FACTORS GOVERNING HOUSEHOLD ACCESS TO KEY SOCIO-ECONOMIC FACILITIES AND THEIR INFLUENCE ON EDUCATION PERFORMACE AND HEALTHCARE SEEKING BEHAVIOUR IN RURAL COMMUNITIES OF MALAWI

by

Witness Shaibu Kuotcha

A thesis submitted in fulfilment of the degree

of

Doctor of Philosophy

DECLARATION OF AUTHOR'S RIGHTS

Signed:……..…… 2014

DEDICATION

This thesis is dedicated to my beloved wife Lusubilo, my adorable children Upile and Sandra. And to my late sister Dorica; you always expected and demanded the best, encouraged me to face challenges and taught me believe and have faith in Almighty **GOD**.

ACKNOWLEDGEMENTS

All praises to Almighty **GOD** who blessed me with strength and knowledge, protected and guided me throughout this research.

This dissertation would not have been possible without the help, advice and support of many people. Firstly I would like to extend my profound thanks to my academic supervisor Dr N.S. Ferguson for his professional advice, suggestion and endless support offered from the very beginning through the very end of this research. I wish to also thank Emeritus Professor marius de Langen who tirelessly and continuously encouraged me throughout this research, your interest, insight and suggestions have been very valuable to me.

I would like to acknowledge the sponsorship received from the Association of Commonwealth Universities (ACU), United Kingdom; the Scotland – Chikwawa Health Initiative Project for providing a motorcycle that was used for the organisation of the surveys. I am also grateful to management team of the Malawi Polytechnic of the University of Malawi, the chairman of the Research and Publication Committee in particular for funding part of the research activities carried out in Malawi.

Particular thanks are extended to Scatter Makumbi for organisation and supervision of the surveys, the fifteen enumerators who worked very hard to make sure that the Chikwawa questionnaires were successfully administered, the village leadership for consenting to have the studies be carried in their villages and the people from these villages for their willingness to participate in this study. Special thanks go to Peter Mhone for his moral and financial contributions towards this research.

Last but not least, I whole heartily thank my wife Lusubilo and our beloved children Upile and Sandra. I recognise your role, perseverance and encouragement.

May **GOD** bless you all.

ABSTRACT

It has been recognized that spatial pattern of activities and how they are connected by the transportation system determines the accessibility of a particular location. It has also been acknowledged that identification of locations with poor accessibility to key services is an important first step in the development of appropriate social and health policy interventions. Moreover, the current literature acknowledges that the lack of accessibility to basic goods and services deepens the isolation of rural households, undermining their opportunities to access socio – economic and basic services. Therefore, provision of effective interventions to reduce the lack of access to basic facilities/services would go a long way to improving peoples' well being in rural areas. From a policy perspective, to ensure that resources are properly targeted, it is important to identify (1) communities that are most deprived in terms of their access to key facilities and (2) how the levels of accessibility affect the health, social and economic well being of the local communities. The focus of this study is to contribute to point (1), and in particular to proper understanding of point (2).

The analysis of this thesis is based on household survey data from a sample of 989 households across thirty villages in a rural district of Malawi. The study employed GIS, TransCAD 4.8 (Caliper Corporation, 2005) tool to estimate distances from the villages to the nearest key facilities. Using SPSS version 19.0 (SPSS, 2010), a series of binary and ordinal logistic regression models were performed to estimate the influence of distance, local topography, state of road network and socio-economic characteristics on (i) school attendance and educational performance and (ii) rural health care seeking behaviour. In addition, a series of bivariate analysis were performed to investigate the trade-offs between school attendance and (i) farm tasks and (ii) water collection.

The main contribution of this thesis is in Chapters Six, Seven and Eight. The results suggested that a significant number of villages in Chikwawa district were far from key services and the general state of the road network in most villages was poor. It was established that distance was the strongest predictor of school attendance and healthcare seeking behaviour. It was also established that villages located close to schools benefited by (a) lower levels of absenteeism and (b) more time available for farm tasks.

The thesis recommends a balanced mix of transport policies that (i) takes into account the actual modes of transport used, (ii) aims at improved local "non-car" paths and footbridges alongside a cost-effective road network and (iii) aims at encouraging a better spread of activity locations.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PLATES

LIST OF FIGURES

ACRONYMS

SEU	Social Exclusion Unit
HDI	Human Development Index
GoM	Government of Malawi
WHO	World Health Organisation
NSO	National Statistical Office
OR	Odds Ratio
SSA	Sub-Saharan Africa
MDGs	Millennium Development Index
GDP	Gross Domestic Product
MRTTP	Malawi Rural Transport and Travel Program
IRAP	Integrated Rural Accessibility Program
RAMPA	Rural Accessibility Mobility Pilot Activity
EPDC:	Education Policy and Data Center
IHS:	Integrated Household Survey
IHSN:	International Household Survey Network
MGDS	Malawi Growth and Development Strategy
NMT	Non Motorised Transport
MLGRD	Ministry of Local Government and Rural Development
RA	Roads Authority
SSATP	Sub-Saharan Africa Transport Programme
VDC	Village Development Committee
ADC	Area Development Committee
VDA	Village Development Area
SPSS	Statistical Package for Social Scientists
TransCAD	Transportation Computer Aided Design
GPS	Global Positioning System
VIF	Variance Inflation Factors
HIV	Human Immunodeficiency Virus
SCHI	Scotland Chikwawa Health Initiative
AIDS	Acquired Immune Deficiency Syndrome

CHAPTER 1

Introducing the context of the thesis

1.1 Introduction

This study investigates the factors affecting accessibility of households to key socio-economic facilities of rural communities in Malawi. Specifically, the study examines whether (a) the physical location of key services, (b) the transport network connectivity and conditions, and (c) the availability and cost of modes of transport have any effect on the utilisation of these services. The key services considered were schools and healthcare facilities. Government of Malawi (GoM) identified education, water & sanitation and health as key priority areas for achieving the millennium development goals (MDGs) and improving the welfare of the people.

The study was conducted in thirty rural villages from one of the districts in Malawi. A household questionnaire was used to understand demographic and socio - economic characteristics of communities, as well as to collect information relating to the trips made by people to key services. The subsequent data was then analysed to determine whether accessibility constraints affected the use of these services within the study areas and whether physical access to key services influenced school attendance, educational performance, healthcare seeking behaviour and trade – offs between school attendance and involvement in farm tasks and water collection.

This chapter discusses the background and significance of this research. The chapter also outlines the research objectives and the organisation of the thesis.

1.2 Research Background

The current literature acknowledges that poor accessibility reduces the opportunities for communities to reach the services (Hansen, 1959; Handy, 1996; Odoki et al., 2003; Porter, 2002; Dercon & Hoddinott, 2005; Thomas et al., 2005; Dunkley et al., 2009). Many studies indicated that the lack of accessibility to basic goods and

services caused by a deficient and ill maintained rural road network and unaffordable or non existent transport is a constraint to rural development and contributes to the low productivity of land and labour observed in rural areas and that it deepens the isolation of rural households, undermining their opportunities to achieve better education, health facilities, job opportunities, markets - and better income (Bigman & Deichmann, 2000; Nejadfard, 2000; Minot, 2005; Bird et al., 2007; World Bank, 2007). On the other hand, some studies also suggested that the efficiency, productivity and quality of life in rural communities could be greatly enhanced by improving access, through the better location of services and facilities, development of off road local community infrastructure, i.e. interventions aimed at reducing the need for longer distance travel and transport and enhancement of mobility with Non Motorised Transport (NMT) (Bryceson, 2002; World Bank, 2007; Hofman et al., 2008; Porter, 2010).

There are two basic approaches to the problem of lack of access to services in rural areas. The first option is to improve road transport infrastructure and transport services by maintaining rural roads, constructing missing road links and improving public transport. Taking this option would reduce travel times (in some cases also distances) and probably also travel costs (although these may remain unaffordable for most of the rural population to use, apart from incidental trips to hospital or market towns), as well as reducing the cost of goods transport. Yet, this approach has no effect on distance (apart from the case of missing links) and, in general, its main impact is on the longer distance trips, and on trips by car or bus or truck (de Langen & Tembele, 2001). The second option is to re – locate services more closely to the communities, in particular to spread the services more widely and to improve off – road village infrastructure (e.g. footbridges) to reduce NMT travel distance and travel time. This of course would increase the cost of service provision (e.g. extra schools, extra health points) but reduce the cost of new road infrastructure and the cost of travel, and probably increase service utilisation. In addition, another potential problem that would contribute to lack of access to services would be the potential lack of specialisation which could be achieved at each facility. Which strategy is

more effective to reach policy goals of reducing rural backwardness and poverty, and which is more cost – effective will basically depend on the local circumstances.

Despite the fact that the importance of accessibility to economic and social development is self-evident, most accessibility policies of developing countries, particularly in sub-saharan Africa, fall short of clear strategies for addressing rural accessibility problems (Bryceson & Howe, 1993). The provision of effective interventions to reduce the lack of access to basic facilities/services would go a long way to improving peoples' well-being in rural areas. From a policy perspective, to ensure that resources are properly targeted, it is important to identify (1) communities that are most deprived in terms of their access to key facilities and (2) how the levels of accessibility affect the local health, social and economic well-being of the local communities and (3) how effective and (4) how cost effective different accessibility improvement interventions are. Interventions that can produce desirable accessibility improvements regardless of the cost are effective and the cheapest option is the most cost effective, but where other interventions provide additional benefits, even if more expensive, they may be more cost effective. The focus of this study is to contribute to point (1), and in particular to proper understanding of point (2) above.

Furthermore, despite the important links between accessibility and human well-being, only a few studies have attempted to investigate the influences of accessibility on quality of life in the rural communities of sub-saharan Africa and Malawi in particular. In addition, the few studies that have been carried out have produced varying outcomes. For example in a study conducted in Tanzania, the results suggested that distance and travel times to centres of greater opportunities (regional centres) had an effect on poverty rates (Minot, 2005). In the rural areas of Ethiopia it was found that, economic activities were affected by access to market (Dercon & Hoddinott, 2005). In Malawi, South Africa and Ghana, Porter et al. (2010) noted that unavailability of proper walking paths and foot bridges affected the attendance of primary schools in peri urban areas especially in the rainy seasons. In another study, the use of bicycle ambulances in rural areas of Northern Malawi resulted in the

reduction of the rate of child death during delivery (Hofman et al., 2008). In his analysis of data taken by the World Bank sub-saharan Africa Transport Programme 2(SSATP 2), Dennis (2000) observed that the data did not show any relationship between difficult of access and percentage of households using the facilities.

Recent studies in rural accessibility planning have advanced the understanding of household level decision making process. The underlying concepts consider distribution of services and factors that deter accessibility of facilities (Bryceson and Howe 1993; Howe, 1996; Odoki, 2003). These concepts provided the basis for the Intergrated Rural Accessibility Planning (IRAP) framework which was initially tested in Malawi.

The IRAP tool is a local level planning tool aimed at identifying the most urgent needs of the local community (Howe 1996; Edmonds 1998). Household needs for access to facilities such as water supply points, healthcare, schools, etc are identified through household data collection.

Like other developing countries, Malawi has attempted to address accessibility and mobility problems in rural areas through a number of programs. One example was the Malawi Rural Travel and Transport Program (MRTTP) which was formed in 1999 within the Ministry of Local Government and Rural Development. This program aimed at planning and implementing rural accessibility initiatives. Among the initiatives was the establishment of the Integrated Rural Accessibility Planning (IRAP) tool in 1999 and the Rural Accessibility and Mobility Pilot Activity (RAMPA) in 2004. RAMPA was conducted in one of the rural district of Malawi to test the IRAP approach. Demand for services was identified through establishment of Accessibility Indicators based on average travel times from Village Development Areas (VDA) to sector facilities (MRTTP, 2006). The findings indicated that most of the VDAs in the pilot district were very far from markets than schools and health care facilities with travel times to the markets ranging from 300 to 400minutes. However, in some instances, the accessibility indicator (which was a product of the number of households in a VDA and the average travel time to a facility) for some

VDAs with higher number of households but lower travel times was more than those VDAs with higher travel times but a low number of households. In view of this, Kayira et al. (2006) highlighted the shortfall of the IRAP approach in giving the full picture of identifying demand for services.

Nevertheless, the IRAP tool can be enhanced and utilised in the development of analytical travel demand framework. The household need identification concept recognises the derived nature of travel and it provides the definition of accessibility on the basis of household and activity attributes. However, the concept misses out the the individual characteristics. There is need to add the individual in the formulation of accessibility problems. This will enhance the behavioural basis of the IRAP framework. Therefore, additional detailed research of the actual accessibility profile of villages/rural services would provide valuable missing information for planning of effective rural transport infrastructure and service provision in rural Malawi.

The study presented in this thesis attempts to strengthen the operation of the IRAP framework and not to offer an alternative. This is achieved by examining the access levels of rural villages to key facilities in rural Malawi, exploring factors governing the accessibility of services and investigating how physical access to key services (schools and health care facilities) influence school non-attendance, educational performance and healthcare seeking behaviour.

Some studies attempted to demonstrate the influence of household characteristics such as income (Diener et al., 1993; Kingdon & Knight, 2004), vehicle ownership (Schimek, 1996; Stead and Marshal, 2001) and literacy levels (Diener & Suh, 1997) on quality of life. In addition some studies exhibited that individual characteristics for example gender (Hon et al., 2008) and age (Netuveli et al., 2006) influenced levels of accessing services vital for improvement of quality of life.

1.3 Significance of the Research

Accessibility to socio-economic facilities has been identified as a key indicator of development. The importance of adequate key facilities in providing sustainable rural development can therefore not be over emphasised. However, while continued investment in rural transport by Government of Malawi and cooperating agencies is viewed as an instrument in local development in Malawi, there has been no reliable evidence to prove that the accessibility interventions that were implemented resulted in enhanced rural development and improved living conditions for the local people.

While the Malawian government policies may have multiple goals, some of them do not have clearly measurable instruments to support the achievement of the objectives for example to achieve universal access to primary education by 2015; to reduce under five mortality by two thirds, to reduce rural urban migration (GoM, 2007), the issue then becomes whether or not it is possible to identify quantifiable variables that are someway linked to those objectives. Furthermore, there has been little focussed research to support development strategy, policy and interventions to enhance the provision of accessibility to targeted communities for promotion of local development and living conditions of the local people.

To be successful, policies for improved accessibility in Malawi must be based on reliable information and detailed understanding of rural accessibility issues. Therefore, this research attempts to identify villages experiencing low levels of accessibility to key services using a more detailed technique than those previously used in Malawi. Also, using empirical evidence from primary data sets, this research seeks to examine the influence of distance on school attendance, educational performance and healthcare seeking behaviour. Moreover, it attempts to highlight fresh insight to the trade offs between school attendance and involvement in farm tasks and water collection which is limited in current studies. This will augment and enrich existing knowledge on rural accessibility and support and complement rural accessibility problem identification and analysis in Malawi. Based on the knowledge

from this research, policy makers in Malawi will be better able to judge priorities for rural development projects.

1.4 Research Objectives

This research investigates factors governing accessibility of household to key socio-economic services and how the factors influence school attendance and performance, healthcare seeking behaviour and farming in the rural communities of Malawi. More specifically, it examines how access to facilities is influenced by network connectivity (distances), transport modes, quality of road network and topography and explores the link between these factors and quality of life outcomes.

The first aim is to identify villages with multiple access deprivation from the study area. Specific objectives are:

⇒ to examine the accessibility of villages to a range of key services in Chikwawa District, rural Malawi

⇒ to assess the multidimensional access deprivation from the study villages

⇒ to identify villages experiencing low levels of accessibility.

The second aim is to investigate the linkages between accessibility, service utilisation and outcomes realised from utilising the services. Specific questions are:

⇒ What factors influence physical access to the services?

⇒ How does service accessibility to key services influence outcomes from their utilisation?

The third aim is to examine whether physical access to key services affects participation in other activities of importance to the well-being. Specific questions are:

⇒ Does distance to school have any influence on the (i) frequency of involvement on farm activities and water collection? (ii) time spent on these household tasks?

⇒ Do frequency and time spent on farm activities and water collection influence school attendance?

⇒ Does time spent on water collection influence the time spent on farm tasks?

1.5 Organization of the Thesis

This Thesis is presented as a series of publishable articles and comprises nine Chapters. Chapter 2 reviews literature and provides the underlying concept of this research.

Chapter 3 presents the process of how locations, route networks and distances from existing data sources were determined and the details of how primary data collection was conducted.

Chapter 4 analyses and validates secondary data. It identifies villages with multiple access deprivation and illustrates how accessibility of the villages to a range of key services in the study area was examined and how villages experiencing low levels of accessibility were identified.

Chapter 5 presents descriptive and exploratory analysis of results from the village level data collection and examines the multidimensional access deprivation.

Chapter 6 examines the factors that affect access to schools and their influence on school attendance and perfomance.

Chapter 7 explores factors that affect access to healthcare facilities and their influence on healthcare seeking behaviour.

Chapter 8 investigates the trade offs made by household school going members between school attendance and involvement in farm tasks and water collection.

Finally, chapter 9 outlines the conclusions that were drawn from the research and makes recommendations on how the research results can be used as a guide to policy formulations on rural accessibility and mobility in Malawi. In addition, the chapter

reflects on whether the results of the research have answered the research questions and whether the research objectives have been addressed. Finally the chapter outlines directions for future research in a similar area.

CHAPTER 2

Literature Review

2.1 Introduction

This chapter provides the conceptualization of this research. It examines literature to understand how other researchers have contributed to the underlying concepts of accessibility and well being measurements. In this chapter existing knowledge on accessibility and quality of life are reviewed and the concepts of accessibility and well – being in developing countries, Malawi in particular, are discussed.

2.2 Understanding the rural accessibility concept

It is understood that the real source of deprivation of the rural population is their lack of accessibility to various activities (Barwell, 1996). It is therefore necessary to explore this concept in order to have a better understanding of rural transport problems. Moseley (1979) provided guidelines for quantifying accessibility and presented various alternatives to solving accessibility problems based on transport and land use. Ellis and Hine (1996) underscored the mobility aspects of rural accessibility. They analysed the effects of providing transport services for a given infrastructure and concluded that the availability of a variety of transport modes other than walking is efficient for transport charges and that the non-availability of low-cost modes was a major source of decreased mobility and increased poverty for rural population in sub-saharan Africa.

Roads facilitate access to key socio-economic activities in rural areas. However, there is a lack of understanding on the actual role of rural roads in the overall roadnetwork hierarchy in developing countries. Rural roads provide basic accessibility especially to personal travel which constitutes the highest proportion of rural travel demand (Hine, 1996). The migration of rural populations into areas of better road access reveals the inadequancy of access in their original areas. As such,

the overall planning of the rural roads must take into consideration the role of rural roads i.e. providing opportunities to the local population (Dercon & Hoddinott, 2005)

2.3 A travel behavioural framework

Jones et al. (1983), Kitamura (1988) recognised the contribution of the activity-based approach on the travel demand analysis. The activity-based approach views travel demand within a behavioural framework and considers the needs of the individual, the opportunities available to him/her and the parameters of the utility on which the individual desires to be involved in an activity. Jones et al. (1983) provided a travel framework basing on two dimensions, i.e. space and time. However Ben-Akiva et al. (1996) noted that the demand for travel is dervived from a demand for activities and recognised a framework based on three points as follows:

- Conceptual development must be based on demand for travel;
- The modelling unit is the individual considering his/her involvement in household duties subject to constraints;
- An activity-based modelling system is used to integrate the daily activity and travel choice in a single framework.

The above references indicate that the prime concern in travel demand modelling is the involvement of activities. Accessibility is a function of proximity of activities and the transportation network.

2.3.1 The underlying concept

People interact in time and space through the activities they perform. Travel is needed to reach spatially separated activities. The overall activity participation behaviour of individuals during a given time period is indicative of their travel patterns and can be influenced by factors deterring accessibility. It is postulated in this study that the individual's utility function relating to a service may be explained by distance/time of travel to the service, network condition, topography and household socio-economic characteristics

$$U_j = f(d, rc, t, se) \quad (1.1)$$

where:

U_j = Utility of service j

d = distance to the service (km)

rc = road network condition

t = topography

se = household socio-economic characteristics

Modelling the Accessibility Criteria

Odoki (1992) developed an accessibility benefit model where the definition of utility of an opportunity is based on accessibility benefit of an activity. The model is used to define the utility function as follows:

$$IM_j^k = \exp\left[-\left(\frac{m}{\alpha I} + \frac{1}{\nu}\right)2x_k\right].[c\rho\omega].h^{\gamma}\left[\tau - \frac{2x_k}{\nu}\right]^{\gamma} \quad (1.2)$$

where:

IM_j^k = index measure of accessibility benefit

j = activity type

k = activity location

m = monetary travel cost per km

αI = value of trave time per hour assigned by the individual having income I

ν = speed of travel in km/hr

x = distance to the location

ρ = level of activity for example number of jobs

ω = attraction characteristics of the activity

c = the model calibration parameter

h = measure of utility per unit time

γ = marginal utility available to the individual for the activity participation

τ = total time budget

This utility function combines the three components of accessibility, namely: the utility of travel, i.e. the transportation component, the utility of location of the activity, i.e. the spatial component and the utility of time, i.e. the temporal component. Considering travel as derived demand, the utility function takes into account the travel related parameters in a negative exponential function. In this way, the IM_j^k function considers factors deterring accessibility such as distance.

The probability of an individual selecting a service at location k is given in the form of multinomial logit model (Ortuzar & Willumsen, 1994) as:

$$P_r(IM_j^k) = \frac{\exp\left(IM_j^k\right)}{\sum_{jk}\exp\left(IM_j^k\right)} \tag{1.3}$$

where:

$P_r(IM_j^k)$ = the probability that the service in location k will be chosen.

The utility model is based on two assumptions: first, people choose the alternative associated to the maximum utility for them as individuals. Second, it is not possible to evaluate all the factors that contribute to the utility of a destination for an individual; this utility can be represented as a sum of random and non-random (or stochastic) components (Odoki, 1992). If we assume that the unobserved utilities have the same spatial distribution and scale as the observed ones, we can derive the expected maximum utility measure from the nested logit choice model (Ben-Akiva & Leman, 1979).

There is a close correspondence between the expected maximum utility of a choice situation and the concept of consumer surplus in microeconomic theory (Ben-Akiva & Leman, 1979; Miller, 2005). The consumer surplus measures the net benefit to an individual for a transaction at the prevailing market price, and is equal to the difference between the amount the consumer is willing to pay for a good and the actual price of the good. The utility function can be seen as a demand curve for a particular destination in which change in attributes could result in a change in the consumer surplus. For example, a change in the condition of road network could

increase accessibility to a shopping market and increase the consumer surplus of individuals using the road linking the shopping centre.

Conceptualization of the relationships among variables

This study focuses on the relationship between factors that govern accessibility which will act as independent variables and their influence on school attendance/educational performance, healthcare seeking behaviour and allocation of time to farm and household duties, which will be the dependent variables. The conceptualized relationships among variables are shown in figure 2.1.

