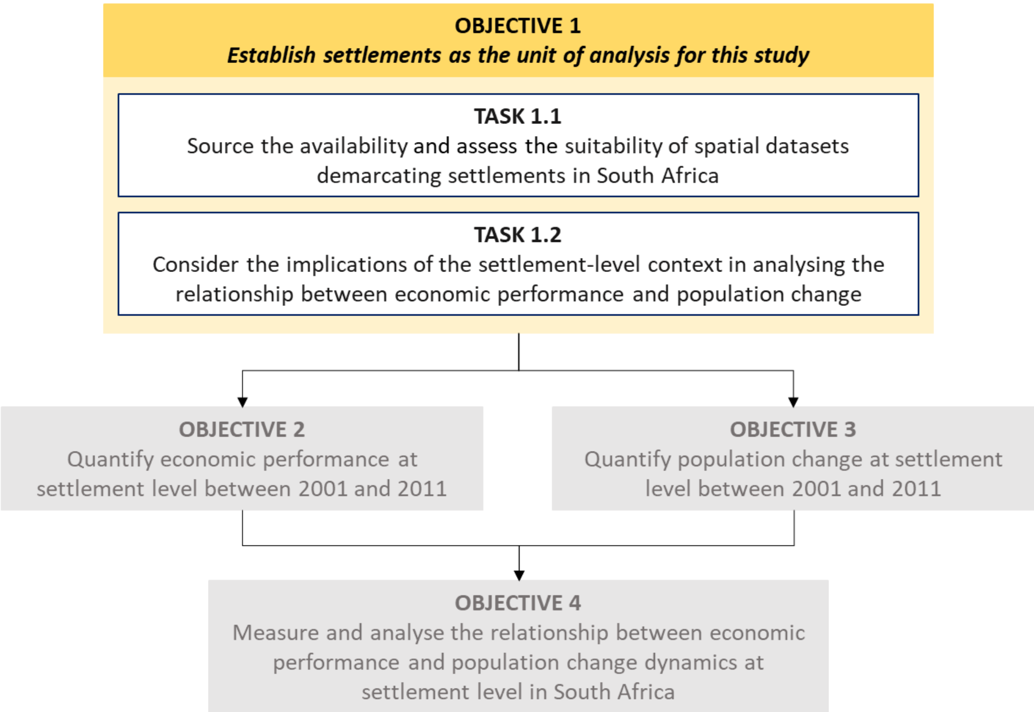


Figure 25: *Task breakdown of Objective 1*

4.5.1.1 Task 1.1: Source the availability and assess the suitability of spatial datasets demarcating settlements in South Africa

There is a growing need to map and monitor the spatial location of human settlements in order to support sustainable development in and around towns and cities. South Africa's official frameworks for spatial data representation comprise a combination of enumeration areas and large administrative zones. These spatial units are created by either the Municipal Demarcation Board (which is responsible for the determination of municipal and provincial boundaries within South Africa) or Statistics South Africa (the custodian of the different spatial units that are used for Census data) (**Figure 26**). Currently, local municipalities (LMs) are the smallest and most detailed demarcation used for administrative management. Most data (or information) relating to municipal management as well as strategic planning and investment decisions are collected or reported at the LM level.

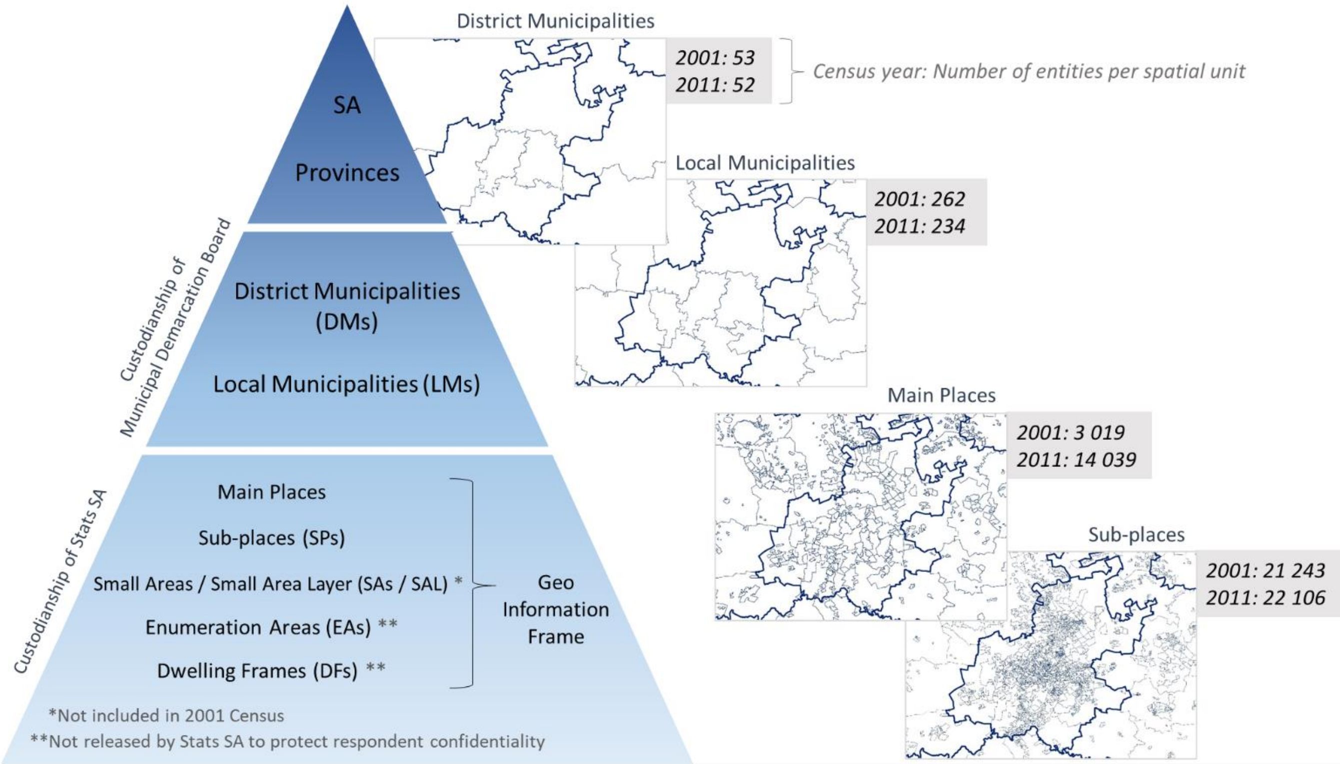


Figure 26: *Nested geographical hierarchy for the 2001 and 2011 South African National Censuses*
Source: Own illustration, derived from Verhoef and Van Eeden (2015)

The nested geographical hierarchy used for the Stats SA Censuses provides detailed spatial data within municipalities, starting with small areas, and working up to sub-places and main places, collated as aggregated data from the enumeration areas (EAs) that were designed to manage Census operations (Verhoef & Van Eeden, 2015) (**Figure 26**). Main places generally correspond to towns, small cities, parts of large cities or tribal areas, while sub-places generally correspond to suburbs, villages or localities. The enumerator area unit was developed by Stats SA for the particular purpose of enumeration and was thus intended to represent fixed sets of people or households per zone (Verhoef & Van Eeden, 2015).

In 2011, Stats SA expanded the original geographical frame by including the small area layer, which was created to fulfil the general research need for data at more detailed levels of locality. Small areas, made up of one or more EAs, were designed in conformance with certain criteria, such as population thresholds, area size, geographical constraints, and land use type; for example, in formal areas, the population of the small area must be over 300 people (Stats SA, 2012c). Where individual EAs fail to meet the set criteria, EAs were combined with neighbouring EAs with similar characteristics to make up these numbers (Stats SA, 2012c). Detailed Census statistics are disseminated on all these standard geographical levels, down to the small area layer in the 2011

Census, and down to the sub-place level in the 2001 Census. Data at EA level are not released by Stats SA to protect respondent confidentiality (Stats SA, 2012c).

While the main place, sub-place and small area demarcations of the Stats SA Census geography do provide users with more detailed spatial data within municipalities, these units fail to accurately represent the extent of settlements within the municipal jurisdictions. There have been efforts to demarcate built-up areas in South Africa in more detail. **Table 3** outlines some of these attempts.

Table 3: *Overview of datasets of built-up areas in South Africa*

Demarcation type	Dataset	Description
Buildings	**SPOT Building Count (SBC)** Eskom	The SPOT Building Count (SBC) point dataset, also known as the Eskom Dwelling Layer, is a geo-referenced inventory of all dwelling units in South Africa, developed using SPOT-5 satellite imagery (De la Rey, 2008). Identifiable dwellings and building structures are mapped by points, while dense informal settlements are mapped by polygons. While this dataset does not explicitly delineate settlements, the benefits of the geo-referenced dwelling frame could also be directly relevant for population estimation and demarcation (Breytenbach, 2010).
	Building Based Land Use (BBLU) dataset Geoterra Image	The BBLU dataset provides data on land use per building for 70+ classes of activity for 2001 and 2010/2012.
Land use/ Land cover	**SA National Land Cover (NLC)** Geoterra Image via DEFF	NLC 2018 is the latest detailed land cover and land use dataset available for South Africa. The dataset contains 73 land use/land cover (LULC) classes, 20 of which are urban LULC classes indicating built-up areas. These data are suitable for use as reference for both rural and urban human settlement classification.
Zones	**Census main places** Stats SA	With regard to settlements, Census main places are categorised as one of the following geographical types: urban, farms and traditional. While showing some degree of alignment between settlement patterns and main places classified as urban, the main place demarcations fail to accurately represent the extent of settlements, since their distinct purpose was to manage Census operations rather than to demarcate settlement boundaries. The main place boundaries between the 2001 and 2011 Censuses are also not spatially aligned.

Demarcation type	Dataset	Description
	SA Functional Town Typology CSIR	The SA Functional Town Typology dataset is a spatial mesozone-based dataset developed by the CSIR to provide a fine-grained overview of the functional town and settlement areas of South Africa. The mesozone set (SA CSIR Mesozone 2018v1 Dataset) is a demarcation of South Africa into a complete grid of 25,000 spatial units. Mesozones are not uniform in shape, but are aimed to be approximately the same size (~50 km^2). A functional town area comprises areas (groupings of mesozones) that have a functioning relationship between them, especially related to government and economic service provision. See Van Huyssteen *et al*. (2009) and CSIR (2018a) for additional information on the rationale and development process.
Settlements	**Global Human Settlement Layer** European Commission Joint Research Centre (JRC)	Developed by the JRC using high-resolution satellite data acquired by the South African National Space Agency (SANSA) (Kemper, Mudau, Mangara & Pesaresi, 2015).
	Settlement Layer Department of Water Affairs (DWA)	Developed by the DWA, this dataset consists of a grouping of structures (in clusters) that often coincide with 'villages'. These groupings represent users of water and sanitation infrastructure and form 'local planning units' for considering the extent of water service provision as well as future services. These units do not combine to form the extent of a coherent village, town, city or large settlement. Therefore, the layer does not always serve to define settlement boundaries.
	Settlement Footprint data frame CSIR	Developed by the CSIR, this dataset spatially demarcates distinct and continuous built-up areas in South Africa, classified as formal or traditional settlements (Mans, McKelly, Komane, Le Roux, Maritz & Ludick, 2019).

The Settlement Footprint data frame developed by the CSIR was chosen as the unit of analysis for this research study. While the other datasets presented in **Table 3** show some degree of alignment with settlement patterns across the country, they fail to fully and accurately represent the extent of settlements, since they were created for other purposes. The Settlement Footprint data frame is a unique spatial layer for South Africa in that it spatially demarcates the 2011 built-up area of each settlement across the country. It was created by the CSIR in 2018, using the EAs produced by Stats SA for the 2011 Census as the main input dataset, and building upon several of the previous attempts to demarcate built-up areas in South Africa, including the SA National Land Cover dataset, the Building Based Land Use dataset and the SPOT Building Count Dwelling Layer (Mans *et al*., 2019) (**Table 3**). The Settlement Footprint data frame distinctly demarcates built-up areas, which in turn enabled the more accurate calculation of population numbers and profiling of individual settlements, and the analysis of changing settlement dynamics and trends. The Settlement Footprint data frame classifies built-up areas as either formal or traditional. Formal settlements are those that were created through formal town establishment processes (but including townships and urban informal settlements joined to metropolitan and non-metropolitan urban areas), and traditional settlements comprise both dense and sparsely populated rural settlements located in traditional authority areas (see **Section 3.3.1** for an overview of the complexities plaguing settlement typology in South Africa). As part of the dataset, every built-up area (settlement footprint) has been assigned a unique identifier, and formal settlements have also been assigned a unique (and logical) name. The Settlement Footprint data frame demarcates 7210 clear built-up areas in South Africa, comprising 1637 formal settlement areas and 5573 traditional settlement areas.

4.5.1.2 Task 1.2: Consider the implications of the settlement-level context in analysing the relationship between economic performance and population change

In establishing the Settlement Footprint as the data frame for this study, several implications for the research design and methodology were identified for consideration:

- **Spatial alignment of datasets**

  All analysis data used in the study would need to be spatially aligned to the settlement footprint demarcation. This prompted concerns of spatial logic and challenges of potential misalignment, including the real possibility of having to downscale datasets. To support the settlement-level analysis scale, special attention was paid to sourcing fine-scale spatial economic and population datasets covering the ten-year analysis window (2001–2011), and applying advanced GIS methods and techniques to prepare, align, analyse and visualise the data.

- **Distinction between the places where people live and where they interface with the economy**

  In determining the economic opportunities accessible to people living within a given settlement, an important aspect to consider is how far an average person travels on a daily basis to the employment opportunities that they access.

- **Location of economic activities both within and around the settlement footprint demarcation**

  An important consideration at settlement level, especially for economic activity, is that not all economic activity related to a settlement takes place within the built-up footprint of the settlement itself, especially in the case of primary economic activities. This prompted consideration of how economic activities would be linked to the settlement footprints for analysis, and the possibility of needing to use a distance measure to establish an association.

- **Settlement-type classification**
  Settlements are not homogeneous entities, especially when considering their economic profiles. Thus, an implication of the settlement-level context was the need to group similar settlements and to distinguish them from settlements of a different type.

4.5.2 Objective 2: Quantify economic performance at settlement level between 2001 and 2011

I. Objective

The aim of Objective 2 was to determine which variables and associated data could be used as proxies to best represent changing economic conditions at settlement level in South Africa, and thereafter, to use GIS processing to quantify economic performance and change at settlement level between 2001 and 2011.

II. Overview of process for meeting Objective 2

A four-stage process was followed in order to meet the outcomes of Objective 2, as illustrated in **Figure 27**.

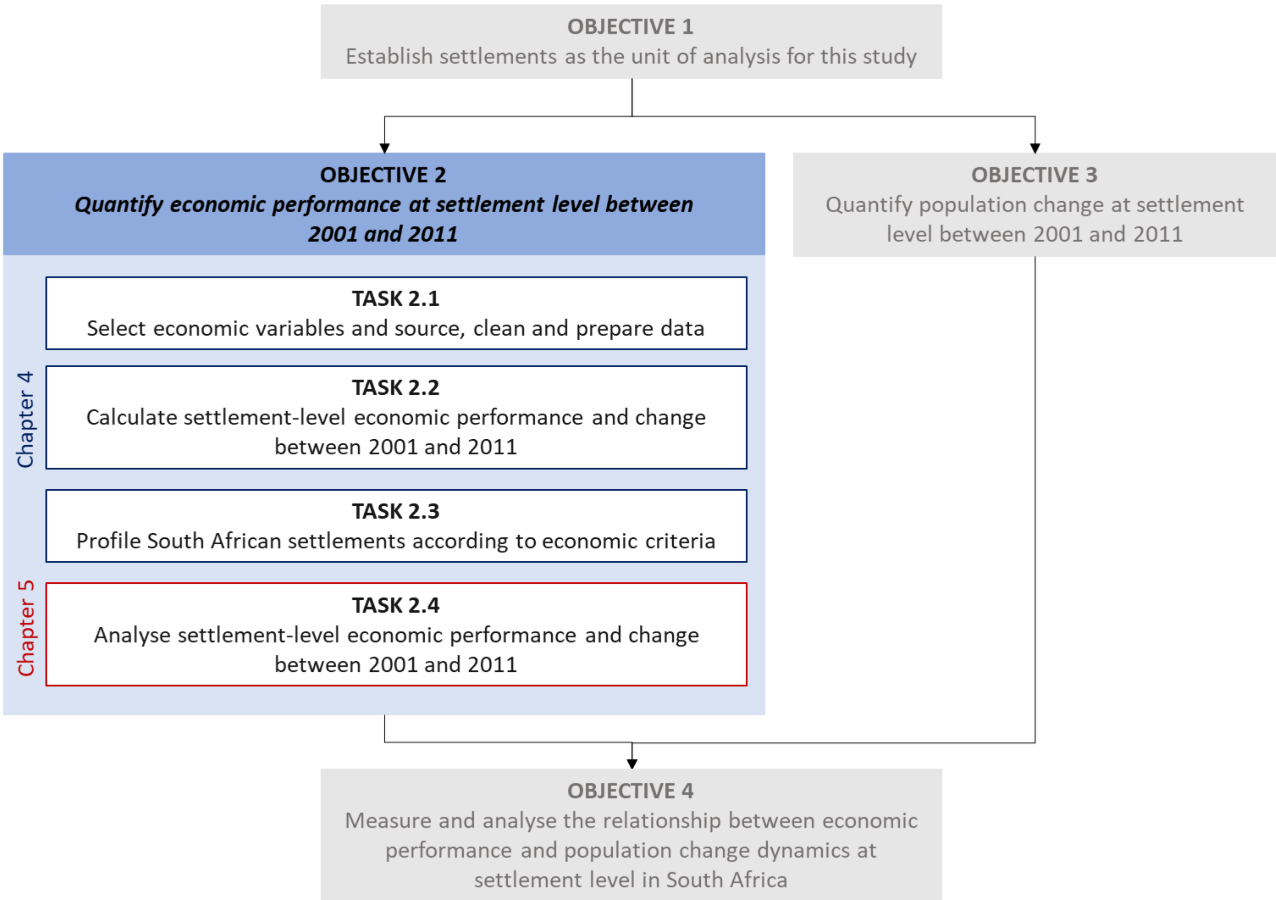


Figure 27: *Task breakdown of Objective 2*

III. Datasets

The datasets used for analysis in Objective 2 are outlined in **Table 4**, together with the data source, GIS shape format and the tasks in which the respective datasets were utilised.

Table 4: *Datasets for quantifying economic performance and change at settlement level between 2001 and 2011*

Dataset	Description	Source	Shape	Task
SA downscaled sector-based GVA database	Indicator of 2001 and 2011 economic production (spatial location and magnitude of production) per sector (SIC 1–4 and SIC 6–9), expressed in millions of Rands per point (measured at constant 2010 prices)	CSIR (2020a)[9]	Points	Tasks 2.1 & 2.2
Settlement Footprint data frame	Spatial demarcation of distinct and continuous built-up areas, classified as formal or traditional settlements	CSIR (2018b)[10]	Polygons	Tasks 2.2 & 2.3

4.5.2.1 Task 2.1: Select economic variables and source, clean and prepare data

Based on the literature review and data availability (considering both the temporal and spatial requirements of the data in relation to the research objectives), fine-scale point-based Gross Value Added (GVA) data for the different economic sectors were sourced from the CSIR and used in this study as the basis for measuring the settlement-level trajectory of economic performance. In economic terms, GVA is the value of goods and services produced in an area, industry or sector of an economy (OECD, 2004). For the data used in this study, GVA was according to factor cost, as follows:

$$\text{GVA (factor cost)} = \text{Gross operating surplus} - \text{Compensation of employees}$$

The concept of GVA is used as the basis for estimating regional economic activity, and is broadly similar to Gross Geographic Product (GGP) (CSIR, 2015a).

In South Africa, Quantec[11] produces GVA data for the nine Standard Industrial Classification (SIC) economic sectors (**Table 5**) down to a local municipal level. Using the principles of dasymetric mapping to disaggregate spatial data, the municipal-level data have been downscaled by the CSIR to a point base; secondary data representing the potential points where production occurs were used as the basis for reassigning the economic production data (Mans, 2011). Dasymetric mapping is an area-based GIS technique in which the original administrative areas are divided into smaller spatial units or points. This technique is applied to aggregate spatial data for which the underlying statistical surface is unknown. The process of dasymetric mapping thus involves the transformation of data from the arbitrary demarcation zones of the aggregate dataset in order to recover (or try to recover) and portray the underlying statistical surface. The quality of the ancillary data used to predict the variation in the spatial distribution of the variable in question has a direct outcome on the accuracy of the data depiction. The outcome of the dasymetric mapping process is therefore heavily dependent on good-quality

[9] Downscaled from Quantec municipal data. See Mans (2011) for additional information on the downscaling process.
[10] See Mans *et al*. (2019) for additional information on the rationale behind, and development of, the Settlement Footprint data frame.
[11] Quantec is a South African-based consultancy providing economic and financial data, country intelligence and quantitative analytical software (Quantec, 2021).

ancillary data. A further consideration is that the ancillary data need to be temporally aligned with the input dataset, and must be updated regularly (at least yearly in the case of annual data) to ensure consistency for future updates (Mans, 2011).

While the fine-scale resolution of the downscaled economic activity data (CSIR, 2020a) was a valuable asset in achieving the aim and objectives of the study, good-quality ancillary or proxy data needed for the dasymetric mapping process were not available for all economic sectors, in particular not for the construction sector. A limitation of this dataset was thus the exclusion of the construction sector (SIC 5) because there was no sound way of spatially downscaling the data for this sector to settlement level due to the temporary nature of construction sites. This was an unavoidable drawback for this study.

The construction sector employed 5–8 % of the total labour force between 2001 and 2011 (Stats SA, 2002; 2011a), predominantly from the manual labour force, and thus accounts for migration processes and population-change outcomes associated with this sector. The movement of people related to the construction sector needs to be acknowledged as inherent in the population data used for the study, and could account for some of the settlement-level population change not explained by the other eight SIC economic sectors analysed in this study.

Table 5: *Standard Industrial Classification (SIC) of sectoral economic activities*

	Sector	SIC Code	Description
Economic production/activity	Primary sector	SIC 1	Agriculture, forestry and fishing
		SIC 2	Mining and quarrying
	Secondary sector	SIC 3	Manufacturing
		SIC 4	Electricity, gas and water supply
		SIC 5	*Construction*
	Tertiary sector	SIC 6	Wholesale and retail trade, catering and accommodation
		SIC 7	Transport, storage and communication
		SIC 8	Finance, insurance, real estate and business services
		SIC 9	General government and community, social and personal (CSP) services

Following the dasymetric mapping process, the output datasets for the different economic sectors (CSIR, 2020a) were point-based spatial proxy layers of annual GVA (i.e., economic production), expressed in millions of Rands per point (measured at constant 2010 prices) (**Figure 28** and **Figure 29**). In total, there are eight point-based GVA datasets for the different economic sectors (SIC 1–4 and SIC 6–9), with attribute data for annual economic production per point from 1995 to 2016. Strictly speaking, as a result of the transformation of the data through the dasymetric mapping process, these data can no longer be seen as representing GVA values[12]. The data, however, serve as a reliable indicator of how much has actually been produced by a specific sector at a particular

[12] In the sense that the GVA point-level data represent the share of GVA owing to each individual point (derived from the dasymetric mapping process using weighted points) based on total municipal GVA values reported by Quantec for a given year and the weighting of each point (Mans, 2011).

location, consisting of point data that can be used not only to compare a location with other locations across space (spatial comparison), but also to compare a location with itself over time (temporal comparison).

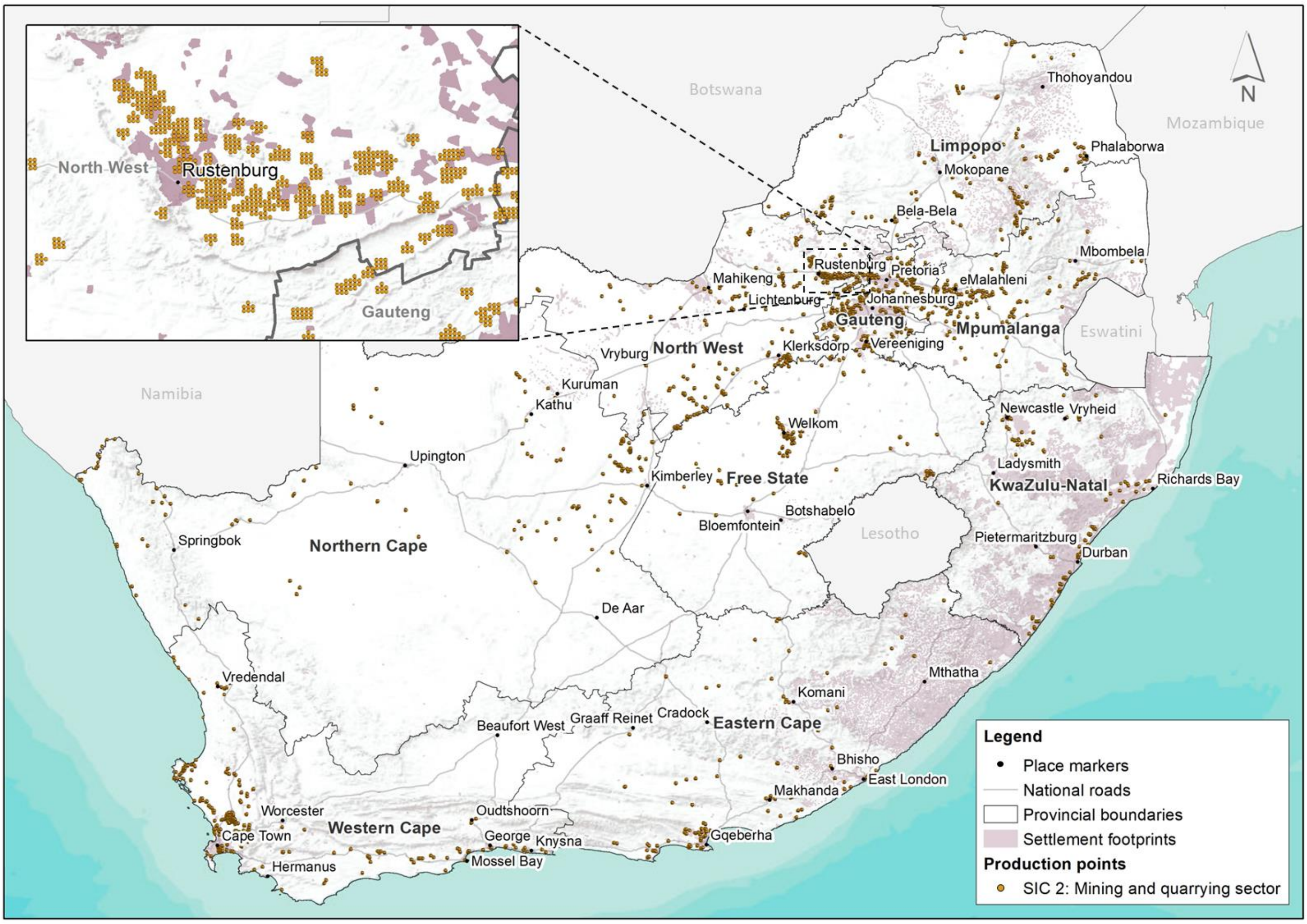
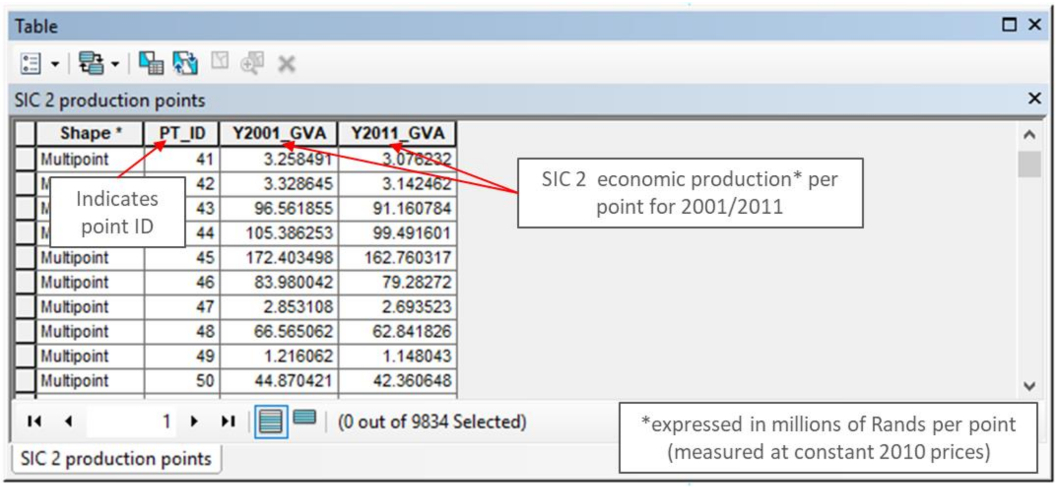


Figure 28: *Example of the point-based GVA data for SIC 2 indicating the economic production locations of mining and quarrying activity*



Shape *	PT_ID	Y2001_GVA	Y2011_GVA
Multipoint	41	3.258491	3.076232
M	42	3.328645	3.142462
M	43	96.561855	91.160784
M	44	105.386253	99.491601
Multipoint	45	172.403498	162.760317
Multipoint	46	83.980042	79.28272
Multipoint	47	2.853108	2.693523
Multipoint	48	66.565062	62.841826
Multipoint	49	1.216062	1.148043
Multipoint	50	44.870421	42.360648

Figure 29: *Extract of the attribute table for SIC 2 showing the GVA contribution per point*

The point-based GVA data for the different economic sectors were deemed the most appropriate dataset for spatially and temporally analysing economic distribution, and were chosen as the basis for calculating both spatial and temporal changes in settlement-level economic performance in this study for the following reasons:

- The GVA point dataset is a useful proxy of economic performance and the spatial distribution thereof.
- The GVA point dataset contains fine-scale spatial and temporal data for eight of the nine economic sectors.
- The nature of the GVA point dataset, being point features, means that any spatial analysis would not be confined by arbitrary spatial boundaries and could thus be aligned to any demarcation.
- The GVA point dataset is temporally complete, with annual data from 1995 to 2016. (For this research, only the economic production figures for 2001 and 2011 were used).
- Point features can be used to transfer the data to a standardised unit of analysis of the user's choice.

In a data-exploration exercise to assist with the data-cleaning and preparation process, the 2001 and 2011 data for each economic sector were spatially mapped (see **Figure 12**, **Figure 13** and **Figure 14** in **Section 3.2.3** and **Figure 88** and **Figure 89** in **Appendix B**). A literature investigation supported this process (see **Section 3.2** outlining South Africa's spatial economy and the broad economic and labour-market trends in the country).

4.5.2.2 Task 2.2: Calculate settlement-level economic production and change between 2001 and 2011

The main objective of the analysis in this task was to quantify the economic opportunities accessible to the people living within a given settlement and to determine how these changed between 2001 and 2011[13]. In doing so, an important aspect to consider is how far an average person travels on a daily basis to the employment opportunities that they access. For a number of reasons, including financial constraints or personal preference, people do not always live in the settlement where they are employed. This is a significant factor, especially in South Africa, given the sprawling spatial structure of the country's cities and the diverse nature of settlements. These local dynamics have resulted in many people living some distance away from their place of employment or the economic opportunities they interface with daily.

It was therefore important to consider economic activity pertaining to a settlement as that which occurs not only within but also around the settlement footprint: firstly because not all economic activity occurs within the physical built-up demarcation of the settlement, especially in the case of the primary sector (e.g., agriculture and mining); and secondly because people do not always live in the settlement where they are employed, but it is assumed that they do generally live within a reasonable proximity.

[13] The Settlement Footprint data frame (CSIR) classifies distinct, continuous built-up areas as settlements across the country. See **Section 4.5.1.1** on spatial datasets demarcating settlements in South Africa for a full overview of this data frame.

The dynamics of labour mobility related to place of work and place of residence, and the varying characteristics of South African settlements, posed a challenge for determining the reasonable availability of economic opportunities for residents at settlement level, taking into account opportunities within the settlement as well as in surrounding areas. The present study needed to account for people's involvement in economic activities that occur outside the built-up demarcation of the settlement where they reside, as well as people not always living in the settlement where they are employed.

For the purposes of this study, a buffer distance was calculated around the settlement footprints as a proxy measure for the economic opportunities accessible to the residents of any given settlement. Key results of the first national Household Travel Survey (DoT, 2005), as well as figures for the average travel distance or time of commuters reported in the literature for South Africa (Mahajan, 2014; Moselakgomo, Mokonyama & Okonta, 2017; TDA Cape Town, 2018), were used to determine a reasonable proximity distance to be applied around settlements in relation to the accessibility of economic opportunities.

As shown in **Figure 30**, most local studies report only on average commuting time to work. Due to the scarcity of literature reporting on commuting distances to work, it was necessary to develop a novel approach to infer a reasonable proximity distance to be applied around settlements in relation to the accessibility of economic opportunities in this study. Using the formula $Speed = \frac{Distance}{Time}$, an average travel speed to work of 0.31 km/min was calculated, based on the TDA Cape Town (2018) study which reported both the average travel time and average travel distance of Cape Town commuters to work across four modes of transport (**Figure 30**). From this average travel speed assumption, the 2003 national average travel time to work of 43 minutes (DoT, 2005) was then calculated to equate to approximately 13.68 km using the formula $Distance = Speed \times Time$ (**Figure 30**). This was rounded up to 14 km for analytical purposes in the present study, which was assumed to be a reasonable proximity distance for access to economic opportunities around settlements. **Figure 31** shows the application of the 14 km buffer around Cape Town, Stellenbosch and Somerset West settlements as an illustrative example, also indicating how the buffers overlap.

Setting a buffer distance was fundamentally necessary for spatial analysis in this study (see **Section 3.3.2** and **Section 3.3.3**), thus effectively assigning an area of potential economic activity to the population of any given settlement. The inevitable limitations of such an approach are acknowledged, in that the size of the area that a settlement population can readily access for economic activity will vary between settlements based on factors such as availability of transport, modes of transport, travel infrastructure conditions and geographical layout.

Literature study		Time Average travel time (min) to work (one-way)	Distance Average travel distance (km) to work (one-way)	Speed Average travel speed (km/min) to work (one-way)	Source
Diepsloot township survey - Travel time to work of Diepsloot residents (2012 figures)	18 % of residents	<15	-	-	Mahajan, 2014
	39 % of residents	15–30	-	-	
	34 % of residents	31–60	-	-	
	7 % of residents	61–90	-	-	
	2 % of residents	>90	-	-	
Gauteng urban neighbourhood type and commuting distance study (2003 figures)	Urban Core	-	19.4	-	Moselakgomo, Mokonyama and Okonta, 2017
	Suburban	-	25.6	-	
	Township	-	38.9	-	
	Average	**-**	**28.0**	**-**	
Cape Town Household Travel Survey (2013 figures)	Low Income (All modes)	53	-	-	Figures extracted from TDA Cape Town (2018)
	Middle Income (All modes)	57	-	-	
	High Income (All modes)	52	-	-	
	Average	**54**	**-**	**-**	
				Distance / Time = Speed	
Transport and Urban Development Authority (TDA) Cape Town (2015 figures)	Rail	59	23	0.39	TDA Cape Town, 2018
	Bus	63	19	0.30	
	BRT	45	9	0.20	
	Minibus Taxi	53	19	0.36	
	Average	**55**	**17.5**	**0.31**	
			Speed x Time = Distance		
National travel survey (2003 figures)	**Average (All modes)**	**43**	0.31 km/min x 43 min **= 13.68 km**		Department of Transport, 2005

Key	
	Figures obtained from source
	Own calculations
	Buffer distance calculated

Figure 30: Buffer distance calculation

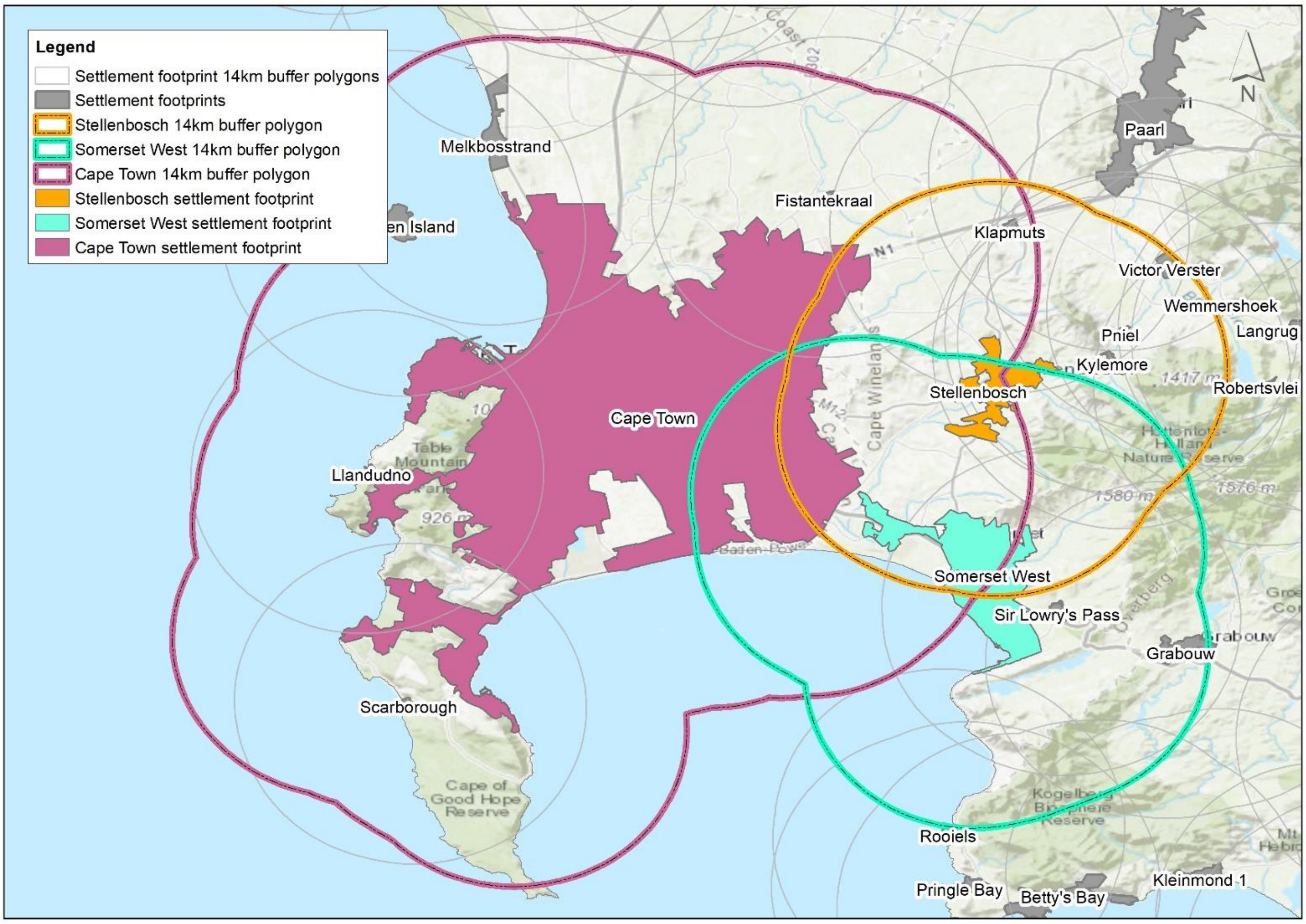


Figure 31: *Example of the 14 km buffer around Cape Town, Stellenbosch and Somerset West settlements*

A brief note may be required here to clarify possible misconceptions related to the 14 km buffer:

- It should be noted that this distance is ***not*** the radius within which individual commuters might travel from their place of residence to their place of employment, since the buffer was applied from the edge of the settlement, extending outside the boundary of the settlement footprint. Commuters within the boundaries of a settlement might travel considerably further than 14 km, particularly township dwellers in large metropolitan areas or geographically constrained cities. This approach eliminates the potential for analytical prejudice related to one's place of residence within a given settlement.
- In establishing this distance as a buffer, it is assumed that the ***average*** size of the potential employment opportunities that people can readily access includes all opportunities within their settlement of residence as well as extending 14 km beyond its physical limits. This approach establishes a proxy for the size of the economy that might attract someone to live in any given settlement.
- This distance is also ***not*** the radius of the economy that may have an impact on the economic affluence of a given settlement, which is beyond the scope of this study.

Using the Settlement Footprint data frame as the unit of analysis has implications for applying the 14 km buffer to settlements of different sizes:

- For all settlements, but especially smaller towns and cities, and those with discrete townships on their periphery[14], it is assumed that people live in a given settlement because they are able to access the employment opportunities within approximately 14 km of the settlement boundary, whether in another settlement or within the rural hinterland.
- For all settlements, but especially large cities and metropolitan areas, which are depicted as conglomerate entities in the settlement footprint data layer, it is assumed that people live in a given city or metro[15] because they are able to access the employment opportunities within their settlement of residence, regardless of the distance of their chosen place of residence from the economic nodes of the settlement.

4.5.2.2.1 Analysis methodology of Task 2.2: Calculate settlement-level economic performance and change between 2001 and 2011

The Settlement Footprint data frame, together with the point-based GVA datasets for the different economic sectors, was used as the basis for calculating settlement-level economic performance and change between 2001 and 2011. Esri ArcGIS Desktop, specifically ArcMap version 10.7 software, was used for this spatial analysis. The analysis workflow is summarised in **Figure 36**.

Using the point-based GVA datasets for the different economic sectors (SIC 1–4 and SIC 6–9) (point-based proxy layers of annual economic production per sector, as explained in **Section 4.5.2.1**), together with the Settlement Footprint data frame, a series of steps were undertaken in order to calculate the settlement-level economic production in 2001 and 2011. An overview of this process is outlined below and summarised in **Figure 36**.

[14] Some smaller towns and rural townships may still be considered discrete settlement footprints if their built-up extents have not converged. For example, Mashaeng township on the periphery of Fouriesburg in the Free State is considered a separate entity from Fouriesburg town in terms of the Settlement Footprint data frame, since the built-up extents of the two settlements do not converge. Thus, it is assumed that residents of the Mashaeng settlement live there because they are able to access various employment opportunities: 1) within the Mashaeng township settlement itself, or 2) in the near-by Fouriesburg settlement within 14 km from the outskirts of Mashaeng, or 3) within the surrounding rural hinterland up to a distance of 14 km from the outer edge of the Mashaeng built-up area.

[15] In most cases, old established urban townships (especially those built until the 1980s) are now seen as inclusive of the settlement footprint in the case of metropolitan cities since their built-up extents have integrated with the expansion of the city over the last five decades. For example, Mamelodi (an old established township) is considered part of the City of Tshwane settlement footprint, since it forms part of the continuous built-up area of the city.

GIS Process: Calculate buffer area around settlement footprints

1. In order to maintain accurate distance, the Settlement Footprint data frame was projected to the Africa Equidistant Conic projection.
2. The buffer analysis[16] operation was used to create 14 km buffer polygons around the settlement footprints.

The buffer polygons were created in order to account for economic production that occurs around a settlement and not only within it. The distance buffer around each settlement footprint was used to calculate each settlement's economic production per sector for the years 2001 and 2011 (**Figure 33**). A uniform buffer distance of 14 km was used to assign economic production to the settlement footprints across all sectors (see **Section 4.5.2.2**). These buffer polygons were not dissolved, allowing buffer areas of closely located settlements to overlap and share access to points of economic activity (**Figure 31**, **Figure 32** and **Figure 33**).

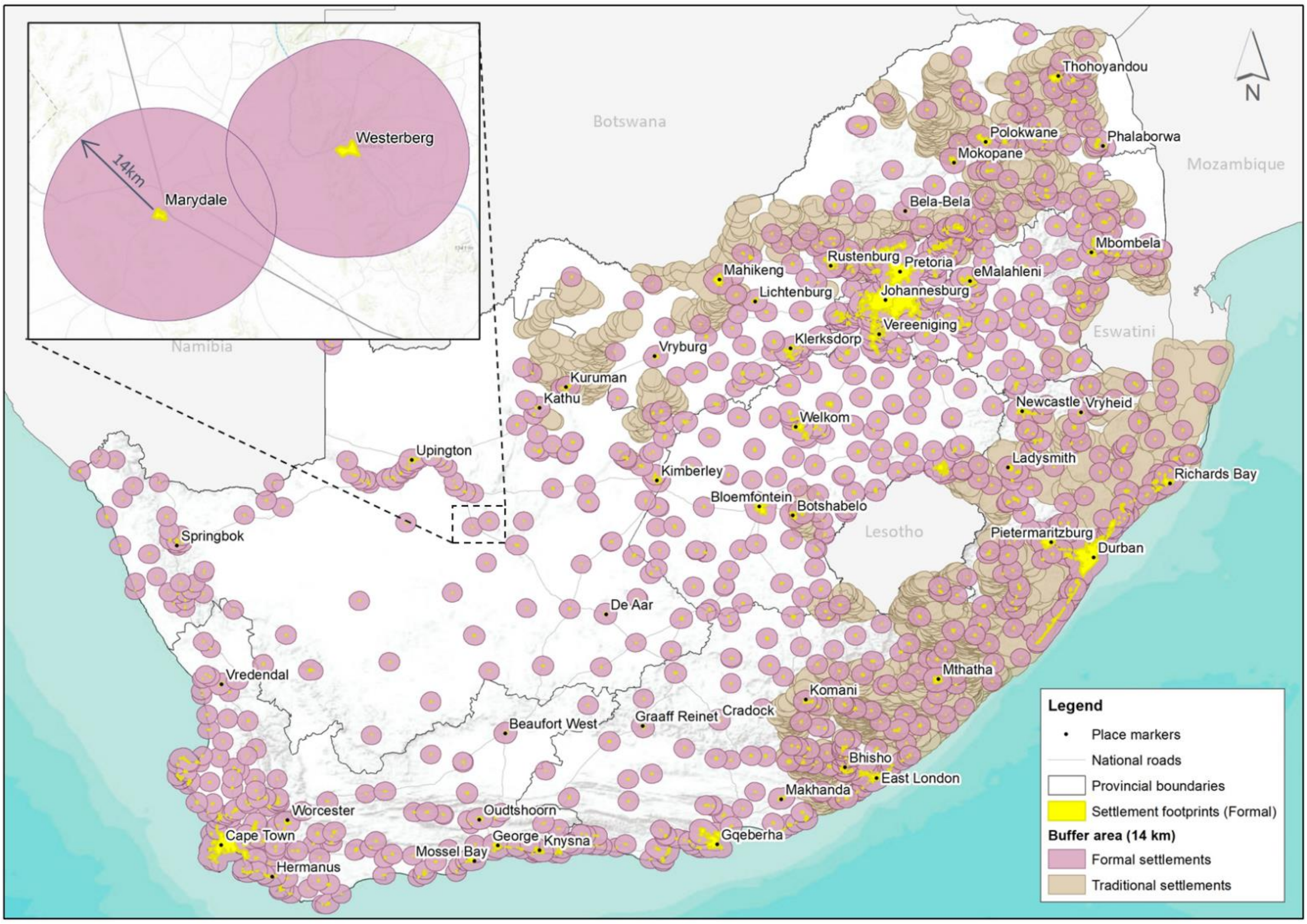


Figure 32: Map showing the 14 km undissolved buffer polygons around settlement footprints

[16] Creates buffer polygons around input features to a specified distance.

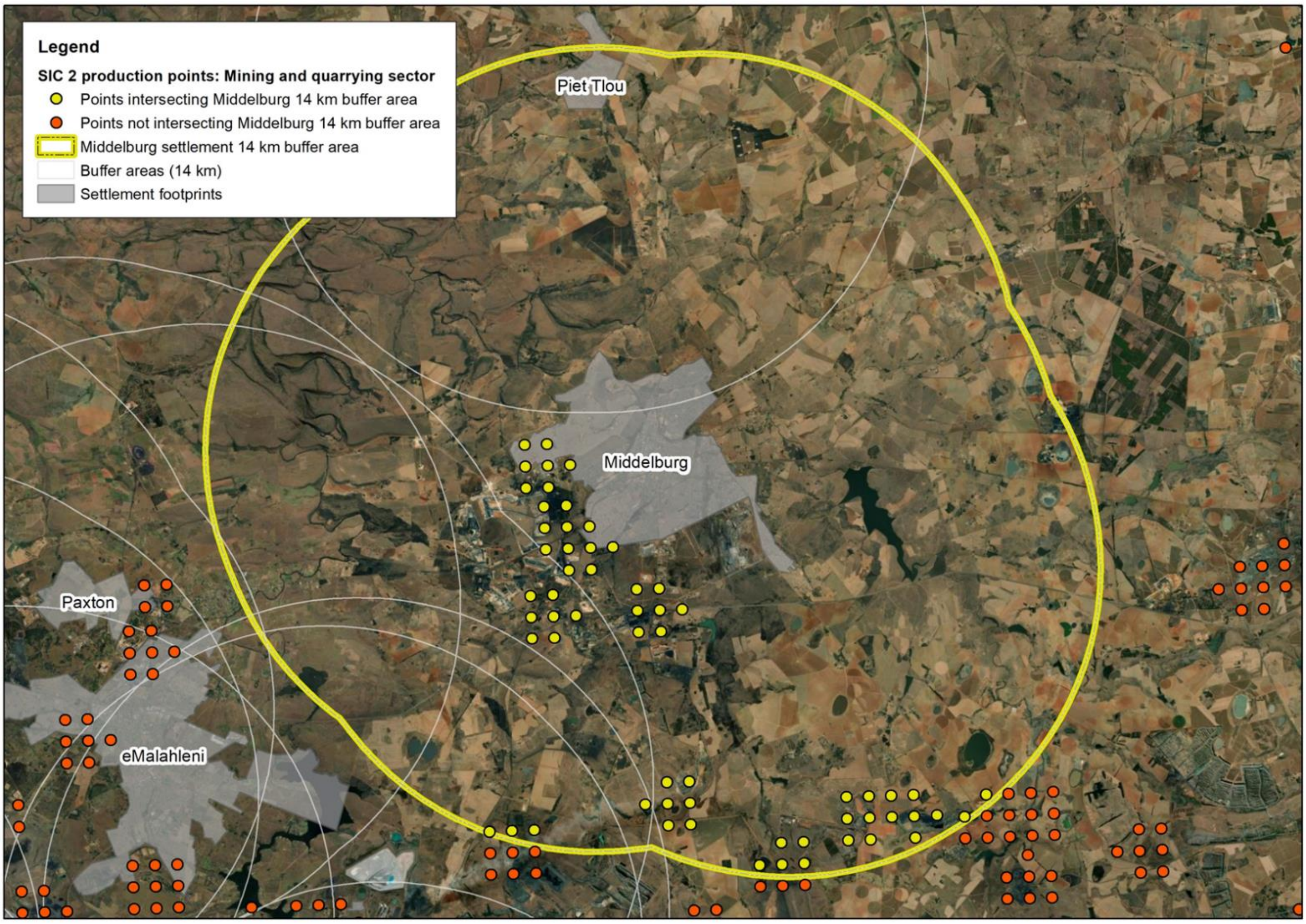
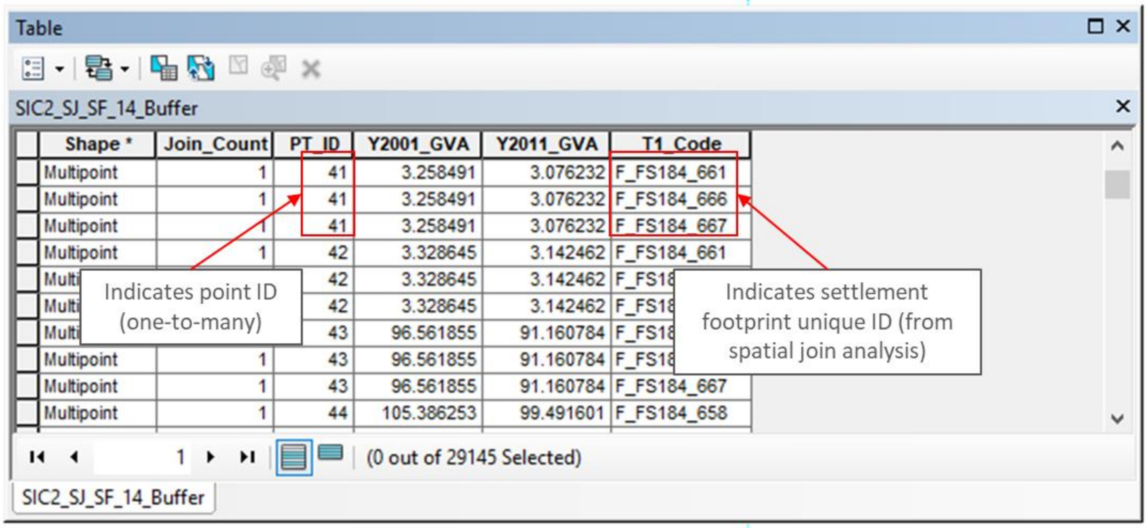


Figure 33: *Example of 14 km settlement footprint buffer polygon for Middelburg settlement, together with location of mining and quarrying (SIC 2) production points*

3. Since each output buffer polygon retained the attribute information of the settlement footprint feature it buffered, next, a spatial join[17] operation was used to assign a settlement footprint ID to each point of economic production, based spatially on the buffer polygon(s) that each point intersected (e.g., **Figure 33** and **Figure 34**). A one-to-many relationship was specified between each point of economic production and the settlement footprint buffer polygons. The spatial join operation was undertaken individually for each economic sector (i.e., SIC 1–4 and SIC 6–9).

[17] Joins attributes from one feature to another based on the spatial relationship. The target features and the joined attributes from the join features are written to the output feature class.



