Assessing the condition of unpaved rural road networks and the associated impacts on the livelihoods of rural communities: A case study of four rural communities in Kwa-Zulu Natal, South Africa.

S'phumelele Lucky Nkomo

A thesis submitted to the College of Agriculture, Engineering and Science, School of Agriculture, Earth and Environmental Sciences at the University of KwaZulu-Natal, in fulfilment of the academic requirements for the degree of Doctor of Philosophy in Geography

Pietermaritzburg

South Africa

January 2018

ABSTRACT

Unpaved road networks, also referred to as gravel or unsealed roads, form an integral function in terms of sustaining the well-being of rural livelihoods, particularly in remote rural areas. The socioeconomic spinoffs of improved rural road networks have been extensively researched in Asia, but not to the same extent in the African continent. Even though the South African economy has consistently been stronger than many countries in Africa, there is more research conducted in Kenya and Ghana on unpaved road network conditions when compared to South Africa. The present study therefore assesses the condition of rural road networks and the associated socioeconomic impacts on the livelihoods of rural areas within the province of KwaZulu-Natal. This study was conducted in four rural areas namely Emazabekweni, Dukuza, Mkhunya and Mhlwazini within the province of KwaZulu-Natal. Due to the complex nature of the research, a multidisciplinary approach was adopted in order to address the aim and objectives of this study. In addition, This study used both quantitative and qualitative methods in the data collection and analysis.

The first part of this study was an assessment of the physical conditions of the gravel road networks in rural communities in order to understand the physical, environmental and anthropogenic factors that influence the state of rural roads. Results showed that there was a direct relationship between road surface characteristics, drainage and maintenance conditions. The results further showed that the nature of road surface distresses was an indication of the influence of traffic and climatic conditions. The second part of this study focused on investigating some of the primary causes of poor road conditions on unpaved road networks. An assessment of surface material quality was performed on the road classes selected for this study in order to understand their susceptibility to surface deterioration. The results obtained indicated that there was a need for better material selection during the construction of unpaved road networks. Most of the road classes assessed had poor material quality, thus making them vulnerable to increased surface deterioration and maintenance costs.

The third part of this study assessed local respondents' perceptions on the socioeconomic role of their unpaved road networks on their livelihoods. The findings obtained perceived that local respondent’s perceptions on the socioeconomic role of unpaved road networks on their livelihoods are influenced by the effectiveness of their roads in servicing their needs. Less than ten percent of all the respondents perceived direct economic spinoffs as a result of road

networks improvements. Majority of the respondents perceived social spinoffs such as improving access to healthcare, education and market services.

Finally, this study identified and assessed the effectiveness of Community Based Maintenance Strategies that were utilised for routine maintenance of unpaved rural roads. The findings emphasised that Community Based Road Management Strategies such as the Zibambele Road Maintenance programme provides an alternative approach that was useful and can be effective on the maintenance of unpaved rural road networks. The major criticism for Community Based Road Management Strategies was that they lack sufficient prioritisation of personnel training and this justification was observed during the assessment of the Zibambele maintenance programme on the selected road lengths.

The overall findings of this study showed that community proximity to towns biasedly determined amongst others, quality of unpaved roads, access to services and the availability of opportunities for income diversification. In this study, the communities that are located close to a town had better quality road access in comparison to communities that are further away from a town. Similarly, these communities had better services and access to services in comparison to communities that are further away from the town. The findings of this study could be used to reassess some of the primary challenges affecting rural economic growth as well as social stability.

PREFACE

The present study was undertaken with the aim of assessing the condition of unpaved rural road networks and the associated impacts on the livelihoods of rural communities within the province of Kwa-Zulu Natal, South Africa. The thesis comprises six chapters in total, with four chapters conceptualised as stand-alone research articles that address each of the objectives listed in Section 1.3.

The articles making up chapter two to five have or will be sent to peer reviewed international journals: chapter two has been published as an article (*Review of Social Science Journal*), and chapter three to five are in preparation for submission. Articles in this study can be read independently from the rest of the thesis but draw conclusion, which are linked and related to the work as a whole. The paper approach used in this document conforms to the University of KwaZulu-Natal format however, to some degree repetition has been unavoidable, given the common thread of the papers.

- Chapter one is the general introduction and contextualisation of the study and serves to provide the background for the chapter that follow.

- Chapter two assesses the condition of unpaved rural road networks in the communities under study. The chapter identifies, classifies and assesses the road networks in order to determine their conditions. Since, unpaved roads are investigated as a subject in this study, the results of this chapter form the basis of the argument presented in this research.

- Chapter three focuses on assessing the surface material quality of unpaved rural roads to understand susceptibility to surface deterioration.

- Chapter four focuses on assessing local respondent's perceptions on the socioeconomic role of their unpaved road networks on their livelihoods. Without findings from chapter two and three, chapter four would have provided an incomplete analysis of the dynamics involved in this chapter. This chapter was paramount for assessing social and economic inequalities which are still prevalent in rural areas.

- Chapter five assesses the effectiveness of Community Based Road Management Strategies. This chapter focuses on identifying and assessing methods that are considered effective with the routine maintenance of unpaved roads in resource-limited areas. This chapter forms the basis for the road maintenance recommendations suggested in this study.

- Chapter six provides a synthesis of the research work.

DECLARATION 1

The research work described in this thesis was carried out in the School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal, Pietermaritzburg, from February 2015 to January 2018, under the supervision of Dr Sumaiya, A Desai (University of KwaZulu-Natal), Dr Kabir, Y Peerbhay (Institute for Commercial Forestry Research) and Dr Khoboso, E Seutloali (The National University of Lesotho).

I would like to declare that the research work reported in this thesis has never been submitted in any form to any other university. It therefore represents my original work except where due acknowledgments are made.

S'phumelele Lucky Nkomo Signed: _____ Date: _____

As the candidate's supervisor, I certify the above statement to be correct to my knowledge and have recommended this thesis for submission.

Dr S.A. Desai:……Date……

Dr K.Y. Peerbhay:……..Date…….

Dr K.E. Seutloali:……Date……

DECLARATION 2- PLAGIARISM

I, S'phumelele Lucky Nkomo, declare that:

1. The research reported in this thesis, except where otherwise indicated, is my original research.

2. This thesis has not been submitted for any degree or examination at any other university.

3. This thesis does not contain other persons' data, pictures, graphs, or other information, unless specifically acknowledged as being sourced from other persons.

4. This thesis does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:

a. Their words have been re-written, but the general information attributed to them has been referenced.

b. Where their exact words have been used, then their writing has been placed in italics and inside quotation marks, and referenced.

5. This thesis does not contain text, graphics, or tables copied and pasted from the Internet, unless specifically acknowledged and the source being detailed in the thesis and in the references section.

Signed_____

DECLARATION 3- MANUSCRIPTS

- **Nkomo, L.S**. Desai, S. A. and Peerbhay, K. Y. (2016) "Assessing the conditions of rural road networks in South Africa using visual observations and field-based manual measurements: A case study of four rural communities in KwaZulu-Natal Province" *Review of Social Science Journal*, 1(2), pp.42-55.

- **Nkomo, L.S**. Desai, S A. Peerbhay, K. Y. Seutloali, K. E and Haynes, T. (In review) "Assessing the surface material quality of unpaved rural roads to understand susceptibility to surface deterioration. A case study of four rural areas in KwaZulu-Natal, South Africa" The Journal of Transport and Land Use.

- **Nkomo, L.S.** Desai, S A. Peerbhay, K. Y. and Seutloali, K. E (In preparation) "A thematic analysis of local respondents' perceptions on the socioeconomic role of unpaved road networks on rural livelihoods. Lessons from rural communities within the province of KwaZulu-Natal, South Africa."

- **Nkomo, L.S.** Desai, S. A. Peerbhay, K. Y. and Seutloali, K.E (In preparation) "Assessing the effectiveness of Community Based Road Management Strategies, lesson from KwaZulu-Natal, South Africa".

DEDICATION

To my late mother Nomathemba, Remegia Nkomo, and

The following families

Muir,

Ngcobo,

Stuart,

Olliver,

Biggar,

Nero,

Fynns

Lyons,

Davids,

Gunkel,

Bentley and

Matheson.

ACKNOWLEDGEMENTS

This research would not have been possible to complete without the generous help and support of the following people and organisations, to whom I would like to extend my sincere appreciation:

I would like to thank God for giving me strength and wisdom to undertake this study.

My sincere appreciation and gratitude goes to my Supervisor's Dr Sumaiya Amod Desai, Dr Kabir Yunus Peerbhay and Dr Khoboso Elizabeth Seutloali. I would like to thank them for their guidance, support, trust and confidence in my abilities, and the valuable comments made throughout my research.

My appreciation is extended to the tribal leaders and the members of the communities where I undertook this research. Special thanks to the staff of the Discipline of Geography within the School of Agricultural, Earth and Environmental Sciences at the University of KwaZulu-Natal for their support. In particular, Mrs Shanitha Ramroop, Prof Heinz Beckedahl and Mr Donavan De Vos, are appreciated for their help and logistical support. Would also like to thank very special women who work at the University of KwaZulu-Natal for their support and love. To Mrs Hazel Rampaul, Mrs Tessa Abrahams, Mrs Priscilla Gouws and Mrs Heather Singh thank you for your support.

To my best friends Bradley De Bryun, Ernest Oakes and Damien Oakes thank you for your their support and encouragement throughout my study. My profound gratitude goes to my family (Mairi, Fiona, Eric, Caslyn, Lubanzi, Payton, Athandiwe and Justin) for their encouragement and support throughout the study period.

I would like to thank the National Research Foundation of South Africa for funding my research.

ACRONYMS

IFRTD	International Forum of Rural Transport and Development
EVD	Ebola Virus Disease
IDP	Integrated Development Plan
UBPL	Upper-Bound Poverty Line
SLA	Sustainable Livelihoods Approach
SL	Sustainable Livelihoods
KZN	KwaZulu-Natal
OLM	Okhahlamba Local Municipality
ULM	Ubuhlebezwe Local Municipality
RAI	Rural Accessibility Index
DoT	Department of Transport
SANRAL	South African National Roads Agency Limited
SPSS	Statistical Package for Social Sciences
GPS	Global Positioning System
TMH	Technical Recommendations for Highways
Sp	Shrinkage product
Gc	Grading coefficient
SRTM	Shuttle Radar Topography Mission
GDP	Gross domestic product
BRICS	Brazil, Russia, India, China and South Africa
PHC	Primary healthcare
TB	Tuberculosis
HIV/AIDS	Human Immunodeficiency Virus, Acquired Immunodeficiency Syndrome
PRA	Participatory Rural Appraisal
ABET	Adult Basic Education and Training
CBRMS	Community Based Road Management Strategies

Table of Contents

List of Figures

List of Tables

CHAPTER ONE

GENERAL INTRODUCTION

1.1. Background

Roads form part of the primary assets or services that are required in order to sustain rural livelihoods (Bryceson, 2002, Njenga and Davis, 2003, Sati and Vangchhia, 2017). According to Plessis-Fraissard (2010:1), *"rural roads have only relatively recently received attention in development research"*. Plessis-Fraissard (2010), argues that institutions such as the International Bank for Reconstruction and Development, or World Bank only started addressing third world issues in the early 1960s on their development agenda. Prior to the 1960s, these institutions only focused on large structural infrastructure development needs, of which rural roads received very little attention because they were mainly viewed as part of the agriculture sector investment. Lebo and Schelling (2001) indicate that in the late 1990s to early 2000s, approximately 900 million people in developing countries lived in rural areas that lacked reliable all-season roads and approximately 300 million lived in areas that were not accessible by any form of vehicle. Rural roads began to receive significant attention after the 1990s and institutions such as the International Forum of Rural Transport and Development (IFRTD) became influential in providing support to the rural transport sector in developing countries throughout the world (Booth et al., 2000). The sub-Saharan Africa Transport Partnership (SSATP) program has played an important role in facilitating policy development in the roads sector within Africa (Porter, 2007).

Rural roads are important in developing countries because they comprise more than 80% of the total road networks. In addition, they facilitate up to 90% of the total mobility in inland regions in developing countries (Bhattacharyay, 2009, Chakwizira et al., 2014). Statistics indicate that there are more people (over 63% of the population) living in rural areas than in urban areas in sub-Saharan Africa. Furthermore, statistics show that up to 90% of the population living in rural areas in Asia and sub-Saharan Africa are poor people (Kachouri et al., 2015). Up to half of the population living in sub-Saharan Africa are experiencing extreme poverty, surviving on less than one US dollar per day (Barrett and Swallow, 2006, Sharpe and Swanson, 2016). Studies have shown that much of rural poverty in developing countries is caused by isolation (Jazairy et al., 1992, Adams and Page, 2005, Chambers, 2014, Dixon, 2015). In the year 2000, a study was done on over 40, 000 poor women and men in 50 countries, where they were asked to speak about their lives and also describe what poverty meant to them (Plessis-Fraissard, 2010). The findings of the study showed that most people did not comment much on the lack of money being the main feature of poverty but they perceived physical, social and political

isolation as key indicators of rural poverty (Plessis-Fraissard, 2010). These findings called for a new focus in the fight against poverty. Countries in Asia began to conduct numerous studies that focused on understanding the significant role of rural roads on rural poverty (Ashley and Maxwell, 2001, Rigg, 2006, Aggarwal, 2015, Rodríguez-Pose and Hardy, 2015).

Studies conducted on roads in rural China show that good investment in rural roads can and does yield substantial socioeconomic benefits in terms of improved regional growth, as they allow for the movement of agricultural and non-agricultural goods and services between producers and markets in and out of communities (Shenggen and Zhang, 2004, Fan and Chan-Kang, 2005, Escobal and Ponce, 2008, Fan and Chan-Kang, 2008, Qin and Zhang, 2016) . Similarly, studies conducted in rural India suggest that roads provide millions of rural people with access to services such as education, health, markets and as well as facilitate agricultural growth (Patel, 1984, Hazell and Haggblade, 1990, Kesterton et al., 2010, Asher and Novosad, 2016). On the one hand, Plessis-Fraissard (2010) indicates that 31% of the world's rural population live in areas that are isolated from markets and services. This population lives more than 2km from an all-season road. An all-season road refers to a road that is drivable at all times of the year (Chambers et al., 1981). According to Porter (2002), all-season roads are crucial for rural economic development because they facilitate the movement of labour between residence and workplace.

Inaccessible rural areas become highly vulnerable to poverty and diseases (Wagstaff et al., 2004, Dercon, 2006). For example a study conducted in Liberia on rural vulnerability to the Ebola Virus Disease (EVD), shows that inadequate health and transportation infrastructure contribute to the challenge of managing the disease outbreak in West Africa (Stanturf et al., 2015). Stanturf et al. (2015), argue that most rural road networks in Liberia were largely inaccessible in the rainy season and this caused for delays in treatment, resulting in increased fatalities in affected regions. According to Riverson and Carapetis (1991) and Teravaninthorn and Raballand (2009), poor rural road conditions result in high transport costs and deficient transport services. In remote rural areas, bad road conditions contribute to costly access to markets. Porter (2014) argues that bad rural roads in remote areas hinder agriculture growth because any delays in the transportation of produce to markets, negatively affects farmgate prices. Good farmgate prices are influenced by the quality of the produce and as well as the sellers arrival time to the market (Jacoby, 2000, Asher and Novosad, 2016). Hence, good rural roads in remote areas are crucial when transporting perishable produce in order to reduce spoils while they are in transit, and thus ensuring better market value for produce. Hettige (2006)

argues that bad rural roads in remote areas contribute to poor transporter competition. The absence of transporter competition is seen as a key component of high transport fares in remote rural areas. However, Porter (2014) suggests that transporter competition in remote rural areas may rise only when the road network conditions are able to provide all-weather access. Studies suggest that many gravel roads across Africa are mostly characterised by an absent in transporter competition (Minten and Kyle, 1999, Ranganathan and Foster, 2011, Ngoye, 2016).

1.1.1. Importance of understanding the socioeconomic role of rural roads in South Africa

An improvement in road infrastructure quality will determine the socioeconomic conditions of rural people living in South Africa Gquaji (2016). Approximately, 34.7 % of the total population in South Africa lives in rural areas (Ncube et al., 2016). Government reports and Integrated Development Plan's (IDP) show that outstanding progress are being achieved with regards to improving the conditions of rural roads in South Africa (Madzivhandila and Asha, 2012). However, studies indicate that many remote rural areas in South Africa remain difficult to access regardless of the interventions (May and Govender, 1998, Tanser et al., 2000, Bryceson, 2002, Porter, 2002, Dlulisa, 2013, Visagie and Schneider, 2014, Ngcobo and Mdani, 2015) . Nonetheless, the question remains as to what implications do these roads pose on the livelihoods of rural areas. A challenge in South Africa is that studies on rural road networks and their implication on rural livelihoods remain very sparse amongst literature. However, a recent study published on the Farmers Weekly magazine indicates that poor rural road conditions in South Africa negatively affects the already threatened agriculture sector (Steyn, 2016). Steyn (2016) argues that poor rural riding quality during the transportation of produce to markets, account for up to 8% of the total income loss in the transportation of perishable produce such as tomatoes.

In South Africa, more research is needed to assess other facets of the role of rural road networks on rural livelihoods. The most recent statistics revealed in South Africa show that the poverty situation in the country has worsened (Lehohla, 2017). Statistics SA results are indicating that the poverty headcounts increased by 2.3% from 2011 (at 53.2%) to 2015 (at 55.5%) (Lehohla, 2017). These results were derived using the upper-bound poverty line (UBPL) prices of R992 per person per month (Lehohla, 2017). As mentioned above, most of the poor population in sub-Saharan African countries lives in rural areas. In response to the existing gap in South African literature, the current study therefore assessed the socioeconomic role of rural road

networks on a number of selected communities in KwaZulu-Natal in order to evaluate the road conditions and to determine their implications on rural livelihoods.

1.2. Conceptual Framework

1.2.1. The Urban Bias Theory

The Urban Bias Theory has been adopted in this study as a framework to understand the role of pre and post-apartheid policies or programs on rural livelihoods in South Africa. As argued by Lipton (1977) that for any policy to be regarded as best, its principles have to be based on two important features which are efficiency and equity. In South Africa, most studies on rural development suggest that poverty in rural areas is predominantly caused by the lack of or pro-poor rural policies (Ellis, 1998, Carter and May, 1999, Ellis, 2000, Aliber, 2003, Briedenhann and Wickens, 2004, Sowman et al., 2014). The Urban Bias Theory forms part of the important argument that aids with the explanation of what leads to the formation of poor rural policies. According Lipton (1977) the Urban Bias Theory is based on the argument that the development processes in third world countries are strategically designed to be biased to the needs of the people living in rural areas and this biasness is driven by political structures dominated by the urban groups. In South Africa, the issue of rural people being politically powerless started when the Bantu Authorities Act was introduced as weapon to forcefully remove black ethnic groups from their land and relocate them in resource-limited areas known as Bantustans in the early 1950s (Horrell, 1973, Van Kessel and Oomen, 1997). Although roads are investigated as a subject in this study, it is not possible for one to fully understand the socioeconomic role of road networks on rural livelihoods without providing a deeper understanding on the history of rural areas in South Africa. During the apartheid era, South African black ethnic groups were allocated to live on 13% of the land that was not favourable for agriculture and they were also denied proper services and infrastructure (Jenkins, 1996). The remainder of the land was reserved for white minority groups. In addition, the apartheid government ensured that in the Bantustans, there were limited investments in rural transport infrastructure and other services in order to isolate black ethnic groups from participating in the country's economy (Butler et al., 1978). Hence, many people in South Africa argue that the level of poverty in rural areas is still a reflection of injustice policies and systems that were created during the apartheid era (Mubangizi, 2008, Barbarin and Richter, 2013, Butler, 2017). So how relevant is the Urban Bias Theory on the management of roads in the post-apartheid era? The management of roads

in South Africa remains open to some of the policy criticism discussed by the Urban Bias Theory. In South Africa, the department of National Treasury indicates that road maintenance funds are allocated based on the value of property or assets along which the road services (Manuel, 2006). This ruling further perpetuates biasness between urban and rural areas because the value of property in rural areas is not quantifiable since people do not have title deeds; with commercial farmers being an exception. In addition, the aforementioned ruling ignores the value of social assets in rural areas by only focusing on the quantifiable economic assets. Hence, the adoption of the Urban Bias Theory as a framework to understand the socioeconomic role of rural roads becomes an important theory that can be used to explain some of the socioeconomic dynamics that are presented in this study.

1.2.2. Sustainable Livelihoods Approach

Poor service delivery is amongst the primary causes of rural poverty (Dorward et al., 2004, Ellis and Freeman, 2004, Alexander, 2010). Transport infrastructure is seen as a crucial service that is required in order to facilitate socioeconomic growth in rural areas (Bayes, 2001, Sullivan et al., 2015). This study adopts the sustainable livelihoods approach (SLA) as a framework to understand the sustainability role of road networks on rural livelihoods. The SLA framework provides a comprehensive analysis in the pursuit to improve the understanding of the main factors that affect poor people's livelihoods and as well as the relationship between these factors (Gilling et al., 2001, Carney, 2003). The main strengths of the SLA framework are that it recognises the complexity of the causes of poverty, and hence provides a set of principles to guide action to address and overcome poverty (Hussein, 2002). The concept of Sustainable Livelihoods (SL) was first presented by the Brundtland Commission in 1987 and thereafter expanded in 1992 United Nations Conference on Environment and Development. The conference promoted for the achievement of SL as a broad goal in the plight to eradicate poverty. Chambers and Conway (1991:16), defined SL as: *"A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living; a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at local and global levels and in the short and long term".*

There is relevance in positioning the sustainability role of road networks on rural livelihoods within SLA. The SLA is relevant as it provides the vulnerability context when understanding

the socioeconomic role of road networks on the livelihoods of rural people. Rural road networks play an important role in the fight to improve the quality of rural life and as well as in the pledge to eradicate extreme rural poverty, especially in sub-Saharan Africa (Banjo et al., 2012). Studies conducted on rural mobility indicate that transport costs in sub-Saharan Africa are higher than in any other parts of the world (Porter, 2002, Jedwab and Storeygard, 2017). Poor road conditions are perceived to be one of the major causes of high transport costs in most sub-Saharan African countries (Minten and Kyle, 1999, Teravaninthorn and Raballand, 2009). Berg et al. (2016) argues that more than 90% of the rural roads in sub-Saharan Africa consists of gravel roads, of which over 80% of the road network conditions do not provide all-weather sustainable vehicle access. South Africa forms part of many countries in sub-Saharan Africa where research on the socioeconomic role of road networks on rural livelihoods remains limited. The current study therefore has assessed some of the socioeconomic role of road networks on rural livelihoods. The adoption of the SLA has been useful in this study because it has helped to contextualise some of the complexities and dynamics of assessing the socioeconomic role of road networks on rural livelihoods.

1.3. Aim and objectives

The aim of the study was to assess the condition of unpaved rural road networks and the associated socio-economic implications on the livelihoods of rural communities in KwaZulu-Natal

The specific objectives of this study are:

- To assess the physical conditions of the gravel road networks in rural communities with the purpose to understand the physical, environmental and anthropogenic factors that influence the state of rural roads.
- To assess the surface material quality of unpaved rural roads to understand susceptibility to surface deterioration.
- To analyse the local respondents' perceptions on the socioeconomic role of unpaved road networks on rural livelihoods.
- To assess the effectiveness of Community Based Road Management Strategies on unpaved road networks.
- To provide recommendations for improving road networks in rural communities.

1.4. Description of the study area

The study was conducted in four rural areas namely, Emazabekweni, Dukuza, Mkhunya and Mhlwazini within the province of KwaZulu-Natal (KZN) (Figure 1.1). Due to the understanding that KZN has a large geographical area, the areas under study were selected to represent the variation in microclimate and geological conditions experienced across the province. Emazabekweni (30^{o} 15' 5, 52" S and 30^{o} 6' 9, 33" E) and Mkhunya (30^{o} 9' 1, 46" S and 30^{o} 26' 29, 44" E) are situated in the south-western while Mhlwazini (28^{o} 56' 18, 60" S and 29^{o} 17' 46, 86" E) and Dukuza (28^{o} 45' 55, 51" S and 29^{o} 11' 49, 94" E) are located in the north-western part of the province. KZN is the second largest populated province in South Africa, with approximately 10.5 million people in an area of 94,361 km² (Housing Development Agency, 2013). The 2013 report on Informal Settlement Status in KZN indicates that 46% of the population live on tribal land, while 47% in urban areas and the remaining 7% on private farms (Housing Development Agency, 2013). Out of nine provinces, KZN is ranked the third poorest region in South Africa based on gross domestic product per capita statistics (Ozler and Hoogeveen, 2005, Kepe and Tessaro, 2014, Musemwa et al., 2015). Huge backlogs in transport infrastructure in terms of maintenance and construction needs are regarded as one of the primary causes of high levels of poverty vested in the province (Kepe and Tessaro, 2014 and Musemwa et al., 2015). Road statistics provided by the KZN Provincial Department of Transport indicate that in 2005, 52% of the total road network conditions in the province were classified as "poor to very poor" and only 17% were in a "good to very good" state.

1.2.3. Municipal administration for the communities under study

The communities in this area are situated within Ubuhlebezwe (Emazabekweni and Mkhunya) and Okhahlamba (Mhlwazini and Dukuza) local municipalities. Ubuhlebezwe Local Municipality (ULM) is situated southwest of KwaZulu-Natal and is one of four municipalities that form part of Harry Gwala District Municipality. Okhahlamba Local Municipality (OLM) is situated on the western boundary of KwaZulu-Natal and is one of the three municipalities that form uThukela District Municipalities. The population in ULM and OLM is predominantly black isiZulu speaking South Africans, 98% and 93% respectively. ULM and OLM are divided into 12 and 14 wards, respectively. The rest of the population is made up of other racial groups such as coloureds, whites and Indians in both the municipalities. ULM and OLM both consists

of two main towns. The communities under study were selected based on their distance from nearby rural towns. Studies on rural livelihoods have shown that proximity to towns determines amongst others, access to services, the quality of infrastructure and the availability of opportunities for income diversification (Ellis, 2000, Barrett et al., 2001, Davis, 2003, Khatun and Roy, 2012, Damena and Habte, 2017, Ingelaere et al., 2017, Mubila and Yepes, 2017). For the purpose of this study, two of the communities had to be situated less than 20 kilometres (km) from their nearest town and the other two communities had to be at a distance of more than 30km. The town of Highflats is about 38km and 12km from Mkhunya and Emazabekweni communities, respectively. While, Mhlwazini community is about 37km from a town called Winterton and Dukuza community is less than 12km from the town known as Bergville. All local municipalities in South Africa cover a distance of not more than 40km from their most central position to the municipal boundaries (Van Donk, 2008). Table 1.1 provides a brief situational overview and some of the key challenges (relevant to the four themes covered) facing the local municipalities implicated in this study.

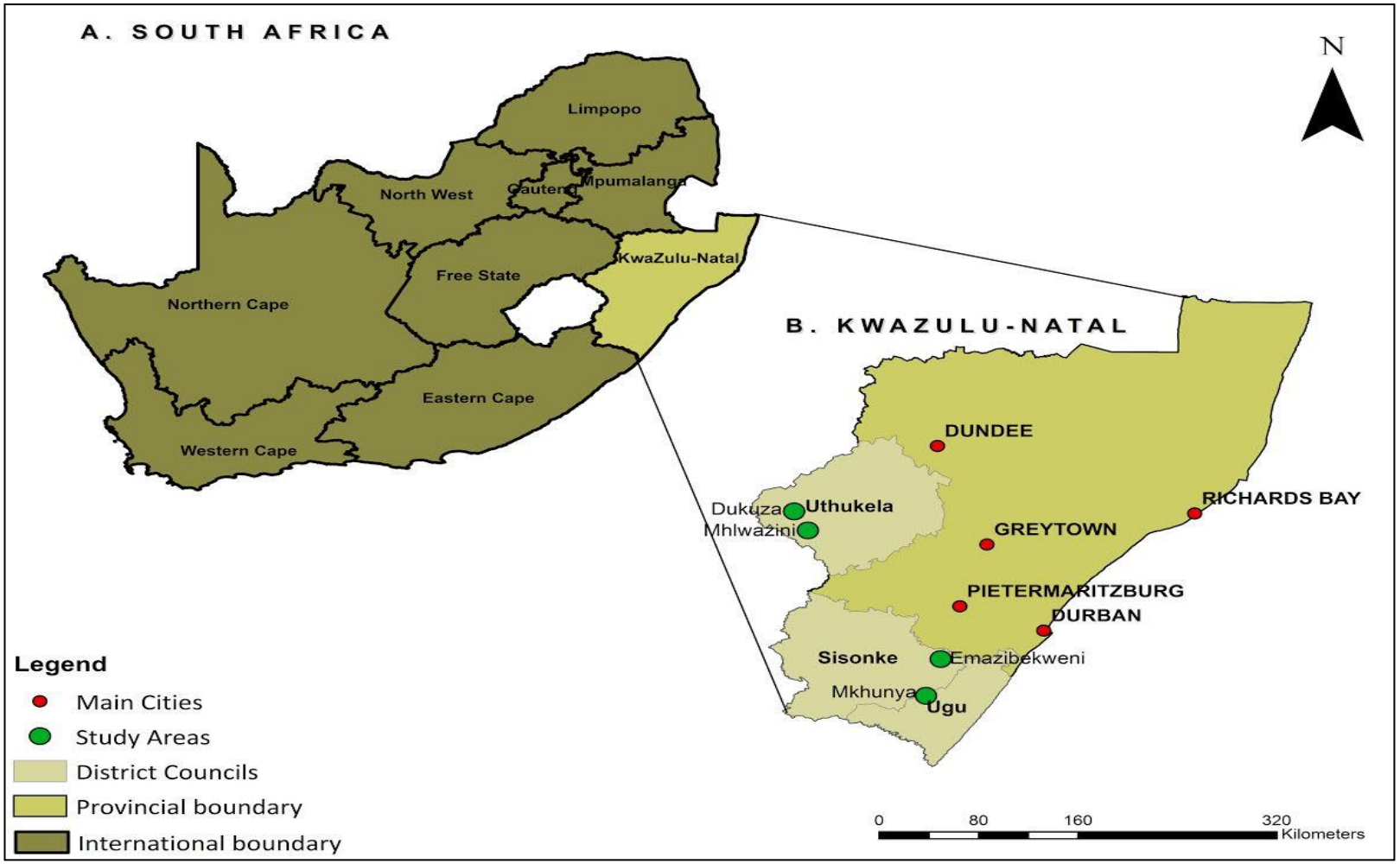

***Figure 1.1**: Map showing the location of the four rural areas under study area*

Municipality	***Basic statistics***	***Some of the key challenges taken directly from the 2017/18 municipal IDPs***			
		Agricultural production	*Education*	*Healthcare*	*Access to markets, information and employment opportunities*
Okhahlamba	***a).*** *Total population is approximated at 132 068,* ***b).*** *-0.43% negative population growth,* ***c).*** *Total number of females is 52 % and males 47,2 %,* ***d).*** *More than 95% of the population is distributed in rural areas,* ***e).*** *Municipal area of 3,971 km²,* ***f).*** *The majority of land ownership comprises of Freehold, Ingonyama Trust and Privately owned land.*	**a).** *Understaffing results in inadequate provision of extension services to emerging farmers.* *b). Currently most rural roads are unusable during the rainy season. If rural roads are not improved the transport of inputs and produce would be negatively affected.* *c). Lack of interest in agriculture by youth*	***a).*** *Large number of the population is illiterate* ***b).*** *In Okhahlamba, it has been identified that the level of education of the residents is very low and shows that the education levels at lower grades has decreased.*	***a).*** *The most important health facility in the Okhahlamba is Emmaus Hospital, situated 15 kilometres from Winterton, which supports four clinics and 22 mobile clinic points located mostly in the southern part of the municipal area,* ***b).*** *Most of the health issues dealt with at Emmaus Hospital relate to Preventative Tuberculosis and HIV-AIDS, while the greatest causes of death amongst children are respiratory disease and Gastro Enteritis.* ***c).*** *Majority of these facilities cover the central portion of the municipality and people have to travel distances up to 20km to access a facility.* ***d).*** *Most northern portions of the municipality are beyond the 20km catchment area, which means that people have to travel more than 25km to access a facility*	***a).*** *Municipality was identified as the Presidential poverty node, due to high levels of poverty, unemployment and inequality,* ***b)*** *High-level of migration out of the municipality, people seeking better opportunities,* ***c).*** *Municipality can be characterised with having a large youthful population, which implies the need for various facilities and focus on specific priority areas e.g. educational facilities, economic opportunities and possibly youth development programmes.* ***d).*** *Inadequate skills and lack of necessary technical knowledge*

Ubuhlebezwe .	***a).*** *Total population is approximated at 118 346,* ***b).*** *Total number of males is 53.1% and females is 46.9%,* ***c).*** *More than 93% of the population is distributed in rural areas,* ***d).*** *Municipal area of 1,604 km²* ***e).*** *The majority of land ownership comprises of Freehold, Ingonyama Trust and Privately owned land.*	***a).*** *The low skill base of emerging farmers limits the rate of development.* ***b).*** *Condition of the roads: the development of business depends on its ability to transport products to consumers and access products from suppliers. The roads within the municipal area are not in good condition and this results in products being damaged while being transported.* ***c).*** *Poor road conditions and lack of transport have a negative influence on the marketing of produce for emerging farmers*	***a).*** *About 20% of the population in the municipality are without any formal education, males (10545) and females (12847),*	***a).*** *HIV is still the leading disease within the municipality in children. Factors that are contributing to the loss of lives are mostly due to socio-economic factors and delay in seeking medical help.*	***a).*** *High unemployment shows that there are still a high rate of people without source of income as it shows 46.8% of people not getting any income* , ***b).*** *Most people in the area do not derive a sustainable living from rural agriculture. There is a heavy dependence on welfare grants ("survival capital") and external in-flows of remittances from urban centres or commercial farms. The key challenge is therefore to transform these rural villages into sustainable human settlements with basic services, social infrastructure and economic development opportunities.*

Table 1.1: *Municipal demographics and challenges experienced in the themes under study (adapted from 2017/2018 IDP reports).*

1.5. References

ADAMS, R. H. & PAGE, J. 2005. Do international migration and remittances reduce poverty in developing countries? *World development,* 33**,** 1645-1669.

AGGARWAL, S. 2015. Do rural roads create pathways out of poverty? Evidence from India. *Manuscript, University of California, Santa Cruz*.

ALEXANDER, P. 2010. Rebellion of the poor: South Africa's service delivery protests–a preliminary analysis. *Review of African political economy,* 37, 25-40.

ALIBER, M. 2003. Chronic poverty in South Africa: Incidence, causes and policies. *World Development*, 31, 473-490.

ASHER, S. & NOVOSAD, P. 2016. Market access and structural transformation: Evidence from rural roads in India. *Job Market Paper January,* 11**,** 2016.

ASHLEY, C. & MAXWELL, S. 2001. Rethinking rural development. *Development policy review,* 19**,** 395-425.

BANJO, G., GORDON, H. & RIVERSON, J. 2012. Rural Transport: Improving its contribution to growth and poverty reduction in Sub-Saharan Africa. *Sub-Saharan Africa Transport Policy Program (SSATP)*, Working Paper No. 93.

BARBARIN, O. A. & RICHTER, L. M. 2013. Mandela's children: Growing up in post-apartheid South Africa. *Routledge publishers*, United Kingdom.

BARRETT, C. B. & SWALLOW, B. M. 2006. Fractal poverty traps. *World development,* 34**,** 1-15.

BAYES, A. 2001. Infrastructure and rural development: insights from a Grameen Bank village phone initiative in Bangladesh. *Agricultural Economics*, 25, 261-272.

BERG, C. N., BLANKESPOOR, B. & SELOD, H. 2016. Roads and rural development in Sub-Saharan Africa. *World Bank Policy Research*, Working Paper No. 7729.

BUTLER, A. 2017. Contemporary South Africa, *Springer*. United States of America.

BUTLER, J., ROTBERG, R. I. & ADAMS, J. 1978. The black homelands of South Africa: The political and economic development of Bophuthatswana and KwaZulu. *University of California Press*, United States of America.

BHATTACHARYAY, B. N. 2009. Infrastructure development for ASEAN economic integration. *Asian Development Bank Institute*, Working Paper 138.

BOOTH, D., HANMER, L. & LOVELL, E. 2000. Poverty and transport. Report prepared for the World Bank in collaboration with DFID. *Overseas Development Institute*. United Kingdom.

BRIEDENHANN, J. & WICKENS, E. 2004. Tourism routes as a tool for the economic development of rural areas—vibrant hope or impossible dream? Tourism management, 25, 71-79.

BRYCESON, D. F. 2002. The scramble in Africa: reorienting rural livelihoods. *World development,* 30**,** 725-739.

CHAKWIZIRA, J., BIKAM, P. & MASHIRI, M. 2014. Are We Parked, Giving Way or Negotiating the Curve of Rural Development: Implications of the State of Rural Transport Research in South Africa for Planning, Policy and Development Choices. *Planning Africa 2014***,** 646.

CARNEY, D. 2003. Sustainable livelihoods approaches: progress and possibilities for change. *Department for International Development,* London.

CARTER, M. R. & MAY, J. 1999. Poverty, livelihood and class in rural South Africa. *World Development*, 27, 1-20.

CHAMBERS, R. 2014. Rural development: Putting the last firs*t. Routledge*. United States of America.

CHAMBERS, R. & CONWAY, G. 1991. Sustainable rural livelihoods. Practical concepts for the 21st Century. *Discussion Paper* 296. IDS, Sussex.

CHAMBERS, R., LONGHURST, R. & PACEY, A. 1981. Seasonal dimensions to rural poverty. *Frances Pinter*. United Kingdom.

DORWARD, A., KYDD, J., MORRISON, J. & UREY, I. 2004. A policy agenda for pro-poor agricultural growth. *World development,* 32, 73-89.

DIXON, C. 2015. Rural development in the third world. *Routledge.* United States of America.

DLULISA, L. 2013. Evaluating the credibility of the integrated development plan as a service delivery instrument in Randfontein local municipality. *Stellenbosch:* Stellenbosch University. Cape Town.

ELLIS, F. 1998. Household strategies and rural livelihood diversification. *The journal of development studies*, 35, 1-38.

ELLIS, F. 2000. Rural livelihoods and diversity in developing countries, *Oxford university press*. United Kingdom.

ELLIS, F. & FREEMAN, H. A. 2004. Rural livelihoods and poverty reduction strategies in four African countries. *Journal of development studi*es, 40, 1-30.

ESCOBAL, J. & PONCE, C. 2008. 9. Enhancing Income Opportunities for the Rural Poor: The Benefits of Rural Roads. *Economic reform in developing countries***,** 307.

FAN, S. & CHAN-KANG, C. 2005. Road development, economic growth, and poverty reduction in China. *International Food Policy Research Institute,* United States of America.

FAN, S. & CHAN-KANG, C. 2008. Regional road development, rural and urban poverty: Evidence from China. *Transport Policy,* 15**,** 305-314.

GILLING, J., JONES, S. & DUNCAN, A. 2001. Sector approaches, sustainable livelihoods and rural poverty reduction. *Development Policy Review*, 19, 303-319.

Gquaji, A. 2016. Perceived impact of public sector leadership on road infrastructure service delivery. *Investment Management and Financial Innovations,* 13(3): 51-59.

HAZELL, P. B. & HAGGBLADE, S. 1990. Rural-urban growth linkages in India. *World Bank Publications,* United States of America.