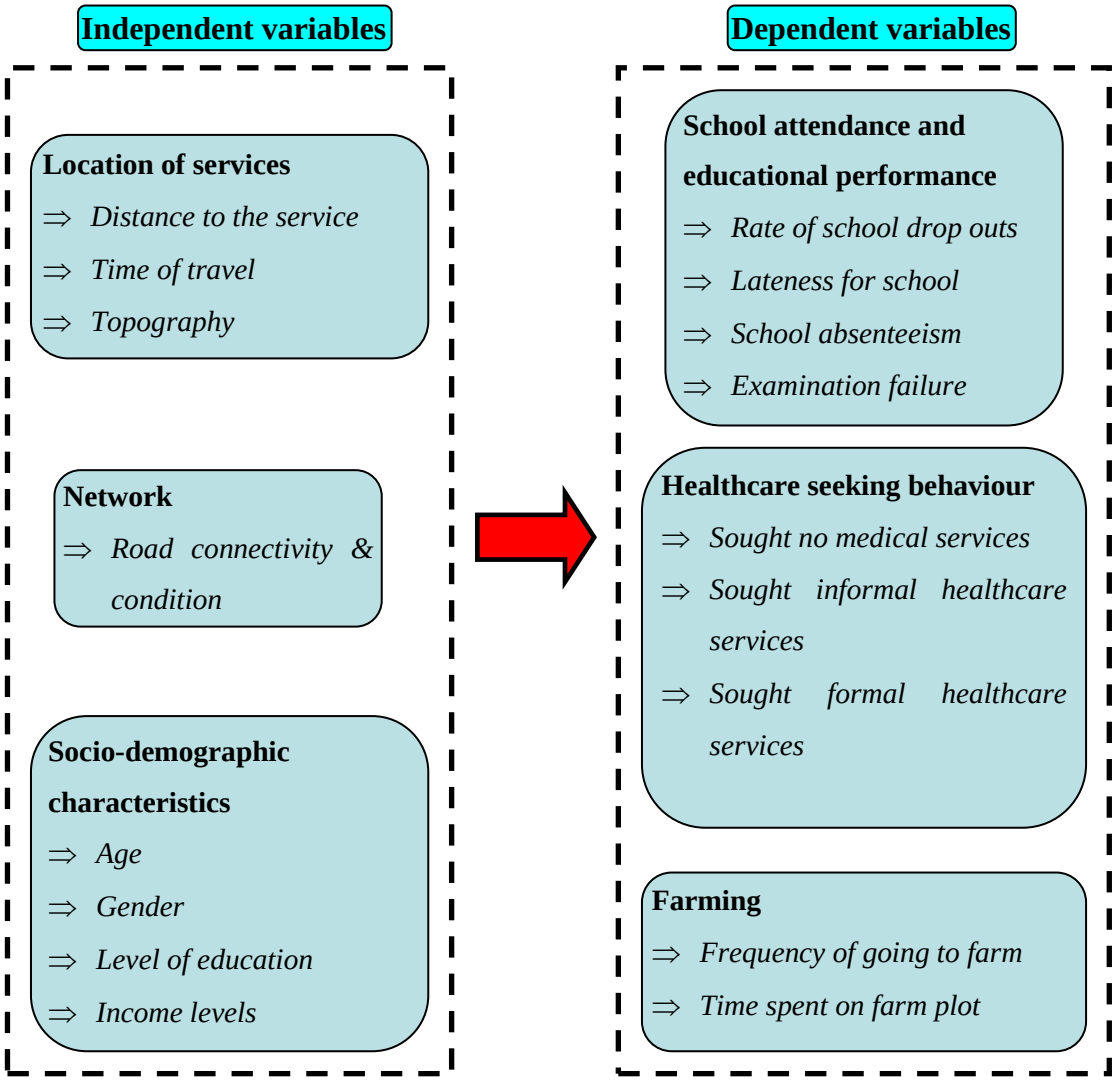


Fig 2.1 Conceptualized relationships among variables

Differences in levels of service utilization vary and are a function of socio-economic and geographical factors and condition of the infrastructure. However, ensuring even and equitable access to services and equitable utilization for the services is difficult since the demand for a service is by individuals who are dispersed across geographical space and differ in their mobility and other characteristics while the service is available at fixed locations (Pinch, 1985).

Physical accessibility problems in developing countries may be attributed to several factors. Among the factors, Barwell (1996) highlighted long distances to services, unavailability of appropriate means of transport, poor conditions of road network and steep slopes in high lands as problems that hinder access to and utilization of services in developing countries. However, the concept of accessibility is broadening to include not only geographical accessibility but also ideas of social inclusion and social exclusion (Donnges et al. 2005; Farrington and Farrington, 2005). The ultimate impacts of accessibility to some extent depend on non-geographical factors that are social and institutional in nature for example age, gender and literacy (Jones & Moon 1987, Birkin et al 1996).

2.4 Accessibility: Definitions and measurement

This section reviews a range of accessibility definitions and measurements. The consideration and analysis of accessibility varies amongst various disciplines. For example, transport planners will generally focus on mobility, land – use planners will focus on geographical accessibility (distances between activity points and the time it takes to reach activity points of your choice), social service planners will focus on accessibility options for specific groups to specific services (such as disabled people's ability to reach medical clinics) and communication experts focus on quality of telecommunication (such as the proportion of households with access to telephone). Because of the variation in the consideration and application of accessibility it then becomes more difficult to define and understand accessibility. Gould (1969) and Geurs & van Wee (2004) highlighted the difficulties in defining accessibility and how it can easily be misunderstood.

2.4.1 Accessibility definition

Accessibility analysis has become a key consideration in both developed and developing countries with the aim of achieving greater economical and social inclusion (Farrington and Farrington, 2005). In defining accessibility, three elements can be characterised; the first element is the demand point which looks at the point of trip generation (i.e. the location of the person who requires access to a service), the second is the supply point or points (i.e. the location(s) of the service sought) and the third is the means of linking the demand for and supply of services (i.e. the connectivity between the first and second elements).

The concept of accessibility has been discussed in parallel with mobility (Handy & Kelly, 2001). Mobility represents the ability to move from one place to another through the network and it is a measure of the transport system, while accessibility is the ease of reaching destinations and measures the interaction between the land-use and transportation systems (Hansen, 1959; Handy, 1994).

Bhat et al. (2000) credited Hansen (1959) with one of the first contribution on accessibility. Hansen (1959) defined accessibility as 'the potential for interaction' while Bhat et al. (2000) defined accessibility as 'the measure of the ease of an individual to pursue an activity of a desired type, at a desired location, by a desired mode, and at a desired time'. This definition was supported by Dunkley et al. (2004) who defined accessibility as the ease with which any land use activity can be reached using a particular transport system. In addition Geurs and van Eck (2001) used the following definition: 'Accessibility is the extent to which the land use-transport system enables individuals or goods to reach activities or destinations by means of transport mode(s).' Bhat et al. (2000) and Geurs & van Eck (2001) definitions underscored the terms "transport" and "land-use" thus implying that accessibility is linked to transport infrastructure and distribution of facilities.

Goodal (1987) observed that accessibility can be defined by the distance to the service point, the time taken to access the service and the range of opportunities that

can be reached. In addition, Handy & Niemeier (1997) and Borzachiello et al. (2009) demonstrated that higher levels of accessibility are achieved by the range and the number of opportunities that can be accessed within a given period of time. Moreover accessibility relates to the freedom of individuals to make decisions about whether or not to participate in certain activities (Burns, 1979; Castella et al., 2005) and also to the benefits provided by the transportation/land – use system (Ben – Akiva & Lerman, 1979; Odoki et al., 2003). Furthermore, Bertolini et al. (2005) made a further definition of accessibility as 'the amount and diversity of places that can be reached within a given travel time and/or cost'.

Geertman & Van Eck (1995) highlighted the link between accessibility and social exclusion or deprivation and it is hypothesized that social exclusion is aggravated by low levels of accessibility; this suggests that accessibility is an indicator of quality of life (Ureta, 2008; Gregory et al., 2009). However, the Social Exclusion Unit (2003) underscored the complexity of people getting to key services at reasonable cost, in reasonable time and with reasonable ease and observed the difficulties of measuring accessibility if it is defined in this way since the term 'ease' and 'reasonable' are subjective and depend on an individual's circumstances. As such, SEU (2003) suggested that consideration of a wider range of accessibility attributes, for example, physical availability of transport, journey time and cost together with information and safety issues need be emphasised.

2.4.2 Accessibility measurement

The methods used to measure accessibility often show different approaches as reviewed in Handy & Niemeier (1997), Makri & Folkesson (1999) and Ettema & Timmermans (2007). Handy & Niemeier (1997) argued that different contexts and study purposes demand different approaches to the measurement of accessibility. In addition, many studies developed numerous means of measuring accessibility often focussing on particular aspects. For example, Kwan (1998) focused on individual accessibility measures that estimate the accessibility enjoyed by a particular person having particular needs, mobility and resources (monetary and time). Geertman &

van Eck (1995), Handy & Niemeier (1997), Geurs & van Eck (2001) and Liu & Zhu (2004) focused on place accessibility which mainly takes into account (i) the transportation system that comprises the travel distance, time or cost of travel by different modes of transport and (ii) the spatial distribution of the potential destinations, and the quality and magnitude of the activities at the destinations.

Regardless of the approach to accessibility, Handy & Niemeier (1997) identified four inter-related issues that must be resolved. These are the scale and nature of disaggregation, the definitions of origins and destinations, the measurement of travel impedance and the measurement of attractiveness. Moreover, Geurs & Ritsema van Eck (2001) and Vandenbulcke et al. (2009) highlighted four accessibility indicator characteristics as follows: (i) a transport component related to the impedance that is, the effort necessary to reach a given destination from a given origin, (ii) a land-use component dealing with the attractiveness of the destination, (iii) a time component addressing the specific time period in which the measure concerned is observed and (iv) an individual component which looks at how individuals perceive relevant opportunities within the socio - economic system. The degree of representation of these components in quantifying accessibility depends on the definition of the accessibility under consideration.

Geurs & van Wee (2004) identified four approaches to the measurement of accessibility based on *infrastructure, location, person and utility* and suggested that existing accessibility measures should be sensitive to changes to these characteristics by demonstrating a checklist of recommendations of how accessibility measure should behave at the same time recognising that the criteria checklist can not be complete. The Geurs and van Wee (2004) recommended checklist is as follows:

1. *"If the service level (travel time, cost, effort) of any transport mode in an area increases (decreases), accessibility should increase (decrease) to any activity in that area, or from any point within that area."* (*p.130)*
2. *"If the number of opportunities for an activity increases (decreases) anywhere, accessibility to that activity should increase (decrease) from any place."* (*p.130)*

3. *"If the demand for opportunities for an activity with certain capacity restrictions increases (decreases), accessibility to that activity should decrease (increase)." (p.130)*

4. *"An increase of the number of opportunities for an activity at any location should not alter the accessibility to that activity for an individual (or groups of individuals) not able to participate in that activity given the time budget." (p.130)*

5. *"Improvements in one transport mode or an increase of the number of opportunities for an activity should not alter the accessibility to any individual (or groups of individuals) with insufficient abilities or capacities (e.g. drivers licence, education level) to use that mode or participate in that activity." (p.130)*

The development of suitable accessibility measures should not only be academically sound but also practical as regards to policy making. An accessibility measure must be consistent with the uses and perceptions of the residents, workers and visitors of an area, it must also be understandable to those taking part in the plan-making process (Bertolini et al., 2005). At plan – making level, where participants typically have different degrees and types of expertise, the challenge often times is to find the right balance between a measure that is theoretically and empirically sound and one that can easily be understood and discussed by the participants.

The follow up sections will review accessibility measures based on the following categories: (a) infrastructure, (b) location, (c) utility and (d) individual.

Infrastructure based measures

Infrastructure based measures as discussed in Geurs & van Eck (2001) and reviewed by Scheurer & Curtis (2007) only use the physical distance between infrastructure elements as input. The measure is simple to calculate, uses readily available data and for policymakers and researchers; it is easy to understand and interpret. Baradaran & Ramjerdi (2001) referred this measure as travel cost approach and Scheurer & Curtis (2007) underscored that the measure does not take into account the spatial component of accessibility for example spatial distribution of opportunities, travel

impedance (network constraints) and travel behaviour. They noted that separation between locations does not need to be measured by geographical distance alone but other additional categories of travel cost or impediment can be employed. Moreover, analysis of accessibility (especially for public transport) based on physical distance is not absolute since travel time and user costs are rarely proportional to physical distance (Scheurer & Porta, 2006). In addition as discussed in Blayac & Causse (2001) and raised by Geurs & van Wee (2004) the disutility of travel time may not be constant across all modes and trip purposes.

Location based measures

Location based measures incorporate land use characteristics and attend to infrastructure constraints by using travel time as indicator for impedance. They are useful when comparing accessibility levels of one zone to another or measuring changes in levels of accessibility brought about by new transportation or land-use projects. Literature discusses several methodological approaches under location based measures and these include: Contour Measures (cumulative opportunity measures), Gravity Measures (gravity model, potential accessibility measure, competition measures)

The contour measure as discussed in Geurs and van Eck (2001) or as Bhat et al. (2000) described the isochronic/cumulative opportunity model, counts the number of opportunities available from a prescribed threshold of maximum desirable travel time or travel distance. For example this measure can be used to identify the number of jobs within 2 kilometres (zone j) of location i or the number of jobs within 30 minutes walk from the residential location. The model is formulated as:

$$A_i = \sum_{j=1}^{n} B_j O_j \tag{1.4}$$

where A_i is accessibility measured at zone i to potential activities in zones j, O_j is the opportunities in zone j, and B_j is a binary value equal to 1 if zone j is within the predetermined threshold and 0 otherwise. This measure incorporates the land use component as well as infrastructure component without any implied assumptions on

their value to the users (Geurs & van Eck, 2001). However, the measure cannot capture variation in accessibility between activities within the same contour. It is sensitive to (i) boundary effect i.e. all opportunities beyond the threshold (no matter how close) are not counted and (ii) the choice of desirable travel time or travel distance thresholds (Baradaran & Ramjerdi, 2001; Bertolini et al., 2005). Also, it does not accurately represent how users perceive and value particular destinations since the definition of travel time contours may be arbitrary. Moreover, contour measures do not differentiate travel purposes and consider all opportunities equal.

The gravity model was first developed by Hansen (1959) and has since been adapted in many ways. For example Geurs and van Eck (2001)'s potential accessibility model was derived from the gravity model. Unlike cumulative opportunity measures where all opportunities are considered equal, the gravity measure treats opportunities differently by firstly identifying the travel cost indicator (travel time, distance) and then the deterrence effect of the indicator captured by the deterrence function (Miller, 1999; Geurs and van Wee, 2004). The measure can be expressed as:

$$A_i = \sum_{j=1}^{n} O_j f(c_{ij}) \tag{1.5}$$

where A_i is a measure of accessibility in zone i to all opportunities O in zone j, and c_{ij} the cost of travel between i and j. The assumption is that the cost of travel from zone i to opportunity in zone j affects the attractiveness of that opportunity, i.e. the more the cost to the opportunity in terms of distance, time or generalized cost the lower is the opportunity's accessibility.

The travel deterrence function estimation in the gravity measure is complex; some literature has adopted a negative exponential function (Miller, 1999). Coefficients from trip distribution models are often used. However, Geurs & van Eck (2001) noted that the selection of the form of function should be done cautiously when evaluating alternative scenarios with different spatial distribution of opportunities or different travel patterns and advocated that deterrence functions used should be empirically derived using the most recent data.

Some of the disadvantages of this measure are its inability to account for individual accessibility (all individuals within a zone are attributed the same level of accessibility; though they may have different levels of accessibility due to personal constraints for example disability) and its failure to account for the demand (it does account for the spatial distribution of the supply of opportunities but not the competition for the available opportunities).

Competition measures are a variation of the original gravity model and take into account competition factors. They are relevant when assessing the attractiveness of new opportunities in comparison to established alternatives for a broader user group or when there is need to explore the potential catchment area for facilities, for example schools. One approach to accounting for competition as applied in Shen (1998) is to divide the supply (for example jobs) in zone j by the demand potential (for example number of job seekers) within reach of zone j. The measure is formulated as:

$$A_i = \sum_{j=1}^{n} \frac{O_j f(c_{ij})}{D_j} , \qquad D_j = \sum_{j=1}^{n} P_j f(c_{ij}) \tag{1.6}$$

where A_i is the accessibility of people living in zone i, O_j are the opportunities at zone j, $f(c_{ij})$ is the deterrent function to travel between i and j, D_j is the demand for the opportunities, and P_j is the number of people in location j seeking the opportunities.

Although accounting for competition improves the practicality of the gravity measure it only accounts for competition at the destination zone without taking into account the impact of other opportunities in other zones $(k, l, m, ...)$. To take into account the effects of activities in adjoining zones van Wee et al. (2001) suggested an additional element to the measure that allows the capacity of opportunity in each of the destination zones to be assessed relative to opportunities in adjoining zones and the results factored into a measure of the original zone and the expression was presented in the following form:

$$A_{O_i:(T\leq T_{max})} = \sum_{j=1}^{j=n} \left(\frac{O_j}{T_{ij}^{f(c_{ij})}} x \frac{\sum_{k=1}^{k=n} \left(\frac{O_k}{Lf_k} x\, Lf_k \right)}{\sum_{k=1}^{k=n} \left(\frac{Lf_k}{T_{jk}^{f(c_{ij})}} \right)} \right) \qquad (1.7)$$

where A_{O_i} is accessibility of opportunities within a certain time $T_{\max}$ from zone i - including competition, $j = 1.....n$ are all zones j within $T_{\max}$ from zone js, O_j is the number of opportunities in zone j, Lf_k is the size of the market (e.g. employment) in zone j/k, T_{ij} is the travel time between zones i and j; between zones j and k, and $f(c_{ij})$ is a parameter for the distance function.

Utility based measures

Utility accessibility measures are based on random utility theory, in which the probability of an individual making a particular choice is relative to the utility of all choices. The measure is directly linked to economic theory and also adheres to travel behaviour theories (Ben-Akiva & Lerman, 1979). An important advantage of this method is its sound theoretical basis which replicates human choice by including the attractiveness of each opportunity. It is based on the economic benefits that people derive from having access to certain activities**.** Moreover, contrary to gravity measures, utility measures do not only represent the accessibility of a place or a location but individual travel behaviours as well.

However, the approach is also characterised by some weaknesses. For example Bhat et al. (2000) highlighted the complexity of defining a set of choices for activities and opportunities to be included in this approach, and pointed that the measure cannot envisage the emergence of new opportunities and their effects on travel behaviour. Geurs and van Eck (2001) underscored (i) the relative inability of this approach to capture feedback effects between transport patterns and land use changes over time

and (ii) the complexity of this approach i.e. its demand for a lot of data and complex calculations; mostly difficult to interpret by laymen.

Individual based Measures

Individual accessibility measures or people-based measures as proposed by Hagerstrand (1970) and discussed in Bhat et al. (2000), Geurs and van Eck (2001) and Geurs and van Wee (2004) are based on the space - time framework. The space - time framework accounts for the spatial and temporal dimensions of participating in a given activity. Bhat et al. (2000) highlighted three types of constraints in this framework: (i) capability constraints: the transportation system (network constraints) affects the amount of time available to participate in spatially distributed activities and this was also underscored by Miller (1999), (ii) coupling constraints (the need to be in particular places at particular times) and (iii) authority constraints (regulations on private space e.g. the times of operation of given activities, or of components of transport infrastructure/service).

This approach is appropriate for the assessment of various activities at different locations and a series of trips (Baradaran and Ramjerdi 2001). Individual accessibility measures require extensive individual-level data and the information required for this approach is not usually available from standardised travel surveys and therefore often needs to be specifically collected as pointed by Kwan (1998), Bhat et al. (2000) and Geurs and van Eck (2001). However, due to extensive individual-level data requirement (which can be difficult to acquire) many studies using this approach were conducted on small numbers of individuals (Geurs & van Eck, 2001; Kwan et al., 2003).

2.4.3 Selecting an appropriate Accessibility Measure

From this review of accessibility measures it is observed that there exists a number of measures with associated advantages and disadvantages. The choice of the measure to be used in transportation planning and projects evaluation depends on the

intended application. Levinson (2003) outlined some elements that are important in any measure of efficiency of the transportation system as follows: (i) the possibility of combining different measures into one overall measure, (ii) the analysis and disaggregation of the system components should not be complicated**,** (iii) measures should be in line with the experiences of the target group and they should not be difficult to understand and (iv) they should be able to predict demand and be useful when policy makers attempt to regularise the system. In addition Geurs & Van Wee (2004) highlighted the four criteria relevant in choosing accessibility measures for transport planning evaluation: (a) their theoretical basis, (b) ease of communication and interpretation, (c) the data requirements and (d) their usability as economic, social or sustainability indicators

The availability of the data required to calculate the accessibility measures and consideration of their usability will certainly play an important role in determining the choice of the one to use. Among others, economic indicators of transportation or land use projects include increased capacity and travel speeds and reduced travel times. For the measure to be used as an economic indicator, Geurs & Van Wee (2004) underscored the need for it to be allied to economic theory that measures consumer surplus and productivity in the same way as utility based models do.

Accessibility used as a social indicator shows levels of access to activities considered to be of social value: education, public services, employment, etc. It is generally measured at the individual level, using disaggregated data, as well as at the community level and its focus is on identifying social inequalities. Social equity can be measured by the number of individuals using a facility belonging to a defined social group for example the number of individuals using playgrounds (Talen & Anselin, 1998), parks (Talen, 1997), elementary schools (Talen, 2001), and supermarkets (Larsen & Gilliland, 2008). The number of facilities and/or opportunities within reach by communities can also be used to examine social equity. The resulting measure can be mapped to visually compare villages (Talen, 1997) or can be used in a statistical analysis to determine the relation between it and other variables, for example the relation between accessibility to schools and examination

grades (Talen, 2001). This helps in targeting the villages that would emerge as primary targets for accessibility improvement.

2.4.4 The Intergrated Rural Accessibility Planning

The Intergrated Rural Accessibility Planning (IRAP) methodology was initially developed for Tanzania and Malawi (initially called the Intergrated Rural Transport Planning). The IRAP is a local level planning tool aimed to optimise the infrastructure investment on the basis of the most urgent needs of the local community (Howe, 1996). This way the IRAP is based on the accessibility-activity approach, i.e. it takes into account the access needs of households and the activities fulfilling these needs.

The main feature that IRAP possesses is its flexibility to solve traditionally considered transport sector problems by either transport or non transport means. For example if water collection is a severe need, the problem can be solved either by provision of better footpaths leading to facility, or by bringing the water collection points closer to the users. In this way, the IRAP is able to incorporate the mobility and siting of service into the same framework.

Howe (1996) highlights the salient features of IRAP framework:

- it is based on household needs (covers all aspects of households needs)
- it is comprehensive in the sense of its ability to suggest solutions to the access problems, not just transport problems
- it is sustainable because it is able to be sustained by local-level participation.

Accessibility Indicators

The first output of the household data collection exercise within the IRAP framewok is the development of Accessibility Indicators (AI) for each of the access needs. In mathematical term, *AI* is given as:

$$AI = \text{number of households} \times \text{time (or distance) to the facility} \quad (1.8)$$

In the above equation the number of households is representative of the population affected. Time or distance to the facility is representative of the effort borne by the population. The higher the value of *AI* the least will be the accessibility of a particular facility to a given population. In this way the *AI* defines, in empirical terms, the inaccessibility of the activities. Since the definition of *AI* is based on two factors i.e. the population (number of households) and the burden (time or distance covered to the facility); the *AI* defines two possible solutions to the access problem:

- reducing the size of the affected population; this can be done by improving the capacity of facilities
- reducing distance or travel time for access; this can be done by improving the infrastructure (provision of roads) or enhancing supply of transport vehicles

2.4.5 Accessibility and mobility in rural Malawi

The vast majority of the population in sub-saharan Africa (SSA) lives in rural areas. Although rural livelihoods in Sub-Saharan Africa are showing some general improvements, they are not enough and these are the reasons why rural people, in particular the young are leaving for the cities and foreign countries (Avila & Gasperini, 2005). In order to achieve the Millennium Development Goals (MDGs) a special effort must be devoted to promoting rural development and fostering better living conditions of the rural poor.

Rural development can be defined as a process of change and transformation of the rural areas. These changes may be promoted by: (i) enhancement of governance at the local, district, regional and national levels, (ii) development of productive sectors for example agriculture, (iii) development of institutions and their capacities for example education, health, marketing and (iv) improvement of rural infrastructure for example roads, electricity, and telecommunications. One of the key indicators for overall development is the Human Development Index (HDI) and is based on three indicators: longevity, as measured by life expectancy; education attainment, as

measured by a combination of adult literacy and the combined gross primary, secondary and tertiary enrolment ratio; and standard of living, as measured by gross domestic product (GDP) per capita.