Table

SIC2_SJ_SF_14_Buffer

Shape *	Join_Count	PT_ID	Y2001_GVA	Y2011_GVA	T1_Code
Multipoint	1	41	3.258491	3.076232	F_FS184_661
Multipoint	1	41	3.258491	3.076232	F_FS184_666
Multipoint	1	41	3.258491	3.076232	F_FS184_667
Multipoint	1	42	3.328645	3.142462	F_FS184_661
Multi		42	3.328645	3.142462	F_FS18
Multi		42	3.328645	3.142462	F_FS18
Multi		43	96.561855	91.160784	F_FS18
Multipoint	1	43	96.561855	91.160784	F_FS18
Multipoint	1	43	96.561855	91.160784	F_FS184_667
Multipoint	1	44	105.386253	99.491601	F_FS184_658

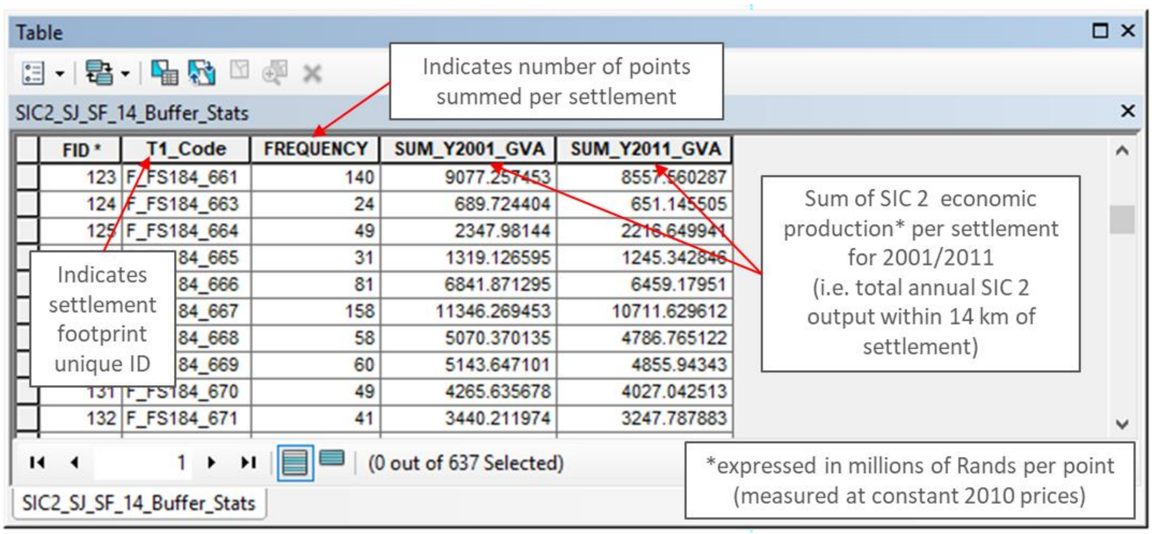
(0 out of 29145 Selected)

SIC2_SJ_SF_14_Buffer

Figure 34: Extract of the output attribute table for SIC 2 after the spatial join analysis

Geodatabase Process: Calculate economic production per settlement for 2001 and 2011

4. Using the settlement footprint ID attribute assigned to the economic production points in Step 3, the economic production per settlement, per sector for 2001 and 2011, was calculated. For each economic sector individually, the summary statistics[18] operation in ArcGIS was used to sum the 2001_GVA and 2011_GVA attributes of the economic production points, if points were assigned the same settlement footprint ID based on their mutual intersection with a given settlement footprint buffer. The summary statistics operation output summary tables for each for the eight economic sectors, calculating the total 2001 and 2011 economic production within a 14 km radius of each settlement, are shown in **Figure 35**.



Table

SIC2_SJ_SF_14_Buffer_Stats

FID *	T1_Code	FREQUENCY	SUM_Y2001_GVA	SUM_Y2011_GVA
123	F_FS184_661	140	9077.257453	8557.560287
124	F_FS184_663	24	689.724404	651.145505
125	F_FS184_664	49	2347.98144	2216.649941
	84_665	31	1319.126595	1245.342846
	84_666	81	6841.871295	6459.17951
	84_667	158	11346.269453	10711.629612
	84_668	58	5070.370135	4786.765122
	84_669	60	5143.647101	4855.94343
131	F_FS184_670	49	4265.635678	4027.042513
132	F_FS184_671	41	3440.211974	3247.787883

(0 out of 637 Selected)

SIC2_SJ_SF_14_Buffer_Stats

Figure 35: Extract of the output summary table for SIC 2 indicating the sum of mining and quarrying economic production (annual totals) per settlement

[18] Calculates summary statistics for fields in a table.

Geodatabase Process: Calculate change in economic production per settlement between 2001 and 2011

5. The total 2001 and 2011 sectoral economic production figures per settlement were used to calculate the absolute and relative settlement-level change in economic performance between 2001 and 2011 using the formulas:

$$Actual\_Economic\_Change_{yz} = GVA11_{yz} - GVA01_{yz}$$

where,

y – economic sector (i.e., SIC 1–4 and SIC 6–9)

z – settlement footprint.

$$Relative\_Economic\_Change_{yz} = \frac{GVA11_{yz} - GVA01_{yz}}{GVA01_{yz}} \times 100$$

where,

y – economic sector (i.e., SIC 1–4 and SIC 6–9)

z – settlement footprint.

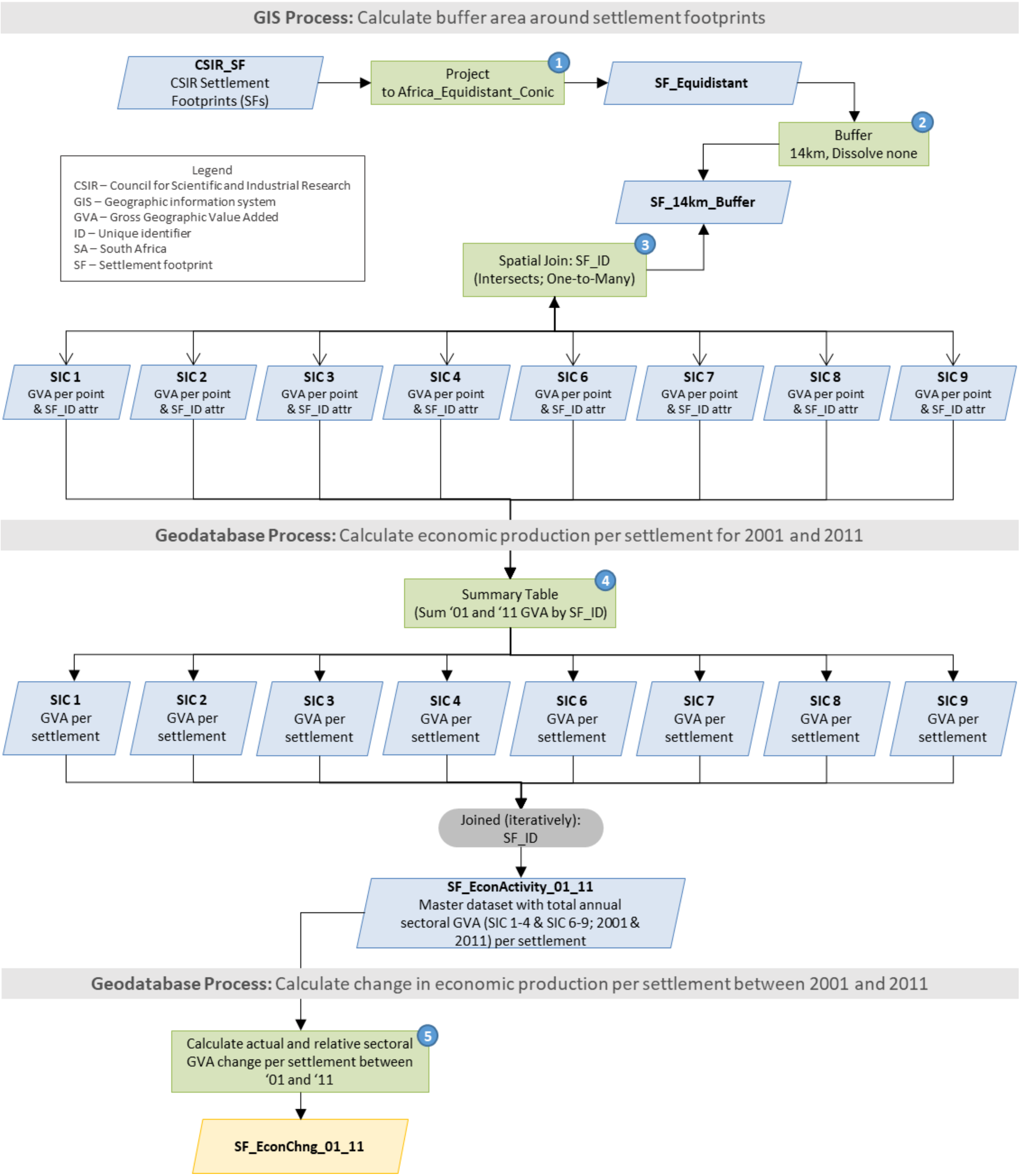


Figure 36: *Analysis workflow of Task 2.2: Calculation of settlement-level economic production and change between 2001 and 2011*

4.5.2.3 Task 2.3: Profile South African settlements according to economic criteria

The main focus of Task 2.3 was to distinguish settlement types based on economic activity in order to delineate settlements with similar economic profiles. These classes were used as the basis for comparing similarly profiled towns and cities with one other. A general overview of the clustering analysis and K-means algorithm is given below; thereafter the analysis workflow is explained in more detail. The analysis workflow is illustrated in **Figure 37**, and extends the analysis outputs of Task 2.2 (illustrated in **Figure 36**).

4.5.2.3.1 Data clustering

Clustering refers to the division of data with the purpose of forming natural groupings based on similarity (Berkhin, 2006). The main goal of clustering is to organise data into meaningful structures by partitioning data observations into groups (clusters) based on common factors in such a way that objects in the same groups are more similar to one another than objects in different groups, according to some defined criteria (Bação, Lobo & Painho, 2004; Huang, 1998). The similarity is considered on the basis of certain features (variables), which can be quantitative (numerical) or qualitative. Qualitative variables are often denoted as categorical.

Clustering applications usually deal with large datasets and data with many attributes. Clustering therefore plays an essential role in a broad range of applications given its ability to provide concise data summaries and draw meaning out of large, complicated datasets (Berkhin, 2006). Cluster analysis has a wide array of applications, including those used by geographers and urban researchers. Literature providers several examples where clustering techniques have been applied to population census or land use data (Dudeni-Tlhone, Holloway, Khuluse-Makhanya & Koen, 2013). Within the domain of Geographical Information Science specifically, further applications include, for example, geodemographics research (Harris, Sleight & Webber, 2005), the identification of deprived areas, and social services provision. In studies employing correlation analysis, clusters can also be identified by applying a clustering technique prior to regression modelling (e.g., Khuluse-Makhanya, Stein, Breytenbach, Gxumisa, Dudeni-Tlhone & Debba, 2017). While clustering has proved to be an effective approach to partitioning a set of objects in databases, a well-known obstacle with clustering is the interpretation of cluster groupings. Supporting information can therefore be useful for describing the clusters.

There are several considerations and decisions required when choosing an appropriate clustering method and carrying it out in practice (Hennig, 2015). Bação, Lobo and Painho (2004) adapted the clustering procedure for GIS data identifying seven points at which decisions are required, and helping to inform the choice of appropriate method:

1. Selecting the objects to be clustered
2. Selecting the measurements or variables
3. Standardisation of data

4. Selecting a clustering method
5. Determining the optimal number of clusters
6. Interpreting, labelling and evaluating the cluster membership allocations of input data
7. Mapping the results.

Like many approaches in data science and statistics, there are different methods for uncovering clusters. The choice of method depends entirely on the particular aim of clustering in the application of interest, together with the type of data measurements or variables one is working with (Hennig, 2015). Depending on whether the clustering data variables are quantitative (e.g., interval or ratio) or qualitative (e.g., categorical), there are a number of different methods that can be used to carry out a segmentation operation. These methods are conceptually placed between statistics and informatics. Common methods include K-means for quantitative data and K-modes for qualitative data.

K-means clustering was identified as the statistical technique most appropriate for clustering South African settlements according to economic criteria, given that the observation dataset contained quantitative ratio variables. K-means is one of the simplest unsupervised learning algorithms. Pioneered by MacQueen in 1967, the K-means algorithm is well-known and well documented and is arguably the most famous of the clustering algorithms. It is used to cluster data observations into homogeneous groups when data are unlabelled (i.e., data without defined categories) (Dudeni-Tlhone *et al*., 2013), given that K-means cannot handle non-numerical data.

The general aim of the K-means algorithm is to categorise n objects into k (k>1) groups (clusters) by using p (p>0) variables. The basic inputs of the K-means algorithm are thus the dataset with observations (where the variables of the observations are numeric), together with the user-specified required number of clusters. Fundamental to K-means is that k points (which represent the initial group of centroids or the required number of clusters) be determined prior to clustering. Defining an appropriate number of clusters ensures that the natural structure of the data is well represented in the k sets of clusters to be formed (Milligan, 1996; Berry & Linoff, 1999).

The objective function of the K-means algorithm assigns observations to cluster centroids so that the intra-cluster distance (the within-group sum of squared errors) is minimised (Trevino, 2016). K-means produces homogeneous clusters in the sense that all observations are assigned to the closest centroid, and large distances within clusters are heavily penalised (Hennig, 2015). At first, each observation is assigned to its closest centroid. The cluster centroids representing the starting points can be selected in a variety of ways (Dudeni-Tlhone *et al*., 2013). For example, some algorithms use specified observations from the dataset as starting cluster centroids, while others generate random 'seeds' and use them to represent the initial clusters. Once all observations have been assigned to a cluster grouping, the centroids of each cluster are recalculated and updated based on the observations that were assigned to it. The algorithm is then iterated until the within-groups sum of squared errors is minimised and there is no change in the cluster assignment of observations. K-means clustering is known as 'hard clustering' since each data point belongs to one cluster only. The outputs of the K-means clustering algorithm are:

- Labels for the training data (each observation is assigned to a single cluster)
- The centroids of the *k* clusters, which can be used to label new data (Trevino, 2016).

The strengths of the K-means technique include the capability of handling large datasets, and ease of adaptation into advanced clustering procedures aimed at superior data-handling efficiency (Dudeni-Tlhone *et al*., 2013). A fundamental limitation of the K-means technique is that it is unable to process categorical datasets (Huang, 1998).

4.5.2.3.2 Analysis methodology of Task 2.3: Profile SA settlements according to their economic composition

Following the analysis outputs of Task 2.2 (Calculate settlement-level economic performance and change between 2001 and 2011) (**Figure 36**), the K-means algorithm was used to cluster settlements based on their similar economic profiles using the 2011 GVA figures. The analysis workflow is summarised in **Figure 37** and is thereafter further explained.

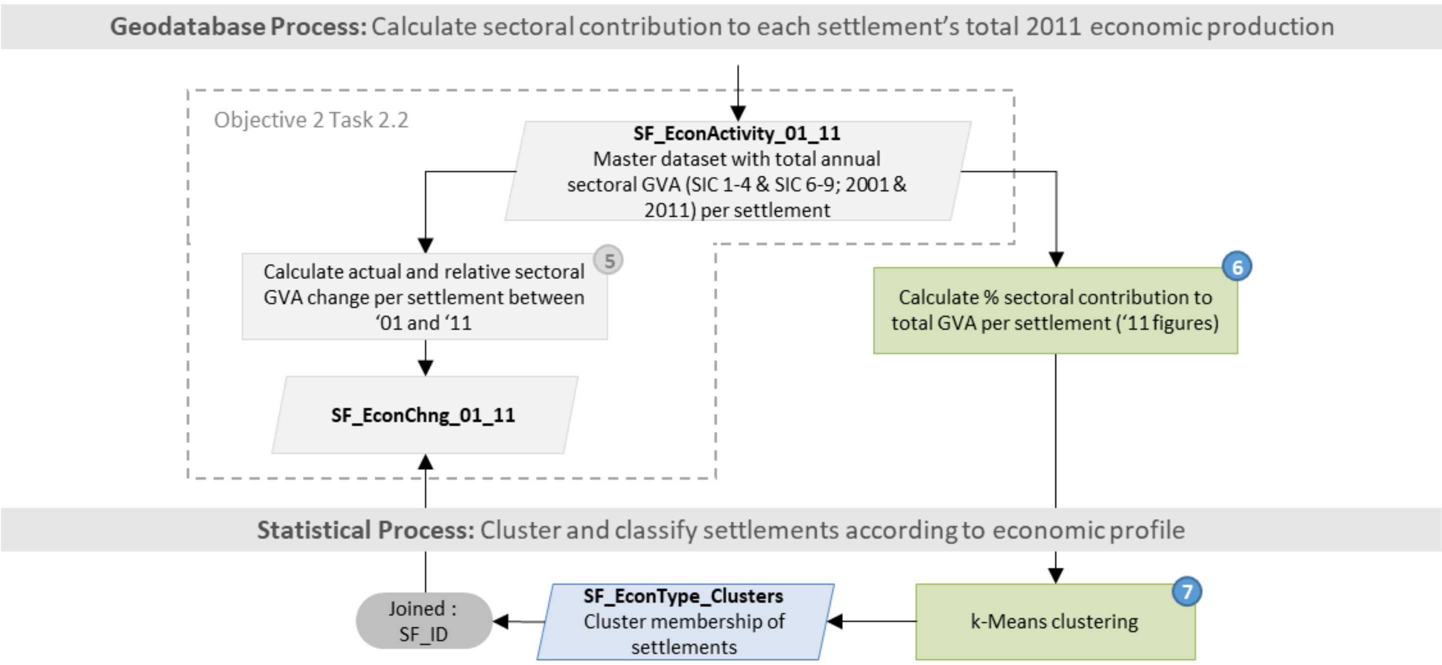


Figure 37: *Analysis workflow of Task 2.3: Profile SA settlements according to their economic composition*

Geodatabase Process: Calculate sectoral contribution to each settlement's total 2011 economic production

6. The sectoral contribution, as a percentage of each settlement's total 2011 economic production[19], was calculated using the formulas:

$$Total\_GVA11_z = SIC1\_GVA11_z + SIC2\_GVA11_z + SIC3\_GVA11_z + SIC4\_GVA11_z + SIC6\_GVA11_z + SIC7\_GVA_{11z} + SIC8\_GVA11_z + SIC9\_GVA11_z$$

where,

z – settlement footprint.

$$\%SIC1\_11_z = \left(\frac{SIC1\_GVA11_z}{Total\_GVA11_z}\right) \times 100$$

$$\%SIC2\_11_z = \left(\frac{SIC2\_GVA11_z}{Total\_GVA11_z}\right) \times 100$$

$$\%SIC3\_11_z = \left(\frac{SIC3\_GVA11_z}{Total\_GVA11_z}\right) \times 100$$

$$\%SIC4\_11_z = \left(\frac{SIC4\_GVA11_z}{Total\_GVA11_z}\right) \times 100$$

$$\%SIC6\_11_z = \left(\frac{SIC6\_GVA11_z}{Total\_GVA11_z}\right) \times 100$$

$$\%SIC7\_11_z = \left(\frac{SIC7\_GVA11_z}{Total\_GVA11_z}\right) \times 100$$

$$\%SIC8\_11_z = \left(\frac{SIC8\_GVA11_z}{Total\_GVA11_z}\right) \times 100$$

$$\%SIC9\_11_z = \left(\frac{SIC9\_GVA11_z}{Total\_GVA11_z}\right) \times 100$$

where,

z – settlement footprint

and

$$\%SIC1\_11_z + \%SIC2\_11_z + \%SIC3\_11_z + \%SIC4\_11_z + \%SIC6\_11_z + \%SIC7\_11_z + \%SIC8\_11_z + S\,\%IC9\_11_z = 100\,\%.$$

Statistical Process: Cluster and classify settlements according to economic profile

7. Using IBM SPSS Statistics software (version 27.0.0), the K-means algorithm[20] was used to cluster all formal settlements into six classes based on each settlement's sectoral profile. The percentage sectoral contribution values calculated in the preceding analysis step were used as the basis for clustering similarly profiled settlements. An overview of the K-means analysis specifications, considering the framework by Bação, Lobo and Painho (2004), is outlined in **Table 6**.

---

[19] Excluding SIC 5 (Construction)

[20] K-means clusters find natural clusters of features based on either location or attribute values using the K-means algorithm. The algorithm works to classify the features so that the features within a cluster are as similar as possible, while the clusters are as different as possible.

Table 6: *K-means analysis specifications*

	Analysis considerations	Clustering method
1	**Clustered objects**	All settlements (as derived from the Settlement Footprint data frame), excluding settlements within metropolitan municipalities as well as settlements classed as traditional
2	**Measurements/variables**	Economic activity per sector (2011 GVA figures) as the basis for deriving settlements with similar economic profiles
3	**Data standardisation**	Percentage sectoral contribution to settlement economy (2011 GVA figures)
4	**Clustering method**	K-means algorithm
5	**Number of clusters**	6 clusters (determined after exploratory analysis)
7	**Cluster membership allocations of input data**	Output results used for further analysis
8	**Map output results**	

The economic-based settlement classes derived from this analysis were used in the research analysis as the basis for comparing similarly profiled towns and cities with one other.

4.5.3 Objective 3: Quantify population change at settlement level between 2001 and 2011

I. Objective

The aim of Objective 3 was twofold: firstly, to segment South Africa's working-age population with respect to key socio-economic variables, and secondly, to calculate population change at settlement level between 2001 and 2011.

II. Overview of process for meeting Objective 3

A four-stage process was followed in order to meet the outcomes of Objective 3, as illustrated in **Figure 38**.

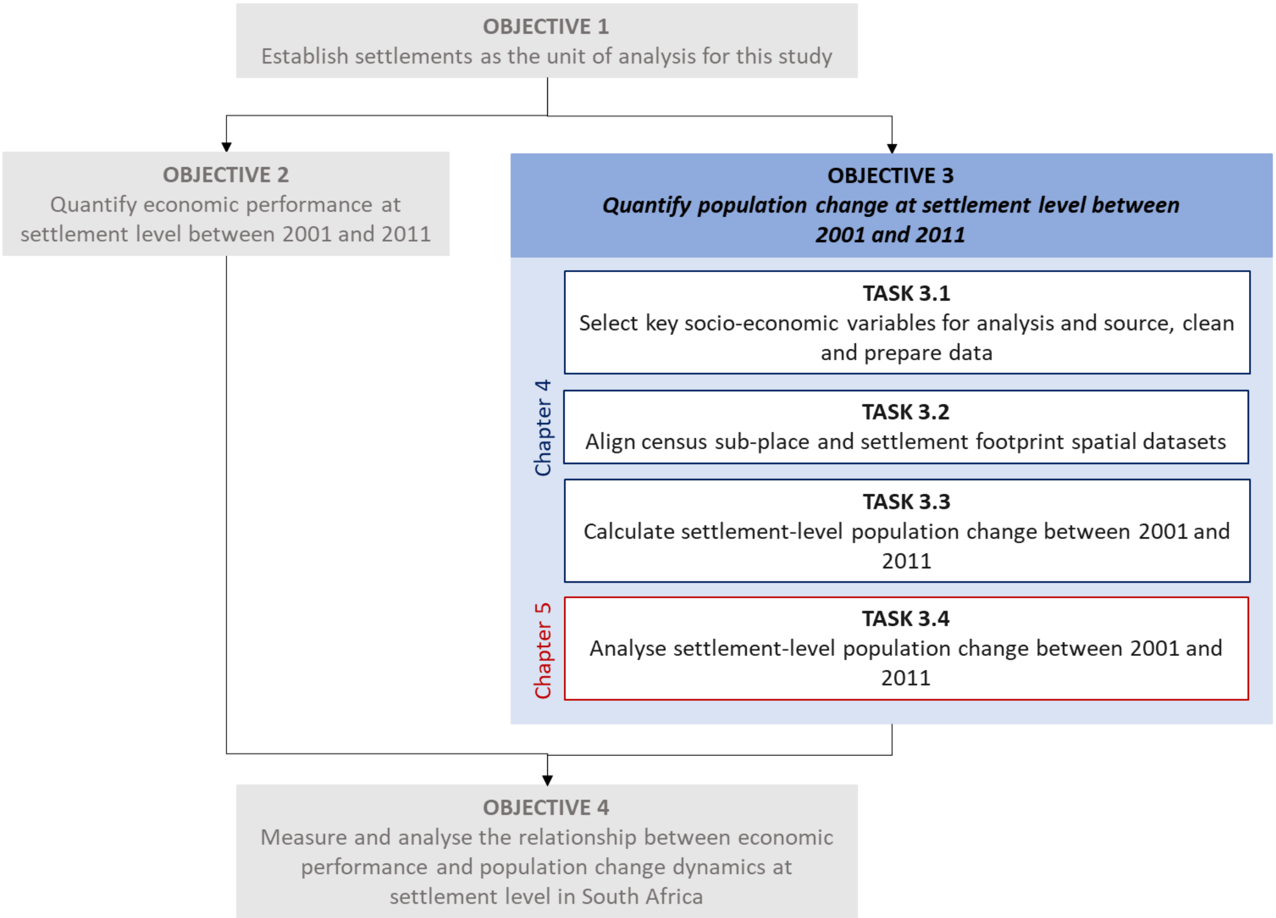


Figure 38: *Task breakdown of Objective 3*

III. Datasets

The datasets used for analysis in Objective 3 are outlined in **Table 7**, together with the data source, GIS shape format and the analysis tasks in which the respective datasets were utilised. The main analysis datasets are further discussed in more detail below.

Table 7: Datasets for population clustering and analysis at settlement level

Dataset	Description	Source	Shape	Task
Main analysis datasets				
2011 Census, non-aggregated	2011 Census line item data	Stats SA[21]	Non-spatial	Task 2.1
Census 2001 sub-place dataset (spatial)	2001 Census sub-place demarcation dataset		Polygons delineating sub-places (suburbs, villages or localities)	Task 2.2 & 2.3
Census 2011 sub-place dataset (spatial)	2011 Census sub-place demarcation dataset			Task 2.2 & 2.3
Census 2001 sub-place dataset (attribute)	2001 Census sub-place attribute dataset, obtained from custom Census 2001 SuperCROSS cross-tabulation of sub-place by gender, age, employment status and highest level of education		Attributes with sub-place ID	Task 2.3
Census 2011 sub-place dataset (attribute)	2011 Census sub-place attribute dataset, obtained from custom Census 2011 SuperCROSS cross-tabulation of sub-place by gender, age, employment status and highest level of education			Task 2.3
Settlement Footprint data frame	Spatial demarcation of distinct and continuous built-up areas, classified as formal or traditional settlements	CSIR (2018b)[22]	Polygons delineating built-up areas	Task 2.2 & 2.3
Supporting analysis datasets				
CSIR Geo-data frame	The SPOT Building Count (SBC) point dataset, also known as the Eskom Dwelling Layer, is a point dataset in which all dwellings and building structures are identified by points (De la Rey, 2008). Given that no other information is available regarding the size or type of structure that each point represents, Mans (2012) adapted the dataset into what is now known as the CSIR Geo-data frame, by assigning a weight to each point using the principles of dasymetric mapping. The weight of each point represents the probable household size	CSIR (2020b)	Points indicating the location of dwellings and building structures	Task 2.2

[21] The 2001 and 2011 National Population Censuses were acquired from Stats SA through their community profiles as the source of population data for this study.

[22] See Mans *et al*. (2019) for additional information on the rationale behind, and development of the Settlement Footprint data frame.

Dataset	Description	Source	Shape	Task
	of that building (Mans, 2012). This was done for both the 2001 and 2011 population distribution.			
National Land Cover (NLC) Dataset 2000	The NLC 2000 data were generated from digital Landsat imagery, acquired primarily from 2000–2001. The land cover data are captured as a digital raster dataset with a minimum mapping unit of 2 ha, containing 45 land cover classes.	GeoTerra Image via DEFF	Raster grid	Task 2.2
National Land Cover (NLC) Dataset 2013/2014	The NLC 2013/14 data, which covers the whole of South Africa, was generated from Landsat 8 multi-spectral imagery. The land cover data are presented in a raster map corrected format, based on 30x30m pixels equivalent to the image resolution of the source imagery. The full dataset contains 72 LULC information classes, covering a wide range of natural and man-made landscape characteristics.		Raster grid (30x30m raster cells)	Task 2.2

4.5.3.1 Task 3.1: Select key socio-economic variables for analysis and source, clean and prepare data

The list of variables used in the population analysis is shown in **Table 8**. These variables were chosen based on the qualitative and quantitative profiling of South Africa's working-age migrant population as the output of the literature review together with the exploratory analysis of the Stats SA non-aggregated Census 2011 data. These data were further classified into discrete classes, and the classification considerations are discussed in this section.

Table 8: *Socio-economic variables used in the analysis*

Broad classification of variables (factors)	Key variables
Gender	Gender
Life cycle stage	Age group
Socio-economic standing	Employment status
Human capital / Skills	Highest level of education

I. Gender variable

While there is little noticeable distinction between male or female migrants at a national aggregate level (**Figure 39**), gender was included as a variable in the cluster analysis to reflect differences introduced by the apartheid (male) migrant labour system, and the more recent rapid feminisation of the labour market (Casale & Posel, 2002; Burger & Von Fintel, 2014). Given that, historically, South African migration has had a strong gender bias

(Oosthuizen & Naidoo, 2004), this research postulates that male and female migrants might be incentivised differently when looking at movement patterns at local level. Thus, including gender as a variable in this study allows one to question whether regions with higher economic activities from mining (for example) are more likely to attract fewer women migrants, since typically men have migrated more towards mining-heavy regions.

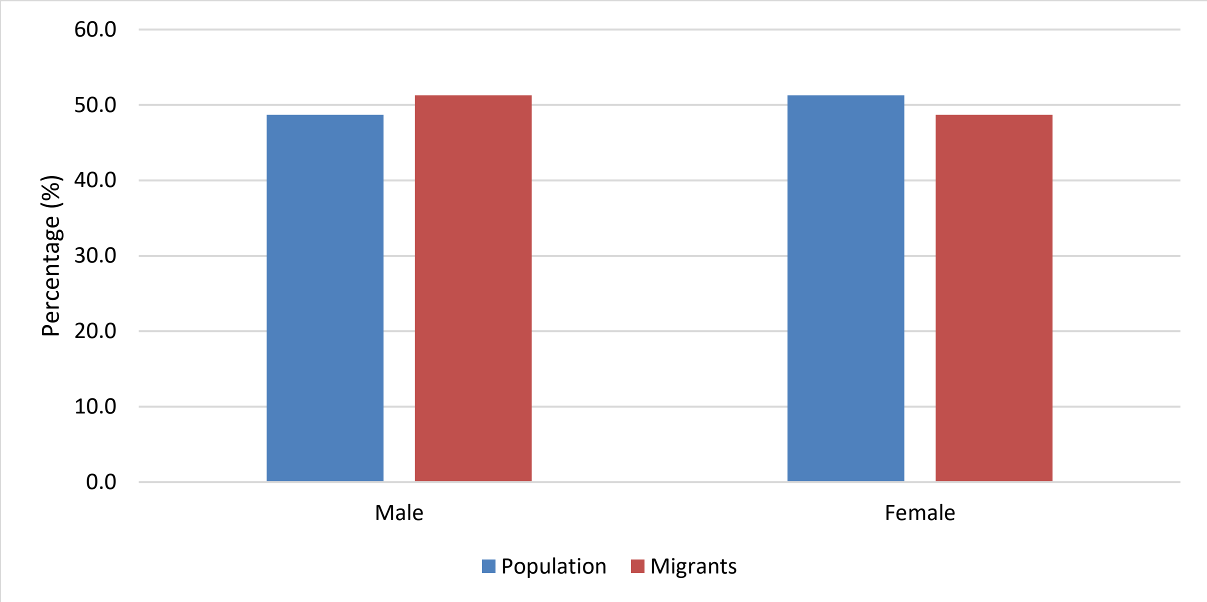


Figure 39: *Gender profile of South Africa's working-age migrant population relative to entire working-age population, 2011*
Source: Own calculations, using Stats SA Census 2011 data

II. Age variable

The National Youth Commission Act (No. 19 of 1996) and the National Youth Development Policy Framework (2002) define youth as the subset of the population aged 14–35 years. These classifications are consistent with the definition in the African Youth Charter, which defines youth as those between the ages of 15 and 35 years (AUC, 2006). Youth employment laws in South Africa make it a criminal offence to employ a child under 15 years of age (see Basic Conditions of Employment Act, No. 75 of 1997), while persons under the age of 18 are considered minors (see Children's Act, No. 38 of 2005).

The specific interest in the working-age youth age group is driven by the observation that young individuals are more likely to move in search of jobs, as outlined in the literature (Van der Berg *et al.*, 2002). Additionally, two further considerations were taken into account in categorising the youth in South Africa, as informed by Hall *et al*. (2015):

- Lower youth (Education seekers): Youth who are attracted to urban spaces for better educational and training opportunities (including schools for the younger end of the group, as well as training colleges and universities). These are predominantly in the 15–24-year age category.
- Upper youth (Employment seekers): Youth who are attracted to urban spaces for better employment or income-generating opportunities. These are predominantly in the 25–34-year age category.

While Grades 1 to 9 are compulsory and are classified as General Education and Training, Grades 10 to 12 are classified as Further Education and Training. The Department of Education's age-grade norms state that the statistical age norm per grade is the grade number plus 6, so a child should be seven years old in Grade 1 (Grade 1 + 6= age 7), eight in Grade 2 (Grade 2 + 6= age 7) and so on. Thus, ideally, Grade 9 learners will be 15 years old (i.e., minimum school-leaving age), and Grade 12 learners will be 18 years old (see South African Schools Act, No. 84 of 1996, and National Education Policy Act, No. 27 of 1996: Age requirements for admission to an ordinary public school).

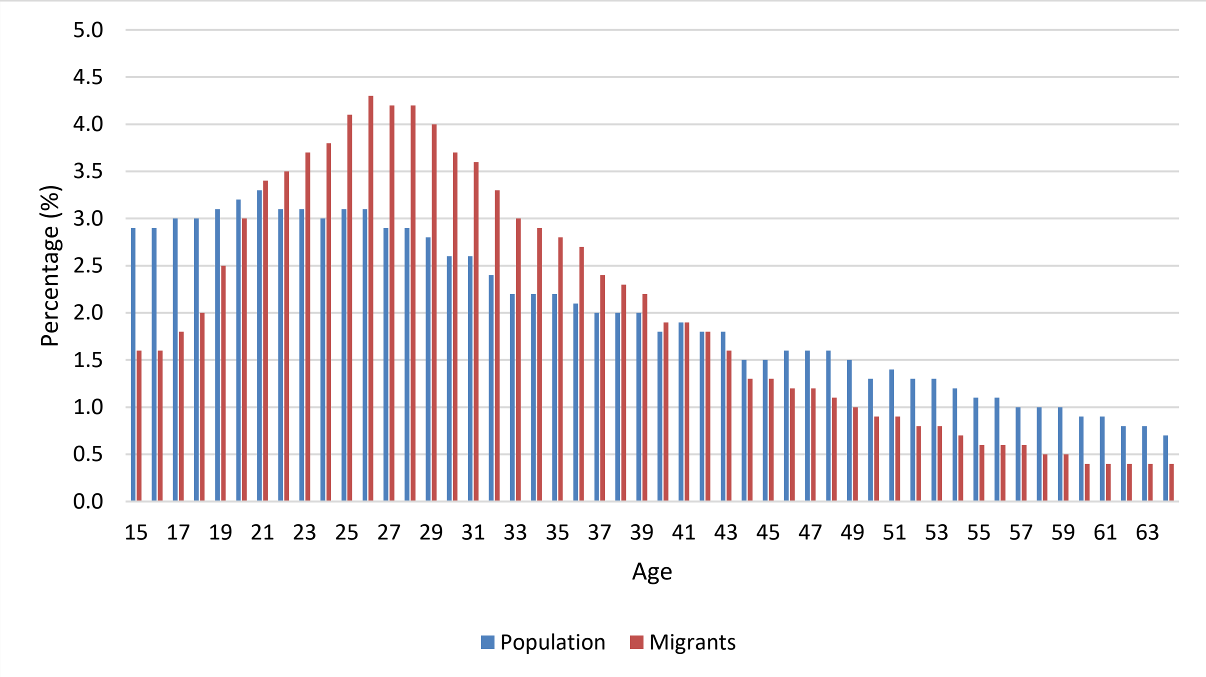


Figure 40: *Age profile of working-age migrant population relative to entire working-age population (ungrouped), 2011*
Source: Own calculations, using Stats SA Census 2011 data

The age profile of South Africa's working-age migrant population was extracted from the Stats SA non-aggregated Census 2011 data and shows (**Figure 40**) a higher frequency of young migrants than those in the older age-brackets. This trend is supported by the findings of the literature review. Based on these observations, and the additional considerations of youth who move in order to access better educational opportunities or employment, **Table 9** outlines the categorisation of the 2001 and 2011 Census variables for age, based on the working-age population groupings used by Quantec (2020a). The percentage of working-age migrants relative to the entire working-age population, by age grouping (as set out in **Table 9**), is shown in **Figure 41**.

Table 9: Age variable categories

Age groups	2001/2011 – Stats SA age groups
Lower youth (e.g., Education seekers)	15–24 years of age
Upper youth (e.g., Employment seekers)	25–34 years of age
Working-age adults	35–64 years of age

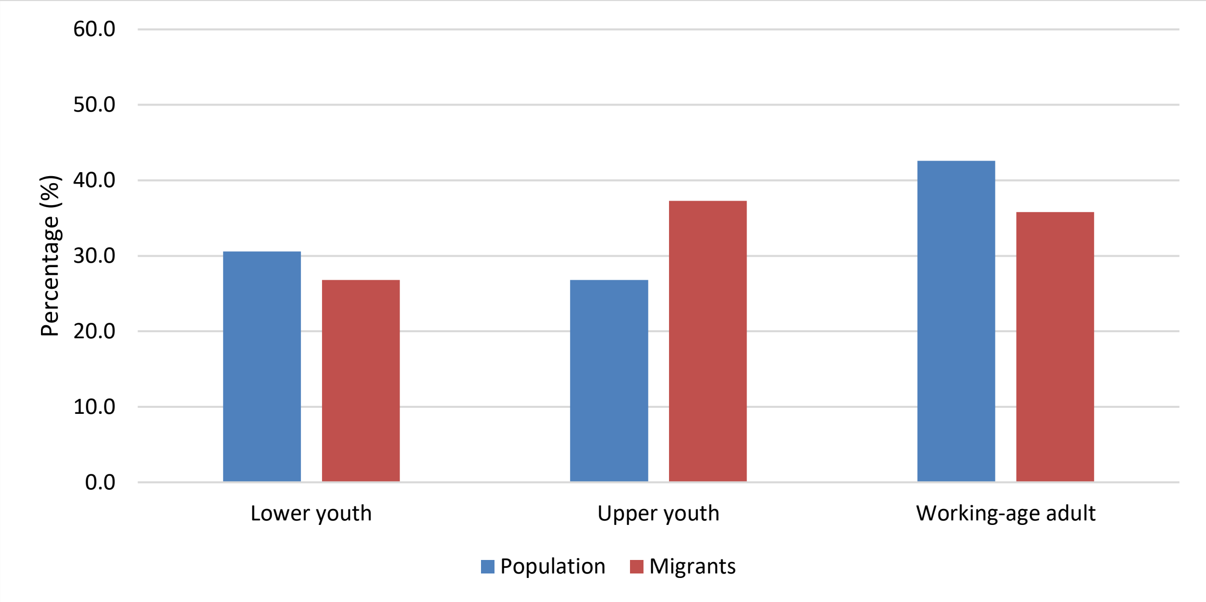


Figure 41: *Age profile of working-age migrant population relative to entire working-age population (grouped), 2011*
Source: Own calculations, using Stats SA Census 2011 data

III. Employment status variable

The broad definition of unemployment was used to derive an individual's employment status. The broad definition of unemployment classes persons who did not work, but were available to work, as unemployed, regardless of whether they were looking for work or not at the time of the Census. **Table 10** outlines the categorisation of the 2001 and 2011 Census variables for employment status. The percentage of working-age migrants relative to the entire working-age population, by employment status group (as set out in **Table 10**), is shown in **Figure 42**. From this figure, it is evident that the largest proportion of migrants fall into the employed status category. This observation does not indicate their employment status before migrating.

Table 10: Employment status categories

Employment status groups	2001/2011 – Stats SA expanded employment status
Employed	Employed
Unemployed	Unemployed
NEA	Not economically active

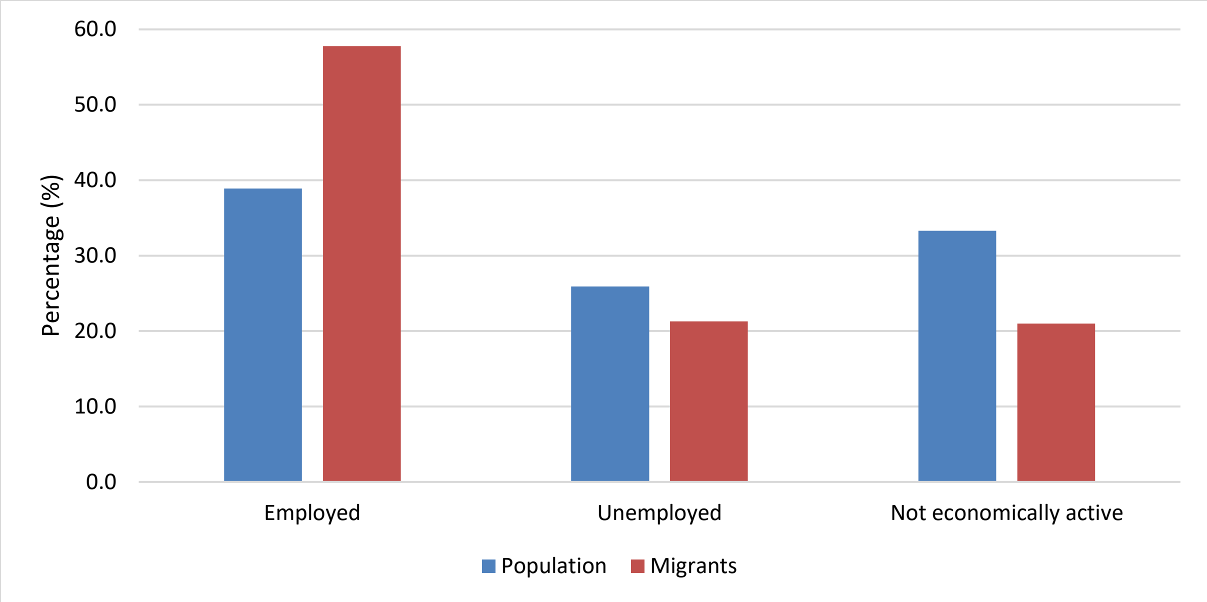


Figure 42: *Employment status profile of working-age migrant population relative to entire working-age population, 2011*
Source: Own calculations, using Stats SA Census 2011 data

IV. Highest level of education variable

Highest level of education was used as a proxy for human capital, being the *"the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being"* (OECD, 2001:18). Literacy and numeracy skills form part of a person's 'human capital' and are important foundations for economic and social participation (Shomos & Forbes, 2014). Higher literacy and numeracy skills tend to be associated with better labour-market outcomes (employment and wages) and are also the necessary building blocks required for cultivating higher-order skills that contribute to a more productive labour force (Shomos & Forbes, 2014; Massing & Schneider, 2017). Comparing the literacy and numeracy skills of individuals with different levels of educational attainment (i.e., grade 11 or lower, grade 12, diploma/certificate, or bachelor's degree or higher), Shomos and Forbes (2014) found a high correlation between literacy and numeracy skills, and educational attainment.

In order to reduce the dimensionality and enhance the stability of the data, the 21 categories for highest level of education in the 2001 Census, and the 29 categories in the 2011 Census were collapsed into four skill level categories for the purpose of this study, where the highest level of education variable was used as a proxy for skill, as outlined in **Table 11**.

In this research, and the broader South African context, individuals with no schooling or incomplete primary schooling (i.e., grade 1–6) were classified as unskilled. Individuals with grade 7 or incomplete secondary schooling (i.e., grade 7–11) were classified as having basic skills. Individuals with a matriculation certificate (grade 12/std 10/NTC 3[23]) (or equivalent) or those with a certificate/diploma (NTC 4–6[24]) were classified as semi-skilled, based on research by Shomos and Forbes (2014), which found that people with diploma/certificate attainment displayed similar literacy profiles to those with only grade 12. Lastly, individuals with higher education (bachelor's degree or higher) were classified as being highly skilled.

Table 11 outlines the categorisation of the 2001 and 2011 Census variables for the level of education. The percentage of working-age migrants relative to the entire working-age population, by highest level of education categorisation (as set out in **Table 11**), is shown in **Figure 43**. From this figure, it is evident that a larger proportion of migrants are semi-skilled or highly skilled relative to the entire working-age population.

***Table 11:** Highest level of education variable categories*

Highest level of education categorisation	2001/2011 – Stats SA level of education groups
Unskilled	No schooling / some primary schooling
Basic-skilled	Grade 7 / Some secondary schooling
Semi-skilled	Grade 12 / std 10 (NTC 3) / certificate / diploma (NTC 4–6)
Highly skilled	Bachelor's degree or higher

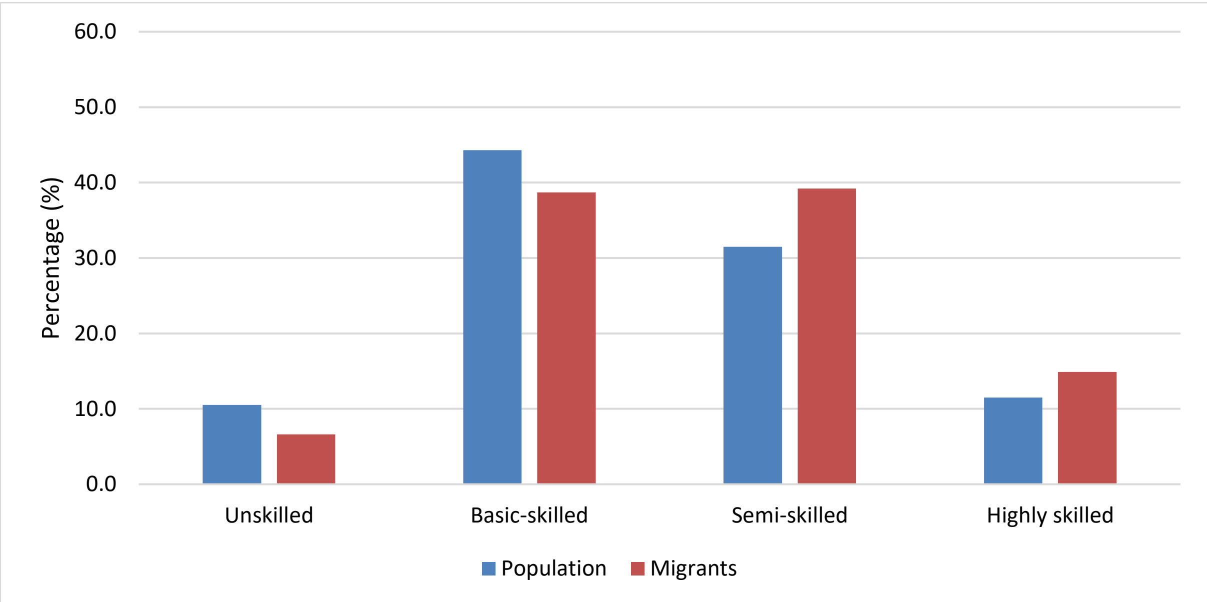


***Figure 43:** Education/Skills profile of working-age migrant population relative to entire working-age population, 2011*
Source: Own calculations, using Stats SA Census 2011 data

[23] A National Technical Certificate (NTC) 3 qualification is equivalent to a National Senior Certificate (NSC) (grade 12 certificate).
[24] An NTC 6 certificate is equivalent to a National Diploma.

V. **Average annual income variable**

In South Africa, where dependency on social grants is high (see **Section 3.2.4**, which outlines South Africa's welfare system), it is important to know where individuals and households obtain their main sources of livelihood, and how much this amounts to. Stats SA (2015a) acknowledges, however, that income is a problematic variable in data collection in South Africa, associated with several challenges and limitations. Given the following challenges, the income variable was excluded from further analysis in this research:

- In response to the income question, a high proportion of both individuals and households reported having no income, or left the question response as unspecified (**Figure 44**). This happened in both the 2001 and 2011 Censuses, but the unspecified responses were far higher in 2011. These difficulties were further highlighted when analysing variables such as employment status, dwelling ownership and assets, together with income (Stats SA, 2015a). Stats SA (2015a) points out the anomalies, explaining that, "*the proportion of individuals who get paid in-kind as a form of remuneration for employment should be very minimal. Furthermore, in a normal situation, it is not expected that households that report no income in turn report renting dwellings or owning a number of assets in high proportions*".

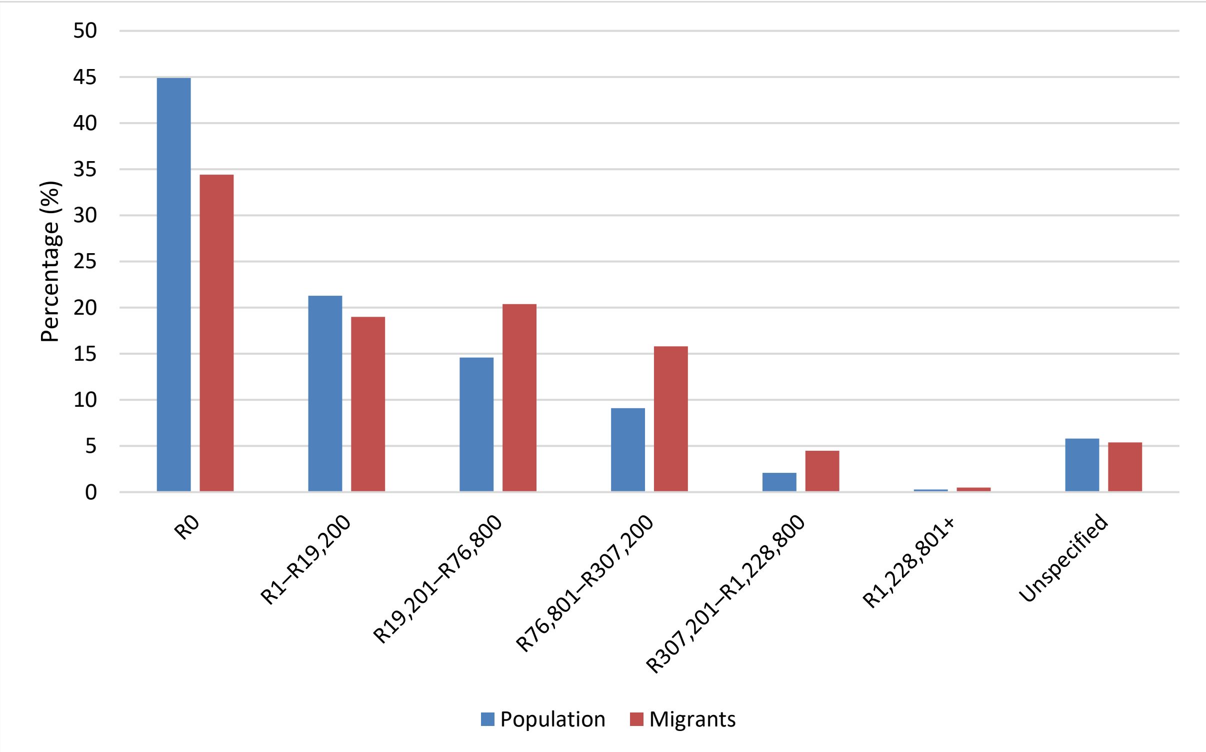


Figure 44: *Income profile per annum of working-age migrant population relative to entire working-age population, 2011*
Source: Own calculations, using Stats SA Census 2011 data

- The interpretation of the income question, as asked in the Census 2011 questionnaire, could have been ambiguous to some respondents in the way in which the question was posed, or in some cases translated. The question could perhaps have been mistaken to imply that income equates only to salaries or wages (Stats SA, 2015a), and a response of 'no income' could therefore not be assumed to mean that the respondent had no source of livelihood.

- Income is a problematic variable to analyse temporally given the complexities that arise due to price inflation. This is further complicated given that Census income data are collected and reported in income brackets. The 2001 and 2011 Censuses used identical income brackets. If these brackets were used to classify low-, medium- and high-income groups, for example, the income groups would need to be adjusted to changes in the consumer price index (CPI) over the intervening period, as demonstrated in studies that have compared income over time (Van Wyk & Van Aardt, 2008; Mokgalaka, Mans, Smit & McKelly, 2014).
- Education level, labour-force status and income are strongly correlated (Stats SA, 2015b). This study focused on the first two of these variables (level of education and employment status). Including income as an additional variable would have been unlikely to reveal significant new insights and would have posed several challenges, as highlighted, while exponentially increasing the scope of the analysis.

4.5.3.2 Task 3.2: Align Census sub-place and settlement footprint spatial datasets

Based on the outcome of the variable-selection process outlined in Task 3.1, South African Census data were used to calculate the total settlement population based on the key socio-economic variables for both 2001 and 2011. It was important to receive these population data at the smallest possible geographical level to best align with the local, settlement-level scale of this research. Given, firstly, that the 2001 Census attribute data were not released at an EA level for reasons of confidentiality (Stats SA, 2007b), and secondly, that the first Census year that the small area layer was used for reporting national results was the 2011 Census, the sub-place level was deemed the most appropriate spatial scale. In the Census data hierarchy, the sub-place level is the smallest scale at which both the 2001 and 2011 Censuses attribute data were released (see **Section 4.5.1.1**).

While Census data present certain advantages for analysing population trends based on demographic and socio-economic variables at fine-grained suburb (sub-place) or city (main place) level, one of the main disadvantages thereof is the inability to easily compare inter-Census datasets and variable dimensions. In this research specifically, several spatial challenges arose due to the misalignment between the 2001 and 2011 sub-place demarcations, which changed between the 2001 and 2011 Censuses, resulting in significant spatial demarcation differences that had to be resolved in order to use the Census data in a time-series capacity. **Figure 45** presents an example of the spatial layout at sub-place level for the Census years 2001 and 2011.