HETTIGE, H. 2006. When do rural roads benefit the poor and how? An in-depth analysis based on case studies. *Asian Development Bank,* Philippines.

HORRELL, M. 1973. The African Homelands of South Africa, *South African Institute of Race Relations,* South Africa.

HUSSEIN, K. 2002. Livelihoods approaches compared. *Department for International Development*, London.

IDLER, E. L. & BENYAMINI, Y. 1997. Self-rated health and mortality: a review of twenty-seven community studies. *Journal of health and social behavior***,** 21-37.

JACOBY, H. G. 2000. Access to markets and the benefits of rural roads. *The Economic Journal,* 110**,** 713-737.

JAZAIRY, I., ALAMGIR, M. & PANUCCIO, T. 1992. The state of world rural poverty: An inquiry into its causes and consequences. *New York University Press*. United States of America.

JEDWAB, R. & STOREYGARD, A. 2017. Economic and Political Factors in Infrastructure Investment: Evidence from Railroads and Roads in Africa 1960–2015.

JENKINS, D. M. 1996. From apartheid to majority rule: A glimpse into South Africa's journey towards democracy. *Arizona Journal of International and Comparative Law,* 13, 463.

KACHOURI, S., ACHOUR, H., ABIDA, H. & BOUAZIZ, S. 2015. Soil erosion hazard mapping using Analytic Hierarchy Process and logistic regression: a case study of Haffouz watershed, central Tunisia. *Arabian Journal of Geosciences,* 8**,** 4257-4268.

KEPE, T. & TESSARO, D. 2014. Trading-off: Rural food security and land rights in South Africa. *Land Use Policy*, 36**,** 267-274.

KESTERTON, A. J., CLELAND, J., SLOGGETT, A. & RONSMANS, C. 2010. Institutional delivery in rural India: the relative importance of accessibility and economic status. *BMC pregnancy and childbirth,* 10**,** 30.

LEBO, J. & SCHELLING, D. 2001. Design and appraisal of rural transport infrastructure: ensuring basic access for rural communities. *World Bank Publications*. United Kingdom.

LEHOHLA, P. 2017. Poverty Trends in South Africa: An examination of absolute poverty between 2006 and 2015. *Statistics South Africa*, South Africa.

LIPTON, M. 1977. Why poor people stay poor: a study of urban bias in world development. *Australian National University Press,* London.

MADZIVHANDILA, T. & ASHA, A. 2012. Integrated development planning process and service delivery challenges for South Africa's local municipalities. *Journal of Public Administration,* 47**,** 369-378.

MAY, J. & GOVENDER, J. 1998. Poverty and inequality in South Africa. *Indicator South Africa,* 15**,** 53-58.

MINTEN, B. & KYLE, S. 1999. The effect of distance and road quality on food collection, marketing margins, and traders' wages: evidence from the former Zaire. *Journal of Development Economics,* 60**,** 467-495.

MUBANGIZI, B. C. 2008. Responses to poverty in post-apartheid South Africa: some reflections. *International Journal of Social Welfare,* 17, 174-181.

NCUBE, K., SHACKLETON, C. M., SWALLOW, B. M. & DASSANAYAKE, W. 2016. Impacts of HIV/AIDS on food consumption and wild food use in rural South Africa. *Food Security,* 8**,** 1135-1151.

NGCOBO, S. & MDANI, M. 2015. Evaluation of strategic management in assisting south african municipalities improve service delivery. *Journal of governance and regulation***,** 113.

NGOYE, C. 2016. The impacts of surface transport development to tourism growth: a case study of roads in Cameroon. *Centria University of Applied Sciences,* Cameroon.

NJENGA, P. & DAVIS, A. 2003. Drawing the road map to rural poverty reduction. *Transport Reviews,* 23**,** 217-241.

PATEL, N. R. 1984. Planning for rural roads in India. in J.P. Brans (ed.), *Operations Research* '84, pp. 350-60.

PLESSIS-FRAISSARD, M. 2010. Rural Roads: the wealth of nations. *International Road Federation*. United States of America.

PORTER, G. 2002. Living in a walking world: rural mobility and social equity issues in sub-Saharan Africa. *World development,* 30**,** 285-300.

PORTER, G. 2007. Transport planning in sub-Saharan Africa. *Progress in development studies,* 7**,** 251-257.

QIN, Y. & ZHANG, X. 2016. The road to specialization in agricultural production: Evidence from rural China. *World Development,* 77**,** 1-16.

RANGANATHAN, R. & FOSTER, V. 2011. East Africa's infrastructure: a regional perspective. *World Bank Policy Research,* Working Paper No. 5844

RIGG, J. 2006. Land, farming, livelihoods, and poverty: rethinking the links in the rural South. *World development,* 34**,** 180-202.

RIVERSON, J. & CARAPETIS, S. 1991. Intermediate means of transport in Sub-Saharan Africa. *World Bank technical paper,* 161.

RODRÍGUEZ-POSE, A. & HARDY, D. 2015. Addressing poverty and inequality in the rural economy from a global perspective. *Applied Geography,* 61**,** 11-23.

SATI, V. P. & VANGCHHIA, L. 2017. Sustainable Livelihood Approach to Poverty Reduction. In: A Sustainable Livelihood Approach to Poverty Reduction. *Springer Briefs in Environmental Science. Springer*, Cham.

SHARPE, R. V. & SWANSON, K. 2016. Poverty in Global Perspective. *The Wiley Blackwell Encyclopedia of Gender and Sexuality Studies*. United stated of America.

SHENGGEN, F. & ZHANG, X. 2004. Infrastructure and regional economic development in rural China. *China economic review,* 15**,** 203-214.

SOWMAN, M., SUNDE, J., RAEMAEKERS, S. & SCHULTZ, O. 2014. Fishing for equality: Policy for poverty alleviation for South Africa's small-scale fisheries. *Marine Policy*, 46, 31-42.

SULLIVAN, L., RYSER, L. & HALSETH, G. 2015. Recognizing change, recognizing rural: The new rural economy and towards a new model of rural service. Journal of Rural and Community Development, 9.

STANTURF, J. A., GOODRICK, S. L., WARREN JR, M. L., CHARNLEY, S. & STEGALL, C. M. 2015. Social vulnerability and Ebola virus disease in rural Liberia. *PloS one,* 10**,** e0137208.

STEYN, W. 2016. The effects of poor rural road conditions on produce: by invitation. *Farmer's Weekly,* 2016**,** 6-7. Accesed 23 October 2016.

TANSER, F., LESUEUR, D., SOLARSH, G. & WILKINSON, D. 2000. HIV heterogeneity and proximity of homestead to roads in rural South Africa: an exploration using a geographical information system. *Tropical Medicine & International Health,* 5**,** 40-46.

TERAVANINTHORN, S. & RABALLAND, G. 2009. *Transport prices and costs in Africa: a review of the main international corridors*, World Bank Publications. United Kingdom.

MANUEL, T. A. 2006. Budget Speech, 2005, *National Treasury Department*, Pretoria. South Africa.

VAN KESSEL, I. & OOMEN, B. 1997. 'One chief, one vote': The revival of traditional authorities in post-apartheid South Africa. African Affairs, 96, 561-585.

VISAGIE, S. & SCHNEIDER, M. 2014. Implementation of the principles of primary health care in a rural area of South Africa. *African journal of primary health care & family medicine,* 6**,** 1-10.

CHAPTER TWO

AN ASSESSMENT OF UNPAVED RURAL ROAD NETWORK CONDITIONS

The chapter is based on:

Nkomo, L.S. Desai, A. S. and Peerbhay, Y. K. (2016) "Assessing the conditions of rural road networks in South Africa using visual observations and field-based manual measurements: A case study of four rural communities in KwaZulu-Natal Province" *Review of Social Science Journal*, 1(2), pp.42-55.

2.1. Abstract

The prioritisation and improvement of rural road networks is important in developing countries in order to uplift the socioeconomic conditions experienced by communities. So far, limited information exists on the conditions of unpaved or gravels roads, particularly in rural areas and the associated implications to rural economies. The present chapter therefore used visual observations and field-based measurements to assess the physical, environmental and anthropogenic factors affecting Minor roads (R3), Collector roads (R4) and Local roads (R5) in four rural communities in the KwaZulu-Natal Province, South Africa. The function of these road classes is to provide access from homesteads to main roads that connect rural areas to towns. In this chapter, two classification methods were used to rate the severity and extent of each surface distress on each road class. Results indicate that there was more than one surface distresses identified and assessed on each road class within the selected communities. It was noted that all the road classes had moderate to severe surface distress, except for the R3 road class in Emazabekweni community, reflecting problems associated with poor drainage systems and maintenance. Visual observation and field-based methods are useful tools that can aid in identifying and assessing the physical conditions of unpaved roads, as well as possible environmental, physical and anthropogenic factors at interplay, especially in resource-limited regions. This chapter recommended that road authorities should ensure that proper drainage systems should be well designed; constructed and maintained on all gravel roads in order to reduce surface deterioration associated with runoff.

2.2. Introduction

The prioritisation and improvement of rural infrastructure is important in developing countries in order to uplift the socioeconomic conditions experienced by communities (Songco, 2002, Briceno-garmendia and Estache, 2004; and Bhattacharya *et al*. 2015). Research done on the importance of rural roads on the economic growth and rural prosperity of communities suggest that improving and expanding rural roads directly increases economic opportunities (Van de walle, 2002, Faiz, 2012 and Porter 2014). In addition, good investment in rural roads yield substantial socioeconomic benefits in terms of improved regional growth, as they allow for the movement of agricultural and non-agricultural goods and services between producers and markets in and out the communities (Connerley and Schroeder, 1996; Hanmer *et al*., 2000; Mwabu and Thorbecke, 2004; Hettige, 2006). For example, a review paper by Faiz, (2012) indicates that in the last decade the improvement and expansion of rural roads in China has had a major impact on their agricultural productivity. In addition, the review stated that well-maintained rural roads enable people to have better access to social services such as health and education facilities, including the movement of labour between residence and the workplace. According to Chambers (2014), the benefit of improved rural road networks has resulted in an increase in urban-rural migration in developed countries, since people make decisions to migrate based on proper infrastructure and access to potential socioeconomic opportunities. In support, Kilkenny (1998) argues that improving rural access attracts new development opportunities, thus decreasing the socioeconomic cost of rural life. However, the controversy is that most studies have assessed the positive impacts of improving rural roads from unpaved to paved roads surfaces.

Research by Alzubaidi and Magnusson (2002) and Zhang and Elaksher (2012) suggest that there have been limited studies undertaken on the impact of unpaved rural roads on the livelihoods of rural people. Moreover there has been a massive slump in research done on gravel roads in developed countries such as Sweden, Norway and Switzerland, when compared to the studies which were done in the 1930s to the 1940s (Alzubaidi and Magnusson, 2002). Similarly, research done in South Africa mainly reviews the possible socioeconomic benefits associated with improving the conditions of paved roads. However, limited studies exists which document the conditions of unpaved or gravels roads, particularly in rural areas and the associated implications to rural economies (Bond, 1999). For instance, literature shows that in the Eastern Cape Province, people from these rural areas travel at least ten kilometers to reach

the main roads that link them to the major towns (Porter et al., 2010). The study by Nkomo (2014) has revealed that poor rural infrastructure such as road networks makes it difficult for accessing rural areas in most parts of South Africa. This finding is in line with the works of Chamberlin and Jayne, (2012) who indicate that poor road networks in rural areas usually binds these communities into perpetual poverty. It is therefore clear, that the presence of well-developed rural road networks enables communities to develop and sustain their livelihoods (socially and economically). Statistics suggest that about 10% of the rural population has migrated to urban areas from 1990 to 2011 in South Africa (Potts, 2013). Findings by Chambers and Conway (1992), Tacoli (2003) and Miheretu (2011), argue that there are a number of reasons why rural people migrate to urban areas, but fundamental to them is the issue of poor infrastructure service. Globally, research indicates that despite the advancement in technology, it is yet not possible to obtain an accurate method used to assess the conditions of rural roads (Faiz, 2012). Moreover, the available studies have either focused on roads or rural economies separately, and this does not provide a clear picture on the link between the state of rural roads and associated economic implications. This therefore requires further insight. Also, literature states that countries continue to use rudimentary methods to assess the conditions of their rural roads (Faiz, 2012). The present study therefore seeks to use visual observation and field-based measurements in order to assess the conditions of gravel road networks in selected rural communities in the KwaZulu-Natal Province of South Africa. The overall purpose of the chapter is to assess the physical conditions of the gravel road networks in rural communities with the purpose to understand the physical, environmental and anthropogenic factors that influence the state of rural roads.

2.2.1. Overview of rural roads in South Africa

Research suggests that only 34% of the rural people live within 2km of all-season roads in Africa, when compared to 65% in other developing countries (Roberts and Rastogi, 2006, Chamorro and Tighe, 2009). Hence, Figure 2.1 shows the percentage of Rural Accessibility Index (RAI) in selected African countries. The RAI is an important transport headline indicator, which estimates the proportion of rural people with access to adequate transport systems (Roberts and Rastogi, 2006).

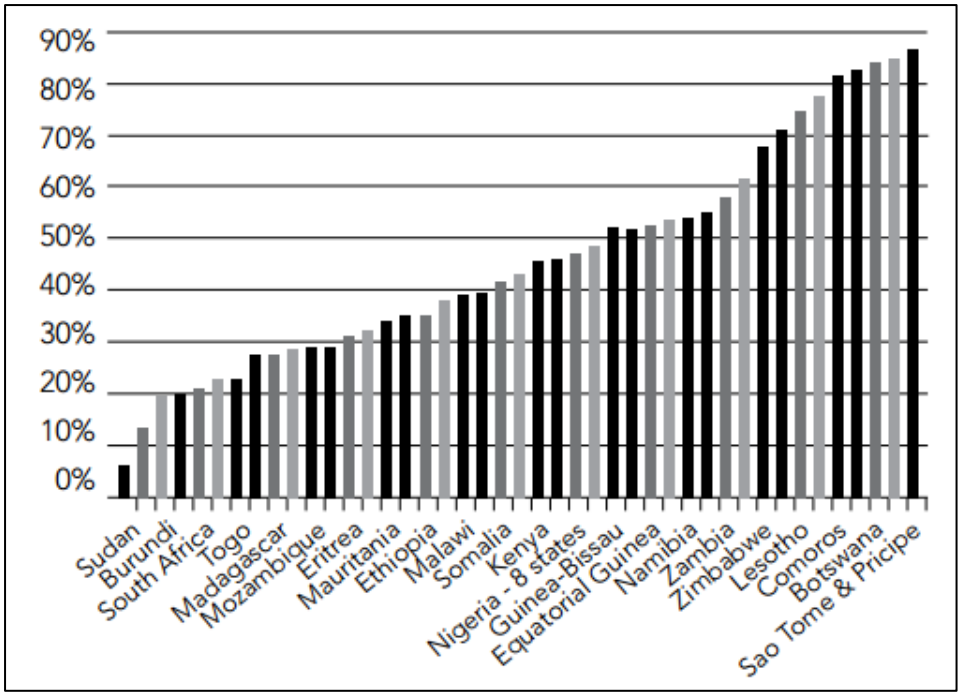

Figure 2.1: *List showing the percentage of Rural Accessibility Index in selected African countries (Sethi, 2008).*

It can be noted from Figure 2.1 that more than half of the selected countries fall below the 50% margin for the RAI, of which rural communities in Sudan, Burundi and South Africa are the least accessible. Although the RAI findings do not provide an indication of the conditions of rural roads and demographics characteristics of each country, they provide a comparative overview of rural accessibility in selected African countries. The above findings become extremely important in understanding socioeconomic conditions of rural communities since studies indicate that more than half of the population in Africa still resides in rural areas (Sahn and Stifel, 2003, Cohen, 2006 and Beegle et al. 2016).

Approximately 80% of rural road networks in South Africa are gravel roads (Gwilliam et al., 2008). Smith and Visser (2001) and Lishman (2013), state that rural networks consist of 301 000 km (gravel) and 63 000 km (surfaced) roads in South Africa. Although, rural and urban roads differ in terms of their scale and standards, they have the same functional purpose (Committee of Transport Officials, 2012). Rural roads are known to have lengthier spreads of connectivity than urban roads (Committee of Transport Officials, 2012). Hence, rural roads in South Africa are classified into two categories and these are based on their main function (Committee of Transport Officials, 2012). Firstly, rural mobility roads connect areas that are large traffic generators (such as cities, towns, villages). Secondly, rural access or activity roads

provide access to individual properties, which include farms, settlements and other outline areas. Table 2.1 provides an overview of the criteria used to differentiate between the classes of rural roads in South Africa (Committee of Transport Officials, 2012). Even though the road functional characteristics provided below are applicable for South Africa's roads, this classification system is used worldwide.

According to Lay (2009), geometric design standards adopted by the South African road authorities, were derived largely from American practices. Although authorities still follow the same American principles, road design and construction practices became localised in order to address South African conditions. The Department of Transport (DoT) is the main government institution that oversees the regulation and delivery of transport services in South Africa (Wenzel, 2007). The National Land Transport Act of 2009 is the main piece of legislation that governs all policy and planning matters related to roads in South Africa. The DoT has established a number of key public entities [including the South African National Roads Agency Limited (SANRAL)] to help deliver on some of the core government's operational activities. All public entities are responsible for different sectors within DoT. For instance, SANRAL manages only activities related to national roads (Mashiri et al., 2002). Other roads are managed by the lower spheres of government and these include; provincial and municipal offices. Rural road networks of interest in this study fall within the roads which are managed at municipal offices.

The recent 2013/2014 financial year report indicates that provinces and municipalities offices received a sum of R18 billion for road construction and maintenance, accounting for 40% of the R42.3 billion allocated to the DoT (Statistics South Africa, 2014). Moreover, the DoT is estimated to have received a 6% increase for the 2015 financial year. Although a substantial amount from the total budget is allocated for provincial and municipal offices, there is limited research that exists on the conditions of rural roads networks in South Africa. Literature that is available only looks at how improving rural road network would produce positive spinoffs for rural livelihoods, without referring to the road network conditions.

Table 2.1: *Description of the different rural road classes and as well as their functional characteristics (Committee of Transport Officials, 2012).*

Rural road Class number (R)	Class name	Origin/destination	Through traffic component	Reach of connectivity	% of built km	AADT (average annual daily traffic
R1	Principal arterials	Metro areas, large cities, large border posts, join national routes	Exclusively	> 50 km		1000 – 100 000+
R2	Major arterials	Cities and large towns, transport nodes (harbours and international airports), smaller border posts, join major routes	Exclusively	> 25 km	2 - 4% Classes 1 and 2	500 – 25 000+
R3	Minor road	Towns, villages and rural settlements, tourist destinations, transport nodes (railway sidings, seaports, landing strips), small border posts, other routes	Predominant	> 10 km	6 - 12% Classes 1, 2 and 3	100 – 2 000+
R4	Collector road	Connect farming districts, rural settlements, tourist areas, national and private parks and mines to mobility routes	Minimal	< 10 km	20 - 25%	< 1 000
R5	Local road	Farm or property access, connection to other routes	Nil Discontinuous	< 5 km	65 - 75%	< 500
R6	Walkway (path or track)	Settlements, farms, transport nodes, water points	n/a	n/a	n/a	n/a

2.2.2. Challenges associated with physical conditions of rural road networks

Problems associated with physical conditions of rural roads differ from one area to another. According to Forman (2003), it is important to understand the different types of rural road surfaces before one can assess the associated problems. Firstly, paved roads generally consist of asphalt or concrete surfaces, which is very rare for rural communities in developing countries. Secondly, unpaved road surfaces in most rural communities consist of gravel or dirt roads. Hence, the present study only assesses conditions associated with unpaved rural road surfaces. The most common challenge associated with unpaved roads is the deterioration of the road surface. Factors such as the behaviour of road material, the drainage capacity and maintenance activities, determine the rate and level of deterioration of gravel roads. Hence, Figure 2.2. provides a schematic overview of the processes and distresses associated with the deterioration of gravel roads.

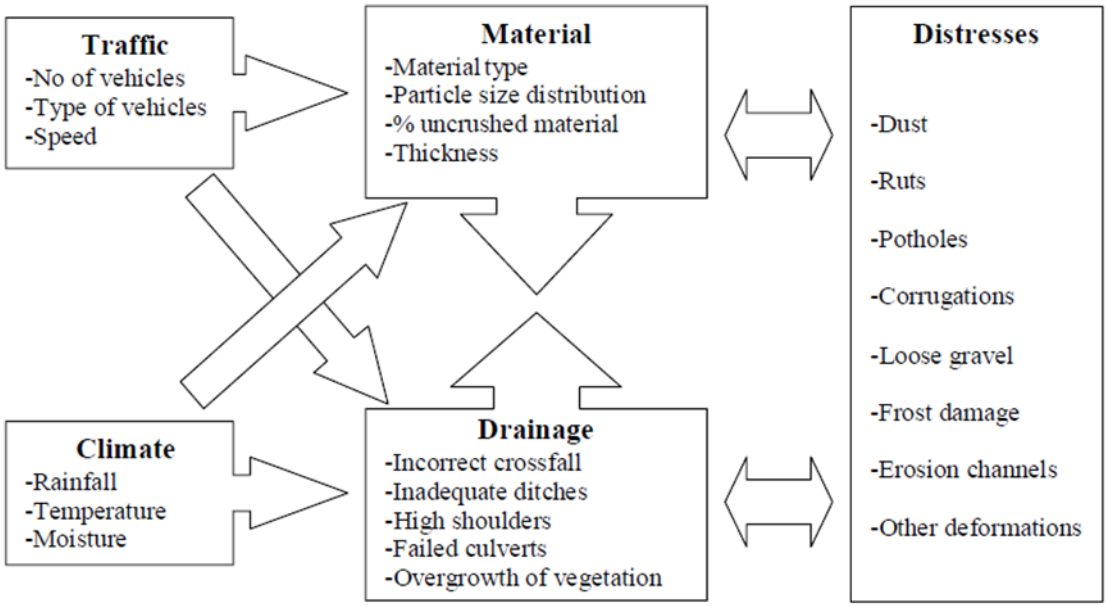

***Figure 2.2**: Processes that influence the deterioration of gravel roads (Alzubaidi and Magnusson, 2002).*

As illustrated in Figure 2.2, climate and traffic conditions directly influence the behaviour of road material and the drainage capacity of gravel roads. The listed distresses are some of the observable features of surface deterioration on gravel roads. However, deteriorated surfaces can show features of multiple distresses on a single gravel road. Severely deteriorated surfaces affect mobility and ride comfort on gravel roads. A number of studies have assessed and

reviewed possible causes of surface deterioration on gravel roads as a result of the behaviour of road material and drainage problems; however, associated findings suggest that such problems require site-specific analysis and interpretation of causalities (Jones, 1984, Shoop et al., 2008, Fu et al., 2010). Similarly, there are different criteria (based on the receiving environment) used to assess and rate the conditions of unpaved or gravel roads.

2.2.3. Methods of assessing and rating of unpaved or gravel roads

There is no standardised method used to assess and rate the conditions of unpaved or gravel roads. Alzubaidi (2000), suggests that road conditions have been traditionally assessed using subjective methods. In reviewing literature, a number of studies have criticised the use of subjective methods arguing that they produce only qualitative results (Alzubaidi 2000, Huntington and Ksaibati, 2005, van der Gryp and van Zyl, 2007). van der Gryp and van Zyl (2007), suggest that gravel roads should be objectively assessed in order to eliminate subjective perceptions and also to provide reliable and quantifiable information for future research. Several studies have also attempted to objectively assess and rate surface condition on gravel roads, but found out that they require highly specialized experts, costly equipment and is time consuming (van der Gryp and van Zyl, 2007). Similarly, Maser (1996) argues that the use of objective methods alone in assessing and rating of gravel roads is irrational, because surface conditions change rapidly. Rainfall conditions, traffic volumes and maintenance activities have the ability to modify the characteristics of gravel road surface conditions within a short period of time (Huntington and Ksaibati, 2007).

2.3. Materials and methods

2.3.1. Identification and classification of rural road networks

Road networks of interest were identified by first traversing the selected communities using recent high resolution Google Earth images. Following the above procedure, transect walks were done in each community in order to identify and classify the road networks respectively. Road networks were then classified using the South African Road Classification and Access Management Manual, version 1.0 of August 2012 (Table 2.1). Due to the focus of this chapter, Principal arterials (R1), Major arterials (R2) and Walkways (R6) road classes were not assessed. This was because the chapter aimed at assessing the conditions of rural roads which

provided access from major/ principal arterials [such as Minor road (R3), Collector road (R4) and Local road (R5)] to homesteads. In assessing the road conditions, this study did not assess the technical engineering (such as the quality of road material, type of machinery used, expertise of the engineers) components of road construction. However, without ignoring the influence and importance of the technical engineering components, the focus of this study was to assess the physical conditions of rural road networks and their implications on road users. In this study, the term 'physical condition' referred to the quality of the road surface (for freedom of vehicle movement) under the influence of human and environmental factors. In assessing the quality of the road surface, this study examined the behavior of road material, the drainage capacity and maintenance activities. The behavior of road material was examined by firstly identifying the apparent surface distresses and thereafter, assessing their severity and extent in each road class. As illustrated in Figure 2.2, the behavior of road material under the influence of traffic and climatic conditions results in the development of distresses which ultimately deteriorate the quality of the road surface.

Research conducted by Chamorro *et al*. (2009), suggest that there is no single method used to assess and rate the conditions of distresses on gravel roads. According to Chamorro *et al*. (2009), most studies have assessed distresses by dividing gravel roads into segments and used visual assessment methods to estimate for the entire road. Studies by Chamorro *et al*. (2009) and Rivera *et al*. (2015) have criticised the assessment of distresses through this method, arguing that the results obtained did not provide accurate estimation of the conditions of the entire road surface. However, Chamorro *et al*. (2009) argues that the accuracy of the results obtained should be determined by the reliability of the methods used and the total road length assessed. The chapter used visual observation and field-based manual measurements to assess the physical conditions of the entire road surface in each road class under study. Combining these two methods strengthens result accuracy and reduce possible biasness caused by subjective observations and interpretations.

2.3.2. Assessing and rating of the road conditions

The R3, R4 and R5 road surfaces were traversed in each community with the aim of identifying the type of distresses apparent. Thereafter the extent of their existence was assessed. Distresses such as potholes, rutting, erosion channels, corrugations, loose material and stoniness were assessed to determine the quality of gravel surfaces. Although, surfaces distress were identified for the entire road surface, their severity and extent were only assessed on the parts of the road

that impacted on ride comfort in each road class. Hence, a tape measure was used to calculate the depth and width of distresses such as potholes, rutting and erosion channels in order to determine their severity. Table 2.2, provides the general description used to classify the severity of each distress (Jones, 2000). For the purpose of this study, if the aforementioned distresses had a depth and width less than 15 cm, their severity ratings were classified between 0-4 and anything more than 15cm was given the rating of 5. This method was adopted and modified from Jones (2000) rating systems. However, the severity of surface distresses such as corrugations, loose material and stoniness were assessed and rated based on visual perceptions.

***Table 2.2**: Overview of the rating system used to assess the severity of each distress (adopted from Jones, 2000.*

Degree	Severity	Description
0	None	No distress visible
1	Slight	Distress difficult to discern. Only the first signs of distress are visible.
2	Between slight and warning	
3	Warning	Distress is distinct. Start of secondary defects. (Distress notable with respect to possible consequences. Maintenance might be required in near future e.g. potholes can be removed by blading)
4	Between warning and severe	
5	Severe	Distress is extreme. Secondary defects are well-developed (high degree of secondary defects) and/or extreme severity of primary defect. (Urgent attention required e.g. potholes require manual repair).

As illustrated in Table 2.2, all distresses with uncertainties regarding their degree of severity were classified as 1 or 4. The severity of each distress was only assessed on the parts of the road that impacted on ride comfort in each road class (R3, R4 and R5). Thereafter, a handheld Garmin etrex Global Positioning System (GPS) with sub-meter accuracy was used to located the distresses in order to determine the widespread of each distress over the total length of the road. Table 2.3, provides the classification method used to assess the extent of each distress.

Table 2.3: *Overview of the classification systems used to assess the extent of each distress (adopted from Jones, 2000)*

Extent	Description	Estimate (%)
A	Isolated occurrence, not representative of the segment length being evaluated. They are usually associated with localized changes in the material, subgrade or drainage conditions. Intersections, steep grades or sharp curves may also result in isolated occurrences.	< 5
B		5 - 20
C	Intermittent occurrence, over most of the segment length, or extensive occurrence over a limited portion of the segment length. When occurring over most of the segment length, problems are usually associated with the material quality or maintenance procedures. When occurring over limited portions, the problem is usually a result of local material variations or drainage problems.	20 - 60
D		60 - 80
E	Extensive occurrence. This is usually a result of poor quality or insufficient wearing course material, or inadequate maintenance.	80 - 100

Using the above classification, the extent of each distress was recorded only for the width of the road that was affecting traffic. Assessing the distresses on each road class was an indication of the behaviour of road material under the influence of traffic and climatic conditions. Furthermore, drainage and maintenance conditions were assessed on each road class in order to determine their influence. Drainage and maintenance conditions were assessed using techniques adopted from the Massachusetts Manual of Investigating Unpaved Roads (Berkshire Regional Planning Commission, 2001). The Massachusetts manual is designed to help local road developers gain a better understanding of the types of problems that occur as a result of improper design, construction and maintenance of drainage on unpaved roads. Roadside drainage consists of three important components namely; ditches, culverts and turnouts (Yifred, 2013). Studies done by Jones (1984) suggest that poorly designed, constructed and maintained roadside drainage systems contribute significantly to the deterioration of surface on gravel roads. The condition of each roadside ditch, if available, was assessed at every 500m intervals in each road class and the number of intervals were determined by the total distance of the road traversed. All culverts and turnouts identified were assessed in each road class. Table 2.4, provides the classification method used to assess and rate drainage and maintenance conditions in each road class.

***Table 2.4**: Overview of the classification system used to assess and rate the drainage systems on each road class (adopted from Jones, 2000).*

	1. Very poor	2. Poor	3. Acceptable	4. Good
Ditches	-None available	-Poorly designed, constructed and maintained	-well-designed, constructed but poorly maintained	-Well-designed, constructed and maintained
Turnouts	-None available	-Poorly constructed, positioned and maintained	-well-constructed and positioned but not maintained	-Well-constructed, positioned and maintained
Culverts	-None available	-Improperly sized, installed and maintained	-Properly sized, installed but poorly maintained	-Well sized, installed and maintained

2.4. Data analysis

The data analysis was done using Statistical package for Social Sciences (SPSS) version 17.1 software. This analysis was performed in order to obtain descriptive statistics, such as frequencies and cross tabulations. Cross tabulation was used to summarize categorical data (surfaces distresses) in order to assess the variations in surface distresses amongst the different road classes. The collected GPS coordinates were imported and displayed in a GIS environment using Arc GIS 10.1. This was done in order to locate the spatial distribution of distresses that impacted on ride comfort in each road class.

2.5. Results Analysis

2.5.1. Characteristics of the road networks

The characteristics of the road networks under study are presented in Table 2.5. Results show that road characteristics differed for each community. The average gradient for the different road classes ranged between 0-20% for Emazabekweni and Dukuza communities when compared to Mkhunya and Mhlwazini communities (0-50%). Similarly, the average hourly traffic for the different road classes ranged higher (from 0-50) for Emazabekweni and Dukuza communities when compared Mkhunya and Mhlwazini communities (0-15). In each community, the R5 roads had a lower average road width when compared to the R3 and R4 roads.

Table 2.5: *Number of households and as well as the characteristics of each road class in the different communities*

		Road characteristics				
Community	Total number of households	Class number (R)	Average road gradient (0%)	Total road length (km)	Average road width (m)	Average hourly traffic
Emazabekweni	251	R3	0-20	20	8	20-50
		R4	0-10	8	5	5-10
		R5	0-10	6	4	0-5
Dukuza	525	R3	0-10	17	7	15-50
		R4	0-20	7	6	5-10
		R5	0-10	20*	5	5-10
Mhlwazini	156	R3**	-	-	-	-
		R4**	-	-	-	-
		R5	30-50	6	5	0-5
Mkhunya	353	R3	10-50	38	5	5-15
		R4	10-50	10*	5	0-5
		R5	0-20	2	4	0-5

Note: *means total number of road networks identified and are classified under that road class, **means that road class does not exist

2.5.2. Road surface conditions

Table 2.5 presents a list of identified and assessed distresses in each road class. Numbers 0 to 5 are used to rate the severity of each distresses and A to E determine the extent of each distress on a particular road class (as see on Table 2.3 and 2.4). It can be noted from Table 2.6 that in each road class, there were more than one distresses identified. However, the extent of each distress was only measured for the distresses that affected drive comfort (such as distress with severity rating of 3 to 5). In Emazabekweni and Dukuza communities, the R3 road classes have better surface conditions than the R4 and R5 classes. Moderate to severe distresses (erosion channels and loose material) dominated and deteriorated the surfaces conditions of the R4 and R5 road classes. Whereas in Mkhunya and Mhlwazini communities, all assessed road class (such as R3, R4 and R5) had moderate to severe distresses deteriorating the surface conditions. Figure 2.3 shows the difference in surface conditions on the R3 road classes for Emazabekweni, Dukuza and Mkhunya communities.

Table 2.6: *Identified distresses, their severity and extent in each road class*

		Apparent distresses					
Communities	**Road class**	Potholes	Rutting	Erosion channels	Corrugations	Loose material	Stoniness
Emazabekweni	R3	0	0	0	2	1	3 [A]
	R4	1	0	3 [C]	1	3 [C]	1
	R5	3 [A]	1	5 [E]	1	3 [B]	2
Dukuza	R3	3 [A]	1	3 [B]	1	0	1
	R4	5 [D]	1	3 [C]	2	3 [C]	3 [C]
	R5	5 [D]	2	3 [C]	0	3 [C]	3 [C]
Mkhunya	R3	1	3 [C]	4 [D]	1	5 [E]	1
	R4	3 [C]	3 [C]	5 [C]	0	2	3 [C]
	R5	3 [C]	3 [B]	5 [C]	0	2	3 [C]
Mhlwazini	R5	1	0	5 [E]	0	5 [C]	5 [C]

Figure 2.3: *View of the surface conditions on the R3 road classes in (A) Emazabekweni, (B) Dukuza and (C) Mkhunya communities*

2.5.3. Drainage and maintenance conditions

The results presented on Table 2.7 illustrate the ratings of drainage conditions for each road class. It can noted that in all the communities, the R4 and R5 road classes had drainage ratings of 1 when compared to the R5 road classes with a drainage rating of 3. Overall, none of the road classes obtained drainage ratings of 5. Hence, Figure 2.4 shows some of the challenges associated with drainage conditions on the R3 road classes in Emazabekweni, Dukuza and Mkhunya communities.

Table 2.7: *Drainage rating results in each road class*

Community	Road class	Drainage ratings
Emazabekweni	R3	3
	R4	1
	R5	1
Dukuza	R3	3
	R4	1
	R5	1
Mkhunya	R3	3
	R4	1
	R5	1
Mhlwazini	R5	1

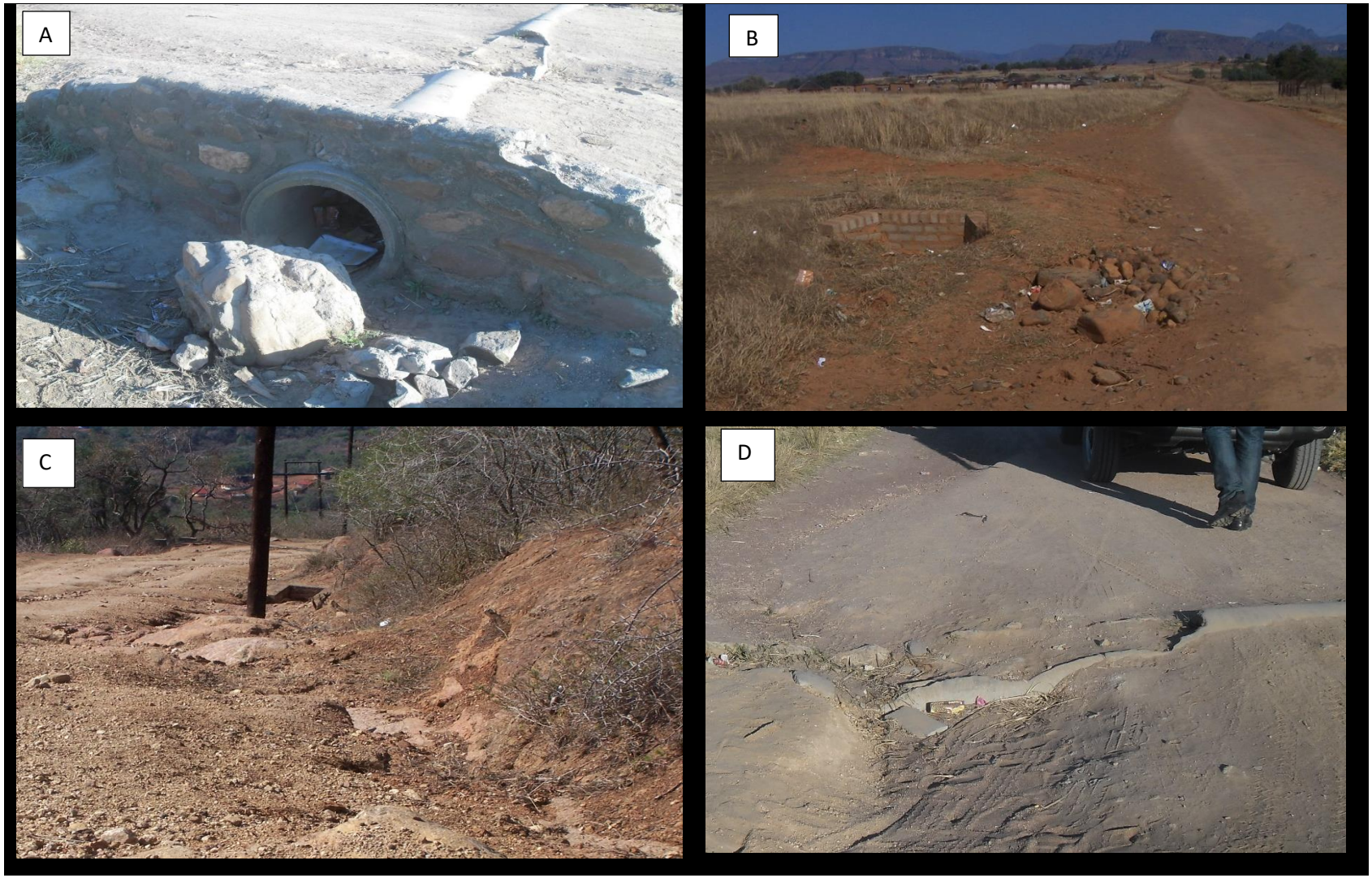

Figure 2.4: *View of poorly maintained drainage systems on the R3 road classes in Emazabekweni (A), Dukuza (B and D) and Mkhunya (C) communities.*

2.5.1 Rainfall characteristics

It can be noted from Figure 2.5 that Mhlwazini community receives more annual rainfall (approximately 1389 mm) than the other communities. However on average, all thecommunities received more than 600mm of rainfall every year.