For decades the road network has been seen as a major catalyst to rural development (Bryceson & Howe, 1993; Porter, 1995; Barwell, 1996; Windle & Cramb, 1997; Escobal & Ponce, 2002). Rural development would therefore be realised if enough of road network was considered to be in good condition; this would ensure satisfactory levels of accessibility to school, healthcare facilities and markets among other services vital to the human well being.

From some studies that have been carried out in Sub Saharan Africa, the outcomes suggested that walking was predominant in rural areas and that footpaths and footbridges were mostly used to move from residential point to a service point (Airely, 1993; Kleih, 1999; Porter, 2002). In rural areas, most travel is made to meet subsistence and socio-economic needs and the trips are often made within the communities. Long distances to district centres, healthcare facilities and markets require other means of transport for example motorised vehicles which are limited in the rural communities. Even within the rural communities, other modes of transport (such as bicycles) which would have eased the burden of travelling long distances by foot are also limited (Sieber, 1997; Gordon, 1997; World Bank, 1999). Where such aspects dominate rural accessibility, it cannot be expected that investment in rural roads will solve the problems.

Some study findings further showed that in addition to limited means of transport, over half of the rural roads in sub-saharan Africa are in poor condition and mostly impassable during the rainy season (Riverson & Carapetis, 1991; Riverson et al., 2010). Coupled with long distances, households in the rural villages spend much effort and time to access community service centres (IT Transport, 1996). The effort and time that is taken to access some of these facilities affect the time required for quite other important activities vital to human well being (Nejadfard, 2000). As such, lack of access is a constraint to essential activities and contributes to poverty in the

rural areas especially of developing countries. Therefore, a good rural transport planning can facilitate social economic development.

2.5 Quality of Life: Definitions and measurements

The term Quality of life (QOL) was originally associated with the effect of material affluence (evidenced by the possession of car, house and other consumer goods) on people's lives (Carr et al., 1996). With time some studies have subsequently associated it with attributes such as education (Ross, 1997), health and welfare (Hawthorne et al., 1999), economic and industrial growth (Deller et al., 1999). It has since been equated to a variety of terms including self satisfaction (Brown et al., 1981; Landesman, 1996), self esteem (Griffiths et al., 2010), well – being (Bulpitt & Fletcher, 1990) and happiness (Álvarez-Díaz et al., 2010).

Quality of life is a notion of human well-being measured by social indicators rather than quantitative measures such as income or production (United Nations, 2011). The term quality of life relates to people's conditions of life in a country, region or community. While quality of life has been a policy goal for a long time, there has never been one accepted definition in most reviews of literature (Carr et al., 1996). Nonetheless, it is seen as the result of interaction of a number of different factors such as health, social, economic and environmental conditions. The effects of these interactions are human and social development at levels of individuals and communities (Diener and Suh, 1997).

Quality of life can be measured by objective as well as subjective indicators across a range of disciplines and scales as illustrated in Figures 2.2 and 2.3. The objective quality of life measures are based on aggregate statistical data from government institutions and organisations. These measures look at the socio – economic and demographic indicators which determine people's welfare as a society. The objective quality of life may be explained as interrelationship of the four determinants (as illustrated in figure 2.2). These determinants are important for the performance of the community (Campbell et al., 1976).

Among other items, the material welfare is determined by the standards of living, housing, education, health system, access to basic services for example drinking water and access to facilities for example markets.

The quality of population refers to its demographic characteristics for example its education levels. The quality of social system includes adequate provision of employment, education, social infrastructure and many other social amenities. This can be provided by government or private sector. The ecology condition is influenced by the quality of the environment, for example the condition of the air and water sources and heavy metal pollution. Bowling (1991) outlined the list of items for definition of quality of life and demonstrated how some of them may belong to more than one category.

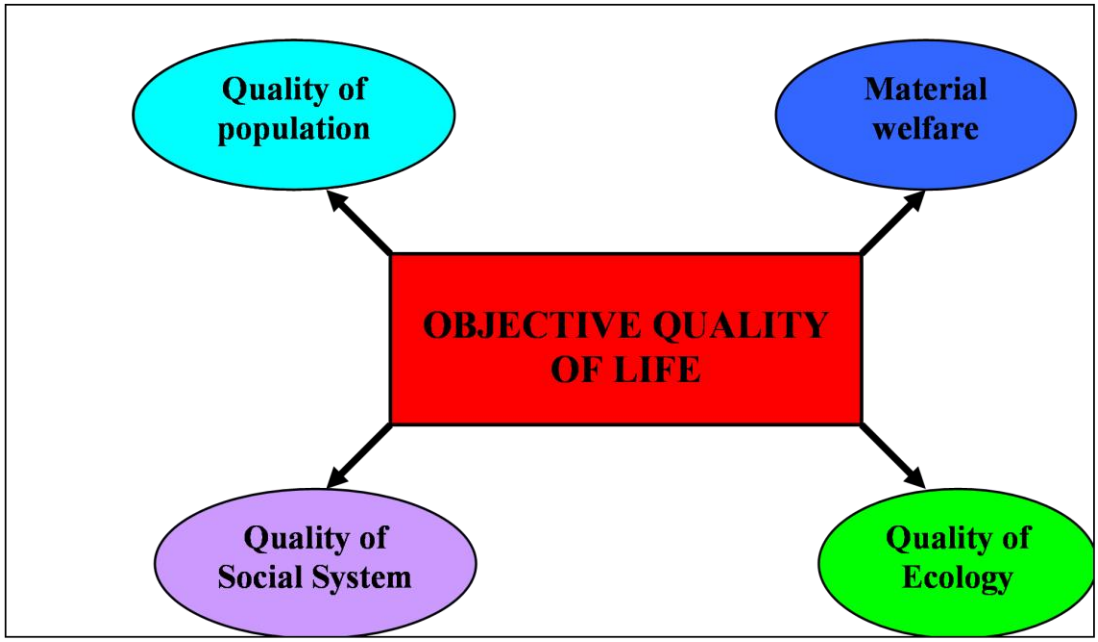


Figure 2.2 Objective well being: adapted from Quality of Life Indicators Monograph (ENVIS Centre on Human Settlement, 2009)

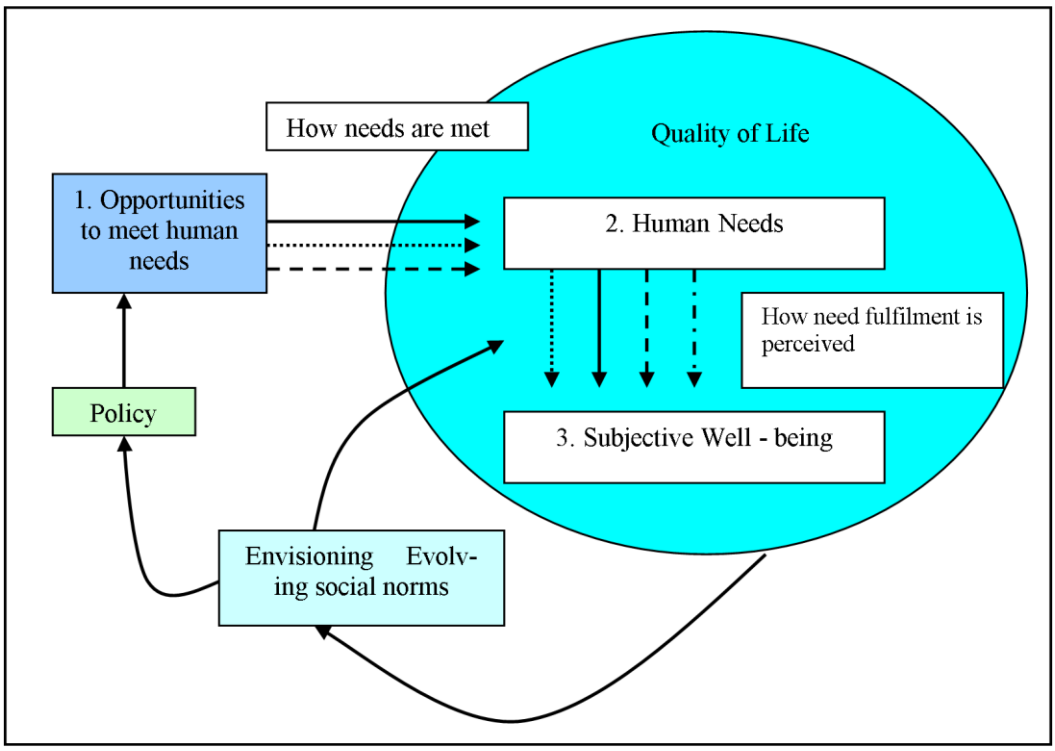


Figure 2.3 Subjective well being: adapted from Quality of Life Indicators Monograph (ENVIS Centre on Human Settlement, 2009)

On the other hand subjective quality of life is about the evaluation of people's lives through data collected at the individual level. This is based on an individual's perception of his or her well-being. Through surveys people can be asked about what they feel about their life and what they care about most. Subjective measures reflect the actual life conditions and the attitude of people toward these conditions. Human needs are numerous; however the availability of opportunities (services) to meet these human needs and the way these needs can be met varies amongst societies and individuals. If a true reflection of social norms for a society is envisaged, policies are made to influence the opportunities to meet the human needs. These policies might be related to transport and/or land use issues. The perception from individuals towards the need fulfilment is generally subjective.

Moser (2009) advocated a two stage approach to the assessment of quality of life as follows: (i) identification of objective environmental conditions and (ii) individual satisfaction with the environmental conditions:

> *"The impact on people's quality of life of a specific neighbourhood may be assessed by looking into the relation between objective facilities and services on the one hand, and the perception and evaluation of people's quality of life on the other, as these two factors may substantially differ according to personal factors like age, gender and cultural background. (See Diener et al (1993). Identifying the environmental conditions of human well being requires inventories of the specific physical and social conditions that may be threatening individuals' quality of life. These may be assessed by detached experts, but also via reports by affected individuals about their environmental conditions" (p.355)*

Quality of life may be based on either economic indicators or outcomes of social measures for example, child mortality, educational attainments, disease outbreaks or life expectancy (Ravallion, 1996). Bourguignon & Chakravarty (2003), Dercon (2005), Chakravarty & Dambrosio (2006) and Alkire & Foster (2009) further attempted to aggregate, analyse these indicators and measure the multidimensionality of the human well-being. The aggregation of these indicators by statistical techniques is vital in the identification of different social groups; for example Rodgers et al. (2006) and Robinson et al. (2007) used analytical techniques to investigate poverty at varying ranges of geographical parameters.

Poverty is an indicator of quality of life. The term quality of life is used to evaluate the general well-being of individuals and socities. It should not be confused with the concept of standards of living which is a measure of the quantity and quality of goods and services available to people. Instead standard indicators of quality of life include not only wealth and employment but also health, education, recreation and social belonging (Gregory et al, 2009). Organisations such as the World Bank declare a goal of "working for a world free of poverty" with poverty defined as a lack of basic human needs such as food, water, shelter, access to education, healthcare or employment (World Bank, 2009).

The empirical analysis of poverty and inequality tends to be based on income or consumption expenditures as a measure of well-being. Sen, (1987) criticised this one dimensional persepective of poverty and inequality and argued that poverty and inequality should be viewed mutidimensionally. Measurement of poverty should go beyond income or consumption and look at other dimensions of well being such as health, education and shelter among others. While income and consumption expenditure are instrumentally important attributes of well-being, Sahn and Younger (2006) highlighted the significance of including the other dimensions of well-being.

2.5.1 An overview of living standards inequalities

The most direct (and popular) measures of living standards are income and consumption. In general terms, income refers to the earnings from productive activities and current transfers. It can be seen as comprising claims on goods and services by individuals or households. In contrast, consumption refers to resources actually consumed. Both income and consumption data are expensive and difficult to collect, and many otherwise useful data sources lack direct measures of living standards (e.g., the Demographic and health surveys). On the face of this, many researchers have been prompted to use household assets data and other characteristics to construct alternative measures of welfare or living standards (Montgomery et al., 2000; Sahn and Stifel, 2000 and Bollen et al., 2001). This approach has the considerable merit of requiring only data that can be easily and quickly collected in a single household interview; and, although lacking somewhat in theoretical foundations, can provide a convenient way to summarize the living standards of a household.

This United Nations Human Development Index (2009) shows a decline in living standards in much of Sub-Saharan African counties. In some cases there is a widening gap between the rich and the poor, and between those who can and cannot access opportunities. It means that access to good schools, healthcare, electricity and other critical services is elusive for many people who live in these growing economies. Chen and Ravallion (2010) attribute this to the overdependence of agricultural commodities for export which has diminished in international trade over

the past years and whose prices also tend to go down. On the other hand, studies by Sahn and Stiefel (2003) and Young (2010) found that poverty reduction and growth has been much faster than suggested using the income poverty statistics. Interestingly, the above mentioned researchers differ widely in their approaches but lead to similar conclusions that the inequalities between the populations of rich and poor countries cannot only be reduced to differentials in income. They also apply to very different living conditions, in particular concerning the access to fundamental goods (e.g. drinking water, food, healthcare and education). For instance, in developed countries, undernourishment has basically disappeared, although it is believed that 15 million people are still plagued by it whereas in developing countries as a whole the rate reaches 16 % and even 30 % in Sub-Saharan Africa (WHO, 2008). In addition, while access to education is improving, again Sub-Saharan Africa is staying behind with an average of 73% in primary and 27% in secondary school (UNESCO, 2012).

In Malawi, the results from Welfare Monitoring Survey (WMS) conducted in 2011 demonstrate improvement in access to drinking water with 83% of the households having access to improved drinking water sources. The improvement was more likely in urban centres than rural areas and that the improved drinking water sources increased with the increasing level of education of the household head (NSO, 2012). The results from the survey also show that 93% of the households take slightly less than half an hour to reach the nearest source of drinking water.

The literacy level of the adult population in Malawi is at 74% (NSO, 2012). The rates were higher in urban than rural areas, 93% and 71% respectively, and high among males than females in both areas. The school attendance rate varied according to age. The rate was higher in the 11-13 year age group (93%) and lower in the 14-17 age group (81%). Moreover, 64% of the households take a little less than half an hour to reach the nearest primary school in their area. Unlike in the urban areas where 80% of the households take less than an hour to reach the nearest primary school, 62% of the rural population take less than an hour to reach the nearest primary school (NSO, 2012).

Life for many children and women in Malawi is characterised by poor access to healthcare and a high incidence of diarrhoea, malaria and other communicable diseases. Malnutrition levels have remained high for over a decade and 46% of children under the age of five are stunted (UNICEF, 2012). In additional, Malawi has a low life expectancy and high infant mortality. There is a high prevalence of HIV/AIDS, which is a drain on the labour force and government expenditures. Moreover, rural healthcare facilities in Malawi are far from communities. Only 17% of the rural population take less than an hour to reach the nearest health centre, clinic or hospital (NSO, 2012).

2.6 Linkages between rural accessibility, quality of life and development

The contribution of accessibility to people's welfare has been widely debated (Bryceson et al., 2002; Dercon, 2006; Bird et al., 2007) and Malawi considers accessibility as key to achieving the Malawi Growth and Development Strategy (GoM, 2007).

Transport is the means by which people access the facilities and services they need for everyday life. This involves time, effort and cost; these are measures of accessibility to facilities and if they are too high they constrain opportunities and potential development. For example, poor access to primary needs (water, food, and firewood) in rural communities of developing countries result in excessive travel times or the decision not to use the service and may constrain potential to produce some crops for sale. A high level of access to education is very important for the future of the families and the nation as a whole. In addition, healthy people contribute more to household economic activities; as such the importance of access to healthcare on people's health need not be overemphasized. Moreover, with good access to markets, farming will progress from subsistence to marketing.

Almost a third of people in developing countries live in poverty and their poverty is reflected in some basic indicators of lack of access to basic services (Nejadfard, 2000). The World Bank studies have shown a clear association between poor access

to basic services and per capita income (World Bank, 2007). Poor access is one of the characteristics of poverty and it has its effects at the most basic level of living. It is also argued that lack of access to basic and social services, employment, technology, land, information and credit contributes to factors such as poor health, low skill, poor education, low investment and limited opportunities. These lead to low productivity and income that in turn, perpetuate the vicious circle of poverty and hinders economic development.

It should be underlined that in the above context "poor access to services" combines two different aspects. One is "physical access", the other "economic/social/political access". A poor household can live next door to a school, a hospital or market, while household members are denied access because they cannot pay for the services. Physical access depends on factors such as trip distance, available means of transport, condition of road network and topography. These determine the travel time and cost, and whether a person can afford to make the trip, given his/her money and time budget.

Whether one is able to use a certain means of transport is clearly income dependent. For most of the rural population, most trips are made on foot, apart from a few incidental important trips by public transport and the use of a bicycle (if available). de Langen & Tembele (2001) pointed out that the primary causal relationship in most cases is as follows: being poor results in limited access; rather than the reverse, limited access being the cause of poverty. However, even if poverty may be the chicken and lack of access the egg, the two also create the vicious circle, from which it isn't easy to escape individually, let alone break it population – wide. Therefore, this study aims at contributing to the better understanding of the mechanisms at hand, and thus to the search for cost – effective policies to improve service accessibility and use in rural Malawi.

CHAPTER 3

Research Methods

3.1 Introduction

This chapter presents (i) the process of how locations, route networks and distances from existing data sources were determined and (ii) the details of how primary data collection was conducted. It shows how the sample of villages and households within the villages were chosen, how the household interviews were conducted and how data was analysed and interpreted. The chapter discusses the instruments used and how correction measures were undertaken to overcome bias during data collection. It also shows how contemporary issues in research especially ethical issues were considered. In addition it outlines the challenges encountered during the data collection process.

3.2 Scope of the study area

3.2.1 Malawi Profile

Malawi is a landlocked country in southeast Africa. It is bordered by Zambia, Tanzania and Mozambique. Malawi has three regions, three main cities and 29 administrative districts as shown in Figure 3.1.

Malawi is over 118,000 km^2 with an estimated population of 14 million out of which 51.4% are females and 85% live in rural areas. Additionally, Malawi has illiteracy rate of 36% and poverty rate of 52.4%. Furthermore, Malawi has a youthful population with more than half of the population under the age of 35 (NSO, 2010).

Malawi as a landlocked country relies on road transport to move goods and people from one point to the other. Malawi has 24,929 km of road network, approximately 76% of which is unpaved and about 89% of the unpaved is in the rural areas and that only 13% of the unpaved road network is in good condition (RA, 2009). Participation

of social and economical activities in rural Malawi is likely to be constrained by these poor conditions of the road network in addition to limited transport services. Therefore, the significance of good road network and means of travel in Malawi need not be overemphasised. At the same time, it can not be overemphasised that without consistent and cost – effective targeting of road network and other accessibility interventions a lot of money can be wasted.

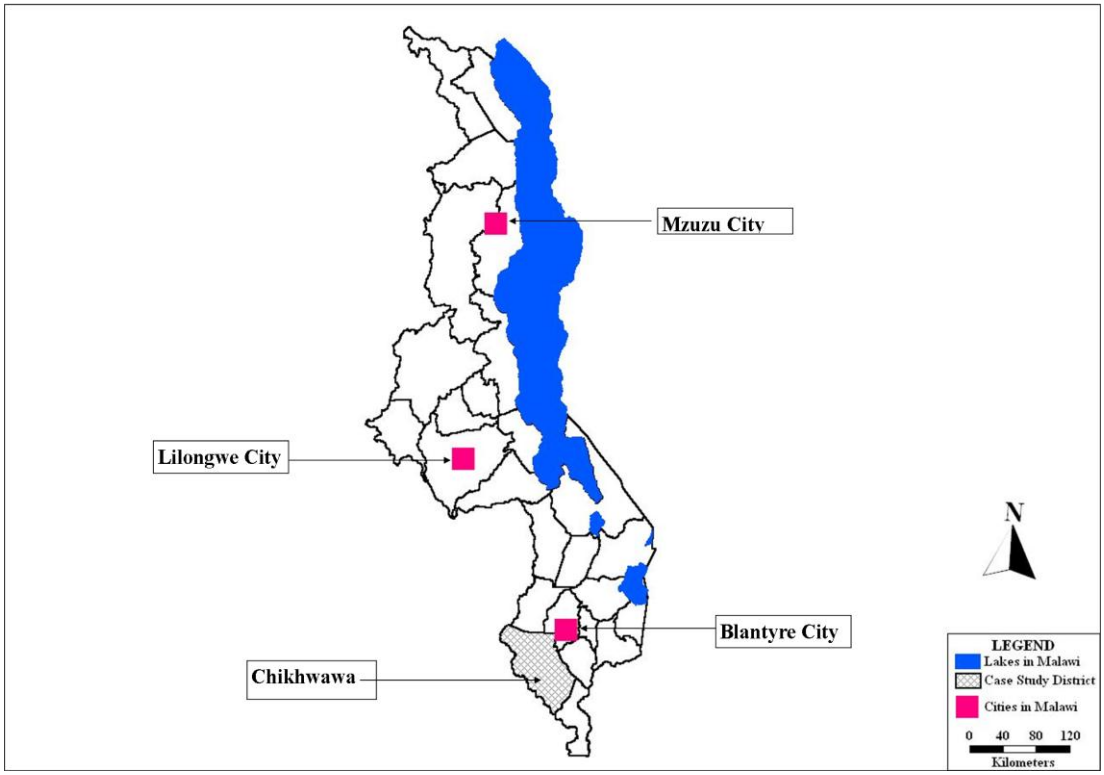


Fig. 3.1 Main Cities and districts in Malawi

3.2.2 Chikwawa District Profile

Chikwawa District is in the Southern Region of Malawi located about 50 km southeast of Blantyre, the commercial Capital - City of Malawi. The district lies along the lower flat basin of Shire River, which is along the Great African Rift Valley. Highlands characterize the eastern side of the district whereas the north and northwest are dominated by hills. Apart from Nchalo Sugar Estate as the main industry in the district, Majete Game Reserve and Lengwe National Park play an important role as tourist attractions as shown in figure 3.2.

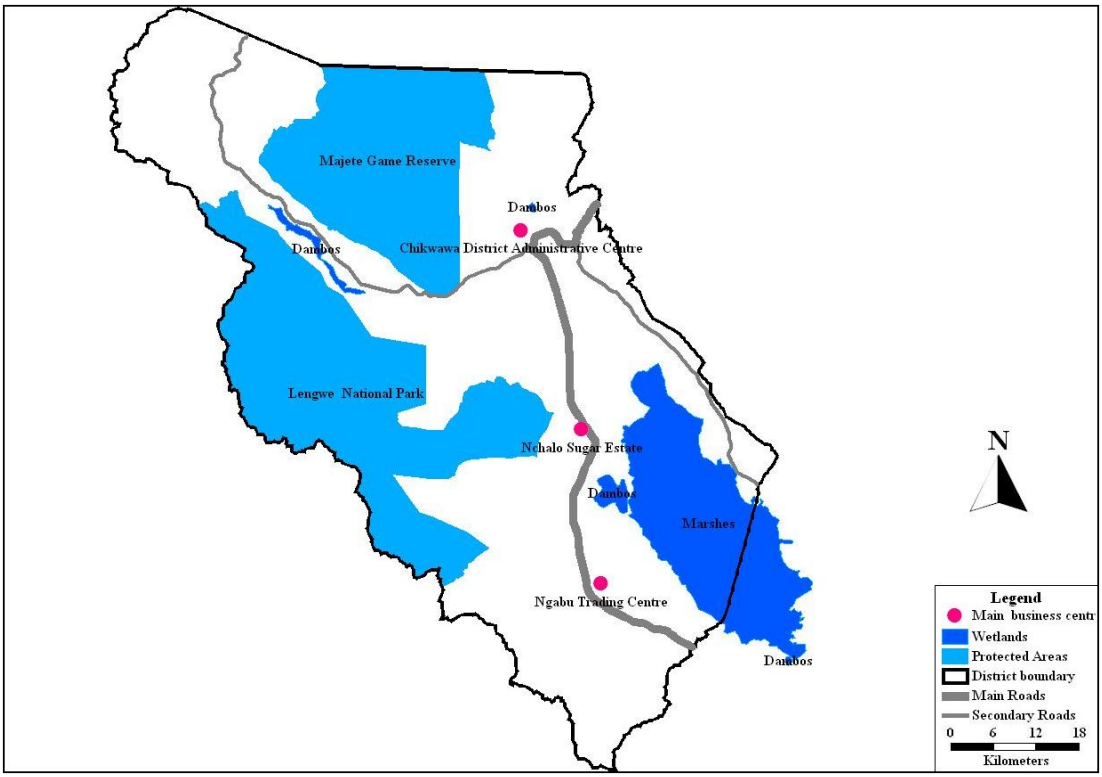


Fig. 3.2 Topographic features of Chikwawa District

Chikwawa has a population of 438,895 and 103,591 households. The district headquarters is connected to Blantyre, by an asphalt road, which passes through it to Nchalo Sugar Estate. Thereafter the district is connected to the southern most district of the country, Nsanje by a gravel road through Ngabu Trading Centre. There is an earth road running along the eastern bank of Shire River. The district has a number of district roads and a large network of tracks, paths and trails. These district roads and paths are mostly accessible during the dry season and hardly accessible in the wet season (RA, 2009).