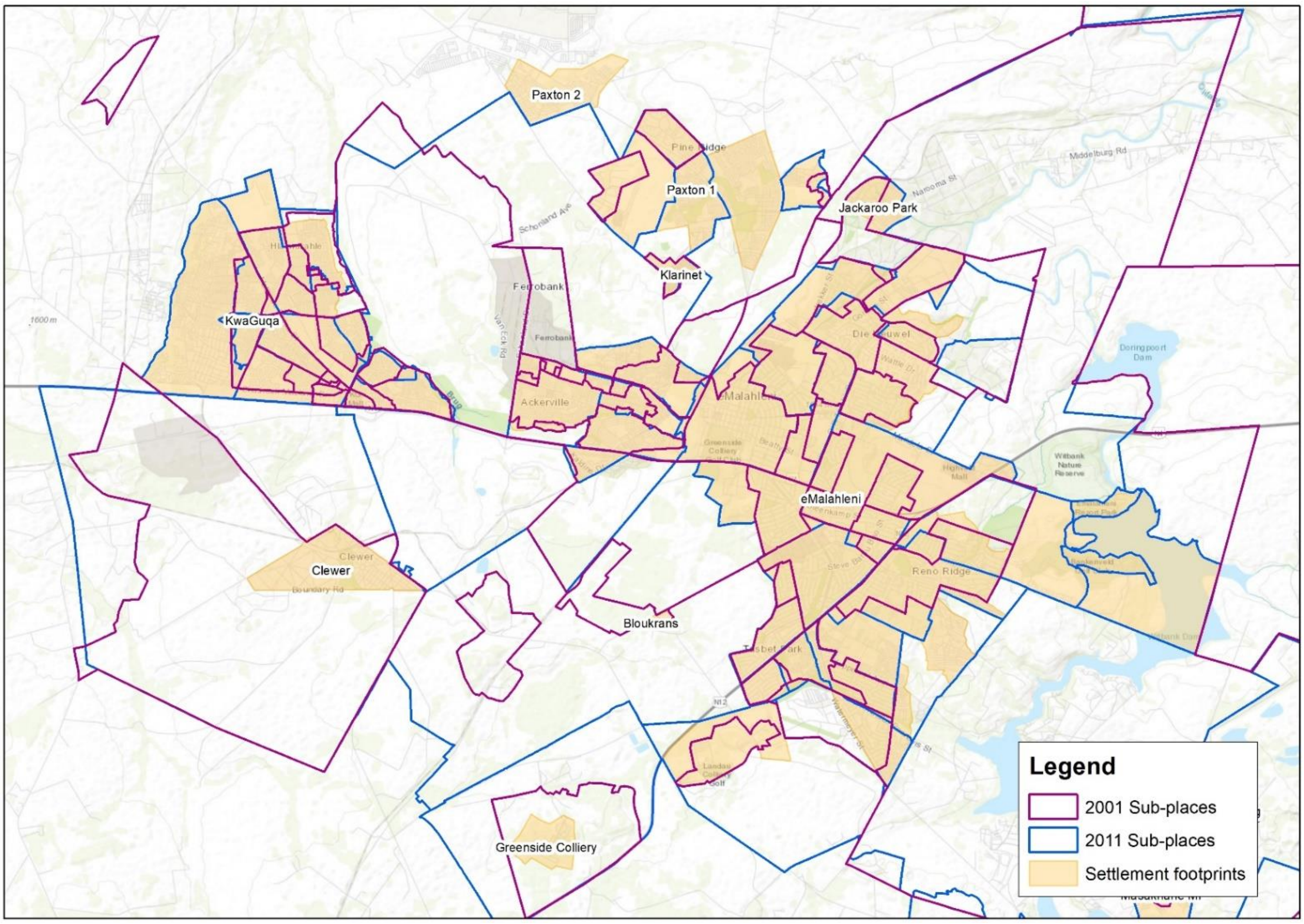


Figure 45: *Misalignment between 2001 and 2011 Census sub-places*

For this research, aligning the different Census geographies (in order to assess population changes of key socio-economic variables between the Census years of 2001 and 2011) was achieved by transferring and transforming the 2001 and 2011 sub-place data, from their spatially unaligned Census demarcations (source layers) to a single uniform layer (the alignment layer). The CSIR Settlement Footprint data frame was used as the common denominator (i.e., the alignment layer) in order to allow for data alignment between the different analysis years, and the resultant temporal change calculations of settlement-level population.

Section 4.5.3.2.1 presents the data analysis workflow for aligning the 2001 and 2011 Stats SA sub-place datasets with the CSIR Settlement Footprint data frame. The generic process is represented, as outlined in **Figure 48** and **Figure 49**, but in reality, the workflow was carried out twice, once for each of the Census years respectively. The outputs from this analysis were two lookup tables: 1) between the 2001 sub-places and settlement footprint alignment pairs, and 2) between the 2011 sub-places and settlement footprint alignment pairs. These reference lookup tables were used as the basis for transforming the Stats SA sub-place data to the settlement footprint level, and thereafter, calculating the settlement-level population change between 2001 and 2011 (as outlined in Task 3.3).

4.5.3.2.1 Analysis methodology of Task 3.2: Align Census sub-place and settlement footprint spatial datasets

The flowcharts in **Figure 48** and **Figure 49** illustrate the analysis workflow that was followed in order to align the 2001 and 2011 Stats SA sub-places with the CSIR Settlement Footprint demarcations. Using Esri ArcGIS Desktop, specifically ArcMap version 10.7 software, the following steps were followed:

In steps 1–5, the population and area were calculated for all the sub-places that intersected the Settlement Footprint date frame. The official sub-place demarcations were used 'as is', without spatial changes. In steps 6–7, the sub-places were spatially clipped to the settlement footprint boundaries, and population and area were calculated for these smaller demarcations. Steps 8–10 explain how the population and area ratios were calculated for the settlement footprint clipped sub-place relative to the entire sub-place.

GIS Process: Identify sub-places that intersect Settlement Footprint data frame

1. The sub-places intersecting the settlement footprints were selected. Since the 2011 Census geography was used as an input dataset in the creation of the settlement footprint data frame, **Figure 46** shows the greater misalignment between the 2001 sub-places compared to the 2011 sub-places and settlement footprints.

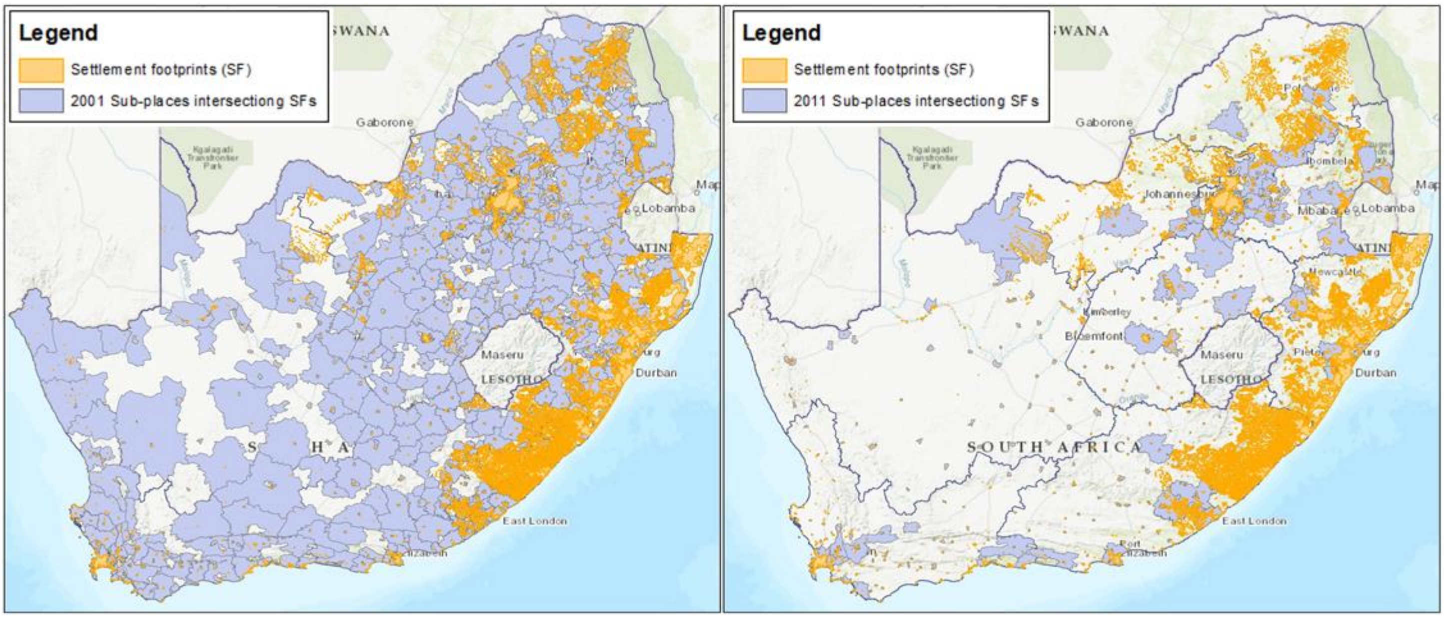


Figure 46: *2001 and 2011 Census sub-places that intersect the settlement footprint dataframe*

Geodatabase Process: Calculate area and population per sub-place for 2001 and 2011

2. The CSIR Geo-data frame, a modified dataset based on the SPOT Building Count (SBC), with probable household size attributes for 2001 and 2011 (CSIR, 2020b) (weight factor = probable household size for 2001/2011 – see **Table 7**) was used to calculate the sub-place population. A spatial join was used to assign a sub-place ID to each SBC point, based on the sub-place within which the SBC point falls.
3. Using the output layer from the spatial join analysis, a summary table was used to aggregate the population field (i.e., potential household size for 2001/2011) by summing the population of all points assigned to the same sub-place ID and calculating the population size of the sub-place (SP_Pop) (**Figure 47**).
4. The sub-place ID was used to join the summary table to the sub-place spatial layer, joining the attribute field for the calculated sub-place population (SP_Pop – as calculated in step 3) to the spatial analysis layer.
5. The sub-place layer was projected to the Albers equal area projection, and an attribute field was created for sub-place area (SP_Area). The total area (km^2) of each sub-place was calculated using the 'calculate geometry' function (**Figure 47**).

GIS Process: Clip sub-places using Settlement Footprint data frame

6. The sub-place layer was clipped using the settlement footprints.

Geodatabase Process: Re-calculate sub-place area and population after clipping

7. Steps 2–5 were repeated, this time using the clipped sub-place layer to calculate the population size (SP_SF_Clip_Pop) and area size (SP_SF_Clip_Area) of the sub-place portions that intersect the settlement footprint demarcation (**Figure 47**).

Geodatabase Process: Calculate proportion of clipped sub-place area and population relative to unclipped sub-place area and population

8. With attributes calculated for both the SP_Area and SP_SF_Clip_Area, the area alignment proportion of each sub-place (area of settlement footprint relative to the sub-place) was calculated (**Figure 47**):

$$\text{Prop\_AreaAlignment} = SP\_SF\_Clip\_Area \div SP\_Area$$

9. With attributes calculated for both the SP_Pop and SP_SF_Clip_Pop, the population alignment proportion of each sub-place (population of settlement footprint relative to the sub-place) was calculated (**Figure 47**):

$$\text{Prop\_PopAlignment} = SP\_SF\_Clip\_Pop \div SP\_Pop$$

10. The clipped sub-placed layer (with calculated attributes) was joined back to the original (unclipped) sub-place layer, keeping only matching records – the resulting output layer being the sub-places that intersected the settlements footprint features, with the percentage overlap portion of area and population calculated for the sub-places intersecting the settlement footprint demarcation.

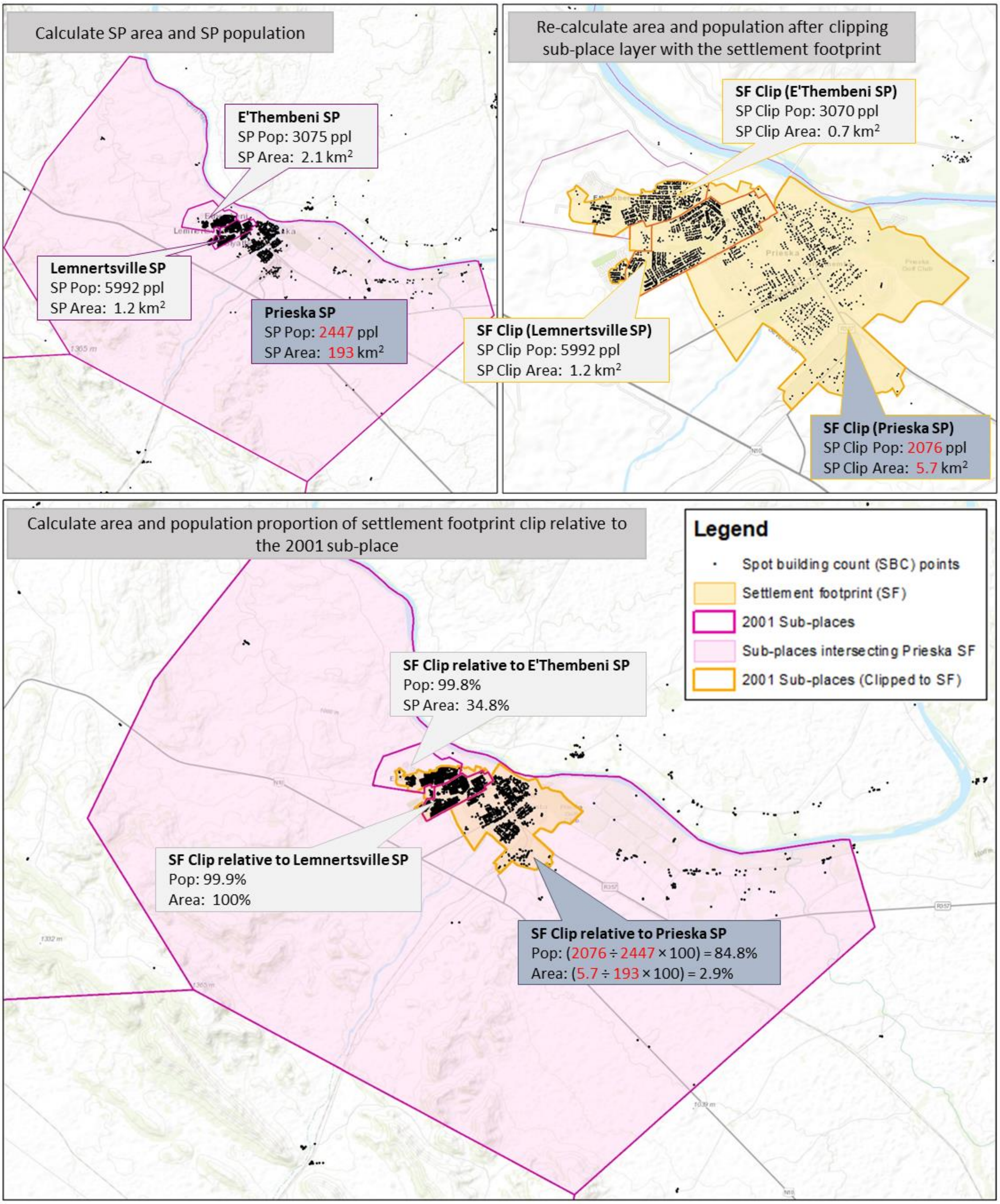


Figure 47: *Population and area calculations for the portions of the sub-places that fall within the intersecting settlement footprint (Example calculations for Prieska)*

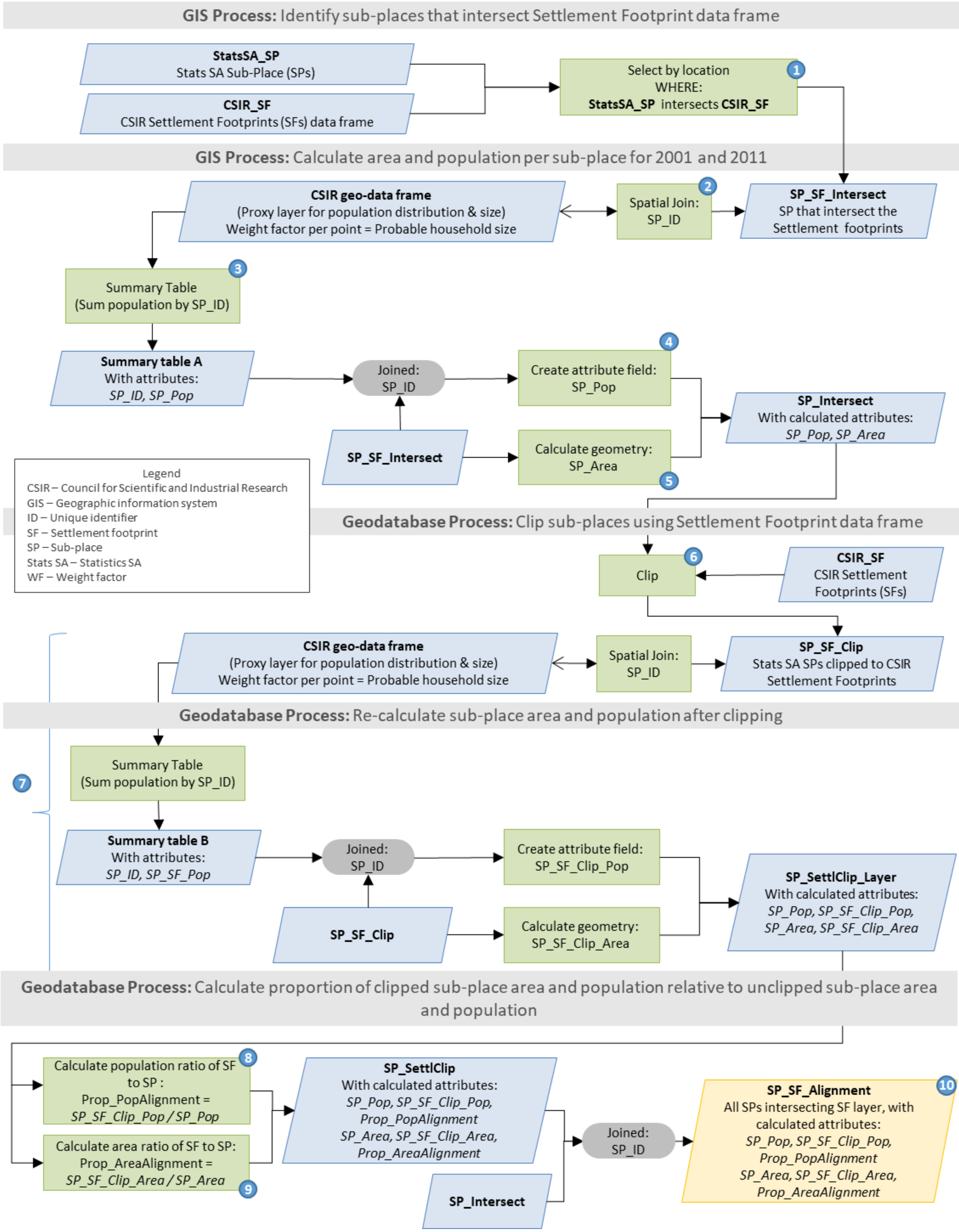


Figure 48: *Analysis workflow of Task 3.2: Align Census sub-place and Settlement Footprint spatial datasets (steps 1–10)*

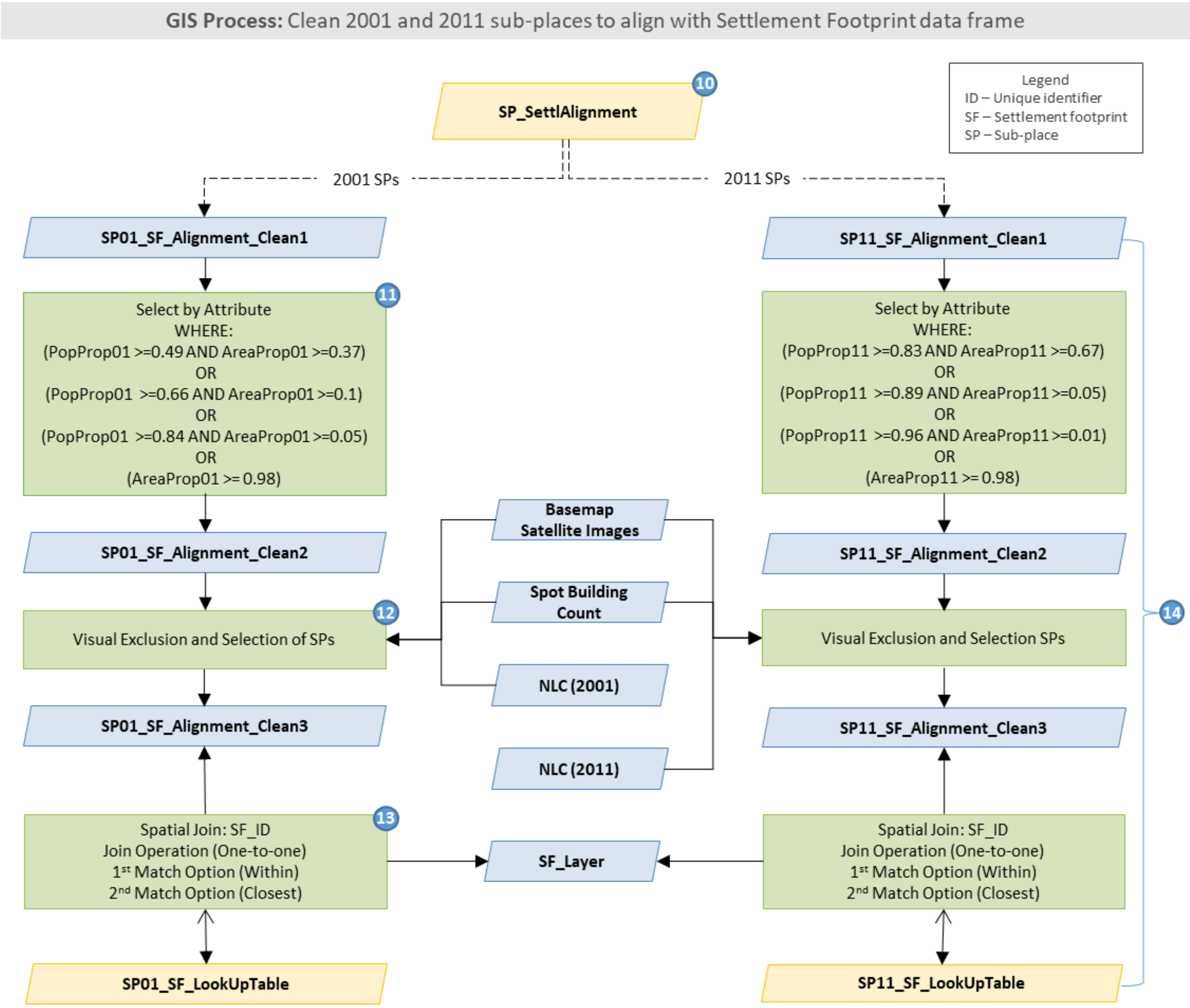


Figure 49: *Analysis workflow of Task 3.2: Align Census sub-place and Settlement Footprint spatial datasets (steps 10–14)*

GIS Process: Clean 2001 and 2011 sub-places to align with Settlement Footprint data frame

To ensure maximum alignment between the sub-places and settlement footprints, the two output layers from step 10 (**Figure 49**) were further cleaned using the area and population proportional alignment calculations together with ancillary datasets:

11. Using the descriptive statistics (mean and standard deviation) of the area and population proportional alignment calculations (settlement footprints relative to the sub-places), the 'select by attribute' operation was used to further clean the 2001 sub-place layer of poorly aligned features.
12. Next, any remaining misaligned 2001 sub-places were manually cleaned by visual assessment. Visual exclusion and selection of sub-places was done, informed by satellite images together with the SBC points and 2001 National Land Cover datasets.

13. After the sub-place (SP) alignment cleaning process, the remaining 2001 SPs were matched to the CSIR Settlement Footprint data frame (each SP matched to only one settlement footprint). Firstly, 2001 SPs falling within a settlement footprint were matched; secondly, 2001 SPs not fully falling within a settlement footprint were matched with their closest settlement footprint.
14. Steps 11–13 were repeated for the 2011 sub-place layer.

The output of the analysis outlined in **Figure 48** and **Figure 49**, to align the 2001 and 2011 Stats SA sub-places with the CSIR settlement footprints, were two lookup tables (one for each of the analysis years respectively), indicating the reference alignment pairs of sub-place IDs and settlement footprint IDs (e.g., **Table 12** and **Table 13**). These two lookup tables were used as the basis for transforming the Stats SA sub-place data to the settlement level, and thereafter, calculating the settlement-level population change between 2001 and 2011 (as outlined in Task 3.3). Together with the reference pairs, the proportional population alignment figure (settlement footprint relative to the sub-place), calculated as the output of step 10 (**Figure 49**), was included in the output lookup tables.

Table 12: *Extract from lookup table of 2001 sub-place–settlement footprint value pairs*

SP01_ID	SP_Name	SF_ID	SF_Name	Prop_PopAlignment
10108000	Vanrhynsdorp SP	F_WC011_2912	Vanrhynsdorp	0.62
10108001	Maskamsig	F_WC011_2912	Vanrhynsdorp	0.996
10109000	Vredendal Part 1 SP	F_WC011_2911	Vredendal	0.994
10109001	Aiville Park	F_WC011_2911	Vredendal	1.00
10109002	Joe Slovo Park	F_WC011_2911	Vredendal	1.00
10109003	Vredendal	F_WC011_2911	Vredendal	1.00
10111001	Vredendal North	F_WC011_2911	Vredendal	1.00
…	…	…	…	…

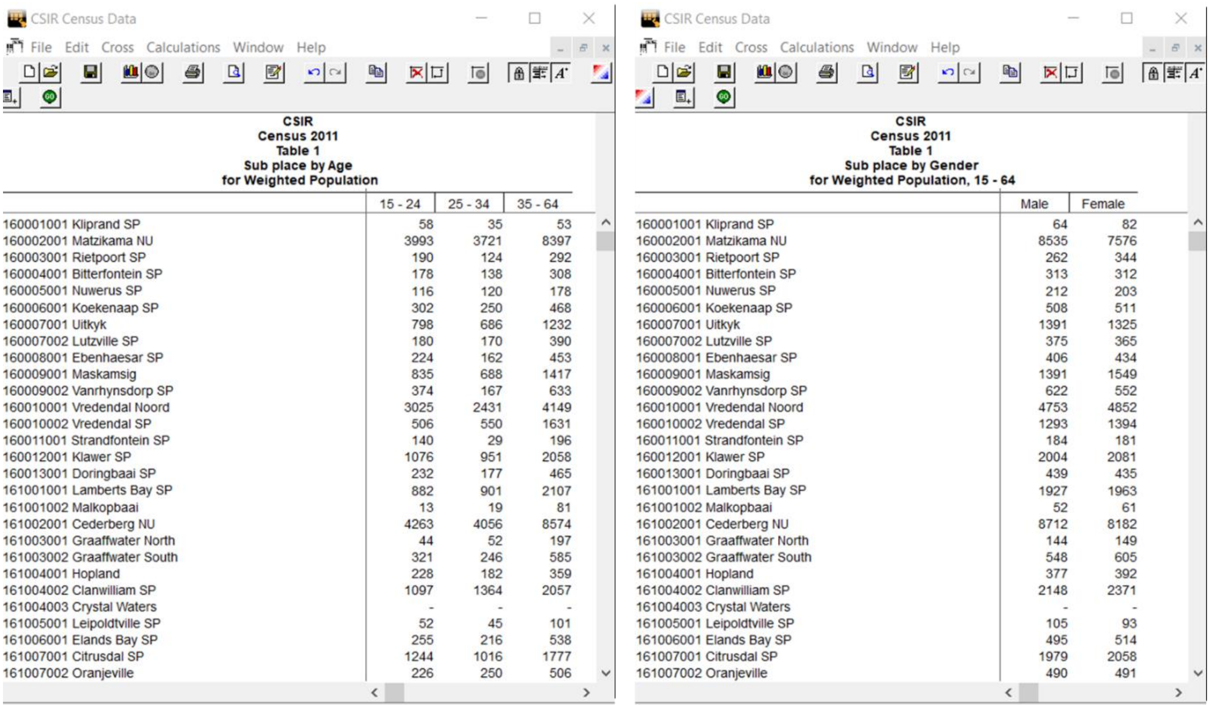
Table 13: *Extract from lookup table of 2011 sub-place–settlement footprint value pairs*

SP11_ID	SP_Name	SF_ID	SF_Name	Prop_PopAlignment
160009001	Maskamsig	F_WC011_2912	Vanrhynsdorp	1.00
160009002	Vanrhynsdorp SP	F_WC011_2912	Vanrhynsdorp	0.83
160010001	Vredendal Noord	F_WC011_2911	Vredendal	1.00
160010002	Vredendal SP	F_WC011_2911	Vredendal	0.97
…	…	…	…	…

4.5.3.3 *Task 3.3: Calculate settlement-level population change between 2001 and 2011*

The lookup tables of the 2001 and 2011 sub-place–settlement footprint alignment pairs (Task 3.2) were used as the basis for transforming the 2001 and 2011 Stats SA Census data from their original sub-place demarcations to the single uniform settlement footprint data frame, allowing for settlement-level population change calculations between the two reference years.

The 2001 and 2011 National Population Censuses were acquired from Stats SA through their community profiles as the source of population data for this study. Customised community profiles for the 2001 and 2011 Census years, in the form of customised SuperCROSS database cubes, were obtained from Stats SA on special request. The variables included in the SuperCROSS database cubes were the outcome of Task 3.1 and Task 3.2. Using the SuperCROSS application, cross-tabulations of sub-place population by gender, age, employment status and highest level of education respectively, were done for both 2001 and 2011 (e.g., **Figure 50**), and the outputs were exported to a usable format for further manipulation and analysis.



CSIR
Census 2011
Table 1
Sub place by Age
for Weighted Population

	15 - 24	25 - 34	35 - 64
160001001 Kliprand SP	58	35	53
160002001 Matzikama NU	3993	3721	8397
160003001 Rietpoort SP	190	124	292
160004001 Bitterfontein SP	178	138	308
160005001 Nuwerus SP	116	120	178
160006001 Koekenaap SP	302	250	468
160007001 Uitkyk	798	686	1232
160007002 Lutzville SP	180	170	390
160008001 Ebenhaesar SP	224	162	453
160009001 Maskamsig	835	688	1417
160009002 Vanrhynsdorp SP	374	167	633
160010001 Vredendal Noord	3025	2431	4149
160010002 Vredendal SP	506	550	1631
160011001 Strandfontein SP	140	29	196
160012001 Klawer SP	1076	951	2058
160013001 Doringbaai SP	232	177	465
161001001 Lamberts Bay SP	882	901	2107
161001002 Malkopbaai	13	19	81
161002001 Cederberg NU	4263	4056	8574
161003001 Graaffwater North	44	52	197
161003002 Graaffwater South	321	246	585
161004001 Hopland	228	182	359
161004002 Clanwilliam SP	1097	1364	2057
161004003 Crystal Waters	-	-	-
161005001 Leipoldtville SP	52	45	101
161006001 Elands Bay SP	255	216	538
161007001 Citrusdal SP	1244	1016	1777
161007002 Oranjeville	226	250	506

CSIR
Census 2011
Table 1
Sub place by Gender
for Weighted Population, 15 - 64

	Male	Female
160001001 Kliprand SP	64	82
160002001 Matzikama NU	8535	7576
160003001 Rietpoort SP	262	344
160004001 Bitterfontein SP	313	312
160005001 Nuwerus SP	212	203
160006001 Koekenaap SP	508	511
160007001 Uitkyk	1391	1325
160007002 Lutzville SP	375	365
160008001 Ebenhaesar SP	406	434
160009001 Maskamsig	1391	1549
160009002 Vanrhynsdorp SP	622	552
160010001 Vredendal Noord	4753	4852
160010002 Vredendal SP	1293	1394
160011001 Strandfontein SP	184	181
160012001 Klawer SP	2004	2081
160013001 Doringbaai SP	439	435
161001001 Lamberts Bay SP	1927	1963
161001002 Malkopbaai	52	61
161002001 Cederberg NU	8712	8182
161003001 Graaffwater North	144	149
161003002 Graaffwater South	548	605
161004001 Hopland	377	392
161004002 Clanwilliam SP	2148	2371
161004003 Crystal Waters	-	-
161005001 Leipoldtville SP	105	93
161006001 Elands Bay SP	495	514
161007001 Citrusdal SP	1979	2058
161007002 Oranjeville	490	491

Figure 50: *Example of cross-tabulation of sub-place working-age population by age (left) and gender (right)*

4.5.3.3.1 Analysis methodology of Task 3.3: Calculate settlement-level population change between 2001 and 2011

The flowchart in **Figure 51** illustrates the analysis workflow and steps that were followed in order to calculate settlement-level population change between 2001 and 2011. Using Excel 2016 software, the following steps were followed to align the Stats SA sub-place data to settlement level, and thereafter, to calculate the settlement-level population change (per variable) between 2001 and 2011:

Geodatabase Process: Align 2001 Stats SA sub-place Census data to Settlement Footprint data frame

1. Using the lookup table of the 2001 sub-place–settlement footprint value pairs (see **Figure 49**), the sub-place population totals per variable (2001 SuperCROSS cross-tabulation of sub-place by gender, age, employment status and highest level of education) were joined (via sub-place ID) with their corresponding settlement footprint IDs and population weight factors (PopProp) (see **Table 14** for an example).

2. Next, based on the population weight factor (Prop_PopAlignment), the sub-place (*i*) population totals per variable (*j*) were proportionally adjusted (see **Figure 48** and **Table 15**), using the formula:

$$AdjustedPop_{ij} = Pop_{ij} \times Prop\_PopAlignment_j$$

where,

i – sub-place

j – variable.

The weight factor, Prop_PopAlignment (as calculated in Task 2.2, step 3) was thus the proportion of population in the settlement footprint relative to the sub-place as a whole; that is, the proportion of population occurring in the overlap between the sub-place and settlement footprint layers. In cases where the sub-place was fully contained by the settlement footprint, a weight factor of 1 (i.e., 100 %) was applied and no adjustment was made to the population totals for that particular sub-place. For larger sub-places, or sub-places not fully contained by a settlement footprint, the proportion of people living within the area of the sub-place covered by the settlement footprint (relative to the entire sub-place) was used to proportionally adjust the sub-place population totals. For example, if only 62 % of the total population living in the sub-place was living in the area covered by the settlement footprint, then the sub-place population for each variable was multiplied by 0.62, so as to proportionally correct the population totals for the settlement footprint (see **Table 15** for a practical example). This was done to account only for the population living within the settlement footprint.

3. To transfer the sub-place data to the settlement footprint, the sub-place data (i.e., proportionally adjusted population values for each variable) for each settlement footprint were summed using the settlement footprint ID assigned to each sub-place via the lookup tables (Task 3.2). The following formula was used (see **Table 16** for practical examples):

$$SettelmentPop_{zj} = \sum (AdjustedPop_j)_z$$

where,

z – settlement footprint

j – variable.

Table 14: *Extract of 2001 sub-place population per variable (as output by SuperCROSS)*

SP01_ID	SF_ID	Prop_ PopAlignment	Variable_1 Working-age pop	Variable_2 Pop 15–24	Variable_3 Pop 25–34	Variable_4 Pop 35–64	Variable_5 Working-age male pop	…
10108000	F_WC011_2912	0.62	866	248	235	383	590	…
10108001	F_WC011_2912	0.996	2103	583	491	1026	957	…
10109000	F_WC011_2911	0.994	4698	1185	1155	2357	2225	…
10109001	F_WC011_2911	1.00	321	114	118	89	200	…
10109002	F_WC011_2911	1.00	679	182	223	274	305	…
10109003	F_WC011_2911	1.00	376	105	145	125	221	…
10111001	F_WC011_2911	1.00	3146	973	711	1462	1531	…
…	…	…	…	…	…	…	…	…

Table 15: *Extract of 2001 sub-place proportionally adjusted population per variable for settlement footprint alignment*

SP01_ID	SF_ID	Prop_ PopAlignment	Variable_1	Variable_2	Variable_3	Variable_4	Variable_5	…
10108000	F_WC011_2912	0.62	866 x 0.62 = 537	248 x 0.62 = 154	146	237	366	…
10108001	F_WC011_2912	0.996	2103 x 0.996 = 2095	581	489	1022	953	…
10109000	F_WC011_2911	0.994	4670	1178	1148	2343	2212	…
10109001	F_WC011_2911	1.00	321	114	118	89	200	…
10109002	F_WC011_2911	1.00	679	182	223	274	305	…
10109003	F_WC011_2911	1.00	376	105	145	125	221	…
10111001	F_WC011_2911	1.00	3146	973	711	1462	1531	…
…	…	…	…	…	…	…	…	…

Table 16: *Extract of 2001 final settlement-level population calculations per variable*

SF_ID	SF_Name	Variable_1	Variable_2	Variable_3	Variable_4	Variable_5	…
F_WC011_2912	Vanrhynsdorp	537 + 2095 = 2632	154 + 581 = 734	635	1259	1319	…
F_WC011_2911	Vredendal	4670 + 321 + 679 + 376 + 3146 = 9192	2552	2345	4293	4469	…
…	…	…	…	…	…	…	…

Geodatabase Process: Align 2011 Stats SA sub-place Census data to Settlement Footprint data frame

4. Steps 1 and 3 were repeated for the 2011 sub-place data (2011 SuperCROSS cross-tabulation of sub-place by gender, age, employment status and highest level of education).

Geodatabase Process: Calculate population change per settlement between 2001 and 2011

5. The 2001 and 2011 working-age population totals per settlement footprint were used to calculate the absolute settlement-level population change between 2001 and 2011 using the formula:

$$Actual\_Pop\_Change_{zj} = SettelmentPop11_{zj} - SettelmentPop01_{zj}$$

where,

z – settlement footprint

j – variable.

6. The 2001 and 2011 working-age population totals per settlement footprint were used to calculate the relative settlement-level population change between 2001 and 2011 using the formula:

If $SettelmentPop01_{zj}$ > 0

$$Relative\_Pop\_Change_{zj} = \frac{SettelmentPop11_{zj} - SettelmentPop01_{zj}}{SettelmentPop01_{zj}} \times 100$$

where,

z – settlement footprint

j – variable.

If $SettelmentPop01_{zj}$ = 0

$$Relative\_Pop\_Change_{zj} = \frac{SettelmentPop11_{zj} - SettelmentPop01_{zj}}{1} \times 100$$

where,

z – settlement footprint

j – variable.

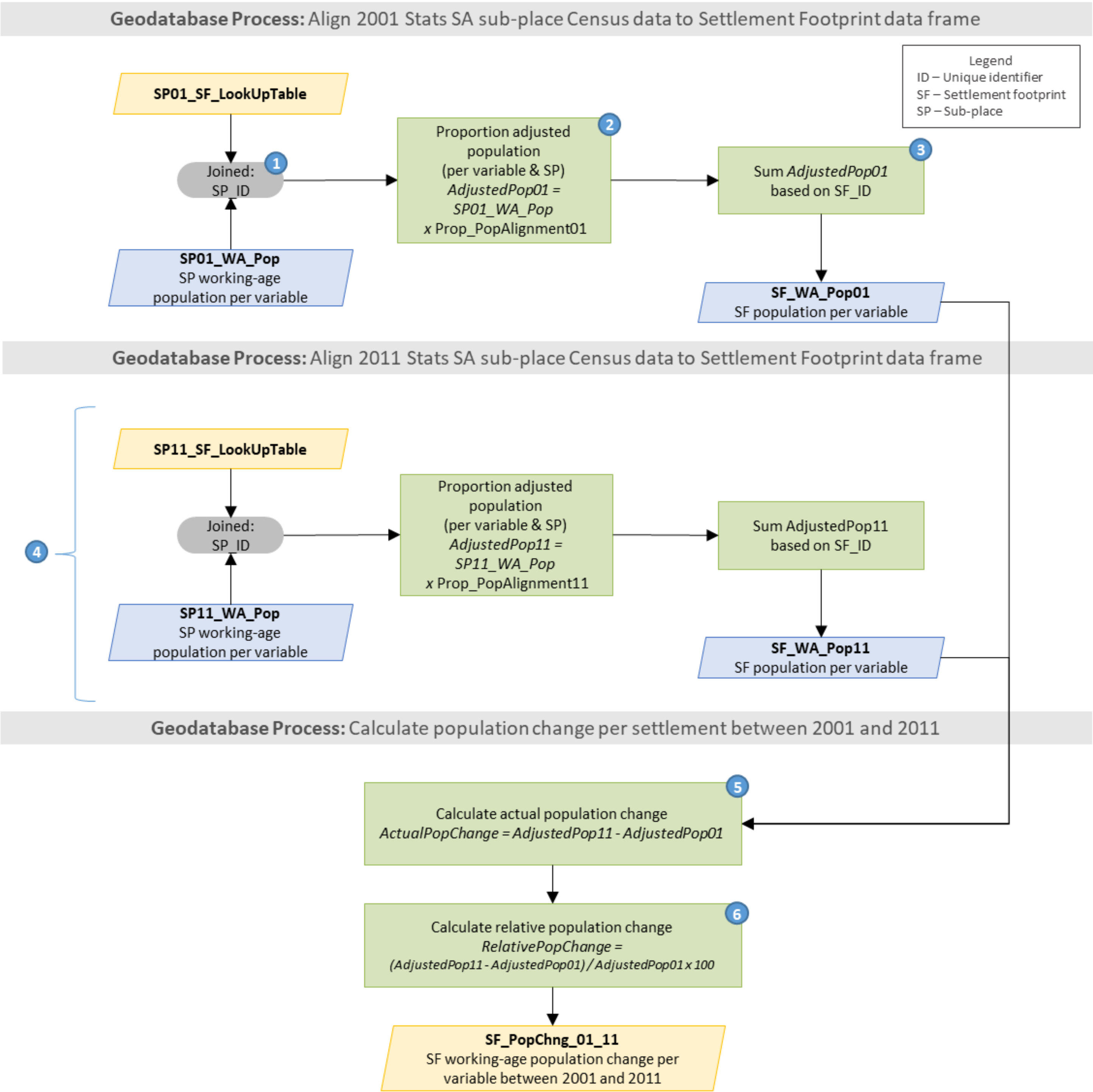


Figure 51: *Flowchart of the settlement-level population change calculation analysis*

4.5.4 Objective 4: Measure and analyse the relationship between economic performance and population-change dynamics at settlement level in South Africa

I. Objective

The aim of Objective 4 was to quantitatively analyse and describe the linkages between economic performance and population change at settlement level in South Africa between 2001 and 2011. The basis for this analysis was the spatial datasets prepared and processed in Objectives 2 and 3.

II. Overview of process for meeting Objective 4

A three-stage process was followed in order to meet the outcomes of Objective 4, as illustrated in **Figure 52**.

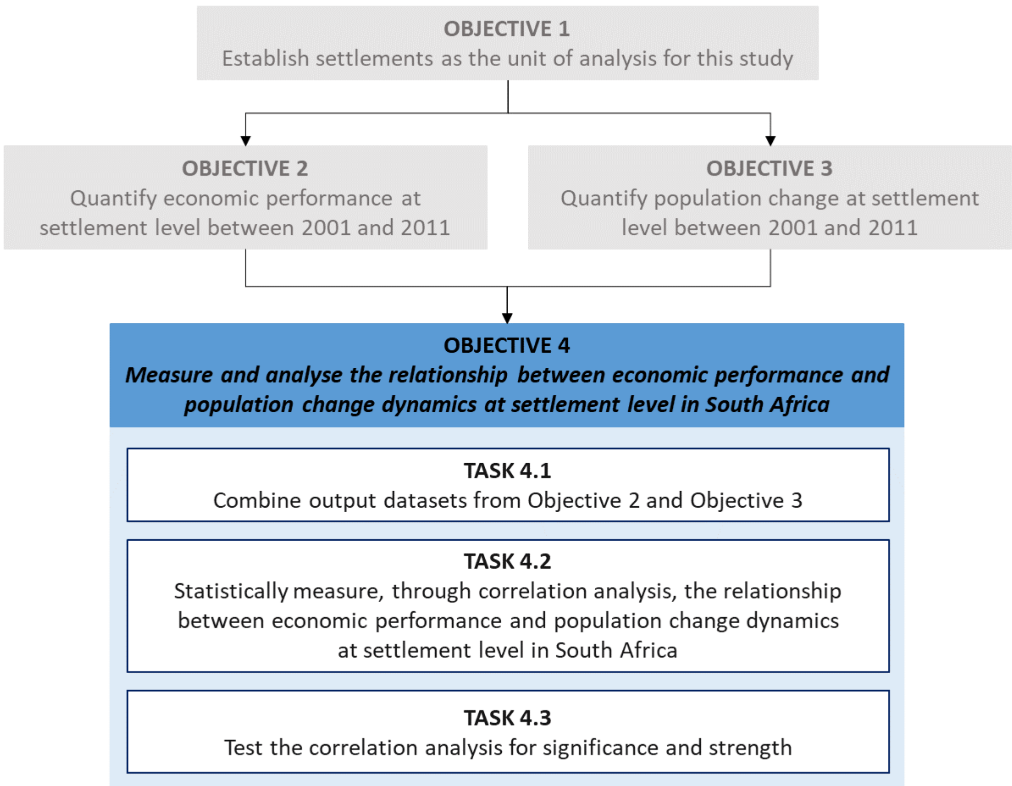


Figure 52: *Task breakdown of Objective 4*

4.5.4.1 Task 4.1: Combine output datasets from Objective 2 and Objective 3

The outputs from Objective 2 and Objective 3, namely the settlement-level change in population and economic performance between 2001 and 2011, were used as the basis for analysis in Objective 4. These data had to be merged and further cleaned and prepared in order to be used as inputs for the general data analysis and correlation testing. The following steps were undertaken to merge, clean and prepare these data:

- The data outputs from Objective 2 and Objective 3 were joined into a single data table using the settlement footprint unique ID.

- Additional explanatory attributes were added to the data table, including province, settlement type (formal or traditional, from CSIR classification) and economic profile type, derived in Task 2.3.
- Settlements with missing or incomplete data were removed.
- Data columns were labelled with descriptive headings, and data columns were logically ordered.
- Data validation checks were done to ensure that all joins were executed correctly.

4.5.4.2 Task 4.2: Statistically measure, through correlation analysis, the relationship between economic performance and population-change dynamics at settlement level in South Africa

In order to test and quantify the relationship between the factors being analysed, a correlation analysis was conducted. Correlation analysis is a statistical process for estimating the association between or among quantitative variables, in other words, how two or more variables are related (Montgomery, Peck & Vining 2006). High correlation means that the variables have a strong relationship with each other, while weak correlation means that the variables are hardly related.

The input variables were the outputs from Objective 2 and Objective 3, namely the settlement-level change in working-age population and economic performance between 2001 and 2011 (**Table 17**). To quantify and better understand the relationship between economic performance as the independent or predictor variable, and population change as the dependent or response variable, across settlement types in South Africa, the settlement-level data were subsequently assessed through a correlation matrix. The correlation matrix contained the results for all the variables under consideration and was obtained by performing a bivariate correlation analysis (IBM, 2021) on all possible pairwise combinations of economic and population variables in the dataset.

Two methods are commonly used to assess correlation, namely the Pearson product-moment correlation and the Spearman rank-order correlation. In addition to being the first of the correlational measures to be developed, the Pearson product-moment correlation is also the most commonly reported measure of association. All subsequent correlation measures, including the Spearman rank-order correlation, were derived from Pearson's equation and are adaptations engineered to control for violations of the assumptions that must be met in order to use Pearson's equation (Montgomery, Peck & Vining, 2006). These correlation coefficients, such as Spearman's rank-order correlation coefficient, have been developed to be more robust than Pearson's, and are therefore more sensitive to nonlinear relationships (Aitken, 1957; Croxton, Cowden & Klein, 1967).

Table 17: *Overview of correlation analysis variables at settlement level*

Correlation analysis variables	
Economic performance variables (independent/predictor variables)	Change in total GVA (SIC 1–4 and SIC 6–9)
	Change in SIC 1 GVA
	Change in SIC 2 GVA
	Change in SIC 3 GVA
	Change in SIC 4 GVA
	Change in SIC 6 GVA
	Change in SIC 7 GVA
	Change in SIC 8 GVA
	Change in SIC 9 GVA
Population change variables (dependent/response variables)	Change in working-age population
	Change in 15–24-year-old population
	Change in 25–34-year-old population
	Change in 35–64-year-old population
	Change in working-age male population
	Change in working-age female population
	Change in working-age employed population
	Change in working-age unemployed population
	Change in working-age not economically active population
	Change in working-age unskilled population
	Change in working-age basic-skilled population
	Change in working-age semi-skilled population
	Change in working-age highly skilled population

In choosing the most appropriate correlation method for this study, it was important to take into account the impact of outliers in order to increase the reliability of the output results. The Spearman rank-order correlation is based on the ranked values for each variable rather than the raw data, and is commonly used when data violate the assumptions of Pearson, namely:

- Data are not normally distributed.
- Data have outliers.
- One or both variables are ordinal.

In such cases, the Spearman correlation is a robust measure of association. Although the assumptions of the Pearson correlation have been intensely debated (Nefzger & Drasgow, 1957; Binder, 1959), and it could be argued that the Pearson correlation coefficient can be calculated as a measure of a linear relationship without any assumptions, proper inference on the existence and strength of the association in the population from which the data were sampled does require that the basic assumptions of data normality are met. Thus, in order to avoid making assumptions about the distribution of the data, a non-parametric metric was chosen, namely the Spearman rank-order correlation coefficient, r_s ('rho').

The Spearman rank-order correlation coefficient is calculated by the formula:

$$r_s = 1 - \frac{6 \times \sum d^2}{n(n^s - 1)}$$

where,

d –difference between the ranks of corresponding variables X and Y

$$d = (x' - y')$$

x' – values of ranks, replacing the actual variants or qualitative features of the argument x

y' – values of ranks, replacing the actual variants or qualitative features of the function y

n – number of observations.

Both the economic and population variables were measured in terms of change between 2001 and 2011. Change was measured in both absolute and relative terms, taking into account the varying sizes of settlements in the study. Since the settlements were classified according to economic profile, separate correlation analyses were undertaken per settlement type. In each of the analysis runs, the predictor variable was economic change, specifically absolute change in total economic activity between 2001 and 2011, while the response variable was the total population change (number of working-age people) for settlements of the same type. All the correlations were done using IBM SPSS statistical software (version 27.0.0), and ArcGIS software (version 10.7) was used for spatial analysis and mapping in this study.

4.5.4.3 Task 4.3: Test the correlation analysis for significance and strength

Spearman's correlation was used to measure the existence (statistical significance given by a *p*-value) and strength (effect size given by the correlation coefficient r_s between -1 and +1) of the association between all the possible pairwise combinations of economic and population variables in the dataset. The interpretation of the Spearman correlation differs from the Pearson correlation. The Pearson correlation coefficient is a measure of linearity, while the Spearman correlation coefficient is a measure of monotonicity (i.e., it determines whether or not the ranked order between the variables is preserved).

To correctly interpret the output results, a 99 % confidence level was used. Thus, the significance threshold for detecting the existence of an association was set at $\alpha = 0.01$, meaning that a *p*-value result of 0.01 or lower was interpreted as there being only a 1 % probability that the result occurred by chance. A *p*-value result of 0.05 was interpreted as there being only a 5 % probability that the result occurred due to chance. Thus, if the outcome was significant, based on $\alpha = 0.01$, it was concluded that a correlation existed.

Next, the strength of a significant correlation was interpreted. Effect sizes allow researchers to move away from the simple identification of statistical significance and towards a more generally interpretable, quantitative description of the strength of an association. The interpretation of the effect size of correlation coefficients varies significantly between different research fields, and there are no absolute rules for their interpretation (e.g., Fritz & Morris, 2012).

The history of effect size interpretation stems from the work of Cohen (1988), whose guidelines suggest the following interpretations for correlation:

- $0.10 < r_s < 0.29$ is classified as small effect (or weak association),
- $0.30 < r_s < 0.49$ is classified as medium effect (or moderate association),
- $0.50 < r_s < 1.0$ is classified as large effect (or strong association).

Cohen (1988) recognised, however, that a large, medium or small effect size would, in practice, depend on the particular area of study. Rosenthal (1996) later expanded this classification through the addition of a 'very large' descriptive category, where $0.70 < r_s < 1.0$.

There is no straightforward way to interpret standardised effect size measures, which tend to remain domain-specific. In the social sciences, for example, it is extremely unusual to have a correlation as high as 0.5 (Cumming & Calin-Jageman, 2018). Similarly, Cumming and Calin-Jageman (2018) report that the mean effect size in both psychology and education research is $r_s = 0.2$. In contrast, medical research is often associated with even smaller effect sizes, commonly in the range of $0.025 < r_s < 0.1$ (Cumming & Calin-Jageman, 2018). Thinking about effect size values across disciplines, the utility of Cohen's (1988) conventions have thus been disputed for many social science applications (Cumming & Calin-Jageman, 2018). In the context of population and migration being a topic of inquiry in the social sciences, **Table 18** outlines the interpretation of Spearman's rank-order correlation coefficients used in this study.

Table 18: *Interpretation table of Spearman's rank-order correlation coefficients*

Spearman's r_s (applies to both positive and negative relationships)	Coefficient of determination (R^2)	Strength / Effect size
≥0.70	≥50.0 %	Very strong relationship
0.50–0.69	25.0 %–49.9 %	Strong relationship
0.40–0.49	16.0 %–24.9 %	Moderately strong relationship
0.30–0.39	9.0 %–15.9 %	Moderate relationship
0.20–0.29	4.0 %–8.9 %	Weak relationship
0.01–0.19	0.1 %–3.9 %	No or negligible relationship

Source: Adapted from Cohen (1988) and Rosenthal (1996)

Lastly, the coefficient of determination (R^2) was calculated. The coefficient of determination is a measurement used to indicate the proportion of variance that two variables have in common, also known as the 'goodness of fit' measure. In the case of Spearman's r_s, the coefficient of determination represents the proportion of shared variance in the two ranked variables as a value between 0 % and 100 % (Fritz & Morris, 2012).

The coefficient of determination (R^2) is calculated by squaring r_s, that is:

$$R^2 = (r_s)^2$$

where,

r_s – Spearman rank-order correlation coefficient.

5 RESULTS

The overarching aim of this research was to describe and model the linkages between economic performance and population change at settlement level in South Africa by analysing, measuring and statistically quantifying the relationship over the ten-year period between the Census years of 2001 and 2011. To achieve this, four objectives were set. The presentation of the results follows the same structure as the outline of the objectives for the study, namely to: 1) Establish settlements as the unit of analysis for this study (**Section 5.1**); 2) Quantify economic performance at settlement level (**Section 5.2**); 3) Quantify population change at settlement level (**Section 5.3**); and 4) Measure and analyse the relationship between economic performance and population-change dynamics at settlement level in South Africa (**Section 5.4**).

5.1 ESTABLISH SETTLEMENTS AS THE UNIT OF ANALYSIS FOR THIS STUDY

The Settlement Footprint data frame developed by the CSIR was chosen as the unit of analysis for this study (also see Objective 1, Task 1.1 and Task 1.2 under **Section 4.5.1**). The Settlement Footprint data frame delineates continuous built-up areas, namely settlements, across the country. There are 7210 settlements in South Africa, comprising 1637 formal settlements and 5573 traditional settlements (**Table 19**). Together, these settlements accounted for 93.7 % of the total national population in 2011, although they covered only 5.1 % of the total land surface area of the country. Formal settlements covered 1.2 % of the land surface area of the country, but accounted for 67.0 % of the total national population in 2011. By comparison, the sprawling traditional settlements of the former homeland areas covered the remaining 3.9 %, but housed only 27.6 % of the 2011 population (**Table 20**, **Table 21** and **Table 22**). Also shown in **Table 21** and **Table 22** is that in 2001, 6.3 % of the national population were living in non-settlement areas (e.g., commercial farms and nature reserves), and that by 2011, this percentage had decreased by almost 1 % to only 5.5 %. This, together with the increase in the percentage of the total population living in formal settlements from 62.2 % in 2001 to 67.0 % in 2011, is a clear indication that internal migration has been decisive in the urban-transition process in South Africa.