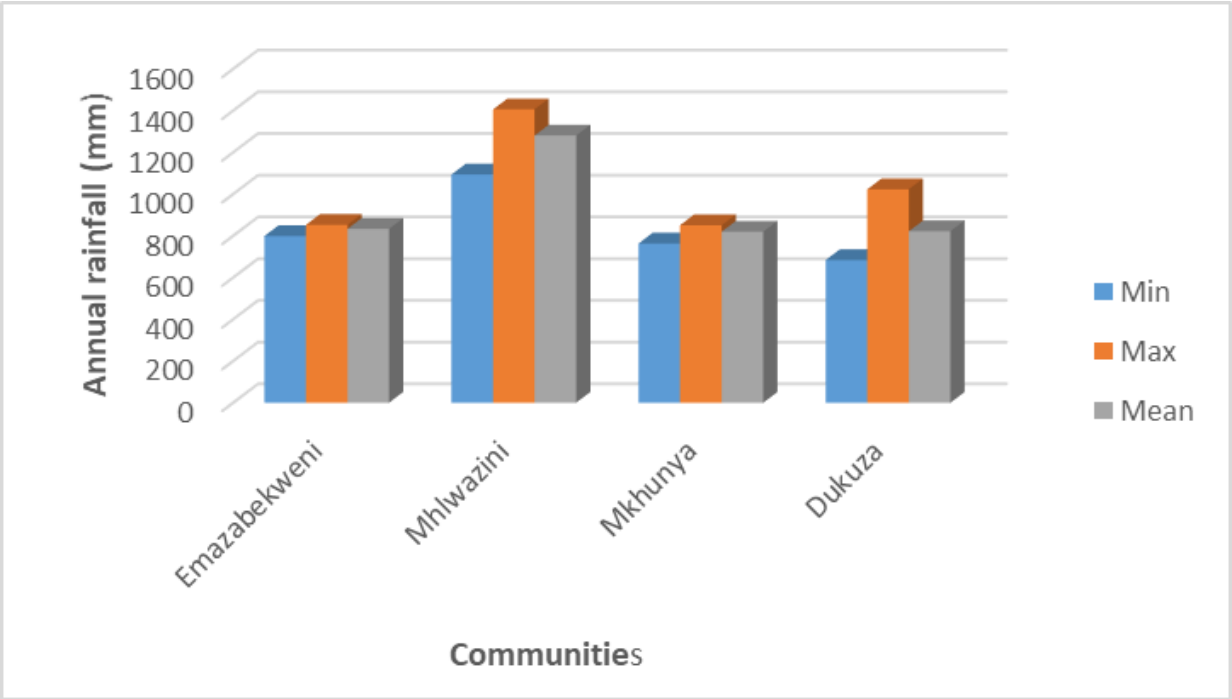

Figure 2.5: *Annual rainfall for the communities under study (Schulze, 2008).*

2.6. Discussions

Understanding the physical conditions of unpaved rural roads could serve as a primary platform that could be used to assess the socioeconomic conditions in rural communities. In this study, the physical conditions of selected road classes were determined by assessing the influence of physical, environmental and anthropogenic factors. Research indicates that despite the advancement in technology, it is yet not possible to obtain an accurate method to assess the conditions of rural roads globally. In this chapter, visual observation and field-based methods were used to identify, assess and rate the physical conditions of gravel roads.

Overall, the results of this study indicate that there is a direct relationship between road surface characteristics, drainage and maintenance conditions. For instance, it was noted that the road

classes with moderate to severe surface distresses had very poor drainage and maintenance conditions when compared to those with slight surface distresses. However, it was further noted that the nature of surface distresses identified were also an indication of the influence of traffic and climate conditions. These results are comparable to previous studies which indicate that surface conditions are determined by the behavior of the road material and drainage capacity under the influence of traffic and climate conditions (Simonsen and Isacsson, 1999, Lugo and Gucinski, 2000 and Alzubaidi and Magnusson, 2002). Moreover, poor surface conditions directly impact on traffic volumes. For example, the results indicate that more average hourly traffic volumes were recorded for the R3 road classes (15-50) in Emazabekweni and Dukuza communities when compared to the R3 road class in Mkhunya community (5-15). The difference in traffic volumes could also be a reflection of the surfaces conditions. This is due to the fact that findings on Table 2.6 show that the R3 road classes in Emazabekweni and Dukuza communities had less severe surface distresses than in Mkhunya community (as seen on Figure 2.3). Although the R3 road surface conditions may be different, the most important factor to be noted is that these road classes have the same function in rural communities. The function of the R3 road class is to connect rural settlements to major arterials (such as the R2). This means that these road classes play a primary role in connecting rural settlements with roads leading to large economic hubs. It is therefore important to ensure that the R3 road classes are well designed constructed and maintained. Hetzel *et al*. (2007) argues that well-maintained rural roads enable people to have better access to social services and they also allow for the movement of labour between residence and workplace. However, surface conditions on the R4 and R5 road classes are just as important because they provide access to the R3 road class. Research suggests that only 34% of the rural people live within 2km of all-season roads in Africa, compared to 65% in other developing countries (Roberts and Rastogi, 2006, Chamorro and Tighe, 2009). The surface conditions in all the R4 and R5 road classes were dominated by moderate to severe surface distresses. Depending on the size of the community, the R4 and R5 road classes are used as primary roads that connect livelihoods to the R3 road classes. Hence, there is a need to ensure that these road classes are well designed, constructed and maintained in order to make rural communities more accessible.

Although the R3 road classes had drainage systems, it was noted that the lack of maintenance affected their function. For instance, all identified roadside ditches, turnouts and culverts were either clogged with sediment, debris or overgrown with vegetation The identified surface distresses (such as erosion channels and potholes) on the R3 road classes reflected ineffective

drainage systems, which contributed to road surface deterioration, particularly on the R3 road classes of Dukuza and Mkhunya communities. In all the communities, the R4 and R5 road classes had no roadside drainage systems. The lack of drainage systems resulted in moderate to severe surfaces distresses dominating these road classes. All the communities under study receive average annual rainfall which is above 700mm. It is therefore important to ensure that all the road classes under study have proper and effective drainage systems because rainfall conditions and traffic volumes have the ability to modify the characteristics of gravel road surface conditions within a short period of time (Huntington and Ksaibati, 2007).

The findings of this study have demonstrated that visual observation and field-based methods are useful tools that can aid in identifying and assessing the physical conditions of unpaved roads as well as possible environmental, physical and anthropogenic factors at interplay, especially in resource limited regions (such as where there is limited funds available for advance technology) such as sub-Saharan Africa. Even though the use of more technologically advanced methods will be useful to avoid manual fieldwork for faster and accurate results and also to eliminate different assessor perceptions, the methods used in this study were more appropriate and cost efficient. As argued by Maser (1996), the use of objective methods alone in assessing and rating of gravel roads is irrational because surface conditions change rapidly. Moreover, identifying surfaces distresses using high-tech equipment will be challenging and very expensive, because it will require the use of technologies with high image resolution. In future, there is a need to develop technology that will be attached to a vehicle which will be able to detect, distinguish and map the severity and extent of surface distresses and as well as detect factors, such as dust. This system will be faster and more accurate than using traditional methods. However, the findings of this study could be useful to road authorities responsible for unpaved rural roads in sub-Saharan Africa. For instance, the understanding of factors affecting the quality of unpaved roads and the ability to identify and assess surface distresses is key to assisting both road authorities and local people deal with challenges associated with unpaved roads. This study was able use cost effective, user-friendly methods to identify and assess surface distresses on unpaved roads. This implies that road authorities could train local people on how to use this method so that they are able to identify, assess and report or help mitigate surface distresses developing on their local roads. Empowering local people will help improve the quality of unpaved roads and as well, as enhance socioeconomic conditions in rural communities.

2.7. Conclusion

This chapter aimed at assessing the physical conditions of selected rural road networks to understand the physical, environmental and anthropogenic factors that influence the condition of rural roads. The results of this study recommend that the characteristics of road classes under study strongly reflected on the effectiveness of drainage and maintenance conditions. For instance, the nature (type, severity and extent) of surface distresses identified on each road class were an indication of the presence and effectiveness of drainage and maintenance conditions. In all the road classes under study, Mkhunya and Mhlwazini communities had more deteriorated road surface conditions than Dukuza and Emazabekweni communities. It was also noted that the more deteriorated the road class, the less traffic movement. Overall, the results indicate that there is a need for road authorities to ensure that rural road networks are well maintained and have proper drainage systems. For instance, the identified and assessed surface distresses indicated that the road networks reflected the need for proper drainage systems and regular maintenance. Therefore, proper drainage systems and regular maintenance is recommended. While this study was able to use user-friendly and cost-effective methods to assess the physical conditions of rural road networks, explicit investigations are required to aid with the quality of observations. Future research should focus on assessing the impact of road designs, landscape characteristics, and the quality of road materials used and associated cost of maintenance. The results of this study can help municipal authorities in carrying out regularly monitoring procedures thus ensuring that surface distresses are identified and resolved during their initial stage. If not, road authorities could train local people on how to use this method so that they are able to identify, assess and report or help mitigate surface distresses developing on their local roads. More importantly, the assessment method used in this study could help local municipal authorities develop a better management system for their rural road networks. For example, using this assessment method, authorities could create their own database indicating the conditions of all their rural road networks. Moreover, the information from the database could be used by municipal planners during the compilation of annual Integrated Development Plans (IDPs). As a result, municipal authorities will better manage the conditions of rural road networks.

2.8. References

ALZUBAIDI, H. 2000. Rating of Gravel Roads in Sweden. Development of a new method. *TRITA-IP FR*, (00-77).

ALZUBAIDI, H., & MAGNUSSON, R. 2002. Deterioration and Rating of Gravel Roads: State of the Art. *Road Materials and Pavement Design*, 3(3), 235-260.

BEEGLE, K., CHRISTIAENSEN, L., DABALEN, A., & GADDIS, I. 2016. Poverty Rising Africa. *World Bank Publications*. United Kingdom.

BERKSHIRE REGIONAL PLANNING COMMISSION. 2001. The Massachusetts Unpaved Roads BMP Manual: A Guidebook on How to Improve Water Quality While Addressing Common Problems. Project 98-06/319.

BHATTACHARYA, A., OPPENHEIM, J., & STERN, L. N. 2015. Driving sustainable development through better infrastructure: Key elements of a transformation program. *Global Economy & Development Working Paper*, 91.

BOND, P. 1999. Basic infrastructure for socio-economic development, environmental protection and geographical desegregation: South Africa's unmet challenge. *Geoforum*, 30(1), 43-59.

BRICENO-GARMENDIA, C., & ESTACHE, A. 2004. Infrastructure services in developing countries: access, quality, costs, and policy reform (Vol. 3468). *World Bank Publications*. United Kingdom.

CHAMBERS, R. 2014. Rural development: Putting the last first. *Routledge*. United Kingdom.

CHAMBERS, R., & CONWAY, G. 1992. Sustainable rural livelihoods: practical concepts for the 21st century. *Institute of Development Studies*, United Kingdom.

Chamberlin, J., & Jayne, T. S. (2013). Unpacking the meaning of 'market access': evidence from rural Kenya. *World development*, 41, 245-264.

CHAMORRO, A., & TIGHE, S. 2009. Development of a management framework for rural roads in developing countries: integrating socioeconomic impacts. Transportation Research Record: *Journal of the Transportation Research Board*, (2093), 99-107.

CHAMORRO, A., DE SOLMINIHAC, H., SALGADO, M., & BARRERA, E. 2009. Development and Validation of a Method to Evaluate Unpaved Road Condition with Objective Distress Measures. Transportation Research Record: *Journal of the Transportation Research Board*, (2101), 3-9..

COHEN, B. (2006). Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology in society*, 28(1), 63-80.

COMMITEE OF TRANSPORT OFFICIALS. 2012. Technical Recommendations For Highways. South African Road Classification and Access Management Manual, Pretoria, South Africa.

CONNERLEY, E., & SCHROEDER, L. 1996. Rural transport planning. Approach Paper, Sub-Saharan Africa, 68, 69-71.

FAIZ, A. 2012. The Promise of Rural Roads: Review of the Role of Low-Volume Roads in Rural Connectivity, Poverty Reduction, Crisis Management, and Livability. *Transportation Research E-Circular*, (E-C167).

FORMAN, R. T. 2003. Road ecology: science and solutions. Island Press.

FU, B., NEWHAM, L. T., & RAMOS-SCHARRON, C. E. 2010. A review of surface erosion and sediment delivery models for unsealed roads. *Environmental Modelling & Software*, 25(1), 1-14.

GWILLIAM, K., FOSTER, V., ARCHONDO-CALLAO, R., BRICE-O-GARMENDIA, C., NOGALES, A., & SETHI, K. 2008. The Burden of Maintenance: Roads in Sub-Saharan Africa. Background Paper, 14.

HANMER, L., BOOTH, D., & LOVELL, E. 2000. Poverty and Transport: A Report prepared for the World Bank in collaboration with DFID. *Overseas Development Institute*.

HETTIGE, H. 2006. When do rural roads benefit the poor and how?: an in-depth analysis based on case studies. *Asian Development Bank*, Philippines.

HETZEL, M. W., ITEBA, N., MAKEMBA, A., MSHANA, C., LENGELER, C., OBRIST, B., & MAYUMANA, I. 2007. Understanding and improving access to prompt and effective malaria treatment and care in rural Tanzania: the ACCESS Programme. *Malaria journal*, 6(1), 83.

HOUSING DEVELOPMENT AGENCY. 2013. The Housing Development Agency annual report 2012/2013 [Online]. Johannesburg, South Africa: HDA. [Accessed 04 October 2015].

HUNTINGTON, G., & KSAIBATI, K. 2005. Gravel roads asset management. Transportation Research Circular E-C078: Roadway Preservation 2005, 214-228.

HUNTINGTON, G., & KSAIBATI, K. 2007. Gravel Roads Surface Performance Modeling. Transportation Research Record: *Journal of the Transportation Research Board*, (2016), 56-64.

JONES, D. 2000. Draft TMH12: Pavement Management Systems: Standard Visual Assessment Manual for Unsealed Roads (Version 1). Pretoria, South Africa.

JONES, T. E. 1984. The Kenya maintenance study on unpaved roads: research on deterioration. Overseas Unit, Transport and Road Research Laboratory.

KILKENNY, M. 1998. Transport costs, the new economic geography, and rural development. *Growth and Change*, 29(3), 259-280.

LAY, M. G. 2009. Handbook of road technology. CRC Press.

LISHMAN, D. 2013. A critical evaluation of road pricing in South Africa. Dessitertion, University of Cape Town, South Africa.

LUGO, A.E. AND GUCINSKI, H., 2000. Function, effects, and management of forest roads. *Forest ecology and management*, 133(3), pp.249-262.

MASER, K. R. 1996. Condition assessment of transportation infrastructure using ground-penetrating radar. *Journal of infrastructure systems*, 2(2), 94-101.

MASHIRI, M., NAUDE, A., & NCHABELENG, A. 2002. Rural transport strategy for South Africa. Contract Report CR-2002/72. Pretoria.

MIHERETU, B. A. 2011. Causes and consequences of rural-urban migration: the case of Woldiya town, North Ethiopia (Doctoral dissertation).

MWABU, G., & THORBECKE, E. 2004. Rural development, growth and poverty in Africa. *Journal of African Economies*, 13(suppl 1), i16-i65.

NKOMO, S. 2013. Developing key success criteria for rural development initiatives in the context of sustainable land management, University of KwaZulu-Natal, Pietermaritzburg Campus (Masters dissertation).

OKHAHLAMBA LOCAL MUNICIPALITY. 2015. Okhahlamba Municipality IDP Review-2015/2016, Bergville, South Africa.

PORTER, G. 2014. Transport services and their impact on poverty and growth in rural Sub-Saharan Africa: a review of recent research and future research needs. *Transport reviews*, 34(1), 25-45.

PORTER, G., HAMPSHIRE, K., MASHIRI, M., DUBE, S., & MAPONYA, G. 2010. 'Youthscapes' and escapes in rural Africa: Education, mobility and livelihood trajectories for young people in Eastern Cape, South Africa. *Journal of international development*, 22(8), 1090-1101.

POTTS, D. 2013. Rural–urban and urban–rural migration flows as indicators of economic opportunity in Sub-Saharan Africa: What do the data tell us. Migrating out of poverty research programme working paper.

RIVERA, F., CHAMORRO, A., LUCERO, R., & ARAVENA, C. 2015. Development of Condition Indicator for Managing Sealed Rural Road Networks. Transportation Research Record: *Journal of the Transportation Research Board*, (2474), 90-97.

ROBERTS, P., KC, S., & RASTOGI, C. 2006. Rural access index: a key development indicator: *The World Bank Group*, Washington DC.

SAHN, D. E., & STIFEL, D. C. 2003. Urban–rural inequality in living standards in Africa. *Journal of African Economies*, 12(4), 564-597.

SCHULZE, R. E. (ed.) 2008. South African Atlas of Climatology and Agrohydrology. WRC Report No. 1489/1/08. *Water Research Commission*, Pretoria, RSA.

SETHI, K. 2008. The Burden of Maintenance: Roads in Sub-Saharan Africa. AICD.

SHOOP, S., AFFLECK, R., HAEHNEL, R., & JANOO, V. 2008. Mechanical behavior modeling of thaw-weakened soil. *Cold Regions Science and Technology*, 52(2), 191-206.

SIMONSEN, E. AND ISACSSON, U., 1999. Thaw weakening of pavement structures in cold regions. *Cold regions science and technology*, 29(2), pp.135-151.

SMITH, A., & VISSER, A. T. 2001. A South African Road Network Classification Based on Traffic Loading. M Eng project report, University of Pretoria.

SONGCO, J. A. 2002. Do Rural Infrastructure Investments Benefit the Poor?: Evaluating Linkages: a Global View, a Focus on Vietnam (Vol. 2796). *World Bank Publications*. United Kingdom.

STARKEY, P. (Ed.). 2002. Improving rural mobility: options for developing motorized and nonmotorized transport in rural areas (Vol. 23). *World Bank Publications*. United Kinddom.

STATISTICS SOUTH AFRICAS. 2014. Annual report 2013/14 [Online]. Pretoria, South Africa. [Accessed 14 October 2015].

TACOLI, C. 2003. The links between urban and rural development. *Environment and Urbanization*, 15(1), 3-12.

UBUHLEBEZWE LOCAL MUNICIPALITY. 2015. Ubuhlebezwe Municipality IDP Review – 2015/2016, Ixopo, South Africa.

VAN DE WALLE, D. 2002. Choosing rural road investments to help reduce poverty. *World Development*, 30(4), 575-589.

VAN DER GRYP, A., & VAN ZYL, G. 2007. Variability and control of gravel road visual assessments. Transportation Research Record: *Journal of the Transportation Research Board*, (1989), 247-253.

WENZEL, P. 2007. Public-sector transformation in South Africa Getting the basics right. *Progress in Development Studies*, 7(1), 47-64.

YIFRED, K. 2013. Performance Assessment of Road Drainage Structures and Proposed Mitigation Measures: The case of Daleti-Odagodere Gravel Road in Benishangul-Gumuz Region (Doctoral dissertation, AAU).

ZHANG, C., & ELAKSHER, A. 2012. An Unmanned Aerial Vehicle-Based Imaging System for 3D Measurement of Unpaved Road Surface Distresses1. *Computer-Aided Civil and Infrastructure Engineering*, 27(2), 118-129.

CHAPTER THREE

ASSESSING FACTORS THAT CAUSE SURFACE DETERIORATION ON UNPAVED ROADS

The chapter is based on:

Nkomo, L.S. Desai, A. S. Peerbhay, Y. K. Seutloali, E.K and Haynes, T. (In review) "Assessing the surface material quality of unpaved rural roads to understand susceptibility to surface deterioration. A case study of four rural areas in KwaZulu-Natal, South Africa" *The Journal of Transport and Land Use.*

3.1. Abstract

Road surface deterioration is one of the most common problems of unpaved road networks worldwide. Surface deterioration on unpaved roads is primarily due to accumulated damage from vehicles. Similarly, environmental and physical effects contribute to the rate and extent of surface deterioration. This chapter assesses the surface material quality of unpaved rural roads in four rural areas in the KwaZulu-Natal Province, South Africa in order to understand susceptibility to surface deterioration. The study further establishes other possible factors such as slope gradient and rainfall that could determine road surface deterioration. Soil samples were collected from R3, R4, and R5 road classes in four rural areas which are: Emazabekweni, Dukuza, Mkhunya and Mhlwazini Area. Laboratory analyses were conducted in order to determine the performance of the material as potential wearing course. Material performance was then determined using the Standard Methods of Testing Road Construction Materials (TMH 1:1976) classification method. The results obtained imply that there is a need for better material selection during the construction of unpaved road networks. All road classes in Mkhunya, Emazabekweni and Mhlwazini areas exhibited grading coefficient values less than 16 and some of the shrinkage product values in excess of 365, corresponding to a classification of Class D, A and B. These results indicate material that is susceptible to slippery conditions, easily erodible and also prone to the formation of ravels and corrugations. Correlation analyses results conducted to assess the individual relationship between measured rainfall and slope with field Sp and Gc values in each area indicated that variation in slope better explains Sp values with each area with an R^2 of 0.62 when compared to rainfall producing a lower R^2 of 0.57. For Gc, slope and rainfall produced similar R^2 of 0.65 and 0.67, respectively.

3.2. Introduction

Surface deterioration is one of the most common problems of unpaved road networks worldwide (Jones, 1984, Wilkie et al., 2000, Porter, 2002, Fu et al., 2010). Unpaved roads usually consist of a graded and compacted surface, which is topped with hard surface material such as gravel or crushed rock that is mostly created from parent material present at that location. Parent material refers to the original geological material, which is also known as bedrock (Buol et al., 2011). The term surface deterioration in this study refers to a reduction in the performances of a road due to a decline in road surface quality. Some of the most commonly prominent features of surface deterioration on unpaved roads include distresses such as potholes, rutting, erosion channels, dust, corrugations, loose material and stoniness.

Road surface quality is determined by factors such as surface material quality amongst others. Material quality is reflected by aggregate durability as a wearing course, of which this is primarily defined by the aggregate's mechanical and chemical properties. Paige-Green (1989) argues that universally, there is no standardised method used for designing wearing courses for unpaved roads. According to Jones (1999) and Paige-Green (2015), a number of specifications exist for selecting materials for unpaved roads, but the common challenge is that their basis is often unclear. However, Paige-Green and Netterberg (1987) state that materials used for construction of unpaved roads must comply with the basic engineering properties. In addition, Paige-Green maintains that all wearing course material must contain the following key characteristics, "*have sufficient cohesion to resist ravelling and erosion; have a particle size distribution that facilitates a tight interlock of the individual material particles, and have sufficient strength to support the applied traffic loads without significant plastic deformation*."(Paige-Green (2006:1). Paige-Green (2006) argues that using surface material with deficiencies in any of the aforementioned characteristics adversely affects material performance and this result in poor riding quality, increased maintenance and as well as an increased road surface material loss. Hence, Paige-Green (2006) established a chart (using material plasticity and grading properties) that classifies the expected performances of unsealed wearing course material (as seen on Figure 3.1).

Paige-Greens (2006) chart has been widely used to classify material performance of unsealed roads in many countries worldwide. For example, a study was conducted recently in New Zealand (using Paige-Green's material performance chart) to test and validate the charts

applicability in determining expected material performance (Henning et al., 2015). The study was conducted on unsealed roads in Whangarei and Central Otago Districts. These two districts were selected because they represent the two most extreme climatic, geology and topographies of New Zealand. A number of samples were collected on different unsealed road networks for analysis. The attained findings were able to validate the applicability of Paige-Green's material performance chart because the nature of surface deterioration that was visually observed on the roads (in both districts), matched the expected material behaviour as classified on the chart. Good material selection is therefore necessary when constructing unpaved roads because it can help enhance surface performance and reduce surface deterioration. Furniss et al. (1991) and Madzikigwa (2003), argue that it is not easy to fully assess the causes of surface deterioration on unpaved roads without understanding the physical, environmental and anthropogenic factors at interplay. On the one hand physical factors include the road engineering components (such as design or alignment), traffic (such as vehicle volumes and sizes) and road surface material. On the other hand, environmental and anthropogenic factors include climate conditions, the surrounding landscape (such as vegetation cover, underlying geology and terrain) and maintenance conditions (Paige-Green, 1999). In light of the aforementioned, research indicates that there have been very limited studies conducted to assess the contribution of environmental and physical factors on surface deterioration of unpaved roads (Leung and Marion, 1996, Alzubaidi and Magnusson, 2002). Plethora of research available has focused on issues around maintenance materials and dust binding methods (Gillies et al., 1999 and Jones, 1999). Few studies have examined the effects of the surrounding landscape, climate conditions and the influence of geological properties because these factors cannot be affected by regular maintenance (Hartley 1974, Keller and Sherar, 2003 and Jones and Paige-Green, 2015). It is therefore crucial to identify and assess environmental forces which could have an impact on road surface material performance. For instance, Mwaipungu and Allopi (2012) indicate that unsealed road surfaces are directly exposed to environmental factors such as rainfall, wind and terrain, which influence the performance of gravel roads.

Unpaved road networks play an important role in the socioeconomic sector of South Africa, particularly in rural areas (Starkey, 2002, Njenga and Davis, 2003, Button, 2010). A study by Smith and Visser (2001) and Lishman (2013) shows that rural networks in South Africa consist of 301 000 km of gravel and 63 000 km of surfaced (paved) roads. In KwaZulu-Natal, gravel roads account for approximately 80 percent of the total of roads in this Province (Balaram and Mostert, 2014). These statistics provide a good indication of the value and services of unpaved

road networks to rural areas and the need for their improvement in quality due to the constant deteriorating conditions experienced (Paige-Green, 2006). In most sub-Sahara Africa, including South Africa, road deterioration could affect the livelihoods of rural communities thus road agencies need to find methods of evaluating the road surface material performance which can be used to assist in determining deterioration. In addition, this knowledge could be used in guiding proper maintenance programs for unpaved road surface material. This chapter therefore seeks to assess the surface material quality of unpaved rural roads in four rural areas in the KwaZulu-Natal in order to understand susceptibility to surface deterioration. This study further establishes other possible factors (such as slope gradient and rainfall) that could determine road surface deterioration.

3.3. Materials and methods

3.3.1. Identification of unpaved road networks

Road networks of interest were identified by first traversing the selected areas using recent high resolution Google Earth imagery. Following this procedure, transect walks were done in each area in order to identify the road networks. A total of 11 roads were selected for this study. The road classes were: minor road (R3), collector road (R4) and local road (R5) selected based on the South African Road Classification and Access Management Manual, version 1.0 of August 2012. Due to the focus of this study, principal arterials (R1), major arterials (R2) and walkways (R6) road classes were not assessed.

3.3.2. Collection of soil samples

A hand held Global Positioning System (GPS) was used to record the location of each sampling point. A total of 16 soil samples were collected from each road class (R3, R4 and R5). In the areas under study, the total length of each road class was divided into sixteen equal intervals and samples were collected at every interval from the starting point. For example, the total road length of the R3 road class in Emazabekweni area is 20km, sixteen equal sampling intervals of 1.2km were utilised. This rationale was applied to all sampled road classes, in order to collect samples that were representative of the entire road class. The area of Mhlwazini did not have the R3 road class, so samples were only taken for the R4 and R5 road classes.

During the field sampling, a hand auger was used to retrieve 1 – 1.5kg of material from the middle of the road at every interval. This material was placed into a plastic sampling bag and then sealed. This sampling procedure was repeated for all road classes and across all 4 of the study sites. All the sampled material was then transported to a laboratory for subsequent analysis.

3.3.4. Assessing road surface material performance

The surface material quality of the unpaved roads was assessed by determining the material performance using the Standard Methods of Testing Road Construction Materials (TMH 1:1976) classification method. This included particle size distribution analysis of sand, silt and clay soil particles. Atterberg Limits (namely liquid limit, plasticity index and linear shrinkage) were also assessed as they are useful in providing basic measure of the critical water content in fine-grained soils (Jones and Jefferson, 2012). The related shrinkage product (Sp) and grading coefficient (Gc) were then determined from the results of soil particle analysis and Atterberg limits according to (TMH 1:1976).

The material performance was assigned using specifications adopted from the Technical Recommendations for Highways report number 20 (TRH20, 1990), which provides technical support to structural design, construction and maintenance of unpaved roads in South Africa (Figure 3.1). This system utilises Sp and Gc to assign performance. The zones in figure 3.1 (namely zone A – E) are described in TRH20 (1990) as shown in Table 3.1.

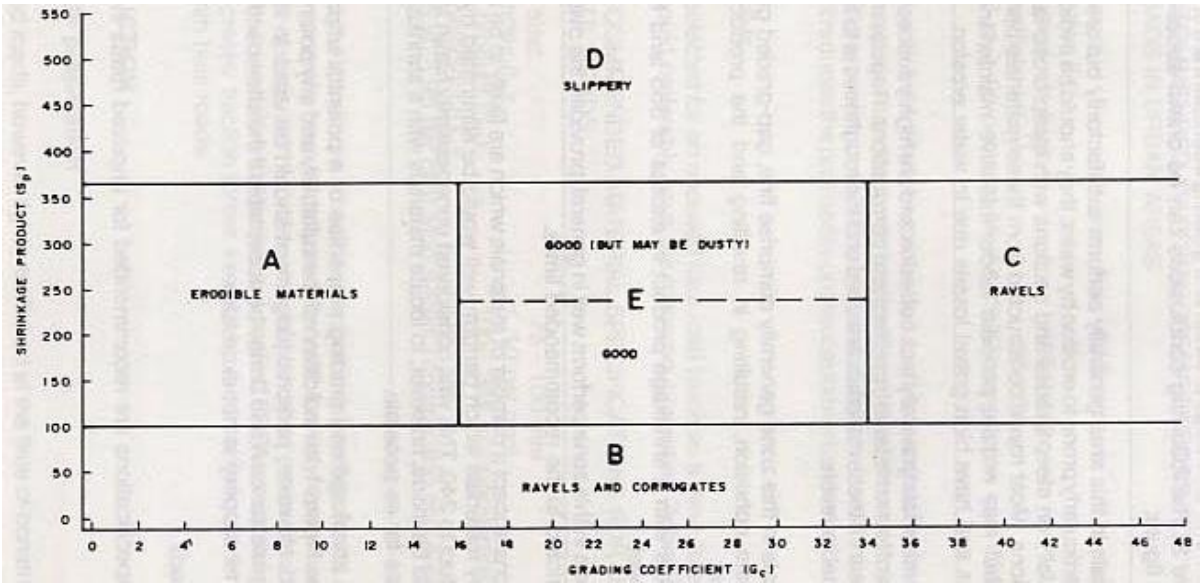

Figure 3.1: *Relationship between shrinkage product, grading coefficient and performance of unpaved wearing course gravels. Adapted from TRH20, 1990).*

Table 3.1: *Description of zones and their expected performance characteristics (adapted from TRH20, 1990).*

Symbol	Description
A	Materials in this area generally perform satisfactorily but are finely graded and particularly prone to erosion by water: they should be avoided if possible, especially on steep grades and sections with steep cross-falls and super-elevations. Most roads constructed from these materials perform satisfactorily but may require periodic labour-intensive maintenance over short lengths and have high gravel losses due to water erosion.
B	These materials generally lack cohesion and are highly susceptible to the formation of loose material (ravelling) and corrugations. Regular maintenance is necessary if these materials are used and the roughness is to be restricted to reasonable levels.
C	Materials in this zone generally comprise fine, gap-graded gravels lacking adequate cohesion, resulting in ravelling and the production of loose material.
D	Materials with a shrinkage product in excess of 365 tend to be slippery when wet.
E	Materials in this zone perform well in general, provided the oversize material is restricted to the recommended limits

3.3.5. Rainfall and slope gradient data

Rainfall and slope gradient data were determined in order to establish environmental factors that could affect road surface deterioration under the given road surface material performance. Rainfall data of the study areas, with a spatial resolution of 1 km × 1 km, was derived from World Bioclim dataset (Hijmans et al., 2005). Topographic data (such as slope gradient) for each sampling area was obtained from the Shuttle Radar Topography Mission (SRTM) (Farr and Kobrick, 2000). Rainfall data was obtained from the South African Water Research Commission.

3.3.6. *Spatially predicting road deterioration using local variables*

The relationship between environmental variables (such as slope gradient and rainfall) and the laboratory results of Sp and Gc was determined using simple linear regression, and the coefficient of determination (R^2) was derived.

3.4. Results Analysis

3.4.1. Road surface material performance classification

The results showing the location of each road class, in terms of shrinkage product and grading coefficient, for the four study sites has been shown in Figure 3.2. From this figure, it can be observed that the R3 and R4 roads in Emazabekweni and Mkhunya lie within zone D. These are characterised by Sp values ranging from 400 – 600 and Gc values between 4 - 24. The results further show that R5 roads for the two study areas fall within zone A which is characterised by Sp values ranging from 300 – 450 and Gc values between 6 – 14. These results therefore indicate that R3 and R4 roads exhibit slippery conditions while R5 is characterised by erodible road surface material.

The results indicate that the studied roads in Mhlwazini and Dukuza lie within zone B and E, respectively. The roads that fall within Zone B are characterised by ravels and corrugates, while Zone E roads exhibit good road conditions which may be dusty.

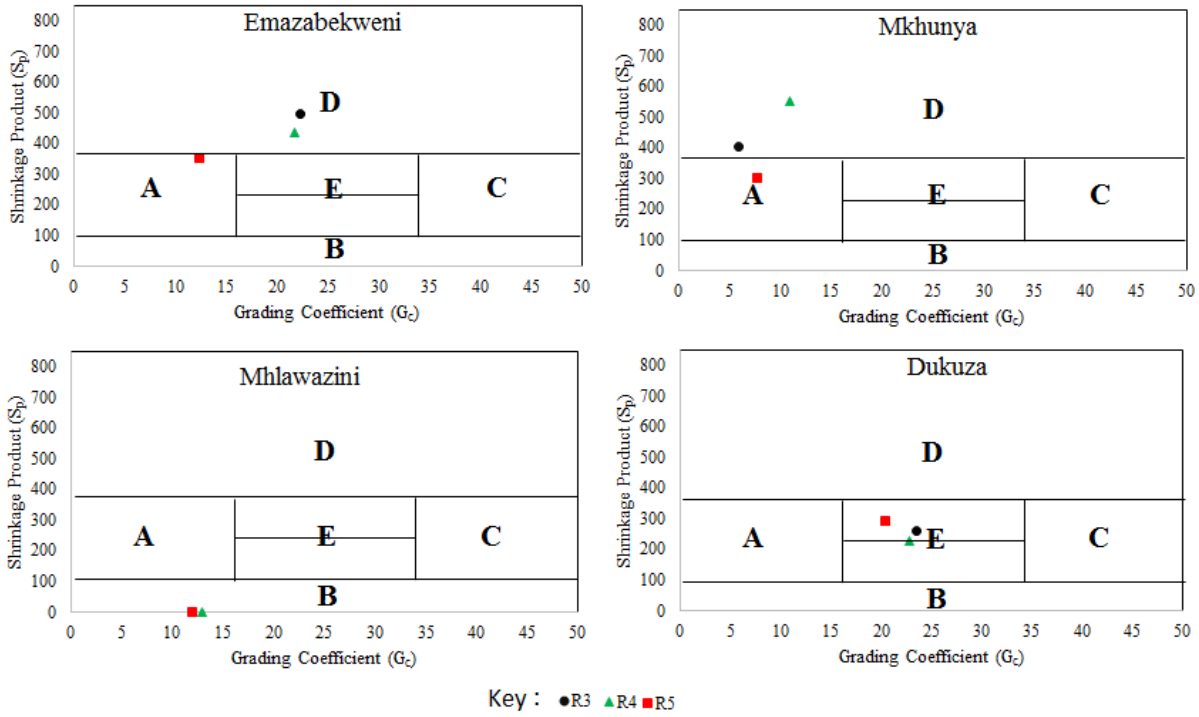

Figure 3.2: *Location of studied roads in terms of TRH20 performance guidelines.*

3.4.2. The environmental variables

Figure 3.3 shows rainfall distribution patterns across the study areas. It can be observed that Mhlwazini exhibit the highest maximum, minimum, and mean annual rainfall. However, Emazabekweni, Mkhunya and Dukuza do not have significant differences in the amount of rainfall received throughout the year.

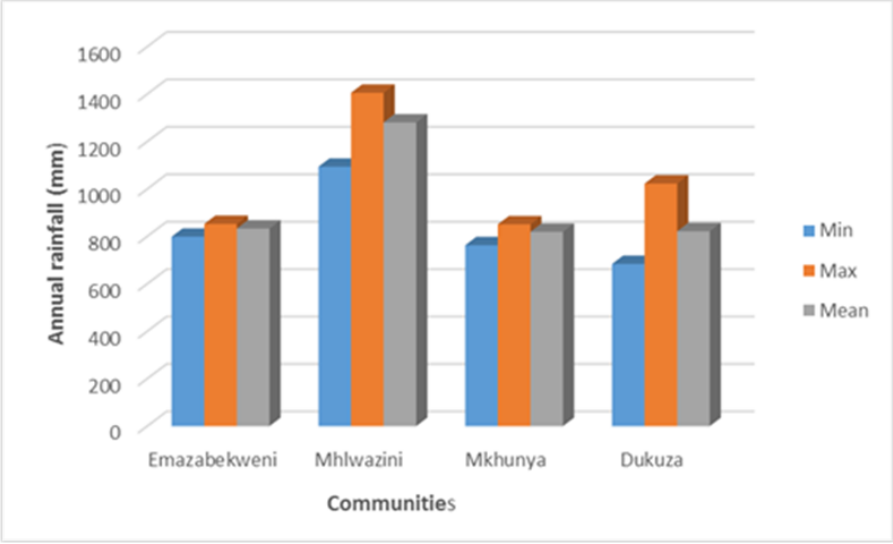

Figure 3.3: *Annual rainfall distribution for Emazabekweni, Mhlwazini, Mkhunya and Dukuza (Schulze, 2008).*

The slope gradient of the study sites are shown in figure 3.4. Figure 3.5 shows the relationship between these environmental variables (such as slope and rainfall) and Shrinkage product and Grading coefficient.