3.3 Determining locations, route networks and distances from existing data sources

Since this study aimed at investigating factors affecting accessibility of households to key facilities of rural communities in Malawi, reliable measurement of accessibility

was the cornerstone of the study. A key requirement of this was to reliably locate villages and facility points on a map of Chikwawa District.

Distances from village to the nearest facility type were measured by using a standard GIS, TransCAD 4.8 (Caliper Corporation, 2005). The distances were directly measured from geo-referenced databases by calculating the shortest path from each village to the nearest facility type. The facility types considered were schools, safe water supply points, healthcare facilities, markets, grinding mills and religious centres.

The input data for this study were as follows:

- the location of facilities, represented by points collected at the centre of the facility by GPS (NSO, 2008, country census data)
- the location of villages, represented by points collected at the centre of the villages by GPS (NSO, 2008 country census data).
- the road network geo-referenced using GPS (National Road Authority, 2009). The geo-referenced road network only includes Main, Secondary, Tertiary and District Roads and excludes tracks/paths/ trails.

The limitation was that households were not geo-referenced; as such distances were measured from the village area centroid.

3.3.1 Sampling of villages

The first sampling frame consisted of all villages in Chikwawa District. Using distance threshold values to key facilities, villages (with multiple distance access deprivation) were identified and clustered in categories with similar accessibility levels (Kuotcha et al., 2012). Detailed discussion on Accessibility-Composite indicator and distance thresholds are presented in Chapter 4.

The next step was to randomly select equal numbers of villages from each accessibility cluster (this being the most cost efficient manner to obtain enough respondents of each accessibility category to allow a statistically meaningful analysis

of the effects of accessibility level). Thereafter, within each accessibility cluster, villages were strategically selected with a probability proportional to the number of villages in each cluster.

3.3.2 Sample size

The robustness and choice of a sample size to get a significant level of representation of the whole population have been widely studied (Atkins, 2005; Maas & Hox, 2005). This study adopted two levels of sample sizes: the village number size and the household number size. Both of these have influence on statistical inferences. In order to get adequate statistical power with respect to estimates of all model parameters and their standard errors, Maas & Hox (2004) and Huang and Lu (2007) suggested sample sizes of at least 30 in level one and at least 30 in level 2. In addition, some researchers have argued that the second - level sample size is more important than the first – level sample size and that estimates of sample errors and variance components tend to be underestimated when the number of units in level 2 is less than 30 (Mass and Hox, 2004; 2005). They suggested that sample size for the first – level can be reduced to 15 given the same number of total observations. However, Huang and Lu (2007) argued that the 30/30 rule is still the better principle based on results from their simulations which demonstrated that reducing first – level sample size performed far worse than 30/30 rule.

In the rural set up of Sub - Saharan Africa, including Malawi, daily trips to basic and socio – economic services are almost exclusively made on foot while trips to health care facilities and markets tend to be made in case of need and will more often be made either by motorized transport or bicycles**.** Hence, no large variation in modes of transport used for trips was expected. In addition, big differences in income levels between inhabitants of different zones or villages were not expected either. Consequently, the study population was fairly homogeneous in many respects[1]. Therefore, beyond a minimum size required to make statistically significant

[1] Although of course those households living in the most inaccessible (service–deprived) villages might turn out to have lower incomes, face more health problems and have lower education levels, as a result of the service deprivation. This is precisely what this study sought to analyse.

statements, differences in sample size would not significantly affect the outcomes of the study (Babbie, 1998).

Considering that (i) many studies cited above demonstrated that convergence rates of parameters at 95% confidence intervals improved considerably with sample size of 30 in the first - level and second – level respectively, (ii) the study population was fairly homogeneous in many respects and (iii) resources for the surveys were limited, this study adopted the 30/30 rule. Therefore, thirty villages were selected for the survey as shown in figure 3.3. In addition, the study sought a minimum number of thirty households from each village.

Household definitions used in multi topic household surveys vary between surveys, but have potentially significant implications for household composition as well as statistics generated for household units. In this study, a household is defined as a domestic unit consisting of members of a family who live together along with non relatives such as servants (Beaman & Dillon, 2011)

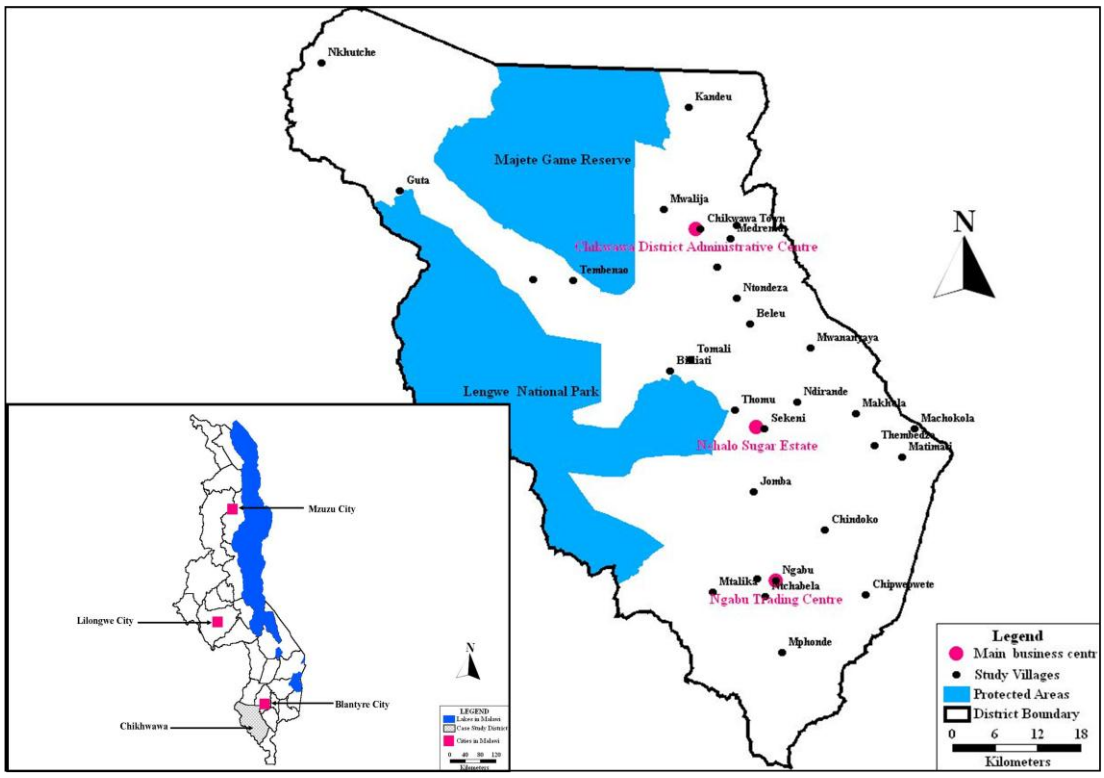


Fig 3.3 Villages that were selected for the study

3.3.3 Development of village and household questionnaires

There were two questionnaires that were developed for this study. Village and household questionnaires were developed in line with the study objectives. Considerations for the use of questionnaires are well documented. Past studies acknowledged the influence of a specific study on questionnaire development (McColl et al., 2002). A study can use standardised questionnaires or questionnaires specific to a particular research. Other standardised questionnaires were considered for this study including the 2008 Malawi National Statistics Survey, the 2006 Malawi Rural Accessibility and Mobility Pilot Activity questionnaire and questionnaires used for measurements of quality of life as demonstrated by Austin (2002). This study adopted some questions from these standardised questionnaires and added some specific to this study. An attempt was made to keep the questions as clear and simple as possible to avoid ambiguity (McColl et al., 2002).

The first questionnaire was designed to seek village information through traditional village chiefs and well informed members from the villages under study. The information sought included the village population, the number of households in the village, the number of key facilities located in the village, the general state of the road network, the number of motorized vehicles that pass through the village or surrounding villages and the distance to the nearest all-weather road.

The second questionnaire was designed to seek household and individual level information and was divided into four parts. The first part had five sections. The first section sought information on characteristics of household and its members for example size of the household, age and gender of the members of the household. The second section sought information on household member's economic characteristics for example employment. The third section looked at household member's health characteristics. The respondents were asked whether a member of the household was disabled, whether any member of the household suffered from illness or injury the previous three months. If yes, whether the member was able to consult any formal healthcare provider or traditional healer and if not the reasons for not seeking

medical services. The fourth section asked questions related to education characteristics. The respondents were asked whether members of the household had ever attended school. If yes, the highest level attended and the qualifications achieved. They were also asked whether they were able to read or write in both English and Chichewa[2]. The fifth section sought information on household vehicle ownership.

The second part focussed on school attendance. The respondents were asked where household school members were attending school, mode of transport used, time spent on the way to school, whether they were sometimes late or absent for school and whether they had failed in any examinations and if yes, the number of occasions they were late or absent for school and number of examinations failed. Detailed information on education characteristics is presented in Chapter 6.

The third part sought information on sources of safe drinking water, the household members who usually collected water, the mode of transport used to collect water and time spent on the way to the water source.

The fourth part characterised healthcare utilisation. The respondents were asked whether a member of household had ever fallen sick or not and for those who fell sick: were they able to sick medical care services or not? If yes where did they seek medical care services? What mode of transport did they use to visit the medical care facility, were they able to pay for the transport? If yes, what was the cost? how long did it take to reach the medical care facility?. Detailed information on healthcare utilisation is presented in Chapter 7.

The fifth part focussed on questions related to household tasks undertaken by school going children for example farm tasks. Among others, the data sought included: frequency of involvement in farm task before school and the time spent on the task. Detailed information on the trade-offs between school attendance and involvement in farm tasks is presented in Chapter 8.

[2]National language of Malawi used for communication in Chikwawa

The village and household questionnaires are presented as Appendices A1 and A2 respectively.

3.4 Field surveys

Field surveys involved (i) validation of secondary data information, (ii) administration of household questionnaires.

3.4.1 Primary data collection and validation of secondary data.

A field check on the correctness and completeness of secondary data was carried out during the period the household survey was conducted, and where necessary corrections were made. With the map constructed from the determination of location of villages, services and route network exercise as shown in sample map, figure 3.4, the researcher with assistance of a locally recruited supervisor conducted a validation exercise from all the sampled villages after seeking permission from various district administrative levels responsible for the administration of the requirements for this study.

The recruited local supervisor was very experienced in community mobilization and was also previously involved in a number of surveys and data collections including the 2008 Malawi National Statistics Surveys and the 2009 Scotland Chikwawa Health Initiative surveys. He also acted as a link between the researcher and the other interviewers during the detailed household surveys.

The validation process involved a check of whether there was an omission of road links, facilities from the initial secondary data and then a check on whether there had been new developments i.e. newly constructed facilities and road links. This primary information gathering was conducted through interviews with traditional village chiefs and well informed members from the villages under study and observations of the condition and connectivity of the transport network. Well informed members

were identified through the Village Development Committees (VDCs) and in most cases they were the chairmen of the VDCs. Thereafter, a new map was constructed as shown in sample map, figure 3.5.

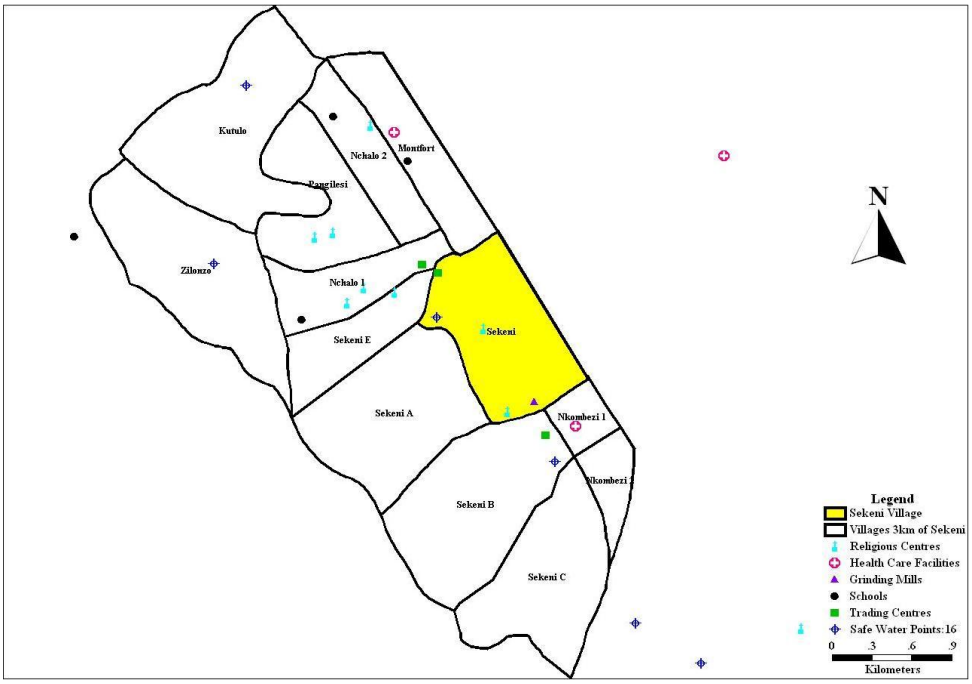


Figure 3.4 Facilities within Sekeni Village from secondary data information

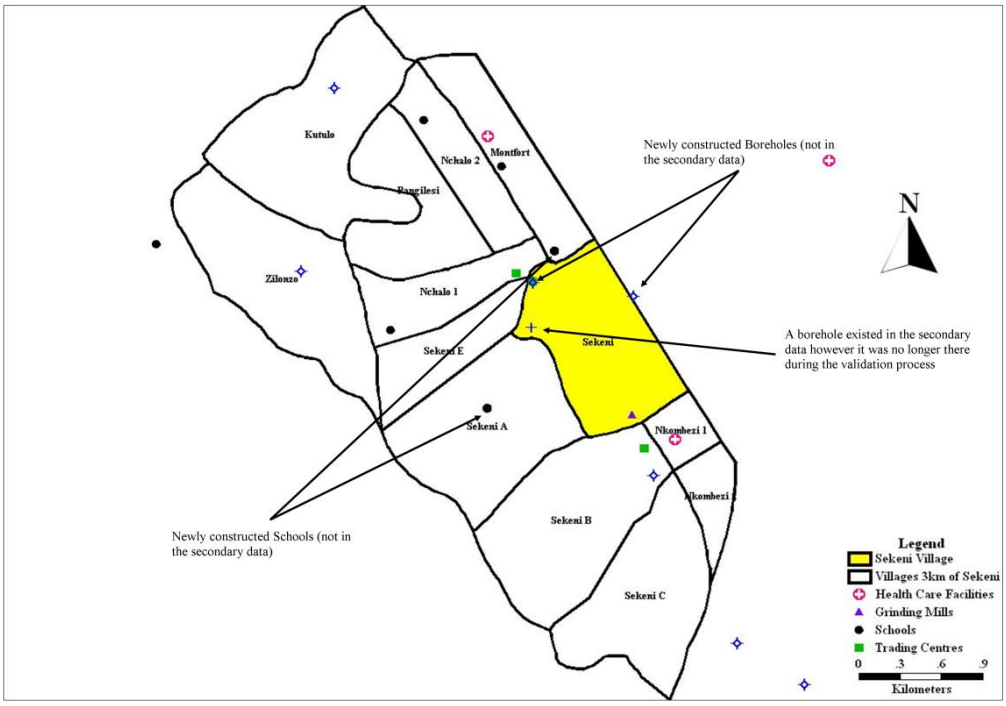


Figure 3.5 Facilities within Sekeni Village after the validation process

3.4.2 Administration of household questionnaires

The administration of household questionnaires firstly involved employment of 15 enumerators and one additional local supervisor to administer the questionnaire. As part of the process of recruiting enumerators, interviews were conducted which took into consideration completion of secondary education and competency in speaking, writing, and reading both English and Chichewa. This was to ensure that the concepts and questions were well understood. Nine of the recruited enumerators had already been involved in the previous surveys for example the 2008 Malawi National Statistics Surveys. The enumerators went through training before conducting a two day pilot study in Sekeni Village.

The Pilot Survey was conducted in order to (i) check the reliability and consistency of various information obtained, (ii) determine the capability of the questionnaire in providing inputs for the study and (iii) accustom the enumerators with survey, interviewing, house selection techniques and the problems they were going to encounter in the field and also share their previous experiences in such exercises. The exercise also sought to recommend improvements in survey methodology and the questionnaire. The training was conducted by the researcher with the assistance of the experienced local supervisor. The overall aims and objectives of the study were explained to the enumerators in great detail, stressing the point that the study was for research purposes and that all the respondents were to participate voluntarily.

All questions and options were explained to the enumerators and clarifications were made where applicable. The process was very time consuming but extremely important. The enumerators were further coached in other general points of the interviewing process such as: (i) introducing the study and building rapport, (ii) how to deal with interruptions and other similarly difficult situations, (iii) how to probe for more information without introducing bias, (iv) how to record the responses, (v) when to skip questions, (v) what to do with the participants to end the interview and (vi) what to do with the questionnaire. Fhi360 (2009) highlighted these points as important guidelines for identifying best practices for a household survey.

After the Pilot Survey and improvements in survey methodology and the questionnaire for example minimising time for introduction and building rapport, proper recording of the responses and improvement of some questions which were not properly answered due to misunderstanding by both the interviewer and respondent, a survey of residents in each of the case study villages was conducted with respect to their travel patterns and socio - economic demographics.

The first step in the management of household surveys was to seek permission from the village chief. A day before the interviews, permission was sought from the local village leaders and requested them to publicise the impending interviews. This effort was intended to maximise the response rate. In general, the response rates were very encouraging (almost 100%). The following day the questionnaires were administered by the enumerators in each of the selected households.

Five interviewers were assigned to one village at a time. Starting points within the village were randomly selected by each interviewer, and from that point by taking a defined short walking route towards a different direction from other enumerators and then in a systematic way randomly pick every 5^{th} house in his/her respective direction. This heavily relied on trust that the interviewers would indeed follow the prescribed systematic sampling. The researcher and the two supervisors consistently checked on each enumerator to ensure that they maintained the prescribed standards. Any member of the household aged 15 and above was eligible for the interviews on behalf of the household. In some cases where one member could not ably respond to some sections of the questionnaire, another member (when available) from the same household was called to assist in responding to questions from that section. For example some members who had never gone to school were not able to respond on questions dealing with access to school and school going children of 15 years and above (when available) were called to assist. If the school children were not available, the interviewing process proceeded by skipping those questions which required the attention of these children, the house details were then properly recorded and appointment made for a follow up interview. Thereafter, the local supervisor

went back to the same house to complete the process. This process was done on the following morning and there were very few cases (n = 11) when the supervisor had to go back to complete the process. The questionnaire involved was considered as coming from one respondent. If no eligible member for interviews was found in the selected household, the interviewer proceeded to the next 5th house. However, this was not common as the impending interviews were widely published the day before the interviews. There was a total number of 43 households which were selected but members of those households were not available. The lowest number of households within each surveyed village was 166.

Data was collected through face – to – face interviews using a questionnaire which was administered by an enumerator to a member of the designated household as shown in plate 3.1. The interviews were conducted in English and Chichewa.

Plate 3.1: A head of household (right) taking questions from an enumerator (left)

All questionnaires were collected from enumerators on a daily basis and reviewed after every 3 days. Any questionnaire that was incorrectly completed was destroyed.

In total there were 19 questionnaires which were incorrectly completed and were subsequently destroyed. Using SPSS version 19.0 (SPSS, 2010), a database was created. Data was entered manually from the completed questionnaires into SPSS file. Each questionnaire was given a code which was also coded in the SPSS file. After all the questionnaires were entered, 200 questionnaires were randomly selected and compared with the information from the database to determine if the information from the respondent had been accurately recorded. Generally very minor inaccuracies were observed. This may be because the data entry was done by the researcher who made sure that the data entry was entered correctly throughout the process. All the inaccuracies were reviewed and corrected by referring back to the original questionnaire of the respondent.

3.5 Household Survey challenges

Whereas in other surveys taboo issues affect the administration of survey questionnaires, the challenges in the conduct of this survey were associated with logistical (limited financial and energy resources) and to some extent ethical issues (the need to seek clearance from village chiefs). The total proposed budget for the Chikwawa surveys was £3,800.00 and the PhD sponsorship did not include field work activities. The Polytechnic College of the University of Malawi offered £1,450.00 from its research and publication fund. The Scotland Chikwawa Health Initiative (SCHI) Project provided a motorcycle which was used by one of the local supervisors. This implied that the researcher had to source the remaining costs from own sources. To cut costs the researcher had to use his own 3 tonne truck as shown in plate 3.2

Plate 3.2: A 3 tonne truck dropping enumerators at one of the villages and a motor cycle that was used by the local supervisor

In addition to the ethical clearance issues which were obtained from the District Commissioner and other government officials without difficulties, permission was also sought from the local traditional authorities as earlier stated. Surveys could only go ahead with their consent. Oftentimes local authorities could not be found in their homes, as such, a number of repeated trips were made to meet the village chief and obtain consent. This proved costly in terms of money for fuels, time and energy considering the geographical locations of some of the villages which are very remote and hilly.

The field surveys were conducted when Malawi had foreign currency exchange problems which resulted in difficulties in the procurement of fuels. In some cases, due to lack of fuels the interviewing team could stay 3 days without conducting interviews. This again proved to be costly in terms of accommodation and food for the enumerators and also time. If the sampled villages were close to each other, the interviewing team was forced to hire bicycles.

Since the aim of the study was to get accessibility information, some of the villages located in hilly and stony areas were deliberately chosen from the accessibility level clusters. These villages were very difficult to reach by either car or bicycle. The interviewing team walked considerable distances to reach these villages. This was very tiresome to most of the enumerators and the number of questionnaires administered per day in each of those villages was low as compared to other villages, thereby pushing up financial costs.

In some cases information on trips to school were reported by head of household and not the student himself/herself. This might have a possible effect on individual data representation. In addition, respondents were not given clear yardstick for assessment of road condition: poor, fair, good and excellent and mobility problems: yes or no. Therefore, the questions relied on the respondent's perception of these parameters other than actual assessment (though a general assessment of the condition of road network within each village was done by the researcher during the validation of secondary data process). This might have created variations amongst different households and villages because perceptions may not be the same across a diverse population. Further a lot of respondents associated mobility problems with motorised transport while walking was a predominant means of accessing facilities in these villages.