Table 19: *Overview of the number of settlements in South Africa, 2011*

	Number of settlements	% of all settlements
Settlements (all)	**7210**	**100.0 %**
Formal settlements	*1637*	
Traditional settlements	*5573*	
Settlements (analysis subset)	**5656**	**78.4 %**
Formal settlements	*1132*	
Traditional settlements	*4524*	

Source: Own calculations from CSIR (2018b) data

Table 20: *Overview of the land surface area and cover of settlements in South Africa*

	Land surface area	% land surface cover
National	**1,220,813 km²**	**100.0 %**
Settlements (all)	**61,860 km²**	**5.1 %**
Formal settlements	*15,032 km²*	*1.2 %*
Traditional settlements	*46,828 km²*	*3.9 %*

Source: Own calculations from CSIR (2018b) data

Table 21: *Overview of the 2001 settlement population*

	Population (2001)	Population (% national)	Population (% all settlements)
National	**44,820,312**	**100.0 %**	
Settlements (all)	**41,999,998**	**93.7 %**	**100.0 %**
Formal settlements	*27,860,525*	*62.2 %*	*66.3 %*
Traditional settlements	*14,139,472*	*31.5 %*	*33.7 %*
Non-settlement	**2,820,314**	**6.3 %**	
Settlements (analysis subset)	**41,003,263**	**91.5 %**	**97.6 %**
Formal settlements	*27,460,895*	*61.3 %*	*65.4 %*
Traditional settlements	*13,542,368*	*30.2 %*	*32.2 %*

Source: Own calculations from CSIR (2018b; 2020b) data

Table 22: *Overview of the 2011 settlement population*

	Population (2011)	Population (% national)	Population (% all settlements)
National	**51,755,129**	**100.0 %**	
Settlements (all)	**48,934,109**	**94.5 %**	**100.0 %**
Formal settlements	*34,654,346*	*67.0 %*	*70.8 %*
Traditional settlements	*14,279,763*	*27.6 %*	*29.2 %*
Non-settlement	**2,821,020**	**5.5 %**	
Settlements (analysis subset)[25]	**47,714,108**	**92.2 %**	**97.5 %**
Formal settlements	*34,126,011*	*65.9 %*	*69.7 %*
Traditional settlements	*13,588,097*	*26.3 %*	*27.8 %*

Source: Own calculations from CSIR (2018b; 2020b) data

Figure 53 illustrates the distribution of both formal and traditional settlements across the country, together with a summary graphic of the economic, population and land area share of formal settlements, traditional settlements and non-settlement areas.

[25] Analysis subset of settlements discussed in **Section 4.5.1.1**.

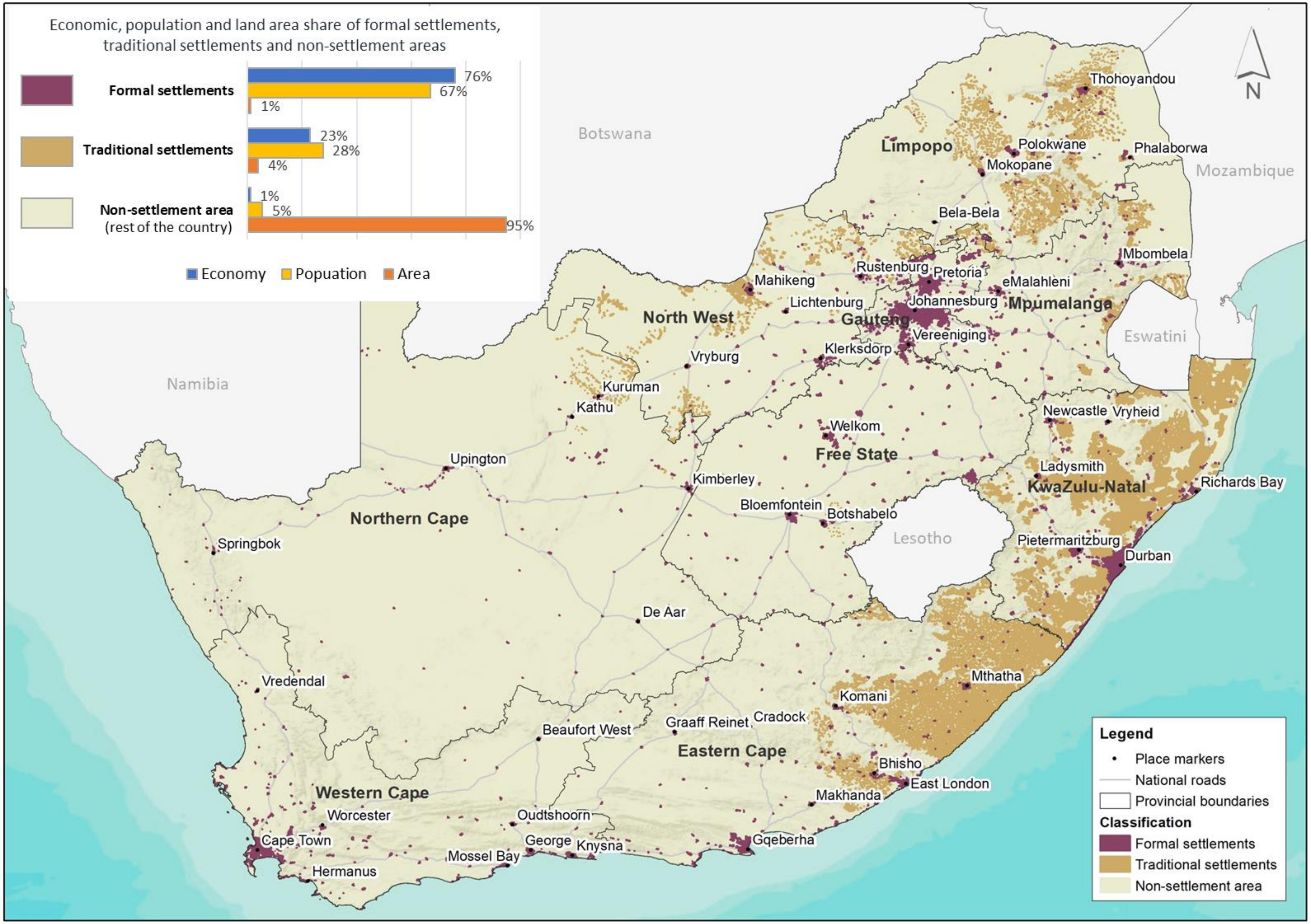


Figure 53: *Distribution of settlements, together with the economic, population and land area share of formal settlements, traditional settlements and non-settlement areas*

Source: Own calculation from CSIR (2018b; 2020a; 2020b) data

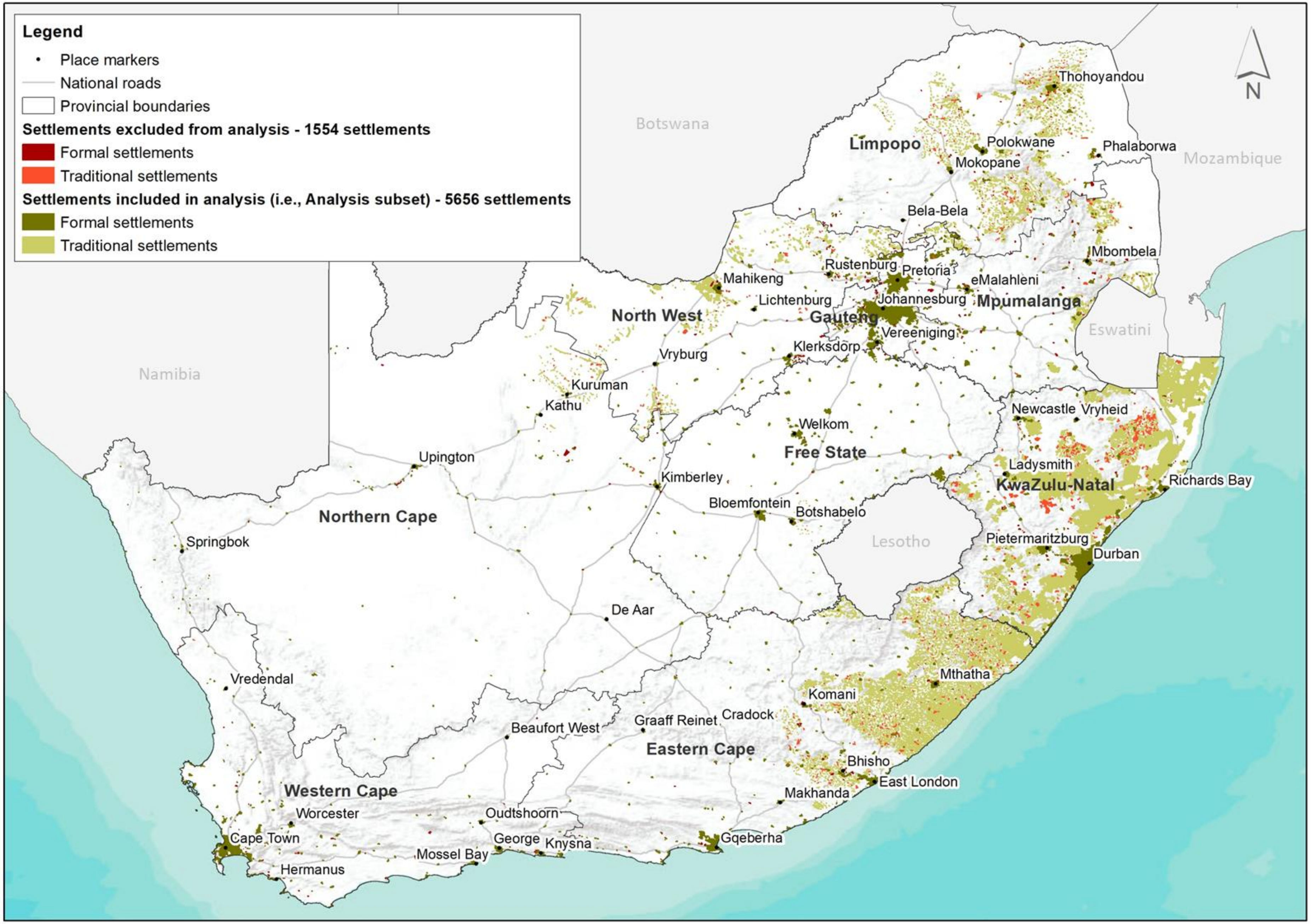


Figure 54: Distribution and spatial locations of included and excluded settlements in the analysis subset

Ideally, all 7210 settlements nationally would have formed part of the study analysis. However, a limitation of the time-series analysis component of this research was that only settlements with comparative economic and population data for both 2001 and 2011 could be included. After the alignment between the Stats SA 2001 and 2011 sub-place data and the CSIR Settlement Footprint data frame, 5656 settlements (1132 formal and 4524 traditional) were found to be adequately aligned for analysis. While this excluded 1554 settlements (21.6 %) from temporal analysis in this study (**Table 19**), its impact on the study was negligible as these settlements accounted for only 2.5 % of the total national population living in settlements. The study sample of settlements accounted for 91.5 % of the national population in 2001 and 92.5 % in 2011, and 97.6 % of the total national population living in settlements in 2001 and 97.5 % in 2011 (**Table 21** and **Table 22**).

Figure 54 maps the spatial locations and distribution of settlements included in and excluded from the analysis subset, showing the extent to which the settlement subset was considered representative of the comprehensive spatial distribution of settlements in South Africa. The subset of settlements used in the analysis was discussed in detail in **Section 4.5.1.1**.

5.2 QUANTIFY ECONOMIC PERFORMANCE AT SETTLEMENT LEVEL BETWEEN 2001 AND 2011

The following section presents the research results for Objective 2 (Task 2.3 and Task 2.4 specifically), which aimed to quantify and analyse economic performance at settlement level between 2001 and 2011.

5.2.1 Profile South African settlements according to economic criteria

Preliminary analysis showed that size alone did not distinguish sufficiently between different settlement types. A classification of settlements, according to their predominant economic activities and status, was therefore developed for this study in order to be able to compare similar settlements with one another in terms of economic profile and relative size (Task 2.3). Using the 2011 settlement data on the percentage sectoral split of total economic activities (prepared as part of Task 2.1 and Task 2.2), K-means cluster analysis was undertaken to produce six classifications of settlements according to their economic profiles. Each settlement (excluding those in metros and traditional areas) was grouped into one of six classes according to its predominant sector-based economic activities. **Section 4.5.2.3** gives more background on the K-means cluster analysis methodology. An overview of the cluster analysis results follows.

Clusters may be described in terms of the cluster averages according to the dominance of individual sector-based economic activity as well as the number of settlements in a cluster. The percentage contribution per sector to the total economic activity of the settlement was used as the basis for clustering, since those economic activities that contribute proportionally more to a cluster profile tend to have cluster means that are further from zero. For each of the six clusters, **Figure 55** shows the percentage contribution to total economic activity for each of the economic sectors (SIC 1–4 and SIC 6–9, bearing in mind the data limitations of SIC 5 discussed in **Section 4.5.2.1**). The economic profile of each of the six clusters is shown according to the final cluster centres, these being the average percentage share of total economic activity per sector for each cluster. Similarly, **Table 23** gives a summary description of the set of clusters obtained from the K-means clustering of the settlement-level economic data, including the average values for each economic variable within a cluster as well as the cluster size, indicating how many settlements were assigned membership to each of the clusters. The clustering analysis was used as the basis for classifying the economic profile of each settlement in South Africa. **Figure 57** maps the relative economic size (2011 figures) of settlements, together with their final classification.

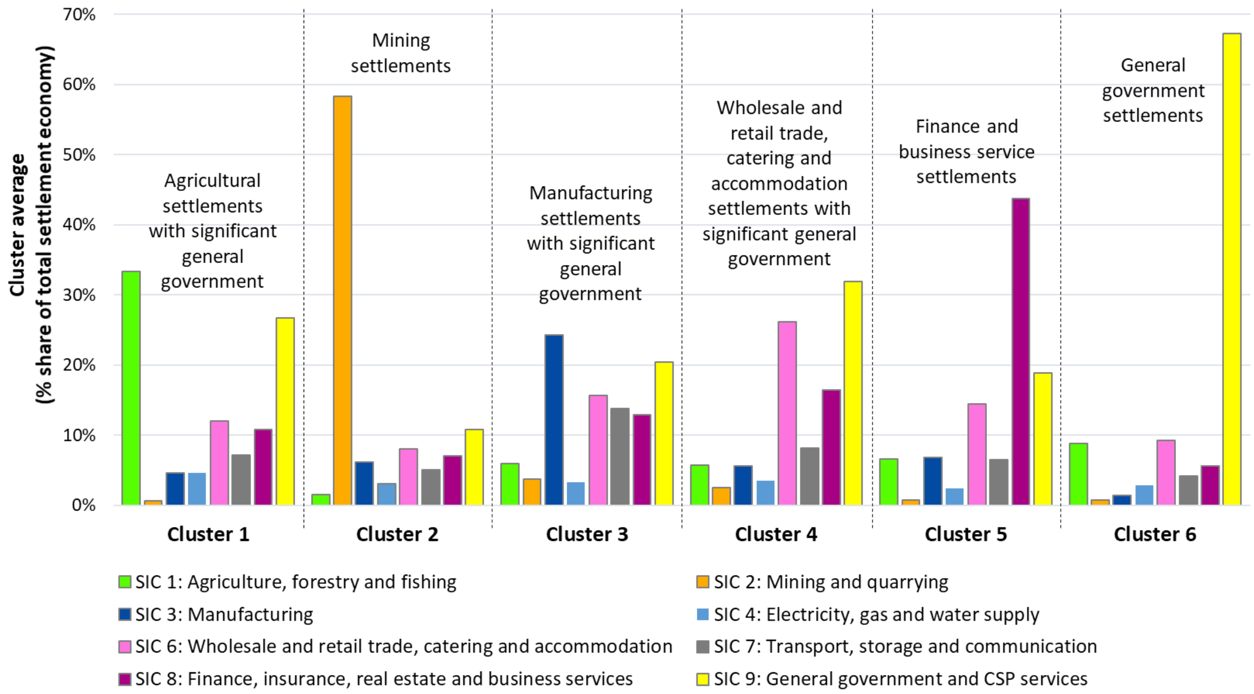


Figure 55: *Cluster averages of settlement economic profiles (Clusters 1–6)*

Table 23: *Cluster summaries for settlement economic profiles (Clusters 1–6)*

		Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Cluster size:	**No. of settlements (% of formal settlements)**	81 (7.2 %)	126 (11.1 %)	256 (22.6 %)	316 (27.9 %)	108 (9.5 %)	147 (13.0 %)
SIC 1: Agriculture, forestry and fishing		33.4 %	1.5 %	5.9 %	5.7 %	6.6 %	8.8 %
SIC 2: Mining and quarrying		0.6 %	58.3 %	3.8 %	2.6 %	0.7 %	0.7 %
SIC 3: Manufacturing		4.7 %	6.2 %	24.3 %	5.6 %	6.8 %	1.4 %
SIC 4: Electricity, gas and water supply		4.6 %	3.1 %	3.3 %	3.6 %	2.4 %	2.8 %
SIC 6: Wholesale and retail trade, catering and accommodation		12.0 %	8.0 %	15.6 %	26.2 %	14.4 %	9.2 %
SIC 7: Transport, storage and communication		7.2 %	5.1 %	13.8 %	8.1 %	6.5 %	4.1 %
SIC 8: Finance, insurance, real estate and business services		10.8 %	7.0 %	12.9 %	16.5 %	43.7 %	5.7 %
SIC 9: General government and CSP services		26.7 %	10.8 %	20.4 %	31.9 %	18.9 %	67.3 %

From **Figure 55**, **Figure 57** and **Table 23**:

Clusters 1 and 2 represent settlements with large economies in the primary sector.

- Cluster 1, which accounted for 81 (or 7.2 %) of the total of 1132 formal settlements being analysed in this study, is characterised predominantly by settlements with a high proportion of SIC 1 (agriculture, forestry and fishing) and SIC 9 (general government, social and personal services) economic activity. Many of the settlements classified in this cluster are located in the fertile agrarian regions along the banks of the Orange River, in the foothills of the southern Drakensberg or the Cape Winelands areas. Examples of settlements falling into this class include Citrusdal, Franschhoek and Op-die-Berg in the Western Cape, Underberg in KwaZulu-Natal and Augrabies in the Northern Cape.
- Cluster 2 represents mining settlements. South Africa is known as a mineral-rich country, and 126 (roughly 11 %) of its settlements fall into this category. Mining regions occur mostly in the northern and central parts of the country, and notable settlements falling into this class include platinum-mining towns such as Rustenburg in North West; coal mining towns such as Secunda and eMalahleni in Mpumalanga; iron ore-mining towns such as Thabazimbi in Limpopo and Kathu (Sishen) in the Northern Cape; gold-mining towns such as Welkom in the Free State; and diamond-mining towns such as Alexander Bay in the Northern Cape.

Clusters 3 represents settlements with large economies in the secondary sector.

- Cluster 3 accounts for those settlements with proportionally large economies in the secondary sector, especially manufacturing activities. There are 256 settlements (22.6 %) that fall into this class based on 2011 GVA figures. Examples include Middelburg in Mpumalanga; Vereeniging in Gauteng; Pietermaritzburg, Newcastle and Ladysmith in KwaZulu-Natal; as well as Mossel Bay and Paarl in the Western Cape.

Clusters 4 to 6 represent settlements that have large tertiary sector economies.

- Cluster 4 is the largest of the six clusters in terms of the number of settlements, accounting for 316 (or 27.9 %) of the total of 1132 formal settlements being analysed in this study. This class is predominantly characterised by settlements with a high proportion of SIC 6 (wholesale and retail trade, catering and accommodation) and SIC 9 (general government, social and personal services) economic activity. Kimberley and Upington in the Northern Cape; Makhanda and Mthatha in the Eastern Cape; and Potchefstroom in North West all fall into this category.
- Cluster 5 represents settlements with proportionally large finance, insurance, real estate and business service industries (SIC 8) relative to other economic sectors. Excluding the metros, 108 settlements (9.5 %) fall into this classification. Examples include Stellenbosch, George and Knysna in the Western Cape; Polokwane in Limpopo; and Howick and Ballito in KwaZulu-Natal.
- Cluster 6 represents settlements that are almost entirely dependent on general government. Accounting for 13 % of all formal settlements, this class forms the third-largest cluster after Cluster 4 (wholesale and retail trade settlements – 27.9 %) and Cluster 3 (manufacturing settlements – 22.6 %).

The vast majority of settlements with this economic profile are located in the former homeland areas in the Eastern Cape and Limpopo, followed by those in Mpumalanga, KwaZulu-Natal and North West.

Based on the outputs of the K-means clustering analysis, each of South Africa's eight metropolitan cities was classified according to one of the six economic profiles. **Table 24** outlines the classification of the metropolitan cities according to the 2011 GVA figures.

Table 24: *Classification of metropolitan municipality main cities*

Economic profile	Metropolitan municipality (main city)
Cluster 3: Manufacturing settlements, with significant general government	City of eThekwini (Durban)
	Nelson Mandela Metropolitan Municipality (Gqeberha, formerly Port Elizabeth)
Cluster 4: Wholesale and retail trade, catering and accommodation settlements, with significant general government	Mangaung Municipality (Bloemfontein)
	Buffalo City (East London)
	City of Tshwane (Pretoria)
Cluster 5: Finance and business service settlements	City of Cape Town (Cape Town)
	Ekurhuleni Metropolitan Municipality (East Rand)
	City of Johannesburg (Johannesburg)

Figure 57 together with the supporting literature review highlights the unequal concentration of population, economic growth and prosperity centred within the metros compared with the rest of the country. By virtue of the concentration of employment opportunities and higher-order services in metros, these settlement types exert particular gravity pull in relation to migration, and it was therefore warranted to consider them as a separate settlement class. Traditional settlements were also considered as a separate settlement class to reflect their unique pushing and pulling forces in relation to population and economic dynamics. These factors, as well as the sensitivity of correlation analysis to data extremes and outliers at both ends of a spectrum (in this case related to the economic and population size of settlements), prompted the decision to group the formal settlements located within the eight metropolitan municipalities as a separate class for the purposes of this study, irrespective of their economic profile, thus allowing for the dynamics within the metros to be analysed and reported on explicitly. Similarly, a decision was taken to analyse traditional settlements collectively as a separate class. This approach allowed for analytical sensitivity with respect to metropolitan and traditional settlements. The classification of traditional settlements was derived by the CSIR as part of the Settlement Footprint data frame (see **Section 4.5.1**). The cluster summaries for the metropolitan settlements and traditional settlements are presented in **Figure 56** and **Table 25**.

Cluster 7 represents formal settlements located within metropolitan municipalities, of which there are 98 settlements across eight municipalities (**Figure 57**). The economic profile of these so-called metropolitan settlements is dominated by proportionally large diversified secondary and tertiary sector activities (**Figure 56** and **Table 25**).

Cluster 8 represents traditional settlements, as defined by the CSIR Settlement Footprint data frame. These large and growing dense rural settlements coincide closely with traditional authority areas (**Figure 57**), and the formal economy generated within these settlements is predominantly in SIC 9 (community, social and personal services, including government services), as illustrated in **Figure 56** and **Table 25**. Given the location of a number of these traditional settlements on the outskirts of notable mining settlements, traditional settlements have the second-highest share of mining activity (11.6 %), on average, of all the settlement typologies. These traditional settlements were estimated to house 27.6 % of the national population in 2011 (**Table 22**).

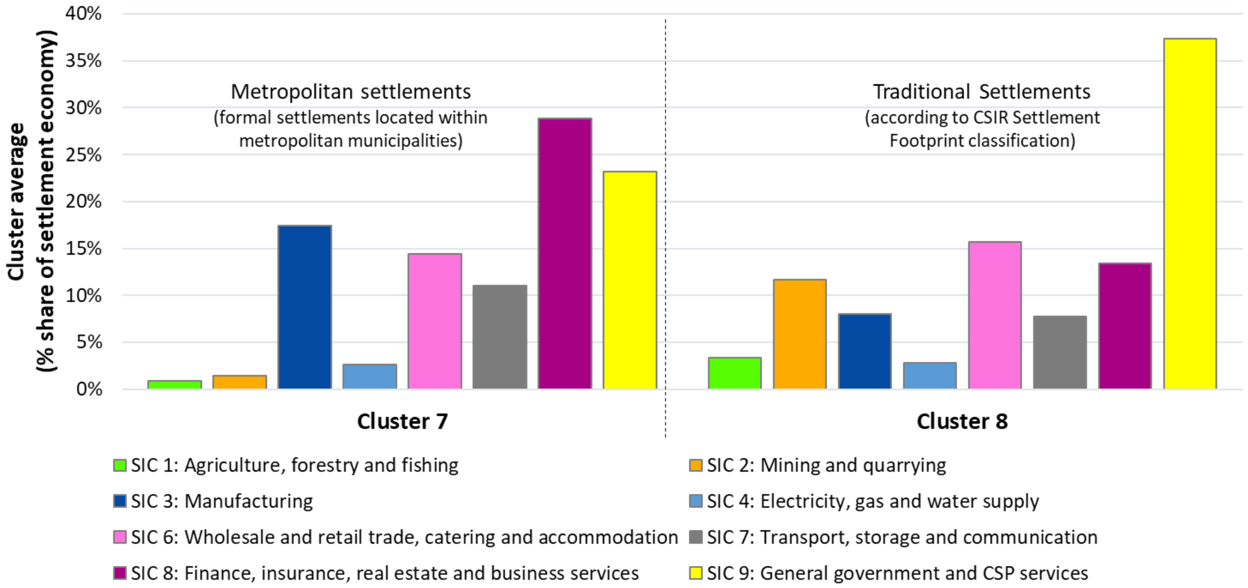


Figure 56: *Cluster averages of settlement economic profiles (Clusters 7 & 8)*

Table 25: *Cluster summaries for settlement economic profiles (Clusters 7 & 8)*

		Cluster 7 (Metropolitan settlements)	Cluster 8 (Traditional settlements)
Cluster size:	**No. of settlements (% of formal settlements)**	98 (8.7 %)	4524 -
SIC 1: Agriculture, forestry and fishing		0.9 %	3.4 %
SIC 2: Mining and quarrying		1.5 %	11.6 %
SIC 3: Manufacturing		17.4 %	8.0 %
SIC 4: Electricity, gas and water supply		2.6 %	2.8 %
SIC 6: Wholesale and retail trade, catering and accommodation		14.5 %	15.7 %
SIC 7: Transport, storage and communication		11.0 %	7.7 %
SIC 8: Finance, insurance, real estate and business services		28.9 %	13.4 %
SIC 9: General government and CSP services		23.2 %	37.3 %

Clusters 7 and 8 (namely metropolitan and traditional settlements), together with the six economic profiles calculated through the K-means clustering analysis (Clusters 1–6), constitute the eight settlement typologies used in the analysis of economic performance and population change in this study.

These settlement typologies were abbreviated, as follows, for ease of reference in the report:

- Cluster 1: Agricultural settlements
- Cluster 2: Mining settlements
- Cluster 3: Manufacturing settlements
- Cluster 4: Wholesale and retail trade settlements
- Cluster 5: Finance and business service settlements
- Cluster 6: General government settlements
- Cluster 7: Metropolitan settlements (formal settlements located within metropolitan municipalities)
- Cluster 8: Traditional settlements (according to CSIR Settlement Footprint classification).

Figure 57 maps the relative economic size (2011 figures) of South African settlements, together with their classification for the purposes of this study. **Table 32** and **Table 33** in **Appendix C** provide examples of settlements that fall under each of these settlement types.

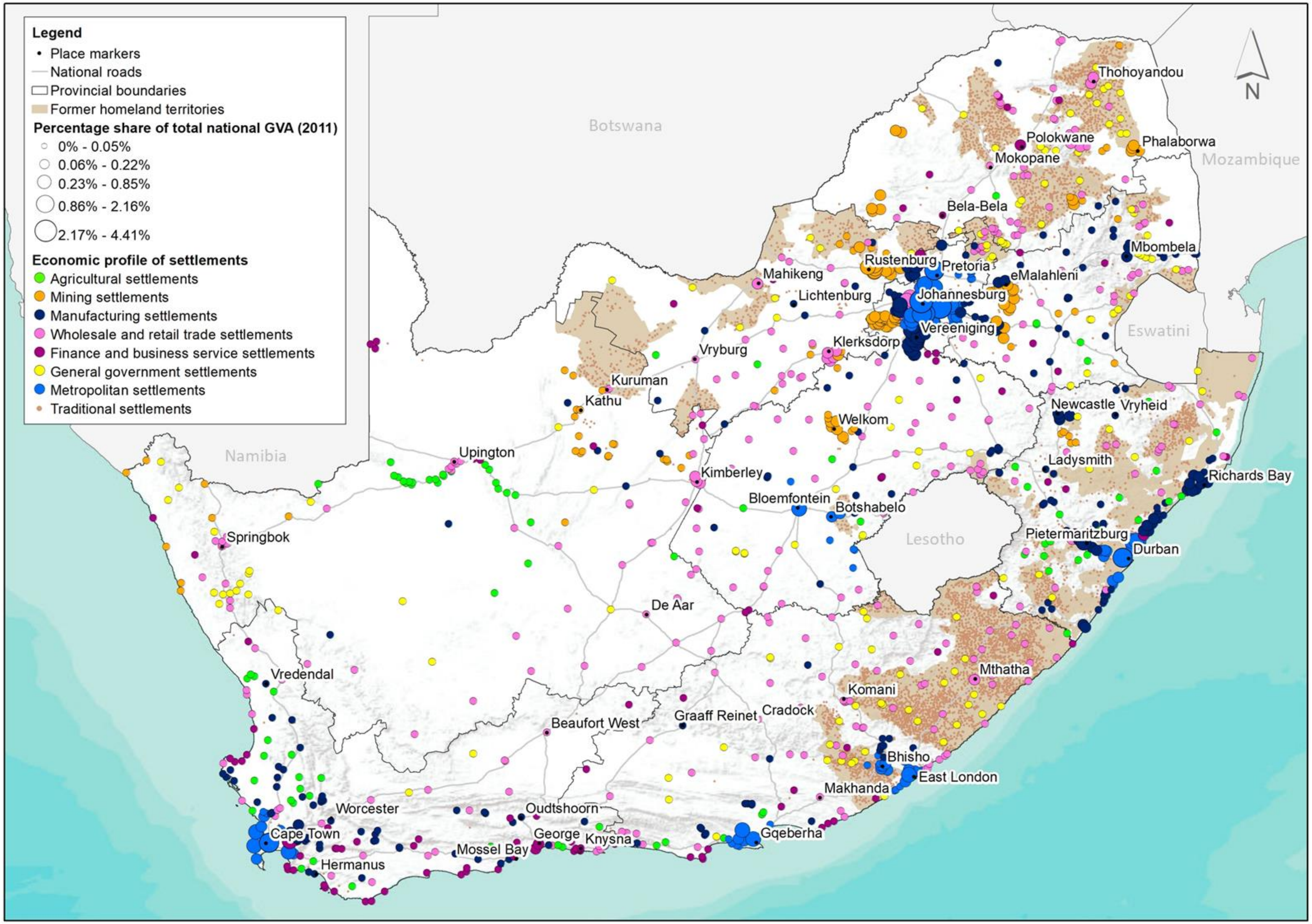


Figure 57: Settlements mapped and classified according to eight economically profiled settlement typologies

5.2.2 Analyse settlement-level economic performance and change between 2001 and 2011

The aim of Task 2.4 was to analyse shifts in economic performance across the eight economically derived settlement typologies in order to explore changing economic activity trends between 2001 and 2011. Using the 2001 and 2011 economic activity data downscaled and aligned to settlement footprint level in Task 2.1 and Task 2.2 and profiled according to settlement type in Task 2.3, the absolute and relative change in economic performance was analysed at the level of total economic activity (**Section 5.2.2.1**) and sectoral-based economic activity (**Section 5.2.2.2**) per settlement type.

5.2.2.1 Using shifts in settlement-based economic production to explore economic distribution and change

Table 26 shows the total economic production (SIC 1–4 and SIC 6–9) in Rands (million) per settlement type, for both 2001 and 2011, as well as the total access to national economic activity. For the purposes of calculating settlement-based economic activity in this study, it was assumed that people have access to economic activities that occur both within their settlements, as well as extending 14 km beyond the settlement boundary (especially in the case of primary sector activities), based on the average commute to work (see **Section 4.5.2.2** as well as **Figure 30**). Thus, the total economic production figures were calculated using the 14 km distance around the settlement footprints. Where settlements are located in close proximity to one another, more than one settlement could have access to the same economic activity, especially in the case of production occurring outside of the settlement footprint itself. Thus, the discussion of economic opportunities refers to *percentage access*, while *proportion share* is used in relation to settlement populations. See **Section 4.5.2.1** for an overview of the data limitations of SIC 5, and **Section 4.5.2.2** for further theoretical rationale for the calculation of settlement-based economic access. **Figure 58** shows the changes, by percentage point[26], in access to economic production (SIC 1–4 and SIC 6–9), within and around settlements per settlement type between 2001 and 2011.

In terms of total economic production, in both 2001 and 2011, agricultural settlements and general government settlements were the smallest of all the eight settlement types, and metropolitan settlements were the largest, with the biggest proportion of total economic production occurring within and around metropolitan settlements as the economic hubs of the country. **Table 26** shows that agricultural settlements and general government settlements similarly offered the smallest overall access of all settlement types to total national economic activity, and metropolitan settlements the largest. The 45.7 % growth in economic production experienced within and around metropolitan settlements between 2001 and 2011 (7.4 percentage points above the national average of 38.3 %) resulted in their further rise in total national economic production and access levels, from 55.2 % in 2001 to 58.1 % in 2011 (**Table 26**). Apart from metropolitan settlements, finance and business service

[26] A percentage point is the unit for the arithmetic difference of two percentages.

settlements were the only other settlement type to experience significant economic growth, far above the national average, over the period. Finance and business service settlements, which experienced economic growth of 47.0 % between 2001 and 2011, saw the biggest relative increase in economic production and corresponding access of any settlement type nationally (**Table 26**, **Figure 58** and **Figure 59**). The growth dynamics witnessed in finance and business service settlements and metropolitan settlements signify that between 2001 and 2011, national economic growth was largely driven by the tertiary sector.

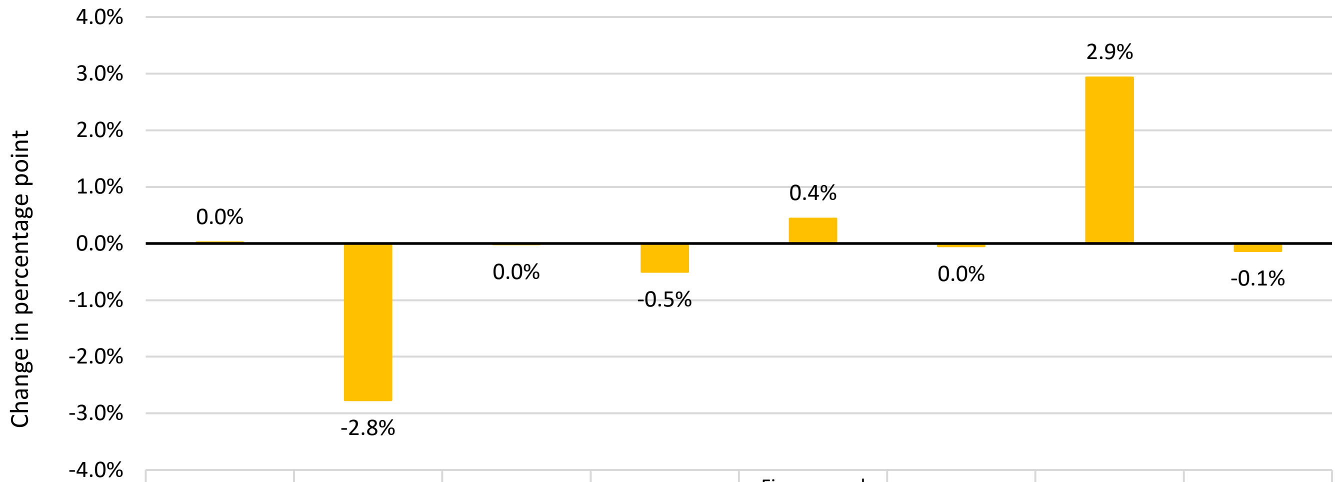
The sheer size of traditional settlements, which accounted for 75.7 % of the national settlement land cover area in 2011 (**Table 20**), meant that as a settlement type, traditional settlements had access to the second-largest share of total national economic activity after metropolitan settlements. This figure reflects the size of the geographical area in and around traditional settlements, and hence the widely dispersed economic opportunities to which the residents had access, and should not be taken as a measure of the strength of economic activity occurring within these areas, given their low levels of economic agglomeration and population concentration as a result of their geographical sprawl (**Table 26**). In reality, traditional settlements were one of the four settlement types that experienced lower economic growth than the national average between 2001 and 2011 (**Figure 58** and **Figure 59**).

Table 26: *Total national economic output and percentage access to economic activity per settlement type, 2001 and 2011*

Settlement type	Economic activity (SIC 1–4 and SIC 6–9)	2001	2011
Agricultural settlements	GVA (millions of Rands)*	20,915	29,394
	% access to national economic activity	*1.2 %*	*1.2 %*
Mining settlements	GVA (millions of Rands)	275,279	312,449
	% access to national economic activity	*15.4 %*	*12.6 %*
Manufacturing settlements	GVA (millions of Rands)	427,958	591,935
	% access to national economic activity	*23.9 %*	*23.9 %*
Wholesale and retail trade settlements	GVA (millions of Rands)	301,239	404,474
	% access to national economic activity	*16.8 %*	*16.3 %*
Finance and business service settlements	GVA (millions of Rands)	126,491	185,947
	% access to national economic activity	*7.1 %*	*7.5 %*
General government settlements	GVA (millions of Rands)	42,282	57,348
	% access to national economic activity	*2.4 %*	*2.3 %*
Metropolitan settlements	GVA (millions of Rands)	987,738	1,439,397
	% access to national economic activity	*55.2 %*	*58.1 %*
Traditional settlements	GVA (millions of Rands)	495,553	682,535
	% access to national economic activity	*27.7 %*	*27.6 %*
National settlement-based economic activity (All settlements in analysis subset)	**GVA (millions of Rands)**	**1,788,842**	**2,475,385**

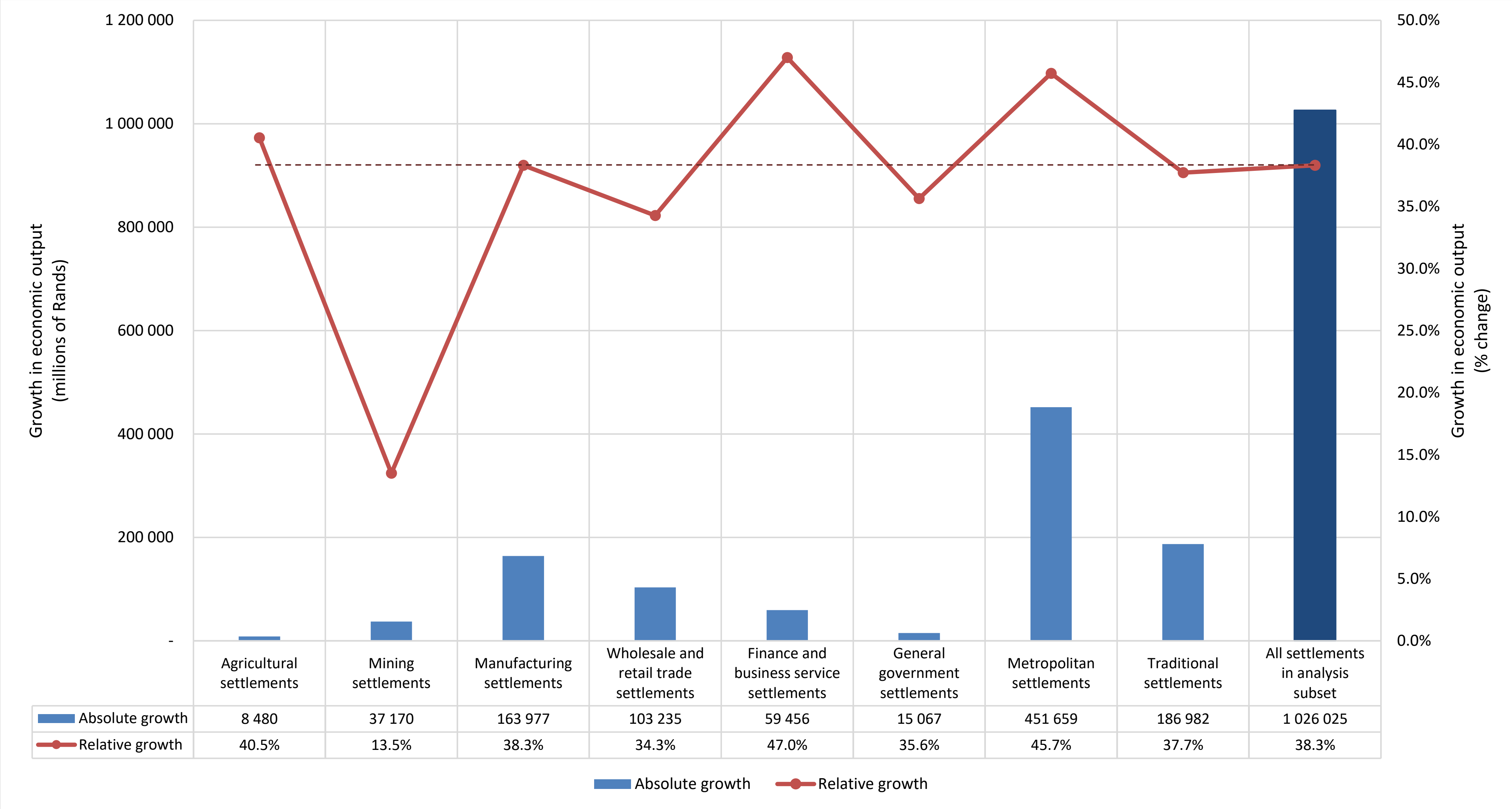
*Measured at constant 2010 prices, according to inflation-related adjustments of Quantec data

Mining settlements showed significant economic change between 2001 and 2011. With a noticeable downturn in mining sector growth as a whole, the total GDP production within and around mining settlements dropped significantly from 15.4 % to 12.6 % (a percentage point change of -2.8 %) between 2001 and 2011 (**Table 26**, **Figure 58** and **Figure 59**). The total economic growth of manufacturing settlements, agricultural settlements, general government settlements, and traditional settlements between 2001 and 2011 was closely aligned to the national average (38.3 %) and did not serve to either increase or decrease the share of national GDP production and access to economic activity of these settlement types over the decade (**Figure 59**).



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements
Change in percentage point	0.0%	-2.8%	0.0%	-0.5%	0.4%	0.0%	2.9%	-0.1%

Figure 58: *Change in access to total economic output within and around settlements per settlement type, 2001–2011*



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
Absolute growth	8 480	37 170	163 977	103 235	59 456	15 067	451 659	186 982	1 026 025
Relative growth	40.5%	13.5%	38.3%	34.3%	47.0%	35.6%	45.7%	37.7%	38.3%

Figure 59: *Absolute and relative change in total settlement-based economic output per settlement type in comparison to the national settlement-based average, 2001–2011*

5.2.2.2 Using shifts in settlement-based economic production per sector to explore economic distribution and change

Section 5.2.2.1 analysed the shifts in total economic production within and around the eight settlement types. This section then analyses shifts in economic production at sectoral level, presenting a high-level summary of the main results. **Table 34**, **Table 35** and **Table 36** in **Appendix D** present the complete set of data results, and further help to support this analysis.

Figure 60 summarises and graphically presents the relative growth in settlement-based economic production per sector between 2001 and 2011. Here, again, the settlement-based economic activity refers to the economic production occurring both within and 14 km around the settlement to account for primary sector activities that do not take place within the settlement footprint itself but may attract workers who reside in nearby settlements. A 14 km area around settlements was used as a proxy for calculating the economic activity to which the residents of a settlement have access.

The most notable trends observed in the data presented in **Figure 60** are the national downturn in the mining sector as a whole (SIC 2), together with the growth in service-based economic activities experienced between 2001 and 2011. From **Figure 60**, it is clear that national economic growth between 2001 and 2011 was driven mainly by the tertiary sector. At national level, the finance and business services sector saw the biggest increase of any sector nationally as a percentage of GDP. The transport sector, together with the wholesale and retail trade sector, experienced more moderate growth, each increasing their share of GDP by 1 % between 2001 and 2011, while the primary sectors (agriculture and mining) together with manufacturing saw a decline in their national share of GDP.

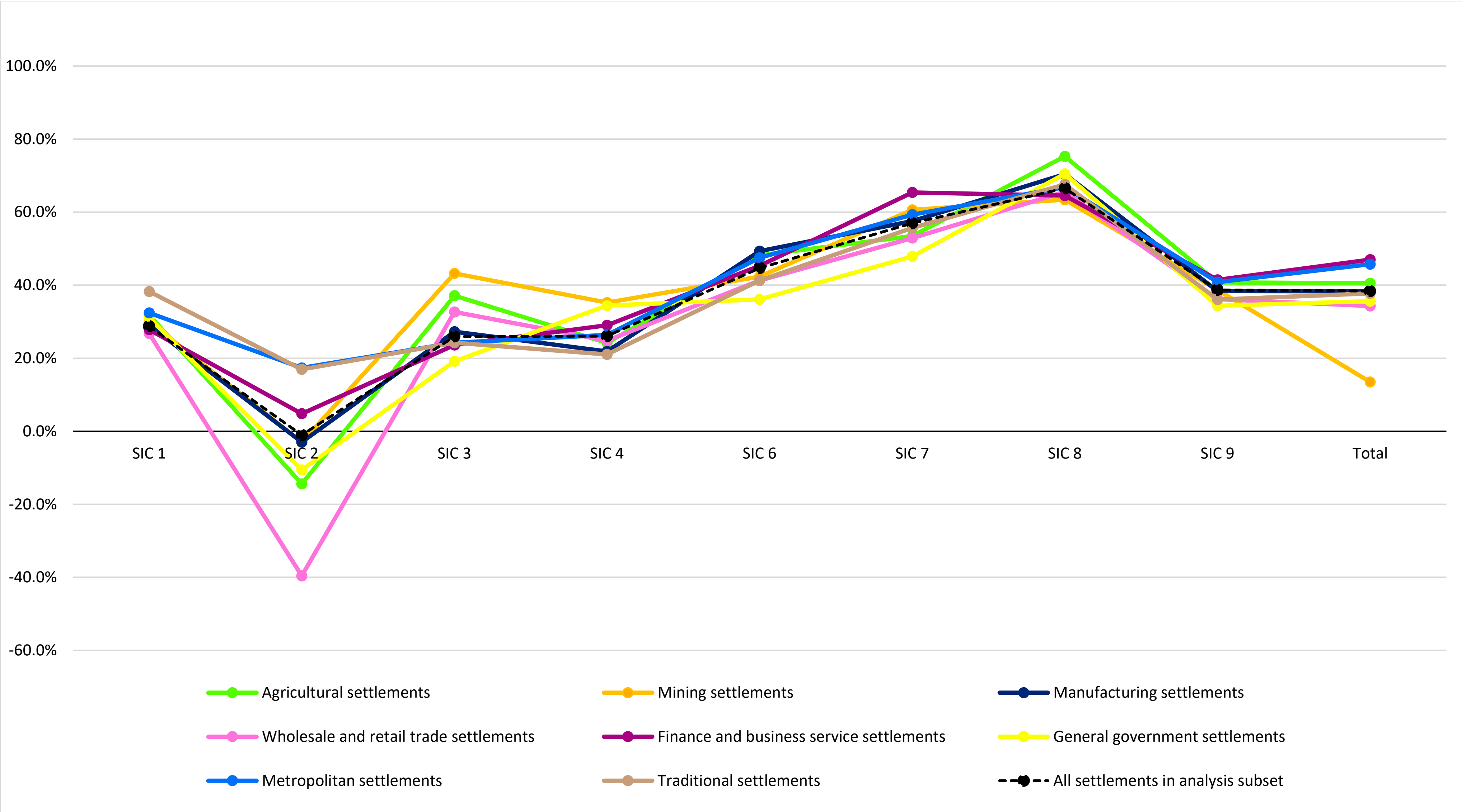


Figure 60: *Growth of settlement-based economic output per sector and settlement type, 2001–2011*

5.3 QUANTIFY POPULATION CHANGE AT SETTLEMENT LEVEL BETWEEN 2001 AND 2011

The following section presents the research results for Objective 3 (Task 3.4 specifically), which aimed to quantify and analyse population change at settlement level between 2001 and 2011.

5.3.1 Analyse settlement-level population change between 2001 and 2011

The aim of Task 3.4 was to analyse shifts in population across the eight economically defined settlement typologies in order to explore changing demographic growth and movement trends between 2001 and 2011. Using the 2001 and 2011 Stats SA Census data prepared and aligned to the settlement footprint level in Tasks 3.1–3.3, absoluteand relative population change across five key socio-economic variables was analysed, namely change in total working-age population (**Section 5.3.1.1**), age distribution (**Section 5.3.1.2**), gender balance (**Section 5.3.1.3**), employment status (**Section 5.3.1.4**) and skill level (**Section 5.3.1.5**).

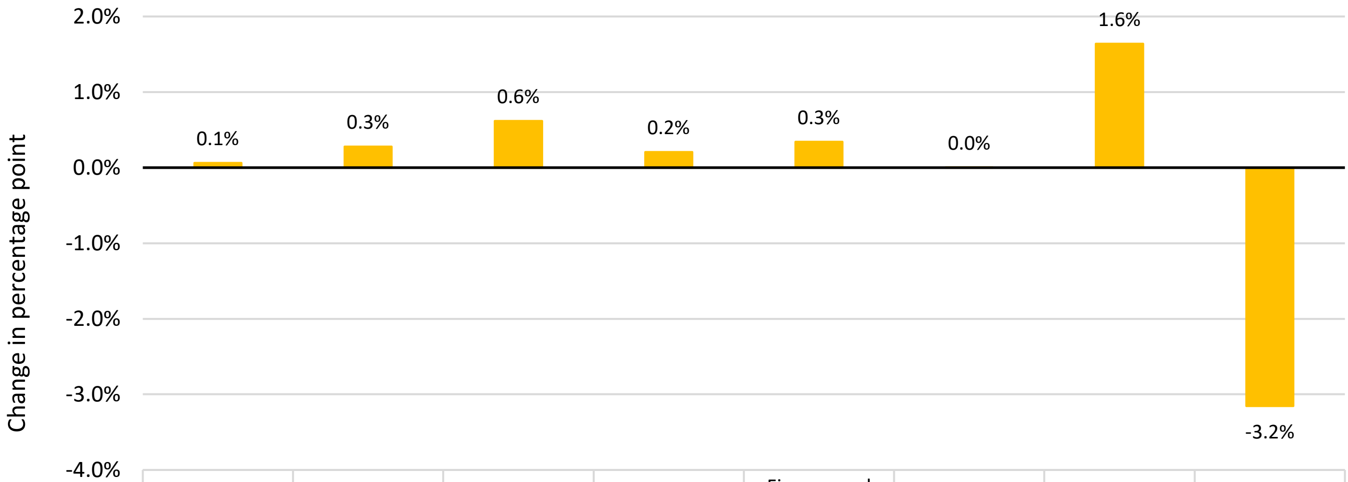
5.3.1.1 Using shifts in working-age population to explore settlement-based population movement and change

Table 27 shows the working-age population totals and proportional share per settlement type for both 2001 and 2011. **Figure 61** shows the changes, by percentage point, in the national share of settlement-based working-age population per settlement type. Nationally, the settlement-based working-age population was 25.2 million people in 2001 and increased to 31.1 million people in 2011. Metropolitan settlements, which were home to between 10.9 million and 13.9 million of the total working-age population in 2001 and 2011 respectively, accounted for the largest accumulation of working-age people, with a share of well over 40 % of the national working-age population in both periods, followed by traditional settlements with around 25 % (roughly 7 million) of the working-age population. The smallest proportions of working-age population were found in general government settlements and agricultural settlements, which together accounted for only 2.2 % of settlement inhabitants. In both 2001 and 2011, agricultural settlements accounted for fewer than 200,000 working-age people. The remaining settlement types fell between these extremes in terms of their share of the working-age population.

The analysis of the shifts in settlement demographics, based on working-age population between 2001 and 2011, showed a national increase of 5.8 million people in settlement-based working-age population, which represented a 23.2 % increase in the national settlement-based working-age population over that period (**Figure 62**). Of this growth, metropolitan settlements received more than half, with growth of just over 3 million working-age people (**Figure 62**). This substantial growth in absolute terms resulted in a 1.6 percentage point increase in the proportional share of working-age people within metropolitan settlements, from 43.3 % in 2001 to 44.9 % in 2011 (**Table 27** and **Figure 61**). After the metropolitan settlements, manufacturing settlements saw the second-largest growth in absolute terms, of 800,000 working-age people, accounting for almost 14 % of all settlement-based working-age population growth between 2001 and 2011.