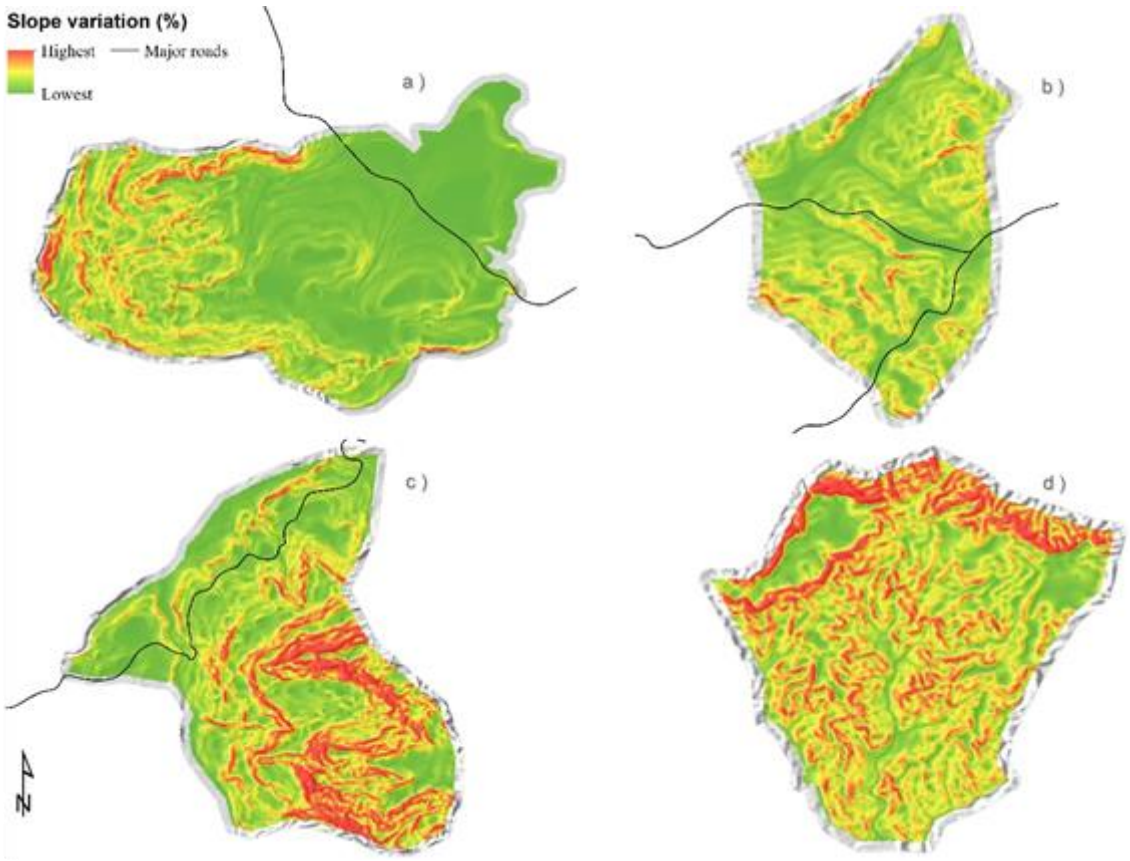

Figure 3.4: *The variation in slope gradient for the Dukuza (a), Emazabekweni (b), Mhlwazini (c) and Mkhunya (d).*

It can be noted that there is a linear relationship between environmental variables and Shrinkage product as well as grading coefficient. For instance, a positive relationship (R^2 = 0.62) and (R^2 = 0.57) was found between Shrinkage product and slope gradient as well as between shrinkage product and rainfall respectively. Similarly, an R^2 value of 0.65 and 0.67 were obtained for the relationship between grading coefficient and slope gradient and rainfall, respectively. This suggests that both the shrinkage product and grading coefficient increase with the increase in slope gradient and rainfall.

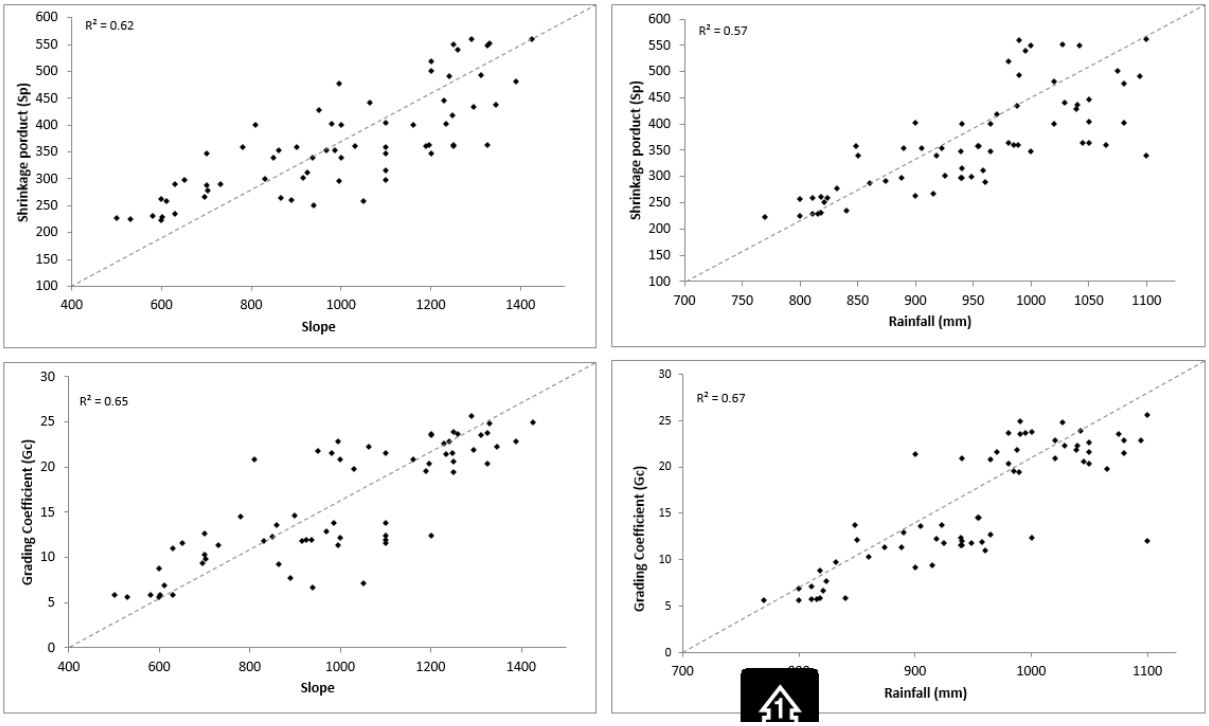

Figure 3.5: *The relationship between environmental variables (namely rainfall and slope) and shrinkage product and grading coefficient.*

3.5. Discussions

The obtained values of Sp generally do not fall within the recommended material specifications for unpaved rural roads in South Africa. The present chapter assessed the surface material quality of unpaved rural roads in four rural areas in KwaZulu-Natal in order to understand susceptibility to surface deterioration. Other possible factors (such as slope gradient and rainfall) that could determine road surface deterioration were evaluated. Literature has already indicated that there is a need to understand the role of material quality in influencing deterioration of unpaved roads. Equally important is the selection of quality material for the construction of unpaved roads thus reducing surface deterioration and maintenance costs (Hodges *et a*l, 1975, Paige-Green 2007, Mwaipungu and Allopi 2012). This study shows that road classes in Mkhunya, Emazabekweni and Mhlwazini areas have poor material quality when compared to road classes in Dukuza area. All road classes in Mkhunya and Mhlwazini areas exhibited Gc values less than 16 and some of the Sp values in excess of 365, corresponding to a classification of Class D, A and B. This indicates susceptibility to slippery conditions, erodible material and the formation of ravels and corrugations. This could result in a rapid

deterioration of the surface area of the unpaved road and hence affecting its use by the rural communities. Mwaipungu and Allopi (2012) indicated that these are typical road surface distress that influence road surface deterioration.

As argued by Queiroz and Gautam (1992), resource-limited regions do not have the capacity and economic means to acquire the best material quality for the construction of their unpaved roads and thus they depend largely on using material that exists within their areas. The findings of this study are comparable with this argument because the soil properties of the sampled road material in each road network indicated strong similarities with the characteristics of the geological material that exists in each area. For example, all the areas under study are located in the regions supported by the Karoo Supergroup (ECCA and Beaufort) geological formations, which are dominated by soils that consist of shale, mudstones and sandstones (Mucina and Rutherford, 2006). The high percentage of mudstone, shale and sandstone particles found in the sampled material from all road classes in Emazabekweni, Mhlwazini and Mkhunya areas provided evidence that these road networks were constructed using local material and the nature of their surface deterioration shows consistent conditions. These conditions further challenge the mobility of residents in the short-term within these areas but also impacts on the long-term lifespan of the roads overall condition. Unpaved roads are semi-permeant infrastructures that are meant to last for many years depending on the nature of their maintenance. However, results of this study also show that material selection, slope and rainfall variability plays a major role in influencing the nature of surface deterioration and lifespan of unpaved road networks.

3.5.1. Other possible factors that could determine road surface deterioration

The high annual rainfall received in Mkhunya and Mhlwazini areas (such as 819.7mm and 1280.9mm respectively) could further influence the deterioration of road classes in addition to the poor material quality in this area. Steeper slopes could further play an important role in the rate and extent of surface deterioration. There is a linear correlation between the slope steepness and the level of soil erosion (Kachouri et al., 2015). An increase in slope gradient is associated with a significant increase in the amount of soil loss. These areas will potentially have higher maintenance costs. Although the results also emphasise that the road classes in Emazabekweni area have poor surface material, the rate and extent of deterioration may be less than that of Mkhunya and Mhlwazini areas where the slopes are steeper. Hence, selecting good surfacing

material will be crucial in reducing the rate and extent of deterioration, especially in areas that have steep slopes and moderately to high annual rainfall.

Roads in the Dukuza area display good material quality, exhibiting Sp values between 100-365 and Gc values between 16-34, similar to those recommended by Paige-Green (Paige-Green, 1999 and Paige-Green, 2007). The material quality in all the road classes corresponded to a classification of class E, indicating good material, which can sometimes be dusty. Even though this area receives moderately to high annual rainfall (822.0mm), the level of surface deterioration is minimal. This may be due to the combination of the gentle terrain and the road classes have good material quality. As argued by Hodges et al. (1975), Paige-Green (2007), and Mwaipungu and Allopi (2012) good material selection reduces surface deterioration and maintenance costs on unpaved roads. Therefore, if all road classes in the Dukuza area were well designed, constructed and maintained, the rate and extent of surface deterioration is expected to be minimal. Terrain and rainfall does have significant influence on surface deterioration in the four areas under study. Furthermore, this accomplishes that regular monitoring of road conditions is conducive as an effective management strategy. Since, this study only assessed four areas with a limited number of wards; future research should focus on including more areas at municipal level for an in-depth analysis. In addition, more research needs to be conducted to investigate the role of engineering designs and construction methods on surface deterioration of on unpaved road networks.

Future studies may investigate the use of other environmental attributes that may improve the prediction of rural road deterioration. Furthermore, this study only used available rainfall and slope information; other studies may consider including aspect, vegetation condition or soil variations to improve mapping predictions. Additionally, including current rainfall information and at finer resolution (< 1 km) would provide more detailed information for areas with the potential of up scaling the methodology with improvement to provide information regionally or at a provincial level on road surface condition.

3.6. Conclusion

This chapter aimed to assess the surface material quality of unpaved rural roads in four rural areas in KwaZulu-Natal in order to understand susceptibility to surface deterioration. This study further establishes other possible factors (such as slope gradient and rainfall) that could determine road surface deterioration. Overall, the findings of this study have shown that material selection remains a common problem in most unpaved rural road networks. In this study, most of the road networks assessed have poor material quality, thus making them vulnerable to increased surface deterioration and maintenance costs. Although the level of surface deterioration was not assessed in this study, the results obtained suggest that material quality has the potential to affect the nature (rate and extent) of surface deterioration on unpaved road networks. For example, erodibility, dustiness, slipperiness and the formation of ravels and corrugations are factors, which are indicative of surface deterioration as a result poor material quality, and other external factors. Furthermore, this study was also able to establish that natural factors such as terrain and rainfall conditions could also play an important role on the nature of surface deterioration of unpaved road networks. Good material selection is therefore a prerequisite to reducing the contribution of the natural variables on surface deterioration of unpaved road networks. Overall, this study provided a framework for assessing road conditions of rural networks and their potential risk to slope and rainfall variabilities.

3.7. References

ALZUBAIDI, H. AND MAGNUSSON, R., 2002. Deterioration and Rating of Gravel Roads: State of the Art. *Road Materials and Pavement Design*, 3(3), pp.235-260.

BALARAM, Y. AND MOSTERT, M., 2014. Lessons learnt from the measurement of gravel road roughness in Kwazulu-Natal. *In SARF/IRF Regional Conference*, 5th, 2014, Pretoria, South Africa.

BUOL, S. W., SOUTHARD, R. J., GRAHAM, R. C. & MCDANIEL, P. A. 2011. Soil genesis and classification, J*ohn Wiley & Sons*. United States of America.

BUTTON, K., 2010. Transport economics. *Edward Elgar Publishing*. Cheltenham, United Kingdom.

BUYS, P., DEICHMANN, U. AND WHEELER, D., 2006. Road network upgrading and overland trade expansion in Sub-Saharan Africa (Vol. 4097). *World Bank Publications*. United Kingdoms.

FARR, T. G., AND KOBRICK, M. (2000). Shuttle Radar Topography Mission Produces a wealth of data. *EOS Transactions – American Geophysical Union* 81, 583–585.

FREEME, C.R., MAREE, J.H. AND VILJOEN, A.W., 1982. Mechanistic design of asphalt pavements and verification using the heavy vehicle simulator. Pretoria: *National Institute for Transport and Road Research*. South Africa.

FU, B., NEWHAM, L.T. AND RAMOS-SCHARRON, C.E., 2010. A review of surface erosion and sediment delivery models for unsealed roads. *Environmental Modelling & Software*, 25(1), pp.1-14.

FURNISS, M.J., ROELOFS, T.D. AND YEE, C.S., 1991. Road construction and maintenance. *American Fisheries Society Special Publication*, 19, pp.297-323.

GILLIES, J.A., WATSON, J.G., ROGERS, C.F., DUBOIS, D., CHOW, J.C., LANGSTON, R. AND SWEET, J., 1999. Long-term efficiencies of dust suppressants to reduce PM10 emissions from unpaved roads. *Journal of the Air & Waste Management Association*, 49(1), pp.3-16.

GWILLIAM, K., FOSTER, V., ARCHONDO-CALLAO, R., BRICEÑO-GARMENDIA, C., NOGALES, A. AND SETHI, K., 2008. The burden of maintenance: roads in sub-Saharan Africa. Background Paper, 14.

HENNING, T. F., FLOCKHART, G., COSTELLO, S. B., JONES, V. & RODENBURG, B. 2015. Managing Gravel Roads on the Basis of Fundamental Material Properties. *Transportation Research Board, 94th Annual Meeting*. Washington DC.

HIJMANS, R. J., CAMERON, S. E., PARRA, J. L., JONES, P. G., AND JARVIS, A. (2005). Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology* 25, 1965–1978.

HODGES, J.W., ROLT, J. AND JONES, T.E., 1975. The Kenya road transport cost study: research on road deterioration. TRL Research Report LR673. *Transport and Road Research Laboratory*, Crowthorne.

HARTLEY, A. 1974. A review of the geological factors influencing the mechanical properties of road surface aggregates. *Quarterly Journal of Engineering Geology,* 7**,** 69-100.

HOUSING DEVELOPMENT AGENCY. (2013). The Housing Development Agency annual report 2012/2013 [Online]. Johannesburg, South Africa: HDA. [Accessed 04 October 2016].

JONES, D., 1999. Holistic approach to research into dust and dust control on unsealed roads. Transportation Research Record: *Journal of the Transportation Research Board*, (1652), pp.3-9.

JONES, L.D. AND JEFFERSON, I., 2012. Expansive soils (pp. 413-441). *ICE Publishing*, United Kingdom.

JONES, T.E., 1984. The Kenya maintenance study on unpaved roads: research on deterioration. *Overseas Unit, Transport and Road Research Laboratory*. Kenya.

JONES, D. & PAIGE-GREEN, P. 2015. Limitations of using conventional unpaved road specifications for understanding unpaved road performance. *Transportation Research Record: Journal of the Transportation Research Board***,** 30-48.

KACHOURI, S., ACHOUR, H., ABIDA, H. & BOUAZIZ, S. 2015. Soil erosion hazard mapping using Analytic Hierarchy Process and logistic regression: a case study of Haffouz watershed, central Tunisia. *Arabian Journal of Geosciences,* 8**,** 4257-4268.

KELLER, G. AND SHERAR, J., 2003. Low-Volume Roads Engineering: Best Management Practices. Transportation Research Record: *Journal of the Transportation Research Board*, (1819), pp.174-181.

LEUNG, Y.F. AND MARION, J.L., 1996. Trail degradation as influenced by environmental factors: A state-of-the-knowledge review. *Journal of soil and water conservation*, 51(2), pp.130-136.

LISHMAN, D. (2013). A critical evaluation of road pricing in South Africa. Dissertation, University of Cape Town, South Africa.

MADZIKIGWA, B., 2003. Nature and effects of low-volume roads in Botswana. Transportation Research Record: *Journal of the Transportation Research Board*, (1819), pp.88-95.

MUCINA, L., & RUTHERFORD, M.C., 2006. The Vegetation of South Africa, Lesotho and Swaziland, Strelitzia 19, *South African Biodiversity Institute*, Pretoria.

MWAIPUNGU, R.R. AND ALLOPI, D., 2012. The appropriate material specifications and manual are key for effective gravel roads design, construction and maintenance practice. Practice' Proceedings of 1st National Conference on Intermodal Transportation: Problems, Practices, and Policies. pp. 176-188.

NJENGA, P. AND DAVIS, A., 2003. Drawing the road map to rural poverty reduction. *Transport Reviews*, 23(2), pp.217-241.

NKOMO, S.L. DESAI, S. AND PEERBHAY, K., 2016. Assessing the conditions of rural road networks in South Africa using visual observations and field-based manual measurements: A case study of four rural areas in Kwa-Zulu Natal. *Review of Social Sciences*, 1(2), pp.42-55.

OZLER, BERK AND HOOGEVEEN, J. G. M. 2005. Not Separate, Not Equal: Poverty and Inequality in Post-Apartheid South Africa. *William Davidson Institute*. Working Paper No. 739. Available at SSRN: https://ssrn.com/abstract.

PAIGE, P. & NETTERBERG, F. 1987. Requirements and properties of wearing course materials for unpaved roads in relation to their performance. *TRAFFIC,* 576**,** 625.

PAIGE-GREEN, P. New performance-related specifications for unpaved roads. *Annual Transportation Convention*, 1989, Pretoria, South Africa.

PAIGE-GREEN, P., 1999. Geological factors affecting performance of unsealed road materials. Transportation Research Record: *Journal of the Transportation Research Board*, (1652), pp.10-15.

PAIGE-GREEN, P., 1999. Materials for sealed low-volume roads. Transportation Research Record: *Journal of the Transportation Research Board*, (1652), pp.163-171.

PAIGE-GREEN, P., 2006. Appropriate roads for rural access. *Third Gulf Conference on Roads, CSIR Built Environment*, South Africa.

PAIGE-GREEN, P., 2007. Improved material specifications for unsealed roads. *Quarterly journal of engineering geology and hydrogeology*, 40(2), pp.175-179.

PAIGE-GREEN, P., 2007. New Perspectives of Unsealed Roads in South Africa. Road & Transport Research: *A Journal of Australian and New Zealand Research and Practice*, 16(3), p.56.

PORTER, G., 2002. Living in a walking world: rural mobility and social equity issues in sub-Saharan Africa. *World development*, 30(2), pp.285-300.

QUEIROZ, C.A. AND GAUTAM, S., 1992. Road infrastructure and economic development: some diagnostic indicators (Vol. 921). *World Bank Publications*. United Kingdom.

SCHULZE, R. E. (ed.) (2008). South African Atlas of Climatology and Agrohydrology. WRC Report No. 1489/1/08. *Water Research Commission*, Pretoria, RSA.

SMITH, A., & VISSER, A. T. (2001). A South African Road Network Classification Based on Traffic Loading. M Eng project report, University of Pretoria.

STARKEY, P. ed., 2002. Improving rural mobility: options for developing motorized and nonmotorized transport in rural areas (Vol. 23). World Bank Publications.

THOMPSON, R.J. AND VISSER, A.T., 2000. The functional design of surface mine haul roads. *Journal-South African Institute of Mining And Metallurgy*, 100(3), pp.169-180.

TECHNICAL RECOMMENDATIONS FOR HIGHWAYS draft 20, 1990. Structural design, construction and maintenance of unpaved roads. Committee of State Road Authorities. Pretoria, South Africa.

WILKIE, D., SHAW, E., ROTBERG, F., MORELLI, G. AND AUZEL, P., 2000. Roads, development, and conservation in the Congo Basin. *Conservation Biology*, 14(6), pp.1614-1622.

WEINERT, H.H., 1968. Engineering petrology for roads in South Africa. *Engineering Geology*, 2(6), pp.363375-372395.

CHAPTER FOUR

EVALUATING RURAL PEOPLE'S PERCEPTIONS ON THE SOCIOECONOMIC ROLE OF ROAD NETWORKS ON THEIR LIVELIHOODS

The chapter is based on:

Nkomo, S.L. Desai, S.A. Peerbhay, K. Y. and Seutloali, K.E. (In preparation) "A thematic analysis of local respondents' perceptions on the socioeconomic role of unpaved road networks on rural livelihoods. Lessons from rural communities within the province of KwaZulu-Natal, South Africa." *Journal of Arts and Humanities.*

4.1. Abstract

Road networks as a physical resource form an integral function in terms of sustaining the well-being of rural livelihoods, particularly in remote rural communities. The socioeconomic benefits of improved rural road networks have be extensively researched in Asia, but not to the same extent in Africa. In response to some of the literature gaps, the current chapter therefore uses a thematic approach to analyse rural people's perceptions on the socioeconomic role of their unpaved road networks on their livelihoods. This study was conducted in four rural communities within the province of KwaZulu-Natal. Quantitative and qualitative research methods were used to thematically analyse four research themes in terms of the role of rural road networks on rural agriculture production, access to health services, access to education services and markets, information and employment opportunities. It is clear from the study that local respondent's perceptions on the socioeconomic role of unpaved road networks on their livelihoods are influenced by the effectiveness of their roads in servicing their needs. Due to a number of factors outlined in this study, this research can conclude that in the four communities assessed, less than ten percent of all the respondents perceived direct economic spinoffs as a results of road networks improvements. Majority of the respondents perceived social spinoffs such as improving access to healthcare, education and market services. The study further concludes that unequal distribution and access to primary services is a notable feature of poor governance in the communities under study. This study therefore recommends for better methods of maintaining rural roads in order to ensure sustainability in mobility.

4.2. Introduction

Transport infrastructure is considered as an important pillar for economic development (Kennedy et al., 2005, Salling and Pryn, 2015).Transport infrastructure refers to all the transport systems that aid in country's or region's mobility, such as roads, railways, ports and airports (Rodrigue et al., 2009). Rodrigue et al. (2016) states that before high-intensity modern trade can get started in Africa, there is a need to improve transport infrastructure systems both from the coast to the interior and within the interior, in order to connect people and economic hubs. Economically booming countries such as China and India have emphasised the importance of developing and improving road networks as one of the key strategies that can be used to facilitate economic growth (Van de Walle, 2002, Ali and Pernia, 2003, Fan and Chan-Kang, 2005, Pucher et al., 2007, Banerjee et al., 2012,). Fan and Chan-Kang (2005), state that during the early 1980s the Chinese government took a stand to prioritise the construction of high-quality roads in order to connect their industrial centres. On the one hand, the Chinese government spent 8.6% of its Gross domestic product (GDP) building roads, railways, airports, seaports and other transport related infrastructure projects between 1992 and 2013 (Dobbs et al., 2013). Dobbs et al. (2013), argue that Western Europe, United States and Canada spent 5% on that same spending figure during that period. The 2017 financial report indicates that India is set to spend 59 billion dollars to upgrade their strained railway, airports and road infrastructure systems (Lehmacher, 2017). Studies by Jedwab and Storeygard (2017) show that India (24,000 km) and China (111,900 km) have more highways than the entire Sub-Saharan Africa (3,700 km). In addition, transport charges in Africa for travels of up to 30 km are as up to two and a half times more than in Asia (Mubila and Yepes, 2017). Statistics further highlight that China and India are currently ranked first and third respectively in terms countries with the largest economies in the world (Chan, 2017). Economists have argued that intensive investment in transport infrastructure has played an instrumental role in China's economic boom (Sahoo et al., 2012, Yu et al., 2016).

However, there are continuous debates amongst Chinese scholars concerning quantifying the benefits received from transport infrastructure investments (Fan et al., 2004, Fan and Chan-Kang, 2008, Wang et al., 2016). The debate stems from the argument that infrastructure investment does not necessarily lead to economic growth (Ansar et al., 2016). The benefits of improved transport infrastructure depend largely on the needs (such as the physical, economic, human, political and social) of a particular community or group (McDonagh, 2006, Shay et al.,

2016) . However, the focus of this paper is not to assess the implications of improved road infrastructure systems on the economies of India and China. This paper uses these countries to provide insight into the South African scenario. Rural economic development strategies and lessons learnt from China and India are important to South Africa because these countries all form part of the Brazil, Russia, India, China and South Africa (BRICS) association.

4.2.1. Road networks and rural livelihoods in South Africa

Road networks form part of one of the important physical resources that help sustain life in rural livelihoods, particularly in remote communities (Porter, 2002, Van de Walle, 2002, Pearce et al., 2006, Hussein and Nelson, 2016). South Africa is currently enjoying just over two decades of colonial freedom but, if one reviews literature, there is limited empirical research conducted on the state of service delivery in rural communities, particularly transport infrastructure. The Integrated Development Planning reports (IDPs) from local municipalities and data from Statistics South Africa are one of the few documents that publish information yearly on the state of service delivery at community level. An IDP is a broad report drafted by a municipality which indicates a broad framework for development, compelled by Municipal Systems Act No 32 of 2000 (Municipality, 2013).

Kon and Lackan (2008) and Chikozho (2016) argue that extensive rural research is needed in South Africa because the country's political history has been associated with major socioeconomic disparities that resulted in unequal distribution of resource amongst racial groups. Lipton (1986), states that under the apartheid Government, majority of black people were forced to live in remote rural areas (homelands), where decent transport infrastructure and services were limited. This system was designed to enforce, perpetuate and strengthen the separation of racial groups and to prevent black people from accessing economic opportunities. Figure 4.1 provides a comparison of real GDP and public sector economic infrastructure investment in South Africa from 1960 to 2005. It can be noted from the graph that both series exhibited positive growth in the early 1960s to mid-1970s and mixed performances between late 1970s and early 1980s. According to Peet (2002) the disastrous economic consequences of the apartheid Government became increasingly notable in the early 1980s to early 1990s. During this period, there was a massive decline in both real GDP and infrastructural investment.

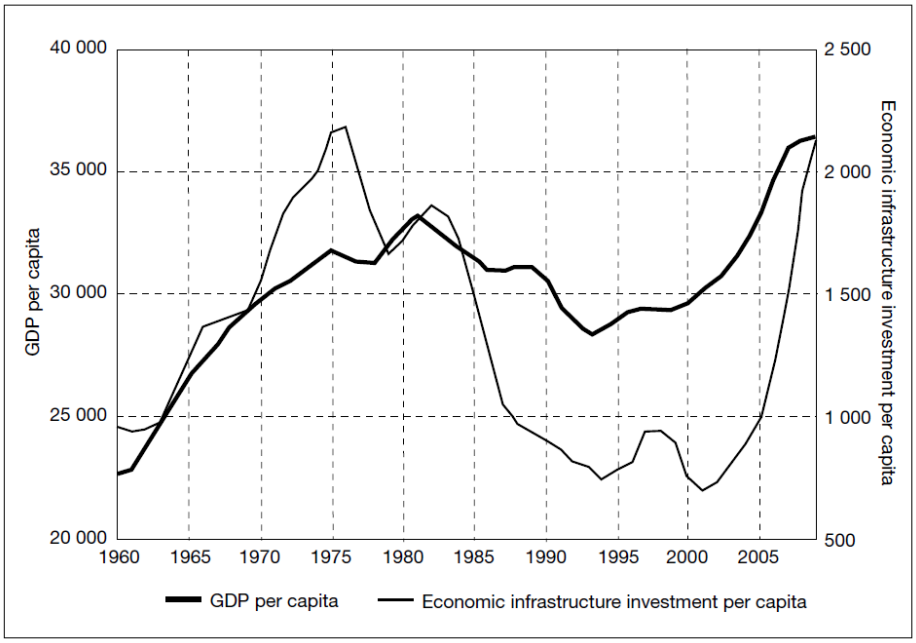

Figure 4.1: *South Africa: real GDP and public-sector economic infrastructural investment, per capita, rands, 2005 prices, moving average (Reserve Bank, 2005).*

Current statistics indicate that 64.3 % of the population in South Africa live in urban areas, compared to 48.4% in 1980 (Sisk, 2017). According to Kessides (2006), poor services delivery and limited economic opportunities have been widely identified as the primary cause of rural-urban migration in sub-Saharan Africa. About 80% of all rural roads in South Africa are unpaved roads (Gwilliam et al., 2008, Mubila and Yepes, 2017). Many rural communities in South Africa still have inappropriate access consisting of unpaved roads that do not necessary provide all-weather access (Paige-Green, 2006). There is plethora of literature available on the impact of good road networks on the livelihoods of rural communities (Ellis, 1998, Ellis and Freeman, 2004, Bryceson et al., 2008, Kanel and Niraula, 2017). In this study, the role of road networks on the livelihoods of rural South Africa will be assessed using four themes that have been extensively researched internationally and noted to form part of the primary benefits of improving road networks in rural communities.

4.2.2. Rural agriculture production

In South Africa, one cannot ignore the country's economic history when assessing the performance of rural agriculture. According to Beinart (2001), throughout the twentieth century, the apartheid Government ensured that heavy investments in agriculture benefited only the white owned commercial farms. The government supported white farmers through legislation such as the Cooperative Societies Act (1925) and the Marketing Act (1968) (Lipton,

1974). These laws, allowed the state to invest in research and development, infrastructure, extension services and the settlement of farmers, and also ensured that domestic markets were protected from international competition. Furthermore, the government established a range of measures to suppress black farmers, such as the 1913 Land Act No. 27, the 1936 Native Trust and Land Act No. 18 (Adams et al., 1999a, Obeng-Odoom, 2012, Mazibuko, 2013). These measures ensured that black farmers were disadvantaged, both in the commercial farming sector and in the communal areas of the former homelands. The apartheid government provided good infrastructure support to commercial white farmers as no empirical studies have been conducted to indicate their dissatisfaction relating to transport infrastructure.

Post 1994, the government developed strategic plans and programs to help speedup service delivery backlogs, particularly in the former homeland areas. South Africa is still experiencing challenges of the past (Butler, 2017) but very few studies have examined or assessed the rate and impact of improving service delivery on agriculture production in rural communities, particularly transport infrastructure systems (Poulton et al., 2006, Gabrysch and Campbell, 2009, Lucas, 2011). In South Africa, the National Treasury department is responsible for managing and allocating national government finances (Ngamlana, 2009, Kaiser and Smallwood, 2014). Although, there are strategic plans and programs in place for fast-tracking rural development, the concern is that the department of National Treasury has a set of criteria for allocating funds for construction and maintaining of national assets. In allocating funds, the department needs to know the exact length of the roads, the value of the infrastructure on it and the condition of the road and its infrastructure (Kaiser and Smallwood, 2014). A key issue in South Africa is that the value of infrastructure on rural road networks, which are predominantly unpaved, is unquantified, meaning that based on the aforementioned criteria, they possibly receive very little financial support. Research suggests that people and their livelihoods in rural communities are becoming increasingly divorced, known as de-agrarianisation from farming as well as from the land (Hussein and Nelson, 1998, Ellis, 2000, Perret, 2001, Zantsi, 2016). Ellis (2000) and Scoones et al. (2009), identified factors such as climate change, poor service delivery, restrictions on access to land (Cross and Hornby, 2002) and the lack of economic opportunities as some of the key drivers that motivate this change in rural farming practices. Therefore, investigating rural road network conditions and their role on agriculture production is fundamental in order to unpack some of the service delivery problems causing people to divorce their livelihoods from farming. Van de Walle (2002) and Qin and Zhang (2016) argue that providing good rural road networks facilitates agricultural specialisation.

4.2.3. Access to markets, information and employment opportunities

As a country, South Africa is regarded as a food secured nation (Koch, 2011) but a large number of households within the country are food insecure (Altman et al., 2009, Baiphethi and Jacobs, 2009, De Cock et al., 2013). According to Khan et al. (2014), the magnitude of the food security challenges in South Africa at national, provincial and household level are subsequently quantified showing that more than 60% of the rural population and 20% of the urban population live below the minimum subsistence level. Walsh and Van Rooyen (2015), states that traditionally, rural households in South Africa were known to grow most of their own food and urban households bought most of their food supply. However, recent studies indicate that there has be an increase in dependence on market purchases for both rural and urban households (Bryceson, 2002, Baiphethi and Jacobs, 2009, Ncube et al., 2016, Tibesigwa and Visser, 2016). Research further suggests that low-income households in sub-Saharan Africa spend as much as 60-80% of their total budget on food expenditure (Von Braun, 2007, De Hoyos and Medvedev, 2009, Lewis and Verhoeven, 2010, van Berkum et al., 2017). Lal et al. (2016) and Zhuo et al. (2016) also argue that the declining investments in research, infrastructure and as well as increasing water shortages have resulted in a decrease in crop yields in remote rural communities.

Research shows that food insecurity in South Africa is more prevalent in regions that have been historically disadvantaged during the apartheid era (the former homelands) and in the growing urban centres (Møller, 1998, Kepe and Tessaro, 2014, Hanoman, 2017, Misselhorn and Hendriks, 2017). In addition, Edigheji (2010) and Phiri (2017) state that the food security problems in South Africa reflect the continuing social and economic inequalities that are still embedded in the country. South Africa is regarded as one of the countries with the highest inequalities rates in the world, with a Gini coefficient that is above 0.60 (Thorbecke and Charumilind, 2002, Woolard, 2002, Adjaye-Gbewonyo et al., 2016, Burns et al., 2017). Scientists and policy makers in South Africa have identified poverty, unemployment and human immunodeficiency virus infection and acquired immune deficiency syndrome (HIV/AIDS) to be the major food security challenges in the country at present (Misselhorn and Hendriks, 2017, Pienaar, 2017). Misselhorn and Hendriks (2017) argue that these challenges are interrelated and disproportionately affect rural people. Although these challenges are a

problem countrywide within South Africa, studies by Labadarios et al. (2011) suggest that rural households are more affected than urban areas.

The issue of food insecurity in rural households is a huge concern and can possibly increase in future. The reason being rural people and their livehoods are becoming increasingly divorced from farming. Ellis (1998) and Yaro (2006), argue that structural adjustments and market liberalization policies fast-tracked deagrarianisation in poor countries, particularly in sub-Saharan Africa. Yaro (2006), further argues that structural adjustments policies have been highly criticised in many countries because they do not favour rural subsistence farming and other subsistence economies. Yaro (2006) argument is comparable with the current situation in rural South Africa because, majority of terraces which were previously cultivated in rural communities are now dormant (Beningfield, 2006, Chirikure et al., 2017). Studies show that rural people have now become dependent on non-agricultural income for their livelihoods (Hussein and Nelson, 1998, Bryceson, 2002, Kay, 2008, Bezu and Holden, 2014, Ojha et al., 2017).

Analysts and experts in South Africa advocate that the contribution of the agriculture industry has declined drastically and could possibly worsen (Hoffmann et al., 2014). Statistics from Grain South Africa in 2015, indicate that the agricultural sector in South Africa represented less than 10% of the GDP in 1960 and currently this figure is below 2,5% (Sender, 2016). A number of issues have been extensively researched and identified as some of the primary causes to the decline and these include amongst others; the impact of climate change, emergence and enforcement of land restitution programs, changes in labour laws and the weakening of the rand in global markets resulting in high inflation (Magadza, 1994, Adams et al., 1999b, Hall, 2004, Sender and Johnston, 2004, Kurukulasuriya and Rosenthal, 2013, Sender, 2016). The aforementioned findings are only limited to research conducted on challenges facing commercial farmers and have excluded small-scale and subsistence farmers. Poor productivity in commercial farms has the potential to create more food insecurity pressure on rural livelihoods because a decline in this sector will result in escalating food prices. Furthermore, the agriculture sector employs around 10% of formal employment in the country, of which the bulk of the labour force is predominantly rural people (Oosthuizen and Bhorat, 2005, Wilkinson et al., 2017). Consequently, if this sector continues to decline unemployment figures in rural areas will escalate. Improvement in rural infrastructure (particularly roads) is therefore crucial for facilitating better access to markets, information and employment opportunities for rural people. Khandker and Samad (2016), argues that greater physical access to markets

consistently improve nonfarm earnings opportunities for rural people. In the plight to revitalise the rural agricultural sector, the South African government in 2015 launched a programme (in 44 district municipalities) led by the Department of Rural Development and Land Reform called Agri-parks. An "Agri-park is a networked innovation system of agro-production, processing, logistics, marketing, training and extension services, located in a District Municipality" (DAFF, 2015:2). The objective of the Agri-parks programme is to establish one agricultural hub or centre in each of the 44-district municipalities in the country. The Government provided ten guiding principles as part of the establishment of the Agri-park hubs or centres:

- *"One Agri-Park per District Municipality*
- *Agri-parks must be farmer controlled*
- *Agri-parks must be the catalyst around which rural industrialization will takes place.*
- *Agri-parks must be supported by government (10 years) to ensure economic sustainability.*
- *Strengthen partnership between government and private sector stakeholders to ensure increased access to services (water, energy, transport) and production on the one hand, while developing existing and create new markets to strengthen and expand value-chains on the other.*
- *Maximise benefit to existing state land with agricultural potential in the provinces, where possible.*
- *Maximise access to markets to all farmers, with a bias to emerging farmers and rural communities.*
- *Maximise the use of high value agricultural land (high production capability).*
- *Maximise use of existing agro-processing, bulk and logistics infrastructure, including having availability of water, energy and roads.*
- *Support growing-towns and revitalization of rural towns, in terms of high economic growth, high population growth over past 10 years and promote rural urban linkages" (DAFF, 2015:3).*

There are two important guiding principles that are off particular importance to this theme (bulletin number three and six). It will be difficult for the Agri-parks programme to achieve the objectives of these two principles if the communities in some of the rural district municipalities are not easily accessible due to poor road networks. Hence, the success of the Agri-parks

programme as a strategy to facilitate access to markets, information and employment opportunities in rural district municipalities is determined by, amongst other, the condition of road networks (Leshoro, 2017).

4.2.4. Access to education

The current educational system in South African is facing lot of criticism and many people argue that this system is neither completely closed nor completely open to the poor (Volmink and van der Elst, 2017). However, for one to fully understand the journey of education in the former homeland areas (and in black townships), it is important for one to remember the words of Dr Hendrik Verwoerd when he was addressing parliament in 1953. Dr Hendrik Verwoerd said, "Blacks should not rise above the level of certain forms of labour" (Fiske and Ladd, 2004, Mazibuko, 2013). Disadvantaging black education systems (Bantu Education Act in 1953) was amongst some of the key strategies that were deployed to achieve Dr Hendrik Verwoerd's objectives. The apartheid Government made sure that schools for white pupils were well funded and those for black pupils were systematically denied adequate facilities, textbooks and quality teachers. In addition, black children were denied free and compulsory education (Mazibuko, 2013). Fiske and Ladd (2004), argue that white schools were resourced ten times better than black schools during apartheid. After 1994, the newly elected democratic government designed laws, strategies, and programs to prioritise the provision of education in previously disadvantaged communities. As enshrined in The Bill of Rights (1996: 12) chapter 2, Section 29 of the South African Constitution that;

"Everyone has the right to a basic education, including adult basic education and to further education, which the state, through reasonable measures, must make progressively available and accessible"

Economic analysts argue that the economy of South Africa is characterised by a growth path, which is both skills-intensive and capital-intensive (Kraak, 2004, Mayer and Altman, 2005, Faulkner and Loewald, 2008, Ferreira and Rossouw, 2016). Reddy et al. (2016), have criticised South Africa's economic growth path, stating that it does not create a sufficient quantum of low-wage employment. Storm and Isaacs (2016) states that in the South African context generating low-wage employment is a possible key in reducing both unemployment and income discrepancies. In addition, Todes and Turok (2017) have also criticised South Africa's economic growth path, arguing that it widens the gap between the rich and poor because it does not take into account the inequalities which were inherited from previous racist policies, particularly in the former homeland areas. According to Rogerson (2017), the government

needs to improve the quality of education, especially in rural areas if it wants to reduce income inequality and poverty. Govender (2016), argues that improving services such as education, communication and transport infrastructure will enable rural people to participate more in nonfarm activities. In support, Bhorat et al. (2016) state that investments in such services opens up new opportunities to previously inaccessible to rural populations.