3.6 Summary of data collected

This chapter has presented (i) the process of how locations, route networks and distances from existing data sources were determined and (ii) the details of how primary data collection was conducted. In addition the chapter showed how the sample was chosen, how the household interviews were conducted and how data was analyzed and interpreted.

The secondary data showed the location of 326 villages in Chikwawa district and the distribution of facility types as follows: schools, safe water supply points, health care

facilities, markets, grinding mills and religious centres. The estimation of the shortest distances from the villages to the facility types is analysed and discussed in chapter 4. Using output from the analysis, 30 villages were selected for primary data collection. Table 3.1 shows the summary of secondary and village level facility types considered in this study and Table 3.2 shows the household and individual levels data outputs.

Secondary data	
No of villages	326
Facility types	Schools
	Safe water supply points
	Health care facilities
	Markets
	Grinding mills
	Religious centres
Variable	Distance to the nearest facility type
Village level Primary data	
No of villages	30
Facility types	Schools (Primary & Secondary)
	Safe water supply points
	Health care facilities
	Markets
	Grinding mills
	"All – weather road" (motorable road)
Variables	Distance to the nearest facility type
	Condition of the road network
	Topography

Table 3.1 Summary of secondary data and village level primary data

		N	%
Household level data			
	No of households	945	100
	No of household headed by literate members	633	67
	No of households with regular income	346	37
Vehicle ownership	A bicycle	263	28
	A motor cycle	19	2
	A car	25	3
	An animal cart	43	5
	Tractor	12	1
Individual level data			
Total sampled population		4157	100
Gender	Female	2172	52
	Male	1985	48
Age	0 - 5	580	14
	6 - 15	1254	30
	16 - 20	655	16
	21 - 35	786	19
	36 - 45	496	12
	46 +	386	9
Formal Education	Yes	2773	67
	No	1384	33
Communication	A telephone or mobile	735	18
	A radio	589	14
	A television	54	1

Table 3.2 Summary of the household and individual levels data outputs

All members of the selected households from the selected 30 villages in the study area were recorded. The number of selected households per village ranged from 30 to 40 adding up to 945 from the 30 villages. The survey managed to interview 1008 households and out of the 1008 households, 945 households were considered to be error free after screening. Of the 945 households, 816 (86%) reported to be headed by males and 129 (14%) by females. The number of individuals per village recorded from the selected households ranged from 110 to 185 and the total population from the selected 945 households was 4157.

Of the 4157 subjects recorded 2172 (52%) were females and 1985 (48%) males. Some differences were noted based on village, with the percentage of males varying from 41% - 55% and females varying from 45% - 59%. These differences were not

statistically significant (χ^2: p = 0.981). The gender composition obtained is in line with the results from the integrated household surveys conducted by the National Statistics Office which found out that the gender composition for males and females in Chikwawa were 49% and 51% respectively (NSO, 2010). Household members were divided among the various age categories. The following was the population distribution based on age group: 580 (14%) in 0 – 5 years age group, 1254 (30%) in the 6 – 15, 655 (16%) in the 16 – 20, 786(19%) in the 21 – 35, 496 (12%) in the 36 – 45 and 386(9%) in the 46 years and over age group as shown in Table 3.2.

Chapter 4 draws from the secondary data and Chapter 5 draws from the secondary and village level primary data. Chapters 6, 7 and 8 draw from secondary data, village level primary data, household level primary data and individual level primary data.

CHAPTER 4

Identifying villages with multiple dimensions of access deprivation using secondary data sources[3]

4.1 Introduction

In rural areas, the most frequently cited attributes affecting the utilisation of key facilities are low population density which affects the viability of the services and large distances between villages and facilities (Thomas et al 2005). Therefore, improving access to basic economic and social facilities is an important element in rural development. Access to these facilities is affected by a range of factors including the location of facilities relative to residential location, transport infrastructure and the availability of the means of travelling between home and key facilities.

Despite the fact that the importance of accessibility to economic and social development is self-evident, most accessibility policies of developing countries, particularly in Sub-Saharan Africa, fall short of clear strategies for addressing rural accessibility problems (Bryceson & Howe, 1993). The provision of effective interventions to improve rural accessibility would go a long way in reducing poverty in rural areas. From a policy perspective, to ensure that resources are properly targeted, it is important to identify communities that are most deprived in terms of their access to key facilities.

Previous studies in Malawi have documented information on the locations of villages and facilities (NS0, 2008) and the road network (Roads Authority, 2009). An attempt has also been made to identify the demand for services through the development of an accessibility indicator based on travel times from residential locations to sector facilities (MRTTP, 2006). However, there has been no attempt to capture the overall

[3] An earlier version of this Chapter was published in World Transport Policy and Practice Journal, 18(1), 12-24.

access level of an area. This Chapter attempts to address this gap by examining the access levels of villages to key facilities in the district of Chikwawa.

In rural Malawi safe drinking water, education, food, energy (firewood), health, milling and market are important services that require good access (NSO, 2008). The distance to the household plot for food production is not usually long (most of household plots are within the household compound). Access to firewood is also not so critical since most households use firewood from the farm plots. This chapter examines the accessibility of six key facility types: schools, safe water supply points, health care facilities, markets, mills and religious centres in Chikwawa District. The most important facility types (school, health and water) are considered and analysed separately.

Chikwawa District is in the Southern Region of Malawi located about 50km southeast of Blantyre which is a commercial City of Malawi. It has a land area of 4,755 square km with a total population of 438,895 people distributed across 326 villages (NSO, 2008). Chikwawa District has inadequate number of primary schools and secondary schools; as such pupils often have to walk long distances in order to access schools (NSO, 2010). There are 41 health care facilities sparsely distributed across the villages. Due to low availability of public and intermediate means of transport in the villages, people walk long distances in order to access medical care services (Hofman et al, 2008). There are also very few piped water system in Chikwawa and limited number of boreholes (the only safe drinking water source) for the district population. Trading centres where people can buy and sell their farm produce are also inadequate and far from the communities. Therefore, this chapter attempts to address the following objectives:

$\Rightarrow$ to examine the accessibility of the villages to a range of key services, and
$\Rightarrow$ to identify villages experiencing low levels of accessibility

The Chapter is structured as follows: section 4.2 reviews concisely the measurement of accessibility. Section 4.3 outlines the methods used. In section 4.4 results are considered and interpreted. Transport policies in line with the study are briefly outlined in section 4.5 and finally, section 4.6 consolidates conclusions.

4.2 Overview of accessibility measures

The concepts used to quantify accessibility have been widely reviewed and often show different approaches as discussed in Chapter 2 of this thesis. Regardless of the approach to accessibility, Geurs & van Wee (2004) raised the issue of incorporating travel impedance when quantifying accessibility. They argued that the choice of the impedance function should be considered with particular attention. In addition Baradaran and Ramjerdi (2001) and Bertolini et al. (2005) recognised the sensitivity of accessibility measures to the choice of desirable travel time or travel distance thresholds.

Travel impedance relates to the effort required to reach a given destination. It is commonly measured as the distance or time between an origin and a destination using objectively-measured or perceived straight-line or network distances/times, or using a generalised cost function which integrates an array of factors which are considered to influence the ease by which a destination can be reached (Geurs et al., 2001; Geurs & van Wee, 2004; Borzachiello et al., 2009; Yoshida & Deichmann, 2009). Attractiveness can be measured either by the existence of an opportunity or in relation to the size of the opportunity (e.g. floor area, number of employees (Odoki et al., 2003).

One of the simplest measures of accessibility is the distance to the nearest opportunity of a specific kind. The closer the destination is from the origin the higher the accessibility. Clearly, the value of an opportunity to an individual will decrease with increasing distance because of the effort/cost in reaching the destination and the amount of time that can be spent there (Geurs et al., 2001).

The identification of gaps in existing service provision and decisions on the location of new facilities can be determined by setting an acceptable or threshold level of accessibility. Individuals are considered to be "not well served" or "deprived of access" if their accessibility falls below this threshold value. Lack of access is then seen as a measure of deprivation, where the 'access gap' is the difference between actual accessibility and an acceptable level of accessibility. Substantively, lack of access is associated with poverty, where poverty is predominantly a result of isolation from opportunities.

4.2.1 The concept of threshold levels

In behavioural theory, Westelius (1972), Alkire and Foster (2009) found out that household needs are accumulated at some rate over time. For each type of need there is a threshold level (TL). When this level is reached, a journey to accomplish that need is triggered (Adler and Ben-Akiva, 1979). In this research the threshold level is re-defined to represent the affordability of trip to a service by a given village. For a village *m* and activity type j, TL is therefore defined as a function of the generalised travel time or distance from village to facility.

The household would place a cost of travel on the required activity. This perceived cost can either be given in time units or in money units (Ortuzar and Willumsen, 1994). The perceived cost given in terms of time units is called generalised time, i.e. the value of time people place on a given journey. Odoki et al. (2003) argued that the generalised travel cost, incorporating money and time variables is able to address monetary and temporal constraints on activity participation faced by individuals in rural areas of developing countries.

One of the assumptions taken into account by Odoki (1992) was that people respond to travel times and costs per unit distance through the generalised time per unit distance. This leads to the conclusion that the generalised time can be attached to the importance of travel for the individual. However in the absence of travel time data the actual distance can be used to estimate threshold levels for activities. Moreover,

Odoki, 2003 demonstarated how higher values of distance to activities would tend to sharply decrease the frequency of trip making. The determination of the maximum allowable distance threshold to facilities is critical as large distance threshold values do not discriminate very well between different levels of accessibility (de Jong & van Eck, 1996). Ideally a maximum threshold value should also be in line with observed travel behaviour in a particular region.

Threshold measures are the most commonly used accessibility measure. They are intuitive and easily understood by transport and non-transport professionals. They incorporate details of the total door-to-door journey time, distance or cost from the origin to the location of the facility or service.

4.3 Research Methods

Accessibility measures based on distance separation were employed in this study. The input data for this study were as follows:

- the location of facilities, represented by points collected at the centre of the facility by GPS (NSO, 2008, country census data)
- the location of villages, represented by points collected at the centre of the villages by GPS (NSO, 2008 country census data).
- the road network geo-referenced using GPS (National Road Authority, 2009). The geo-referenced road network only includes Main, Secondary, Tertiary and District Roads and excludes local tracks/paths/ trails.

This study's approach was to measure accessibility directly from these geo-referenced databases. Firstly, the shortest path from each village to the nearest facility of each type was calculated through the road network using a standard GIS, TransCAD 4.8 (Caliper Corporation, 2005). Villages and facilities were connected to the nearest point on the road network using dummy links representing the centroid connectors to the network as shown in Figure 4.1.

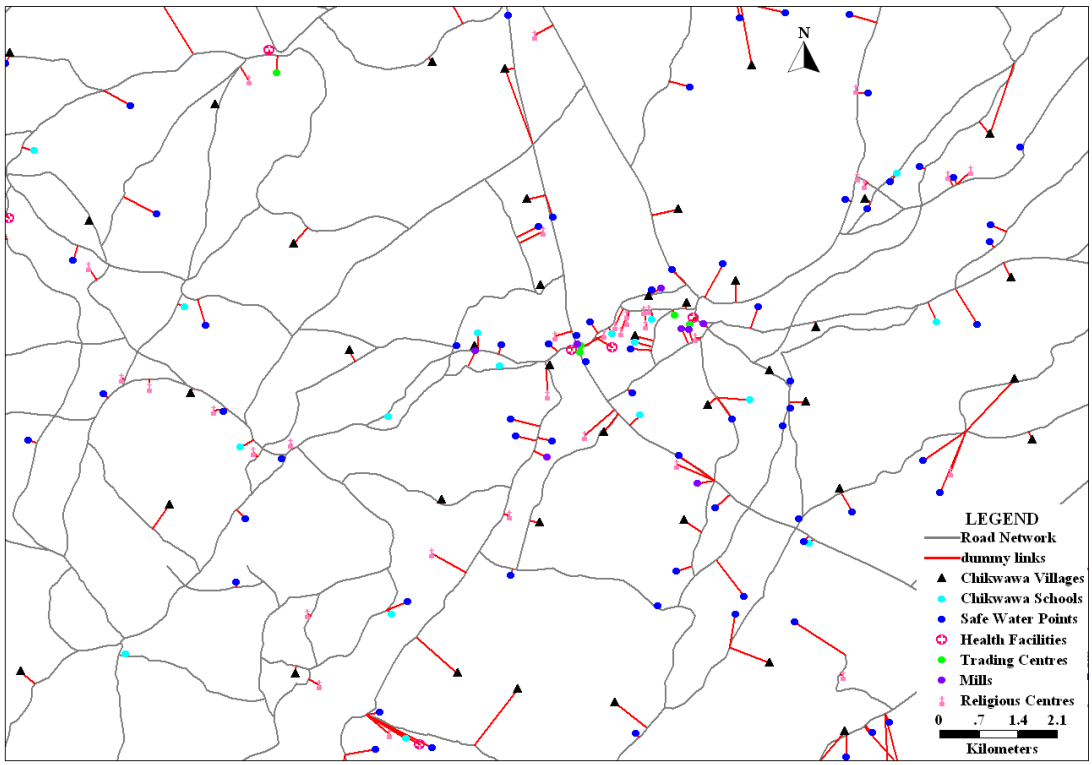


Figure 4.1 Villages connected to facilities through road network

Secondly, straight-line distances were calculated from each village to the nearest facility of each type to take account of the fact that a majority of trips to the facilities concerned were made on foot and often use off-road direct footpaths which were not included in the road network data.

The distance to the nearest facility of a specific type was calculated: $d_{ij} = \min(x_{ij})$, where x_{ij} is the distance from village i to facility type j (e.g. school, clinic)

Thresholds were defined such that $p_j(d_{ij}, z_j) = 0$ if $d_{ij} < z_j$ and $p_j(d_{ij}, z_j) = 1$ otherwise

z_j is the threshold distance for the facility type j (km).

Accessibility - Composite Indicator $(A_i) = \sum_{j=1}^{n} p_j \left(x_{ij}; z_j \right)$ (1.9)

The threshold values for different facilities (except for religious centres where a value was assumed based on the distances to the market and/or health care facilities: most of the churches in the study area were located close to either Trading Centre or

health care facility) were proposed following a synthesis of recommendations from studies by organisations as tabulated in Dennis (2000). The proposed thresholds (in kilometres) were as follows: 3.0, 1.0, 6.0, 6.0, 6.0, and 6.0 for primary schools, safe water supply points (boreholes and protected wells), health care facilities, markets, grinding mills and religious centres respectively.

A matrix of accessibility scores for the 326 villages and the six facility types was constructed as illustrated in Figure 4.2, where $d_{i1}, d_{i2}, d_{i3}, d_{i4}, d_{i5}, d_{i6}$ were distances from the village to the nearest primary school, safe water supply point, health facility, main trading centre, grinding mill and religious centre respectively. To identify villages with multiple dimensions of access deprivation this study adopted a dual cut-off approach which fixes a cut-off point k i.e. A_i = k (Alkire & Foster, 2009), where k is the number of dimensions in which a village is deprived. The approach taken in this Chapter was to examine intermediate cut-off levels for A_i that lie somewhere between the two extremes of being deprived in one facility type (k=1) or in all facility types (k=6). Villages were regarded as suffering multiple deprivation if the number of facility types which were located beyond specified thresholds was equal to or greater than A_i. The outcome matrix is illustrated in Figure 4.2 and the calculated distances from the villages to the nearest facilities are as shown in Appendix C.

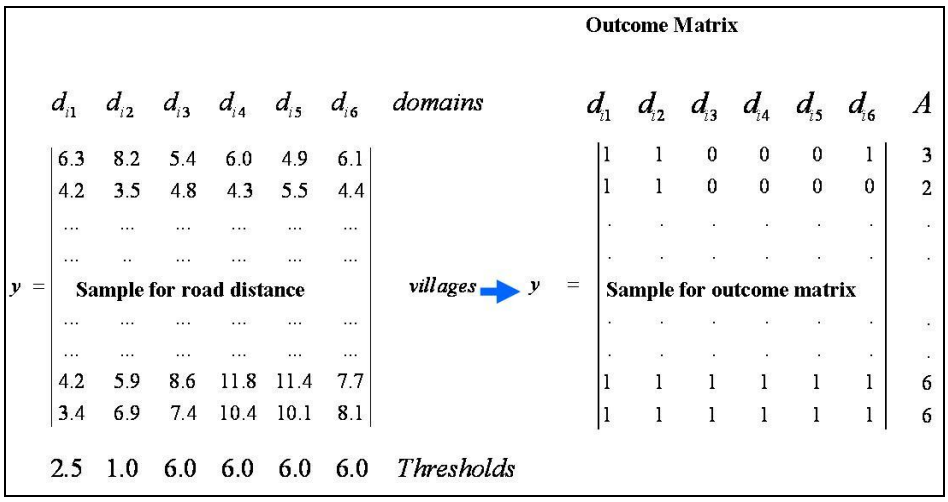


Figure 4.2 Matrix of distance measurements

4.3.1 Data quality

i. The location of each village was represented by a point which lies at the centre of the village, whereas in reality a village has a certain size which depends on the number of houses and on how clustered these houses are. If the houses were not very clustered the total area covered by a village could well be 1-2km in radius. In this case the actual distance to the nearest facility for some households would be less (or more) than the measured distance. Unobserved intra-village variation in accessibility will be more pronounced for larger and lower-density villages.

ii. The data used in this study came from surveys carried out by Malawi Office for National Statistics and Roads Authority. There was no any physical validation on the location and existence of the concerned facilities. Practically, there might be omissions of road links and facilities from this secondary data and there might also be new facilities and road links which were constructed after the creation of this data. Discussion after the validation process is presented in Chapter 5.

iii. The threshold values used were adopted from results on travel behaviour of sub-Saharan countries. Ideally, thresholds should be in line with observed travel behaviour of a particular community.

4.4 Results

4.4.1 Distribution of distances to key facilities

The distribution of villages according to the distance to the nearest facility of each type is shown in figures 4.3 and 4.4. Figure 4.3 shows the distribution where distance was measured along the road network. Figure 4.4 shows the distribution based on straight - line distances.

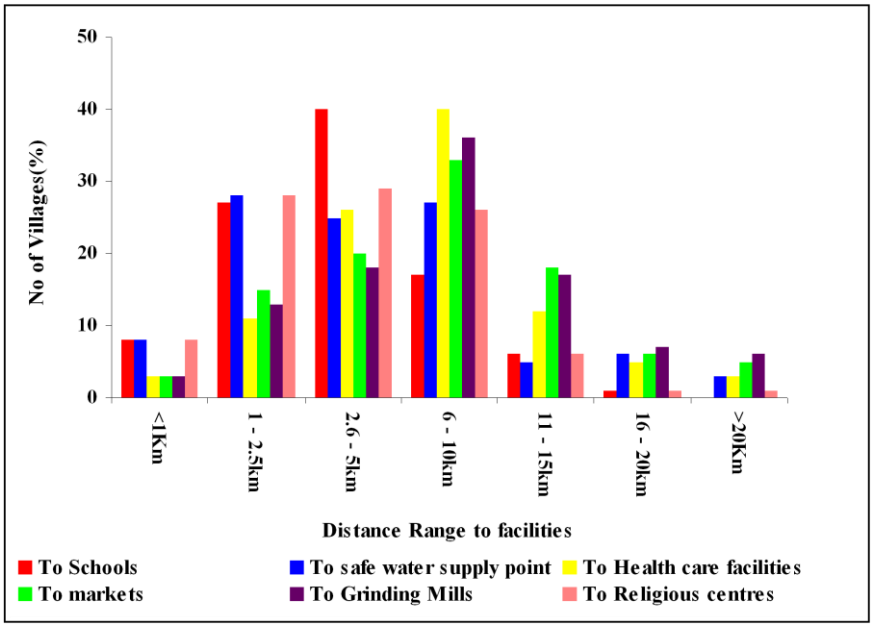


Figure 4.3 Distance ranges from villages to key services through the road network

The difference between the two indicates that only looking at distances to facilities over the road network might lead to the overestimation of the level of service deprivation experienced by villages. Figure 4.4 data is skewed to the left suggesting a higher proportion of villages with good levels of accessibility.

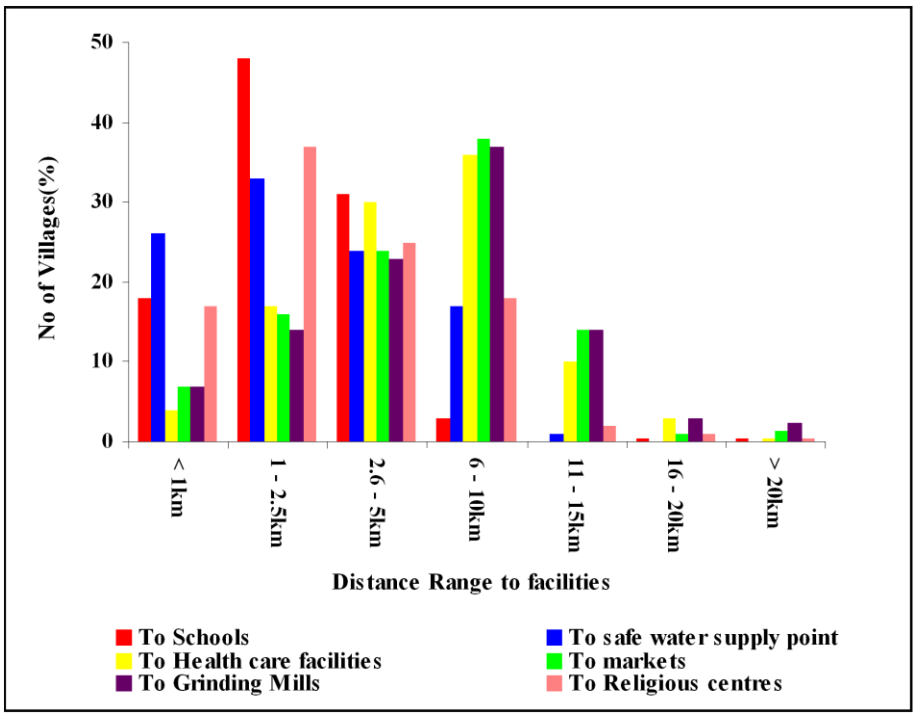


Figure 4.4 Distance ranges from villages to key services using straight line distances

Figures 4.5 and 4.6 show the number of villages that are located at distances less and more than distance threshold values to facilities using road network and straight line distances respectively. They demonstrate that about 65% and 23% of the villages in Chikwawa District have schools located beyond a threshold distance of 3.0kms when road network and straight - line distances are used respectively.

Furthermore, for 60% of the villages, health care facilities are located beyond a threshold distance value of 6km when road network distances are used and 38% when straight - line distances are used. There is a significant increase in the number of villages with access to each facility type below the threshold distance and this is most pronounced for schools and religious centres, with increases by 42% (77% - 35%) and 50% (86% - 36%) respectively.

Given the difference there is a strong incentive for villagers to seek and use trails and paths (where these exist) which do not form part of the mapped road network to access these services or that they would benefit from the existence of such trails.