Table 27: *Total national working-age population and proportional share per settlement type, 2001 and 2011*

Settlement type	Working-age population (15–64 years)	2001	2011
Agricultural settlements	Working-age population	128,910	177,775
	% share (relative to national settlement-based total)	*0.5 %*	*0.6 %*
Mining settlements	Working-age population	936,166	1,240,484
	% share	*3.7 %*	*4.0 %*
Manufacturing settlements	Working-age population	2,648,705	3,455,923
	% share	*10.5 %*	*11.1 %*
Wholesale and retail trade settlements	Working-age population	2,705,590	3,397,424
	% share	*10.7 %*	*10.9 %*
Finance and business service settlements	Working-age population	584,335	826,671
	% share	*2.3 %*	*2.7 %*
General government settlements	Working-age population	411,621	507,733
	% share	*1.6 %*	*1.6 %*
Metropolitan settlements	Working-age population	10,936,325	13,983,254
	% share	*43.3 %*	*44.9 %*
Traditional settlements	Working-age population	6,929,319	7,554,232
	% share	*27.4 %*	*24.3 %*
National settlement-based population (All settlements in analysis subset)	**Working-age population**	**25,280,972**	**31,143,496**
	% share	***100 %***	***100 %***

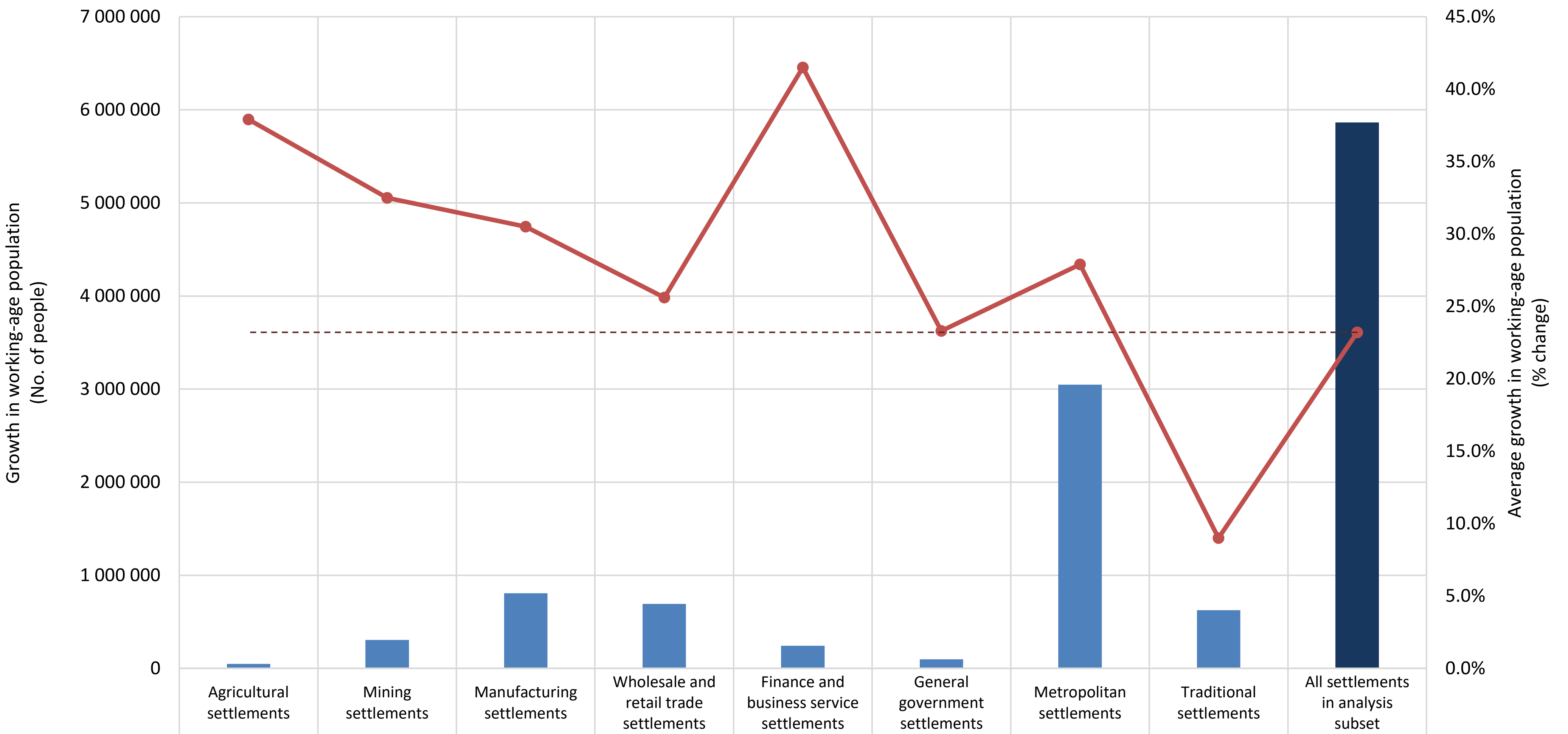


	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements
Change in percentage point	0.1%	0.3%	0.6%	0.2%	0.3%	0.0%	1.6%	-3.2%

Figure 61: *Change in the national share of settlement-based working-age population per settlement type, 2001–2011*

Figure 62 summarises the growth trends seen across the country in terms of the working-age population per settlement type and shows which settlement types grew the most in both relative and absolute terms, and which settlement types saw relative growth above or below the national average. While the working-age population growth in the metropolitan settlements overshadowed all other settlement types in absolute terms, their relative growth was only slightly higher than that of the national average. This growth should be understood in the context of metropolitan settlements having the largest population base of all settlement types in 2001. Several settlement types experienced far more rapid growth than that of the national average or of the metros in relative terms over this ten-year period (**Figure 62**). Of all settlement types, finance and business service settlements saw the largest relative growth (41.5 %), while agricultural settlements, the smallest settlement type in absolute terms, experienced significant relative growth in the working-age population of 37.9 % between 2001 and 2011, far above the national average of 23.2 %. Similarly, mining settlements and manufacturing settlements also experienced working-age population growth of over 30 % (**Figure 62**). General government settlements experienced working-age population growth at a similar level to the national average across all settlement types (23.2 %) between 2001 and 2011, while at the other end of the spectrum, traditional settlements witnessed the smallest growth in working-age population of all settlement types. With only 9.0 % growth between 2001 and 2011, 14.2 % below the national average of 23.2 %, the national share of working-age people in traditional settlements dropped considerably by -3.2 percentage points, from 27.4 % in 2001 to 24.3 % in 2011 (**Table 27**, **Figure 61** and **Figure 62**).

From **Figure 62**, it is evident that general government settlements and traditional settlements experienced the least working-age population growth, while metropolitan settlements together with finance and business service settlements experienced the largest growth in the working-age population between 2001 and 2011.



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
Absolute growth	48 865	304 318	807 218	691 834	242 336	96 112	3 046 929	624 912	5 862 524
Relative growth	37.9%	32.5%	30.5%	25.6%	41.5%	23.3%	27.9%	9.0%	23.2%

Absolute growth Relative growth

Figure 62: *Absolute and relative change in working-age population per settlement type in comparison to the national settlement-based average, 2001–2011*

5.3.1.2 Using shifts in age brackets to explore settlement-based population movement and change

Section 5.3.1.1 analysed the shifts in total working-age population per settlement type between 2001 and 2011. Following this, the next four sections analyse shifts in working-age population across a number of demographic and socio-economic variables. Firstly, settlement-based working-age population shifts between 2001 and 2011 were analysed across three age brackets: 15–24-year-olds (lower youth), 25–34 (upper youth) and 35–64-year-olds (working-age adults). This section presents only a high-level summary of the main results. **Figure 63** shows and compares the percentage of the population per age bracket and settlement type for 2011, while **Figure 64** shows the changes, by percentage point, in the proportional share of the working-age population per age bracket and settlement type between 2001 and 2011. **Table 37**, **Table 38** and **Table 39** in **Appendix E** present the full set of detailed results, and further help to support this analysis. On their own, the 2001 and 2011 figures (**Table 37** and **Table 38**) provide limited insight given the inconsistent sizes of the three age-bracket categories (i.e., 15–24 and 25–34 being ten-year age spans, and 35–64 being a 30-year age span) (see **Section 4.5.3.1** for an overview of this analysis decision). Looking at changes between 2001 and 2011, especially which age bracket experienced the most change per settlement type (**Figure 64**), provides better understanding.

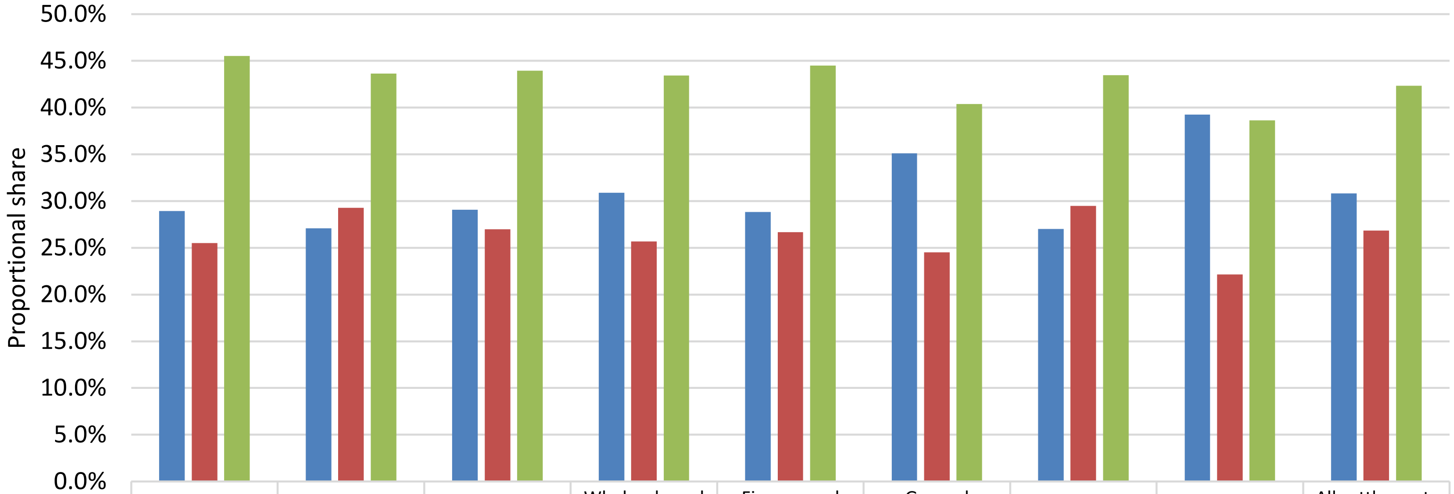
First, changes are considered between all settlements in the study analysis subset, regardless of type. From **Figure 64**, the national settlement-based population growth in the 25–34 and 35–64 age brackets far outpaced that seen among the 15–24-year-old lower youth group. The upper youth group (aged 25–34) accounted for the largest relative growth nationally, increasing by over 1.8 million people (28.9 %) between 2001 and 2011 (**Table 39**). At 26.6 % growth (2.7 million people), the working-age adults group (aged 35–64) also saw substantial growth above the 23.2 % average for the total settlement-based working-age population (**Table 39**). Conversely, the growth among 15–24-year-olds was much smaller, growing by only 14.6 % over the ten-year analysis period (**Table 39**). As a result of the varying growth between age brackets, the national proportional population share of the 25–34 and 35–64 age brackets increased by just over 1 % each between 2001 and 2011 (**Figure 64**), while slower growth in the 15–24-year-old lower youth group contributed to an overall drop of over -2 % in the national settlement-based population share of this group (**Figure 64**), from 33.2 % in 2001 to 30.8 % in 2011 (**Table 37** and **Table 38**).

The substantially lower population growth observed among the 15–24-year-old lower youth group between 2001 and 2011 compared to the other age brackets (**Table 39** and **Figure 64**) could perhaps result from declining fertility rates as well as the ongoing demographic impact of HIV/AIDS on mortality since the 1990s, thus lending support to the view of Potts (2012) that fertility and mortality are the main drivers of population change in Africa, and the identification by Van Aardt (2008) of the impact of HIV/AIDS on population growth rates in South Africa. Exploring the influence of these factors on population change is, however, outside the scope of this study.

Looking at the trends across the eight economically profiled settlement types, similar trends emerged. Without exception, the lowest relative growth was in the 15–24-year-old lower youth group compared to the other two age brackets, although agricultural settlements, mining settlements, manufacturing settlements, finance and business service settlements, and metropolitan settlements showed larger growth in this age bracket than the national settlement-based average, an indication that these settlement types were still exerting a strong pulling force on 15–24-year-olds (**Table 39**). It can also then be considered that the effects of population movement and internal migration as the third agent of population change (after mortality and fertility) are better observed as local deviations above or below national trends.

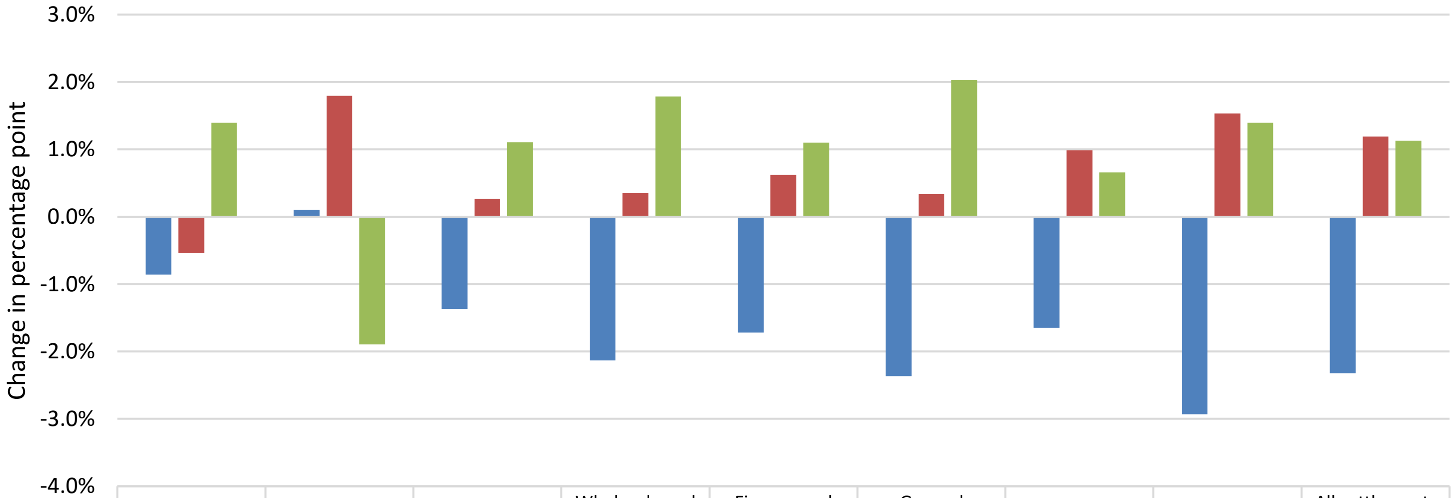
Figure 64 shows which age bracket saw the most growth between 2001 and 2011 per settlement type. For agricultural settlements, manufacturing settlements, wholesale and retail trade settlements, finance and business settlements and general government settlements, the 34–64-year-old age bracket saw the largest growth. Mining settlements together with metropolitan settlements saw the most growth in the 25–34-year-old age bracket.

The least growth was seen in traditional settlements, especially in the 15–24-year-old age bracket. While **Figure 61** and **Figure 62** showed population growth in traditional settlements to be on the decline, **Figure 64** shows that this decline was mostly in the lower youth group (aged 15–24). Between 2001 and 2011, the population of 15–24-year-olds in traditional settlements grew by only 42,000 people (**Table 39**). This represented an almost stagnant 1.4 % relative growth compared to the growth seen in other settlement types, which experienced an average 14.6 % relative growth of 15–24-year-olds (**Table 39**). The result was a -2.9 % decline in the overall population share of working-age youth in the lower youth group in traditional settlements (**Figure 64**).



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
15–24	28.9%	27.1%	29.1%	30.9%	28.8%	35.1%	27.0%	39.2%	30.8%
25–34	25.5%	29.3%	27.0%	25.7%	26.7%	24.5%	29.5%	22.1%	26.8%
35–64	45.5%	43.7%	43.9%	43.4%	44.5%	40.4%	43.5%	38.6%	42.3%

Figure 63: *Proportional share of settlement-based working-age population by age bracket and settlement type, 2011*



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
15–24	-0.9%	0.1%	-1.4%	-2.1%	-1.7%	-2.4%	-1.6%	-2.9%	-2.3%
25–34	-0.5%	1.8%	0.3%	0.4%	0.6%	0.3%	1.0%	1.5%	1.2%
35–64	1.4%	-1.9%	1.1%	1.8%	1.1%	2.0%	0.7%	1.4%	1.1%

Figure 64: *Change in the proportional share of settlement-based working-age population by age bracket and settlement type, 2001–2011*

5.3.1.3 Using shifts in gender distribution to explore population movement and change

This section provides an analysis of shifts in the gender distribution of working-age settlement-based population from 2001 to 2011 in relation to the eight economically profiled settlement types. The proportions of settlement-based working-age males to females were analysed in terms of gender balance. This section presents only a high-level summary of the main results. **Figure 65** shows and compares the gender balance of working-age population per settlement type for 2011, while **Figure 66** shows the changes, by percentage point, in the proportional share of settlement-based working-age population by gender and settlement type between 2001 and 2011. **Table 40**, **Table 41** and **Table 42** in **Appendix E** present the full set of detailed results and help to further support this analysis. It should be noted that these results indicate the gender balance between males and females among the settlement-based working-age population. These statistics cannot be used to infer how many working-age males relative to females were actually employed, and are thus silent about gender equality in the workplace, which was outside the scope of this study.

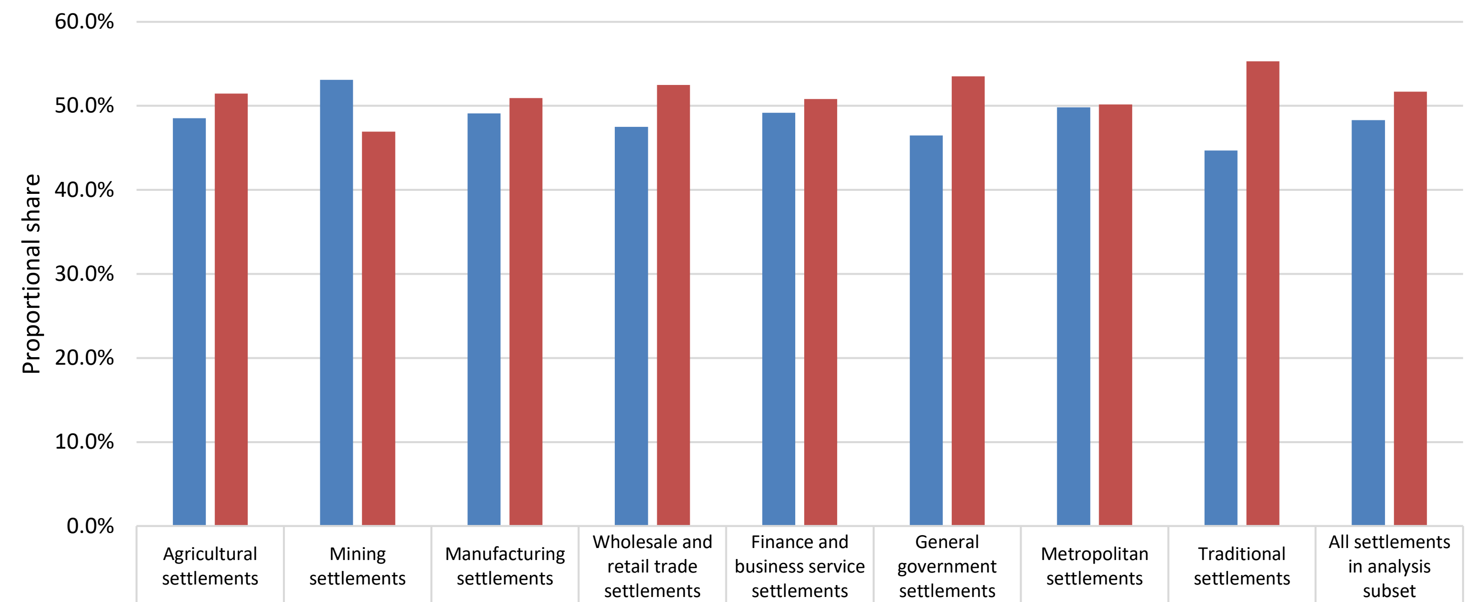
Figure 65 and **Figure 66** show that in both 2001 and 2011, the national settlement-based working-age population was unbalanced in terms of gender distribution, being slightly biased towards females. In 2001, South Africa's settlement-based working-age male population was approximately 11.9 million (47.1 %) inhabitants, while the female population totalled roughly 13.4 million (52.9 %) (**Table 40**). By 2011, the gender imbalance had narrowed slightly to 48.3 % (15.0 million) working-age males and 51.7 % (16.1 million) working-age females (**Table 41**), indicating slightly higher relative growth among men than women between 2001 and 2011 and resulting in a slight evening out of the gender balance (**Figure 65**, **Figure 66** and **Table 42**).

Looking at the gender balance per settlement type in terms of the economic profile of settlements also sheds light on the demographic dynamics within these settlements. Although growth in all eight settlement types between 2001 and 2011 favoured men over women (**Figure 66** and **Table 42**), the 2011 working-age female population still dominated the gender ratio in all except one settlement type (**Figure 65** and **Table 41**). Across all settlement types, in both 2001 and 2011, the number of working-age females outnumbered males, with the exception of mining settlements. **Figure 65** and **Figure 66** show that in mining settlements, the gender balance was biased towards males, who comprised 51.5 % of the working-age population of mining settlements in 2001, and grew even further to 53.1 % in 2011, a notable relative growth of 36.7 % over the decade (**Table 42**). While mining settlements had the highest imbalance of working-age men relative to women in both 2001 and 2011, traditional settlements and general government settlements had the biggest imbalance of working-age women relative to men. In both 2001 and 2011, the largest gender imbalance towards the female population among all eight settlement types was found in traditional settlements, where, in 2001, working-age females outnumbered males by more than 1 million, a ratio of 1 man to every 1.3 women (**Table 40**). In 2001, 57.0 % of the traditional settlement-based working-age population was female, which represented 15.6 % of the total national settlement-based female working-age population (**Table 40**). While the literature acknowledges that working-age women are more likely to be located in the former homeland areas than their male counterparts

(Department of Women, 2015; Kwenda, Ntuli & Mudiriza, 2020), it is interesting to note that the growth between 2001 and 2011 was in the opposite direction, with the national share of the female-based population in traditional settlements dropping by -1.7 % to 55.3 % females in 2011 (**Figure 65**).

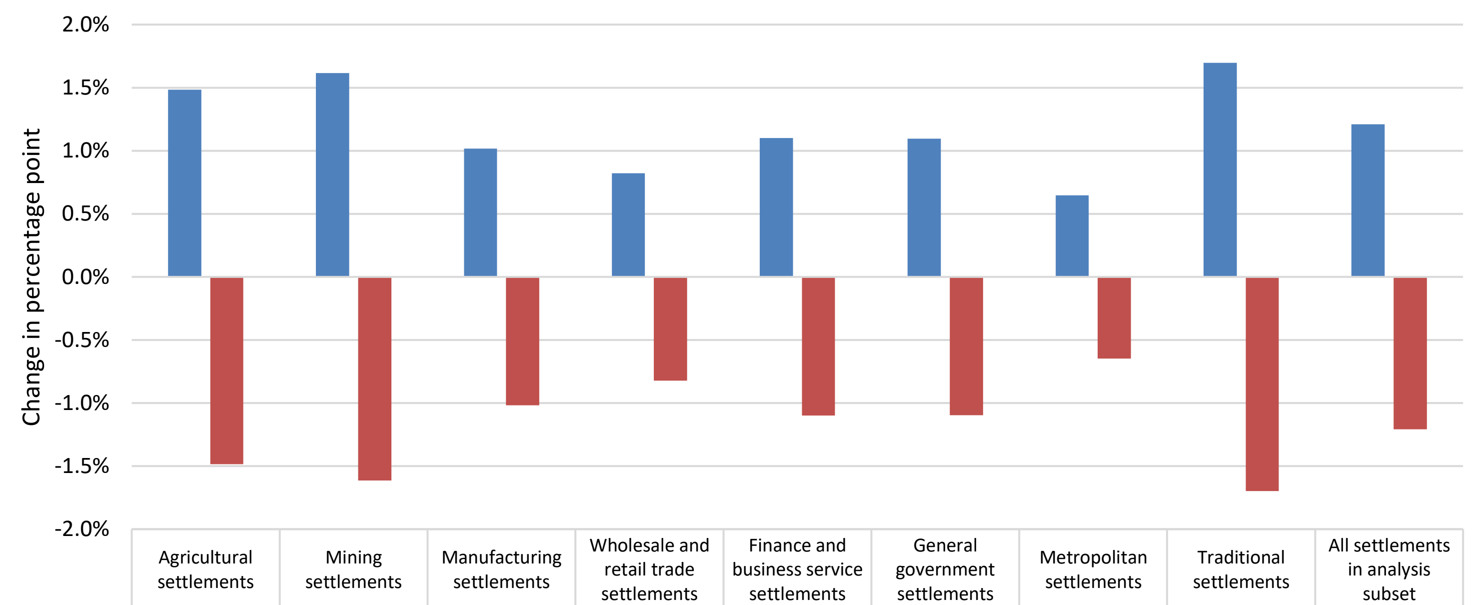
Looking at the gender balance in settlement types with strong tertiary service-orientated economies, especially metropolitan settlements, the gender ratio favoured females over males in both 2001 and 2011, but the imbalance was only very slightly less than 1 % (49.8 % men to 50.2 % women) (**Table 40**, **Table 41** and **Figure 65**), which was more likely to have resulted from natural forces (e.g., fertility and mortality) than from economic forces such as internal migration.

Considering the shifts in total working-age population per settlement type between 2001 and 2011, as analysed in **Section 5.3.1.1** and shown in **Figure 65** and **Figure 66**, mining settlements and agricultural settlements saw the largest growth of men relative to women, while traditional settlements saw the least decline in men in relation to women.



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
Male	48.5%	53.1%	49.1%	47.5%	49.2%	46.5%	49.8%	44.7%	48.3%
Female	51.5%	46.9%	50.9%	52.5%	50.8%	53.5%	50.2%	55.3%	51.7%

Figure 65: *Proportional share of settlement-based working-age population by gender and settlement type, 2011*



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
Male	1.5%	1.6%	1.0%	0.8%	1.1%	1.1%	0.6%	1.7%	1.2%
Female	-1.5%	-1.6%	-1.0%	-0.8%	-1.1%	-1.1%	-0.6%	-1.7%	-1.2%

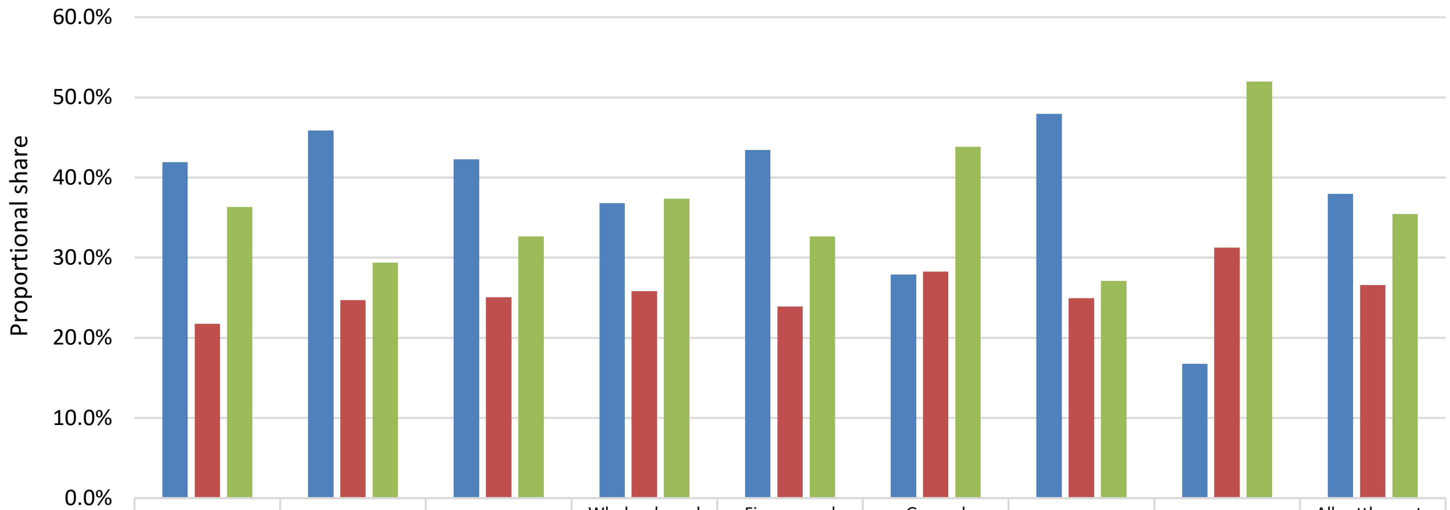
Figure 66: *Change in the proportional share of settlement-based working-age population by gender and settlement type, 2001–2011*

5.3.1.4 Using shifts in employment status to explore population movement and change

This section analyses shifts in the employment status of the working-age settlement-based population between 2001 and 2011 in the eight economically profiled settlement types. No distinction between formal sector, informal sector or private household employment is made in this study, given that the 2001 and 2011 Censuses recorded this differently, and the data were thus not comparable. The broad definition of unemployment was used to derive an individual's employment status. According to this definition, unemployed persons are those within the economically active population who were not working, but were available to work, regardless of whether they were looking for work or not at the time of the Census. In comparison, not economically active (NEA) persons are those aged 15–64 years who were neither employed nor unemployed at the time of the Census, for example, full-time students, home-makers/housewives, pensioners/retired persons, disabled persons not able to work, seasonal workers not working at the time of the Census, or people unwilling to work (Stats SA, 2012d). This section presents a high-level summary of the main results. **Figure 67** shows and compares the employment status of the working-age population per settlement type for 2011, while **Figure 68** shows the changes, by percentage point, in the proportional share of settlement-based working-age population by employment status and settlement type between 2001 and 2011. **Table 43**, **Table 44** and **Table 45** in **Appendix E** present the full set of detailed results, and further help to support this analysis.

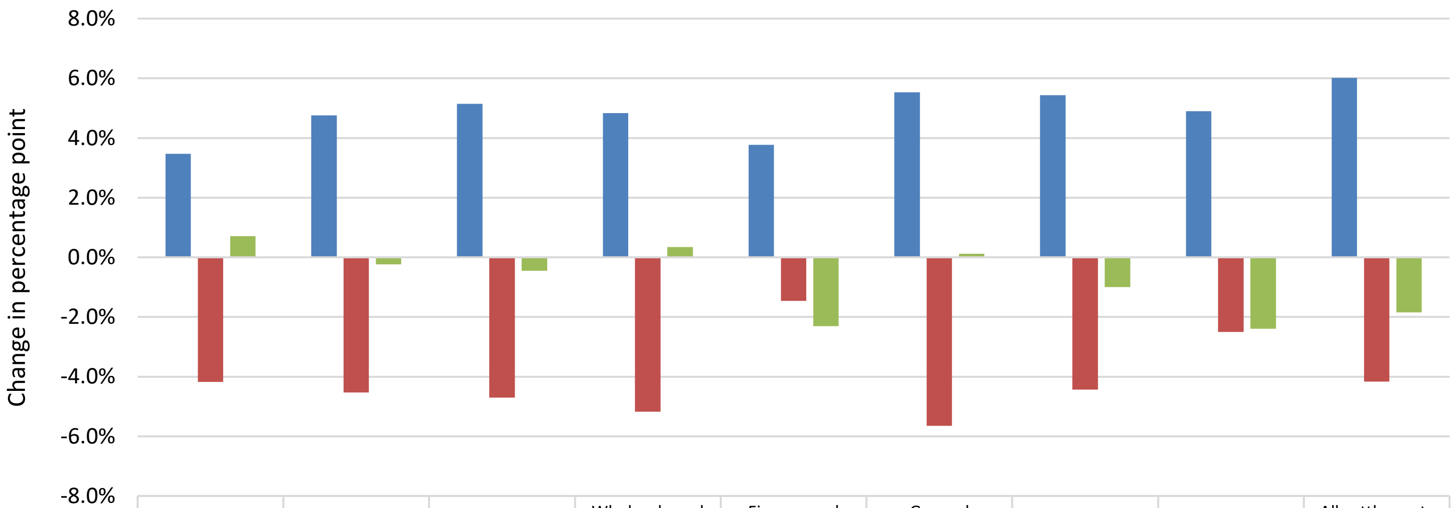
Historical data confirm that high rates of unemployment have been a long-standing challenge for South Africa (see **Figure 9**). Of all the settlement types, metropolitan settlements had the highest levels of employment in both 2001 and 2011, with more than 40 % of the working-age population being employed (**Table 43**, **Table 44** and **Figure 67**). Metropolitan settlements also had the lowest proportion of NEA working-age population in the same ten-year period. Traditional settlements had the lowest levels of employment, with only 16.8 % of the working-age population being employed in 2011, followed by general government settlements at 27.9 % (**Table 44** and **Figure 67**). Both traditional settlements and general government settlements also had the highest proportions of NEA working-age population. In traditional settlements, more than half (52.0 %) of the population were classed as NEA in 2011 (**Table 44** and **Figure 67**).

In the first decade of the 21st century, South Africa's highest levels of unemployment were experienced in the early 2000s (see **Figure 9**). Looking at the national settlement-based employment rates between 2001 and 2011 with this in mind, unemployment decreased substantially between 2001 and 2011, from 30.7 % to 26.6 % over the ten-year period (**Table 43**, **Table 44** and **Figure 67**). National decreases in working-age settlement-based unemployment came with a 6.0 percentage point increase in average working-age settlement-based employment across all settlement types, from 32.0 % in 2001 to 38.0 % in 2011 (**Figure 67** and **Figure 68**). This wide-scale increase in employment and decrease in unemployment was witnessed across all settlement types between 2001 and 2011. While some of the largest relative changes in employment were experienced in traditional settlements and general government settlements, it should be noted that these were off a very small employment base in 2001 (**Figure 67** and **Figure 68**). Agricultural settlements, together with general government settlements and wholesale and retail trade settlements, were the only settlement types to experience net increases in the proportion of the NEA population (**Figure 68**).



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
Employed	41.9%	45.9%	42.3%	36.8%	43.4%	27.9%	48.0%	16.8%	38.0%
Unemployed	21.8%	24.7%	25.1%	25.8%	23.9%	28.2%	24.9%	31.2%	26.6%
NEA	36.3%	29.4%	32.7%	37.4%	32.7%	43.8%	27.1%	52.0%	35.4%

Figure 67: *Proportional share of settlement-based working-age population by employment status and settlement type, 2011*



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
Employed	3.5%	4.8%	5.1%	4.8%	3.8%	5.5%	5.4%	4.9%	6.0%
Unemployed	-4.2%	-4.5%	-4.7%	-5.2%	-1.5%	-5.6%	-4.4%	-2.5%	-4.2%
NEA	0.7%	-0.2%	-0.4%	0.3%	-2.3%	0.1%	-1.0%	-2.4%	-1.9%

Figure 68: *Change in the proportional share of settlement-based working-age population by employment status and settlement type, 2001–2011*

5.3.1.5 Using shifts in skill level/highest level of educational attainment to explore population movement and change

Educational attainment is an important socio-economic variable to monitor, given its links to labour-force outcomes. This section provides an analysis of shifts in the average educational attainment of the working-age settlement-based population from 2001 to 2011 in relation to the eight economically profiled settlement types. Settlement-based working-age population shifts between 2001 and 2011 were analysed across four skill levels, with the highest level of education attained variable being used as a proxy for skill (see **Section 4.5.3.1**):

- Unskilled: no schooling / Some primary schooling
- Basic-skilled: grade 7 / Some secondary schooling
- Semi-skilled: grade 12 / std 10 (NTC 3) / certificate / diploma (NTC 4–6)
- Highly skilled: bachelor's degree or higher.

This section presents only a high-level summary of the main results. **Figure 69** shows and compares the skill level of working-age population per settlement type for 2011, while **Figure 70** shows the changes, by percentage point, in the settlement-based working-age population by skill level and settlement type between 2001 and 2011. **Table 46**, **Table 47** and **Table 48** in **Appendix E** present the full set of detailed results, and further help to support this analysis.

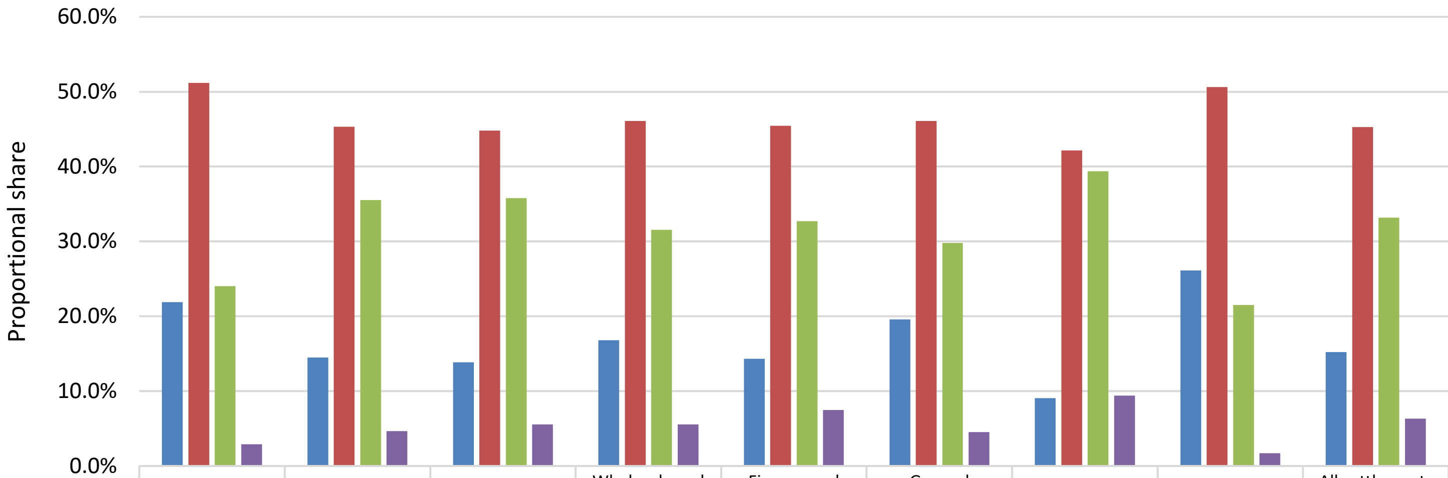
Figure 69 shows that, in 2011, the majority (45.3 %) of South Africa's settlement-based working-age population was basic-skilled, their highest level of educational attainment being grade 7 or some secondary education (up to grade 11). **Figure 69** also shows that traditional settlements, followed by agricultural settlements, had the highest proportions of unskilled population, with more than 20 % of the settlement-based working-age population in these settlement types being unskilled. General government settlements also had a proportionally large unskilled population at 19.6 %, and all three settlement types had a larger unskilled settlement-based working-age population than the national settlement-based average of 15.2 % in 2011 (**Figure 69** and **Table 47**).

The proportions of semi-skilled and highly skilled settlement-based working-age population varied significantly across the eight settlement types. The settlement types with the largest concentrations of semi-skilled and highly skilled working-age population were those with strong tertiary sectors, namely metropolitan settlements and finance and business services settlements (**Figure 69**). In mining and manufacturing settlements with strong secondary sector economies, the semi-skilled and highly skilled settlement-based working-age population also made up more than 35 % of the total, and accounted for larger proportions of the settlement-based working-age population than the national average. Traditional settlements and agricultural settlements, which had the highest levels of unskilled working-age population across all eight settlement types, were the settlement types with the lowest levels of semi-skilled and highly skilled workforce (**Figure 69**).

Considering changes between 2001 and 2011, specifically changes in national trends first, evidence of rising educational attainment and associated skill level of the settlement-based working-age population is apparent from **Figure 70**. Shifts in the 2011 educational attainment and skill level data relative to 2001 confirm an increase in the proportions of persons completing primary, secondary and tertiary education, as well as a decrease in the proportion of unskilled persons with without any formal education or with incomplete primary schooling. Between 2001 and 2011, the unskilled settlement-based working-age population decreased by -2.1 million people, from 26.9 % of the national population (6.8 million) in 2001 to 15.2 % (or 4.6 million) in 2011 (**Table 48, Figure 69** and **Figure 70**). While declines in the unskilled working-age population were seen across all eight settlement types, indicating a national trend, traditional settlements, which had the largest share of unskilled population in 2001 (3 million working-age people or 12.0 % of the national settlement-based working-age population) experienced the largest decline in unskilled population, both in absoluteand relative terms (**Table 48** and **Figure 70**). From the literature, this phenomenon may signify the successful implementation of policies such as compulsory education up to grade 9, the introduction of Adult Basic Education and Training (ABET) programmes for illiterate persons, no-fee schools, as well as the National Student Financial Aid Scheme (NSFAS) in an endeavour to address unequal access to higher education (Stats SA, 2011b).

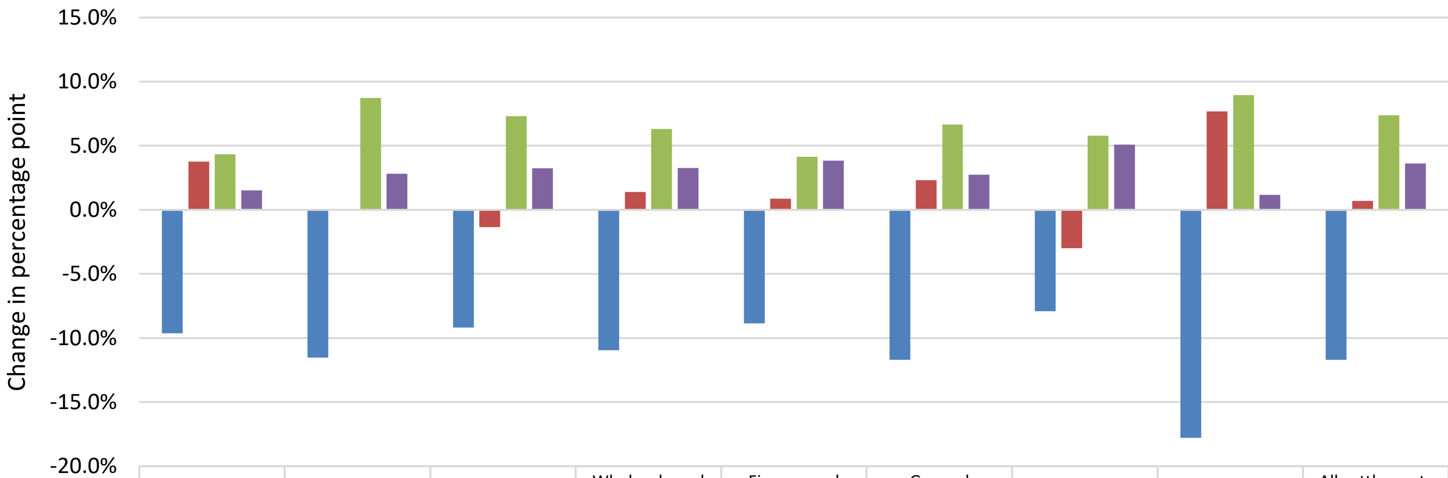
With the rising educational attainment and associated decline in unskilled settlement-based working-age population, the largest growth in skill was seen in the semi-skilled and highly skilled categories. Between 2001 and 2011, the national semi-skilled population grew by more than half, from 6.5 million in 2001 to over 10.1 million (growth of 55.3 %), while the highly skilled population more than doubled over the same ten-year period, from 2.7 % (680,000) of the national settlement-based working-age population in 2001 to 6.3 % (1.9 million) in 2011 (**Table 46**, **Table 47** and **Figure 69**).

Since traditional settlements saw the largest decline in unskilled working-age population, it comes as little surprise that they also saw some of the largest growth in basic-skilled and semi-skilled working-age persons (**Figure 69** and **Figure 70**). They also saw a large relative growth in highly skilled persons, although this growth came off a very small base in 2001. Mining settlements also saw substantial relative growth in semi-skilled and highly skilled working-age persons, far above the national average. Agricultural settlements saw the largest relative growth in basic-skilled working-age population. Metropolitan settlements saw the largest absolute growth in the semi-skilled and highly skilled working-age population (**Table 48**).



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
Unskilled	21.9%	14.5%	13.8%	16.8%	14.3%	19.6%	9.1%	26.1%	15.2%
Basic-skilled	51.2%	45.3%	44.8%	46.1%	45.5%	46.1%	42.1%	50.6%	45.3%
Semi-skilled	24.0%	35.5%	35.8%	31.5%	32.7%	29.8%	39.4%	21.5%	33.2%
Highly skilled	2.9%	4.7%	5.5%	5.6%	7.5%	4.5%	9.4%	1.7%	6.3%

Figure 69: *Proportional share of settlement-based working-age population by skill level and settlement type, 2011*



	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
Unskilled	-9.6%	-11.5%	-9.2%	-10.9%	-8.9%	-11.7%	-7.9%	-17.8%	-11.7%
Basic-skilled	3.8%	0.0%	-1.4%	1.4%	0.9%	2.3%	-3.0%	7.7%	0.7%
Semi-skilled	4.3%	8.7%	7.3%	6.3%	4.1%	6.6%	5.8%	8.9%	7.4%
Highly skilled	1.5%	2.8%	3.2%	3.3%	3.8%	2.7%	5.1%	1.2%	3.6%

Figure 70: *Change in the proportional share of settlement-based working-age population by skill level and settlement type, 2001–2011*

5.4 Measure and analyse the relationship between economic performance and population-change dynamics at settlement level in South Africa

The following section presents the research results for Objective 4 (Task 4.3 specifically), which aimed to measure and analyse the relationship between economic performance and population-change dynamics at settlement level between 2001 and 2011.

5.4.1 Linkages between economic performance and population change

In order to explore the relationship between economic performance and population change at settlement level, the results from **Section 5.2.2** and **Section 5.3.1** were revisited and collectively analysed. **Figure 71** shows a composite representation of the data presented in **Figure 59** and **Figure 62**, indicating the relative growth in settlement-based working-age population as well as total economic activity per settlement type between 2001 and 2011.

Figure 71 shows the fluctuating trend between economic and population growth per settlement type, with a distinct pattern emerging – working-age population growth tends to follow economic growth, lagging slightly behind. This is observed across all settlement types apart from mining settlements, where the average settlement-based economic growth between 2001 and 2011 exceeded the average settlement-based working-age population growth. Looking at the average for mining settlements, while working-age population growth was considerably higher (32.5 %) than the national settlement-based average between 2001 and 2011 (23.2 %), the average economic growth for mining settlements (13.5 %) was 24.8 percentage points below the national average (38.3 %) for the same period.

In agricultural settlements, finance and business service settlements and metropolitan settlements, economic growth outpaced the working-age population growth, and both economic and population growth exceeded the national average.

In manufacturing settlements, wholesale and retail trade settlements and general government settlements, while larger comparative economic growth than population growth was observed, the economic growth of these settlement types was lower than the national average.

Traditional settlements were the only settlement type where both the average economic growth and the population growth were below the national average for all settlements. Moreover, the disparity between the average settlement-based population growth in relation to the average economic growth was largest for this settlement type, with a 28.7 percentage point difference between the two (**Figure 71**).

	Agricultural settlements	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements	All settlements in analysis subset
Economic growth	40.5%	13.5%	38.3%	34.3%	47.0%	35.6%	45.7%	37.7%	38.3%
Population growth	37.9%	32.5%	30.5%	25.6%	41.5%	23.3%	27.9%	9.0%	23.2%

Figure 71: *Relative change in total settlement-based working-age population in comparison to relative change in economic output per settlement type, 2001–2011*

5.4.2 Bivariate correlation analysis results

A bivariate correlation analysis was performed to further analyse the relationship between settlement-level economic performance and population change outcomes. For the analysis, the change in a settlement's working-age population (dependent or response variable) was analysed as a function of its change in economic output, or Gross Value Added (GVA) (independent or predictor variable). Absolute change was measured in terms of both variables between 2001 and 2011. Spearman's correlation was used to measure the existence (statistical significance given by the *p*-value) and strength (relationship effect size given by the coefficient r_s) of the monotonic association between all the possible pairwise combinations of economic and population variables in the dataset (**Table 17**). In a monotonic relationship, the variables tend to change together, but not necessarily at a constant rate. The strength of the association between two variables is denoted by r_s being closer to either -1 or +1 (depending on the direction of the relationship). The closer the value of r_s to 0, the greater the variation around the line of best fit. See **Section 4.5.4** for more information on the correlation analysis methodology.

The correlation analysis was conducted for the range of national settlement types in this study, including traditional settlements and various types of economically profiled typologies. Firstly, settlements were distinguished based on their formal or traditional classification, and two separate correlations were conducted for these settlement types. Next, individual correlation analysis was undertaken for each of the eight economically profiled settlement types. For each settlement type, a bivariate correlation analysis was performed on each possible pairwise combination of economic and population variables in the dataset. The high-level results of the bivariate correlation analyses for total change in economic output (or GVA) (for SIC 1–4 and SIC 6–9) and total change in population (settlement-based working-age) are presented in **Table 28** for each settlement group. **Table 29** and **Table 30** show the expanded bivariate correlation analysis results for the correlation among a number of demographic variables in relation to the total settlement-level change in economic output.

Table 28 shows the association between the change in settlement-level total economic output and working-age population between 2001 and 2011. Positively correlated, statistically significant correlations (p-value < 0.01) were observed between total change in economic output and total change in working-age population for all settlement types, although the strength of the association varied considerably across the different settlement types. None of the settlement types exhibited a very strong relationship ($r_s \geq 0.70$) between the two variables, but several settlement types did indicate a moderate to moderately strong association. Metropolitan settlements and general government settlements were found to have moderately strong associations ($0.40 \leq r_s \leq 0.49$) between total change in economic output and total change in working-age population, while agricultural settlements, wholesale and retail trade settlements, and finance and business settlements were found to have moderate associations ($0.30 \leq r_s \leq 0.39$) between the two variables. By comparison, the association between total change in economic output and total change in working-age population for mining settlements, manufacturing settlements and traditional settlements was weak to negligible ($0.10 \leq r_s \leq 0.29$).

Table 28: Association between settlement-level changes in total working-age population analysed as a function of the change in total economic output (GVA) between 2001 and 2011 per settlement type (Spearman's r_s and R^2 values)

Settlement type	r_s	R^2
All settlements in analysis subset	0.214**	0.046
Formal settlements	0.330**	0.109
Agricultural settlements	0.374**	0.140
Mining settlements	0.294**	0.086
Manufacturing settlements	0.180**	0.032
Wholesale and retail trade settlements	0.324**	0.105
Finance and business service settlements	0.392**	0.154
General government settlements	0.438**	0.192
Metropolitan settlements	0.468**	0.219
Traditional settlements	0.135**	0.018

**Correlation is significant at the 0.01 level (2-tailed)

At national level, jointly observing all settlements in the analysis subset, regardless of settlement-type classification, the association between change in economic output and the observed change in total working-age population between 2001 and 2011 was weak at best (r_s = 0.214). The R-squared (R^2) metric indicated that for all settlements nationally, only 4.6 % of the change observed in the working-age population across settlements could be explained by the change in economic output of the settlements (**Table 28**).

When formal settlements were analysed collectively (i.e., by removing traditional settlements from the analysis), the correlation coefficient increased to r_s = 0.330, indicating a moderate association between economic change and population change in formal settlements. The R-squared (R^2) metric of 0.109 implied that across all formal settlements, change in total economic output between 2001 and 2011 was able to explain 10.9 % of the working-age population change experienced (**Table 28**).

Conversely, looking only at traditional settlements, a positive statistically significant correlation was found (p-value < 0.01), but the strength of the association between economic change and population change was negligible (r_s = 0.135, R^2 = 0.018). This meant that only 1.8 % of the settlement-level change in the working-age population between 2001 and 2011 could be explained by change in the economic output of the settlements (**Table 28**).

Table 29: *Correlation matrix indicating association between settlement-level changes in demographic variables analysed as a function of the change in total economic output (GVA) between 2001 and 2011 per settlement type (Spearman's r_s values)*

Spearman's correlation coefficient (r_s)	All settlements in analysis subset	Formal settlements	Agricultural settlement	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements
Demographic variables	**Change in total GVA (SIC 1–4 and SIC 6–9)**									
Total working-age population	**0.214****	**0.330****	**0.374****	**0.294****	**0.180****	**0.324****	**0.392****	**0.438****	**0.468****	**0.135****
Change in 15–24-year-old population	0.160**	0.305**	0.348**	0.255**	0.195**	0.259**	0.323**	0.327**	0.468**	0.064**
Change in 25–34-year-old population	0.222**	0.311**	0.365**	0.326**	0.165**	0.291**	0.355**	0.361**	0.480**	0.161**
Change in 35–64-year-old population	0.232**	0.325**	0.381**	0.255**	0.167**	0.331**	0.419**	0.411**	0.431**	0.164**
Change in working-age male population	0.242**	0.343**	0.381**	0.332**	0.188**	0.331**	0.377**	0.420**	0.486**	0.174**
Change in working-age female population	0.187**	0.314**	0.363**	0.188*	0.191**	0.310**	0.410**	0.453**	0.441**	0.097**
Change in working-age employed population	0.248**	0.336**	0.406**	0.275**	0.212**	0.326**	0.339**	0.364**	0.510**	0.196**
Change in working-age unemployed population	0.051**	0.171**	-0.036	0.161	0.173**	0.057	0.350**	0.127	0.283**	-0.027
Change in working-age NEA population	0.179**	0.280**	0.352**	0.218*	0.144*	0.316**	0.360**	0.373**	0.357**	0.095**
Change in working-age unskilled population	-0.184**	-0.097**	0.116	0.143	-0.077	-0.204**	-0.113	-0.199*	-0.273**	-0.237**
Change in working-age basic-skilled population	0.219**	0.226**	0.284*	0.225*	0.046	0.253**	0.312**	0.384**	0.386**	0.188**
Change in working-age semi-skilled population	0.295**	0.317**	0.326**	0.228*	0.178**	0.352**	0.354**	0.375**	0.446**	0.267**
Change in working-age highly skilled population	0.346**	0.407**	0.364**	0.145	0.314**	0.458**	0.547**	0.519**	0.454**	0.295**
N	***5649***	***1132***	***81***	***126***	***256***	**316**	**108**	***147***	***98***	***4517***

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table 30: *Association between settlement-level changes in demographic variables analysed as a function of the change in total economic output (GVA) between 2001 and 2011 per settlement type (R^2 values)*

Coefficient of determination (R^2)	All settlements in analysis subset	Formal settlements	Agricultural settlement	Mining settlements	Manufacturing settlements	Wholesale and retail trade settlements	Finance and business service settlements	General government settlements	Metropolitan settlements	Traditional settlements
Demographic variables	**Change in total GVA (SIC 1–4 and SIC 6–9)**									
Total working-age population	**0.046**	**0.109**	**0.140**	**0.086**	**0.032**	**0.105**	**0.154**	**0.192**	**0.219**	**0.018**
Change in 15–24-year-old population	0.026	0.093	0.121	0.065	0.038	0.067	0.104	0.107	0.219	0.004
Change in 25–34-year-old population	0.049	0.097	0.133	0.106	0.027	0.085	0.126	0.130	0.230	0.026
Change in 35–64-year-old population	0.054	0.106	0.145	0.065	0.028	0.110	0.176	0.169	0.186	0.027
Change in working-age male population	0.059	0.118	0.145	0.110	0.035	0.110	0.142	0.176	0.236	0.030
Change in working-age female population	0.035	0.099	0.132	0.035	0.036	0.096	0.168	0.205	0.194	0.009
Change in working-age employed population	0.062	0.113	0.165	0.076	0.045	0.106	0.115	0.132	0.260	0.038
Change in working-age unemployed population	0.003	0.029	0.001	0.026	0.030	0.003	0.123	0.016	0.080	0.001
Change in working-age NEA population	0.032	0.078	0.124	0.048	0.021	0.100	0.130	0.139	0.127	0.009
Change in working-age unskilled population	0.034	0.009	0.013	0.020	0.006	0.042	0.013	0.040	0.075	0.056
Change in working-age basic-skilled population	0.048	0.051	0.081	0.051	0.002	0.064	0.097	0.147	0.149	0.035
Change in working-age semi-skilled population	0.087	0.100	0.106	0.052	0.032	0.124	0.125	0.141	0.199	0.071
Change in working-age highly skilled population	0.120	0.166	0.132	0.021	0.099	0.210	0.299	0.269	0.206	0.087
N	***5649***	***1132***	***81***	***126***	***256***	**316**	**108**	***147***	***98***	***4517***

5.4.2.1 Agricultural settlements with significant general government

Looking first at the association between total working-age population change as a function of the settlement-level change in total economic output in agricultural settlements, the Spearman's correlation coefficient r_s in **Table 28** shows a moderate positively correlated relationship ($r_s = 0.374$) between the two variables. The R-squared (R^2) metric of 0.140 implies that the total economic growth in output explained 14.0 % of the growth in the working-age population in agricultural settlements between 2001 and 2011.