One of the objectives of this study is to understand the role of road networks conditions on access to services such as education and health. Accessibility is one of the primary indicators used to assess equal educational opportunities. According to Lucas et al. (2016), the assessment of equal educational opportunity is not a matter of whether the systems produces equal education results for pupils of all races, but whether the systems eliminate differences in the educational opportunities for students of different races. A number of factors that contribute to low educational participation in rural areas have been identified and amongst others, scholars have identified that the opportunity costs of attending schools are often higher in rural than in urban areas (Lockheed and Verspoor, 1991, Heyneman and Stern, 2014, Sewell and Desai, 2016). Studies conducted by the World Bank in 2004 in rural Chad as part of the Rural Access Initiative, indicated that student enrolment decreased rapidly with the distance to school (Fiske and Ladd, 2004). The results of the same study further showed that schools that were located one kilometre away from the villages had less than half student enrolment than those that are located within the villages. Similar studies done in Lesotho in 2005 showed that 69% of the children who had never attended school lived more than 30 minutes from schools (Mulkeen, 2005). It is therefore important to assess whether accessibility is still a challenge in the provision of rural education in South Africa.

4.2.5. Access to primary healthcare services

Primary healthcare (PHC) provision is a global challenge. Studies by Penchansky and Thomas (1981) have identified five key barriers in the provision of PHC, which include availability, accessibility, affordability, acceptability and accommodation. Research shows that most countries in Africa are confronted with healthcare challenges as a result of poor coverage, access, management and high costs (Tanser et al., 2006). South Africa's health sector has been associated with a long history of racial and spatial inequalities and thus the health sector is undergoing major restructuring in an attempt to improve health outcomes and reduce inequalities relating to access (Gatrell and Elliott, 2014). Coovadia et al. (2009), argue that the one of the most notable post-1994 improvements was the establishment of a district-based

system, in an effort to make health management more open to local needs and to also distribute resources more fairly. According to Organisation (2003), community-based PHC remains the only effective service that is available for populations in many developing countries. Studies have widely shown that geographical accessibility of PHC services influence service utilisation (Duong et al., 2004, Tanser et al., 2006, Peters et al., 2008, Regan and Wong, 2009, Fishman et al., 2016). Guagliardo (2004) and Pérez-Cuevas et al. (2017), suggest that access to PHC is recognised as an important facilitator of overall population health.

Statistics indicate that the South African Government spends over 8% of GDP in the public health sector (more than any other African country), of which rural areas remain the most under resourced (Aliber, 2003, Govender, 2016, Jakovljevic et al., 2017). Since 1994, a lot has been achieved in terms of alleviating poverty but poor population health and an increase in poverty remains a challenge. Recent health results indicate that South Africa is ranked first in the world in terms of the number of people (estimated at 7 million) infected and living with HIV and AIDS (Bhargava et al., 2017, Rotheram-Borus et al., 2017). Hence, providing good access to PHC remains to be a very important service in South Africa. Schneider et al. (2008), states that the majority of people in rural South Africa are poor and rely almost totally on public health facilities for PHC, of which Thomas et al. (2017) suggests that rural areas are amongst the most deprived in terms of accessing quality PHC. A child which is born and lives in the Eastern Cape province (which is largely rural) is more than twice as likely to die in its first year of life than a child from the Western Cape province (predominantly urban areas) (Commission and UNICEF, 2014). Similarly, the under-5 mortality rates between the Western Cape and Eastern Cape province vary significantly, 40/1000 and 80/1000 respectively (Commission and UNICEF, 2014). Pronyk et al. (2001) and Bond et al. (2015), also argue that a person with Tuberculosis (TB) in the Gauteng province (largely urban) has more than 19% higher chance of being cured from TB when compared to a person suffering from the same disease who is living in the North West province (largely rural). The aforementioned geographical inequalities in PHC are not only endemic to South Africa but are also common in many low-middle income countries worldwide. Child mortality statistics in India show that children who are born in urban areas are more than twice as likely to survive birth than children in rural areas, 39 /1000 and 62 /1000 respectively (Collaborators, 2010, Venkatesh et al., 2016). Plethora of studies have argued that proximity to PHC services is an important factor that affects health outcomes. For example, the greater the distance to PHC services results in decreased contraceptive use (Nteta et al., 2010), increased maternal and infant mortality (Basinga et al., 2011), decreased

vaccination coverage (Nteta et al., 2010) and increased pregnancy complications (Al-Nasser et al., 1994). Aday and Andersen (1974) and Mwangome et al. (2016), argue that patients in rural areas need to travel two to three times more than those in urban areas in order to seek medical attention and patients with chronic sicknesses such as heart and diabetes diseases travel even longer distances. Having good rural roads is vital in reducing one or more of the health barriers listed above. According to Peters et al. (2008) and van Rensburg (2014), good rural roads which are often difficult to find play a pivotal role not only in access to PHC services but will facilitate the easy distribution of drugs and other supplies to health services. Hence, the present study will assess the role of the current state of rural road networks in promoting access to PHC services.

4.3. Materials and Methods

4.3.1. Introduction

The chapter used both quantitative and qualitative methods of data collection. A structured questionnaire was used to obtain the demographic profile data in the households under study. Unstructured questionnaires were used to gather the respondent's perceptions on the themes (access to information, markets and employment opportunities, education facilities, health facilities and agriculture opportunities) covered in this research. Qualitative data collection methods are time consuming but produce information that is rich and has a deeper insight into a situation under study (Patton, 2005, Gill et al., 2008, Hancock and Algozzine, 2016). Since, the current study involved assessing people perceptions, informal interviews were more preferred rather than structured interviews. A perception is a process that uses the interactionist approaches of distinguishing and interpretation of data in order to produce meaningful information (Lindlof and Taylor, 2017). Studies on people's opinions, perceptions and attitudes show that informal interviews are the best suited and produce better results than structured interviews (Oppenheim, 1992 Hancock et al., 1998, Gillham, 2005). Gillham (2005), highlighted some of the more notable advantages of informal interviews in comparison to structured interviews. According to Gillham (2005), informal interviews create an atmosphere which is conducive for the respondents, allowing them to be more forthright and honest. They enable the respondent to engage with questions and answer in as much detail as possible. As a result, more valid information about the respondents attitudes, values and opinions are obtained

(Gillham, 2005, Lindlof and Taylor, 2017). Although structured interviews are less time consuming and can reach a larger sample area, they are known to force respondents to choose the alternative answers given by the interviewer (Rose, 1994, Cohen and Crabtree, 2006). Furthermore, structured interviews limit the respondent's answers to the asked questions even though further insights could be possibly probed during the interviews (Cohen and Crabtree, 2006).

4.3.2. Selecting participants for interviews

The interviewed participants were selected based on the following three important categories pertaining to the study;

Participants category	**Number in each community**	**Gender**
Primary school learners	30	Male (15) and Female (15)
Secondary school learners	30	Male (15) and Females (15)
General public	*100 (households)	N/A (household dependent)

* This value refers to the number of dwelling units visited and not respondents interviewed

The three sampling groups chosen in this study were vital because their perceptions provided information that unpacked the past, present and future assessments of the themes in question. Participatory Rural Appraisal (PRA) in terms of transect walks were carried-out in the four respective communities. PRA tools are highly recommended interactive methods which are used to engage rural communities in the pursuit to understand their societies (Narayanasamy, 2009, Kamble, 2014).

A total of 240 learners (primary and secondary school) were interviewed in the communities under study. Half of the learners interviewed in this study were selected randomly outside their school on the way home. Forty percent were selected on their routes (footpaths and roads) while traversing to or from school. Ten percent were interviewed at transport drop-off and pickup points. The age and school grades of the learners interviewed were not considered because the study aimed at identifying the level of schooling (primary or secondary school), mode of transport used to school and their perceptions on the journey travelled to access school. A sum of 400 households were visited to obtain insights from the public (referring to all the members of the communities). Interviews were done in collective discussions with household members in order obtain a deeper understanding of the subject matter under study. For

example, in every household visited, all the members in that household that were present during the interviews were interviewed, giving a total of 2128 respondents for the study. Since the four communities under study have different number of households, a systematic structural sampling technique was adopted in order to achieve a representative overview of the general public perceptions. For example, in Emazabekweni and Mkhunya communities with 251 and 353 households respectively, participants were interviewed at every second household, whereas in Dukuza with 526 households, interviews were conducted at every fifth households. Since the community of Mhlwazini had the smallest number of households (156), the hundred households visited were selected randomly to accommodate their spatial distribution. All the households visited were firstly identified using google earth maps and thereafter, transect walks were conducted to ground truth their location.

Although the interviews conducted were informal, the set of question asked were guided by the following parameters;

- the respondents perceptions were mainly restricted to the four themes covered in this research,
- the main focus was to gain their insights on how accessible ,acceptable and reliable are their roads in respect to servicing the four themes, and
- the respondents perceptions had to provide information that unpacks the past, present and future socioeconomic realities in terms of the four themes in question.

A Dictaphone was used as well as the interviewer had made notes while the interviewee responded to the open-ended questions. The respondent has provided informed consent to the recording and anonymity was respected when recording were transcribed. Opdenakker (2006), argues that using a Dictaphone instrument during interviews ensures for better information accuracy. Opdenakker (2006) further maintains that the making of notes to complement digital recording instruments is vital to check if all the questions asked and answered are complete, as well as a contingency measure in case if the recording instrument foes into disrepair. All interviews were conducted in the respondent's mother tongue (IsiZulu). Studies suggest that the use of respondents' mother tongue language in qualitative research strengthens mutual trust and respect between the interviewer and the interviewee (Marschan-Piekkari and Reis, 2004, Sana et al., 2016)

4.4. Data analysis

Handwritten notes of interviews were checked against the audio recording for accuracy. The handwritten notes and audio recording were analysed thematically by creating coding nodes for common themes and subthemes. Statistical Package for Social Sciences 24 was used to analyse the demographics of the households. According to Vaismoradi et al. (2013), thematic analysis is one of the most favourable methods of analysing qualitative research. This type of analysis emphasises pinpointing, assessment and recording patterns within data.

4.5. Results Analysis

4.5.1. Demographic information of the respondents (the general public)

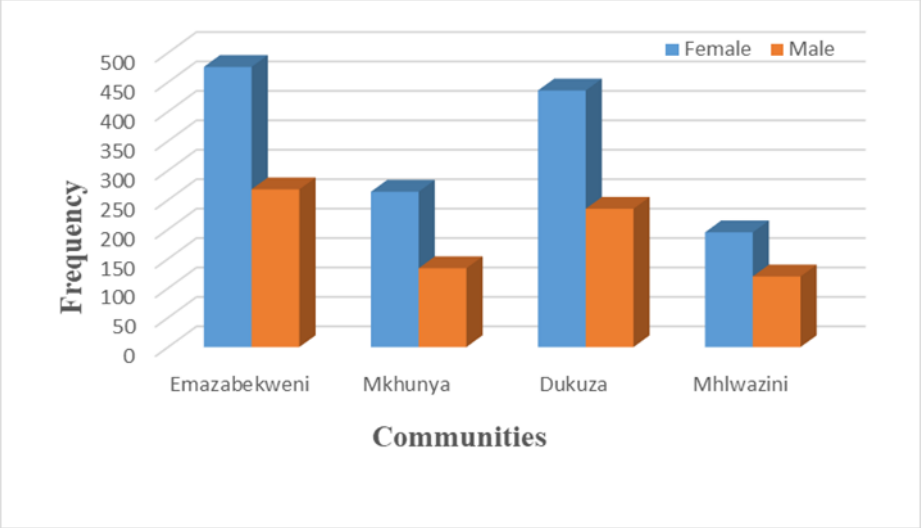

***Figure 4.2**: Gender of respondents in each community.*

In this study, a total of 2128 respondents were interviewed from Dukuza (671), Mhlwazini (315), Emazabekweni (744) and Mkhunya (398) communities. The demographic results across the four communities under study show that females were more than males among the respondents (see Figure 4.2). In Dukuza, 65% of the respondents were females, 62% in Mhlwazini, 64% in Emazabekweni and 66% in Mkhunya. According to the respondents, the absence of males in the communities was mainly due to rural-urban migration, facilitated by lack of employment opportunities amongst others.

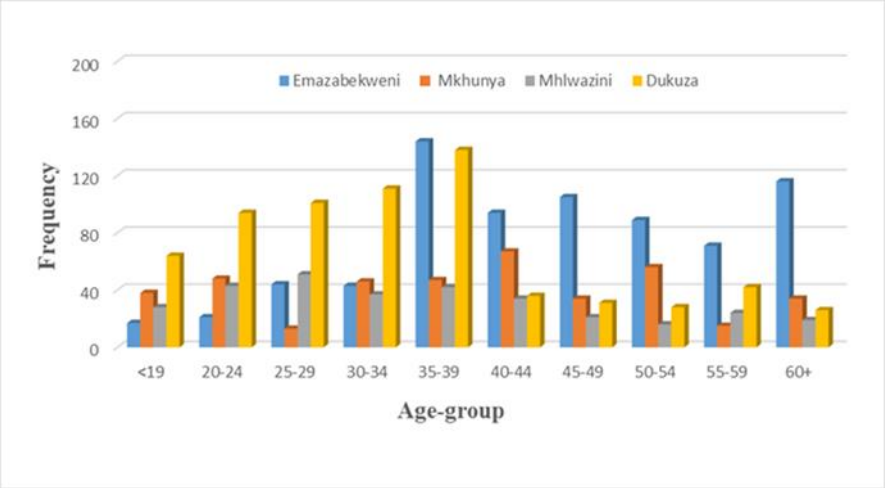

Figure 4.3: *Age group distribution of respondents (n=2128).*

The results in Figure 4.3 provide the age distribution of the respondents in the communities under study. In this study, respondents were categorised by age into young adults (ages 19-34), middle aged adults (ages 35-54), and older adults (ages older than 54). It can be noted from the results that the age of respondents interviewed in Dukuza and Mhlwazini communities was dominated by the young adults population group, 55% and 50% respectively. Whereas in Emazabekweni and Mkhunya communities, 58% and 51% respectively, of the respondents were classed in the middle aged adult category. The distribution of older adult respondents was fairly similar across the communities (ranging bewteen 10% and 13%), expect for Emazabekweni community where there was a 25% representative.

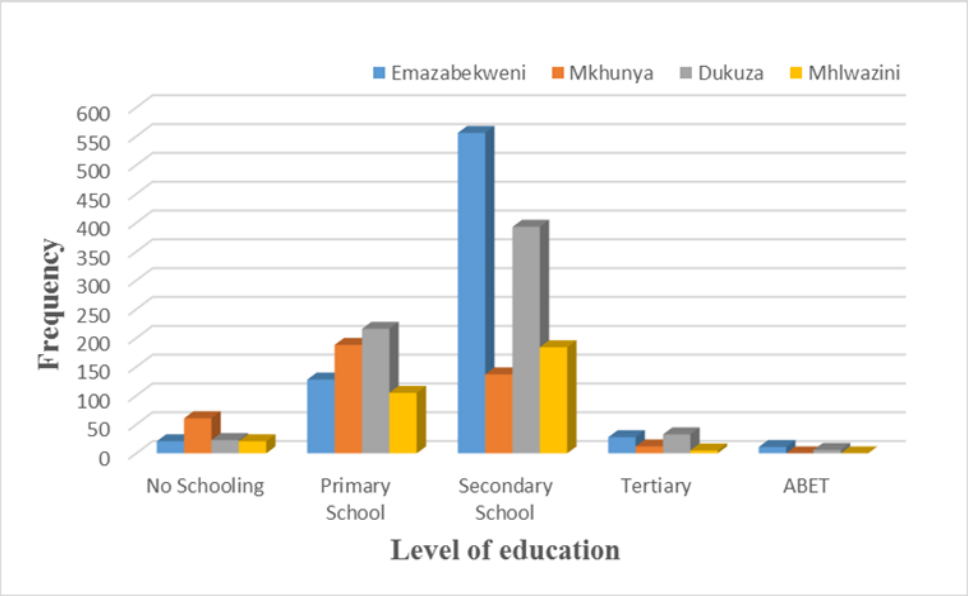

Figure 4.4: *Highest level of education obtained by respondents in each community.*

Figure 4.4 illustrates the highest level of education obtained by the respondents in each community. The results from Mkhunya indicate that this community had higher number of respondents who have never had any form of schooling when compared to the other communities. The results further show that there were more respondents in Emazabekweni and Dukuza communities with primary and secondary schooling than in the other communities. The number of respondents who obtained any form of tertiary or ABET (Adult Basic Education and Training) education were very low across the communities.

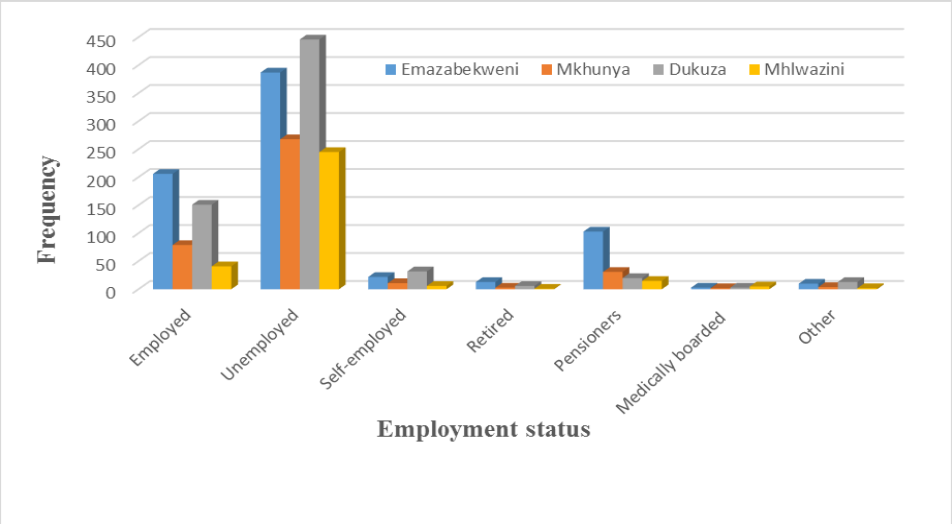

***Figure 4.5**: Employment status of the respondents (n=2128).*

The results in Figure 4.5 show the employment status of the respondents interviewed for this study. It can be noted from the results that in all the communities, there was a high number of respondents without employment. However, Emazabekweni and Dukuza communities had the highest number of respondents that were employed and self-employed in comparison to the other two communities. The number of respondents selecting the category 'other' were mostly tertiary students in all the communities.

***Table 4.1**: Number of households with vehicle ownership in the communities under study.*

Community	Number of Households	Number of households with access to their own vehicle	Distribution by vehicle type	Number of households relying on public transport
Emazabekweni	100	44	Private cars (32) Bakkies (12)	56

Mkhunya	100	16	Private cars (9) Bakkies (7)	84
Dukuza	100	37	Private cars (26) Bakkies (11)	63
Mhlwazini	100	11	Private cars (4) Bakkies (7)	89

The results provided on Table 4.1 show the number of households with and without access to their own vehicles. As depicted in Table 4.1, Emazabekweni and Dukuza communities had the highest number of households with access to their own vehicles, 44 and 37 respectively. Whereas, Mkhunya and Mhlwazini communities had the highest number of households who were relying on public transport.

4.5.2. Respondents' perceptions on the socioeconomic role of their road networks on their livelihoods

The following questions were asked in each household visited in order to obtain the respondents perceptions:

4.5.2.1. How will you be able to explain the condition of your road (these are referred to as access roads in this study) from your household to the main road?

a) Dukuza community (n=671 respondents)

The respondents in Dukuza community did not have major concerns regarding the condition of their roads in terms of accessibility and reliability. The common concern among respondents (85%) in Dukuza were the issues relating to poor maintenance and dustiness. The respondents further identified that the road drainage systems were clogged with debris and potholes were starting to form. The balance of the respondents (15%) did not have any problems with their roads because their households were situated within 100m of the main road, which is tarred. Furthermore, a 46-year-old female respondent, from household number 22 stated:

"Our house is less than 50m from the road and during the day when there are cars driving pass towards the clinic, it gets very dusty. We no longer hang washing in the daytime and we have to keep all house windows closed throughout the day."

b) Mhlwazini community (n=315 respondents)

More than 65% of the respondents from Mhlwazini voiced dissatisfaction that their roads were not reliable such as scarred by erosion and inaccessible during the rainy season. The balance of respondents (35%) stated that they relied on cattle tracks or footpaths as access to the main road. About 90% of the respondents with road access (from their households) stated that their roads were very poorly maintained.

"One of our family members in this household is disabled and uses a wheelchair. Our house is on a slope and a bit distant from the road. We rely on public transport to take our uncle to collect his medication and disability grant. The challenge is that, when it is raining, no taxi can navigate these roads. We have to ask our neighbours (males) to help us carry our uncle to the taxi pickup stop. These roads have always been a problem to us because there are no strong males living in our households to help us transport our uncle to the road," (32-year-old female respondent, from household number 7)

c) Emazabekweni community (n=744 respondents)

Majority of the respondents (90%) from the Emazabekweni community had no major problems with the condition of the roads. An 82-year-old female respondent from household number 5 stated:

"As a human being you can never be 100% satisfied, only if the roads were tarred then maybe we will be fully satisfied. I have lived in this community for over 70 years and these roads have never been better that this in the past. So regular maintenance is the only thing I would suggest so that the roads remain usable forever."

Thus, these roads were accessible and reliable throughout the four seasons. Most of the respondents interviewed indicated that their roads only required regular maintenance.

d) Mkhunya community (n=398 respondents)

Majority of the respondents (95%) in the Mkhunya community complained that their roads were very poor and challenging to traverse throughout the seasons. The dissatisfied respondents stated that their roads were dominated by surface distresses such as erosion channels and loose material. In addition, all the respondents visited in Mkhunya agreed that poor maintenance deteriorates the road even further.

"I think irrespective of the road maintenance techniques and frequency, our roads will always be difficult to use during the rainy season because we (community) are situated on a very steep slope, unless maybe the government decided to tar the roads."(44-year-old male respondent, from household number 11)

"Only people with 4x4 cars can afford to have sustainable vehicles in this community. My son bought me a small car but it did not last even 3 years. When you live far from services and town life as we do, it is wise to have your own vehicle but where do you drive it."(51-year-old female respondent, from household 63)

"I bought a kombi (16 seater taxi) and started transporting local people to town. I had to sell the taxi after 2 years because it spent more time getting fixed than making me money. I was only doing two trips to town (38 km away) a day but, these roads still damaged it."(57-year-old male respondent, from household 31)

4.5.2.2. What are your perceptions on the agricultural sector in your community (climate conditions, landscape conditions, soil conditions, and access to markets)?

a) Dukuza community (n=671 respondents)

More than 85% of the respondents in this community identified that their soils were not suitable for crop farming due to very sandy soils. Majority of the respondents (90%) identified that their community receives a lot of rain during the rainy season, however in winter, frost and sometimes snow challenges their crops and livestock farming. About 95% of the households visited had small vegetable gardens that consisted predominantly of maize, spinach and cabbage on their properties. Nonetheless, less than 5% of the households were depending on agriculture as main source of income

"I am a sheep and goat farmer. I have been relying on farming for the past 15 years. I sell my sheep and goats in town (Winterton and Bergville) and sometimes at the local farmer's actions. I do not have a problem with transporting my goods." (52-year-old male respondent, from household number 28)

b) Mhlwazini community (n=315 respondents)

Overall, all the respondents in this community did not have an issue with their climate conditions; expect when there is frost and sometimes snowfall in winter. More than 60% of the

respondents identified that their soils were arable for farming but their terrain is very mountainous which impedes agricultural activity especially farming. None of the households that were interviewed were relying on any form of agricultural production as their main source of income. Yet 90% of the households had vegetable gardens on their properties. Households sold the excess produce or livestock occasionally when in desperate situations or having excess.

c) Emazabekweni community (n=744 respondents)

All the respondents perceived their area to have good climate conditions. However, they did share the same views that recent droughts that affected KZN in the past few years had major impact on their livelihoods. Likewise, respondents were pleased with the soil conditions in the area. All the households had vegetable gardens on their properties and there was no major road challenges affecting the agricultural sector.

"After finishing my standard seven (grade 9), I joined my father in running his farming business. I am now over 20 years farming in this community, the soils and climate conditions are good. In the 1980s, these roads were terrible but now there are good, they just need maintenance. We supply our fresh produce (butternut, cabbage, lettuce, carrots, potatoes, green pepper and chillies) to SPAR and other shops in Ixopo and Highflats." (47-year-old male respondent, from household number 36)

d) Mkhunya community (n=398 respondents)

Over 90% of the respondents in this community perceived that their soils and climate conditions are good. Majority (90%) of the respondents in this community perceived their soils and climate conditions as favourable. However, approximately 80% of the respondents indicated that their limitation in terms of agriculture particularly crop production is the mountainous landscape where their community is situated. Only 60% of the households visited had vegetables gardens. More than 95% of respondents argued that their bad roads have no direct impact on agricultural production in this community.

4.5.2.3. What can you say about access to information, markets and employment opportunities in your community in terms of accessibility, reliability, availability, extension officers, and marketing?

a) Dukuza community (n=671 respondents)

Majority of the respondents (85%) perceived that their roads are not a limitation in respect of accessing information, markets and employment opportunities (for those who are employed). Furthermore, 70% of the respondents identified that public transport to access the town is readily available and affordable in comparison to places that are further away from the town. In addition, most respondents identified that the lack of employment opportunities within the community and the neighbouring towns results in migration to the urban areas.

"I work as a teller in one of the supermarkets in town (Bergville). I use public transport daily and I have no problem with it." (26-year-old female respondent, from household number 81)

b) Mhlwazini community (n=315 respondents),

Majority of the respondents (95%) in the Mhlwazini community perceived that their roads had no impact on access to information, markets and employment opportunities. Respondents stated that their locality to nearby towns amongst other factors hinders them from accessing and participating in employment opportunities.

The main road (tarred) is not far from my house but the town is very far (37km away). We are compelled to buy daily necessities (like bread and milk) from our local tuckshops, which are very expensive. We have no option but to buy from our local tuckshops because it is not worth taking a taxi to town to buy a single loaf of bread. (38-year-old female respondent, from household number 2)

c) Emazabekweni community (n=744 respondents)

All the respondents in this community had no problem accessing markets. More than 85% of the respondents argued that that their community is located at the centre of the two major towns (Ixopo and Highflats) within this municipality. Although the number of unemployment respondents were high, more than 70% of the employed respondents stated that commuting to work was not a challenge.

d) Mkhunya community (n=398 respondents)

More than 90% of the respondents in this community complained about their locality and conditions of their roads, stating that these are amongst some of the key limiting factors affecting their access to markets, information and employment opportunities. Over 80% of the

respondents argued that their community was located far from their local town (38km from Highflats), exacerbating the living conditions. Majority of the respondents (90%) mentioned that the poor road conditions limited the frequency of public transport visits to Mkhunya.

4.5.2.4. What can you identify about access to education in your community particularly focusing on challenges, accessibility, reliability and availability?

a) Dukuza community (n=671 respondents)

Currently in the Dukuza community, all the respondents perceived that there are no problems in accessing primary schools. The reason being there are three schools in the community of Dukuza. Majority of the respondents perceived that access to secondary schools is a major issue. The reason being Okhahlamba High School is the only secondary school available in the community, of which limited number of learners can be accommodated and hence the rest of the learners have to travel to neighbouring communities.

"I have three of my children who are in high school. The challenge I have is that only one of them is in our local high school and the others are out of the community. I cannot afford to pay for both their transport costs. I do not earn much because I work as a petrol attendant." (44-year-old female respondent, from household number 15)

b) Mhlwazini Community (n=315 respondents)

Majority of the respondents (95%) perceived that the community only had two primary schools, which are Ididima and Mampongwana that are not easily accessible as they are servicing a large community spatially and in terms of population. In the Mhlwazini community access to secondary schools is a huge challenge such as the community only has one high school namely Mhlwazini Secondary School. Approximately 62% of the respondents who attended secondary school stated that they attend secondary school outside of the Mhlwazini area. Overall, factors such as distance travelled to schools, the number of schools available and poor road conditions were identified as the main education challenges in this community.

"I cannot say that access to school is not a challenge toady but, when I was in school, there were no high schools in the area. My brothers and I had to walk more than 2 hours (using pathways) to get to school in the morning. I failed standard six and dropped out because I could not tolerate the distance I had to walk to attend the same grade. The government must do more to improve the roads and the number of school in isolated communities like ours." (77-year-old male respondent, from household number 41)

c) Emazabekweni community (n=744 respondents).

All the respondents visited had no problems with the locality and accessibility of the schools in this community. A common problem that was raised by more than 65% of the respondents was that the community only has one secondary school and outsiders were beginning to compete with the local learners for the limited space in this school.

d) Mkhunya community (n=389 respondents)

Majority of the respondents (95%) perceived that the availability and access to secondary schools is and always has been problematic for learners who reside in the Mkhunya community Respondents in this community had no problems with the availability and access to primary schools in area. Most of the respondents (95%) who attended secondary school perceived their distance to be approximately 2 hours daily to and from school. All respondents in this community suggested that an improvement in the condition of their roads is a requirement to assist in reducing the cost of schooling particularly, secondary schools.

"Our children spend more time travelling to school that doing their homework. How do you expect them to pass? They can back from school tired. I am a high school teacher at one of the local schools and you can see in the morning when the learners walk into class that they are tired. The government must improve access and ensure availability of transport facilities if they want to improve rural education. The government also has ABET programmes for adults who want to improve their education and other skills but these programmes are available to limited areas and remote communities like ours do not have access." (46-year-old female respondent, from household 27)

"I am a local principal in one of the high schools in this area and I can sadly say that most schools around here have very low matric (grade 12) pass rates and high student dropout. Undeniably, there are many factors causing this issue but the distance travelled by our learners to attend schools also plays a big role on their attitudes and outcomes. Our roads should be at a better state at all times so that we eliminate delays in travel time" (51-year-old male respondents, from household number 5)

4.5.2.6. What can you say about access to primary healthcare (accessibility, availability, reliability)?

a) Dukuza Community (n=671 respondents)

All the respondents in this community rely on their local clinic namely Dukuza clinic as the main source of primary health care and for emergency cases they travel approximately 41km to the Emmaus Hospital. Furthermore, all the respondents perceive that the service at the clinic is not completely satisfactory but the facility is easily accessible to locals. More than 80% of the respondents stated that the clinic should operate 24 hours a day especially on weekends since it is a challenge to access the hospital in cases pertaining to emergencies especially at night. Majority of the respondents 95% who want the clinic to be operating 24hours perceived that the ambulance takes approximately an hour to attend to an emergency callout and people without vehicles have to rely on their neighbours for transport.

"I am working as a paramedic at the Emmaus Hospital for more than 10 years. I can honestly say that the hospital has limited ambulances to provide adequate support to the communities it is meant to service. The main problem is that we have to drive mainly on bad gravel roads and this effects the time taken to reach the callout destination." (47-year-old female respondent, from household number 26)

b) Mhlwazini community (n=315 respondents)

Approximately 60% of the respondents in this community perceived that they rely on mobile clinics for PHC services, of which 30% of the respondents stated that they travel 40km to access PHC facilities located in Bergville such as Bergville Clinic and Emmaus hospital. Approximately 60% of the respondents criticised the effectiveness of mobile clinics stating that there are many challenges when accessing the mobile clinics such as not reliable especially during extreme weather conditions, not easily accessible, diminished medication as not available at night and on weekend. All the respondents in this community unanimously agreed that the government needs to construct a clinic for the community of Mhlwazini. This will curb the access challenge. The reason being 60% of the respondents in this community perceive that the ambulance takes approximately 2 hours to reach an emergency destination.

Emazabekweni community (n=744 respondents)

Respondents in this community had no issue with access to a healthcare facility since they have one available in their community (Emazabekweni Clinic). All the respondents raised that they are content with the service they receive at the clinic but they would like the clinic to operate throughout the day, at night and over the weekends. Majority of the respondents (95%) perceived that they had no issue with the locality of the clinic, as it is centrally located. Furthermore approximately 80% of the Emazabekweni respondents perceived that an

ambulance takes approximately less than an hour to attend to their emergency requests. The reason being the homes in Emazabekweni are accessible

c) Mkhunya community (n=398 respondents)

All the respondents in this community stated that access to PHC is one of their major challenges. Moreover, the respondents mentioned that there are no clinics in close proximity to their community. Respondents in this community rely predominantly on mobile clinics. Majority of the respondents (95%) criticised the effectiveness of mobile clinics. The Mkhunya respondents identified the following reasons: the ambulance does not attend promptly to emergency cases, has limited stock of medication and it is not replenished, leaves very early and are not available at night and weekends. Majority of the respondents (95%) perceived that it takes approximately 3 hours for an ambulance to attend to a callout in the Mkhunya community.

"My mother passed away in 2007 because she could not get to hospital in time. She started having a stroke around 8 o'clock at night, we contacted the hospital (Christ the King in Ixopo, about 90 km away) for emergency services, and the ambulance arrived at 1 o'clock at night, the ambulance still travelled an hour before getting to hospital, by then it was too late." (49-year-old female respondent, from household number 22)

4.5.3. Perceptions of learners about the condition of their roads

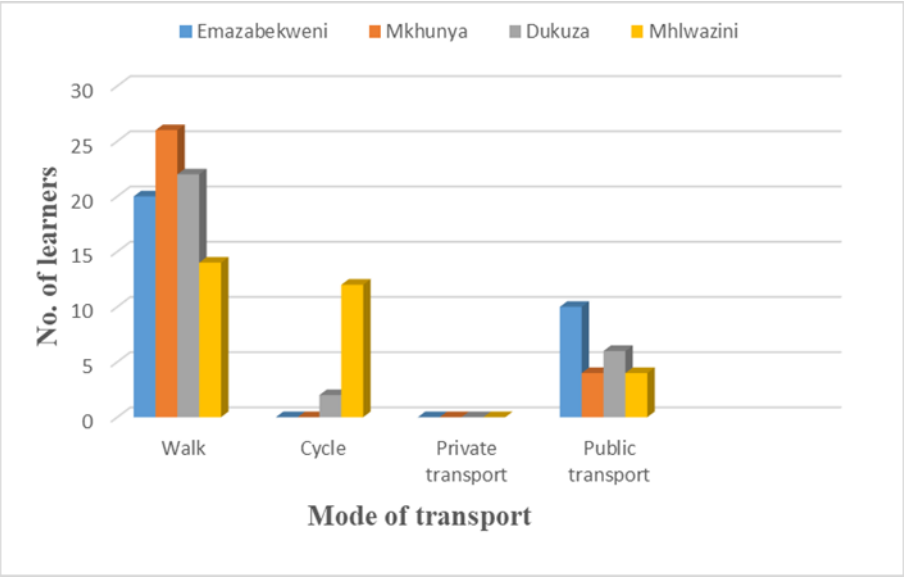

Figure 4.6: *The mode of transport used by secondary school learners (n=120 learners).*

Results in figure 4.6 above illustrates the mode of transport used by secondary school learners in the four rural communities under study. From Figure 4.6 it can be noted that in all the four rural communities the main mode of transport used by respondents to access secondary schools is walking. Emazabekweni community had most respondents who used public transport to access school in comparison to other three communities.

Approximately 60% of the learners who walked to school in these communities (Emazabekweni, Mkhunya, Dukuza and Mhlwazini) complained that the distance they were travelling was too much. Majority of the respondents (90%) stated that they travelled approximately 30 minutes to an hour daily to access school. Approximately 80% of the respondents in Mkhunya and Mhlwazini argued that their roads were very difficult to travel during the rainy season. All the respondents who cycle to school in Mhlwazini identified that the bicycles were provided by the school. Although the respondents were grateful for their bicycles, 90% of them complained that their mountainous terrain made it difficult for them to cycle and extremely dangerous during the rainy season. Out of the six respondents who stated they cycled to school, there was only one female respondent who cycled to school.

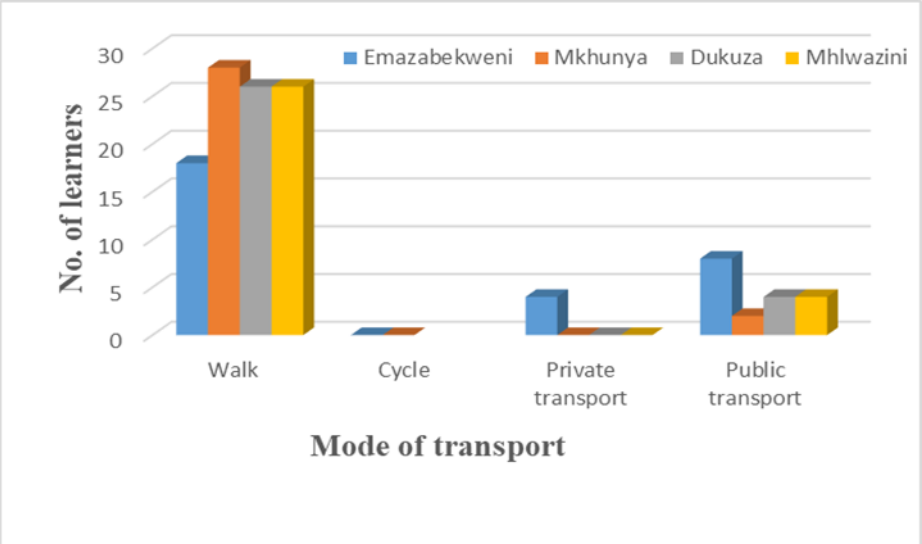

Figure 4.7: *The mode of transport used by primary school learners (n=120 learners).*

Figure 4.7 shows the mode of transport used by the interviewed primary school going learners in the communities under study. As indicated in the results, most respondents in these communities walked to school. All of the respondents who used private and public transport were attending schools outside (out of preference) of their communities. Only 40% of the respondents regarded distance as a challenge in accessing schools, of which 90% of these

respondents were from Mkhunya and Mhlwazini communities. Similar to the secondary school respondents, these respondents complained that their mountainous terrain and poor road conditions made it difficult for them to access school.

4.6. Discussions

The overall aim of this study was to assess local respondents' perceptions on the socioeconomic role of unpaved road networks on their livelihoods. As argued by McDonagh (2006) and Shay et al. (2016), the benefits of improved transport infrastructure depend largely on the needs (such as the physical, economic, human, political and social) of a particular community or group. The results discussed in the themes below are comparable with McDonagh (2006) and Shay et al. (2016) argument.

(a) Respondent's perceptions on the state of their roads

The objective of this question was to obtain the respondents perceptions on how accessible and reliable were their roads. Kgamanyane (2015) and Paige-Green (2006) argue that many rural communities in South Africa still have inappropriate access consisting of unpaved roads that do not necessarily provide all-weather access. This study established that there was a relationship between community locality and road conditions in terms of accessibility and reliability. In this study, communities that are located closer to their local towns had better road conditions. For example, Dukuza and Emazabekweni communities are both located less than 20km from their local towns and in both these communities, respondents had no major concerns about the conditions of their roads, except for poor maintenance. Whereas, the majority of respondents in Mhlwazini and Mkhunya communities (located more than 30km from their local towns) complained that their roads were not easily accessible and unreliable during the rainy season. The findings of this study are comparable with other studies on rural livelihoods. A number of studies on rural livelihoods show that proximity to towns determines amongst others, access to services, the quality of infrastructure and the availability of opportunities for income diversification (Ellis, 2000, Barrett et al., 2001, Davis, 2003, Khatun and Roy, 2012, Damena and Habte, 2017, Ingelaere et al., 2017, Mubila and Yepes, 2017). Hence, following themes will discuss the respondent's perceptions of the socioeconomic impacts of their road networks on their livelihoods in communities under study.