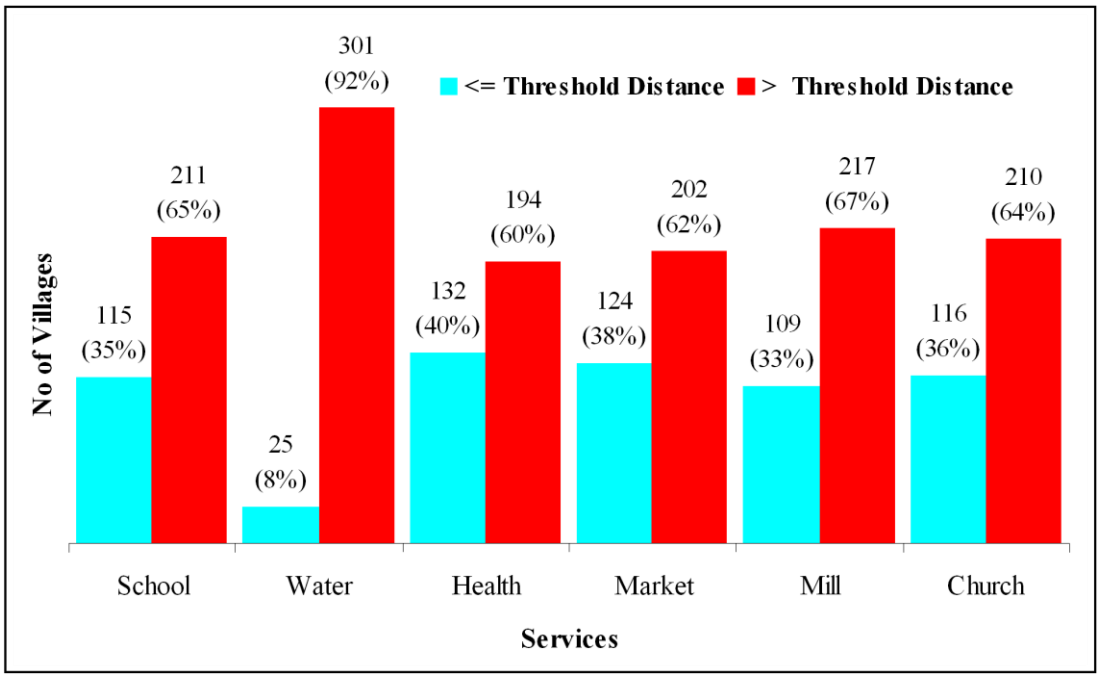


Figure 4.5 Distribution of villages according to distance threshold values to facilities using road - network distances

Generally, Figures 4.5 and 4.6 demonstrate there is a large number of villages in Chikwawa with key facilities located at distances beyond the threshold values adopted in this study. This is most pronounced with safe water supply points where only 8% (by road network) and 32% (by straight-line distances) of the villages have safe water supply points located within a threshold value of 1km.

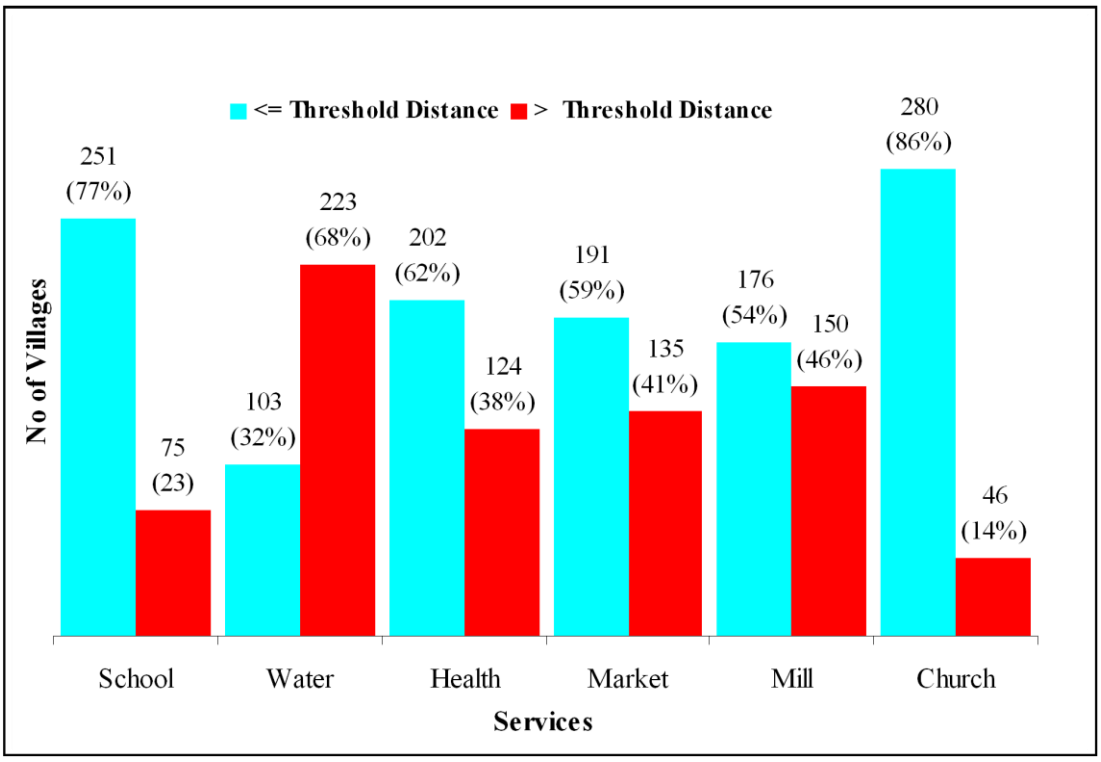


Figure 4.6 Distribution of villages according to distance threshold values to facilities using straight line distances

Table 4.1 indicates the average distance (and standard deviation) to each facility type. For all facilities (except water: average = 2.5km) the average distances are within the threshold distances when straight - line distances are considered.

	Schools	Safe Water Points	Health Care Facilities	Main Trading Centres	Grinding Mills	Religious Centres
Number of Facilities	196 (60%)[a]	267 (81%)	49 (15%)	40 (12%)	57 (17%)	289 (89%)
Mean distance: network	4.2[b]	5.4	6.9	7.6	8.3	4.6
Standard deviation distance: network	3.3	5	4.9	5.5	5.9	3.7
Mean distance: straight-line	2.1	2.5	5.3	5.6	3	2.9
Standard deviation: straight - line	1.7	2.2	3.4	3.9	2.7	2.3

Table 4.1 Number of facilities, average distances and standard deviation

[a] The number in brackets is the number of each facility as a percentage of the number of villages in the study district.
[b] The average distances in kilometres from villages to each facility

If one considers road network distances then all concerned services (except religious centres) are located beyond their distance thresholds. This further expresses the variation of the outcomes between road network and straight-line distance measurements.

4.4.2 Identifying villages experiencing multiple deprivation

Table 4.2 below shows the cumulative distribution of villages with respect to the number of different facility types that are located beyond the threshold distances.

	Number of villages with k or greater dimensions of access deprivation					
	k >= 1	**k >= 2**	**k >= 3**	**k >= 4**	**k >= 5**	**k = 6**
Road network distance	301[c] (92%)	209 (64%)	192 (59%)	170 (52%)	127 (39%)	67 (21%)
Straight-line distance	223 (68%)	166 (51%)	107 (33%)	64 (20%)	35 (11%)	17 (5%)

Table 4.2 Number of villages with multiple dimensions of access deprivation

[c] The number of villages deprived of k or more facility types and the corresponding percentage. Note that the higher the value of k, the more isolated a village is from the services analysed.

The results in Table 4.2 show that most (92% and 68%) villages in Chikwawa District have one or more basic services located beyond the threshold (k >= 1) by network and straight – line distances respectively. From a policy analysis perspective, it then becomes important to identify those communities with a large number of services located beyond their generally recommended thresholds. Taking

k = 3, then 59% and 33% of the villages would be targeted when road network and straight - line distance measurements are considered respectively. If consideration is given to villages where all six basic facilities are located beyond their threshold distances then 21% and 5% of the villages would be targeted when road network and straight - line distances are used respectively. If one only considers the three most important services (School, Safe Water Supply Points and Healthcare), the distribution of villages cumulative deprivation is shown in Table 4.3.

	Number of villages with k or greater dimensions of access deprivation		
	k >= 1	**k >= 2**	**k = 3**
Road network distance	301 (92%)	201 (61%)	138 (42%)
Straight-line distance	223 (68%)	126 (39%)	43 (13%)

Table 4.3 Number of villages with multiple dimensions of access deprivation (three most important services)

The results demonstrate a rise of 21% and 8% on the number of "most isolated" villages when only these three most important facility types are considered compared to six facility types, using road network and straight – line distances respectively. This underlines the effect of considering more domains in identifying service accessibility gaps in the rural villages. There might be a shift of focus on villages to be targeted when more facilities are considered in the analysis. Figure 4.7 shows the villages that would emerge as primary targets for accessibility improvement in the case where one considers all six facility types analysed in this study. The results demonstrate that many of the villages are located in the eastern boundary which is characterised by highlands. Perhaps this has to do with the difficulties associated with provision of services in highlands or low demand for the services (highlands in rural Malawi are characterised by low population density).

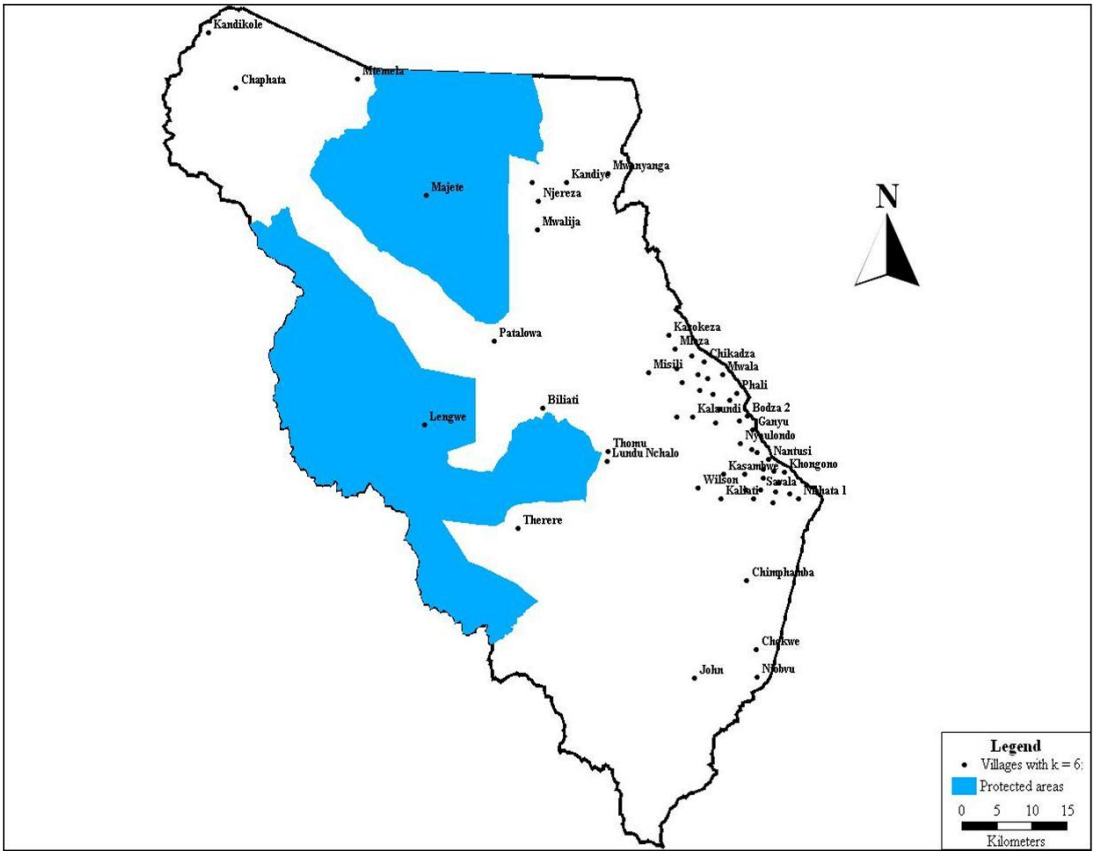


Figure 4.7 Map of villages with six facility types located beyond specified threshold distance based on road network distances

4.5 Policy implications

Like in other rural areas in Malawi, walking is the most common means of travel not only for shorter trips but even for trips of up to 10km. Often, many trips on foot use "off-road" trails (paths) that as much as possible follow a straight - line to the destination. The bicycle and the motorcycle (though not common due to high purchase prices) are the other modes of transport often used for off-road shortcuts**.** Public transport mainly operates on main and secondary roads to the District Business Centre and is for those who can afford to pay for the services.

It has been established through this study that a significant number of villages are closer to facilities when straight-line distances are used compared to road network distances. This indicates that it is important to carefully consider off-road local short-cut trails. To contribute positively in the long run to Chikwawa District mobility**,** it

could be quite cost-effective to give special care to direct walking routes with all weather quality. Currently, off road short cut routes are not considered for maintenance by either Central or Local Government.

This study has also demonstrated that a large number of villages have facilities located beyond their generally recommended threshold distances. Clearly, the District Planning Policy for Chikwawa District should develop a vision on the desirable spatial distribution of facilities in order to reduce the maximum required trip distance for most trips. It should also develop a vision on how the road and local trail network connectivity can be used as an instrument to support a balanced development of the district without a strong spatial segregation between activity centres and large parts of the population.

4.6 Conclusions

This chapter has examined the accessibility of villages to key facilities in the district of Chikwawa. It has demonstrated that there are more villages whose facilities are beyond their threshold access-distances when road network distance measures are considered than when straight-line distances are used. Based on these outcomes, it can be suggested that comparison of road network and straight-line distances to services can be used as a technique to identify villages that have services fairly close to them but lack a direct road connection (e.g. face significant detours in road network, perhaps caused by steep gradients or rivers). Therefore, transport policies for Chikwawa District should be a balanced mix, taking into account the actual modes of transport used, aiming at improved local “non-car” paths and footbridges alongside a cost-effective road network, and aim at encouraging a better spread of activity locations. Such a balanced mix could well turn out to be cheaper as well as more effective than expanding the rural road network.

Bearing in mind that there might be (i) omission of road links and facilities from the initial secondary data and/or (ii) new developments (for example newly constructed facilities and road links) after the secondary data, chapter 4 characterizes the study

villages based on secondary and primary data and re-examines the multidimensional access deprivation.

CHAPTER 5

Understanding the multidimensional village access deprivation using secondary and primary data

5.1 Introduction

Chapter 4 identified villages with multiple access deprivation and villages experiencing low levels of accessibility. The analysis was based on secondary data from the 2008 Malawi National Statistics Surveys and 2009 Malawi Roads Authority road network yearbook and employed distance as deterrent factor contributing to lack of access to services. Based on village information identification surveys that aimed at validating the initial secondary data used in Chapter 4; this chapter attempts to further analyse the multidimensional access deprivation experienced by the 30 selected villages in Chikwawa district. In addition to distance to the nearest facility type (including distance to the nearest motorable road), this chapter employed road condition and local topography as deterrent factors contributing to lack of access to services.

For people living in rural areas, the physical accessibility to services and facilities is a key component to human well being. The quality of life for a particular area depends on the ability of its inhabitants to access essential public services (Talen & Anselin, 1998), educational services (Vasconcellos, 1997; DiGuiseppi et al., 1998; Das et al., 2001; Cooper et al., 2003) and medical facilities (Whitehead, 1990; Ajala et al., 2005; Hofman et al., 2008) amongst other factors such as rainfall (Diener & Suh, 1997), agricultural potential of the soil (Tilman et al., 2002) and security (Kahn, 2002). Physical proximity to services and facilities contributes to individual welfare by conferring choice and opportunities and results in travel cost savings which can be used for other expenditures (Gupta et al., 2003; Hyndman et al., 2003; Dercon & Hoddinott, 2005; Thomas et al., 2005; Birdsall & Orivel, 2006; Gage & Calixte, 2006; Dunkley et al., 2009).

Among others, distance to the facility including the distance to the nearest motorable road (where individuals can access motorised transport), the quality of the road infrastructure, and the terrain are the deterrent factors of physical access to services. The subject of how distance to service types contribute to inability to access socio – economic and basic services in developing countries have been well researched (Buor, 2003; Thomas et al., 2005; Awoyemi et al., 2011). In addition, Das et al. (2001), Ajala et al. (2005) and Hofman et al. (2008) highlighted the influence of proximity to all-weather road access on health and education services. The importance of having good condition of road transport infrastructure and various means of transport services (that can easily be accessed) on improved access to services has widely been document (Vasconcellos, 1997; DiGuiseppi et al., 1998; Cooper et al., 2003). Other studies have also investigated the impact of topography on access to services (Gage & Calixte, 2006; Boris et al., 2007; Omole & Owoeye, 2012). Moreover, Bryson and Howe (1993) highlighted long distances to services, poor conditions of road network, steep slopes in high lands and unavailability of appropriate means of transport as accessibility problems in developing countries.

The utilisation of services varies as a result of socio-economic and physical factors and it is very difficult to ensure even utilisation of services and equitable access to services because of the variations in individuals' socio-economic characteristics and the spatial separation between communities and services (Pinch, 1985). Social factors also play a large part in determining access to services (Jones & Moon 1987, Birkin et al., 1996). Accessibility used as a social indicator shows levels of access to activities considered to be of social value for example education. It is generally measured at the individual level, using disaggregated data, as well as at the community level and its focus is on identifying social inequalities. The resulting measure can be mapped to visually compare villages (Talen, 1998) or can be used in a statistical analysis to determine the relation between it and other variables. This helps in targeting the villages that would emerge as primary targets for accessibility improvement. Consequently, an understanding of both physical factors influencing access to services and social – economic characteristics of households is the first step

in the development of policies and strategies for provision of effective interventions to improve rural accessibility.

Attention of researchers has recently been focussed on spatial distribution of, and differential accessibility to urban services than rural services (Pacione, 1989; Talen, 1997; Hewko et al, 2002; Tsou et al, 2005; Oh & Jeong, 2007; Chang & Liao, 2011; Wash et al, 2011; Mobaraki et al, 2012*).* Limited research has devoted attention on physical accessibility to rural services especially in developing countries like Malawi though access to public assets, services and economic opportunities is profoundly unequal across the population (NSO, 2010). Access to education, a major driver of relative wealth, is highly inequitable. Access to clean water, a key to well being is unevenly distributed across the rural communities. In addition, health care facilities are sparsely distributed. Moreover, despite efforts by successive governments in Malawi to improve on service delivery, the situation on ground in the rural areas is far from being adequate. The condition of the rural road infrastructure is very poor. It is difficult to access services by motorised vehicles or on foot during wet season. It becomes even more difficult in hilly areas. Therefore, to policy makers it then becomes more important to have adequate information and data about the actual status of the determinants of the village access deprivation. This chapter attempts to contribute to the understanding of how rural villages experiencing multiple access deprivation to services may be identified thereby helping policy makers in Malawi to identify villages that would emerge as primary targets for accessibility improvement.

This chapter focuses on the following three factors that contribute to lack of access to services: (i) distance to the service (including motorable road), (ii) condition of the road network and (iii) the local topography. Based on these deterrent factors this chapter attempts to address the same objectives as addressed in Chapter 3 as follows:

$\Rightarrow$ examine the accessibility of the villages to a range of key services

$\Rightarrow$ identify villages experiencing low levels of accessibility

5.2 Research methods

In chapter 4, 326 villages (with multiple distance access deprivation) were identified and grouped in six bands of accessibility using distance threshold values to key facilities. From each band 25 villages were randomly selected. Thereafter, from the selected villages in each band, villages were strategically selected with a probability proportional to the number of villages in each band for a sample size of 30 villages.

This chapter draws on the analysis of data from the Malawi National Statistics Office (NSO, 2008) and data collected from village and household surveys conducted in the 30 selected villages in 2011. The village information identification survey aimed at checking the correctness and completeness of the secondary data as discussed in Chapter 3 of this thesis. The validation process involved a check of whether there were omissions of road links and facilities from the initial secondary data or whether there had been new developments i.e. newly constructed facilities and road links. This primary information gathering was conducted through interviews with traditional village chiefs and well informed members from the villages under study and observations of the condition and connectivity of the transport network in addition to locating the nearest motorable road from the villages.

Accessibility measures based on distances to the nearest facility employed GIS, TransCAD 4.8 (Caliper Corporation, 2005) tool to measure the shortest path from each village to the nearest facility of each type. Villages and facilities were connected to the nearest point on the road network using dummy links representing the centroid connectors to the network.

The calculation of distance to the nearest facility of a specific type and the Accessibility - Composite Indicator employed the same equations and distance threshold levels as shown in Chapter 4 (section 4.3) of this thesis. The location of the nearest motorable road where public transport could be accessed was established by the Global Positioning System (GPS) during the village information identification exercise. A distance threshold of 2.0kms was defined as recommended by the World

Bank and highlighted by Roberts and Rastogi (2006). The World Bank is now measuring for each country the "portion of rural residents residing within two kilometres, typically a walk of 20-25 minutes to an all-weather road" as an index of each country's accessibility level.

Unlike in Chapter 4, this Chapter considered secondary schools because the village surveys identified the location of the secondary schools. However, religious centres were not considered as it was established during the village information identification exercise that there were a lot of church establishments within 6kms radius of the study villages that were established after the 2008 National statistics surveys and most of them were being conducted within family compounds[4]. It would have required extra time and resources to locate the centres using Global Positioning System which was beyond the time/resources available.

A matrix of accessibility scores for the 30 villages and seven facility types (primary schools, secondary schools, safe water supply points, healthcare facilities, markets, grinding mills and motorable road) was then constructed. To identify villages with multiple dimensions of access deprivation based on distance to the nearest facility type this study adopted Alkire & Foster (2009) approach: A_i = k where k is the number of dimensions in which a village is deprived and considers two extremes of being deprived in one facility type (k = 1) or in all facility types (k = 7).

The Malawi Roads Authority classifies road condition as poor, fair, good and excellent. The respondents (village chiefs and/or well informed individuals) from the village identification surveys were asked to rate the general state of the roads in their villages and surrounding areas where they accessed services. The rating was subjective and was supplemented by visual observations which were conducted by the researcher[5]. The information from the Village Chief and/or the well informed member sought to understand the perception of the village members towards the condition of the road network to services. To take care of the subjectivity in the

[4] Family compounds consist of a number of households whose members are closely related
[5] The researcher had experience in road condition assessment having worked for the Ministry of Transport and Public Works as a road maintenance Engineer

rating, the informants were carefully directed on how to rate the condition of the road network as follows: poor condition of the road network were to be rated as roads which were impassable by a four wheeled pickup during the rainy season. For rural villages where access to services is predominantly on foot, the roads were also to be rated as roads which were hardly passable on foot during rainy season. Predictable interruptions of short duration during inclement weather (e.g. heavy rainfall) were acceptable. Fair condition of the road network were to be rated as roads which were passable using a four wheeled pickup, however with difficulties and also passable with some difficulties on foot during the rainy season. Good condition of the road network also referred to as an "all-season road" were to be rated as a roads that were motorable all year round by the prevailing means of rural transport (often a pick-up or a truck which does not have four-wheel-drive) (World Bank, 2007). Whereas excellent condition of the road network were to be rated as roads which were mostly paved and passable through out the year.

Where the trips to the services were made through different classes of road network, the class attribute to the service was the one associated with the longest travel time. For example a trip to health care facility which would require accessing public transport where the condition of the 1st mile (distance to the nearest motorable road where public transport could be accessed) was poor and required more time to access the public transport access point, then the condition of the road to the service was rated as poor. It was very difficult for the informants to differentiate the classes, for example "poor and fair" or "good and excellent". To them, the road to the service was characterised as either poor or good. As such, this study adopted this characterisation which is also used in the subsequent Chapters 6 and 7. A village accessibility indicator based on condition of the road network was estimated as $l = 0$ when the road condition was good and $l = 1$ otherwise.

Chikwawa District is characterized by highlands, hills and flat plains. The levels of access to services may differ with villages from highlands perhaps experiencing low levels of accessibility due to steep slopes. The secondary data information distinguished topographic villages in highlands and flat plains. While it is important

to have an in-depth topographic analysis of the village – service connection which can be conducted through digital terrain models, this study adopted a binary variable (Hilly and Flat) as a measure of topography. In the exploration of whether location did matter in the growth of urban centres in Nepal and in a study on the impact of hilly topography on settlement pattern and housing development in Idanre, Nigeria, Boris et al. (2007) and Omole & Owoeye (2012) respectively used binary variable in the absence of digital terrain models. A village accessibility indicator to a specific facility type based on topography was then estimated as $l = 0$ when the village – service connection was located in flat area and $l = 1$ otherwise.