The scatter plot illustrated in **Figure 72** shows the absolute change in total economic output in relation to the absolute change in total working-age population between 2001 and 2011 for the 81 identified agricultural settlements in South Africa. Each dot on the scatter plot represents an individual settlement and indicates the province in which the settlement is located. **Figure 73** maps agricultural settlements in South Africa together with the spatial patterns of economic change and population change.

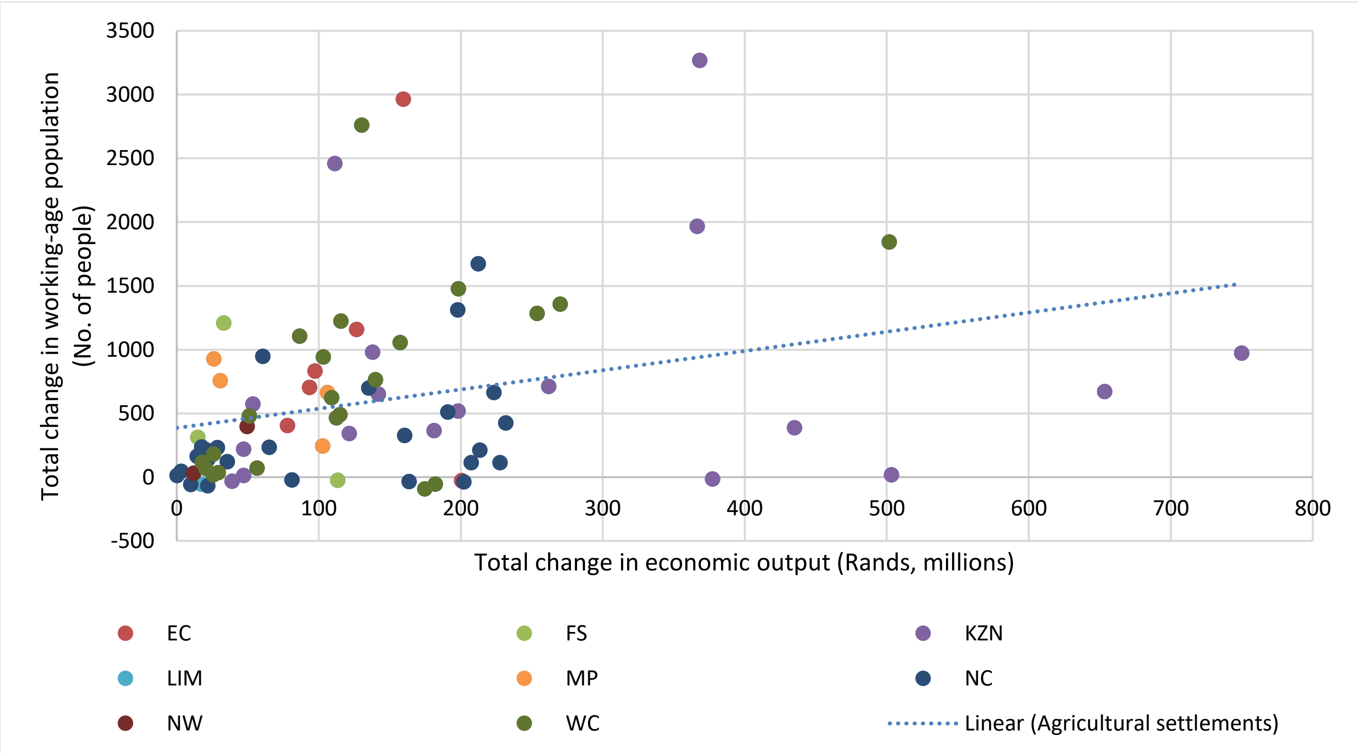


Figure 72: *Scatter plot of absolute change in total economic output compared with absolute change in total working-age population for all agricultural settlements between 2001 and 2011*

Figure 72 and **Figure 73** show that agricultural settlements in KwaZulu-Natal experienced the most growth in economic output between 2001 and 2011, compared to agricultural settlements in other provinces. **Figure 72**, supported by **Figure 73**, also shows that while economic growth was associated with varying degrees of population growth for the vast majority of agricultural settlements across the country, and especially for settlements in the Western Cape, a handful of settlements, especially in KwaZulu-Natal and the Northern Cape, experienced economic growth with little population change. Some settlements in these provinces even experienced stagnation and decline in their total working-age population over the ten-year period between 2001 and 2011.

Table 29 and **Table 30** set out the association between population changes among a range of demographic variables as a function of settlement-level change in total economic output per settlement type. For agricultural settlements, looking at the correlation between change in economic output, and population change broken down according to the three age brackets, there was a slightly stronger association between the population growth in the 35–64-year-old working-age bracket than for the working-age youth of 15–24 and 25–34-year-olds in relation to settlement-level economic change. When gender was included, for agricultural settlements, there was a slightly higher association between changes in working-age males (r_s = 0.381, R^2 = 0.145) than females (r_s = 0.363, R^2 = 0.132) when correlated with the change in settlement-level economic output.

Of all the demographic variables, the highest bivariate correlations between the economy and population were found between growth in the working-age employed population and growth in the working-age highly skilled population. The Spearman's correlation coefficients revealed a moderately strong association between changes in the working-age employed population and economic output (r_s = 0.406, R^2 = 0.165), and a moderate association between the changes in working-age highly skilled population and economic output (r_s = 0.364, R^2 = 0.132) (**Table 29** and **Table 30**).

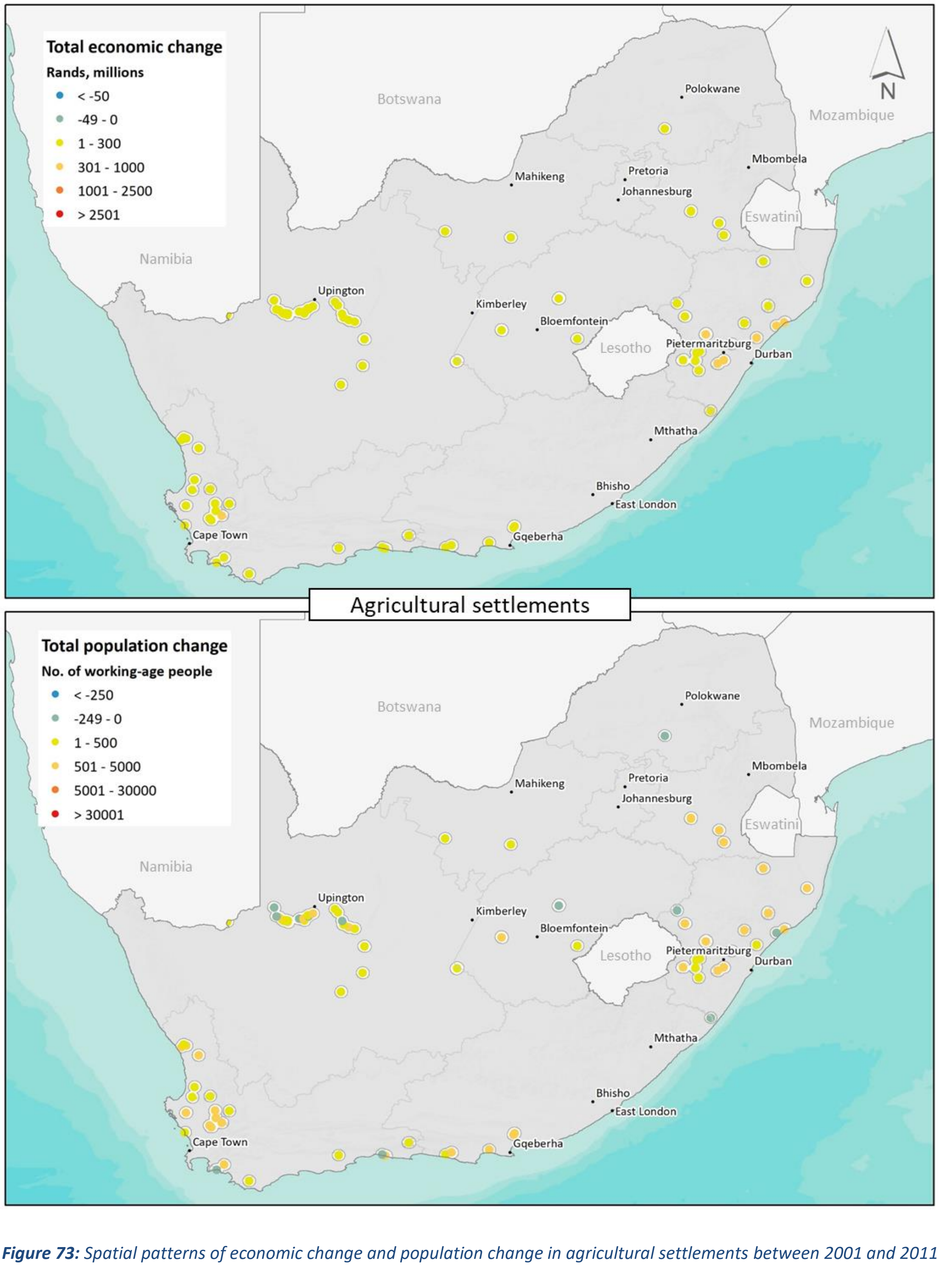


__Figure 73:__ Spatial patterns of economic change and population change in agricultural settlements between 2001 and 2011

5.4.2.2 *Mining settlements*

A positive but weak association (r_s = 0.294) between change in total economic output and change in the total working-age population was found for mining settlements (**Table 28**). The R-squared (R^2) metric of 0.086 implies that total economic change explained only 8.6 % of the absolute patterned change experienced in the working-age population of mining settlements between 2001 and 2011.

The scatter plot in **Figure 74** shows total economic change and total working-age population change for mining settlements between 2001 and 2011. Each dot represents one of the 126 mining settlements analysed in this study, and graphs each settlement's absolute economic change against its absolute working-age population change over the ten-year period, as well as indicating the province in which the settlement is located. **Figure 75** maps mining settlements in South Africa together with the spatial patterns of economic change and population change.

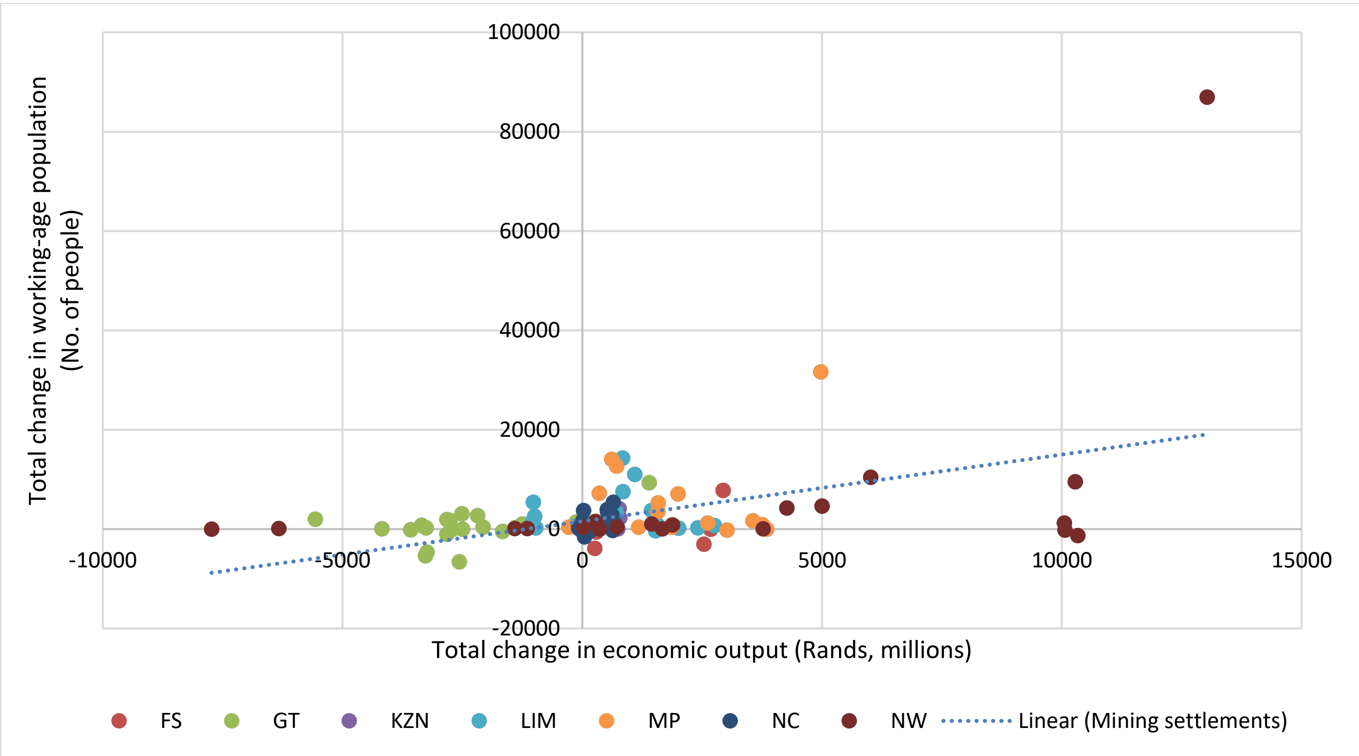


***Figure 74:** Scatter plot of absolute change in total economic output compared with absolute change in total working-age population for all mining settlements between 2001 and 2011*

From **Figure 74** and **Figure 75**, it is clear that there was considerable volatility in the economic performance of mining settlements between 2001 and 2011, perhaps resulting from the national mining sector downturn experienced during that period, although many mining settlements in Mpumalanga, North West and the Free State experienced economic growth over the decade. **Figure 74** and **Figure 75** show that economic growth (or decline) in mining settlements is not automatically associated with population growth (or decline), a sentiment echoed by the weak correlation coefficient for mining settlements. In mining settlements experiencing economic stagnation and decline, many of which were located in the West Rand area of Gauteng, the City of Matlosana region of North West, the Ba-

Phalaborwa region of Limpopo, and the Namakwa region of the Northern Cape, the downturn in economic production was not necessarily associated with a perceptible decline in the working-age population. In the vast majority of mining settlements, settlement-level economic decline was even associated with varying degrees of population growth. Only a handful of mining settlements experienced both economic decline and population decline. These were mostly located on the West Rand of Gauteng, although this trend cannot be generalised for all settlements located in this area. For other well-established mining settlements such as eMhalahleni, Rustenburg, Marikana and Steelpoort, varying degrees of economic growth were associated with varying degrees of population growth.

While the correlation between the total change in economic output and working-age population was found to be weak for mining settlements ($r_s = 0.294$, $R^2 = 0.086$), this correlation increased substantially when specific demographic variables were considered (**Table 29** and **Table 30**), and moderate degrees of correlation were observed, especially in relation to age and gender.

For mining settlements, when the total working-age population was segmented by age, population changes in the 25–34-year-olds (upper youth, employment seekers) exhibited the largest correlation of all the age brackets with change in total economic output. The Spearman's correlation coefficient r_s in **Table 29** shows a moderate positively correlated relationship ($r_s = 0.326$) between settlement-level changes in the 25–34-year-old population and the total economic output from mining settlements. Correlations between economic change and changes in the other age brackets were much weaker (**Table 29**). The R-squared (R^2) metric of 0.106 implies that the total growth in economic output was able to explain 10.6 % of the population growth in the 25–34-year-old age bracket between 2001 and 2011 (**Table 30**), a 2.0 percentage point increase over the association when the total working-age population was considered.

A similar trend was observed when the total working-age population was segmented by gender. In mining settlements, it was found that settlement-level changes in the working-age male population were significantly more correlated to changes in economic output ($r_s = 0.332$, $R^2 = 0.110$) than correlations between the working-age female population and the economy ($r_s = 0.188$, $R^2 = 0.035$), which were found to be weak (**Table 29** and **Table 30**). Thus, in mining settlements, the settlement-level population changes among 25–34-year-old males were found to be more closely associated with the economy than population changes exhibited in other age groups or in relation to gender. In particular, the settlement-level changes in the economic output of mining settlements were found to explain more than 10 % of population change among 25–34-year-old males, constituting the most notable observation for mining settlements.

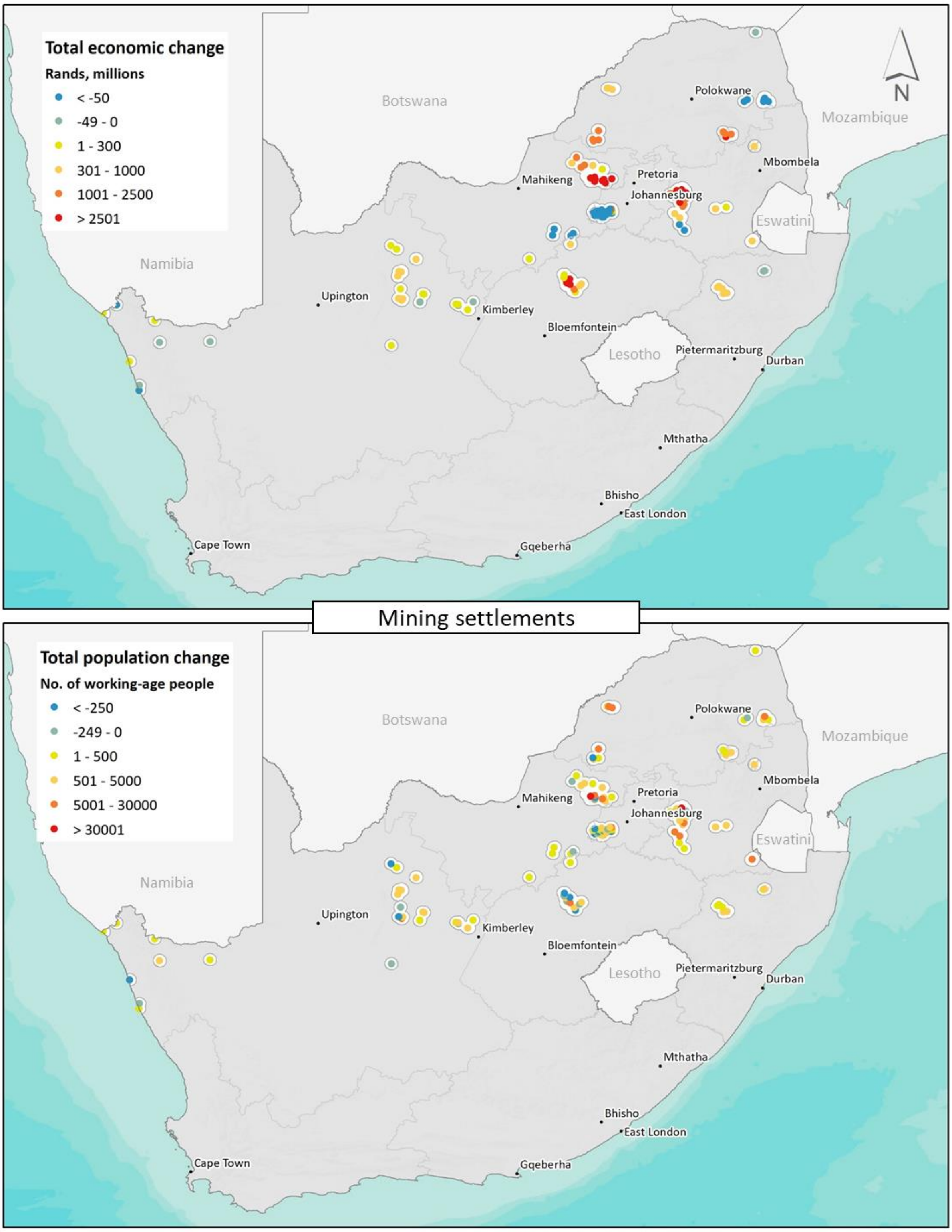


Figure 75: Spatial patterns of economic change and population change in mining settlements between 2001 and 2011

5.4.2.3 Manufacturing settlements with significant general government

Of all settlement types, manufacturing settlements had the second-lowest association between change in total economic output and change in the total working-age population. The Spearman's correlation coefficient of r_s = 0.180 indicated a negligible association between the two variables. The R-squared metric of 0.032 implies that only 3.2 % of the change between total economic growth output and change in working-age population in manufacturing settlements between 2001 and 2011 could be explained by the linear model.

The scatter plot illustrated in **Figure 76** shows the absolute change in total economic output against the absolute change in total working-age population between 2001 and 2011 for the 256 manufacturing settlements classified and analysed in this study. Each dot on the scatter plot represents an individual settlement and also indicates the province in which the settlement is located. **Figure 77** maps manufacturing settlements in South Africa together with the spatial patterns of economic change and population change.

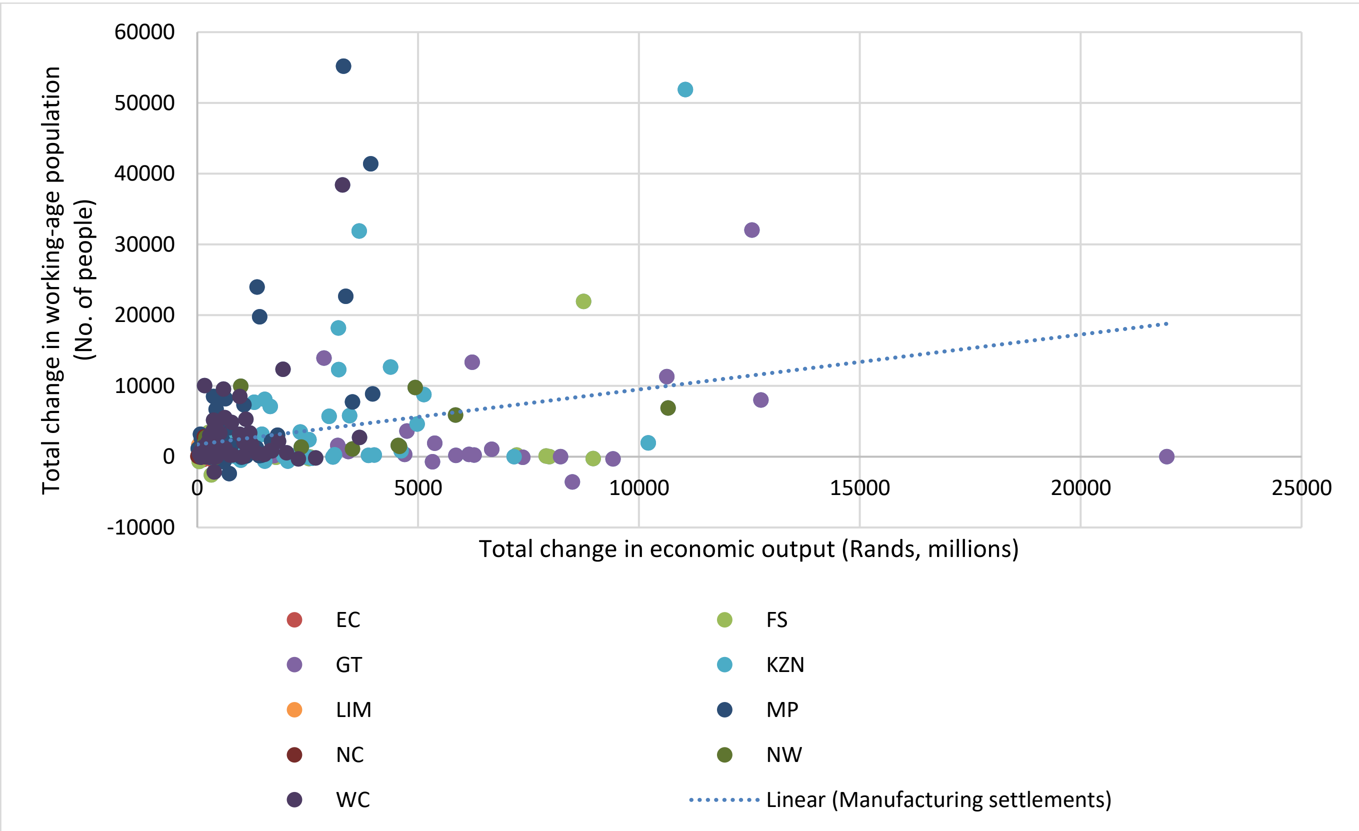


Figure 76: *Scatter plot of absolute change in total economic output compared with absolute change in total working-age population for all manufacturing settlements between 2001 and 2011*

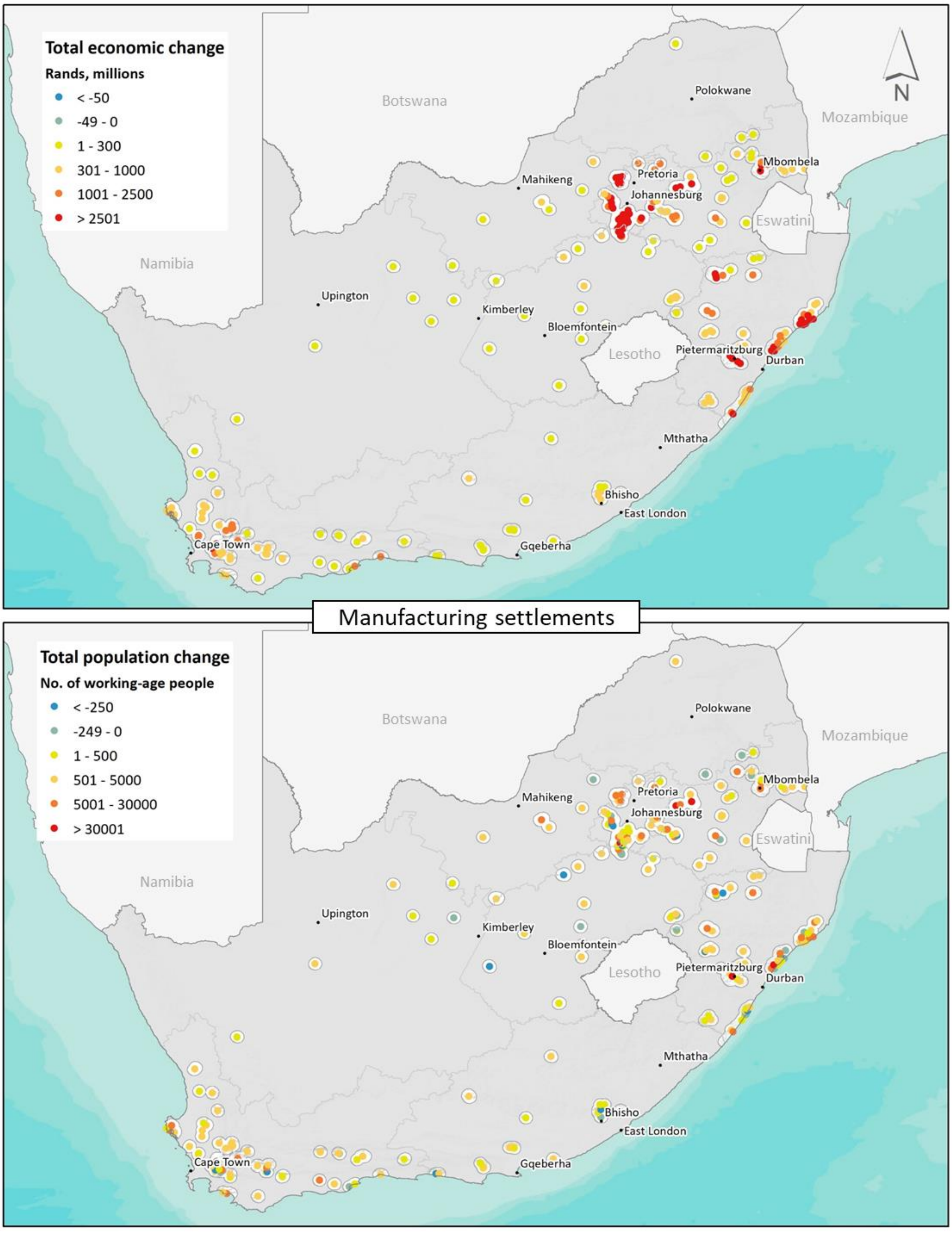


Figure 77: Spatial patterns of economic change and population change in manufacturing settlements between 2001 and 2011

Figure 76 and **Figure 77** show that for a number of manufacturing settlements in Gauteng, large economic growth was not associated with population growth of equal proportion. These settlements tended to be located on the outskirts of the large metropolitans around the periphery of the province. Conversely, for a number of manufacturing settlements in Mpumalanga, large growth in their total working-age population was experienced without corresponding economic growth. These contradictory dynamics resulted in a negligible association between change in economic output and working-age population in manufacturing settlements.

For manufacturing settlements, the only noteworthy observation from **Table 29** and **Table 30** was the relationship between change in the working-age highly skilled population and change in economic output, although the Spearman's correlation coefficient revealed only a weak, but bordering on moderate, association (r_s = 0. 314, R^2 = 0.099). Across all demographic variables, the association between economic change as a function of population change in manufacturing settlements was thus found to be weak to negligible.

5.4.2.4 Wholesale and retail trade settlements

From **Table 28**, **Table 29** and **Table 30**, it is evident that settlement types with larger footholds in the tertiary sector economy experience stronger associations between their economic performance and population change. Looking at the association between settlement-level change in the total working-age population as a function of settlement-level change in total economic output in wholesale and retail trade settlements with significant general government, the Spearman's correlation coefficient r_s in **Table 28** shows a moderate positively correlated relationship (r_s = 0.324) between the two variables. The R-squared (R^2) metric of 0.105 implies that the total economic growth in output explained 10.5 % of the total working-age population growth in these settlements between 2001 and 2011.

Figure 78 is a scatter plot showing total economic change and total working-age population change for wholesale and retail trade settlements between 2001 and 2011. Each dot represents one of the 316 classified settlements, and graphs each settlement's absolute economic change against its absolute working-age population change over the ten-year analysis period, as well as indicating the province in which the settlement is located. **Figure 79** maps wholesale and retail trade settlements in South Africa together with the spatial patterns of economic change and population change.

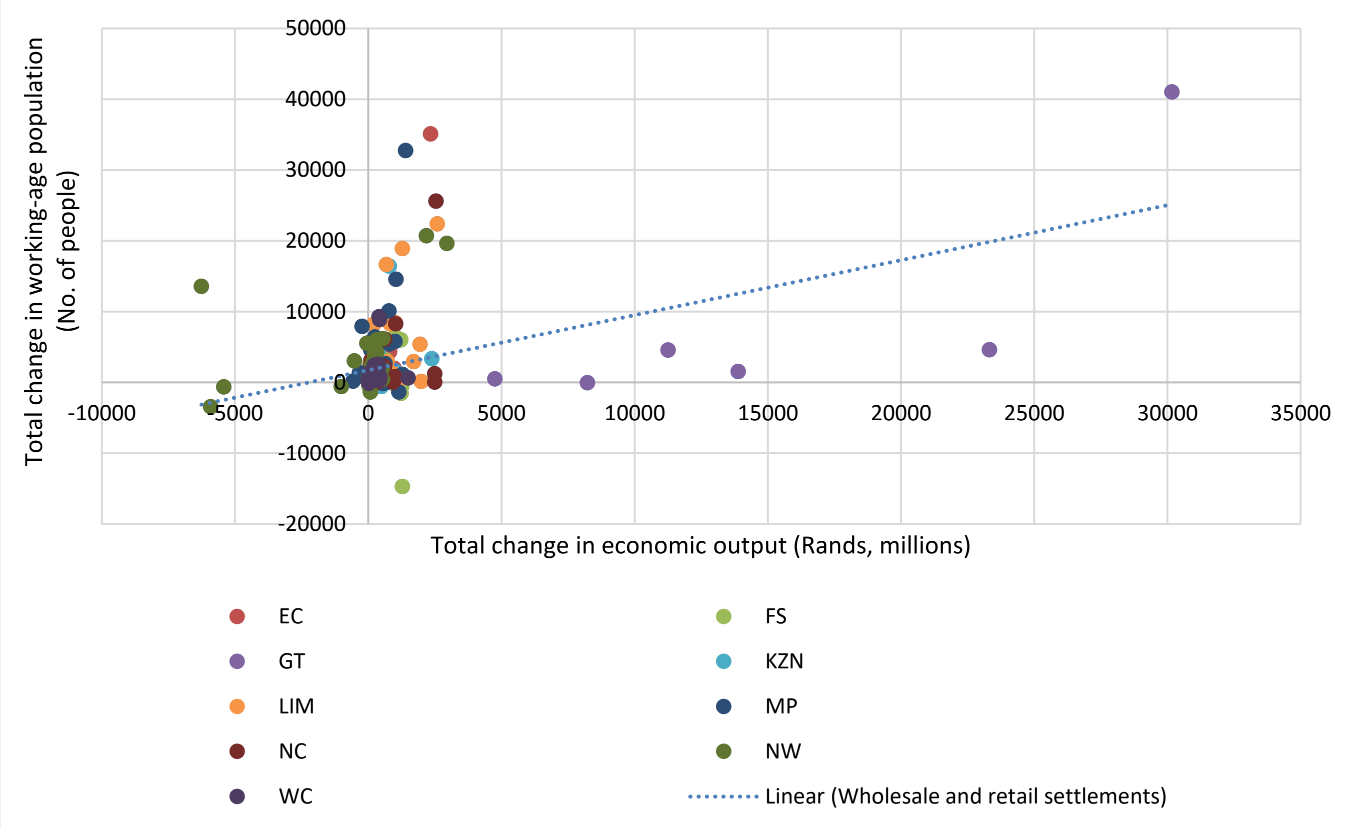


Figure 78: *Scatter plot of absolute change in total economic output in relation to absolute change in total working-age population for all wholesale and retail trade settlements between 2001 and 2011*

There were substantial increases and decreases in correlations between specific demographic variables and the economy, especially in relation to age and skill level (**Table 29** and **Table 30**). For wholesale and retail settlements, when the total working-age population was segmented by age, population changes in the 35–64-year-old age bracket (working-age adults) exhibited the largest correlation with change in total economic output of all age brackets. The Spearman's correlation coefficient r_s in **Table 29** shows a similar moderate positively correlated relationship (r_s = 0.331, R^2 = 0.110) between settlement-level changes in the population of 35–64-year-olds and the total economic output of mining settlements, compared with the total working-age population. Correlations with the other age-bracket categories were much weaker (**Table 29**), indicating a weaker association between the population changes seen in the working-age youth categories and economic trends in the settlements (**Table 29** and **Table 30**). When the total working-age population was segmented by gender, the correlations were very similar, although slightly higher among men (r_s = 0.331, R^2 = 0.110) than women (r_s = 0.310, R^2 = 0.096) (**Table 29** and **Table 30**), indicating moderate positively correlated relationships regardless of gender.

Of all demographic variables, the strongest correlation observed between the economy and population for wholesale and retail trade settlements was between economic output and the growth in the working-age highly skilled population, where the Spearman's correlation coefficient revealed a moderately strong association between the two indices (r_s = 0.458, R^2 = 0.210) (**Table 29** and **Table 30**). The R-squared (R^2) metric of 0.210 indicates that the total economic growth in wholesale and retail settlements explained 21.0 % of the settlement-based growth patterns seen in the working-age highly skilled population.

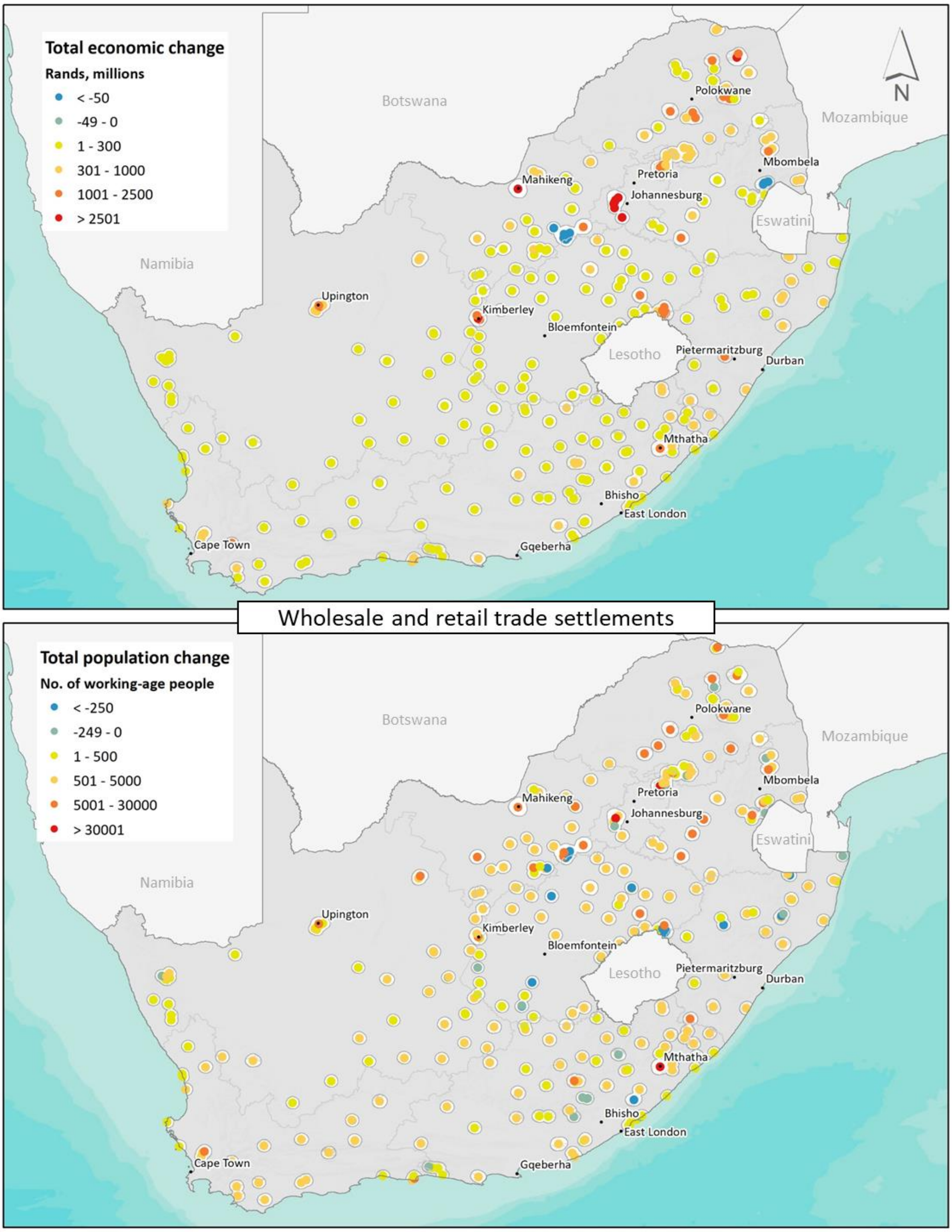


Figure 79: *Spatial patterns of economic change and population change in wholesale and retail trade settlements between 2001 and 2011*

5.4.2.5 *Finance and business service settlements*

In finance and business service settlements, the Spearman's correlation coefficient of $r_s = 0.392$ indicated a moderate positively correlated relationship between changes in total economic output and total working-age population between 2001 and 2011. The R-squared (R^2) metric of 0.154 implies that total economic growth explained 15.4 % of the settlement-based patterns seen in working-age population growth (**Table 28**).

Figure 80 shows the distribution of settlements on a scatter plot graph where each of the 108 finance and business service settlements is plotted by a dot, according to their absolute change in total economic output against absolute change in the total working-age population between 2001 and 2011. **Figure 81** maps finance and business service settlements in South Africa together with the spatial patterns of economic change and population change between 2001 and 2011. **Figure 80** and **Figure 81** show that settlements that experienced large economic growth between 2001 and 2011 also tended to experience larger population growth.

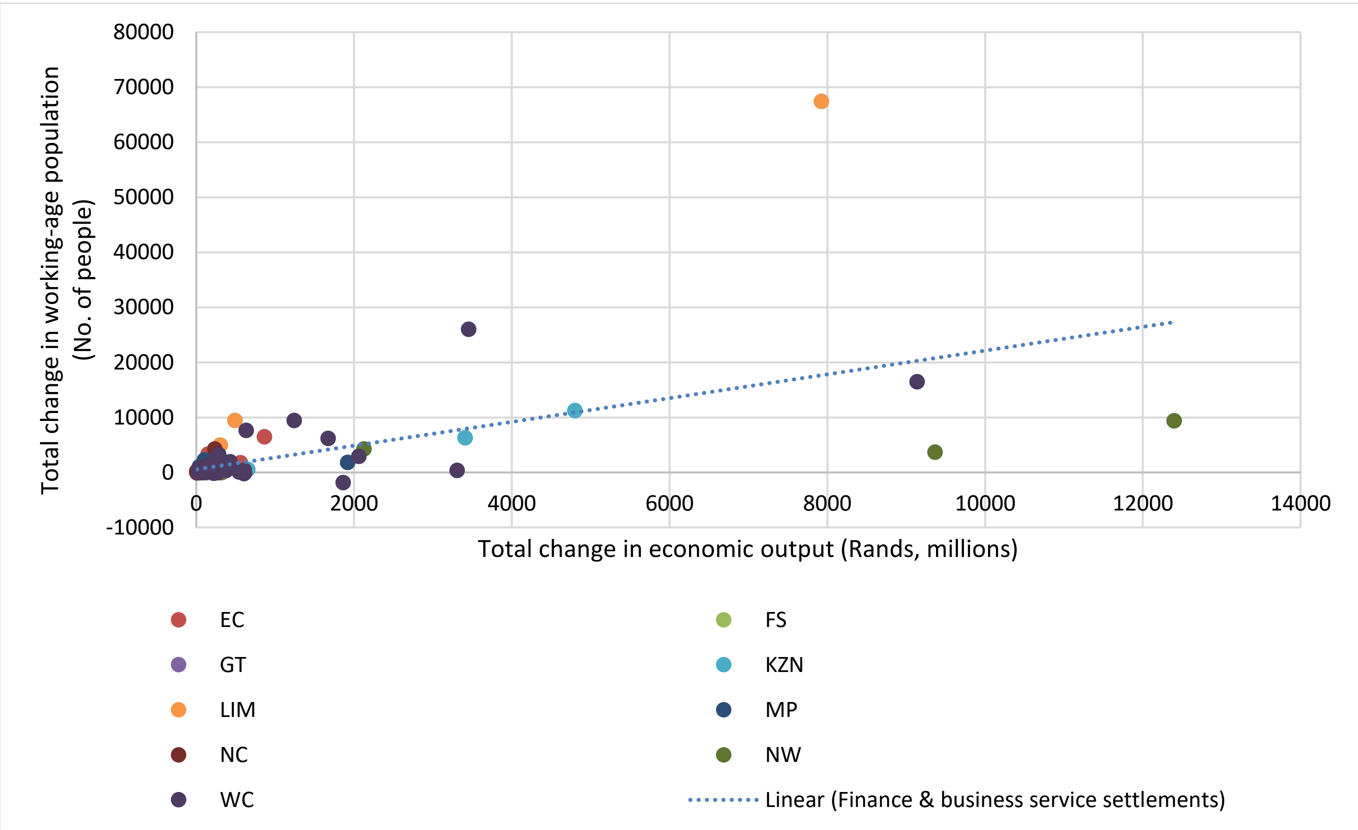


Figure 80: *Scatter plot of absolute change in total economic output in relation to absolute change in total working-age population for all finance and business service settlement between 2001 and 2011*

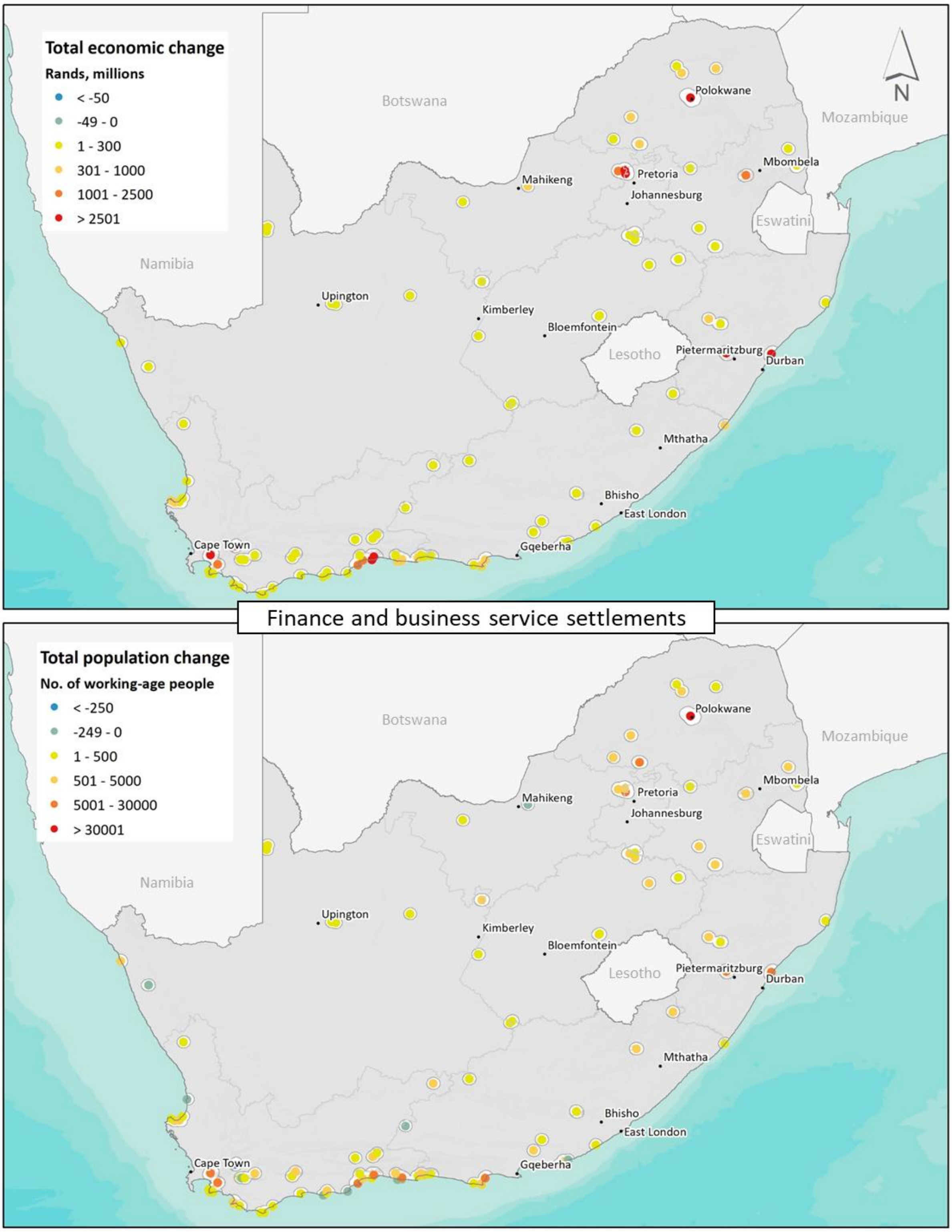


Figure 81: Spatial patterns of economic change and population change in finance and business service between 2001 and 2011

Interesting observations emerged when the working-age population variable was segmented based on age bracket, gender, skill level and employment status (**Table 29** and **Table 30**). When settlement-based population changes in the 35–64-year-old age bracket were correlated against settlement-level change in economic output, the strength of the relationship between change in the economy and the population increased from a moderate association to a moderately strong association (r_s = 0.419, R^2 = 0.176). Correlations with the other age-specific demographic variables in **Table 29** were comparatively far weaker.

In finance and business service settlements, unlike agricultural settlements, mining settlements and wholesale and retail settlements, when the working-age population variable was segmented by gender and correlated with total economic output, population changes among working-age females were found to have a slightly higher correlation with changes in the economy than population changes among working-age males (**Table 29** and **Table 30**).

Of all demographic variables, the highest correlations between the economy and population were related to growth in the working-age highly skilled population. Spearman's correlation coefficients revealed a strong association between changes in the working-age employed population and economic output in finance and business service settlements (r_s = 0.547, R^2 = 0.229) (**Table 29** and **Table 30**).

5.4.2.6 General government settlements

General government settlements were one of only two settlement types to exhibit a moderate to strong association between changes in total working-age population and changing economic output. Based on Spearman's correlation coefficient, there was a significant moderately strong positive relationship (r_s = 0.438) between the total working-age population change and total economic change in general government settlements between 2001 and 2011. The R-squared (R^2) metric of 0.192 implies that total economic change over the ten-year period from 2001 to 2011 explained 19.2 % of the absolute patterned change observed in the working-age population over the same reference period (**Table 28**).

Figure 82 shows the distribution of settlements on a scatter plot graph where each of the 148 general government settlements is plotted by a dot, according to their absolute change in total economic output in relation to absolute change in total working-age population between 2001 and 2011. **Figure 83** maps general government settlements in South Africa together with the spatial patterns of economic change and population change between 2001 and 2011. **Figure 82** and **Figure 83** show that settlements that experienced large economic growth between 2001 and 2011 also tended to experience larger population growth, especially in several settlements in Limpopo, Mpumalanga and the Eastern Cape. **Figure 82** and **Figure 83** also show a number of settlements in KwaZulu-Natal, North West and the Eastern Cape that experienced decline in the working-age population. These settlements were generally not associated with large economic growth.

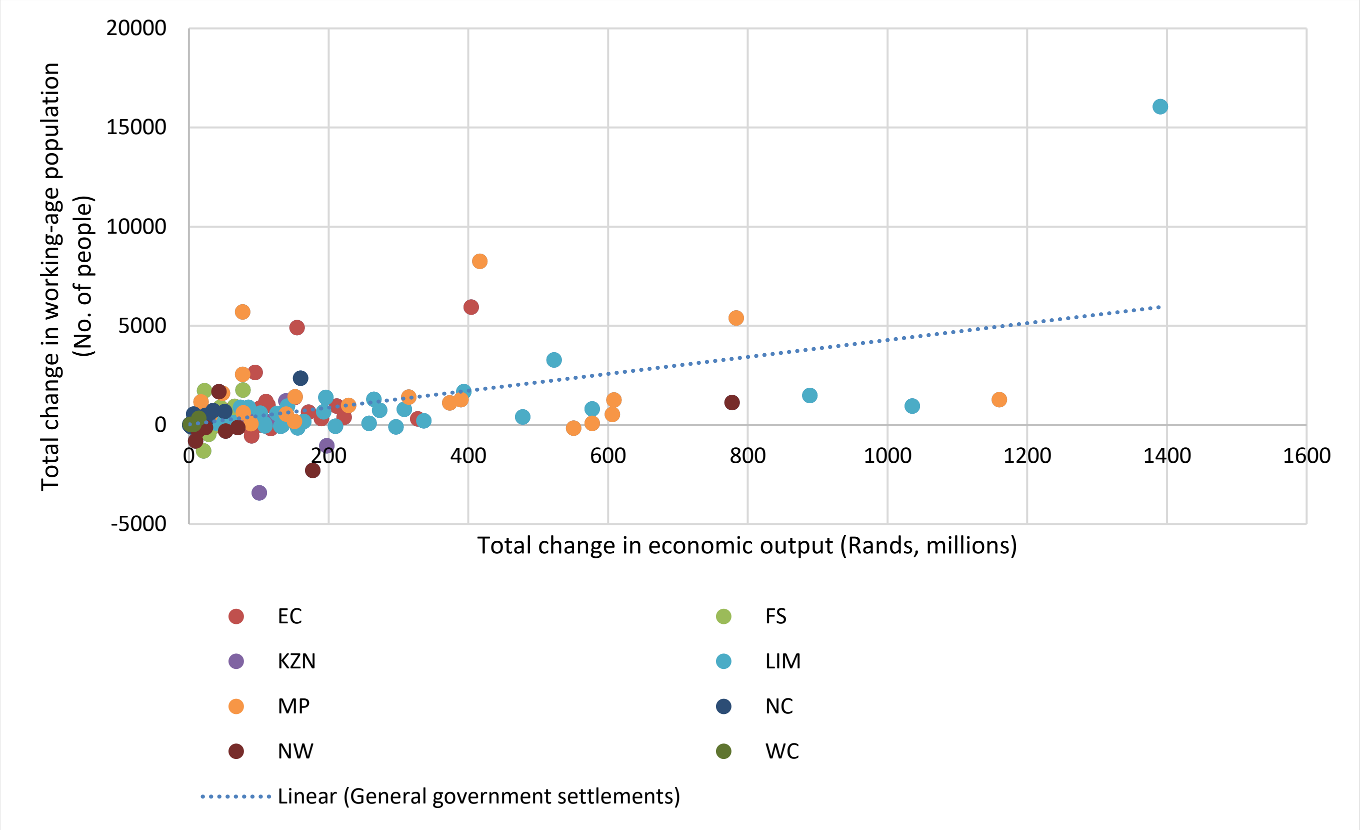


***Figure 82:** Scatter plot of absolute change in total economic output in relation to absolute change in total working-age population for all general government settlements between 2001 and 2011*

Table 29 and **Table 30** set out the association between population change and a range of demographic variables in relation to change in total economic output per settlement type. For general government settlements, looking at the correlation between change in economic output and change in the working-age population for three age brackets, there was a slightly stronger association in relation to the 35–64-year-old working-age adults age bracket than for the working-age youth brackets of 15–24 and 25–34-year-olds.

In general government settlements, when comparing the correlation between change in settlement-level economic output and the working-age population segmented by gender, there was a higher association for working-age females (r_s = 0.453, R^2 = 0.205) than males (r_s = 0.420, R^2 = 0.176). The only other settlement type to exhibit this trend was finance and business service settlements (**Table 29** and **Table 30**).