(b) Respondent's perceptions on agriculture

Van de Walle (2002) and Qin and Zhang (2016) argue that providing good rural road networks facilitates agricultural specialisation. This argument can be justifiable if factors such as amongst others climate, landscape and soil conditions are also conducive for agriculture in that specific region. In this study, the community of Emazabekweni is a good example of how an improvement in road conditions (coupled with good climate, soils and landscape) facilitates agriculture specialisation. In Emazabekweni community, seven households that were visited relied on farming as their main source of income. All the respondents in these households stated that their area is well suitable for farming, and their improved roads make it easy for them to transport their produce to the markets. Majority of the households (90%) in the Emazabekweni community had bigger vegetables gardens than most households visited in Mkhunya, Mhlwazini and Dukuza communities. In addition, about 70% of the respondents who were not relying on agriculture as their main source of income in Emazabekweni community argued that the main factor hindering their growth is limited agricultural space. In Mhlwazini and Mkhunya communities, respondents argued that an improvement in road conditions would not facilitate agriculture production because of their mountainous landscape. However, in these communities, most respondents argued that their soils and climate conditions are good for farming but the limiting factor is their landscape. Whereas, the Dukuza community had accessible roads, with good climate and landscape conditions but more than 85% of the respondents in this community stated that their soils are very sandy and not suitable for farming.

(c) Respondents perceptions on access to information, markets and employment opportunities

Most of the respondents in Emazabekweni and Dukuza communities had no problem in accessing information and markets. These two communities had the most number of households with access to their own vehicles The respondents from households without access to their own vehicles stated that the use of public transport was not a problem in their communities. Most of the challenges associated with access to information and markets were experienced in Mhlwazini and Mkhunya communities, of which most of the households in these communities relied on public transport for mobility. Almost all the respondents in Mkhunya community complained that accessing markets was a major challenge. Respondents in this community stated that poor road conditions caused for high transport costs thus resulting in less public transport commuting to local towns. In Mhlwazini community, respondents complained about the poor conditions of their access roads. Over 80% of the respondents in

Mhlwazini community stated that their access roads were very difficult to travel by car and during the rainy season, most of them were not driveable. Although the access roads are difficult to access in Mhlwazini, this community is slightly fortunate because the main tarred road runs on the southern part of the community. Out of the four communities under study, Mkhunya community has the poorest road conditions. Khandker and Samad (2016), argue that greater physical access to markets consistently improves nonfarm-earning opportunities for rural people. This argument is comparable with the results obtained in Emazabekweni and Dukuza communities because there were more respondents in these communities who were employed and travelling to work.

(d) Respondents perception on access to education

The result of this study suggest that access to education remains a challenge in rural communities. The findings indicate that less than 3% of all the respondents in the communities under study attained tertiary education. The availability of primary schools is no longer a problem in Mkhunya, Mhlwazini, Dukuza and Emazabekweni communities. Leaners from Mkhunya and Mhlwazini communities mostly complained about their distance travelled to schools. Access to secondary schools remains a major challenge in Mkhunya and Mhlwazini communities. Both Mkhunya and Mhlwazini communities had no secondary schools in their communities. The lack of secondary schools in these communities is perceived to be a major factor that affects education levels obtained. Thus, majority of the respondents (90%) in the Mkhunya and Mhlwazini respectively have not completed secondary schooling. Respondents who have not completed matric list a number of contributing factors such as long distances travelled, poor road conditions and high transport costs. These factors impede on the respondents education. Approximately 80% of the secondary school respondents in the communities under study stated that they walked to school. There were more respondents from Mkhunya and Mhlwazini complaining about the distances travelled to access schools than in the other communities respectively. The respondents stated that the mountainous terrain and poor road conditions made it difficult for them to access schools. Access to school for the learners in Mkhunya and Mhlwazini communities must be improved to ensure that the learners complete school. A number of high schools respondents from Mhlwazini who were interviewed for this study stated that their school provided them with bicycles. Most of the respondents complained that riding bicycles was very difficult and dangerous because their terrain is mountainous and the road conditions were bad for riding. The communities of Dukuza and Emazabekweni respectively have secondary schools in their communities. The issue of outside

competition was the only problem of access to secondary schools that affected Dukuza and Emazabekweni communities. According to most respondents, outside competition is created by the issue that surrounding communities have limited secondary schools and learners from other communities prefer the secondary schools in Dukuza and Emazabekweni communities. As argued by Lucas et al. (2016), the assessment of equal educational opportunity is not a matter of whether the systems produces equal education results for pupils of all races, but whether the systems eliminate differences in the educational opportunities for students of different races.

(e) Respondents perceptions on access to health care

Gatrell and Elliott (2014) argued that South Africa's health sector has been associated with a long history of racial and spatial inequalities and thus the health sector is undergoing major restructuring in an attempt to improve health outcomes and reduce inequalities relating to access. Although, much has been achieved in ensuring adequate access to PHC in rural areas, findings from this study suggest that more efforts are needed, particularly in very remote rural arears. In this study, respondents from Dukuza and Emazabekweni had no major PHC challenges relating to access because their communities have accessible local clinics. The major PHC challenges are experienced in the remote rural communities of Mkhunya and Mhlwazini respectively. Respondents in these communities perceive that the distances travelled to access PHC facilities were intolerable at times. According to Peters et al. (2008) and van Rensburg (2014), good rural roads, which are often seldom to find, play an important role not only in provide access to PHC services but they also facilitate for the easy distribution of drugs and other supplies to health services. Almost all the respondents in Mkhunya and Mhlwazini communities complained that bad road conditions delayed their access to medical help during an emergency. Respondents in these two communities respectively relied mostly on mobile clinics whereby they have stated that PHC is not readily accessible and reliable People in these two communities relied mostly on mobile clinics, whereby the respondents stated that they were not easily accessible and reliable.

4.7. Conclusion

This study has assessed local respondents' perceptions on the socioeconomic role of unpaved road networks on their livelihoods. Community perceptions are very important when assessing the effectiveness of any system, particularly one that is meant to benefit them. It is clear from the study that people's perceptions on the socioeconomic role of unpaved road networks on their livelihoods are influenced by the effectiveness of their roads in servicing their needs. For example, respondents from Mkhunya and Mhlwazini communities stated that an improvement in their road conditions would benefit their access to health, education and markets rather than their agricultural sector. The agriculture sector in these communities is not a priority since people are located on mountainous terrain that do not favour agriculture growth. Current debates around quantifying the benefits received from transport infrastructure investments tend to overlook the potential contributions that natural (such as climate conditions, terrain amongst others) and physical assets can have on livelihoods. Most rural communities normally have unique natural and physical assets. The contribution of natural and physical assets need to be better addressed and understood within the context of rural livelihoods to ensure that the socioeconomic benefits of rural road networks remain community or area specific. Important assets such as terrain, climate conditions, soils and geology and are some of the factors that are mostly overlooked when assessing the socioeconomic benefits of rural road networks on community livelihoods. A favourable understanding of the contribution of these assets is crucial for effective assessment and management of unpaved rural roads. This study recommends that community based road management strategies should be implemented throughout rural communities in South Africa in order to aid with the maintenance of unpaved rural roads. Furthermore, government institutions and other rural investors must consult rural communities before introducing development initiatives. The lack of public participation in decision-making hinders anticipated benefits. Due to a number of factors outlined above, this study can conclude that in the four communities assessed in this research, less than ten percent of all the respondents perceived direct economic spinoffs as a results of road network improvements. Majority of the respondents perceived social spinoffs such as improving access to healthcare, education and market services.

4.8. References

ADAMS, M., COUSINS, B. & MANONA, S. 1999a. *Land tenure and economic development in rural South Africa: Constraints and opportunities*, Overseas Development Institute, London.

ADAMS, M., SIBANDA, S. & TURNER, S. D. 1999b. *Land tenure reform and rural livelihoods in Southern Africa*, Overseas Development Institute, London.

ADAY, L. A. & ANDERSEN, R. 1974. A framework for the study of access to medical care. *Health services research,* 9**,** 208.

ADJAYE-GBEWONYO, K., AVENDANO, M., SUBRAMANIAN, S. & KAWACHI, I. 2016. Income inequality and depressive symptoms in South Africa: A longitudinal analysis of the National Income Dynamics Study. *Health & place,* 42**,** 37-46.

AL-NASSER, A., BAMGBOYE, E. & ABDULLAH, F. 1994. Providing antenatal services in a primary health care system. *Journal of community health,* 19**,** 115-123.

ALI, I. & PERNIA, E. M. 2003. Infrastructure and Poverty Reduction-What is the Connection? *Asian Development Bank*, Philippines.

ALIBER, M. 2003. Chronic poverty in South Africa: Incidence, causes and policies. *World Development,* 31**,** 473-490.

ALTMAN, M., HART, T. & JACOBS, P. 2009. Household food security status in South Africa. *Agrekon,* 48**,** 345-361.

ANSAR, A., FLYVBJERG, B., BUDZIER, A. & LUNN, D. 2016. Does infrastructure investment lead to economic growth or economic fragility? Evidence from China. *Oxford Review of Economic Policy,* 32**,** 360-390.

BAIPHETHI, M. N. & JACOBS, P. T. 2009. The contribution of subsistence farming to food security in South Africa. *Agrekon,* 48**,** 459-482.

BANERJEE, A., DUFLO, E. & QIAN, N. 2012. On the road: Access to transportation infrastructure and economic growth in China. *National Bureau of Economic Research,* United States of America.

BARRETT, C. B., BEZUNEH, M. & ABOUD, A. 2001. Income diversification, poverty traps and policy shocks in Côte d'Ivoire and Kenya. *Food policy,* 26**,** 367-384.

BASINGA, P., GERTLER, P. J., BINAGWAHO, A., SOUCAT, A. L., STURDY, J. & VERMEERSCH, C. M. 2011. Effect on maternal and child health services in Rwanda of payment to primary health-care providers for performance: an impact evaluation. *The Lancet,* 377**,** 1421-1428.

BEINART, W. 2001. Twentieth-Century South Africa, *Oxford Paperbacks*, 10: 0192893181.

BENINGFIELD, J. 2006. The Frightened Land: Land, landscape and politics in South Africa in the twentieth century, *Routledge publisher*, United Kingdom.

BEZU, S. & HOLDEN, S. 2014. Are rural youth in Ethiopia abandoning agriculture? *World Development,* 64**,** 259-272.

BHARGAVA, A., BOOYSEN, F. L. R. & WALSH, C. M. 2017. Health status, food insecurity, and time allocation patterns of patients with AIDS receiving antiretroviral treatment in South Africa. *AIDS care***,** 1-8.

BHORAT, H., LILENSTEIN, K., OOSTHUIZEN, M. & THORNTON, A. 2016. Vulnerability In Employment: Evidence from South Africa, DPRU Working Paper WP201604.

BOND, V., CHILESHE, M., SULLIVAN, C. & MAGAZI, B. 2015. The converging impact of tuberculosis, HIV/AIDS, and food insecurity in Zambia and South Africa, *Working* Paper in *International Information System for the Agricultural Science and Technology*.

BRYCESON, D. F. 2002. The scramble in Africa: reorienting rural livelihoods. *World development,* 30**,** 725-739.

BRYCESON, D. F., BRADBURY, A. & BRADBURY, T. 2008. Roads to poverty reduction? Exploring rural roads' impact on mobility in Africa and Asia. *Development Policy Review,* 26**,** 459-482.

BURNS, J. K., TOMITA, A. & LUND, C. 2017. Income inequality widens the existing income-related disparity in depression risk in post-apartheid South Africa: Evidence from a nationally representative panel study. *Health & Place,* 45**,** 10-16.

BUTLER, A. 2017. Contemporary South Africa, *Springer*, Germany.

CHAN, G. 2017. China's Economic Power and the Global Financial Structure. CHINA'S ECONOMIC STATECRAFT: Co-optation, Cooperation and Coercion. *World Scientific*, Singapore.

CHIKOZHO, C. 2016. The Disjuncture between Economic Growth, Poverty Reduction and Social Inclusion in South Africa. *Inclusive Growth and Development Issues in Eastern and Southern Africa***,** 109.

CHIRIKURE, S., DANDARA, C., FERRAZ, F., KRAEMER-MBULA, E., MABEZA, C., MAHARAJH, R., MPHAHLELE, L., MURIMBIKA, M., POGUE, T. & SCERRI, M.

2017. Emergence of Innovations in (South) ern Africa: Long Histories and Contemporary Debates, *Real African Publishers Pty Ltd*, South Africa.

COHEN, D. & CRABTREE, B. 2006. *Qualitative research guidelines project* [Online]. Available: http://www.qualres.org/ [Accessed 06-05-2017].

COLLABORATORS, M. D. S. 2010. Causes of neonatal and child mortality in India: a nationally representative mortality survey. *The Lancet,* 376**,** 1853-1860.

COMMISSION, S. A. H. R. & UNICEF 2014. Poverty traps and social exclusion among children in South Africa. *Pretoria: SAHRC*.

COOVADIA, H., JEWKES, R., BARRON, P., SANDERS, D. & MCINTYRE, D. 2009. The health and health system of South Africa: historical roots of current public health challenges. *The Lancet,* 374**,** 817-834.

CROSS, C. & HORNBY, D. 2002. Opportunities and obstacles to women's land access in South Africa, *National Land Committee Johannesburg*, South Africa.

DAMENA, A. & HABTE, D. 2017. Effect of Non-farm Income on Rural Household Livelihood: A Case Study of Moyale District Oromia Regional State, Ethiopia. *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*, 33**,** 10-36.

DAVIS, J. R. 2003. The rural-non-farm economy, livelihoods and their diversification: Issues and options. Working Paper. *Natural Resources Institute*, Chatham, Uinted Kingdom.

DE COCK, N., D'HAESE, M., VINK, N., VAN ROOYEN, C. J., STAELENS, L., SCHÖNFELDT, H. C. & D'HAESE, L. 2013. Food security in rural areas of Limpopo province, South Africa. *Food Security,* 5**,** 269-282.

DE HOYOS, R. E. & MEDVEDEV, D. 2009. Poverty effects of higher food prices: a global perspective. Policy Research working Paper ; no. WPS 4887. Washington, DC: World Bank.

DEPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES, 2015, Agricultural Policy Action Plan 2015–2019, Pretoria. http://www.ruraldevelopment.gov.za/agri-parks#.WjjmaedsDb0.

DOBBS, R., POHL, H., LIN, D.-Y., MISCHKE, J., GAREMO, N., HEXTER, J., MATZINGER, S., PALTER, R. & NANAVATTY, R. 2013. Infrastructure

productivity: how to save $1 trillion a year. *McKinsey Global Institute*, United states of America.

DUONG, D. V., BINNS, C. W. & LEE, A. H. 2004. Utilization of delivery services at the primary health care level in rural Vietnam. *Social Science & Medicine,* 59**,** 2585-2595.

EDIGHEJI, O. 2010. Constructing a democratic developmental state in South Africa: potentials and challenges. *Constructing a democratic developmental state in South Africa. Cape Town: Human Sciences Research Council***,** 1-33.

ELLIS, F. 1998. Household strategies and rural livelihood diversification. *The journal of development studies,* 35**,** 1-38.

ELLIS, F. 2000. *Rural livelihoods and diversity in developing countries*, Oxford university press. South Africa.

ELLIS, F. & FREEMAN, H. A. 2004. Rural livelihoods and poverty reduction strategies in four African countries. *Journal of development studies,* 40**,** 1-30.

FAN, S. & CHAN-KANG, C. 2005. Road development, economic growth, and poverty reduction in China, *International Food Policy Research Institute*, United States of America

FAN, S. & CHAN-KANG, C. 2008. Regional road development, rural and urban poverty: Evidence from China. *Transport Policy,* 15**,** 305-314.

FAN, S., ZHANG, L. & ZHANG, X. 2004. Reforms, investment, and poverty in rural China. *Economic Development and Cultural Change,* 52**,** 395-421.

FAULKNER, D. & LOEWALD, C. 2008. Policy change and economic growth: A case study of South Africa, *International Bank for Reconstruction and Development/The World Bank,* Washington DC.

FERREIRA, L. & ROSSOUW, R. 2016. South Africa's economic policies on unemployment: a historical analysis of two decades of transition. *Journal of Economic and Financial Sciences,* 9**,** 807-832.

FISHMAN, J., MCLAFFERTY, S. & GALANTER, W. 2016. Does Spatial Access to Primary Care Affect Emergency Department Utilization for Nonemergent Conditions? *Health services research*. United States of America.

FISKE, E. B. & LADD, H. F. 2004. *Elusive equity: Education reform in post-apartheid South Africa*, Brookings Institution Press.

GABRYSCH, S. & CAMPBELL, O. M. 2009. Still too far to walk: literature review of the determinants of delivery service use. *BMC pregnancy and childbirth,* 9**,** 34.

GATRELL, A. C. & ELLIOTT, S. J. 2014. Geographies of health: An introduction, *John Wiley & Sons*, United States of America.

GILL, P., STEWART, K., TREASURE, E. & CHADWICK, B. 2008. Methods of data collection in qualitative research: interviews and focus groups. *British dental journal,* 204**,** 291-295.

GILLHAM, B. 2005. Research interviewing: The range of techniques: A practical guide, *McGraw-Hill International*. United States of America.

GOVENDER, J. 2016. Social justice in South Africa. *Civitas-Revista de Ciências Sociais,* 16.

GUAGLIARDO, M. F. 2004. Spatial accessibility of primary care: concepts, methods and challenges. *International journal of health geographics,* 3**,** 3.

GWILLIAM, K., FOSTER, V., ARCHONDO-CALLAO, R., BRICEÑO-GARMENDIA, C., NOGALES, A. & SETHI, K. 2008. The burden of maintenance: roads in sub-Saharan Africa. *AICD Background Paper,* 14.

HALL, R. 2004. A political economy of land reform in South Africa. *Review of African Political Economy,* 31**,** 213-227.

HANCOCK, B., OCKLEFORD, E. & WINDRIDGE, K. 1998. An introduction to qualitative research, *Trent focus group*, University of Nottingham, United Kingdom.

HANCOCK, D. R. & ALGOZZINE, B. 2016. Doing case study research: A practical guide for beginning researchers, *Teachers College Press*, Columbia University.

HANOMAN, J. 2017. *Hunger and Poverty in South Africa: The Hidden Faces of Food Insecurity*, Routledge.United Kingdom.

HEYNEMAN, S. P. & STERN, J. M. 2014. Low cost private schools for the poor: What public policy is appropriate? *International Journal of Educational Development,* 35**,** 3-15.

HOFFMANN, T., TODD, S., NTSHONA, Z. & TURNER, S. 2014. Land degradation in South Africa. *National Botanical Institute*, CapeTown

HUSSEIN, K. & NELSON, J. 1998. Sustainable livelihoods and livelihood diversification, IDS Working Paper 69.

HUSSEIN, K. & NELSON, J. 2016. Sustainable livelihoods and livelihood diversification, IDS Working Paper 69.

INGELAERE, B., CHRISTIAENSEN, L., DE WEERDT, J. & KANBUR, R. 2017. Why secondary towns can be important for poverty reduction: a migrant's perspective. Policy Research Working Paper. *World Bank Group*, Washington, D.C.

JAKOVLJEVIC, M., POTAPCHIK, E., POPOVICH, L., BARIK, D. & GETZEN, T. E. 2017. Evolving health expenditure landscape of the BRICS nations and projections to 2025. *Health economics,* 26**,** 844-852.

JEDWAB, R. & STOREYGARD, A., 2017. Economic and Political Factors in Infrastructure Investment: Evidence from Railroads and Roads in Africa 1960–2015 (No. 2017-3).

KAISER, G. & SMALLWOOD, J. 2014. Towards a systems thinking approach in allocating infrastructure budgets in local government. *Journal of the South African Institution of Civil Engineering,* 56**,** 93-99.

KAMBLE, S. M. 2014. Participatory rural appraisal: a tool for inclusive growth and participatory development a case study of Village Marale, MS, India. *Int Res J Soc Sci,* 3**,** 48-50.

KANEL, K. R. & NIRAULA, D. R. 2017. Can rural livelihood be improved in Nepal through community forestry? *Banko janakari,* 14**,** 19-26.

KAY, C. 2008. Reflections on Latin American rural studies in the neoliberal globalization period: a new rurality? *Development and Change,* 39**,** 915-943.

KENNEDY, C., MILLER, E., SHALABY, A., MACLEAN, H. & COLEMAN, J. 2005. The four pillars of sustainable urban transportation. *Transport Reviews,* 25**,** 393-414.

KEPE, T. & TESSARO, D. 2014. Trading-off: Rural food security and land rights in South Africa. *Land Use Policy,* 36**,** 267-274.

KESSIDES, C. 2006. *The urban transition in Sub-Saharan Africa: Implications for economic growth and poverty reduction*, Cities Alliance Washington DC.

KGAMANYANE, M., 2015. The importance of road transport infrastructure development and maintenance in trade facilitation: a South African case, Doctoral dissertation, University of Cape Town.

KHAN, Z. R., MIDEGA, C. A., PITTCHAR, J. O., MURAGE, A. W., BIRKETT, M. A., BRUCE, T. J. & PICKETT, J. A. 2014. Achieving food security for one million sub-Saharan African poor through push–pull innovation by 2020. *Philosophical Transactions of the Royal Society of London B: Biological Sciences,* 369**,** 20120284.

KHANDKER, S. R. & SAMAD, H. A. 2016. Transformation of Rural Bangladesh: Role of Infrastructure and Financial Institutions.

KHATUN, D. & ROY, B. 2012. Rural Livelihood Diversification in West Bengal: Determinants and Constraints. *Agricultural Economics Research Review,* 25.

KOCH, J. 2011. The food security policy context in South Africa. Country Study, International Policy Centre for Inclusive Growth.

KON, Z. R. & LACKAN, N. 2008. Ethnic disparities in access to care in post-apartheid South Africa. *American Journal of Public Health,* 98**,** 2272-2277.

KOTHARI, C. R. 2004. *Research methodology: Methods and techniques*, New Age International.

KRAAK, A. 2004. *An overview of South African human resources development*, HSRC Press.

KURUKULASURIYA, P. & ROSENTHAL, S. 2013. Climate change and agriculture: A review of impacts and adaptations.

LABADARIOS, D., MCHIZA, Z. J.-R., STEYN, N. P., GERICKE, G., MAUNDER, E. M. W., DAVIDS, Y. D. & PARKER, W.-A. 2011. Food security in South Africa: a review of national surveys. *Bulletin of the World Health Organization,* 89**,** 891-899.

LAL, R., KRAYBILL, D., HANSEN, D. O., SINGH, B. R. & EIK, L. O. 2016. Research and development priorities. *Climate Change and Multi-Dimensional Sustainability in African Agriculture.* Springer.

LEHMACHER, W. 2017. Trade and the Global Supply Chain. *The Global Supply Chain.* Springer.

LESHORO, S. 2017. TIPS FORUM 2017. Sustainable agriculture for a better economy: policy planning and public financing Department of Agriculture, Forestry and Fisheries, South Africa

LEWIS, M. & VERHOEVEN, M. 2010. Financial crises and social spending: The impact of the 2008-2009 crisis.

LINDLOF, T. R. & TAYLOR, B. C. 2017. *Qualitative communication research methods*, Sage publications.

LIPTON, M. 1974. White farming: A case study of change in South Africa. *Journal of Commonwealth & Comparative Politics,* 12**,** 42-61.

LIPTON, M. 1986. *Capitalism and Apartheid: South Africa, 1910-1986*, New Africa Books.

LOCKHEED, M. E. & VERSPOOR, A. M. 1991. *Improving primary education in developing countries*, Oxford University Press for World Bank.

LUCAS, K. 2011. Making the connections between transport disadvantage and the social exclusion of low income populations in the Tshwane Region of South Africa. *Journal of Transport Geography,* 19**,** 1320-1334.

LUCAS, K., VAN WEE, B. & MAAT, K. 2016. A method to evaluate equitable accessibility: combining ethical theories and accessibility-based approaches. *Transportation,* 43**,** 473-490.

MAGADZA, C. 1994. Climate change: some likely multiple impacts in Southern Africa. *Food Policy,* 19**,** 165-191.

MARSCHAN-PIEKKARI, R. & REIS, C. 2004. Language and languages in cross-cultural interviewing. *Handbook of qualitative research methods for international business,* 1**,** 224-244.

MAYER, M. J. & ALTMAN, M. 2005. South Africa's economic development trajectory: implications for skills development. *Journal of Education and Work,* 18**,** 33-56.

MAZIBUKO, S. 2013. Understanding underdevelopment through the sustainable livelihoods approach. *Community Development,* 44**,** 173-187.

MCDONAGH, J. 2006. Transport policy instruments and transport-related social exclusion in rural Republic of Ireland. *Journal of Transport Geography,* 14**,** 355-366.

MISSELHORN, A. & HENDRIKS, S. L. 2017. A systematic review of sub-national food insecurity research in South Africa: Missed opportunities for policy insights. *PloS one,* 12**,** e0182399.

MØLLER, V. 1998. Quality of life in South Africa: Post-apartheid trends. *Social Indicators Research,* 43**,** 27-68.

MUBILA, M. & YEPES, T. 2017. Infrastructure and rural productivity in Africa. *Infrastructure in Africa: Lessons for Future Development***,** 137.

MULKEEN, A. 2005. Teachers for rural schools: A challenge for Africa. Africa region World Bank. Washington, DC: World Bank.

MUNICIPALITY, D. 2013. FINAL INTEGRATED DEVELOPMENT PLAN (IDP). *IDP),* 2013.

MWANGOME, M. N., GEUBBELS, E., KLATSER, P. & DIELEMAN, M. 2016. "I don't have options but to persevere." Experiences and practices of care for HIV and diabetes in rural Tanzania: a qualitative study of patients and family caregivers. *International journal for equity in health,* 15**,** 56.

NARAYANASAMY, N. 2009. *Participatory rural appraisal: Principles, methods and application*, SAGE Publications India.

NCUBE, K., SHACKLETON, C. M., SWALLOW, B. M. & DASSANAYAKE, W. 2016. Impacts of HIV/AIDS on food consumption and wild food use in rural South Africa. *Food Security,* 8**,** 1135-1151.

NGAMLANA, P. X. 2009. *Improving public-private partnership deal flow for infrastructure delivery in South Africa: the role of National Treasury.* Stellenbosch: University of Stellenbosch.

NTETA, T. P., MOKGATLE-NTHABU, M. & OGUNTIBEJU, O. O. 2010. Utilization of the primary health care services in the Tshwane Region of Gauteng Province, South Africa. *PloS one,* 5**,** e13909.

OBENG-ODOOM, F. 2012. Land reforms in Africa: Theory, practice, and outcome. *Habitat international,* 36**,** 161-170.

OJHA, H. R., SHRESTHA, K. K., SUBEDI, Y. R., SHAH, R., NUBERG, I., HEYOJOO, B., CEDAMON, E., RIGG, J., TAMANG, S. & PAUDEL, K. P. 2017. Agricultural land underutilisation in the hills of Nepal: Investigating socio-environmental pathways of change. *Journal of Rural Studies,* 53**,** 156-172.

OOSTHUIZEN, M. & BHORAT, H. 2005. *The post-apartheid South African labour market*, Development Policy Research Unit.

OPDENAKKER, R. Advantages and disadvantages of four interview techniques in qualitative research. Forum Qualitative Sozialforschung/Forum: Qualitative Social Research, 2006.

OPPENHEIM, A. N. 1992. *Questionnaire design, interviewing and attitude measurement*, Bloomsbury Publishing.

ORGANIZATION, W. H. 2003. Primary health care: 25 years after ALMA-ATA.

PAIGE-GREEN, P. 2006. Appropriate roads for rural access.

PALINKAS, L. A., HORWITZ, S. M., GREEN, C. A., WISDOM, J. P., DUAN, N. & HOAGWOOD, K. 2015. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research,* 42**,** 533-544.

PATTON, M. Q. 2005. *Qualitative research*, Wiley Online Library.

PEARCE, J., WITTEN, K. & BARTIE, P. 2006. Neighbourhoods and health: a GIS approach to measuring community resource accessibility. *Journal of epidemiology and community health,* 60**,** 389-395.

PEET, R. 2002. Ideology, discourse, and the geography of hegemony: From socialist to neoliberal development in postapartheid South Africa. *Antipode,* 34**,** 54-84.

PENCHANSKY, R. & THOMAS, J. W. 1981. The concept of access: definition and relationship to consumer satisfaction. *Medical care***,** 127-140.

PÉREZ-CUEVAS, R., GUANAIS, F. C., DOUBOVA, S. V., PINZÓN, L., TEJERINA, L., PINTO MASIS, D., ROCHA, M., HARRIS, D. O. & MACINKO, J. 2017. Understanding public perception of the need for major change in Latin American healthcare systems. *Health Policy and Planning,* 32**,** 816-824.

PERRET, S. R. 2001. Poverty and diversity of livelihood systems in post-apartheid rural South Africa: Insights into local levels in the Eastern Cape Province. *Pretoria: Department of Agricultural Economics, Extension and Rural Development,* University of Pretoria.

PETERS, D. H., GARG, A., BLOOM, G., WALKER, D. G., BRIEGER, W. R. & HAFIZUR RAHMAN, M. 2008. Poverty and access to health care in developing countries. *Annals of the New York Academy of Sciences,* 1136**,** 161-171.

PHIRI, M. Z. 2017. Comparative Perspectives on South Africa's and Brazil's Institutional Inequalities under Progressive Social Policies. *Journal of Southern African Studies***,** 1-18.

PIENAAR, K. 2017. Rethinking the poverty-disease nexus: the case of HIV/AIDS in South Africa. *Journal of Medical Humanities,* 38**,** 249-266.

PORTER, G. 2002. Living in a walking world: rural mobility and social equity issues in sub-Saharan Africa. *World development,* 30**,** 285-300.

POULTON, C., KYDD, J. & DORWARD, A. 2006. Overcoming market constraints on pro-poor agricultural growth in Sub-Saharan Africa. *Development policy review,* 24**,** 243-277.

PRONYK, P., MAKHUBELE, M., HARGREAVES, J., TOLLMAN, S. & HAUSLER, H. 2001. Assessing health seeking behaviour among tuberculosis patients in rural South Africa. *The International Journal of Tuberculosis and Lung Disease,* 5**,** 619-627.

PUCHER, J., PENG, Z. R., MITTAL, N., ZHU, Y. & KORATTYSWAROOPAM, N. 2007. Urban transport trends and policies in China and India: impacts of rapid economic growth. *Transport Reviews,* 27**,** 379-410.

QIN, Y. & ZHANG, X. 2016. The road to specialization in agricultural production: Evidence from rural China. *World Development,* 77**,** 1-16.

REDDY, V., BHORAT, H., POWELL, M., VISSER, M. & ARENDS, F. 2016. Skills supply and demand in South Africa.

REGAN, S. & WONG, S. T. 2009. *Patient perspectives on primary health care in rural communities: effects of geography on access, continuity and efficiency.* University of British Columbia.

RODRIGUE, J.-P., COMTOIS, C. & SLACK, B. 2009. *The geography of transport systems*, Routledge.

RODRIGUE, J.-P., COMTOIS, C. & SLACK, B. 2016. *The geography of transport systems*, Taylor & Francis.

ROGERSON, C. M. 2017. *Geography and Economy in South Africa and its Neighbours*, Routledge.

ROSE, K. 1994. Unstructured and semi-structured interviewing. *Nurse Researcher,* 1**,** 23-30.

ROTHERAM-BORUS, M. J., TOMLINSON, M., SCHEFFLER, A., HARRIS, D. M. & NELSON, S. 2017. Adjustment of a Population of South African Children of Mothers Living With/and Without HIV Through Three Years Post-Birth. *AIDS and Behavior,* 21**,** 1601-1610.

SAHOO, P., DASH, R. K. & NATARAJ, G. 2012. China's growth story: The role of physical and social infrastructure. *Journal of Economic Development,* 37**,** 53.

SALLING, K. B. & PRYN, M. R. 2015. Sustainable transport project evaluation and decision support: indicators and planning criteria for sustainable development. *International Journal of Sustainable Development & World Ecology,* 22**,** 346-357.

SANA, M., STECKLOV, G. & WEINREB, A. A. 2016. A test of the stranger-interviewer norm in the Dominican Republic. *Population studies,* 70**,** 73-92.

SCHNEIDER, H., HLOPHE, H. & VAN RENSBURG, D. 2008. Community health workers and the response to HIV/AIDS in South Africa: tensions and prospects. *Health policy and Planning,* 23**,** 179-187.

SCOONES, I., THOMPSON, J. & CHAMBERS, R. 2009. Farmer first revisited. *Rugby: Practical Action*.

SENDER, J. 2016. Backward capitalism in rural South Africa: Prospects for accelerating accumulation in the Eastern Cape. *Journal of agrarian change,* 16**,** 3-31.

SENDER, J. & JOHNSTON, D. 2004. Searching for a weapon of mass production in rural Africa: Unconvincing arguments for land reform. *Journal of Agrarian Change,* 4**,** 142-164.

SEWELL, S. J. & DESAI, S. 2016. The Impacts of Undeveloped Roads on the Livelihoods of Rural Women. *Review of Social Sciences,* 1**,** 15-29.

SHAY, E., COMBS, T. S., FINDLEY, D., KOLOSNA, C., MADELEY, M. & SALVESEN, D. 2016. Identifying transportation disadvantage: Mixed-methods analysis combining GIS mapping with qualitative data. *Transport Policy,* 48**,** 129-138.

SISK, T. 2017. *Democratization in South Africa: The elusive social contract*, Princeton University Press.

STORM, S. & ISAACS, G. 2016. Modelling the impact of a national minimum wage in South Africa: Are general equilibrium models fit for purpose? : University of the Witwatersrand, Johannesburg: CSID, Research Brief.

TANSER, F., GIJSBERTSEN, B. & HERBST, K. 2006. Modelling and understanding primary health care accessibility and utilization in rural South Africa: an exploration using a geographical information system. *Social science & medicine,* 63**,** 691-705.

THOMAS, S., WAKERMAN, J., HUMPHREYS, J. & HUMPHREYS, S. T. J. W. J. 2017. What does it cost to provide equity of access to high quality, comprehensive primary health care in rural Australia? A pilot study. *Rural and Remote Health,* 17.

THORBECKE, E. & CHARUMILIND, C. 2002. Economic inequality and its socioeconomic impact. *World Development,* 30**,** 1477-1495.

TIBESIGWA, B. & VISSER, M. 2016. Assessing gender inequality in food security among small-holder farm households in urban and rural South Africa. *World Development,* 88**,** 33-49.

TODES, A. & TUROK, I. 2017. Spatial inequalities and policies in South Africa: Place-based or people-centred? *Progress in Planning*.

VAISMORADI, M., TURUNEN, H. & BONDAS, T. 2013. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & health sciences,* 15**,** 398-405.

VAN BERKUM, S., ACHTERBOSCH, T., LINDERHOF, V., GODESCHALK, F. & VROEGE, W. 2017. Dynamics of food systems in Sub-Saharan Africa. Wageningen Economic Research.

VAN DE WALLE, D. 2002. Choosing rural road investments to help reduce poverty. *World Development,* 30**,** 575-589.

VAN DONK, M. 2008. *Consolidating developmental local government: lessons from the South African experience*, Juta and Company Ltd.

VAN RENSBURG, H. C. 2014. South Africa's protracted struggle for equal distribution and equitable access–still not there. *Human resources for health,* 12**,** 26.

VENKATESH, V., RAI, A., SYKES, T. A. & ALJAFARI, R. 2016. Combating Infant Mortality in Rural India: Evidence from a Field Study of eHealth Kiosk Imlementations. *Mis Quarterly,* 40**,** 353-380.

VOLMINK, J. & VAN DER ELST, L. 2017. The evolving role of 21st Century Education NGOs in South Africa: Challenges and Opportunities.

VON BRAUN, J. 2007. *The world food situtation: new driving forces and required actions*, Intl Food Policy Res Inst.

WALSH, C. M. & VAN ROOYEN, F. C. 2015. Household food security and hunger in rural and urban communities in the Free State Province, South Africa. *Ecology of food and nutrition,* 54**,** 118-137.

WANG, Z., WANG, Z., SUN, S. & SUN, S. 2016. Transportation infrastructure and rural development in China. *China Agricultural Economic Review,* 8**,** 516-525.

WILKINSON, A., PETTIFOR, A., ROSENBERG, M., HALPERN, C. T., THIRUMURTHY, H., COLLINSON, M. A. & KAHN, K. 2017. The employment environment for youth in rural South Africa: A mixed-methods study. *Development Southern Africa,* 34**,** 17-32.

WOOLARD, I. 2002. An overview of poverty and inequality in South Africa. *Unpublished briefing paper, HSRC, Pretoria*.

YARO, J. A. 2006. Is deagrarianisation real? A study of livelihood activities in rural northern Ghana. *The Journal of Modern African Studies,* 44**,** 125-156.

YU, N., DE ROO, G., DE JONG, M. & STORM, S. 2016. Does the expansion of a motorway network lead to economic agglomeration? Evidence from China. *Transport Policy,* 45**,** 218-227.

ZANTSI, S. 2016. *The influence of aspirations on changing livelihood strategies in rural households of Ndabakazi villages in the Eastern Cape.* University of Fort Hare.

ZHUO, L., MEKONNEN, M. M. & HOEKSTRA, A. Y. 2016. The effect of inter-annual variability of consumption, production, trade and climate on crop-related green and blue water footprints and inter-regional virtual water trade: A study for China (1978–2008). *Water research,* 94**,** 73-85.

CHAPTER FIVE

ASSESSING COMMUNITY BASED ROAD MANAGEMENT STRATEGIES USED FOR MAINTAINING UNPAVED RURAL ROADS

The chapter is based on:

Nkomo, S.L. Desai, S. A. Peerbhay, K. Y. and Seutloali, K.E. (In preparation) "*Assessing the effectiveness of Community Based Road Management Strategies, lesson from KwaZulu-Natal, South Africa".*

5.1. Abstract

Maintenance of unpaved rural road networks remains a common challenge facing most developing countries, particularly in sub-Saharan Africa. Community Based Road Management Strategies have become a popular approach for maintaining unpaved rural roads in many underdeveloped sub-Saharan African countries. The major challenge in sub-Saharan Africa is that there are limited studies conducted to highlight the effectiveness of Community Based Road Management Strategies on the maintenance of rural roads. This study therefore aimed at identifying and assessing some of the Community Based Road Management Strategies used to maintain unpaved road networks on the south-eastern parts of KwaZulu-Natal province. A total of 432 km of unpaved road networks were traversed in randomly selected rural communities and a sum of 28 groups of contractors, employed by the Zibambele Road Maintenance System were identified while performing routine maintenance over specified road lengths. The effectiveness of the Zibambele maintenance programme was assessed based on road surfaces and roadside drainage conditions. Maintenance effectiveness was assessed based on a scale of one, which means poor performance, to four depicting successful performance. Overall, the findings of this study show that Community Based Road Management Strategies such as the Zibambele Road Maintenance programme provides an alternative approach that is useful and can be effective on the maintenance of unpaved rural road networks. The biggest criticism for Community Based Road Management Strategies is that they lack sufficient prioritisation of personnel training and this justification was observed during the assessment of the Zibambele maintenance programme on the selected road lengths.