Finally, villages experiencing multiple access deprivation were identified based on the Accessibility - Composite Indicator (k-values), condition of road network and topography (l-values). The aggregation of these indicators is vital in identifying the multidimensionality of access deprivation experienced by different villages; for example Rodgers et al. (2006) and Robinson et al. (2007) used analytical techniques to investigate poverty at varying ranges of geographical parameters.

5.3 Results

5.3.1 Characterization of the Village Form

Distribution of facilities

The most obvious way that the villages under study can be differentiated is through their basic structure as determined by the road connectivity and distribution of services. Some villages were well connected with road network while others were sparsely connected. On the other hand, some villages had more than one of a particular facility type while others did not have any such facility within distance threshold values. The number of facilities within distance threshold of each facility type from the villages is shown in Table 5.1.

Study Village	Primary Schools within 3kms	Secondary Schools within 6kms	Boreholes within 1km	Healthcare facilities within 6kms	Markets within 6kms	Grinding mills within 6kms
Beleu	2	1	2	2	3	2
Biliati	1	0	0	0	2	0
Chikwawa Township	3	2	2	1	3	2
Chindoko	1	0	0	0	0	1
Chipwepwete	1	0	0	0	1	0
Guta	0	0	0	1	1	1
Jomba	1	1	0	0	1	4
Kandeu	1	0	0	1	0	1
Machokola	0	0	0	0	0	0
Makhula	0	0	0	0	0	0
Matimati	0	0	0	0	0	0
Medremu	1	1	0	2	3	2
Mphonde	2	1	1	0	1	0
Mtalika	1	0	0	0	1	1
Mwalija	0	1	0	1	2	1
Mwanayaya	1	0	0	0	0	0
Namila	0	0	1	2	2	2
Ndirande	0	1	0	3	1	0
Ngabu	2	2	2	3	3	6
Ngalu	1	2	0	3	3	6
Nkhutche	1	1	0	4	1	7
Ntchabela	0	1	0	3	2	4
Ntondeza	2	0	0	2	1	1
Salumeje	1	0	0	3	2	2
Sekeni	0	0	0	2	0	1
Tembenao	1	1	0	0	1	2
Thembedza	0	0	1	0	1	0
Thomu	0	0	0	3	0	1
Tomali	0	1	0	4	1	1
Tombondera	0	0	0	0	1	0

Figure 5.1 Number of facilities within threshold distances of each facility type from the villages

The table demonstrates that three villages had all the facility types located within the threshold distances and three villages had all the facilities located beyond the threshold distances.

Distribution of villages based on accessibility deterrent factors

Villages can also be characterised by the distance from the village to the facility type including distance to the nearest motorable road where inhabitants can access motorised public transport to services, condition of the road network and the local

topography. This section presents results on the distribution of villages based on these accessibility deterrent factors.

Distribution of villages based on distances to the facilities

The distribution of villages based on distances to the nearest facility type is shown in Figure 5.1. It demonstrates that most villages (26 and 24) were located at less than 5kms from the nearest primary schools and nearest motorable road respectively.

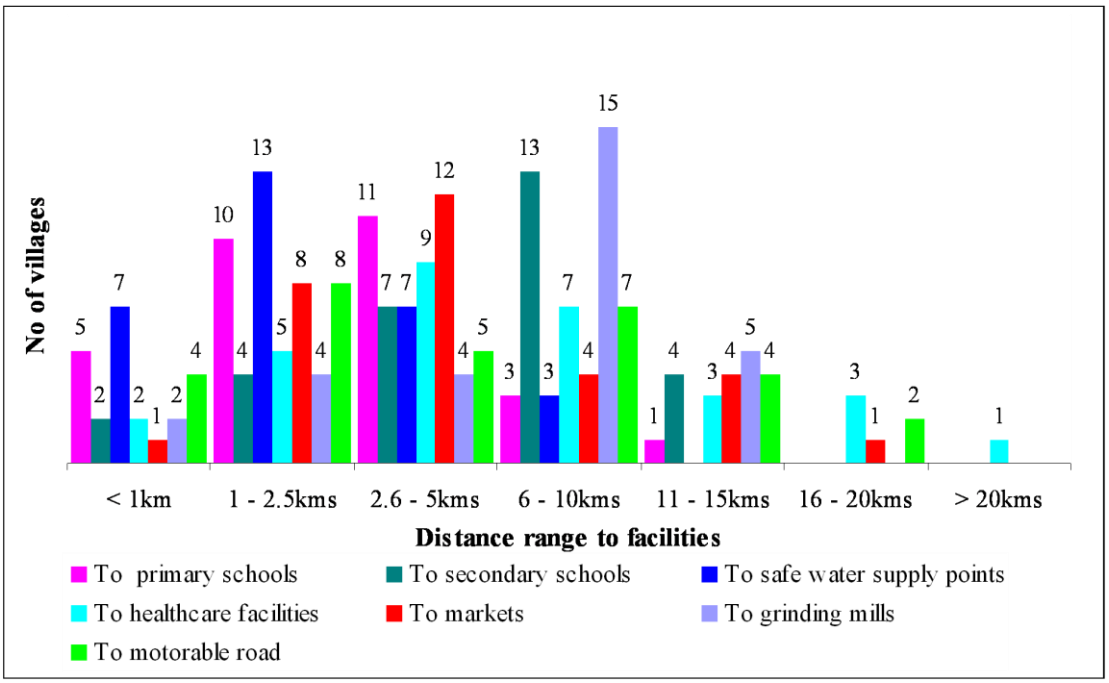


Figure 5.1 Distance ranges from villages to key services

In addition, 7 (23%) were located at more than 11kms to the nearest healthcare facilities. Moreover, of the 30 villages, 5 (17%) and 6 (20%) were located at more than 11kms from the nearest market and motorable road respectively. The number of villages with access to each facility type below and beyond their distance threshold values is demonstrated in Figure 5.2.

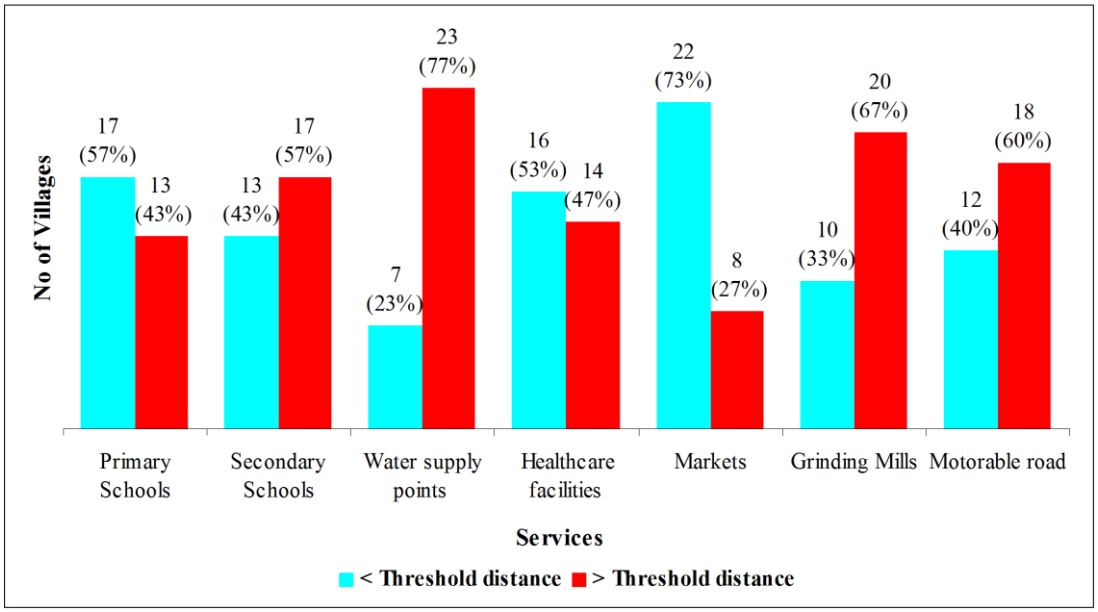


Figure 5.2 Distribution of villages according to distance threshold values to facilities

Figure 5.2 demonstrates more villages with secondary schools, water supply points and healthcare facilities located at distances beyond their threshold values adopted in this study. This was most pronounced with safe water supply points where 77% of the villages had safe water supply points located beyond a threshold value of 1km. The distribution of villages based on distances to the nearest motorable road demonstrates that out of the 30 study villages, 18 (60%) were located at distance of more than 2kms to the nearest motorable road where they could access motorised public transport. The distances from the villages to the nearest motorable road are shown in Appendix D. The number of dimensions in which a village was deprived (k-values) based on distance to facilities is shown in Table 5.2

Distribution of villages based on local topography and condition of the road network

Figure 5.3 shows the distribution of villages based on the local topography and the general state of road network. It shows that 40% of the study villages were located in hilly areas and the road network in 19 villages was in poor condition.

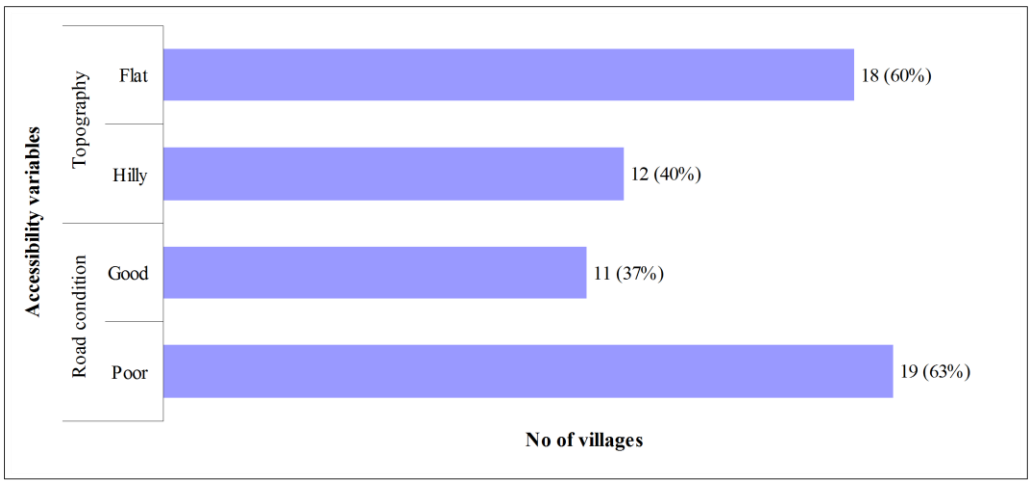


Figure 5.3 Distribution of villages based on local topography and road condition

5.3.2 Identifying villages experiencing multiple dimensions of access deprivation

Table 5.2 shows the number of villages with multiple dimensions of deprivation based on distance to various facility types (primary schools, secondary schools, water supply points, healthcare facilities, markets, grinding mills and motorable road), road condition and the local topography.

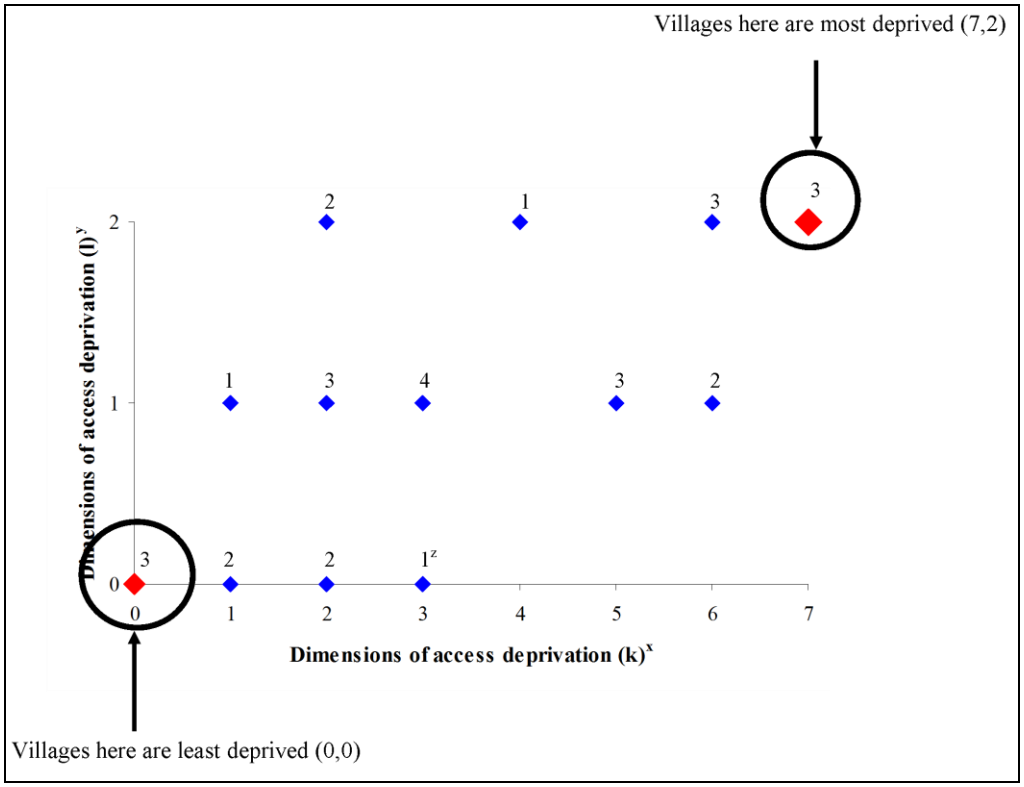
	Dimensions of access deprivation (k)							
Deterrent factors	**k = 0**	**k = 1**	**k = 2**	**k = 3**	**k = 4**	**k = 5**	**k = 6**	**k = 7**
Distance to the nearest facility type	3	3	7	5	1	3	5	3
	Dimensions of access deprivation (l)							
	l = 0	**l = 1**	**l = 2**					
Condition of the roads and local topography	8	13	9	-	-	-	-	-

Table 5.2 Number of villages with multiple dimensions of access deprivation

The results exhibit that 27 (90%) of the villages had one or more basic services located beyond the threshold distance to the facility type (k >= 1) and 3 villages had all the facility types located beyond the threshold distance (k = 7). In addition, Table 5.2 demonstrates that 8 (27%) of the villages were located in flat areas and their road network was in good condition (l = 0). Moreover 9 (30%) of the villages were both located in hilly areas and their road network was in poor condition (l = 2).

Aggregated multidimensional access deprivation

It has been shown that the status of the condition of the road network varies from village to village. It has also been shown that some villages are located in highlands and others in flat plains. In addition, the minimum distances to the motorised road differ from village to village, ranging from less than one kilometre to more than six kilometres. It then becomes difficult to examine whether there are differences in accessibility levels amongst villages when accessibility indicators are considered separately because different villages can be deprived of accessibility through different indicators. For example, a village can have its road network in good condition, however far away from basic services whereas the other may have its road network in poor condition but closer to services. This section presents the multidimensional access deprivation based on all the deterrent factors and the results are as demonstrated Figure 5.4.



[x] based on distances to the nearest facility type

[y] based on the general state of the road network and the local topography

[z] number of villages at the particular point

Figure 5.4 Villages experiencing multiple dimensions of access deprivation

Figure 5.4 shows a plot of villages with multiple dimensions of access deprivation. There were three least access deprived villages (point (0,0)) and three most access deprived villages (point (7,2)). The study villages and the associated dimensions of access deprivation (k and l) are presented in Appendix E.

5.4 Conclusions

It has been established in this chapter that inequality exists in the distribution of existing facilities among the villages. Some villages have more than one of the facility types while others do not have facilities within distance threshold values. It has also been demonstrated that more than 50% of the study villages had secondary schools, water supply points, grinding mills and motorable road located beyond distance thresholds. 60% of the villages had motorable road located beyond a threshold value of 2kms. In addition, it has also been established in this chapter that 90% of the villages had one or more basic services located beyond the threshold distance to the facility type. This chapter has also shown that the road network in 63% of the study villages was in poor condition. Moreover, this chapter identified three most deprived villages and three least deprived villages.

These findings demonstrate serious inadequacy in the provision of key facilities to the inhabitants from the study villages. The findings also demonstrate lack of well maintained road infrastructure. This access deprivation may influence access to basic and socio – economic services such as education and healthcare. However, what this chapter has not analysed is the balance between demand for and supply of services because there was limited data to validate the measurement of the supply – demand balance. Bearing in mind that demand shapes the provision of services, knowledge on the balance between demand and supply is important for policy implications, especially when considering allocation of resources.

CHAPTER 6

The influence of school accessibility on school attendance and educational performance/achievement

6.1 Introduction

Accessibility to services such as schools is an important aspect of an individual's quality of life. Apart from the poor connectivity between households and schools that reflects the physical or geographical dimension of inaccessibility, lack of or low quality schools and individual's or/and household's socio-economic characteristics (for example gender, income and level of education) are also factors that may deter accessibility to schools. This Chapter employs this concept as a framework for analyzing the influence of physical accessibility on school attendance and performance in Chikwawa District – rural Malawi.

Many studies have looked into the relationship between physical accessibility and development focussing around improved accessibility through roads as a factor of economic growth (World Bank, 2007). The problem of road deterioration due to lack of maintenance has become a growing issue in a number of developing countries and has been widely discussed (World Bank, 1992; Howe, 1997; Donnges, 2003; Edmonds, 2004 and Johansson, 2006). With poor roads, travel time to schools obviously increases and when travel becomes too difficult, many people choose not to go to such schools.

Physical accessibility problems in developing countries may be attributed to several factors. Among the factors, Barwell (1996) highlighted long distances to services, unavailability of appropriate means of transport, poor conditions of road network and steep slopes in high lands as problems that hinder access to schools in developing countries. With longer distance to school, time of travel may partly be reduced when mode of transport appropriate for such longer trips (e.g. motorised transport or

bicycle) is used. Vasconcellos (1997), DiGuiseppi et al. (1998) and Cooper et al. (2003) underscored the importance of having various means of transport (that can easily be accessed) on children's education. However, the performance of various means of transport may be influenced by the condition of the road network and topography. Du & Mulley (2007) demonstrated the importance of adequate and well-maintained transport infrastructure on the performance of various means of transport. Moreover, Gage & Calixte (2006), Boris et al. (2007) and Omole & Owoeye (2012) highlighted the impact of topography on access to schools. In the case of rural Malawi (where school trips are predominantly on foot), cycling is the other means of travel especially for long distance school trips. However, longer school trips (where cycling would be applicable) are often made on foot due to non-availability of bicycles and/or steep slopes. Whilst, it is difficult to walk through steep and rocky terrain, it is even more difficult when bicycles are used for obvious reasons. Most available bicycles do not have gears and therefore, movement wholly relies on human effort.

The concept of accessibility is broadening to include not only geographical accessibility but also ideas of social inclusion and social exclusion (Donnges et al. 2005; Farrington and Farrington, 2005). Together with this maturing notion of accessibility there is now need to investigate, in a more evidence-based manner, the extent to which physical or geographical accessibility can affect social outcomes such as school attendance. The ultimate impacts of accessibility to some extent depend on non-geographical factors that are social and institutional in nature. Farrington & Farrington (2005) highlighted that there are multiple and complex cause-effect relationships between social-economic constraints and accessibility constraints and their combined effects on life chances. However, to a great extent, the understanding of the relationship is based on simple bi-variate associations and subjective evidence that do not take into account a host of social and institutional determinants that may affect relationship of accessibility with the outcome. On this account, Rama (2005) underlined the need for further exploration of the impact of a lack of transport infrastructure on children's development, well-being and their livelihood taking into account social determinants.

It is true that appropriate levels of accessibility are critical for the overall development of a nation; however evidence-based research on how it is so, particularly on achieving educational attainment is inadequate. Moreover, Porter et al. (2006) observed that children and teachers face many difficulties getting to school in rural parts of Africa, Asia and Latin America but pointed out lack of sufficient evidence to show the extent and nature of impacts on school enrolment and attendance.

The Malawi Growth and Development Strategy (MGDS) identified education as one of the key priority areas which would define and accelerate the attainment of the Millennium Development Goals (MDGs) (GoM, 2007). The MGDS recognized that an educated population is necessary if Malawi is to achieve sustainable development. However, the strategies highlighted on education improvement emphasise institutional determinants i.e. provision of adequate learning and teaching materials and rehabilitation and construction of modern schools at all levels and not physical determinants of school accessibility. There has not been any study linking physical accessibility and school attendance in Malawi.

This Chapter therefore attempts to contribute to the existing knowledge, however in a distinct way by exploring the influence of physical accessibility on school non-attendance, lateness for school, absenteeism for school and failure of examination in Chikwawa District, rural Malawi. The study seeks to answer the following questions:

⇒ Does distance have influence on the number of individuals who have never attended school or dropped out of school?

⇒ What factors influence levels of lateness for school, school absenteeism and rate of examination failure? The accessibility factors considered are distance to school, one way travel time to school, topography and condition of the road network in addition to socio-economic characteristics.

⇒ Is school examination failure associated with levels of lateness and absenteeism for school?

6.2 Research methods

This research draws on the analysis of data collected from a household survey conducted in 2011 in a sample of 30 villages located in Chikwawa District-rural Malawi. Chikwawa District is in the Southern Region of Malawi located about 50 km southeast of Blantyre, the commercial Capital of Malawi. The district lies along the lower flat basin of Shire River, which is along the Great African Rift Valley. Chikwawa has a population of 438,895 and 103,591 households (NSO, 2010).

The focus of this study was to find out the influence of distance on school non-attendance and educational performance. In order to do so, the study was divided into the following sections: sampling of the study villages and households, questionnaire administration and data analysis. There were two sampling phases for this study: The first phase involved sampling of villages in Chikwawa district. Study villages were selected based on levels of distance access deprivation as discussed in Chapters 3 and 4. The second sampling phase involved random selection of households during the household surveys. The household surveys were conducted after village identification surveys and survey questionnaire piloting. The sampling process, village identification process, questionnaire development and administration and data coding process are discussed in Chapter 3.

The village identification survey sought the following information: the number of key facility types within distance threshold for each facility type, the location of the villages and the condition of the road network (discussed in chapter 5). The household survey sought information on accessibility characteristics and individual and family level socio-economic characteristics. The respondents were asked about the following: gender and age of the members of the household, education level of the head of household, household's regular income, whether a member of household had never attended school or dropped out of school and for those attending school: where they were attending school, mode of transport used, time spent on the way to school, whether they were sometimes late or absent for school and whether they had failed in any examinations and if yes, the number of occasions they were late or absent for school and number of examinations failed. The outcomes of this survey

were individual level variables, and the unit of analysis considered in this chapter was the child. Some of the explanatory variables were strictly at the individual level (e.g. age and sex), others were at the household level (e.g. education level of head of household and wage employment) and still others were at the community or higher level (e.g. condition of the road network).

From this survey, the following variables were derived: distance to school, travel time to school, topography, road condition, gender, age, level of education and regular income. Shortest path from village to school was estimated using a standard GIS, TransCAD 4.8 (Caliper Corporation, 2005) tool as discussed in chapters 3 and 4. Distances were classified as less than 1.5kms, 1.5 – 3.0kms, 3.0 – 6.0kms and more than 6.0kms. One way travel time to school was categorised as less than 30minutes, 30 – 60minutes, 60 – 120minutes and more than 120minutes.

Two location characteristics were considered in this study: Hilly/Flat and Poor/Good road network. The secondary data distinguished villages in hilly areas and flat areas and this was validated through the village survey exercise as discussed in chapters 3 and 5. Villages were either considered to be located in hilly areas or flat areas. Good condition of the road network also referred to as an "all-season road" is a road that is motorable all year round by the prevailing means of rural transport (often a pick-up or a truck which does not have four-wheel-drive) (World Bank, 2007). For rural villages where access to services is predominantly on foot, the road condition termed "good" was considered to be a road that was passable without difficulties all year round by foot. Predictable interruptions of short duration during inclement weather (e.g. heavy rainfall) were acceptable. Villages were identified by the condition of its road network as presented in chapter 5.