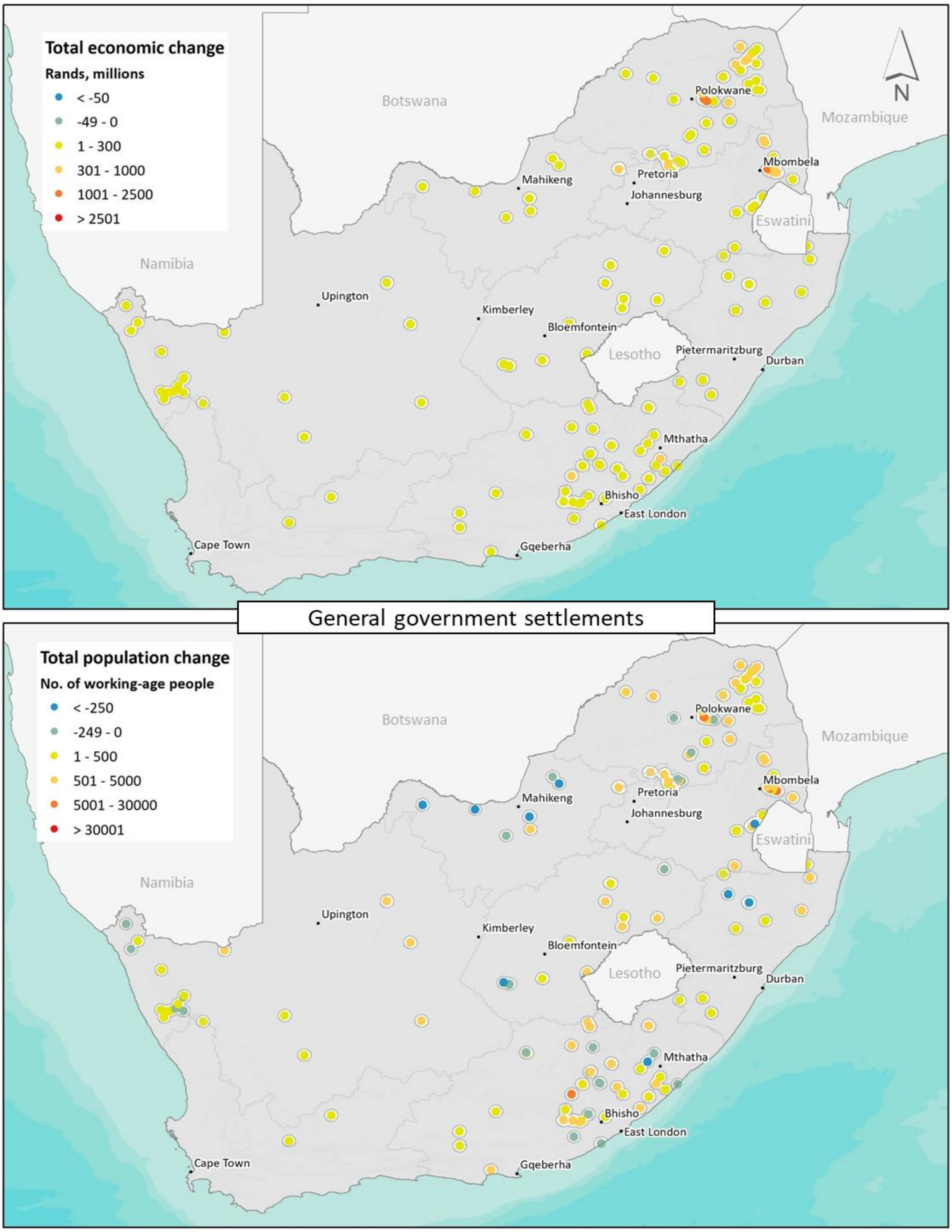


__Figure 83:__ Spatial patterns of economic change and population change in general government settlements between 2001 and 2011

5.4.2.7 *Metropolitan settlements*

Of all settlement types, metropolitan settlements (i.e., formal settlements located within metropolitan municipalities) exhibited the strongest association between economic growth and population growth. Looking at settlement-level changes in the total working-age population as a function of change in total economic output over the period 2001 to 2011, the Spearman's correlation coefficient of r_s = 0.468 for metropolitan settlements indicates a significant positive and moderately strong correlated association. Furthermore, metropolitan settlements were the only settlement type where the association between settlement-level changes in the economy and population explained more than 20 % of the data variability observed over the reference period between 2001 and 2011, as given by the R-squared (R^2) metric of 0.219. These results are set out in **Table 28**.

Figure 84 shows the distribution of settlements on a scatter plot graph where each of the 98 metropolitan settlements is plotted by a dot, according to their absolute change in total economic output in relation to absolute change in the total working-age population between 2001 and 2011. **Figure 85** maps metropolitan settlements in South Africa together with the spatial patterns of economic change and population change between 2001 and 2011. **Figure 84** and **Figure 85** show that settlements that experienced large economic growth between 2001 and 2011 also tended to experience larger population growth.

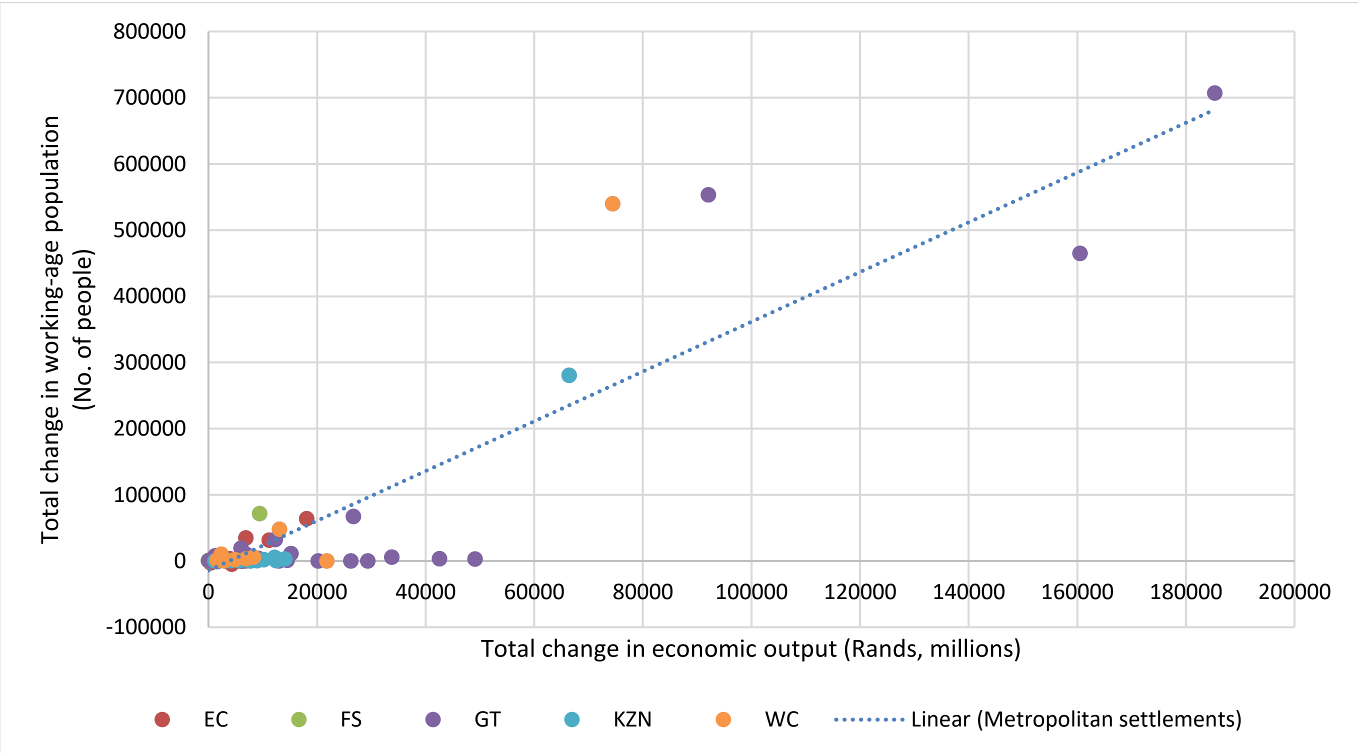


Figure 84: *Scatter plot of absolute change in total economic output in relation to absolute change in total working-age population for all metropolitan settlements between 2001 and 2011*

A noticeable trend in metropolitan settlements was the number of horizontal points running along the x-axis, which were related to security estates, especially in the metropolitan areas of Gauteng (**Figure 84**). Because of the nature of the Settlement Footprint data frame (see **Section 4.5.1.1**), some security estates are delineated as separate settlements, and thus formed discrete data entities in the analysis. The association between population growth and economic growth was not evident in these cases.

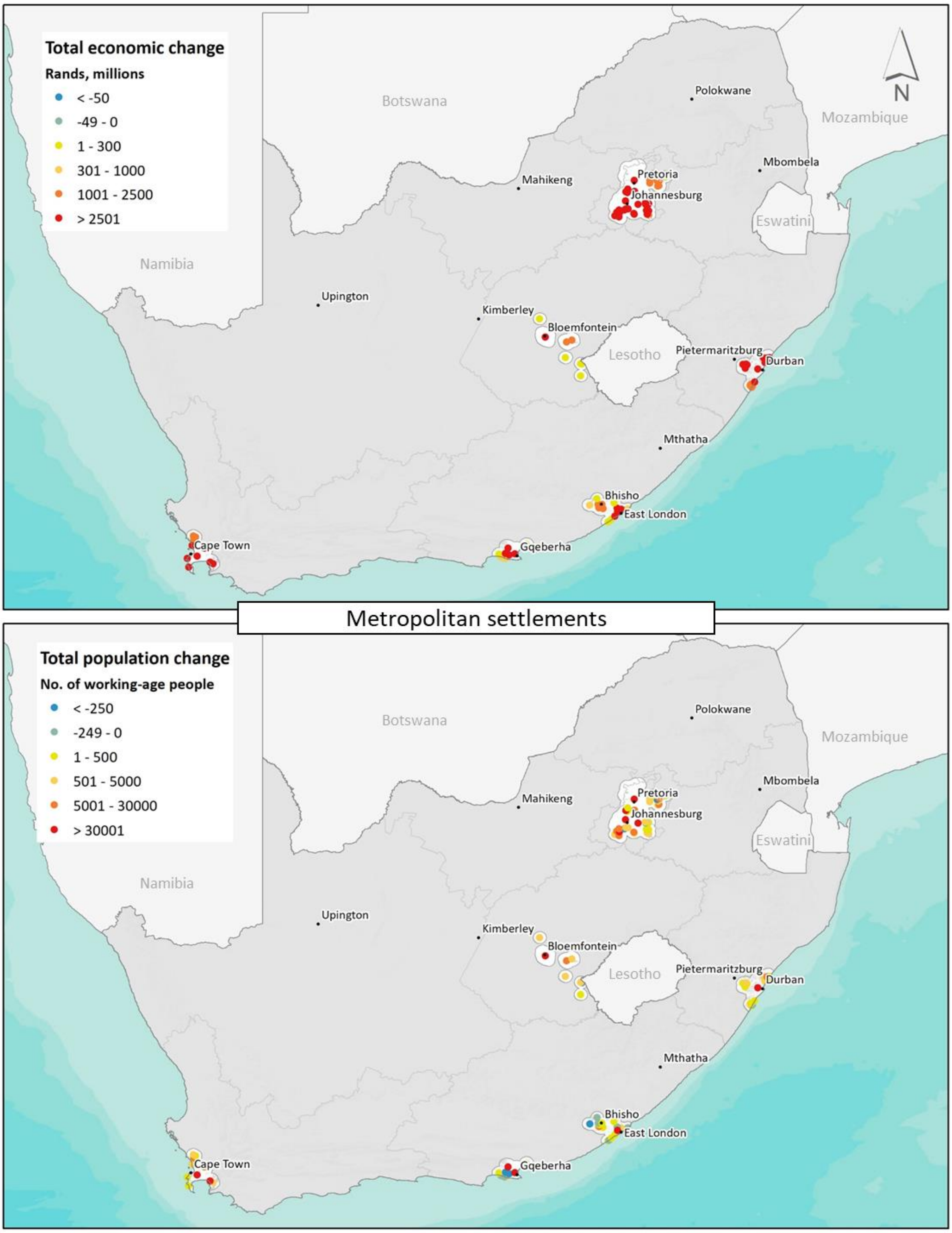


Figure 85: *Spatial patterns of economic change and population change in metropolitan settlements between 2001 and 2011*

For metropolitan settlements, as with the other settlement types, **Table 29** and **Table 30** set out the association between population change and economic change for a range of demographic variables. From **Table 29** and **Table 30**, stronger associations were observed between changes in economic output and changes in the working-age youth age brackets (i.e., 15–24-year-olds and 25–34-year-olds), compared to working-age adults (35–64-year-olds). Similarly, when comparing the correlations between economic change and changes in the working-age population in metropolitan settlements when segmented by gender, there was a higher association in relation to the working-age male population (r_s = 0.486, R^2 = 0.236) than the working-age female population (r_s = 0.441, R^2 = 0.194). A strong positive association was also found between changes in the employed working-age population and changes in settlement-level economic output (r_s = 0.510, R^2 = 0.260).

Comparing the association between economic change and changes in the working-age population based on skill level, higher associations were found with increases in the highest level of education attained (which served as a proxy for skill level). While changes in the unskilled and basic-skilled population showed a moderate positive correlation with economic output, changes in the semi-skilled and highly skilled population were found to be strongly associated with changes in the total economic output of metropolitan settlements (**Table 29** and **Table 30**).

5.4.2.8 Traditional settlements

Traditional settlements (according to the CSIR classification) exhibited the weakest association between economic growth or decline, and population change of all settlement types in South Africa between 2001 and 2011 (**Table 28**). Looking at settlement-level changes in the working-age population as a function of change in economic output over this period, a positive statistically significant correlation (*p*-value < 0.01) was found, but the strength of the association was negligible (r_s = 0.135, R^2 = 0.018), which meant that in traditional settlements only 1.8 % of the total settlement-level change in the working-age population change between 2001 and 2011 could be explained by change in their economic performance (**Table 28**).

The scatter plot in **Figure 86** shows absolute change in total economic output in relation to absolute change in the total working-age population between 2001 and 2011 for all traditional settlements analysed in this study. Each dot on the scatter plot represents an individual settlement and indicates the province in which the settlement is located. **Figure 87** maps traditional settlements in South Africa together with the spatial patterns of economic change and population change between 2001 and 2011. From **Figure 86** and **Figure 87**, the weak association between total economic change and total working-age population change in traditional settlements is evident, as demonstrated by the vertical spread of points in the scatter plot, indicating settlements that experienced large population growth between 2001 and 2011 in the absence of economic growth.

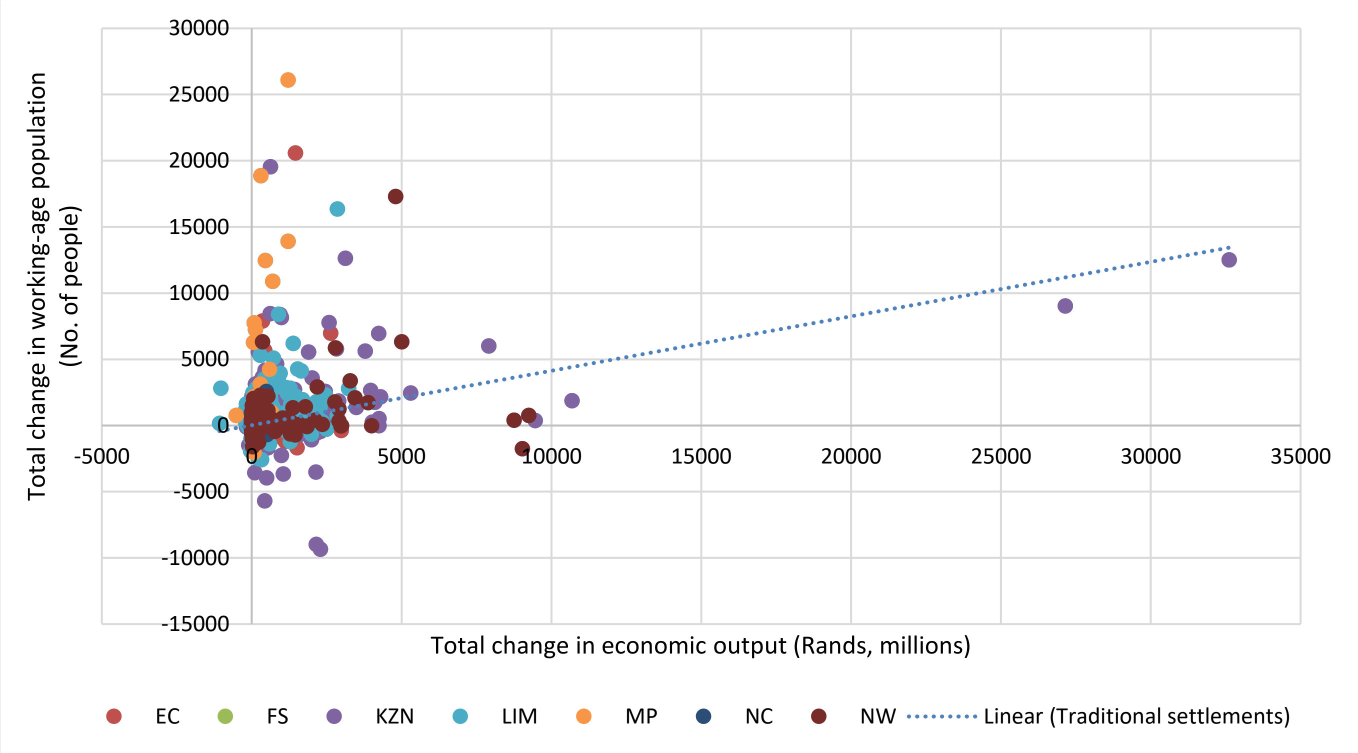


Figure 86: *Scatter plot of absolute change in total economic output in relation to absolute change in total working-age population for all traditional settlements between 2001 and 2011*

While the weak to negligible association between population change as a function of economic change in traditional settlements is evident across all categories of demographic inquiry, some demographic variables did present slightly stronger correlations with the economy than others. From **Table 29** and **Table 30**, the weakest correlation between population change and economic change was for working-age youth (15–24-year-olds) in traditional settlements (r_s = 0.064, R^2 = 0.004). Correlations between economic performance and population changes in the 25–34 and 35–64-year-old age brackets were slightly higher, but were still regarded as negligible. When the working-age population of traditional settlements was segmented by gender, there were slightly stronger correlations with economic change for the male population than for the female population.

Lastly, comparing the association between the economic output of traditional settlements and the working-age population based on skill level, higher associations were found with increases in the highest level of education, and positive but weak correlations were found for the semi-skilled and highly skilled population (**Table 29** and **Table 30**).

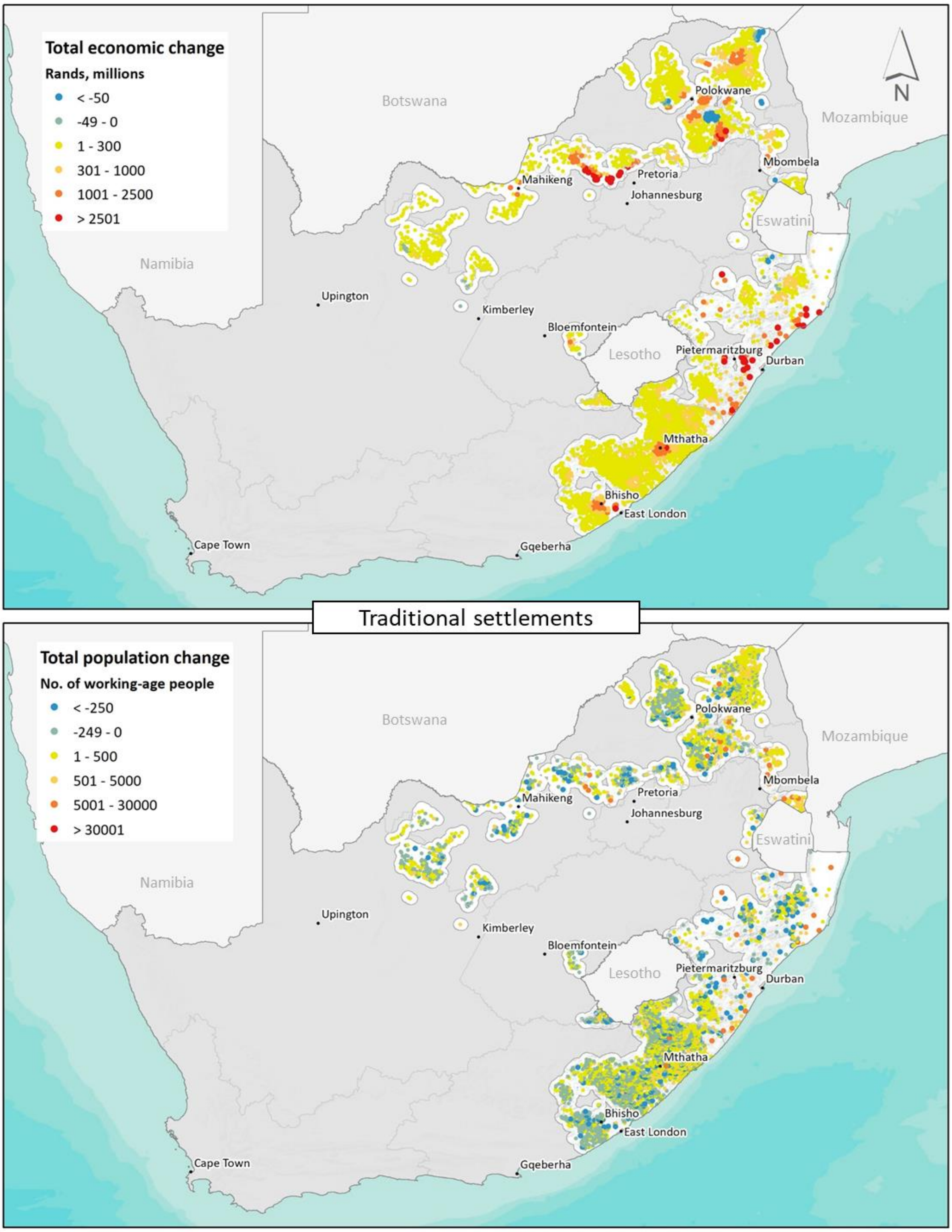


Figure 87: *Spatial patterns of economic change and population change in traditional settlements between 2001 and 2011*

6 DISCUSSION AND CONCLUSION

The research study set out to establish a settlement-level perspective of the spatial relationship between economic performance and population change in South Africa. This chapter presents an overview of the main findings in order to answer the two research questions, namely, 1) What is the relationship between economic performance and population change at settlement level in South Africa? and 2) Are there variances in the relationship between economic performance and population change between different settlement types and demographic variables, and can trends be identified? Furthermore, the theoretical, practical and methodological implications of the study and its results are briefly discussed, together with the research limitations and suggestions for further research.

6.1 SUMMARY OF MAIN FINDINGS

> *What is the relationship between economic performance and population change at settlement level in South Africa?*

Population change in the working-age labour force was found to have a positive statistically significant association with economic performance at settlement level in South Africa. This relationship proved to be complex and multifaceted, with considerable variability (based on the strength of the relationship) across settlement types. While none of the eight settlement types exhibited a very strong relationship between economic performance and population change, several settlement types did indicate a moderate to strong association, while other settlement types were shown to have negligible to weak associations. When the entire working-age population was considered, change in total economic output (excluding the construction sector) accounted for between 1.8 % and 21.9 % of the population change observed in the eight different economically profiled settlement types identified in South Africa.

At national level, jointly observing all settlements in the analysis subset irrespective of settlement-type, the analysis found that the association between change in total economic output (the measure of economic performance used in this study) and the observed change in total working-age population between 2001 and 2011 was weak at best. For all settlements nationally, only 4.6 % of the change observed in the working-age population across all settlements could be explained by the change in economic output of settlements.

Considering South Africa's transition to becoming a service-led economy (Bhorat & Rooney, 2017), it is noteworthy that in formal settlements and settlements where larger shares of the economies are centred in the tertiary sector, the association between change in economic output and the observed change in total working-age population between 2001 and 2011 was found to be significantly higher than in traditional settlements and settlements with larger primary or secondary sector economies.

In formal settlements, irrespective of settlement-type classification, a moderate association between economic performance and population change was found, with changes in total economic output explaining 10.9 % of the working-age settlement-based population change experienced between 2001 and 2011.

All formal settlement types with dominant tertiary sector economies exhibited moderate to moderately strong associations between economic performance and population change in persons of working age, ranging from 10.4 % in wholesale and retail trade settlements and increasing to 15.4 % in finance and business service settlements, 19.2 % in general government settlements and 21.9 % in metropolitan settlements, which had the strongest association of all eight settlement types.

Conversely, the strength of the association between economic change and population change was negligible for traditional settlements, where only 1.8 % of the settlement-level change in the working-age population between 2001 and 2011 could be explained by changes in the economic output of these settlements. Similarly, weak associations were found in manufacturing settlements and mining settlements, where less than 10.0 % of the change observed in the working-age population could be explained by change in economic output. Contrary to the trends observed in mining settlements, agricultural settlements, as the other primary sector-focused settlement type, showed a moderate association between economic change and working-age population change, in that 14.0 % of the settlement-level change in the working-age population between 2001 and 2011 could be explained by changes in the economic output of the settlements.

Are there variances in the relationship between economic performance and population change between different settlement types and demographic variables, and can trends be identified?

Interesting patterns of association emerged when the working-age population was segmented by age, gender, employment status and highest level of education (a proxy for skill level). Across these four demographic variables (comprising 12 population classifications) and all eight economically profiled settlement types identified in South Africa, economic output accounted for between 0.4 % and 29.9 % of the variance observed. Thus, in certain settlement types, some demographic groups were found to have markedly higher associations with the economy than others, revealing clear patterns.

Firstly, the age variable was considered by segmenting the working-age population into three age brackets. Higher rates of association between the economy and population were found for some of these age segments in several settlement types than when the population was considered as a whole. For the 15–24-year-old age bracket, metropolitan settlements were found to have the largest associations between economic performance and population change. For the 25–34-year-old age bracket, the association between economic performance and population change was found to be markedly higher in mining settlements and metropolitan settlements than for the other age brackets in those settlement types. In mining settlements, the association between economic change and population change increased, from a weak relationship for the working-age population as a whole, to a moderate association when considering population change only for the 25–34-year-old age bracket. Likewise, the population age breakdown was found to increase the association between economic and population change in metropolitan settlements to 23.0 % for the 25–34-year-old age bracket (from 21.9 % for the entire working-age population). For the 35–64-year-old age bracket, the association between economic performance and population change was found to be markedly higher in agricultural settlements, wholesale and retail trade settlements, finance and business service settlements, general government settlements and traditional settlements.

Next, the gender variable was considered, and the working-age population was further segmented into male and female groupings. Several settlement types were found to have stronger associations between economic performance and population change in relation to working-age males than females. In agricultural settlements, mining settlements, wholesale and retail trade settlements, metropolitan settlements and traditional settlements, population changes in the male population were found to be more closely associated with economic change than population changes in the female population. Conversely, in finance and business settlements and general government settlements, the association between economic and population change was found to be higher for working-age females than males.

When employment status (according to Stats SA's broad definition of unemployment) was considered, a notable trend was that an increase in settlement-level economic output was found to increase employment levels across all settlement types, although the association was strongest in agricultural settlements and metropolitan settlements. In particular, in metropolitan settlements, it was found that 26.0 % of the change in employment status between 2001 and 2011 could be explained by the settlement-level change in economic output.

Of all the demographic variables used to segment the working-age population in this study, the highest level of education (as a proxy for skill level) was found to have the biggest influence on the association between economic performance and population change at settlement level. Of all pairwise combinations of settlement type and demographic variable, the strongest association between economic performance and population change was found in relation to the highly skilled population (bachelor's degree or higher) in finance and business service settlements, where 29.9 % of the variance in the highly skilled working-age population between 2001 and 2011 could be explained by the settlement-level change in economic output. Similarly strong associations between change in economic output and observed change in the highly skilled working-age population were found in all four tertiary sector-focused settlement types[27], where more than 20.0 % of the change in the highly skilled working-age population across settlements could be explained by change in their economic output. Thus, for settlements with large tertiary sectors, the settlement-level change in economic performance was found to have the strongest association with settlement-level change in the highly skilled population.

[27] Wholesale and retail trade settlements, finance and business service settlements, general government settlements, and metropolitan settlements

In all settlement types, the association between the economy and the population of unskilled persons was found to be weak, but some interesting observations were noted. In all settlement types, with the exception of agricultural and mining settlements, an increase in economic output between 2001 and 2011 was associated with a decrease in the unskilled population. This could be due to general increases in education levels (see **Section 5.3.1.5**), or to out-migration. In agricultural and mining settlements, the reverse was found, in that an increase in economic output was associated with an increase in the unskilled population.

In summary:

- Of all settlement types, the working-age population changes observed in metropolitan settlements were found to be most closely associated with settlement-level economic performance, while those in traditional settlements were found to be least associated with settlement-level economic performance.
- In settlements with large tertiary sector economies, working-age population change in the highly skilled population (bachelor’s degree or higher) was found to be more closely associated with settlement-level economic performance than for any of the other demographic variables analysed.
- In agricultural settlements, the association between economic performance and population change was found to be highest for the 35–64-year-old population and for males (although significant but slightly weaker associations were also found for the 15–24-year-old and 25–34-year-old populations, as well as for the female population).
- In mining settlements, the association between economic performance and population change was highest for the 25–34-year-old population and for males, as well as for the basic- and semi-skilled population.
- In manufacturing settlements, negligible associations between economic performance and population change were found across all demographic variables, with the exception of the highly skilled population, which was found to have a moderate association with settlement-level economic performance.
- In wholesale and retail trade settlements, the strongest association between economic performance and population change was found in relation to the highly skilled population. Considering age and gender, slightly stronger associations were found between the economic performance of wholesale and retail trade settlements and population change for the 35–64-year-old population, as well as the male population (although significant associations were also found for the female population).
- In finance and business service settlements, as well as in general government settlements, the strongest associations between economic performance and population change were found for the highly skilled population. Considering age and gender, stronger associations between economic performance and population change were found for the 35–64-year-old population, as well as the female population (although significant but slightly weaker associations were also found for the male population).
- In traditional settlements, while weak to negligible associations between economic performance and population change were found across all demographic variables, the smallest associations were for the 15–24-year-old population and the female population, both of which were found to be negligible. Changes in the populations of 25–34-year-olds and 35–64-year-olds, as well as males, were found to be associated

with economic factors to a greater extent than for other population segments, although these relationships were still weak.

6.2 DISCUSSION OF RESULTS

The research study set out to establish a settlement-level perspective of the spatial relationship between economic performance and population change in South Africa. The results of this study confirm the literature that the relationship between migration and labour markets is complex and multifaceted (Demko, Ross & Schnell, 1970; Weeks, 2012), and that nuanced and dynamic interplays are evident between the push and pull factors influencing population-change dynamics (Van Tonder, 2018).

The literature abounds with assertions that economic considerations are the real root of migration decisions (e.g., Stats SA, 2019c), but this study found that while settlement-level economic performance explains, to some extent, absolute patterned changes in settlement-level population in South Africa between 2001 and 2011, it does not, on its own, account for all population change in the working-age bracket. Change in economic output (as a measure of economic performance) was found to explain at most 29.9 % of the variance observed in the working-age population at settlement level across the country over this period. These results imply that 70.1 % or more of the observed settlement-level working-age population-change dynamics cannot be explained by economic factors alone, and thus have to be attributed to other factors. Considering these results, a number of theoretical, practical and methodological observations and arguments are presented and discussed:

- **Natural increase, rather than net in-migration, is the predominant growth factor in most urban populations**
  Research in the global context suggests that migration is more commonly replacing fertility and mortality as the principal demographic process shaping the patterns of contemporary human settlement (Poston & Bouvier, 2010; Bell *et al*., 2015; Rees *et al*., 2016). In the African context, however, natural increase is estimated to be a more dominant factor than migration in the increase in urban populations (Potts, 2012). Although the present study attempted to isolate economically induced migration-related population changes from population change due to fertility and mortality by focusing on population change in the working-age category, it should be acknowledged that in this approach, the contribution of natural increase as an agent of population change cannot be discounted. This is not a new challenge in South Africa, as Morrison (1980, in Kok & Collinson, 2006:5) acknowledges, *"... [migration researchers in South Africa] must content themselves with data that only partly satisfy their conceptual requirements"*. Unlike registration systems for births and deaths, there is no migration registration system in South Africa (as found in some European and Asian countries). Added to this challenge is that socio-economic data from the National Censuses have not dealt with migration in sufficient depth for detailed analysis.

- **In the case of economic opportunities, perception does not necessarily reflect reality**

  The migration literature argues that, generally speaking, people do not move at random – they go where they *believe* opportunity exists, and the role of subjective perception should not be understated (Weeks, 2012). People make decisions regarding their own migration on the basis of the information at their disposal (Gelderblom, 2006). Depending to a large extent on the accuracy of the information on which they base their decisions, migration may easily be driven by ill-informed perceptions of potential financial benefit in terms of the availability of employment opportunities. Thus, subjective perceptions – with respect to both the aggregate regional indicators, as well as town-specific assumptions – are a very important push and pull factor, although a challenging measure for quantitative empirical research.

- **Economic growth does not necessarily equate to economic opportunities**

  This study analysed changes in settlement-level economic output (GVA) between 2001 and 2011 as a measure of economic performance, and consequently a factor of economic opportunity. However, some authors, such as Musvoto (2014), have cautioned against assuming that economic growth equates to economic opportunities. Furthermore, in the context of increasing rural-to-urban migration, as well as international migration, a large proportion of people may be finding employment in the informal sector (Geyer, Ngidi & Mans, 2018). Settlement-level data reflecting the number of formal-sector employment opportunities (i.e., jobs available), together with variables such as business investment and even informal-sector employment, would have been useful measures to include in this study, but such data do not exist for the spatial and temporal scales of this study. In the absence of such data, this study has had to rely on the assumption that economic growth is equivalent to economic opportunities.

- **The 2008 global financial crisis affected economic growth in South Africa**

  The full effects of the global financial crisis of 2008 were not experienced in South Africa until the first quarter of 2009, when the country officially went into a recession for the first time in 17 years (**Figure 8**) (Rena & Msoni, 2014). The effects of this recession on economic growth and population change are implicit in the data used for this study, although it was outside the research scope to focus explicitly on the impact of this event on population change and migration patterns in South Africa.

- **Migration may not always be opportunity-driven, as the frequent assumptions would imply**

  The results of this study confirm that population movements in the South African context are not necessarily driven by labour-market and economic forces, thus supporting the theory proposed by Bekker (2002) that a 'secondary engine' fuelling migration processes in South Africa might be the search for improved living conditions rather than economic opportunities. In the local context, as has been noted, prevailing levels of unemployment, poor employment prospects and the critical scarcity of jobs may in fact induce some migrants to move with other goals in mind. This finding corroborates that of Cross (2009), who notes that rural migrant overcrowding into small towns with a very limited employment base has become a significant social problem.

- **Male and female migrants may be incentivised differently**

  While this study did not explicitly look at gender-based migration incentives, the findings in relation to the variances observed by gender and settlement type, especially in the case of general government settlements, support the theory, proposed by Von Fintel and Moses (2017), that male and female migrants might be incentivised differently. In their view, women do not move only to seek livelihoods from the job market – which does not serve them as well as men – but they also follow service provision in more developed areas.

- **Many towns in South Africa are predominantly places of welfare grant pay-outs, dominated by state service employment**

  South Africa's exceptionally large state welfare system, making the country proportionally one of the biggest welfare states in the world (IRR, 2017; Stats SA, 2019a), has several implications for settlement-level economic–population dynamics. For a large proportion of the working-age population, state welfare grants have become the primary form of income, thus releasing them from the typical constraints and dynamics of formal wage employment, including their chosen place of residence. People living on welfare grants have more freedom with respect to their place of residence and may choose places where they can live most cost-effectively, such as small towns or settlements in the former homelands. This is especially true in small towns, which, although playing a vital role in the livelihoods of their residents as places of services, and welfare support and provision (Hoogendoorn & Visser, 2015), do not necessarily function as places of formal economic opportunities.

- **Factors such as social, political, cultural and environmental forces also have a bearing on migration processes**

  Social, political, cultural and environmental forces (as categorised generally in existing studies), which are typically regarded as lesser factors in migration processes (in the local context) when compared to economic and labour-market forces, also have a bearing on migration processes and population-change outcomes. In this study, settlement-level population changes in the working-age bracket between 2001 and 2011 were examined at aggregate level, and thus the effects of economic forces, together with all other forces (both known and unknown) that may affect population movement dynamics, including social, political, cultural and environmental factors, need to be acknowledged as being inherent in the study data and could account for some of the population movement not explained by the economic forces analysed.

- **As a result of South Africa's long-standing culture and history of labour migration, the specificity of migration may be grounded in the historical connections that have developed between places over time**

  A pervasive system of migrant labour has played a fundamental part in shaping the past and present of South Africa's economy. Systems of labour migration are thus deeply entrenched in South Africa's history and culture. Historically, the agricultural and mining sectors have played key roles in economic growth as well as employment actors, drawing unskilled and semi-skilled labour migrants from the former homelands and South Africa's neighbouring countries for employment on commercial farms and mines (Parshotam & Ncube, 2017). While both the mining and agricultural sectors have faced economic and employment downturn in the past two decades through mine closures and agricultural downscaling, it is likely that present-day labour streams are still influenced by the long-standing connections that have developed between people in planned destinations and places of origin over time, forming social networks that provide initial support to recent migrants, as identified by Lucas (2015).

- **Census data contain inherent structural issues**

  The nature and structure of the National Population Census, which spatially captures and quantifies the population according to size, composition and structure, means that population is recorded according to a single moment in time (the 2001 and 2011 National Censuses were conducted in the month of October) at ten-year intervals. The National Census data therefore do not fully reflect the long-established patterns of circular migration associated with seasonal work or temporary worker migratory flows and movement to and from former homeland areas to farms (Todes *et al*., 2010).

- **Not everyone who wants to move is able to do so**

  Migration has cost implications. In sending areas, poverty and unemployment act as the major push factors, *provided that* the costs of migration can be met (Gelderblom, 2006; O'Reilly, 2015). In South Africa, it has been observed that truly impoverished households may become trapped in under-serviced rural areas and small towns with limited economic opportunities. Thus, higher unemployment or economic performance levels do not necessarily generate higher levels of out-migration (Kok *et al*., 2003).

- **Circular migration has population-growth implications at settlement level**

  This study found that in traditional settlements located in the former homeland areas, working-age population growth is occurring in the absence of any formal economy. This observation may, in part, be attributed to circular migration. Gelderblom (2006) explains that a potential migrant may be pushed away from the sending area due to poor employment prospects, but can also be pulled back again by social connections. By retaining their social connections with their place of origin in rural areas and former homelands, migrants are able to fall back upon land and resources available to them in these areas, as well as the support of family members left behind, by periodically moving back in times of economic hardship and supplementing their livelihoods through subsistence (Atkinson, 2014). This contradictory combination of forces may help in understanding why migration is often circular in nature, with the migrant returning home periodically and not committing to the destination area in a permanent fashion (Gelderblom, 2006).

- **Economic change appears to be a more dynamic process than population change**
  An assumption of the present study from the outset was that working-age population change at settlement level was viewed as reacting or responding to economic change. This assumption was borne out by the research findings, observing that working-age population growth tends to follow economic growth, lagging slightly behind. The lagged effect of population change was observed across all settlement types, in cases of both population growth and decline, although further work into this line of enquiry would be required to support these observations.

- **The assumption that all settlements have the capacity for population growth is not always valid**
  An assumption of this study was that settlements are not constrained in their capacity to grow their populations, but this assumption may not be valid for all settlements analysed in the study. Due to the nature of the Settlement Footprint data frame, security estates, for example, sometimes formed discrete data entities as separate settlements in the analysis. The inability for population growth in established security estates, in the context of economic growth in their immediate surroundings, may have had some bearing on the correlation outcomes, especially in the Gauteng metros, where these settlement types are most prevalent.

- **Correlation is not equivalent to causality**
  In the context of this study, the importance of distinguishing between correlation (association or relationship) and causality (cause and effect) needs to be emphasised. While causality cannot exist without some form of correlation, correlation does not necessarily imply the existence of causality. Thus, while this study proved and quantified the association between economic performance and population change at settlement level, it does not attempt to prove causality, given the multiple channels through which population change and the economy can influence each other.

6.3 Scientific contribution of this study

The novel contributions of this research to the disciplines of Geographical Information Science and Urban and Regional Planning are highlighted. In broad terms, the study:

- **Motivated and justified the case for the GIS application of spatial economic data at fine resolution.** The use of fine-resolution economic data is particularly novel in this research. Economic output is typically reported at the national, provincial or municipal level (e.g., Quantec, 2020b), and not at settlement level, as developed and used in this study. For this study, a unique dataset was developed for South Africa, namely, the Settlement-Level Economic Output Dataset for 2001 and 2011.

- **Devised and executed a GIS method and workflow for aligning Stats SA Census data with the CSIR Settlement Footprint data frame.** By applying advanced GIS methods and techniques, the study developed and refined a methodology and workflow for aligning the Stats SA Census data, at sub-place delineation, with the CSIR Settlement Footprint data frame demarcating distinct built-up settlement areas.

- **Developed an economically profiled settlement classification typology.** The research proposed and developed a novel way of classifying settlements in South Africa, according to their economic profiles. This typology distinguished between eight broad settlement types in South Africa according to economic profile.

- **Empirically set out a settlement-level perspective of the spatial relationship between economic output and working-age population change in South Africa.** This study is the first of its kind to develop and quantify the relationship between economic output and working-age population change at settlement level in South Africa. Despite the prolific literature on migration as a broad concept and phenomenon, there was a dearth of published empirical work on the contribution of local economies as push–pull factors in migration, especially within the domain of GIS, that could inform the present study and help in establishing suitable metrics. This meant that a relatively novel research approach was required, which attests to the innovative nature of the study.

6.4 STUDY LIMITATIONS

The study succeeded in achieving the overarching aim and the supporting objectives, but not without certain limitations. Given the settlement-level scale of this research, the biggest limitations of the study were associated with the nature of the local spatial data requirements in relation to the available data:

- A limitation of the time-series analysis component of this research was that only settlements with comparative economic and population data for both 2001 and 2011 could be analysed. Thus, a subset of settlements was analysed, excluding settlements where the Stats SA 2001 and/or 2011 sub-place data could not be aligned to the Settlement Footprint data frame (see **Section 4.5.1** and **Section 4.5.3.2**). While this excluded 1554 settlements (21.6 %) from temporal analysis in this study, its impact on the study was negligible, as these settlements accounted for only 2.5 % of the total national population living in settlements (see **Section 5.1**).
- The settlement-level analysis of economic performance was limited to economic output as a single measure of economic performance (see **Section 4.5.2.1**). Settlement-level data reflecting the number of formal-sector employment opportunities (i.e., number and location of jobs available), together with variables such

as business investment and even informal-sector employment, would have been useful measures to include in this study (e.g., see **Appendix A**), but such data were not found to be available at the spatial and temporal scales of this study.

- The fine-scale resolution of the downscaled economic activity data (CSIR, 2020a) was a valuable asset in achieving the aim and objectives of the study. A limitation of this dataset, however, was the exclusion of the construction sector (SIC 5) because there was no sound way of spatially downscaling the data for this sector to settlement level due to the temporary nature of construction sites (see **Section 4.5.2.1**).
- Setting a buffer distance around the settlement footprints (i.e., 14 km) was fundamentally necessary for spatial analysis in this study (see **Section 3.3.2** and **Section 3.3.3)**, thus effectively assigning an area of potential economic activity to the population of any given settlement. The inevitable limitations of such an approach are acknowledged, in that the size of the area that a settlement population can readily access for economic activity will vary between settlements based on factors such as availability of transport, modes of transport, travel infrastructure conditions and geographical layout (see **Section 4.5.2.2**).

6.5 THEMES THAT REQUIRE FURTHER EMPIRICAL INVESTIGATION

It is clear that there is considerable interest among geographers, demographers, economists, planners and policy-makers alike in better understanding the dynamics and processes of population movement and migration. Suggestions for future research include:

- Exploring possible ways to incorporate the construction sector into the economic perspective, as well as expanding upon the perspective established by this research, through quantitative research into other explanatory factors for population movement highlighted in the discussion of the results, such as service provision (education and healthcare) and government-provided housing.
- Furthering the empirical investigation into the gender-specific dynamics of migration decisions.
- Exploring the implications of different distance thresholds, apart from the 14 km buffer used in this study, relating to the proximity distance for access to economic opportunities around settlements would be another interesting line of enquiry.
- Expanding the scope to include different approaches to measuring and analysing change could be potentially fruitful, given the very large ranges observed in the key variables of the study and their skewness to the lower ranges. Two approaches that were considered but not pursued were to use relative change rather than absolute change, as well as the effect of using a logarithmic scale.

6.6 Conclusion

South Africa's towns and cities face substantial challenges, related largely to the pace of economic growth, and continued in-migration from rural areas. This study provided empirical evidence for the relationship between economic performance and working-age population change at settlement level in South Africa. Understanding migration dynamics and trends in the local context is vitally important and has an impact on how to think about, and plan for, urban transition in South Africa. If the pace of urban population expansion continues to outstrip the rate of economic growth, South Africa's cities will increasingly become home to expanding poor populations. Decision-makers across all spheres of government rely on a strong evidence base, reinforced by the availability of timely, accurate, robust and nuanced data to support their development planning and to ensure better service delivery. There is a growing and urgent imperative for public-sector planning to take into account the high number of migrants who, on a regular basis, move between rural and urban areas, so that poverty alleviation and spatial planning initiatives can be more successfully targeted to address the prevailing needs.

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APPENDIX A: MEASURES OF ECONOMIC PERFORMANCE

Variables that measure levels of economic prosperity and productivity, together with those that identify how economic conditions change over time, are likely to be important explanatory factors of population change. Therefore, an assessment of variables and measures of economic and labour-market prosperity was undertaken.

The most representative economic variable is per capita gross domestic product (GDP), which is used to measure the overall economic output of an area. GDP is widely considered by economists to be the most important measure of economic health, where an increase in GDP is considered a sign of economic strength. Gross value added (GVA) can also be used to measure the value of goods and services produced in an area, industry or sector of an economy. Income and wages are other key indicators of economic prosperity – if the economy is operating efficiently, earnings should increase regularly to keep up with inflation and the average cost of living. Labour-market variables and employment opportunities can similarly serve as indicators of economic performance and strength, both locally and regionally. Variables relating to occupation and income, such as the proportion of the workforce employed in the primary, secondary and tertiary economic sectors, as well as the extent of skills shortages in particular sectors or discrepancies in income rates between sectors, are also indicators of relative economic performance. **Table 31** highlights variables and measures of economic and labour-market prosperity that have been identified in the local and international literature on the determinants of migration.

Table 31: *Variables and measures of economic and labour-market prosperity*

	Variable	Source
Size of the economy	GDP per capita (proxy for income and indicator of economic development)	Etzo, 2008; Bunea, 2012; Bell *et al*., 2015; Jozi, 2015; Wajdi, Adioetomo & Mulder, 2017
	Relative GDP	Bouare, 2001–2002
	GDP production / Gross value added (GVA)	Morudu & du Plessis, 2013; Geyer, Ngidi & Mans, 2018
	Regional income	Bunea, 2012
	Municipal income	Morudu & du Plessis, 2013
	Economic concentration (size of local economy relative to national)	Yang, Han & Song, 2014
Economic diversification	Manufacturing activity	Le Roux *et al*., 2019
	Economy dependent on agriculture forestry and fisheries	Le Roux *et al*., 2019
	Economy dependent on mining	Le Roux *et al*., 2019
	Percentage economy dependent on primary sector	Etzo, 2008
	Percentage economy dependent on secondary sector	Etzo, 2008
	Percentage economy dependent on tertiary sector	Etzo, 2008

	Variable	Source
Economic growth	GDP change over time	Le Roux *et al.*, 2019
	Growth in income	Etzo, 2008
Economic prosperity	Business investment (e.g., number of new business registrations)	Bunea, 2012
	Building development (e.g., building permits issued,)	Van der Gaag, Wissen Rees, Stillwell & Kupiszewsk, 2003; Arnold, 2016
	Tightness of the housing market. Housing	Van der Gaag *et al.*, 2003
	Housing market (e.g., rental prices, housing prices, sales activity)	Van der Gaag *et al.*, 2003; Etzo, 2008; Arnold, le Roux & Hattingh, 2017
	Cost of living	Basile & Causi, 2005, in Etzo, 2008
	Consumer price index (reflects the increased cost of living or inflation)	Jozi, 2015
	Local income tax	Bunea, 2012
Inequality	Gini coefficient (income inequality)	Bell *et al.*, 2015; Le Roux *et al.*, 2019
	Proportion of population earning no income	Le Roux *et al.*, 2019
Labour force	Level of (un)employment	Bouare, 2001–2002; Bunea, 2012; Jozi, 2015
	Unemployed/discouraged work seekers in economically active population	Le Roux *et al.*, 2019
	Unemployed females in economically active population	Le Roux *et al.*, 2019
	Workforce employed in the primary, secondary and tertiary economic sectors	Etzo, 2008
	Labour force participation	Bell *et al.*, 2015
	Female labour force participation	Bell *et al.*, 2015
	Population living on social grants	Geyer, Ngidi & Mans, 2018
	Proportion of the workforce employed in agriculture	Van der Gaag *et al.*, 2003
	Magnitude of skills and labour shortage	Van der Gaag *et al.*, 2003
	Size of the rural/urban population	Kainth, 2010
	Average annual household income	Jozi, 2015
	Relative wage or salary rate	Van der Gaag *et al.*, 2003
	Economic concentration (size of local economy relative to national) in relation to population concentration (size of local population relative to national)	Yang, Han & Song, 2014

APPENDIX B: SPATIAL EXPLORATION OF ECONOMIC DATA

Figure 88 and **Figure 89** show the degree and spatial distribution of economic change (2001 to 2011) by economic sector.

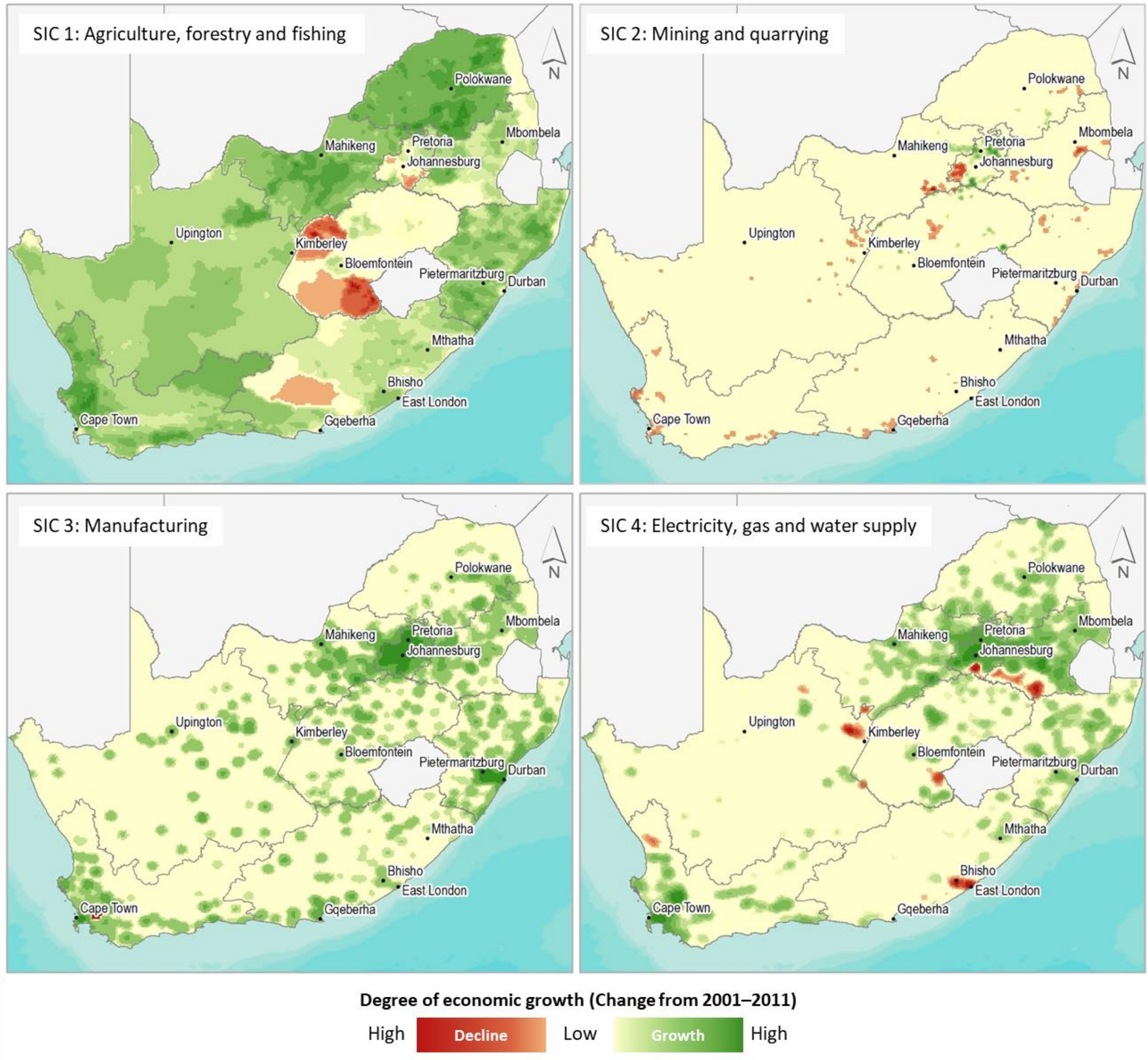

__Figure 88:__ Spatial distribution of economic change between 2001 and 2011 for primary and secondary sector activities
Source: Author's own, using CSIR (2020a) data

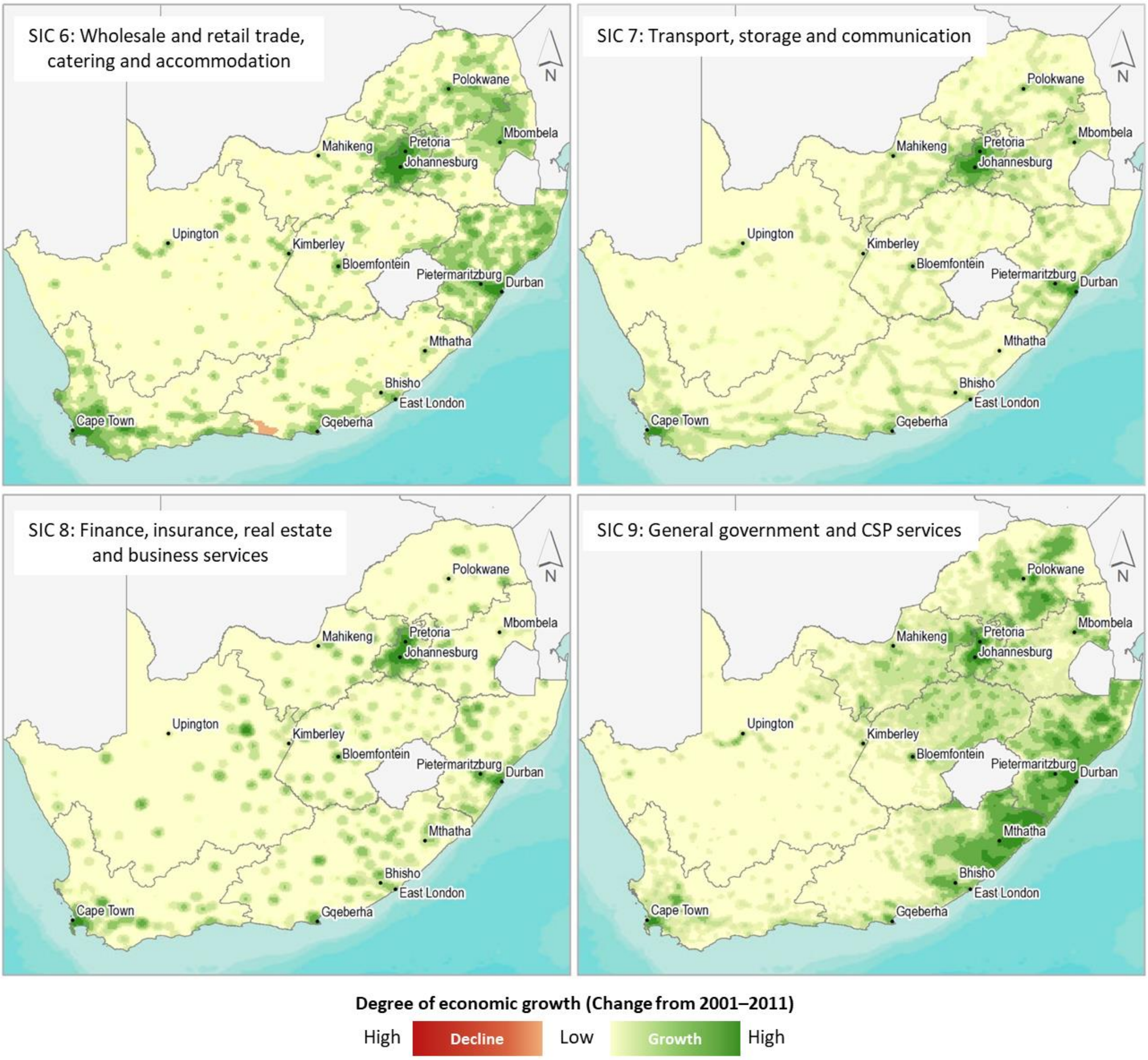

Figure 89: Spatial distribution of economic change between 2001 and 2011 for tertiary sector activities

Source: Author's own, using CSIR (2020a) data

APPENDIX C: EXAMPLE LIST OF CLASSIFIED SETTLEMENTS

The study categorised eight broad settlement types in South Africa, according to the economically profiled settlement classification typology. **Table 32** and **Table 33** provide examples of settlements that fall under each category. This list is not an exhaustive, but serves to provide examples of the various settlement types.