5.2. Introduction

Maintenance of unpaved rural road networks remains a common challenge facing most developing countries, particularly in sub-Saharan Africa (Gwilliam et al., 2008, Saghir, 2017). Maintenance can be defined as "*all the technical and associated administrative functions intended to retain an item or system in, or restore it to, a state in which it can perform its required function"* (Dekker, 1996:1). The maintenance of unpaved rural roads in sub-Saharan Africa has been handicapped by many challenges (Riverson et al., 1991, Porter, 2014). Jones et al. (2014) and Porter (2014) argue that unpaved rural road conditions in sub-Saharan are devastatingly poorer by comparison to Asia and Latin America. Poor unpaved rural road conditions in sub-Saharan Africa have been primarily caused by factors such as amongst others; poor road design and construction and as well as the lack of maintenance (Riverson et al., 1991). In addition, Porter (2014) argues that the maintenance of unpaved rural roads in sub-Saharan Africa have been highly strained by the lack of funds and as well as the introduction of structural adjustment programs (SAPs). The SAPs undermined the socioeconomic value of unpaved rural roads in sub-Saharan Africa and as a consequence, road construction standards and road maintenance conditions deteriorated.

Several studies have been conducted to assess the socioeconomic benefits of well-maintained unpaved rural road networks (Hajj and Pendakur, 2000, Porter, 2002, Emeasoba and Ogbuefi, 2013, Nkomo et al., 2016, Sieber and Allen, 2016). Berdegué et al. (2001), Qin and Zhang (2016) and Soltani et al. (2017) argue that an improvement in rural road networks facilitates rural development, agriculture specialisation, improves access to markets and nonfarm employment opportunities amongst others. In contrast, poorly maintained roads limit mobility in rural areas and thus, increasing vehicle operation costs (Sieber and Allen, 2016), aggravating isolation (Starkey, 2002), perpetuate poverty and limit access to services (Porter, 2014). Rural transport costs in sub-Saharan Africa are higher than in any other parts of the world (Porter, 2002, Jedwab and Storeygard, 2017). According to Beuran et al. (2015), poor government project prioritisation of rural roads remains a contemporary problem contributing to poor management of rural access roads in most developing countries, particularly in sub-Saharan Africa. Beuran et al. (2015) argues that budget constraints, lack of policy prioritisation, limited number of skilled human capital (engineers), spatial isolation and small number of beneficiaries are amongst some of the major contributing factors resulting in poor government prioritisation of rural access roads in sub-Saharan Africa. Resource limitation and financial constraints has

caused some of the developing countries to consider using cheaply available resource and labour intensive methods as strategies for managing unpaved rural roads in the pledge to improve road conditions and as well as provide sustainable access.

Recently, Community Based Road Management Strategies (CBRMS) have become widely used and recommended as the most effective and sustainable method of maintaining unpaved rural roads in communities with scarce public resources (Guade et al., 1987, Edmonds and De Veen, 1992, McCutcheon, 1995, Burningham and Stankevich, 2005). Korten (1987) argues that from the 1980s, community based strategies to development have become the more preferred mechanisms for channelling development. CBRMS utilise local resource and community involvement in the maintenance of rural roads (Fukubayashi and Kimura, 2014). For the past 3 decades CBRMS have become a popular rural road maintenance strategy in many African countries (Fukubayashi and Kimura, 2017). For example, in Kenya the Government uses the Lengthman model for routine maintenance of rural roads and minor roads (Jones and Petts, 1991, Chebon, 2013). The Lengthman model is an initiative that uses labour-based methods for routine maintenance over specified lengths (usually 1.5-2.0 km) of road. For example when using the Lengthman model in Kenya, a group of about 15 people, supervised once a month, are given hand tools to carryout 12 days of work per month on days of their choice for routine maintenance on sections of road length (Jones and Petts, 1991, Chebon, 2013). All the people selected for the maintenance are people who live adjacent to the roads and hence transportation and accommodation costs are not require (Chebon, 2013). In Kenya, the Lengthman model is utilised to maintain over 8000km of rural access and minor roads (Jones and Petts, 1991). Although the Lengthman model in Kenya is considered to be an effective maintenance initiative, however, it underestimates training and supervision needs of personnel (Jones and Petts, 1991, Chebon, 2013). In addition, the training received does not determine accurate maintenance requirements under various conditions of rainfall, alignment, pavement or soil type and traffic (Jones and Petts, 1991). Nevertheless, the model is highly recognised for creating productive work opportunities for people living in rural areas where there are limited employment opportunities (Jones and Petts, 1991).

So far, to the best of our knowledge, no studies have assessed the effectiveness of CBRMS on unpaved roads in South Africa. Previous studies that have been conducted have focused mainly on the role of CBRMS as a strategy for rural road construction (Ngebulana, 2008, Musekene, 2013), creating rural employment (McCord, 2002, Mashiri et al., 2008, Chakwizira, 2010), and poverty alleviation (McCord, 2008, Purchase, 2010). This chapter will therefore identify and

visually assess CBRMS used to maintain unpaved road networks in rural communities in KwaZulu-Natal in order to establish their effectiveness. Unpaved rural roads are crucial in KwaZulu-Natal because they account for approximately 80 percent of the total road networks and therefore their maintenance is vital for providing sustainable rural access.

5.3. Materials and methods

In order to identify CBRMS employed on unpaved road networks, a total of 432km of gravel roads were traversed in randomly selected rural communities on the south-eastern parts of KwaZulu-Natal province. A sum of 28 groups which comprised of approximately 3 to 4 personnel per group were identified doing routine maintenance on parts of the traversed roads. The group of personnel is also referred to as a contractor. The identified contractors were all working for the Zibambele Road Maintenance Contract System. The Zibambele Road Maintenance initiative is a poverty alleviation programme that was designed in the year 2000 by the KwaZulu-Natal Department of Transport (McCutcheon, 2001, Phillips, 2004). The Zibambele Road Maintenance programme was adapted from Kenya's Lengthman Model and these programmes simultaneously utilise labour intensive methods (Ngubane, 2011). The socioeconomic benefits of the Zibambele Road Maintenance programme are similar to the Lengthman Model that is utilised in Kenya. The reason being, both these programmes contract households rather than individuals to maintain a length of road. In addition, the length of the road allocated to a household is dependent on the difficulty of the landscape and the more difficult the landscape, the shorter the allocated road length. The Zibambele Road Maintenance programme requires contractors to work a maximum of 60 hours or 8 days per month and they given a 12 months renewable contract (McCutcheon, 2001, Ngubane, 2011). Contractors are supplied with tools such as a wheelbarrow, a pick or a hoe, a shovel, a machete and a slasher or a sickle. When conducting road maintenance, contractors are required to ensure that drainage systems are adequately maintained, there is enough roadside visibility, road surface conditions are good and that all litter and noxious weeds are removed on road verges (McCutcheon, 2001). Recent statistics indicate that the programme employs more than seventeen thousand contractors to maintain approximately eleven thousand kilometres of gravel roads in KwaZulu-Natal province (Odhiambo et al., 2015).

5.2.1. Assessing the effectiveness of the Zibambele contract system on road maintenance

The effectiveness of the Zibambele Road Maintenance system was visually assessed semi-quantitatively by assigning scores ranging from 1 (very poor) to 4 (excellent) based on expert knowledge. This study only assessed the sections of the roads where the Zibambele contractors (the 28 groups identified) were doing maintenance. Table 5.1 shows the description of scores for assessing the effectiveness of the Zibambele maintenance system on rural road maintenance.

Table 5.1: *Description of scores for assessing the effectiveness of the Zibambele Road Maintenance programme on road surface and side drainage systems.*

Road maintenance	Scores			
	1	2	3	4
Road surface	Heavily dominated by surface distresses	Surface distress are beginning to dominate	Signs of surface distress are minimal	No signs of surface distress
Drainage systems (include culverts, turnouts and ditches)	No drainage systems or heavily clogged with debris or sediments and	debris or sediments are beginning to dominate	Minimal signs of debris or sediments	No signs of debris or sediments

Note: 1=very poor; 2=poor; 3=good; 4=excellent

According to Karlaftis and Golias (2002) and Skorseth et al. (2000), the shape of a gravel road directly affects the performance of a road in any location. Figure 5.1 shows the components of a properly shaped roadway cross section. Poorly shaped road surfaces result in distresses such as potholes, rutting and erosion channels. In addition, proper maintained gravel roads must have a well-crowned driving surface, the road shoulders must be designed to slope away from the driving surface edge and a ditch must be constructed to facilitate drainage (Skorseth et al., 2000, Karlaftis and Golias, 2002).

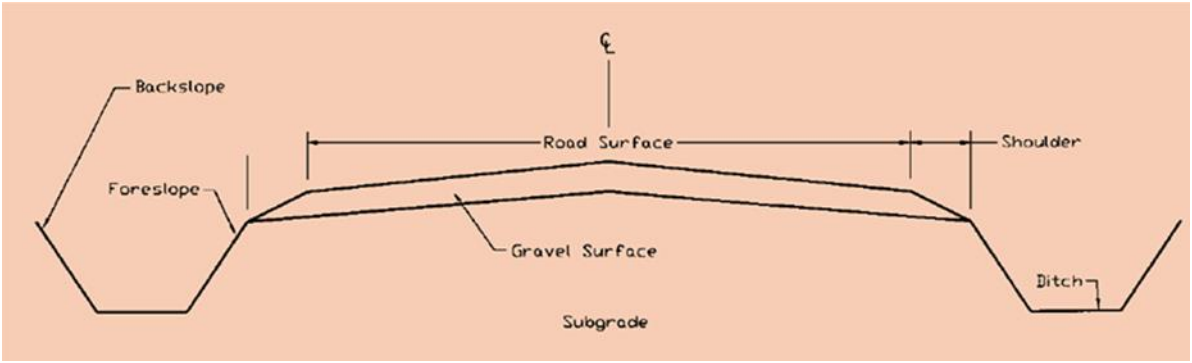

Figure 5.1: *The characteristics of the roadway cross section (Skorseth et al., 2000).*

Informal interviews were also used to assess whether all contractors that were identified received any form of train for performing their duties. All the contractors identified for this study were asked whether they received any formal training and if yes, for how long? Knowing whether the contractors received training is important because understating the technical components is essential for effective maintenance programs.

5.3. Results Analysis

The findings of this study only represent the assessment conducted on road lengths where the Zibambele Road Maintenance contractors (28 groups) were observed performing road maintenance during data collection. On average, the road length allocated to each contractor (made up of 3 to 4 people including a supervisor) range between 500 metres to 1.5 kilometres. Approximately, 85 percent of the people observed working for the programme were women. All contractors were asked during the assessment if they received any form of training for performing their duties and they all said no form of training was given to them.

5.3.1. Assessing the effectiveness of the Zibambele maintenance programme on road surface conditions.

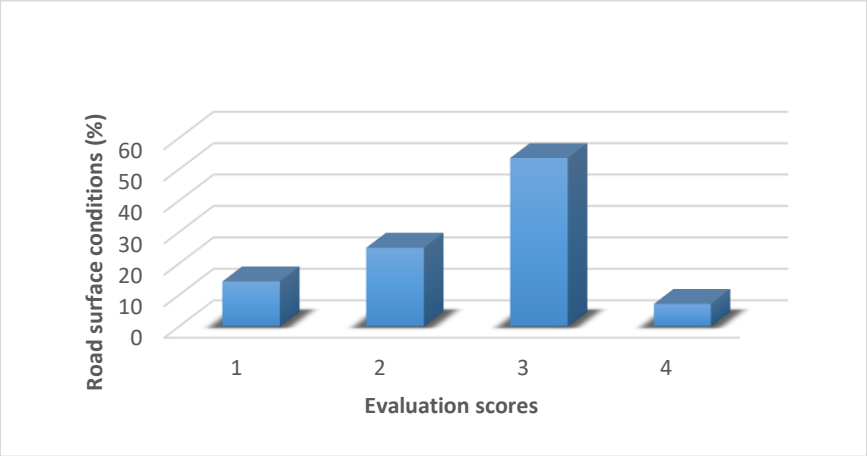

***Figure 5.2**: Scores for the road surface conditions.*

In general, the road surface conditions on the road lengths selected for this study varied significantly from very poor to excellent (Figures 5.3). Approximately 14.2 % of the road surfaces obtained a score of 1 that displays very poor surface conditions (Figure 5.2). In addition, 25% of the road surfaces obtained a score of 2 that highlights poor conditions while 53.5% obtained a score of 3 that shows good conditions (Figure 5.2). Only 7.1% of the road surfaces obtained a score of 4 that illustrates excellent conditions.

Figure 5.3: *Figure 3: The variation of road surface conditions in some of the road lengths selected for this study. The surface road conditions were: (A) very poor (B) poor (C) good and (D) excellent.*

5.3.2. Assessing the effectiveness of the Zibambele maintenance programme on road drainage systems

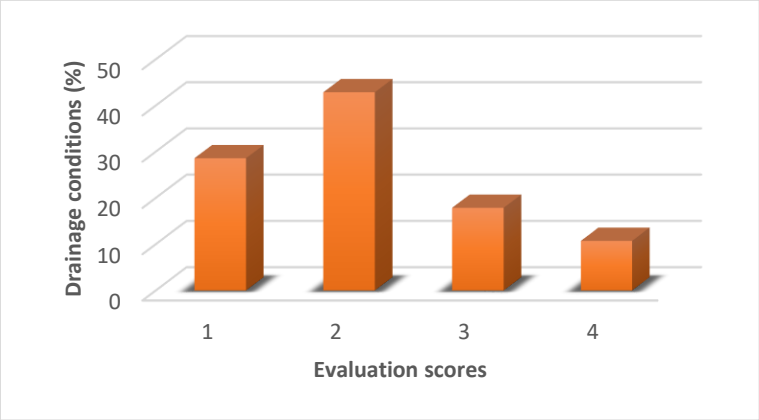

Figure 5.4: *Scores for the roadside drainage conditions on the selected road lengths.*

Overall, the effective maintenance of roadside drainage systems proved to be a common problem in many of the selected road lengths (Figure 5.4). About 28.6% of the road lengths obtained a score of 1 for drainage, indicating very poor conditions while 42.8% obtained a score of 2 that shows poor drainage conditions. Approximately 17.8% and 10.7% of the selected road lengths obtained drainage conditions scores of 3 and 4 respectively. Figure 5.5 shows some of the conditions of drainage which were randomly selected from road lengths in this study.

Figure 5.5: *Roadside drainage conditions on some of the selected road lengths. The conditions ranged from very poor (A, B and C) to poor (D and E) and excellent (F).*

5.4. Discussions

The aim of study was to identify and assess CBRMS used to maintain unpaved road networks in rural communities in KwaZulu-Natal in order to establish their effectiveness. A total of 432 km of unpaved road networks were traversed in randomly selected rural communities on the south-eastern parts of KwaZulu-Natal in order to identify and assess the effectiveness of the employed CBRMS. This study identified that the Zibambele Road Maintenance Contract System was the only CBRMS utilised to maintain unpaved roads on the traversed rural networks. Overall, the Zibambele Road Maintenance programme produced positive results in terms of effective maintenance of road surfaces to ensure sustainable vehicle mobility on the selected road lengths. However, in relation road lengths where the programme produced ineffective results, the lack of personnel training, poor road design and construction, as well as differences in personnel work ethics and commitment were perceived to be some of the underlying causes.

5.4.1. Effectiveness of the programme on the road surface maintenance

The effectiveness of the programme on the maintenance of road surfaces varied significantly across the selected road lengths. However, there were a number of important factors, which were not related to maintenance, that were identified to contribute to the noted surface variation and these include road surface design and construction amongst others. For example, it can be observed on inserts A and B on Figure 5.3 that poor road surface shape caused by poor design and construction techniques limited the effectiveness of maintenance on these road networks. According to Skorseth et al. (2000), the shape of a gravel road directly affects the performance of a road in any location. Skorseth et al. (2000) argues is that gravel roads must have a well-crowed driving surface, of which the shoulder of the road must be designed to slope away from the driving surface edge in order to facilitate good drainage (as illustrated on Figure 1). Insert C and D on Figure 5.3 are a good demonstration of argument made by Skorseth et al.(2000). Poor personnel training could be one of the primary causes of poor road surfaces maintenance on the selected road lengths. For example, insert A on Figure 5.3 obtained an evaluation score of 1 indicating a road length with very poor surface conditions and this was caused by the lack of maintaining erosion channels and also allowing vegetation to encroach on the road surface. The lack of training seems to be a common limitation that hinders the effectiveness of CBRMS programme used for unpaved road maintenance. Similarly, the Lengthman Model in Kenya is also criticised for underestimating personnel training. Much of the criticism with the Length

Model is due to the programme not determining accurate maintenance requirements under various conditions of rainfall, alignment, pavement/soil type and traffic (Jones and Petts, 1991). Hence, the Zibambele Road Maintenance programme coordinators must take note of this criticism because it was clearly observed that most of the personnel on the selected road lengths lacked the understanding of maintenance requirements under the different surface conditions.

5.4.2. Effectiveness of the programme on the maintenance of roadside drainage systems

The study established that most personnel used for the Zibambele Road Maintenance programme on the selected road lengths had very little knowledge on the technical requirements and functions of roadside drainage systems, with the exception of personnel from insert F on Figure 5.5. Thus, over 70% of the selected road lengths obtained a score of between 1 and 2 for the assessment of roadside drainage conditions. Most of the road lengths had no roadside drainage systems (insert A, B and C on Figure 5.5) or the drainage systems were highly cogged with debris or sediments (insert D and E on Figure 5.5). The development of erosion channels on the road surface (insert C and E) were some of notable consequences of the lack of roadside drainage systems. Poor road design and construction also contributed to lack of roadside drainage systems on some of the road lengths (insert A and B on Figure 5.5) selected for this study. Therefore, there is a need for the Zibambele Road Maintenance programme coordinators to prioritise personnel training so that roadside drainage requirements and functions are better understood in order to ensure effective maintenance.

The results of this study are useful in providing a basic assessment of the effectiveness of the Zibambele Road Maintenance on unpaved roads. However, the results could be improved by obtaining data from a larger area within the province. In addition, the method used in this study could be improved by providing a criterion for effectively rating the road surface and drainage conditions. Nevertheless, the results of this study can help the programme authorities to understand some of the basic limitations that hinder the effectiveness of the programme on routine maintenance of unpaved rural roads.

5.5. Conclusion

This chapter identified and assessed some of the CBRMS used for maintenance of rural roads on the south-eastern parts of KwaZulu-Natal province. A total of 28 groups of contractors, employed by the Zibambele Road Maintenance programme were identified doing road maintenance on sections of the road that were traversed during the course of this study. The effectiveness of the Zibambele maintenance programme was assessed on road surfaces and roadside drainage conditions on all the identified road lengths. Overall, the findings of this study show that CBRMS provide such as the Zibambele Road Maintenance programme provide an alternative approach that is useful and can be effective on the maintenance of unpaved rural road networks. The biggest criticism for CBRMS is that they lack sufficient prioritisation of personnel training and this justification was observed during the assessment of the Zibambele maintenance programme on the selected road lengths. The overall findings of chapter show that the Zibambele Road Maintenance programme is a good initiative for maintenance of rural roads and if proper training requirements are provided to personnel, the effectiveness of the programme will yield better results. In addition, the study further established that the effectiveness of the Zibambele Road Maintenance programme on road maintenance is also determined by a number of factors such as road design and construction techniques amongst others. The chapter recommends for prioritisation of personnel training in order to ensure effectiveness on the maintenance services rendered under the programme. Although this research is useful in providing lessons learnt from using the Zibambele Road Maintenance programme on selected road lengths on south-eastern parts of KwaZulu-Natal, future research needs to focus on developing simple maintenance specification for the different environmental conditions in the province.

5.6. References

ADAMS, M., COUSINS, B. & MANONA, S. 1999a. *Land tenure and economic development in rural South Africa: Constraints and opportunities*, Overseas Development Institute London.

ADAMS, M., SIBAN DA, S. & TURNER, S. D. 1999b. *Land tenure reform and rural livelihoods in Southern Africa*, Overseas Development Institute London.

ADAY, L. A. & ANDERSEN, R. 1974. A framework for the study of access to medical care. *Health services research,* 9, 208.

ADJAYE-GBEWONYO, K., AVENDANO, M., SUBRAMANIAN, S. & KAWACHI, I. 2016. Income inequality and depressive symptoms in South Africa: A longitudinal analysis of the National Income Dynamics Study. *Health & place,* 42, 37-46.

AL-NASSER, A., BAMGBOYE, E. & ABDULLAH, F. 1994. Providing antenatal services in a primary health care system. *Journal of community health,* 19, 115-123.

ALEXANDER, P. 2010. Rebellion of the poor: South Africa's service delivery protests–a preliminary analysis. *Review of African political economy,* 37, 25-40.

ALI, I. & PERNIA, E. M. 2003. Infrastructure and Poverty Reduction-What is the Connection?

ALIBER, M. 2003. Chronic poverty in South Africa: Incidence, causes and policies. *World Development,* 31, 473-490.

ALTMAN, M., HART, T. & JACOBS, P. 2009. Household food security status in South Africa. *Agrekon,* 48, 345-361.

ANSAR, A., FLYVBJERG, B., BUDZIER, A. & LUNN, D. 2016. Does infrastructure investment lead to economic growth or economic fragility? Evidence from China. *Oxford Review of Economic Policy,* 32, 360-390.

BAIPHETHI, M. N. & JACOBS, P. T. 2009. The contribution of subsistence farming to food security in South Africa. *Agrekon,* 48, 459-482.

BANERJEE, A., DUFLO, E. & QIAN, N. 2012. On the road: Access to transportation infrastructure and economic growth in China. National Bureau of Economic Research.

BANJO, G., GORDON, H. & RIVERSON, J. 2012. Rural Transport: Improving its contribution to growth and poverty reduction in Sub-Saharan Africa.

BARBARIN, O. A. & RICHTER, L. M. 2013. *Mandela's children: Growing up in post-apartheid South Africa*, Routledge.

BARRETT, C. B., BEZUNEH, M. & ABOUD, A. 2001. Income diversification, poverty traps and policy shocks in Côte d'Ivoire and Kenya. *Food policy,* 26, 367-384.

BASINGA, P., GERTLER, P. J., BINAGWAHO, A., SOUCAT, A. L., STURDY, J. & VERMEERSCH, C. M. 2011. Effect on maternal and child health services in Rwanda

of payment to primary health-care providers for performance: an impact evaluation. *The Lancet,* 377, 1421-1428.

BAYES, A. 2001. Infrastructure and rural development: insights from a Grameen Bank village phone initiative in Bangladesh. *Agricultural Economics,* 25, 261-272.

BEINART, W. 2001. *Twentieth-Century South Africa*, Oxford Paperbacks.

BENINGFIELD, J. 2006. *The Frightened Land: Land, landscape and politics in South Africa in the twentieth century*, Routledge.

BERDEGUÉ, J. A., RAMíREZ, E., REARDON, T. & ESCOBAR, G. 2001. Rural nonfarm employment and incomes in Chile. *World Development,* 29, 411-425.

BERG, C. N., BLANKESPOOR, B. & SELOD, H. 2016. Roads and rural development in Sub-Saharan Africa.

BEURAN, M., GACHASSIN, M. & RABALLAND, G. 2015. Are There Myths on Road Impact and Transport in Sub-Saharan Africa? *Development Policy Review,* 33, 673-700.

BHARGAVA, A., BOOYSEN, F. L. R. & WALSH, C. M. 2017. Health status, food insecurity, and time allocation patterns of patients with AIDS receiving antiretroviral treatment in South Africa. *AIDS care*, 1-8.

BHATTACHARYAY, B. N. 2009. Infrastructure development for ASEAN economic integration.

BHORAT, H., LILENSTEIN, K., OOSTHUIZEN, M. & THORNTON, A. 2016. Vulnerability In Employment: Evidence from South Africa.

BOND, V., CHILESHE, M., SULLIVAN, C. & MAGAZI, B. 2015. The converging impact of tuberculosis, HIV/AIDS, and food insecurity in Zambia and South Africa.

BRIEDENHANN, J. & WICKENS, E. 2004. Tourism routes as a tool for the economic development of rural areas—vibrant hope or impossible dream? *Tourism management,* 25, 71-79.

BRYCESON, D. F. 2002. The scramble in Africa: reorienting rural livelihoods. *World development,* 30, 725-739.

BURNINGHAM, S. & STANKEVICH, N. 2005. Why road maintenance is important and how to get it done.

BURNS, J. K., TOMITA, A. & LUND, C. 2017. Income inequality widens the existing income-related disparity in depression risk in post-apartheid South Africa: Evidence from a nationally representative panel study. *Health & Place,* 45, 10-16.

BUTLER, A. 2017. *Contemporary South Africa*, Springer.

BUTLER, J., ROTBERG, R. I. & ADAMS, J. 1978. *The black homelands of South Africa: The political and economic development of Bophuthatswana and KwaZulu*, Univ of California Press.

CARNEY, D. 2003. *Sustainable livelihoods approaches: progress and possibilities for change*, Department for International Development London.

CARTER, M. R. & MAY, J. 1999. Poverty, livelihood and class in rural South Africa. *World Development,* 27, 1-20.

CHAKWIZIRA, J., BIKAM, P. & MASHIRI, M. 2014. Are We Parked, Giving Way or Negotiating the Curve of Rural Development: Implications of the State of Rural Transport Research in South Africa for Planning, Policy and Development Choices. *Planning Africa 2014*, 646.

CHAMBERS, R. & CONWAY, G. 1991. Sustainable livelihood-chambers and conway1991. pdf. Dec.

CHAN, G. 2017. China's Economic Power and the Global Financial Structure. *CHINA'S ECONOMIC STATECRAFT: Co-optation, Cooperation and Coercion.* World Scientific.

CHEBON, C. C. 2013. *Development of Road Maintenance Management System for Unpaved Roads in Kenya.*

CHIKOZHO, C. 2016. The Disjuncture between Economic Growth, Poverty Reduction and Social Inclusion in South Africa. *Inclusive Growth and Development Issues in Eastern and Southern Africa*, 109.

CHIRIKURE, S., DANDARA, C., FERRAZ, F., KRAEMER-MBULA, E., MABEZA, C., MAHARAJH, R., MPHAHLELE, L., MURIMBIKA, M., POGUE, T. & SCERRI, M. 2017. *Emergence of Innovations in (South) ern Africa: Long Histories and Contemporary Debates*, Real African Publishers Pty Ltd.

COHEN, D. & CRABTREE, B. 2006. *Qualitative research guidelines project* [Online]. Available: http://www.qualres.org/ [Accessed 06-05-2015].

COLLABORATORS, M. D. S. 2010. Causes of neonatal and child mortality in India: a nationally representative mortality survey. *The Lancet,* 376, 1853-1860.

COMMISSION, S. A. H. R. & UNICEF 2014. Poverty traps and social exclusion among children in South Africa. *Pretoria: SAHRC*.

COOVADIA, H., JEWKES, R., BARRON, P., SANDERS, D. & MCINTYRE, D. 2009. The health and health system of South Africa: historical roots of current public health challenges. *The Lancet,* 374, 817-834.

CROSS, C. & HORNBY, D. 2002. *Opportunities and obstacles to women's land access in South Africa*, National Land Committee Johannesburg.

DAMENA, A. & HABTE, D. 2017. Effect of Non-farm Income on Rural Household Livelihood: A Case Study of Moyale District Oromia Regional State, Ethiopia. *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*, 33, 10-36.

DAVIS, J. R. 2003. The rural-non-farm economy, livelihoods and their diversification: Issues and options.

DE COCK, N., D'HAESE, M., VINK, N., VAN ROOYEN, C. J., STAELENS, L., SCHÖNFELDT, H. C. & D'HAESE, L. 2013. Food security in rural areas of Limpopo province, South Africa. *Food Security,* 5, 269-282.

DE HOYOS, R. E. & MEDVEDEV, D. 2009. Poverty effects of higher food prices: a global perspective.

DEKKER, R. 1996. Applications of maintenance optimization models: a review and analysis. *Reliability engineering & system safety,* 51, 229-240.

DOBBS, R., POHL, H., LIN, D.-Y., MISCHKE, J., GAREMO, N., HEXTER, J., MATZINGER, S., PALTER, R. & NANAVATTY, R. 2013. Infrastructure productivity: how to save $1 trillion a year. *McKinsey Global Institute*.

DORWARD, A., KYDD, J., MORRISON, J. & UREY, I. 2004. A policy agenda for pro-poor agricultural growth. *World development,* 32, 73-89.

DUONG, D. V., BINNS, C. W. & LEE, A. H. 2004. Utilization of delivery services at the primary health care level in rural Vietnam. *Social Science & Medicine,* 59, 2585-2595.

EDIGHEJI, O. 2010. Constructing a democratic developmental state in South Africa: potentials and challenges. *Constructing a democratic developmental state in South Africa. Cape Town: Human Sciences Research Council*, 1-33.

EDMONDS, G. & DE VEEN, J. 1992. A labour-based approach to roads and rural transport in developing countries. *Int'l Lab. Rev.,* 131, 95.

ELLIS, F. 1998. Household strategies and rural livelihood diversification. *The journal of development studies,* 35, 1-38.

ELLIS, F. 2000. *Rural livelihoods and diversity in developing countries*, Oxford university press.

ELLIS, F. & FREEMAN, H. A. 2004. Rural livelihoods and poverty reduction strategies in four African countries. *Journal of development studies,* 40, 1-30.

EMEASOBA, U. R. & OGBUEFI, J. 2013. Sustainable socio-economic development in Nigeria: a case for road infrastructure maintenance.

FAN, S. & CHAN-KANG, C. 2005. *Road development, economic growth, and poverty reduction in China*, Intl Food Policy Res Inst.

FAN, S. & CHAN-KANG, C. 2008. Regional road development, rural and urban poverty: Evidence from China. *Transport Policy,* 15, 305-314.

FAN, S., ZHANG, L. & ZHANG, X. 2004. Reforms, investment, and poverty in rural China. *Economic Development and Cultural Change,* 52, 395-421.

FAULKNER, D. & LOEWALD, C. 2008. *Policy change and economic growth: A case study of South Africa*, International Bank for Reconstruction and Development/The World Bank.

FERREIRA, L. & ROSSOUW, R. 2016. South Africa's economic policies on unemployment: a historical analysis of two decades of transition. *Journal of Economic and Financial Sciences,* 9, 807-832.

FISHMAN, J., MCLAFFERTY, S. & GALANTER, W. 2016. Does Spatial Access to Primary Care Affect Emergency Department Utilization for Nonemergent Conditions? *Health services research*.

FISKE, E. B. & LADD, H. F. 2004. *Elusive equity: Education reform in post-apartheid South Africa*, Brookings Institution Press.

FUKUBAYASHI, Y. & KIMURA, M. 2014. Improvement of rural access roads in developing countries with initiative for self-reliance of communities. *Soils and Foundations,* 54, 23-35.

FUKUBAYASHI, Y. & KIMURA, M. 2017. Spot Improvement of Rural Roads Using a Local Resource-Based Approach: Case Studies from Asia and Africa. *International Development.* InTech.

GABRYSCH, S. & CAMPBELL, O. M. 2009. Still too far to walk: literature review of the determinants of delivery service use. *BMC pregnancy and childbirth,* 9, 34.

GATRELL, A. C. & ELLIOTT, S. J. 2014. *Geographies of health: An introduction*, John Wiley & Sons.

GILL, P., STEWART, K., TREASURE, E. & CHADWICK, B. 2008. Methods of data collection in qualitative research: interviews and focus groups. *British dental journal,* 204, 291-295.

GILLHAM, B. 2005. *Research interviewing: The range of techniques: A practical guide*, McGraw-Hill International.

GILLING, J., JONES, S. & DUNCAN, A. 2001. Sector approaches, sustainable livelihoods and rural poverty reduction. *Development Policy Review,* 19, 303-319.

GOVENDER, J. 2016. Social justice in South Africa. *Civitas-Revista de Ciências Sociais,* 16.

GUADE, J., GUICHAOUA, A., MARTENS, B. & MILLER, S. 1987. Rural Development and Labour-Intensive Schemes-Impact of Studies of Some Pilot Programmes. *Int'l Lab. Rev.*, 126, 423.

GUAGLIARDO, M. F. 2004. Spatial accessibility of primary care: concepts, methods and challenges. *International journal of health geographics*, 3, 3.

GWILLIAM, K., FOSTER, V., ARCHONDO-CALLAO, R., BRICEÑO-GARMENDIA, C., NOGALES, A. & SETHI, K. 2008. The burden of maintenance: roads in sub-Saharan Africa. *AICD Background Paper*, 14.

HAJJ, H. & PENDAKUR, V. S. 2000. Roads improvement for poverty alleviation in China.

HALL, R. 2004. A political economy of land reform in South Africa. *Review of African Political Economy*, 31, 213-227.

HANCOCK, B., OCKLEFORD, E. & WINDRIDGE, K. 1998. *An introduction to qualitative research*, Trent focus group Nottingham.

HANCOCK, D. R. & ALGOZZINE, B. 2016. *Doing case study research: A practical guide for beginning researchers*, Teachers College Press.

HANOMAN, J. 2017. *Hunger and Poverty in South Africa: The Hidden Faces of Food Insecurity*, Routledge.

HEYNEMAN, S. P. & STERN, J. M. 2014. Low cost private schools for the poor: What public policy is appropriate? *International Journal of Educational Development*, 35, 3-15.

HOFFMANN, T., TODD, S., NTSHONA, Z. & TURNER, S. 2014. Land degradation in South Africa.

HORRELL, M. 1973. *The African Homelands of South Africa*, South African Institute of Race Relations.

HUSSEIN, K. 2002. Livelihoods approaches compared. *London, Department for International Development*.

HUSSEIN, K. & NELSON, J. 1998. Sustainable livelihoods and livelihood diversification.

HUSSEIN, K. & NELSON, J. 2016. *Sustainable livelihoods and livelihood diversification*.

INGELAERE, B., CHRISTIAENSEN, L., DE WEERDT, J. & KANBUR, R. 2017. Why secondary towns can be important for poverty reduction: a migrant's perspective.

JAKOVLJEVIC, M., POTAPCHIK, E., POPOVICH, L., BARIK, D. & GETZEN, T. E. 2017. Evolving health expenditure landscape of the BRICS nations and projections to 2025. *Health economics*, 26, 844-852.

JEDWAB, R. & STOREYGARD, A. 2017. Economic and Political Factors in Infrastructure Investment: Evidence from Railroads and Roads in Africa 1960–2015.

JENKINS, D. M. 1996. From apartheid to majority rule: A glimpse into South Africa's journey towards democracy. *Ariz. J. Int'l & Comp. L.*, 13, 463.

JONES, T. & PETTS, R. 1991. Maintenance of minor roads using the lengthman contractor system. *Transportation Research Record*.

KAISER, G. & SMALLWOOD, J. 2014. Towards a systems thinking approach in allocating infrastructure budgets in local government. *Journal of the South African Institution of Civil Engineering*, 56, 93-99.

KAMBLE, S. M. 2014. Participatory rural appraisal: a tool for inclusive growth and participatory development a case study of Village Marale, MS, India. *Int Res J Soc Sci*, 3, 48-50.

KARLAFTIS, M. G. & GOLIAS, I. 2002. Effects of road geometry and traffic volumes on rural roadway accident rates. *Accident Analysis & Prevention*, 34, 357-365.

KENNEDY, C., MILLER, E., SHALABY, A., MACLEAN, H. & COLEMAN, J. 2005. The four pillars of sustainable urban transportation. *Transport Reviews*, 25, 393-414.

KEPE, T. & TESSARO, D. 2014. Trading-off: Rural food security and land rights in South Africa. *Land Use Policy*, 36, 267-274.

KESSIDES, C. 2006. *The urban transition in Sub-Saharan Africa: Implications for economic growth and poverty reduction*, Cities Alliance Washington DC.

KHAN, Z. R., MIDEGA, C. A., PITTCHAR, J. O., MURAGE, A. W., BIRKETT, M. A., BRUCE, T. J. & PICKETT, J. A. 2014. Achieving food security for one million sub-Saharan African poor through push–pull innovation by 2020. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 369, 20120284.

KHANDKER, S. R. & SAMAD, H. A. 2016. Transformation of Rural Bangladesh: Role of Infrastructure and Financial Institutions.

KHATUN, D. & ROY, B. 2012. Rural Livelihood Diversification in West Bengal: Determinants and Constraints. *Agricultural Economics Research Review*, 25.

KOCH, J. 2011. The food security policy context in South Africa. Country Study, International Policy Centre for Inclusive Growth.

KON, Z. R. & LACKAN, N. 2008. Ethnic disparities in access to care in post-apartheid South Africa. *American Journal of Public Health*, 98, 2272-2277.

KORTEN, D. C. 1987. Third generation NGO strategies: A key to people-centered development. *World development*, 15, 145-159.

KOTHARI, C. R. 2004. *Research methodology: Methods and techniques*, New Age International.

KRAAK, A. 2004. *An overview of South African human resources development*, HSRC Press.

KURUKULASURIYA, P. & ROSENTHAL, S. 2013. Climate change and agriculture: A review of impacts and adaptations.

LABADARIOS, D., MCHIZA, Z. J.-R., STEYN, N. P., GERICKE, G., MAUNDER, E. M. W., DAVIDS, Y. D. & PARKER, W.-A. 2011. Food security in South Africa: a review of national surveys. *Bulletin of the World Health Organization,* 89, 891-899.

LAL, R., KRAYBILL, D., HANSEN, D. O., SINGH, B. R. & EIK, L. O. 2016. Research and development priorities. *Climate Change and Multi-Dimensional Sustainability in African Agriculture.* Springer.

LEHMACHER, W. 2017. Trade and the Global Supply Chain. *The Global Supply Chain.* Springer.

LESHORO, S. 2017. TIPS FORUM 2017.

LEWIS, M. & VERHOEVEN, M. 2010. Financial crises and social spending: The impact of the 2008-2009 crisis.

LINDLOF, T. R. & TAYLOR, B. C. 2017. *Qualitative communication research methods,* Sage publications.

LIPTON, M. 1974. White farming: A case study of change in South Africa. *Journal of Commonwealth & Comparative Politics,* 12, 42-61.

LIPTON, M. 1977. Why poor people stay poor: a study of urban bias in world development.

LIPTON, M. 1986. *Capitalism and Apartheid: South Africa, 1910-1986,* New Africa Books.

LOCKHEED, M. E. & VERSPOOR, A. M. 1991. *Improving primary education in developing countries,* Oxford University Press for World Bank.

LUCAS, K. 2011. Making the connections between transport disadvantage and the social exclusion of low income populations in the Tshwane Region of South Africa. *Journal of Transport Geography,* 19, 1320-1334.

LUCAS, K., VAN WEE, B. & MAAT, K. 2016. A method to evaluate equitable accessibility: combining ethical theories and accessibility-based approaches. *Transportation,* 43, 473-490.

MAGADZA, C. 1994. Climate change: some likely multiple impacts in Southern Africa. *Food Policy,* 19, 165-191.

MARSCHAN-PIEKKARI, R. & REIS, C. 2004. Language and languages in cross-cultural interviewing. *Handbook of qualitative research methods for international business,* 1, 224-244.

MAYER, M. J. & ALTMAN, M. 2005. South Africa's economic development trajectory: implications for skills development. *Journal of Education and Work,* 18, 33-56.

MAZIBUKO, S. 2013. Understanding underdevelopment through the sustainable livelihoods approach. *Community Development,* 44, 173-187.

MCCUTCHEON, R. 1995. Employment creation in public works: labour-intensive construction in sub-Saharan Africa: the implications for South Africa. *Habitat International,* 19, 331-355.

MCCUTCHEON, R. 2001. Employment generation in public works: recent South African experience. *Construction Management & Economics,* 19, 275-284.

MCDONAGH, J. 2006. Transport policy instruments and transport-related social exclusion in rural Republic of Ireland. *Journal of Transport Geography,* 14, 355-366.

MCCORD, A.G. 2002. Public works as a response to labour market failure in South Africa (Doctoral dissertation, University of Cape Town).

MINTEN, B. & KYLE, S. 1999. The effect of distance and road quality on food collection, marketing margins, and traders' wages: evidence from the former Zaire. *Journal of Development Economics,* 60, 467-495.

MISSELHORN, A. & HENDRIKS, S. L. 2017. A systematic review of sub-national food insecurity research in South Africa: Missed opportunities for policy insights. *PloS one,* 12, e0182399.

MØLLER, V. 1998. Quality of life in South Africa: Post-apartheid trends. *Social Indicators Research,* 43, 27-68.

MUBANGIZI, B. C. 2008. Responses to poverty in post-apartheid South Africa: some reflections. *International Journal of Social Welfare,* 17, 174-181.

MUBILA, M. & YEPES, T. 2017. Infrastructure and rural productivity in Africa. *Infrastructure in Africa: Lessons for Future Development*, 137.

MUSEKENE, E. N. 2013. The impact of a labour-intensive road construction programme in the Vhembe District, Limpopo Province. *Development Southern Africa*, *30*(3), pp.332-346.

MULKEEN, A. 2005. Teachers for rural schools: A challenge for Africa. Africa region World Bank. Washington, DC: World Bank.

MUNICIPALITY, D. 2013. FINAL INTEGRATED DEVELOPMENT PLAN (IDP). *IDP),* 2013.

MWANGOME, M. N., GEUBBELS, E., KLATSER, P. & DIELEMAN, M. 2016. "I don't have options but to persevere." Experiences and practices of care for HIV and diabetes in rural Tanzania: a qualitative study of patients and family caregivers. *International journal for equity in health,* 15, 56.

NARAYANASAMY, N. 2009. *Participatory rural appraisal: Principles, methods and application*, SAGE Publications India.

NCUBE, K., SHACKLETON, C. M., SWALLOW, B. M. & DASSANAYAKE, W. 2016. Impacts of HIV/AIDS on food consumption and wild food use in rural South Africa. *Food Security,* 8, 1135-1151.

NGAMLANA, P. X. 2009. Improving public-private partnership deal flow for infrastructure delivery in South Africa*: the role of National Treasury*. Stellenbosch: University of Stellenbosch.

NGEBULANA, M.R. 2008. Evaluation of labour-intensive construction projects in Madibeng municipality, North-West Province, *South Africa* (Doctoral dissertation).

NGUBANE, B. O. S. 2011. An Implementation Analysis of the Zibambele Road Maintenance Programme in the KwaZulu-Natal Department of Transport. Citeseer.

NKOMO, S.L. DESAI, S. & PEERBHAY, K. 2016. Assessing the conditions of rural road networks in South Africa using visual observations and field-based manual measurements: A case study of four rural communities in Kwa-Zulu Natal. *Review of Social Sciences,* 1, 42-55.

NTETA, T. P., MOKGATLE-NTHABU, M. & OGUNTIBEJU, O. O. 2010. Utilization of the primary health care services in the Tshwane Region of Gauteng Province, South Africa. *PloS one,* 5, e13909.

OBENG-ODOOM, F. 2012. Land reforms in Africa: Theory, practice, and outcome. *Habitat international,* 36, 161-170.

ODHIAMBO, O., ASHIPALA, J. & MUBIANA, F. 2015. Are public works programmes effective in reinforcing social protection systems? Evidence from Northern Namibia. *Working Paper, International Policy Centre for Inclusive Growth.*

OOSTHUIZEN, M. & BHORAT, H. 2005. *The post-apartheid South African labour market*, Development Policy Research Unit.

OPDENAKKER, R. Advantages and disadvantages of four interview techniques in qualitative research. Forum Qualitative Sozialforschung/Forum: Qualitative Social Research, 2006.

OPPENHEIM, A. N. 1992. *Questionnaire design, interviewing and attitude measurement*, Bloomsbury Publishing.

ORGANIZATION, W. H. 2003. Primary health care: 25 years after ALMA-ATA.

PAIGE-GREEN, P. 2006. Appropriate roads for rural access. Third Gulf Conference on Roads (TGCR06), March 6-8.

PALINKAS, L. A., HORWITZ, S. M., GREEN, C. A., WISDOM, J. P., DUAN, N. & HOAGWOOD, K. 2015. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research,* 42, 533-544.

PATTON, M. Q. 2005. *Qualitative research,* Wiley Online Library.

PEARCE, J., WITTEN, K. & BARTIE, P. 2006. Neighbourhoods and health: a GIS approach to measuring community resource accessibility. *Journal of epidemiology and community health,* 60, 389-395.

PEET, R. 2002. Ideology, discourse, and the geography of hegemony: From socialist to neoliberal development in postapartheid South Africa. *Antipode,* 34, 54-84.

PENCHANSKY, R. & THOMAS, J. W. 1981. The concept of access: definition and relationship to consumer satisfaction. *Medical care,* 127-140.

PÉREZ-CUEVAS, R., GUANAIS, F. C., DOUBOVA, S. V., PINZÓN, L., TEJERINA, L., PINTO MASIS, D., ROCHA, M., HARRIS, D. O. & MACINKO, J. 2017. Understanding public perception of the need for major change in Latin American healthcare systems. *Health Policy and Planning,* 32, 816-824.

PERRET, S. R. 2001. Poverty and diversity of livelihood systems in post-apartheid rural South Africa: Insights into local levels in the Eastern Cape Province. *Pretoria: Department of Agricultural Economics, Extension and Rural Development, University of Pretoria*.

PETERS, D. H., GARG, A., BLOOM, G., WALKER, D. G., BRIEGER, W. R. & HAFIZUR RAHMAN, M. 2008. Poverty and access to health care in developing countries. *Annals of the New York Academy of Sciences,* 1136, 161-171.

PHILLIPS, S. The Expanded Public Works Programme (EPWP). Presentation to the Conference on Overcoming Under-Development in South Africa's Second Economy, Pretoria, 2004.

PHIRI, M. Z. 2017. Comparative Perspectives on South Africa's and Brazil's Institutional Inequalities under Progressive Social Policies. *Journal of Southern African Studies,* 1-18.

PIENAAR, K. 2017. Rethinking the poverty-disease nexus: the case of HIV/AIDS in South Africa. *Journal of Medical Humanities,* 38, 249-266.

PORTER, G. 2002. Living in a walking world: rural mobility and social equity issues in sub-Saharan Africa. *World development,* 30, 285-300.

PORTER, G. 2014. Transport services and their impact on poverty and growth in rural sub-Saharan Africa: A review of recent research and future research needs. *Transport reviews,* 34, 25-45.

POULTON, C., KYDD, J. & DORWARD, A. 2006. Overcoming market constraints on pro-poor agricultural growth in Sub-Saharan Africa. *Development policy review,* 24, 243-277.

PRONYK, P., MAKHUBELE, M., HARGREAVES, J., TOLLMAN, S. & HAUSLER, H. 2001. Assessing health seeking behaviour among tuberculosis patients in rural South Africa. *The International Journal of Tuberculosis and Lung Disease,* 5, 619-627.

PURCHASE, R.B. 2010. Perceptions of poverty: eThekwini. *IMIESA, 35*(8), pp.38-41.

PUCHER, J., PENG, Z. R., MITTAL, N., ZHU, Y. & KORATTYSWAROOPAM, N. 2007. Urban transport trends and policies in China and India: impacts of rapid economic growth. *Transport Reviews,* 27, 379-410.

QIN, Y. & ZHANG, X. 2016. The road to specialization in agricultural production: Evidence from rural China. *World Development,* 77, 1-16.

REDDY, V., BHORAT, H., POWELL, M., VISSER, M. & ARENDS, F. 2016. Skills supply and demand in South Africa.

REGAN, S. & WONG, S. T. 2009. *Patient perspectives on primary health care in rural communities: effects of geography on access, continuity and efficiency.* University of British Columbia.

RODRIGUE, J.-P., COMTOIS, C. & SLACK, B. 2009. *The geography of transport systems,* Routledge.

RODRIGUE, J.-P., COMTOIS, C. & SLACK, B. 2016. *The geography of transport systems,* Taylor & Francis.

ROGERSON, C. M. 2017. *Geography and Economy in South Africa and its Neighbours,* Routledge.

ROSE, K. 1994. Unstructured and semi-structured interviewing. *Nurse Researcher,* 1, 23-30.

ROTHERAM-BORUS, M. J., TOMLINSON, M., SCHEFFLER, A., HARRIS, D. M. & NELSON, S. 2017. Adjustment of a Population of South African Children of Mothers Living With/and Without HIV Through Three Years Post-Birth. *AIDS and Behavior,* 21, 1601-1610.

SAGHIR, J. 2017. Sustainable Infrastructure Development in Sub Saharan Africa: A View from the Ground.

SAHOO, P., DASH, R. K. & NATARAJ, G. 2012. China's growth story: The role of physical and social infrastructure. *Journal of Economic Development,* 37, 53.

SALLING, K. B. & PRYN, M. R. 2015. Sustainable transport project evaluation and decision support: indicators and planning criteria for sustainable development. *International Journal of Sustainable Development & World Ecology,* 22, 346-357.

SANA, M., STECKLOV, G. & WEINREB, A. A. 2016. A test of the stranger-interviewer norm in the Dominican Republic. *Population studies,* 70, 73-92.

SCHNEIDER, H., HLOPHE, H. & VAN RENSBURG, D. 2008. Community health workers and the response to HIV/AIDS in South Africa: tensions and prospects. *Health policy and Planning,* 23, 179-187.

SCOONES, I., THOMPSON, J. & CHAMBERS, R. 2009. Farmer first revisited. *Rugby: Practical Action*.

SENDER, J. 2016. Backward capitalism in rural South Africa: Prospects for accelerating accumulation in the Eastern Cape. *Journal of agrarian change,* 16, 3-31.

SENDER, J. & JOHNSTON, D. 2004. Searching for a weapon of mass production in rural Africa: Unconvincing arguments for land reform. *Journal of Agrarian Change,* 4, 142-164.

SEWELL, S. J. & DESAI, S. 2016. The Impacts of Undeveloped Roads on the Livelihoods of Rural Women. *Review of Social Sciences,* 1, 15-29.

SHAY, E., COMBS, T. S., FINDLEY, D., KOLOSNA, C., MADELEY, M. & SALVESEN, D. 2016. Identifying transportation disadvantage: Mixed-methods analysis combining GIS mapping with qualitative data. *Transport Policy,* 48, 129-138.

SIEBER, N. & ALLEN, H. 2016. Impacts of rural roads on poverty and equity. *Transport and Communications Bulletin for Asia and the Pacific*, 23.

SISK, T. 2017. *Democratization in South Africa: The elusive social contract*, Princeton University Press.

SKORSETH, K., SELIM, A. A. & LTAP, J. P. O. 2000. Gravel roads maintenance and design manual.

SOLTANI, A., SANKHAYAN, P. L., HOFSTAD, O., ESHRAGHI, F. & ARABMAZAR, A. 2017. Consequences of an Improved Road Network in Rural Iran: Does it Lead to Better Livelihoods and Forest Protection? *Small-scale Forestry,* 16, 347-365.

SOWMAN, M., SUNDE, J., RAEMAEKERS, S. & SCHULTZ, O. 2014. Fishing for equality: Policy for poverty alleviation for South Africa's small-scale fisheries. *Marine Policy,* 46, 31-42.

STARKEY, P. 2002. Improving rural mobility: options for developing motorized and nonmotorized transport in rural areas, *World Bank Publications.*

STORM, S. & ISAACS, G. 2016. Modelling the impact of a national minimum wage in South Africa: Are general equilibrium models fit for purpose? : University of the Witwatersrand, Johannesburg: CSID, Research Brief.

SULLIVAN, L., RYSER, L. & HALSETH, G. 2015. Recognizing change, recognizing rural: The new rural economy and towards a new model of rural service. *Journal of Rural and Community Development,* 9.

TANSER, F., GIJSBERTSEN, B. & HERBST, K. 2006. Modelling and understanding primary health care accessibility and utilization in rural South Africa: an exploration using a geographical information system. *Social science & medicine,* 63, 691-705.

TERAVANINTHORN, S. & RABALLAND, G. 2009. *Transport prices and costs in Africa: a review of the main international corridors*, World Bank Publications.

THOMAS, S., WAKERMAN, J., HUMPHREYS, J. & HUMPHREYS, S. T. J. W. J. 2017. What does it cost to provide equity of access to high quality, comprehensive primary health care in rural Australia? A pilot study. *Rural and Remote Health,* 17.

THORBECKE, E. & CHARUMILIND, C. 2002. Economic inequality and its socioeconomic impact. *World Development,* 30, 1477-1495.

TIBESIGWA, B. & VISSER, M. 2016. Assessing gender inequality in food security among small-holder farm households in urban and rural South Africa. *World Development,* 88, 33-49.

TODES, A. & TUROK, I. 2017. Spatial inequalities and policies in South Africa: Place-based or people-centred? *Progress in Planning*.

TREASURY, N. & MANUEL, T. A. 2006. *Budget Speech, 2005,* National Treasury Pretoria.

VAISMORADI, M., TURUNEN, H. & BONDAS, T. 2013. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & health sciences,* 15, 398-405.

VAN BERKUM, S., ACHTERBOSCH, T., LINDERHOF, V., GODESCHALK, F. & VROEGE, W. 2017. Dynamics of food systems in Sub-Saharan Africa. Wageningen Economic Research.

VAN DE WALLE, D. 2002. Choosing rural road investments to help reduce poverty. *World Development,* 30, 575-589.

VAN DONK, M. 2008. *Consolidating developmental local government: lessons from the South African experience*, Juta and Company Ltd.

VAN KESSEL, I. & OOMEN, B. 1997. 'One chief, one vote': The revival of traditional authorities in post-apartheid South Africa. *African Affairs,* 96, 561-585.

VAN RENSBURG, H. C. 2014. South Africa's protracted struggle for equal distribution and equitable access–still not there. *Human resources for health,* 12, 26.

VENKATESH, V., RAI, A., SYKES, T. A. & ALJAFARI, R. 2016. Combating Infant Mortality in Rural India: Evidence from a Field Study of eHealth Kiosk Imlementations. *Mis Quarterly,* 40, 353-380.

VOLMINK, J. & VAN DER ELST, L. 2017. The evolving role of 21st Century Education NGOs in South Africa: Challenges and Opportunities.

VON BRAUN, J. 2007. *The world food situtation: new driving forces and required actions*, Intl Food Policy Res Inst.

WALSH, C. M. & VAN ROOYEN, F. C. 2015. Household food security and hunger in rural and urban communities in the Free State Province, South Africa. *Ecology of food and nutrition,* 54, 118-137.

WANG, Z., WANG, Z., SUN, S. & SUN, S. 2016. Transportation infrastructure and rural development in China. *China Agricultural Economic Review,* 8, 516-525.

WILKINSON, A., PETTIFOR, A., ROSENBERG, M., HALPERN, C. T., THIRUMURTHY, H., COLLINSON, M. A. & KAHN, K. 2017. The employment environment for youth in rural South Africa: A mixed-methods study. *Development Southern Africa,* 34, 17-32.

WOOLARD, I. 2002. An overview of poverty and inequality in South Africa. *Unpublished briefing paper, HSRC, Pretoria*.

YARO, J. A. 2006. Is deagrarianisation real? A study of livelihood activities in rural northern Ghana. *The Journal of Modern African Studies,* 44, 125-156.

YU, N., DE ROO, G., DE JONG, M. & STORM, S. 2016. Does the expansion of a motorway network lead to economic agglomeration? Evidence from China. *Transport Policy,* 45, 218-227.

ZANTSI, S. 2016. *The influence of aspirations on changing livelihood strategies in rural households of Ndabakazi villages in the Eastern Cape.* University of Fort Hare.

ZHUO, L., MEKONNEN, M. M. & HOEKSTRA, A. Y. 2016. The effect of inter-annual variability of consumption, production, trade and climate on crop-related green and blue water footprints and inter-regional virtual water trade: A study for China (1978–2008). *Water research,* 94, 73-85.

CHAPTER SIX

SYNTHESIS

6.1. Introduction

The overall intention of the study was to assess the condition of unpaved rural road networks and the associated socio-economic implications on the livelihoods of rural communities within the province of KwaZulu-Natal. Due to the complex nature of the research in question, a multidisciplinary approach was adopted in order to understand the aim of this study. Hence, the objectives of this study were:

- To assess the physical conditions of the gravel road networks in rural communities with the purpose to understand the physical, environmental and anthropogenic factors that influence the state of rural roads.
- To assess the surface material quality of unpaved rural roads to understand susceptibility to surface deterioration.
- To analyse the local respondents' perceptions on the socioeconomic role of unpaved road networks on rural livelihoods.
- To assess the effectiveness of Community Based Road Management Strategies on unpaved road networks.
- To provide recommendations for improving road networks in rural communities.

6.1.1. An assessment of unpaved rural road network conditions

The socioeconomic role of unpaved road networks on rural livelihoods would not be completely understood without the assessment of the physical road conditions. The first objective of this study therefore forms the foundation for the research in question. In this chapter, road assessments were conducted using visual observations and field-based measurements in order to establish the impact of physical, environmental and anthropogenic factors on the road classes (R3, R4 and R5) selected for this study. The function of the road classes selected for this study is very important for rural mobility because they provide access from homesteads to main tarred roads that connect rural area to towns. The study used two classifications methods to identify, assess and rate the severity and extent of surface distresses on the selected road classes and as well, as determine the drainage conditions. The overall findings of this display that unpaved road surface conditions on the selected road classes were

more deteriorated in Mkhunya and Mhlwazini communities by comparison to Emazabekweni and Dukuza communities. Drainage conditions were generally poor across all the road classes, with the exception of the R3 road class in Emazabekweni community. It was also noted in this study that traffic movement was directly affected by the level of surface deterioration across all the road classes. For example road classes in Mkhunya and Mhlwazini communities had less traffic movement in comparison to road classes in Emazabekweni and Dukuza communities. In conclusion, this chapter was able to successfully assess the conditions of unpaved road networks on the selected road classes. The identified and assessed surface distresses indicated that the road networks reflected the need for proper drainage systems and regular maintenance. Therefore, proper drainage systems and regular maintenance is recommended. While this study was able to adopt user-friendly and cost-effective methods to assess the physical conditions of rural road networks, explicit investigations are required to aid with the quality of observations. Future research should focus on assessing the impact of road designs, landscape characteristics, and the quality of road materials used and associated costs of maintenance.

6.1.2. Assessing factors that cause surface deterioration on unpaved roads

The first chapter concludes that the overall conditions of unpaved road networks, selected in the communities under study were deteriorated, and recommended for the need to investigate their causes. This chapter therefore aimed to assess the surface material quality on the road classes selected for this study in order to understand susceptibility to surface deterioration. Soil samples were collected from R3, R4, and R5 road classes in the communities under study. Thereafter, laboratory analyses were conducted in order to determine the performance of the material as potential wearing course. Material performance was then determined using the Standard Methods of Testing Road Construction Materials (TMH 1:1976) classification method. The overall findings of this chapter have shown that material selection remains a common problem in most unpaved rural road networks. In this study, most of the road networks assessed have poor material quality, thus making them vulnerable to increased surface deterioration and maintenance costs. Although the level of surface deterioration was not assessed in this study, the results obtained suggest that material quality has the potential to affect the nature (rate and extent) of surface deterioration on unpaved road networks. For example, erodibility, dustiness, slipperiness and the formation of ravels and corrugations are

factors, which are indicative of surface deterioration as a of result poor material quality, and other external factors.

Furthermore, this chapter was also able to establish that natural factors such as terrain and rainfall conditions could also play an important role on the nature of surface deterioration of unpaved road networks. Good material selection is therefore a prerequisite to reducing the contribution of the natural variables on surface deterioration of unpaved road networks. Overall, this study provided a framework for assessing road conditions of rural networks and their potential risk to slope and rainfall variabilities. The results of this chapter could be improved by investigating and incorporating original areas where the material used for the construction of road classes were selected.

6.1.3. Evaluating rural people's perceptions on the socioeconomic role of road networks on their livelihoods

The first two chapters provided the important analysis that was required to understand the physical nature of road conditions in the communities under study. This chapter therefore assessed local respondent's perceptions on the socioeconomic role of unpaved road networks on their livelihoods. Quantitative and qualitative research methods were used to thematically analyse four research themes in terms of the role of rural road networks on rural agriculture production, access to health services, access to education services and markets, information and employment opportunities. Overall, the findings of this chapter show that local respondent's perceptions on the socioeconomic role of unpaved road networks on their livelihoods are influenced by the effectiveness of their roads in servicing their needs. For example, respondents from Mkhunya and Mhlwazini communities stated that an improvement in their road conditions would benefit their access to health, education and markets rather than their agricultural sector. The agriculture sector in these communities is not a priority since people are located on mountainous terrain that do not favour agricultural growth. Current debates around quantifying the benefits received from transport infrastructure investments tend to overlook the potential contributions that natural (such as climaticconditions, terrain amongst others) and physical assets can have on livelihoods. A favourable understanding of the contribution of these assets is crucial for effective assessment and management of unpaved rural roads. This chapter recommends that community based road management strategies should be implemented throughout rural communities in South Africa in order to aid with the maintenance of unpaved rural roads. Furthermore, government institutions and other rural

investors must consult rural communities before introducing development initiatives. The lack of public participation in decision-making hinders anticipated benefits. Due to a number of factors outlined above, this chapter can conclude that in the four communities assessed in this study, less than ten percent of all the respondents perceived direct economic spinoffs as a results of road network improvements. Majority of the respondents perceived social spinoffs such as improving access to healthcare, education and market services.

6.1.4. Assessing community based road management strategies used for maintaining unpaved rural roads

After determining the conditions of unpaved road networks and as well as obtaining local respondent's perceptions on the socioeconomic role of these networks on their livelihoods, the next study objective was to identify and assess the effectiveness of using CBRMS. This chapter therefore, identified and assessed some of the CBRMS used to maintain unpaved road networks on the south-eastern parts of KwaZulu-Natal province. In so doing, a total of 432 km of unpaved road networks were traversed in randomly selected rural communities and a sum of 28 groups of contractors, employed by the Zibambele Road Maintenance System were identified while performing routine maintenance over specified road lengths. The effectiveness of the Zibambele maintenance programme was assessed based on road surfaces and roadside drainage conditions. Maintenance effectiveness was assessed based on a scale of one, which means poor performance, to four depicting successful performance. Overall, the findings of this chapter show that Community Based Road Management Strategies such as the Zibambele Road Maintenance programme provides an alternative approach that is useful and can be effective on the maintenance of unpaved rural road networks. The major criticism for CBRMS is that they lack sufficient prioritisation of personnel training and this justification was observed during the assessment of the Zibambele maintenance programme on the selected road lengths. The overall findings of chapter show that the Zibambele Road Maintenance programme is a good initiative for maintenance of rural roads and if proper training requirements are provided to personnel, the effectiveness of the programme will yield better results. In addition, the study further established that the effectiveness of the Zibambele Road Maintenance programme on road maintenance is also determined by a number of factors such as road design and construction techniques amongst others. This chapter recommends for prioritisation of personnel training in order to ensure effectiveness on the maintenance services rendered under the programme. Although this research is useful in providing lessons learnt from using the

Zibambele Road Maintenance programme on selected road lengths on south-eastern parts of KwaZulu-Natal, future research needs to focus on developing simple maintenance specification for the different environmental conditions in the province.

6.1.5. Conclusion

The assessed communities were strategically selected within the province of KwaZulu-Natal in order to accommodate for factors such as community location and as well as geographic differences. The findings show that community proximity to town biasedly determined amongst others, quality of unpaved roads, access to services and as well as the availability of opportunities for income diversification. In this study, the communities that are located close to town had better quality road access in comparison to communities that are further away from towns. Similarly, these communities had better services and access to services in comparison to communities that are further away from towns. The old famous phrase, "*out of sight out of mind"* sums up some of the social and physical disparities that were related to spatial location of the communities. The urban bias framework adopted in this study, aided with the assessment and understanding of possible inequalities that are associated with community location. The urban bias theory argues that, based on location, rural communities and inhabitants may be subjected to political, economic and physical biasness. The unequal distribution of social assets and as well as the quality of roads in the communities under study validated some of the spatial injustice which form part of the argument presented in the urban bias theory. The findings of this study highlight some of the socioeconomic contemporary challenges that are facing rural areas in South Africa. Hence, the findings of this study could be used to reassess some of the primary challenges affecting rural economic growth and as well as social stability. The multidisciplinary approach used to achieve the research aim of this study could help rural developers and government authorities to formulate better pathways for assessing and understanding complex problems and situations in rural areas. The multidisciplinary approach is effective because it eliminates one-sided views in favour of holistic ideas.

6.1.6. Recommendations and the need for further research

The findings of this study have shown that there is a need for extensive research in rural areas in South Africa. Even though, by definition rural areas are categorised by the same characteristics, this study recommends that their assessment needs to be area specific. Rural developers, donors and government authorities very often fail to recognise that there are no "*one size fits all"* solutions when dealing with rural problems. For example, one would naively assume that an improvement in road conditions in all the communities under study would, by the same standard produce similar outcomes in terms of socioeconomic benefits. However, the findings of this study show that, the same outcomes will not be easily achievable if factors such as amongst others geographical characteristics, and community location are not the same. Hence, the study recommends that rural research should be area specific in order to effectively assess and address complex problems such as the one unpacked in this research.

The findings of this study also recommend that community participation in rural development initiatives should be prioritised. For example, the Agri-park programme that is currently being established across district municipalities in South Africa will only be successful in communities (Emazabekweni) that are favourable for agriculture and not so much in communities such as Mhlwazini, Dukuza and Mkhunya. In these three communities, more than 90 percent of the respondents perceived agriculture as a "no" go opportunity, due to their unfavourable conditions. Hence, the intended socioeconomic spinoffs from the programme will subjectively benefit selective communities. Similarly, differences in road quality and access conditions will further determine the anticipated socioeconomic outcomes of the programme. It is on this basis that the study recommends that community participation should be prioritised.

In conclusion, this study recommends that CBRMS such as the Zibambele Road Maintenance System should be utilised in performing routine maintenance of unpaved road networks in all the communities within KwaZulu-Natal. This programme is relatively cheap to maintain (uses local labour and limited resource) in comparison to using machinery. In addition, this programme could also be very effective for routine maintenance if the personnel are provided with sufficient training. CBRMS are recommended for the maintenance of unpaved roads because the rate and extent of surface deterioration on unpaved roads could be determined by a storm event. Hence, having CBRMS becomes an important asset for reducing major deterioration because of the use of local labour rather than waiting for assistance from road authorities who may delay the process.

The following recommendations are also suggested for future research:

- Future research must collect data from a larger sample size of rural communities – sounds in order to obtain results that cover a large population area. Perhaps do a cross assessment of different rural areas within different provinces in South Africa.
- Future research must develop a better method of assessing the conditions of unpaved road networks in order to aid with accurately evaluating their state, by incorporating road design and construction techniques used and as well as the providing data on the frequency of routine maintenance.
- Future research should include diverse themes in order to holistically assess the impacts of roads on rural livelihoods.

APPENDIXES

Appendix 1

NB: Participants are free to withdraw from the research at any time without any negative or undesirable consequences to themselves.

Understanding the role of unpaved road networks on the socioeconomic of rural livelihoods: A case study of four rural communities

Community survey

Community name: _____

Municipality: _____

Section A: Demographic profile of respondents

A1.Gender

1. Male	2. Female

A2. Age (in years)

1. 10-17	
2. 18-21	
3. 22-30	
4. 30-40	
5. 41-50	
6. 51-60	
7. >60	

A3. How many persons currently reside in your household?

0	1	2	3	4	5	6	7	8	9	10	>10

A4. How long have you been living here for?

1. 10-5 years	
2. 6-10 years	

3. 11-15 years	
4. 16-25 years	
5. 26-30 years	
6. >30	

A5. Why have you settled in this community?

7. Born	
8. Allocated (without a choice)	
9. Migrated (out of choice)	
10. If other, specify	

A6.What is your employment status?

11. Employed	
12. Unemployed	
13. Self-employed	
14. Retired	
15. Medically boarded	
16. Student	
17. If other, specify	

A7. Marital status

1. Currently married	
2. Single	
3. Widowed	
4. Separated	

5. If other, specify	

Section B: Background information of households

B1. Main source of monthly income

Sources	Amount in Rands
1. Pensions	
2. Remittances	
3. Wages	
4. Informal income	
5. Farm-harvest	
6. Disability grants	
7. Other state of grants (specify)	

B2. Does your household own any land?

1.Yes	2. No

B3. Does your household have access to land for the following?

	1. Yes	2. No
Grazing		
Cultivation		

B4. How would you rate the adequacy of land for the following use?

	1. Poor	2. Satisfactory	3. Good	4. Excellent
Land				
Grazing				
Cultivation				

Section C: To understand the implications of rural roads on health conditions

C1. What primary healthcare facility is available to you in your community?

18. Hospital	
19. Clinic	
20. Mobile clinic	
21. Private practice	
22. Traditional healers	
23. If other, specify	

C2. How long do you have to travel to access your primary healthcare facility?

24. 0-30m	
25. 30-60m	
26. 60m+	
27. If other, specify	

C3. What mode of transport do you use to access your primary healthcare facility?

28. Walk	
29. Public transport	
30. Private transport	
31. If other, specify	

C4. In your pursuit to access your primary healthcare facility, any challenges you can identify that are related to the nature of the roads you use

32. Distanced travelled is too far	
33. Cost of transport is too much	
34. Our roads are in bad conditions	
35. If other, specify	

C5. What do you think could be done to reduce the impact of the roads on your challenges?

36. A clinic must be built in your community	
37. Relocating the clinic to ensure that every household can access easily	
38. Improving the state of our roads	
39. Decreasing transport cost	
40. If other, specify	

C6. Do you suffer from a long-term illness?

1 Yes	2. No

C7. If yes, how often do you travel to collect your treatment/medication?

41. Daily	
42. Weekly	
43. Monthly	

44. If other, specify	

C8. Do you think your primary healthcare facility is accessible and available during times of emergency?

1. Yes	2. No

C9. If not, what challenges related to the nature of your roads contribute to your response?

45. The distance is too far to travel by foot under such circumstances	
46. Transport is not easily available	
47. Transport costs are too expensive	
48. The roads are difficult to travel at an emergency speed	
49. If other, specify	

Section D: Assessing the impact of road networks on the agricultural sector in rural livelihoods

D1. Do you think your household has a large area enough for farming?

1. Yes	2. No

D2. Does your household farm?

1. Yes	2. No

D3. If yes, which of the following produce do you plant?

1. Spinach	
2. Sweet potatoes	
3. Potatoes	
4. Mealies	
5. Lettuce	
6. Carrots	
7. Cabbages	
8. Beans	
9. Onions	
10. Pumpkins	
11. Amadumbe	
12. If other, specify	

D4. If no, what stops your household from planting?

1. Landscape is poor	
2. Poor or rocky soils	
3. Lack of water for irrigation	
4. Lack of funds to buy seedlings	

5. No physical strength or labour	
6. Cannot afford to buy fencing equipment to prevent livestock damages	
7. If other specify	

D5. What is done with the produce after harvesting?

1. Used for family consumption	
2. Sell	
3. Only sell if there is a surplus	
4. Trade with neighbours non-financial benefits	
5. If other, specify	

D6. Who do you sell your produce to?

1. Members of the community	
2. Private buyers from outside the community	
3. Farmers market by the nearest town	
4. If other, specify	

D7. How do you deliver your produce to your suppliers outside of you community?

1. Public transport	
2. Private transport	
3. Buyers come and collect	
4. If other, specify	

D8. How much money do you make after selling your produce seasonally?

1. R0-1000	
2. R1000-5000	
3. R5000-10000	
4. R10000 and more	

D9. What are the farming challenges affecting your produce?

1. Lack of farming equipment	
2. Lack of fertilizers	
3. Unable to cope when there is a spread of diseases, droughts and floods	
4. Livestock damaging produce	
5. Poor soils	
6. Poor landscape	
7. Limited farming space	
8. Shortage of water for irrigation	
9. Shortage of labour	
10. Limited farming knowledge	
11. If other, specify	

D10. Which of the following challenges associated with the nature of your roads can you say affects your ability to sell your produce outside your community?

1. Lack of own transport, making it very difficult to sell produce outside the community	

2. Poor roads, making it very difficult for customers to access my produce	
3. Distance to the nearest town is too far to travel hence, costly	
4. If other, specify	

Section E: Understanding the role of roads on rural education

NB: (Adults or those out of school)

E1. What is you highest level of education?

1. Never attended school	
2. Primary school	
3. Dropped out in secondary school	
4. Completed secondary school	
5. Adult based education	
6. Tertiary education	
7. If other, specify	

E3. How did you travel to school?

1. Walked	
2. Public transport	
3. Private transport	
4. If other, specify	

E4. How long did it take you to get to school?

1. 0-30m	
2. 30-60m	
3. 60m+	

E5. What time did you have to wake-up to prepare for school?

1. 4-5am	
2. 5-6am	
3. 6-7am	

E6. Which of the following contributed to the time you woke-up to prepare for school?

1. Morning chores associated with the living conditions	
2. Distance walked to school	
3. Transport schedule	
4. If other, specify	

E7. If your answer in **E1** is **1**, what prevented you from attending school?

1. My parents did not have money to pay for my schooling (fees, uniforms, books etc.)	
2. My parents did not have money to pay for my transport to school	
3. I have disabilities	
4. If other, specify	

E8. If your answer in **E1** is **2**, why did you stop in primary school?

1. I had learning difficulties	
2. No secondary school in my community, so the distance and travelling cost were too much	
3. If other, specify	

E9. If your answer in **E1** is **3**, why did you dropout in secondary school?

1. I had learning difficulties	
2. No secondary school in my community, so the distance and travelling cost were too much	
3. If other, specify	

NB: For pupils who are still schooling

E10. Are you in primary [ ] or secondary [ ] school?

E11. Is the primary school that you are attending in your community?

1. Yes	2. No

E12. Is the secondary school that you are attending in your community?

1. Yes	2. No

E13. How do you travel to school?

1. Walk	
2. Public transport	

3. Private transport	
4. If other, specify	

E14. How long does it take you to get to school?

1. 0-30m	
2. 30-60m	
3. 60m+	

E15. What time do you have to wake-up to prepare for school?

4. 4-5am	
5. 5-6am	
6. 6-7am	

E16. Which of the following contributes to the time you wake-up to prepare for school?

1. Morning chores associated with the living conditions	
2. Distance walked to school	
3. Transport schedule	
4. If other, specify	

E17. What is your monthly transport cost?

1. R0-100	
2. R100-200	
3. R200-300	

4. R300 and more	

Section F: Assessing the role of road networks on access to markets, information and employment opportunities

Access to markets and Information

F1. Where do you go to for your domestic errands (grocery shopping etc.)?

1. Local supermarket	
2. Town	
3. City	
4. If other, explain	

F2. How far is the place where you go to for your domestic errands?

4. 0-30m	
5. 30-60m	
6. 60m+	

F3. How do you travel to the place?

1. Walk	
2. Public transport	
3. Private transport	
4. If other, specify	

F4. How much does it cost to travel to the place?

1. R0-50	
2. R50-100	
3. R100 and more	

F5. How often do you travel to this destination for your domestic errands?

1. Daily	
2. Weekly	
3. Monthly	
4. If other, specify	

F6. Which of the following problems contribute to your challenges in accessing markets?

1. Transport cost	
2. Long distance to walk from the main road to dwellings carrying items	
3. Roads are in bad conditions making it difficult for vehicles	
4. If other, specify	

F7. What is your main source of information (agricultural, educational, political etc.)?

1. Radio	
2. Television	
3. Newspapers	
4. Library	
5. Extension officers	

6. If other, specify	

Employment opportunities

F8. If you are employed, where do you work?

1. Within community	
2. Town	
3. City	
4. If other, specify	

F9. How often do you travel home?

50. Daily	
51. Weekly	
52. Monthly	
53. If other, specify	

F10. If your answer is not daily, what factors associated with the nature of your roads contribute to you staying away from home?

1. Distance to my work place is too far	

2. Transport costs are too much	
3. Transport is too scarce	
4. If other, specify	

Section 1: assessing the perceptions of the general public

NB: in each question consider the past, present and future

1.1 What do you think about the state of your roads from your household to the main roads (accessibility, reliability, maintenance)?

1.2. What can you say about your primary healthcare facility (accessibility, availability, reliability)?

1.3. What are your perceptions on the agricultural sector in your community (climate conditions, landscape, soil quality, access to markets)?

1.4. What do you think about access to education in your community (challenges, accessibility, reliability, availability)?

1.5. What can you say about access to information, markets and employment opportunities in your community (accessibility, reliability, availability, extension officers, marketing)?

Section 2: Assessing the perceptions of school children

2.1 Are you in primary ☐ or secondary ☐ school?

2.1. How do you feel about going to school (challenges, distance, and possible changes)?

APPENDIX 2: INFORMED CONSENT FORM

S'phumelele Lucky Nkomo
University of KwaZulu-Natal
School of Agriculture, Earth and Environmental Science
Faculty of Science, Agriculture and Engineering,
Private Bag X01,
Scottsville, 3209, South Africa

To whom it may concern

I am undertaking a PhD in Geography, at the University of KwaZulu-Natal, Pietermaritzburg Campus, South Africa. As part of this course, I am undertaking research that seeks to examine the role of road networks in understanding the socioeconomic standards of rural communities. As part of my research, I will conduct interviews with community members from different households. The interviews will assess the nature of services delivery in each community. The information provided will be invaluable to my research.

I would like to assure you of the confidentiality and anonymity you will receive if you agree to take part in this research. The University of KwaZulu-Natal has an ethical code that all students are obliged to follow when undertaking research. I would also like to assure you that as a participant you have the right to withdraw from the research process at any stage, there is no payment to the participants since it is a voluntary exercise. Data will be stored in secure storage and destroyed after the completion of this research.

If you are willing to be interviewed, please indicate (by ticking as applicable) whether or not you are willing to allow the interview to be recorded by the following equipment:

	willing	Not willing
Audio equipment		
Photographic equipment		

I sincerely hope you will be able to help me with this project and I would also like to offer you the opportunity of receiving a summary of the report once it is completed.

If you require any further information, please contact me

Email: sphumelelesn@gmail.com

Cell: 072 4262589

Or my supervisors or the HRSC University Section

Contacts Details

HRSC

Prem Mohum (Mr)

University of KwaZulu-Natal

Research Office: Ethics

Govan Mbheki Centre

Tel+27312604557

Fax+27312604609

Email:

Supervisors

Dr Sumaiya Desai

University of KwaZulu-Natal

Private Bag X01, Scottsville, 3209,

South Africa

Phone: 27 (33) 260 6568

Email desai@ukzn.ac.za

I……(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT DATE

……
……