Table 32: *Examples of settlements falling under Clusters 1–6*

Cluster 1 Agricultural settlements	**Cluster 2** Mining settlements	**Cluster 3** Manufacturing settlements	**Cluster 4** Wholesale and retail trade settlements	**Cluster 5** Finance and business services settlements	**Cluster 6** General government settlements
(Settlement name, Provincial code)					
Augrabies, NC	Alexander Bay, NC	Ermelo, MP	Calvinia, NC	Ballito, KZN	Alice, EC
Citrusdal, WC	Amersfoort, MP	eNtokozweni, MP	Clarens, FS	Bela-Bela, LIM	Britstown, NC
Franschhoek, WC	Burgersfort, LIM	Graaff Reinet, EC	Colesberg, NC	George, WC	Coffee Bay, EC
Jacobs Bay, WC	eMalahleni, MP	Harrismith, FS	eMakhazeni, MP	Hebron, NW	Eksteenfontein, NC
Kakamas, NC	eMkhondo, MP	Hermanus, WC	Hazyview, MP	Howick, KZN	GaMokwane, LIM
Kareedouw, EC	Kathu, NC	KwaDukuza, KZN	Hoedspruit, LIM	Jeffrey's Bay, EC	Jozini, KZN
Lutzburg, NC	Lephalale, LIM	Ladysmith, KZN	Kimberley, NC	Knysna, WC	Maboloka, NW
Melmoth, KZN	Phalaborwa, LIM	Mashishing, MP	Komani, EC	Polokwane, LIM	Malamulele, LIM
Op-die-berg, WC	Postmasburg, NC	Mbombela, MP	Krugersdorp, GT	Stellenbosch, WC	Mankweng, LIM
Raaswater, NC	Rustenburg, NW	Middelburg, MP	Kuruman, NC		Matjiesfontein, WC
Riebeek-Kasteel, WC	Secunda, MP	Mossel Bay, WC	Lichtenburg, NW		Paul Roux, FS
Sedgefield, WC	Steelpoort, LIM	Newcastle, KZN	Mahikeng, NW		Pomeroy, KZN
Underberg, KZN	Thabazimbi, LIM	Paarl, WC	Makhado, LIM		Rosendal, FS
Wartburg, KZN	Vierfontein, FS	Pietermaritzburg, KZA	Makhanda, EC		Steynsrus, FS
	Vioolsdrift, NC	Richards Bay, KZN	Mokopane, LIM		Wakkestroom, MP
	Welkom, FS	Sasolburg, FS	Mookgopong, LIM		
		Vereeniging, GT	Mthatha, EC		
		Vryburg, NW	Musina, LIM		
		Vryheid, KZN	Oudtshoorn, WC		
			Phuthaditjhaba, FS		
			Potchefstroom, NW		
			Senwabarwana, LIM		
			Springbok, NC		
			Tabankulu, EC		
			Upington, NC		

***Table 33:** Examples of settlements falling under Cluster 7*

Cluster 7 Metropolitan settlements	
Settlement footprints within the City of Tshwane Metropolitan Municipality	Blair Atholl Golf Estate
	Bronkhorstspruit
	Bultfontein GT
	Cheetah Park
	Cullinan 1
	Cullinan 2
	Cullinan 3
	Doornkloof
	Ekandustria
	Ekangala
	Ekangala Section B
	Gardener Ross Golf and Country Estate
	Kameelkraal
	Keinfontein
	Kungwini Country Estate
	Leeuwfontein
	Onverwacht
	Premier Diamond Mine
	Pretoria
	Rayton
	Refilwe
	Rethabiseng
	Riamar park
	Roodeplaat
	Sizanani Village
	Sokhulumi
	Waterval GT

Appendix D: Detailed analysis results of economic production shifts by settlement type between 2001 and 2011

The detailed analysis results of economic production shifts by settlement type between 2001 and 2011 are presented in this appendix. **Table 34** and **Table 35** show the total economic production per sector in Rands (million) (measured at constant 2010 prices) per settlement type, for both 2001 and 2011. For the purposes of calculating settlement-based economic activity in this study, it was assumed that people have access to economic activities that occur both within their settlements, as well as extending 14 km beyond the settlement boundary (especially in the case of primary sector activities), based on the average commute to work (see **Section 4.5.2.2** as well as **Figure 30**). Thus, the total economic production figures were calculated using the 14 km distance around the settlement footprints. Where settlements are located in close proximity to one another, more than one settlement could have access to the same economic activity, especially in the case of production occurring outside of the settlement footprint itself. See **Section 4.5.2.1** for an overview of the data limitations of SIC 5, and **Section 4.5.2.2** for further theoretical rationale for the calculation of settlement-based economic access. **Table 36** shows the absolute and relative growth in settlement-based economic production per sector between 2001 and 2011.

Table 34: *Settlement-based economic activity by economic sector and settlement type, 2001*

Settlement type	Economic activity (GVA) (SIC 1–4 and SIC 6–9)	SIC 1	SIC 2	SIC 3	SIC 4	SIC 6	SIC 7	SIC 8	SIC 9	Total
Agricultural settlements	GVA (millions of Rands)*	6,194	671	1,764	864	2,497	1,573	2,024	5,328	**20,915**
	% share (relative to total of settlement type)	*29.6 %*	*3.2 %*	*8.4 %*	*4.1 %*	*11.9 %*	*7.5 %*	*9.7 %*	*25.5 %*	**100.0 %**
	% access to national sector total	*11.9 %*	*0.3 %*	*0.6 %*	*1.6 %*	*0.9 %*	*1.0 %*	*0.6 %*	*1.3 %*	***1.2 %***
Mining settlements	GVA (millions of Rands)	2,054	182,417	17,778	8,066	19,491	8,831	15,006	21,637	**275,279**
	% share (relative to total of settlement type)	*0.7 %*	*66.3 %*	*6.5 %*	*2.9 %*	*7.1 %*	*3.2 %*	*5.5 %*	*7.9 %*	**100.0 %**
	% access to national sector total	*4.0 %*	*79.6 %*	*6.1 %*	*14.7 %*	*7.3 %*	*5.8 %*	*4.6 %*	*5.2 %*	***15.4 %***
Manufacturing settlements	GVA (millions of Rands)	15,460	38,939	107,049	17,465	58,816	42,119	54,721	93,388	**427,958**
	% share (relative to total of settlement type)	*3.6 %*	*9.1 %*	*25.0 %*	*4.1 %*	*13.7 %*	*9.8 %*	*12.8 %*	*21.8 %*	**100.0 %**
	% access to national sector total	*29.7 %*	*17.0 %*	*36.5 %*	*31.9 %*	*22.1 %*	*27.9 %*	*16.7 %*	*22.5 %*	***23.9 %***
Wholesale and retail trade settlements	GVA (millions of Rands)	9,212	32,155	26,508	10,039	63,976	21,807	49,738	87,805	**301,239**
	% share (relative to total of settlement type)	*3.1 %*	*10.7 %*	*8.8 %*	*3.3 %*	*21.2 %*	*7.2 %*	*16.5 %*	*29.1 %*	**100.0 %**
	% access to national sector total	*17.7 %*	*14.0 %*	*9.0 %*	*18.4 %*	*24.0 %*	*14.4 %*	*15.2 %*	*21.1 %*	***16.8 %***
Finance and business service settlements	GVA (millions of Rands)	6,222	1,117	18,792	4,767	18,059	10,206	39,409	27,919	**126,491**
	% share (relative to total of settlement type)	*4.9 %*	*0.9 %*	*14.9 %*	*3.8 %*	*14.3 %*	*8.1 %*	*31.2 %*	*22.1 %*	**100.0 %**
	% access to national sector total	*12.0 %*	*0.5 %*	*6.4 %*	*8.7 %*	*6.8 %*	*6.8 %*	*12.1 %*	*6.7 %*	***7.1 %***
General government settlements	GVA (millions of Rands)	2,534	677	1,267	1,491	4,357	1,839	2,183	27,933	**42,282**
	% share (relative to total of settlement type)	*6.0 %*	*1.6 %*	*3.0 %*	*3.5 %*	*10.3 %*	*4.4 %*	*5.2 %*	*66.1 %*	**100.0 %**
	% access to national sector total	*4.9 %*	*0.3 %*	*0.4 %*	*2.7 %*	*1.6 %*	*1.2 %*	*0.7 %*	*6.7 %*	***2.4 %***
Metropolitan settlements	GVA (millions of Rands)	9,620	15,237	203,364	27,356	154,518	101,069	236,328	240,246	**987,738**
	% share (relative to total of settlement type)	*1.0 %*	*1.5 %*	*20.6 %*	*2.8 %*	*15.6 %*	*10.2 %*	*23.9 %*	*24.3 %*	**100.0 %**
	% access to national sector total	*18.5 %*	*6.7 %*	*69.4 %*	*50.0 %*	*58.0 %*	*66.8 %*	*72.3 %*	*57.9 %*	***55.2 %***
Traditional settlements	GVA (millions of Rands)	19,332	76,652	62,788	16,901	68,940	37,914	67,985	145,041	**495,553**
	% share (relative to total of settlement type)	*3.9 %*	*15.5 %*	*12.7 %*	*3.4 %*	*13.9 %*	*7.7 %*	*13.7 %*	*29.3 %*	**100.0 %**
	% access to national sector total	*37.2 %*	*33.5 %*	*21.4 %*	*30.9 %*	*25.9 %*	*25.1 %*	*20.8 %*	*34.9 %*	***27.7 %***
National settlement-based economic activity (All settlements in analysis subset)	**GVA (millions of Rands)**	**519,80**	**229,114**	**293,031**	**54,694**	**266,584**	**151,189**	**327,002**	**415,247**	**1,788,842**
	% share (relative to national settlement-based total)	***2.9 %***	***12.8 %***	***16.4 %***	***3.1 %***	***14.9 %***	***8.5 %***	***18.3 %***	***23.2 %***	**100.0 %**

*Measured at constant 2010 prices, according to inflation-related adjustments of Quantec data

Table 35: *Settlement-based economic activity by economic sector and settlement type, 2011*

Settlement type	Economic activity (GVA) (SIC 1–4 and SIC 6–9)	SIC 1	SIC 2	SIC 3	SIC 4	SIC 6	SIC 7	SIC 8	SIC 9	Total
Agricultural settlements	GVA (millions of Rands)*	8,168	575	2,419	1,073	3,700	2,415	3,547	7,498	**29,394**
	% share (relative to total of settlement type)	*27.8 %*	*2.0 %*	*8.2 %*	*3.7 %*	*12.6 %*	*8.2 %*	*12.1 %*	*25.5 %*	**100.0 %**
	% access to national sector total	*12.2 %*	*0.3 %*	*0.7 %*	*1.6 %*	*1.0 %*	*1.0 %*	*0.7 %*	*1.3 %*	***1.2 %***
Mining settlements	GVA (millions of Rands)	2,670	176,950	25,460	10,910	27,749	14,183	24,523	30,004	**312,449**
	% share (relative to total of settlement type)	*0.9 %*	*56.6 %*	*8.1 %*	*3.5 %*	*8.9 %*	*4.5 %*	*7.8 %*	*9.6 %*	**100.0 %**
	% access to national sector total	*4.0 %*	*78.0 %*	*6.9 %*	*15.8 %*	*7.2 %*	*6.0 %*	*4.5 %*	*5.2 %*	***12.6 %***
Manufacturing settlements	GVA (millions of Rands)	19,949	37,788	136,233	21,283	87,819	66,363	93,237	129,263	**591,935**
	% share (relative to total of settlement type)	*3.4 %*	*6.4 %*	*23.0 %*	*3.6 %*	*14.8 %*	*11.2 %*	*15.8 %*	*21.8 %*	**100.0 %**
	% access to national sector total	*29.8 %*	*16.7 %*	*36.9 %*	*30.9 %*	*22.8 %*	*28.0 %*	*17.1 %*	*22.4 %*	***23.9 %***
Wholesale and retail trade settlements	GVA (millions of Rands)	11,679	19,429	35,171	12,529	90,400	33,338	82,351	119,577	**404,474**
	% share (relative to total of settlement type)	*2.9 %*	*4.8 %*	*8.7 %*	*3.1 %*	*22.3 %*	*8.2 %*	*20.4 %*	*29.6 %*	**100.0 %**
	% access to national sector total	*17.5 %*	*8.6 %*	*9.5 %*	*18.2 %*	*23.4 %*	*14.0 %*	*15.1 %*	*20.8 %*	***16.3 %***
Finance and business service settlements	GVA (millions of Rands)	7,955	1,171	23,226	6,150	26,236	16,880	64,828	39,502	**185,947**
	% share (relative to total of settlement type)	*4.3 %*	*0.6 %*	*12.5 %*	*3.3 %*	*14.1 %*	*9.1 %*	*34.9 %*	*21.2 %*	**100.0 %**
	% access to national sector total	*11.9 %*	*0.5 %*	*6.3 %*	*8.9 %*	*6.8 %*	*7.1 %*	*11.9 %*	*6.9 %*	***7.5 %***
General government settlements	GVA (millions of Rands)	3,324	605	1,510	2,005	5,931	2,720	3,722	3,7531	**5,7348**
	% share (relative to total of settlement type)	*5.8 %*	*1.1 %*	*2.6 %*	*3.5 %*	*10.3 %*	*4.7 %*	*6.5 %*	*65.4 %*	**100.0 %**
	% access to national sector total	*5.0 %*	*0.3 %*	*0.4 %*	*2.9 %*	*1.5 %*	*1.1 %*	*0.7 %*	*6.5 %*	***2.3 %***
Metropolitan settlements	GVA (millions of Rands)	12,739	17,882	252,699	34,573	227,908	160,993	394,274	338,329	**1,439,397**
	% share (relative to total of settlement type)	*0.9 %*	*1.2 %*	*17.6 %*	*2.4 %*	*15.8 %*	*11.2 %*	*27.4 %*	*23.5 %*	**100.0 %**
	% access to national sector total	*19.0 %*	*7.9 %*	*68.5 %*	*50.1 %*	*59.1 %*	*67.8 %*	*72.4 %*	*58.7 %*	***58.1 %***
Traditional settlements	GVA (millions of Rands)	26,727	89,642	78,020	20,459	97,379	59,015	113,931	197,362	**682,535**
	% share (relative to total of settlement type)	*3.9 %*	*13.1 %*	*11.4 %*	*3.0 %*	*14.3 %*	*8.6 %*	*16.7 %*	*28.9 %*	**100.0 %**
	% access to national sector total	*39.9 %*	*39.5 %*	*21.1 %*	*29.7 %*	*25.2 %*	*24.9 %*	*20.9 %*	*34.3 %*	***27.6 %***
National settlement-based economic activity (All settlements in analysis subset)	**GVA (millions of Rands)**	**66,913**	**226,765**	**369,127**	**68,943**	**385,696**	**237,341**	**544,542**	**576,059**	**2,475,385**
	% share (relative to national settlement-based total)	***2.7 %***	***9.2 %***	***14.9 %***	***2.8 %***	***15.6 %***	***9.6 %***	***22.0 %***	***23.3 %***	100.0 %

*Measured at constant 2010 prices, according to inflation-related adjustments of Quantec data

Table 36: *Absolute and relative change in settlement-based economic activity by economic sector and settlement type between 2001 and 2011*

Settlement type	Economic activity (GVA) (SIC 1–4 and SIC 6–9)	SIC 1	SIC 2	SIC 3	SIC 4	SIC 6	SIC 7	SIC 8	SIC 9	Total
Agricultural settlements	Absolute growth (millions of Rands)*	1,974	-97	655	209	1,204	841	1,523	2,171	**8,480**
	Relative growth	*31.9 %*	*-14.4 %*	*37.1 %*	*24.2 %*	*48.2 %*	*53.5 %*	*75.3 %*	*40.7 %*	***40.5 %***
Mining settlements	Absolute growth	616	-5,467	7,683	2,844	8,258	5,353	9,517	8,367	**37,170**
	Relative growth	*30.0 %*	*-3.0 %*	*43.2 %*	*35.3 %*	*42.4 %*	*60.6 %*	*63.4 %*	*38.7 %*	***13.5 %***
Manufacturing settlements	Absolute growth	4,489	-1,152	29,183	3,818	29,003	24,243	38,517	35,875	**163,977**
	Relative growth	*29.0 %*	*-3.0 %*	*27.3 %*	*21.9 %*	*49.3 %*	*57.6 %*	*70.4 %*	*38.4 %*	***38.3 %***
Wholesale and retail trade settlements	Absolute growth	2,467	-12,726	8,664	2,490	26,424	11,532	32,613	31,772	**103,235**
	Relative growth	*26.8 %*	*-39.6 %*	*32.7 %*	*24.8 %*	*41.3 %*	*52.9 %*	*65.6 %*	*36.2 %*	***34.3 %***
Finance and business service settlements	Absolute growth	1,732	54	4,434	1,383	8,178	6,673	25,419	11,583	**59,456**
	Relative growth	*27.8 %*	*4.8 %*	*23.6 %*	*29.0 %*	*45.3 %*	*65.4 %*	*64.5 %*	*41.5 %*	***47.0 %***
General government settlements	Absolute growth	790	-71	243	514	1,574	881	1,539	9,598	**15,067**
	Relative growth	*31.2 %*	*-10.6 %*	*19.2 %*	*34.4 %*	*36.1 %*	*47.9 %*	*70.5 %*	*34.4 %*	***35.6 %***
Metropolitan settlements	Absolute growth	3,119	2,645	49,334	7,217	73,390	59,924	157,946	98,082	**451,659**
	Relative growth	*32.4 %*	*17.4 %*	*24.3 %*	*26.4 %*	*47.5 %*	*59.3 %*	*66.8 %*	*40.8 %*	***45.7 %***
Traditional settlements	Absolute growth	7,395	12,990	15,231	3,558	28,438	21,101	45,946	52,321	**186,982**
	Relative growth	*38.3 %*	*16.9 %*	*24.3 %*	*21.1 %*	*41.3 %*	*55.7 %*	*67.6 %*	*36.1 %*	***37.7 %***
National settlement-based economic activity (All settlements in analysis subset)	**Absolute growth**	**22,581**	**-3,824**	**115,427**	**22,033**	**176,469**	**130,549**	**313,020**	**249,770**	**1,026,025**
	Relative growth	***32.0 %***	***-1.1 %***	***26.3 %***	***25.3 %***	***45.2 %***	***57.9 %***	***67.0 %***	***38.5 %***	***38.3 %***

*Measured at constant 2010 prices, according to inflation-related adjustments of Quantec data

APPENDIX E: DETAILED ANALYSIS RESULTS OF WORKING-AGE POPULATION SHIFTS BY SETTLEMENT TYPE BETWEEN 2001 AND 2011

The detailed analysis results of working-age population shifts by settlement type between 2001 and 2011, across the four demographic and socio-economic variables, namely, age (**Table 37**, **Table 38** and **Table 39**), gender (**Table 40**, **Table 41** and **Table 42**), employment status (**Table 43**, **Table 44** and **Table 45**) and highest level of education (a proxy for skill level) (**Table 46**, **Table 47** and **Table 48**) are presented in this section.

Working-age population shifts by age bracket and settlement type

Table 37 shows the working-age population totals and proportional share by settlement type and age bracket for 2001, while **Table 38** show figures for 2011. In both **Table 37** and **Table 38**, the proportional share of population by age bracket is given in two ways, firstly as a share of the settlement type working-age population, and secondly as a share of the national settlement-based (i.e., all settlements in the analysis subset) working-age population. **Table 39** shows the absolute and relative change in working-age population by settlement type and age bracket between 2001 and 2011.

Table 37: *Working-age population and proportional share by age bracket and settlement type, 2001*

Settlement type	Working-age population	15–24 years	25–34 years	35–64 years	All working-age (Total)
Agricultural settlements	Population	38,428	33,598	56,892	**128,918**
	% share (relative to this settlement type)	*29.8 %*	*26.1 %*	*44.1 %*	***100.0 %***
	% share (relative to all settlements)	*0.2 %*	*0.1 %*	*0.2 %*	***0.5 %***
Mining settlements	Population	252,619	257,173	426,374	**936,166**
	% share (relative to this settlement type)	*27.0 %*	*27.5 %*	*45.5 %*	***100.0 %***
	% share (relative to all settlements)	*1.0 %*	*1.0 %*	*1.7 %*	***3.7 %***
Manufacturing settlements	Population	806,586	707,575	1,134,565	**2,648,726**
	% share (relative to this settlement type)	*30.5 %*	*26.7 %*	*42.8 %*	***100.0 %***
	% share (relative to all settlements)	*3.2 %*	*2.8 %*	*4.5 %*	***10.5 %***
Wholesale and retail trade settlements	Population	893,327	685,391	1,126,873	**2,705,590**
	% share (relative to this settlement type)	*33.0 %*	*25.3 %*	*41.6 %*	***100.0 %***
	% share (relative to all settlements)	*3.5 %*	*2.7 %*	*4.5 %*	***10.7 %***
Finance and business service settlements	Population	178,600	152,221	253,502	**584,323**
	% share (relative to this settlement type)	*30.6 %*	*26.1 %*	*43.4 %*	***100.0 %***
	% share (relative to all settlements)	*0.7 %*	*0.6 %*	*1.0 %*	***2.3 %***
General government settlements	Population	154,245	99,551	157,825	**411,621**
	% share (relative to this settlement type)	*37.5 %*	*24.2 %*	*38.3 %*	***100.0 %***
	% share (relative to all settlements)	*0.6 %*	*0.4 %*	*0.6 %*	***1.6 %***
Metropolitan settlements	Population	3,135,565	3,118,285	4,682,454	**10,936,304**
	% share (relative to this settlement type)	*28.7 %*	*28.5 %*	*42.8 %*	***100.0 %***
	% share (relative to all settlements)	*12.4 %*	*12.3 %*	*18.5 %*	***43.3 %***
Traditional settlements	Population	2,922,556	1,427,312	2,579,549	**6,929,416**
	% share (relative to this settlement type)	*42.2 %*	*20.6 %*	*37.2 %*	***100.0 %***
	% share (relative to all settlements)	*11.6 %*	*5.6 %*	*10.2 %*	***27.4 %***
National settlement-based population (All settlements in analysis subset)	**Population**	**8,381,925**	**6,481,105**	**10,418,035**	**25,281,065**
	% share (relative to national settlement-based total)	***33.2 %***	***25.6 %***	***41.2 %***	***100.0 %***

Table 38: Working-age population and proportional share by age bracket and settlement type, 2011

Settlement type	Working-age population	15–24 years	25–34 years	35–64 years	All working-age (Total)
Agricultural settlements	Population	51,463	45,379	80,937	**177,780**
	% share (relative to this settlement type)	*28.9 %*	*25.5 %*	*45.5 %*	***100.0 %***
	% share (relative to all settlements)	*0.2 %*	*0.1 %*	*0.3 %*	**0.6 %**
Mining settlements	Population	335,995	363,018	541,476	**1,240,489**
	% share (relative to this settlement type)	*27.1 %*	*29.3 %*	*43.7 %*	***100.0 %***
	% share (relative to all settlements)	*1.1 %*	*1.2 %*	*1.7 %*	**4.0 %**
Manufacturing settlements	Population	1,005,220	932,256	1,518,474	**3,455,951**
	% share (relative to this settlement type)	*29.1 %*	*27.0 %*	*43.9 %*	***100.0 %***
	% share (relative to all settlements)	*3.2 %*	*3.0 %*	*4.9 %*	**11.1 %**
Wholesale and retail trade settlements	Population	1,049,265	872,540	1,475,584	**3,397,390**
	% share (relative to this settlement type)	*30.9 %*	*25.7 %*	*43.4 %*	***100.0 %***
	% share (relative to all settlements)	*3.4 %*	*2.8 %*	*4.7 %*	**10.9 %**
Finance and business service settlements	Population	238,455	220,473	367,745	**826,673**
	% share (relative to this settlement type)	*28.8 %*	*26.7 %*	*44.5 %*	***100.0 %***
	% share (relative to all settlements)	*0.8 %*	*0.7 %*	*1.2 %*	**2.7 %**
General government settlements	Population	178,247	124,510	204,980	**507,737**
	% share (relative to this settlement type)	*35.1 %*	*24.5 %*	*40.4 %*	***100.0 %***
	% share (relative to all settlements)	*0.6 %*	*0.4 %*	*0.7 %*	**1.6 %**
Metropolitan settlements	Population	3,778,945	4,125,158	6,079,147	**13,983,250**
	% share (relative to this settlement type)	*27.0 %*	*29.5 %*	*43.5 %*	***100.0 %***
	% share (relative to all settlements)	*12.1 %*	*13.2 %*	*19.5 %*	**44.9 %**
Traditional settlements	Population	2,964,646	1,672,010	2,917,607	**7,554,263**
	% share (relative to this settlement type)	*39.2 %*	*22.1 %*	*38.6 %*	***100.0 %***
	% share (relative to all settlements)	*9.5 %*	*5.4 %*	*9.4 %*	**24.3 %**
National settlement-based population (All settlements in analysis subset)	**Population**	**9,602,238**	**8,355,344**	**13,185,951**	**31,143,533**
	% share (relative to national settlement-based total)	***30.8 %***	***26.8 %***	***42.3 %***	**100.0 %**

Table 39: *Absolute and relative change in working-age population by age bracket and settlement type between 2001 and 2011*

Settlement type	Change in working-age population (15–64 years)	15–24 years	25–34 years	35–64 years	All working-age (Total)
Agricultural settlements	Absolute growth	13,035	11,780	24,045	**48,861**
	Relative growth	*33.9 %*	*35.1 %*	*42.3 %*	***37.9 %***
Mining settlements	Absolute growth	83,376	105,845	115,102	**304,324**
	Relative growth	*33.0 %*	*41.2 %*	*27.0 %*	***32.5 %***
Manufacturing settlements	Absolute growth	198,634	224,681	383,909	**807,225**
	Relative growth	*24.6 %*	*31.8 %*	*33.8 %*	***30.5 %***
Wholesale and retail trade settlements	Absolute growth	155,939	187,150	348,711	**691,799**
	Relative growth	*17.5 %*	*27.3 %*	*30.9 %*	***25.6 %***
Finance and business service settlements	Absolute growth	59,855	68,252	114,243	**242,350**
	Relative growth	*33.5 %*	*44.8 %*	*45.1 %*	***41.5 %***
General government settlements	Absolute growth	24,002	24,958	47,155	**96,116**
	Relative growth	*15.6 %*	*25.1 %*	*29.9 %*	***23.4 %***
Metropolitan settlements	Absolute growth	643,380	1,006,873	1,396,693	**3,046,946**
	Relative growth	*20.5 %*	*32.3 %*	*29.8 %*	***27.9 %***
Traditional settlements	Absolute growth	42,090	244,699	338,058	**624,847**
	Relative growth	*1.4 %*	*17.1 %*	*13.1 %*	***9.0 %***
National settlement-based population (All settlements in analysis subset)	**Absolute growth**	**1,220,312**	**1,874,239**	**2,767,916**	**5,862,468**
	Relative growth	***14.6 %***	***28.9 %***	***26.6 %***	***23.2 %***

Working-age population shifts by gender and settlement type

Table 40 and **Table 41** show the settlement-based working-age population of South Africa for 2001 and 2011 by settlement type and gender. The proportional share of settlement-based working-age population is also given by settlement type, firstly in relation to the settlement type working-age population, and secondly in relation to the national settlement-based working-age population, considering all settlements in the analysis subset. **Table 42** shows the absolute and relative change in working-age population by gender and settlement type between 2001 and 2011.

Table 40: *Working-age population and proportional share by gender and settlement type, 2001*

Settlement type	Working-age population (15–64 years)	Male	Female	All working-age (Total)
Agricultural settlements	Working-age population	60,655	68,267	**128,923**
	% share (relative to this settlement type)	*47.0 %*	*53.0 %*	***100.0 %***
	% share (relative to all settlements)	*0.2 %*	*0.3 %*	***0.5 %***
Mining settlements	Working-age population	481,821	454,332	**936,153**
	% share (relative to this settlement type)	*51.5 %*	*48.5 %*	***100.0 %***
	% share (relative to all settlements)	*1.9 %*	*1.8 %*	***3.7 %***
Manufacturing settlements	Working-age population	1,273,165	1,375,544	**2,648,709**
	% share (relative to this settlement type)	*48.1 %*	*51.9 %*	***100.0 %***
	% share (relative to all settlements)	*5.0 %*	*5.4 %*	***10.5 %***
Wholesale and retail trade settlements	Working-age population	1,263,468	1,442,129	**2,705,597**
	% share (relative to this settlement type)	*46.7 %*	*53.3 %*	***100.0 %***
	% share (relative to all settlements)	*5.0 %*	*5.7 %*	***10.7 %***
Finance and business service settlements	Working-age population	280,959	303,374	**584,332**
	% share (relative to this settlement type)	*48.1 %*	*51.9 %*	***100.0 %***
	% share (relative to all settlements)	*1.1 %*	*1.2 %*	***2.3 %***
General government settlements	Working-age population	186,763	224,868	**411,631**
	% share (relative to this settlement type)	*45.4 %*	*54.6 %*	***100.0 %***
	% share (relative to all settlements)	*0.7 %*	*0.9 %*	***1.6 %***
Metropolitan settlements	Working-age population	5,377,197	5,559,164	**10,936,361**
	% share (relative to this settlement type)	*49.2 %*	*50.8 %*	***100.0 %***
	% share (relative to all settlements)	*21.3 %*	*22.0 %*	***43.3 %***
Traditional settlements	Working-age population	2,979,029	3,950,308	**6,929,337**
	% share (relative to this settlement type)	*43.0 %*	*57.0 %*	***100.0 %***
	% share (relative to all settlements)	*11.8 %*	*15.6 %*	***27.4 %***
National settlement-based population (All settlements in analysis subset)	**Working-age population**	**11,903,057**	**13,377,986**	**25,281,043**
	% share (relative to national settlement-based total)	***47.1 %***	***52.9 %***	100.0 %

Table 41: *Working-age population and proportional share by gender and settlement type, 2011*

Settlement type	Working-age population (15–64 years)	Male	Female	All working-age (Total)
Agricultural settlements	Working-age population	86,275	91,493	**177,768**
	% share (relative to this settlement type)	*48.5 %*	*51.5 %*	***100.0 %***
	% share (relative to all settlements)	*0.3 %*	*0.3 %*	***0.6 %***
Mining settlements	Working-age population	658,489	581,993	**1,240,482**
	% share (relative to this settlement type)	*53.1 %*	*46.9 %*	***100.0 %***
	% share (relative to all settlements)	*2.1 %*	*1.9 %*	***4.0 %***
Manufacturing settlements	Working-age population	1,696,353	1,759,597	**3,455,950**
	% share (relative to this settlement type)	*49.1 %*	*50.9 %*	***100.0 %***
	% share (relative to all settlements)	*5.4 %*	*5.6 %*	***11.1 %***
Wholesale and retail trade settlements	Working-age population	1,614,445	1,782,970	**3,397,415**
	% share (relative to this settlement type)	*47.5 %*	*52.5 %*	***100.0 %***
	% share (relative to all settlements)	*5.2 %*	*5.7 %*	***10.9 %***
Finance and business service settlements	Working-age population	406,570	420,094	**826,664**
	% share (relative to this settlement type)	*49.2 %*	*50.8 %*	***100.0 %***
	% share (relative to all settlements)	*1.3 %*	*1.3 %*	***2.7 %***
General government settlements	Working-age population	235,933	271,808	**507,741**
	% share (relative to this settlement type)	*46.5 %*	*53.5 %*	***100.0 %***
	% share (relative to all settlements)	*0.8 %*	*0.9 %*	***1.6 %***
Metropolitan settlements	Working-age population	6,965,788	7,017,441	**13,983,229**
	% share (relative to this settlement type)	*49.8 %*	*50.2 %*	***100.0 %***
	% share (relative to all settlements)	*22.4 %*	*22.5 %*	***44.9 %***
Traditional settlements	Working-age population	3,375,912	4,178,344	**7,554,256**
	% share (relative to this settlement type)	*44.7 %*	*55.3 %*	***100.0 %***
	% share (relative to all settlements)	*10.8 %*	*13.4 %*	***24.3 %***
National settlement-based population (All settlements in analysis subset)	**Working-age population**	**15,039,765**	**16,103,739**	**31,143,504**
	% share (relative to national settlement-based total)	***48.3 %***	***51.7 %***	**100.0 %**

Table 42: *Absolute and relative change in working-age population by gender and settlement type between 2001 and 2011*

Settlement type	Change in working-age population (15–64 years)	Male	Female	All working-age (Total)
Agricultural settlements	Absolute growth	25,619	23,226	**48,845**
	Relative growth (%)	*42.2 %*	*34.0 %*	***37.9 %***
Mining settlements	Absolute growth	176,668	127,661	**304,330**
	Relative growth	*36.7 %*	*28.1 %*	***32.5 %***
Manufacturing settlements	Absolute growth	423,188	384,053	**807,241**
	Relative growth	*33.2 %*	*27.9 %*	***30.5 %***
Wholesale and retail trade settlements	Absolute growth	350,977	340,841	**691,818**
	Relative growth	*27.8 %*	*23.6 %*	***25.6 %***
Finance and business service settlements	Absolute growth	125,611	116,720	**242,331**
	Relative growth	*44.7 %*	*38.5 %*	***41.5 %***
General government settlements	Absolute growth	49,170	46,940	**96,109**
	Relative growth	*26.3 %*	*20.9 %*	***23.3 %***
Metropolitan settlements	Absolute growth	1,588,591	1,458,277	**3,046,868**
	Relative growth	*29.5 %*	*26.2 %*	***27.9 %***
Traditional settlements	Absolute growth	396,883	228,035	**624,918**
	Relative growth	*13.3 %*	*5.8 %*	***9.0 %***
National settlement-based population (All settlements in analysis subset)	**Absolute growth**	**3,136,708**	**2,725,753**	**5,862,461**
	Relative growth	***26.4 %***	***20.4 %***	***23.2 %***

Working-age population shifts by employment status and settlement type

Table 43 and **Table 44** show the settlement-based working-age population of South Africa for 2001 and 2011 by settlement type and employment status. **Table 45** shows the absolute and relative change in working-age population by settlement type and employment status between 2001 and 2011.

***Table 43:** Working-age population and proportional share by employment status and settlement type, 2001*

Settlement type	Working-age population (15–64 years)	Employed	Unemployed	Not economically active	All working-age (Total)
Agricultural settlements	Working-age population	49,575	33,434	45,907	**128,916**
	% share (relative to this settlement type)	*38.5 %*	*25.9 %*	*35.6 %*	***100.0 %***
	% share (relative to all settlements)	*0.2 %*	*0.1 %*	*0.2 %*	***0.5 %***
Mining settlements	Working-age population	385,006	273,855	277,293	**936,154**
	% share (relative to this settlement type)	*41.1 %*	*29.3 %*	*29.6 %*	***100.0 %***
	% share (relative to all settlements)	*1.5 %*	*1.1 %*	*1.1 %*	***3.7 %***
Manufacturing settlements	Working-age population	983,611	788,103	876,964	**2,648,679**
	% share (relative to this settlement type)	*37.1 %*	*29.8 %*	*33.1 %*	***100.0 %***
	% share (relative to all settlements)	*3.9 %*	*3.1 %*	*3.5 %*	***10.5 %***
Wholesale and retail trade settlements	Working-age population	864,677	839,228	1,001,657	**2,705,562**
	% share (relative to this settlement type)	*32.0 %*	*31.0 %*	*37.0 %*	***100.0 %***
	% share (relative to all settlements)	*3.4 %*	*3.3 %*	*4.0 %*	***10.7 %***
Finance and business service settlements	Working-age population	231,700	148,234	204,392	**584,325**
	% share (relative to this settlement type)	*39.7 %*	*25.4 %*	*35.0 %*	***100.0 %***
	% share (relative to all settlements)	*0.9 %*	*0.6 %*	*0.8 %*	***2.3 %***
General government settlements	Working-age population	92,171	139,491	179,962	**411,625**
	% share (relative to this settlement type)	*22.4 %*	*33.9 %*	*43.7 %*	***100.0 %***
	% share (relative to all settlements)	*0.4 %*	*0.6 %*	*0.7 %*	***1.6 %***
Metropolitan settlements	Working-age population	4,650,209	3,211,601	3,074,548	**10,936,359**
	% share (relative to this settlement type)	*42.5 %*	*29.4 %*	*28.1 %*	***100.0 %***
	% share (relative to all settlements)	*18.4 %*	*12.7 %*	*12.2 %*	***43.3 %***
Traditional settlements	Working-age population	823,586	2,338,338	3,767,254	**6,929,178**
	% share (relative to this settlement type)	*11.9 %*	*33.7 %*	*54.4 %*	***100.0 %***
	% share (relative to all settlements)	*3.3 %*	*9.2 %*	*14.9 %*	***27.4 %***
National settlement-based population (All settlements in analysis subset)	**Working-age population**	**8,080,536**	**7,772,284**	**9,427,977**	**25,280,797**
	% share (relative to national settlement-based total)	***32.0 %***	***30.7 %***	***37.3 %***	100.0 %

Table 44: *Working-age population and proportional share by employment status and settlement type, 2011*

Settlement type	Working-age population (15–64 years)	Employed	Unemployed	NEA	All working-age (Total)
Agricultural settlements	Working-age population	74,528	38,685	64,569	**177,783**
	% share (relative to this settlement type)	*41.9 %*	*21.8 %*	*36.3 %*	***100.0 %***
	% share (relative to all settlements)	*0.2 %*	*0.1 %*	*0.2 %*	***0.6 %***
Mining settlements	Working-age population	569,251	306,722	364,524	**1,240,497**
	% share (relative to this settlement type)	*45.9 %*	*24.7 %*	*29.4 %*	***100.0 %***
	% share (relative to all settlements)	*1.8 %*	*1.0 %*	*1.2 %*	***4.0 %***
Manufacturing settlements with	Working-age population	1,461,294	865,798	1,128,841	**3,455,934**
	% share (relative to this settlement type)	*42.3 %*	*25.1 %*	*32.7 %*	***100.0 %***
	% share (relative to all settlements)	*4.7 %*	*2.8 %*	*3.6 %*	***11.1 %***
Wholesale and retail trade settlements	Working-age population	1,250,027	878,047	1269,318	**3,397,392**
	% share (relative to this settlement type)	*36.8 %*	*25.8 %*	*37.4 %*	***100.0 %***
	% share (relative to all settlements)	*4.0 %*	*2.8 %*	*4.1 %*	***10.9 %***
Finance and business service settlements	Working-age population	358,992	197,625	270,060	**826,678**
	% share (relative to this settlement type)	*43.4 %*	*23.9 %*	*32.7 %*	***100.0 %***
	% share (relative to all settlements)	*1.2 %*	*0.6 %*	*0.9 %*	***2.7 %***
General government settlements	Working-age population	141,748	143,394	222,593	**507,734**
	% share (relative to this settlement type)	*27.9 %*	*28.2 %*	*43.8 %*	***100.0 %***
	% share (relative to all settlements)	*0.5 %*	*0.5 %*	*0.7 %*	***1.6 %***
Metropolitan settlements	Working-age population	6,705,421	3,485,866	3,791,938	**13,983,225**
	% share (relative to this settlement type)	*48.0 %*	*24.9 %*	*27.1 %*	***100.0 %***
	% share (relative to all settlements)	*21.5 %*	*11.2 %*	*12.2 %*	***44.9 %***
Traditional settlements	Population	1,267,637	2,360,453	3,926,064	**7,554,154**
	% share (relative to this settlement type)	*16.8 %*	*31.2 %*	*52.0 %*	***100.0 %***
	% share (relative to all settlements)	*4.1 %*	*7.6 %*	*12.6 %*	***24.3 %***
National settlement-based population (All settlements in analysis subset)	**Working-age population**	**11,828,899**	**8,276,590**	**11,037,907**	**31,143,396**
	% share (relative to national settlement-based total)	***38.0 %***	***26.6 %***	***35.4 %***	***100.0 %***

Table 45: *Absolute and relative change in working-age population by employment status and settlement type between 2001 and 2011*

Settlement type	Change in working-age population (15–64 years)	Employed	Unemployed	NEA	All working-age (Total)
Agricultural settlements	Absolute growth	24,953	5,251	18,663	**48,867**
	Relative growth	*50.3 %*	*15.7 %*	*40.7 %*	***37.9 %***
Mining settlements	Absolute growth	184,245	32,867	87,230	**304,343**
	Relative growth	*47.9 %*	*12.0 %*	*31.5 %*	***32.5 %***
Manufacturing settlements	Absolute growth	477,683	77,695	251,877	**807,255**
	Relative growth	*48.6 %*	*9.9 %*	*28.7 %*	***30.5 %***
Wholesale and retail trade settlements	Absolute growth	385,350	38,818	267,662	**691,830**
	Relative growth	*44.6 %*	*4.6 %*	*26.7 %*	***25.6 %***
Finance and business service settlements	Absolute growth	127,293	49,391	65,669	**242,353**
	Relative growth	*54.9 %*	*33.3 %*	*32.1 %*	***41.5 %***
General government settlements	Absolute growth	49,576	3,903	42,631	**96,110**
	Relative growth	*53.8 %*	*2.8 %*	*23.7 %*	***23.3 %***
Metropolitan settlements	Absolute growth	2,055,211	74,265	717,390	**3,046,866**
	Relative growth	*44.2 %*	*8.5 %*	*23.3 %*	***27.9 %***
Traditional settlements	Absolute growth	444,051	22,115	158,809	**624,976**
	Relative growth	*53.9 %*	*0.9 %*	*4.2 %*	***9.0 %***
National settlement-based population (All settlements in analysis subset)	**Absolute growth**	**3,748,363**	**504,306**	**1,609,930**	**5,862,599**
	Relative growth	***46.4 %***	***6.5 %***	***17.1 %***	***23.2 %***

Working-age population shifts by skill level and settlement type

Table 46 and **Table 47** show the settlement-based working-age population of South Africa for 2001 and 2011 respectively by settlement type and skill level. **Table 48** shows the absolute and relative change in working-age population by settlement type and skill level between 2001 and 2011.

Table 46: *Working-age population and proportional share by skill level and settlement type, 2001*

Settlement type	Working-age population (15–64 years)	Unskilled	Basic-skilled	Semi-skilled	Highly skilled	All working-age (Total)
Agricultural settlements	Working-age population	40,619	61,104	25,392	1,804	**128,919**
	% share (relative to this settlement type)	*31.5 %*	*47.4 %*	*19.7 %*	*1.4 %*	***100.0 %***
	% share (relative to all settlements)	*0.2 %*	*0.2 %*	*0.1 %*	*0.0 %*	***0.5 %***
Mining settlements	Working-age population	243,637	424,417	250,806	17,278	**936,138**
	% share (relative to this settlement type)	*26.0 %*	*45.3 %*	*26.8 %*	*1.8 %*	***100.0 %***
	% share (relative to all settlements)	*1.0 %*	*1.7 %*	*1.0 %*	*0.1 %*	***3.7 %***
Manufacturing settlements	Working-age population	609,624	1,222,791	755,007	61,282	**2,648,704**
	% share (relative to this settlement type)	*23.0 %*	*46.2 %*	*28.5 %*	*2.3 %*	***100.0 %***
	% share (relative to all settlements)	*2.4 %*	*4.8 %*	*3.0 %*	*0.2 %*	***10.5 %***
Wholesale and retail trade settlements	Working-age population	750,640	1,209,764	682,660	62,547	**2,705,611**
	% share (relative to this settlement type)	*27.7 %*	*44.7 %*	*25.2 %*	*2.3 %*	***100.0 %***
	% share (relative to all settlements)	*3.0 %*	*4.8 %*	*2.7 %*	*0.2 %*	***10.7 %***
Finance and business service settlements	Working-age population	135,473	260,549	167,023	21,290	**584,336**
	% share (relative to this settlement type)	*23.2 %*	*44.6 %*	*28.6 %*	*3.6 %*	***100.0 %***
	% share (relative to all settlements)	*0.5 %*	*1.0 %*	*0.7 %*	*0.1 %*	***2.3 %***
General government settlements	Working-age population	128,724	180,224	95,348	7,330	**411,625**
	% share (relative to this settlement type)	*31.3 %*	*43.8 %*	*23.2 %*	*1.8 %*	***100.0 %***
	% share (relative to all settlements)	*0.5 %*	*0.7 %*	*0.4 %*	*0.0 %*	***1.6 %***
Metropolitan settlements	Working-age population	1,856,800	4,935,774	3,673,924	469,826	**10,936,323**
	% share (relative to this settlement type)	*17.0 %*	*45.1 %*	*33.6 %*	*4.3 %*	***100.0 %***
	% share (relative to all settlements)	*7.3 %*	*19.5 %*	*14.5 %*	*1.9 %*	***43.3 %***
Traditional settlements	Working-age population	3,043,207	2,977,040	869,964	38,822	**6,929,003**
	% share (relative to this settlement type)	*43.9 %*	*43.0 %*	*12.6 %*	*0.6 %*	***100.0 %***
	% share (relative to all settlements)	*12.0 %*	*11.8 %*	*3.4 %*	*0.2 %*	***27.4 %***
National settlement-based population (All settlements in analysis subset)	**Working-age population**	**6,808,725**	**11,271,663**	**6,520,122**	**680,178**	**25,280,688**
	% share (relative to national settlement-based total)	***26.9 %***	***44.6 %***	***25.8 %***	***2.7 %***	***100.0 %***

Table 47: *Working-age population and proportional share by skill level and settlement type, 2011*

Settlement type	Working-age population (15–64 years)	Unskilled	Basic-skilled	Semi-skilled	Highly skilled	All working-age (Total)
Agricultural settlements	Working-age population	38,161	89,264	41,943	5,071	**174,438**
	% share (relative to this settlement type)	*21.9 %*	*51.2 %*	*24.0 %*	*2.9 %*	***100.0 %***
	% share (relative to all settlements)	*0.1 %*	*0.3 %*	*0.1 %*	*0.0 %*	***0.6 %***
Mining settlements	Working-age population	175,229	547,244	429,079	56,221	**1,207,772**
	% share (relative to this settlement type)	*14.5 %*	*45.3 %*	*35.5 %*	*4.7 %*	***100.0 %***
	% share (relative to all settlements)	*0.6 %*	*1.8 %*	*1.4 %*	*0.2 %*	***4.0 %***
Manufacturing settlements	Working-age population	466,070	1,508,661	1,205,280	186,836	**3,366,846**
	% share (relative to this settlement type)	*13.8 %*	*44.8 %*	*35.8 %*	*5.5 %*	***100.0 %***
	% share (relative to all settlements)	*1.5 %*	*4.9 %*	*3.9 %*	*0.6 %*	***11.0 %***
Wholesale and retail trade settlements	Working-age population	553,579	1,519,324	1,039,313	183,434	**3,295,651**
	% share (relative to this settlement type)	*16.8 %*	*46.1 %*	*31.5 %*	*5.6 %*	***100.0 %***
	% share (relative to all settlements)	*1.8 %*	*5.0 %*	*3.4 %*	*0.6 %*	***10.8 %***
Finance and business service settlements	Working-age population	114,775	364,160	262,167	59,956	**801,059**
	% share (relative to this settlement type)	*14.3 %*	*45.5 %*	*32.7 %*	*7.5 %*	***100.0 %***
	% share (relative to all settlements)	*0.4 %*	*1.2 %*	*0.9 %*	*0.2 %*	***2.6 %***
General government settlements	Working-age population	95,877	225,716	145,964	22,103	**489,661**
	% share (relative to this settlement type)	*19.6 %*	*46.1 %*	*29.8 %*	*4.5 %*	***100.0 %***
	% share (relative to all settlements)	*0.3 %*	*0.7 %*	*0.5 %*	*0.1 %*	***1.6 %***
Metropolitan settlements	Working-age population	1,241,794	5,762,794	5,384,448	1,284,295	**13,673,331**
	% share (relative to this settlement type)	*9.1 %*	*42.1 %*	*39.4 %*	*9.4 %*	***100.0 %***
	% share (relative to all settlements)	*4.1 %*	*18.9 %*	*17.6 %*	*4.2 %*	***44.8 %***
Traditional settlements	Working-age population	1,964,952	3,807,329	1,616,538	129,774	**7,518,594**
	% share (relative to this settlement type)	*26.1 %*	*50.6 %*	*21.5 %*	*1.7 %*	***100.0 %***
	% share (relative to all settlements)	*6.4 %*	*12.5 %*	*5.3 %*	*0.4 %*	***24.6 %***
National settlement-based population (All settlements in analysis subset)	**Working-age population**	**4,650,437**	**13,824,493**	**10,124,733**	**1,927,688**	**30,527,352**
	% share (relative to national settlement-based total)	***15.2 %***	***45.3 %***	***33.2 %***	***6.3 %***	***100.0 %***

Table 48: *Absolute and relative change in working-age population by skill level and settlement type between 2001 and 2011*

Settlement type	Change in working-age population (15–64 years)	Unskilled	Basic-skilled	Semi-skilled	Highly skilled	All working-age (Total)
Agricultural settlements	Absolute growth	-2,458	28,159	16,551	3,267	**45,519**
	Relative growth	*-6.1 %*	*46.1 %*	*65.2 %*	*181.1 %*	***35.3 %***
Mining settlements	Absolute growth	-68,409	122,828	178,273	38,943	**271,634**
	Relative growth	*-28.1 %*	*28.9 %*	*71.1 %*	*225.4 %*	***29.0 %***
Manufacturing settlements	Absolute growth	-143,554	285,870	450,273	125,554	**718,143**
	Relative growth	*-23.5 %*	*23.4 %*	*59.6 %*	*204.9 %*	***27.1 %***
Wholesale and retail trade settlements	Absolute growth	-197,061	309,560	356,654	120,887	**590,040**
	Relative growth	*-26.3 %*	*25.6 %*	*52.2 %*	*193.3 %*	***21.8 %***
Finance and business service settlements	Absolute growth	-20,698	103,611	95,145	38,666	**216,723**
	Relative growth	*-15.3 %*	*39.8 %*	*57.0 %*	*181.6 %*	***37.1 %***
General government settlements	Absolute growth	-32,847	45,492	50,617	14,774	**78,036**
	Relative growth	*-25.5 %*	*25.2 %*	*53.1 %*	*201.6 %*	***19.0 %***
Metropolitan settlements	Absolute growth	-615,006	827,020	1,710,525	814,469	**2,737,008**
	Relative growth	*-33.1 %*	*16.8 %*	*46.6 %*	*173.4 %*	***25.0 %***
Traditional settlements	Absolute growth	-1,078,256	830,290	746,575	90,952	**589,561**
	Relative growth	*-35.4 %*	*27.9 %*	*85.8 %*	*234.3 %*	***8.5 %***
National settlement-based population (All settlements in analysis subset)	**Absolute growth**	**-2,158,288**	**2,552,830**	**3,604,611**	**1,247,511**	**5,246,664**
	Relative growth	***-31.7 %***	***22.6 %***	***55.3 %***	***183.4 %***	***20.8 %***

APPENDIX F: OLD AND EQUIVALENT NEW NAMES OF SETTLEMENTS IN SOUTH AFRICA

The settlement naming convention adopted for this report was to use the most current official place names, including any changes after either the 2001 or 2011 censuses. For the benefit of the reader, **Table 49** and **Table 50** set out the old and equivalent new names of settlements and countries referred to in this report.

Table 49: *Old and equivalent new names of settlements in South Africa*

New Settlement Name	Old Settlement Name
Bela-Bela	Warmbaths
Bhisho	Bisho
eMakhazeni	Belfast
eMalahleni	Witbank
eMkhondo	Piet Retief
eNtokozweni	Machadodorp
Gqeberha	Port Elizabeth
Komani	Queenstown
Komani	Queenstown
KwaDukuza	Stanger
Lephalale	Ellisras
Mahikeng	Mafikeng
Makhado	Louis Trichardt
Makhanda	Grahamstown
Mashishing	Lydenburg
Mbombela	Nelspruit
Modimolle	Nylstroom
Mokopane	Potgietersrus
Mthatha	Umtata
Musina	Messina
Polokwane	Pietersburg
Senwabarwana	Bochum

Table 50: *Old and equivalent new names of countries neighbouring South Africa*

New Country Name	Old Country Name
Eswatini	Swaziland