The education level completed by the head of the household was taken as a measure of educational stratification amongst the households. The levels were classified into two categories: (i) those that have had no formal education (illiterate), (ii) those that could at least read and write a letter (literate). In this study wage employment also referred to as regular income was measured at household level and the survey sought

information on whether there was a member of the household who was engaged in paid up employment; Yes or No.

To explore the influence of distance on school non – attendance, firstly individuals who reported to have dropped out of primary and secondary schools were selected and distances to the nearest schools were measured. In addition, those who reported to have never attended school were matched against the nearest primary schools. In estimating the distances, the assumption was that the individuals start their trip from the village area centroid. The distances were arranged into four categories namely, less than 1.5km, 1.5 – 3.0kms, 3.0 – 6.0kms and more than 6.0kms. In each distance to school interval a total number of individuals from 6 – 15 and 16 - 20 age groups were selected from the sampled population. Having selected the total number of individuals of the same age group and within the same distance to school group who had never attended school and dropped out of school percentages of not attending school against the total selected number of individuals from the 6 – 15 and 16 - 20 age groups were calculated to test if the percentages increased with longer distances. Secondary education level had the least dropouts (n = 43).

The school non-attendance was a binary variable and the research sought information on whether the child was enrolled at the time of survey, defined in the survey as those currently attending school, or not. Children in two age groups 6 to 15 and 16 to 20 were studied. This resulted in a sample size of 1909 cases from the 945 households. Although students falling into each of these age groups would typically attend primary and secondary school respectively, this was not strictly so. Obviously there were some children from the 16 to 20 age group going to primary school and a few from the younger group going to secondary. Nevertheless, this research was looking at school attendance and performance irrespective of the grade the child was attending.

To statistically estimate the magnitude of the influence that distance had on school non-attendance, a series of binary logistic regression models were performed using SPSS version 19.0 (SPSS, 2010) since the non-attendance variable, whether enrolled

or not enrolled in school, was categorical and its relationship with the independent variables was non-linear. Binary categorical dependent variables could not be modelled as a linear function of the independent variables (Long and Freese, 2006). The following were the binary logistic regressions considered:

$$In\left(\frac{y}{1-y}\right) = \alpha + \beta_P(P) + \varepsilon \text{ .... Model (1)}$$

$$In\left(\frac{y}{1-y}\right) = \alpha + \beta_P(P) + \beta_L L + \varepsilon \text{ .... Model (2)}$$

$$In\left(\frac{y}{1-y}\right) = \alpha + \beta_P(P) + \beta_L L + \beta_R R + \varepsilon \text{ .... Model (3)}$$

$$In\left(\frac{y}{1-y}\right) = \alpha + \beta_P(P) + \beta_L L + \beta_R R + \sum \beta_S S + \varepsilon \text{ .... Model (4)}$$

where, y = Predicted event of school non-attendance, P = Physical accessibility (distance), L = location (hilly or flat areas), R = Road condition (poor or good) and S = Socio-demographic characteristics.

The first model was estimated with only one independent variable as the regressor variable. The second model was estimated after controlling for location factors. The third model was estimated after controlling for road condition factors. The fourth model was estimated after controlling for socio-demographic factors relevant to the child and his/her household to assess the direct effects of accessibility separated from the direct effects that were mediated through socio-economic characteristics.

A very high collinearity between independent variables would limit the ability to determine which independent variable was producing the effect on the outcome variables. As such, the degree of multi-collinearity between independent variables was checked by computing the Variance Inflation Factors (VIF) for each independent variable. VIF for each variable is equivalent to the reciprocal of (1-R squared), where R is the correlation coefficient of the variable with other independent variables. Chen et al. (2003) suggested that as a rule of thumb, a variable whose VIF values are greater than 10 may merit further investigation. In the case of this study all VIFs were less than 10.

The data explaining the lateness for school, school absenteeism and examination failure was ordinal. As such, the influence of accessibility (distance) on these outcome variables was estimated by employing a series of ordinal regression models. The binary logistic models were modified to incorporate the ordinal nature of the dependent variables by defining the probabilities differently. Instead of considering the probability of an individual event, the probability of that event and all events that are ordered before it were considered and using the same 4 model system as for the binary attendance, parameters and odds ratios were estimated.

One way between groups analysis of variance with post – hoc tests was employed to test the variation of travel time groups and levels of lateness for school, school absenteeism and rate of examination failure.

6.2.1 Limitations

There are primarily three broad dimensions of factors that may deter accessibility to schools and these are: (i) geographical/physical (ii) social and (iii) institutional. Geographical barriers imply long distances to school. Social barriers entail barriers that emanate from community and/or household characteristics in addition to gender, age (personal traits that can determine one's accessibility levels). Institutional barriers imply the lack of or low quality institutions such as schools.

The models estimated using the cross sectional data are based on the following fundamental relationship between development and accessibility: Development outcome = f (accessibility) and based on the theory above this research expanded the relationship to: School attendance/performance = f (physical access, socio-economic). However, to fully understand the affects of accessibility, the fundamental relationship between school attendance/performance and accessibility need be as follows: School attendance/performance = f (physical access; socio-economic; institutional). This research did not look at institutional barriers of access to schools

(rural school infrastructure quality, teacher availability, unscheduled closures, etc) because data in this area was not collected due to financial limitations.

There were no geo-referenced positions of households instead village area centroids were employed to estimate distances from the villages to schools. It was likely that the actual distance to school for a specific respondent would deviate from the estimated with a considerable error margin depending on how dispersed the households were and how large the village was. In addition, distance measured in terms of different modes is potentially endogenous (Jacoby, 2000). However, travel time is the variable that is dependent on the mode of transport and other controls of accessibility characteristics such as topography and condition of the road network. In this study the mode of travel to schools was predominantly on foot, hence the issue of endogeneity was not a major problem for school accessibility.

6.3 Results

6.3.1 Characterisation of the study population

The total number of individuals (aged between 6 – 20 years) recorded from 945 sampled households was 1909 of which 1037 (54%) were females and 872 (46%) males as shown in Table 6.1. The gender composition obtained was in line with the results from the integrated household surveys conducted by the National Statistics Office which found out that the gender composition for males and females aged between 6 – 20 years in Chikwawa were 48% and 52% respectively (NSO, 2010).

		Numbers of individuals	%
Independent variables	Overall	1909	100%
Gender	Female	1037	54%
	Male	872	46%
Age group	6 - 15	1254	66%
	16 - 20	655	34%
Literacy	Yes	1326	69%
	No	583	31%
Regular income	Yes	732	38%
	No	1177	62%
Distance to the nearest primary school (kilometres)	Less than 1.5	863	45%
	1.5 - 3.0	747	39%
	3.0 - 6.0	256	13%
	More than 6.0	43	2%

Table 6.1 Characteristics of study population aged between 6 – 20 years

As presented in Table 3.2, section 3.6 of chapter 3, of the 945 sampled households in this study, 633 (67%) were headed by literate members and 346 (37%) reported having regular income. As demonstrated in Table 6.1, of the 1909 participants aged between 6 and 20 years, 1326 (69%) were from households headed by literate members and 583 (31%) by illiterate members. In addition, 732 (38%) respondents were from households with regular income compared to 1172 (62%) with no regular income.

Table 6.1 also shows the number of individuals aged between 6 – 20 years based on the distance from their village to the nearest primary school. It demonstrates that more children (863) were living at a distance of less than 1.5 kilometres to the nearest primary school and only few (43) individuals were living at a distance of more than 6km to the nearest primary school.

6.3.2 Outcome variable 1: School non-attendance

Descriptive analysis

The total number of individuals aged 6 – 20 who either had never attended school or had dropped out of school from the sampled population was 404 (21%) as shown in Table 6.2.

		Numbers of individuals
Independent variables	Overall	N = 404
Gender	Male	184
	Female	220
Age group	6 - 15	193
	16 - 20	211
Literacy	Yes	114
	No	290
Regular income	Yes	87
	No	327
Distance to the nearest primary school (kilometres)	Less than 1.5	167
	1.5 - 3.0	163
	3.0 - 6.0	61
	More than 6.0	13

Table 6.2 Number of individuals who either dropped from school or never attended school

Of the 193 individuals from the 6 – 15 years age group, 67 were males and 126 females and of 211 individuals from the 16 – 20 years group, 117 were males and 94 females. The likely reason for the high proportion of females (23%) dropping out of school than males (20%) is that females in rural Malawi, Chikwawa in particular get married as young as 15 years and with high levels of poverty, many female students

drop out of school for marriage. On the other hand more males (117) than females (94) in the 16 – 20 years age group reportedly never attended or dropped out of school. It is likely that the males were employed as casual labours in the sugar plantation fields. The biggest sugar production company in Malawi is in the study district and the need for casual labour from the surrounding villages is very high.

Exploring the influence of distance on school non-attendance

This study section aims at exploring whether distance to school had any influence on the proportion of individuals who never attended school or dropped out of school. The results from the analysis are demonstrated in Figure 6.1.

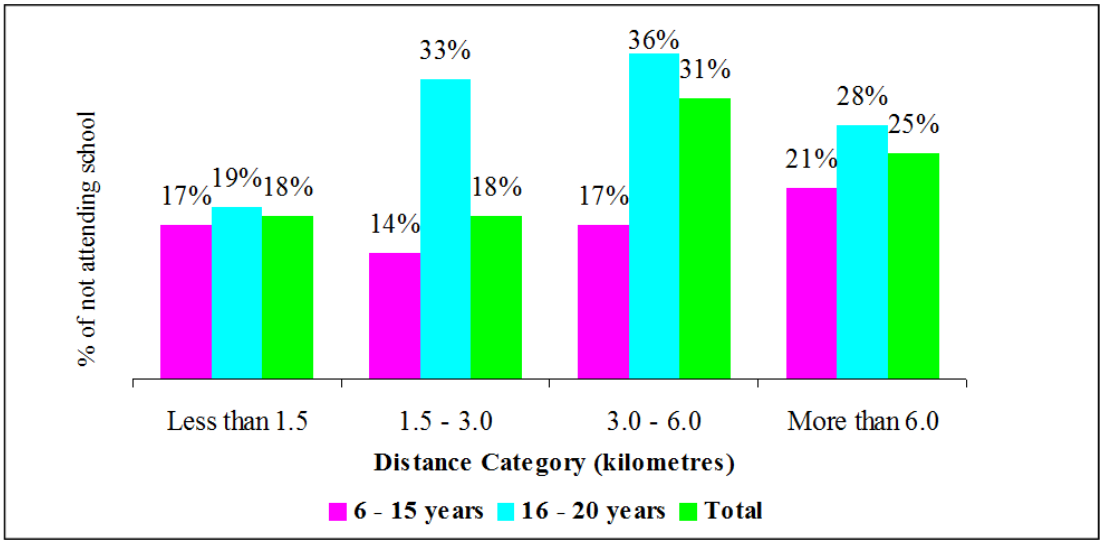


Figure 6.1 Household members who did not attend school based on age and distance as a percentage of total number of members in that age group and within the same distance category

Based on Figure 6.1, the percentage (the number of members who did not attend or drooped out of school as a percentage of the total sampled population in the particular age group) of individuals who did not attend school slightly increased with longer distances especially between 3.0 – 6.0kilometres, however slightly decreased after 6.0kms suggesting that school non-attendance in Chikwawa – rural Malawi was partly influenced by longer distances to school.

Statistical analysis

Results from a bivariate relationship between the main independent variable (accessibility) and other independent variables are demonstrated in Table 6.3.

	Distance to School	Gender	Age	Education level (HH head)
Distance to School				
Gender	.027			
Age	.407**	.048*		
Literacy	.034**	- .065**	.057*	
Regular income	.086**	.003	.11	- .11

** Correlation is significant at the 0.01 level, * correlation is significant at the 0.05 level (2 – tailed)

Table 6.3 Correlation between independent variables (distance, gender, age, literacy and regular income)

Age of the individuals was positively correlated with distance to schools (Table 6.3). Individuals from the higher age category appear to live at longer distances to school than those from the lower category, presumably because children were going to secondary school. Regular income was also positively correlated with distance to schools. Households with paid up employment appear to live closer to schools than households with no paid up employment suggesting that household with paid employment enjoy higher degree of school accessibility. Household head's education is positively correlated with distance to schools. Households which had illiterate household heads appear to live at longer distances to school than those households with literate household heads. This is perhaps an indication that illiteracy is more concentrated in areas where schools are far whereas higher education is concentrated in more accessible areas.

Binary logistic regression models

The binary logistic regression models are presented in Table 6.4. The full model containing all predictors was statistically significant, $\chi^2 = 187.24$, $p < 0.001$ indicating that the model was able to distinguish the respondents who reported they enrolled and did not enrol for school.

The bivariate regression (presented in Table 6.4, Model I) demonstrate that the association between distance and enrolment is statistically significant and the strongest predictor of school non – attendance was the distance of more than 6kms recording an odds ratio of 4.6 indicating that those children from villages located at more than 6.0kms from schools were 4.6 times more likely not to enrol for school than those located at less than 1.5kms.

	Odds ratios from binary logistic regression			
Independent variables	**Model I**	**Model II**	**Model III**	**Model IV**
Distance (Kms)				
< 1.5	1.000			
1.5 - 3.0	1.066	1.115	1.113	1.096
3.0 - 6.0	1.879*	1.928*	1.924*	1.707*
> 6.0	4.641*	4.850*	4.857*	4.154*
Location				
Flat areas		1.000	1.000	1.000
Hilly areas		1.287*	1.214	1.338
Road condition				
Good			1.000	1.000
Poor			1.072	1.014
Gender				
Male				1.000
Female				1.121
Age				
6 - 15				1.000
16 - 20				1.417*
Literacy				
Yes				1.000
No				1.709*
Regular Income				
Yes				1.000
No				1.544*
Constant	0.181	0.156	0.155	0.146

**P<0.05, ** P<0.01*

Table 6.4 Binary logistic regression models: predicting the likelihood of school non-attendance

When locational characteristics were included in the model, the relationships between distance and enrolment became stronger. The magnitude of the effect of distance of more than 6.0 kms on enrolment increased from 4.641 to 4.850 and the significance of the relationship is retained (Table 6.4, Model II). The probability of the children being enrolled in school reduces significantly as households become more inaccessible due to hilliness. Children from villages located in hilly areas were 1.3 times more likely not to enrol for school or drop out of school than those from villages in flat areas.

As shown in Table 6.4, Model III, distance continues to have significant influence on school non-attendance after controlling for road condition characteristics (OR = 4.857 for the > 6kms distance category) although road condition made no unique statistical contribution to the school non-attendance. Model IV demonstrates that apart from distance (> 6kms OR = 4.154); age (OR = 1.417), literacy (OR = .709), and regular income (OR = 1.544) made a statistically unique contribution to the school non-attendance. It shows that children aged 16 – 20 years were 1.4 times more likely not to enrol for school than those aged 6 – 15 years. In addition, children from households headed by illiterate members were 1.7 times more likely not to enrol for school than those households headed by literate members. Moreover, children from households with no regular income were 1.5 times more likely not to enrol for school than those from households with regular income. However, although distance continues to have significant association with school enrolment after controlling for socio-economic characteristics of the child (Table 6.4, Models IV), > the OR coefficient for the > 6.0kms distance category reduces by about 14% (from 4.857 to 4.154) suggesting that some of the distance association with enrolment is actually a result of the socio-economic differences amongst the children.

6.3.3 School attendance

A total number of 1596 reported to be attending school during the period of the interviews as shown in Table 6.5.

		Numbers of individuals
Independent variables		N = 1596
Gender	Female	824 (52%)
	Male	772 (48%)
Age group	6 - 15	1061(66%)
	16 - 20	444 (28%)
	21 - 25	91 (6%)
Type of School	Primary	1127 (71%)
	Secondary	469 (29%)
Means of Transport	Walking	1544 (97%)
	Cycling	52 (3%)
Distance (kilometres)	Less than 1.5	629 (39%)
	1.5 - 3.0	528 (33%)
	3.0 - 6.0	282 (18%)
	More than 6.0	157 (10%)
Travel time (minutes)	< 30	515 (32%)
	30 - 60	529 (33%)
	60 - 120	399 (25%)
	> 120	153 (10%)

Table 6.5 School attendance by independent variables

In addition to 1505 members who were attending school from the 6 – 20 years population group, 91 members from the 21 – 35 years group reported to be attending school during the survey period. 1127 (71%) were attending primary school education and 469 (29%) secondary school education. Out of 1596 individuals 772 (48%) were males and 824 (52%) females. In addition, 1061 (66%) were from the 6 – 15 years age group, 444 (28%) from the 16 – 20 years group and 91 (6%) from the 21 – 35 years age group.

The school attendance distribution showed that from the 6 – 15 years age group more females (548) were attending school than males (513), also more females (230) than males (214) from the 16 – 20 years group were attending school. Moreover, out of

1596 individuals who were attending schools 629 (39%) went to schools located at a distance of less than 1.5km, 528 (33%) to schools located between 1.5 – 3.0kms, 282 (18%) to schools between 3.0 – 6.0kms and 157 (10%) went to schools located at more than 6.0kms. The distribution of school trips by level of school attendance and distance categories is demonstrated in Figure 6.2.

Figure 6.2 demonstrates that most of the individuals (74%) who were attending secondary school education covered a distance of more than 3km to access school. It is also demonstrated that most of the primary school trips (92%) were made within 3kms distance demonstrating that most secondary schools were far from the villages and that most primary schools were within 3kms when straight line distances were considered.

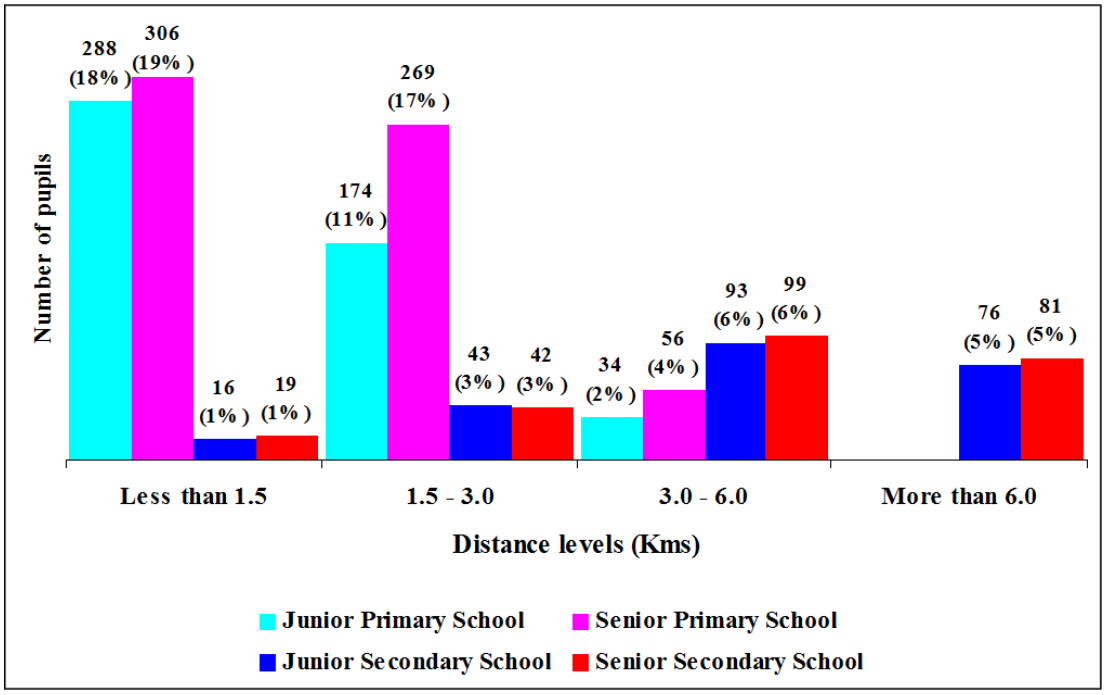


Figure 6.2 Number of school going children by level of attendance and distance categories

Table 6.5 further demonstrates the reported mode of transport to school. Out of the 1596 individuals, 1544 (97%) went to school on foot and 52 (3%) by bicycles. Out of 52 members who used bicycles to school, 38 (73%) were males and 14 (27%) females. In addition, 43 (83%) of the bicycle trips were made to secondary schools.

Outcome variable 2: Reporting late for school

Apart from increased travel time, late report for school can also be due to other factors such as starting off late from home. Normally in rural areas of Malawi, children assist in the household chores before and/or after school. Females will normally draw water from the boreholes or wells for use on that particular day. The water sources are sometimes far from the household and it takes more time to draw enough water for the day. Males will normally go to the farm to assist in farm work. While most of the farm plots are close to the household compound, others are very far from the household. The time spent on travelling to and from farm plot and the time spent on farm work will normally influence the time to start off for school. To take account of the members who reported late because of these other reasons, respondents were asked the time they normally start off for school and the time they started off when they reported late for school. The members who reported late for school for other reasons other than travelling to school were not included in the analysis.

Descriptive Statistics

As Table 6.6 shows, of the 1596 individuals who attended primary school, 390 (24%) reported to have been late for school in the previous three months before the interviews after taking control of 74 members who reported late for school, however started off late. A slightly higher percentage of females (25%) than men (24%) reported being late for school. 369 (23%) and 21 (40%) of those who went to school on foot and by bicycles respectively, reported late for school.

There appears to be higher rates of being late as individuals get older, with 141 (32%) and 30 (33%) of those from the 16 – 20 and 21 – 25 age groups respectively reporting late for school. In addition, more members, 58 (38%) who spent more than 120 minutes to reach school reported to have been late for school.

		Number of Individuals (%)
Independent variables		N = 390 (24%)
Gender	Female	203 (25%)
	Male	187 (24%)
Age group	6 - 15	219 (21%)
	16 - 20	141 (32%)
	21 - 25	30 (33%)
Type of School	Primary	236 (21%)
	Secondary	154 (33%)
Distance to school	< 1.5kms	112 (18%)
	1.5 – 3.0kms	129 (24%)
	3.0 – 6.0kms	84 (30%)
	> 6.0kms	65 (41%)
Travel time	< 30 minutes	70 (14%)
	30 - 60 minutes	140 (26%)
	60 - 120 minutes	122 (31%)
	> 120 minutes	58 (38%)

The number in brackets is the number of members who were late for school as a percentage of the number who attended school

Table 6.6 Individuals who reported to have sometimes arrived late for school

The number of individuals who reported being late for school varied amongst the villages. 180 (25%) and 210 (24%) from hilly areas and flat areas respectively reported to have been late for school in one or more occasions.

The descriptive analysis involved the number of individuals who reported being late for school either once or more. However, many individuals reported to have been late for school on more than one occasion in the previous three months. The influence of the independent variables (distance-to-school, travel time to school, topography, condition of road network, gender, age, literacy and regular income) on levels of lateness is explored in the next section.

Statistical analysis

Ordinal logistic regression models

The ordinal logistic regression models are presented in Table 6.7. The results demonstrate that the association between distance and being late for school is statistically significant. The Odds ratios (Model I) demonstrate that children from villages located at less than 1.5kms, 1.5 – 3.0kms and 3.0 – 6.0kms from school were respectively 3.98, 2.6 and 1.6 times less likely to be late for school than those located at more than 6.0kms.

	Parameter estimates (β)				**Exponential of parameter estimates (ODDS RATIOS)**			
Independent variables	Model I	Model II	Model III	Model IV	Model I	Model II	Model III	Model IV
Distance (Kms)								
< 1.5	-1.382*	-1.295*	-1.277*	-1.262*	0.251*	0.274*	0.279*	0.283*
1.5 - 3.0	-0.962*	-0.924*	-0.914*	-0.906*	0.382*	0.397*	0.401*	0.404*
3.0 - 6.0	-0.476*	-0.437*	-0.423*	-0.414*	0.621*	0.646*	0.655*	0.661*
> 6	0	0	0	0	1.000	1.000	1.000	1.000
Topography								
Flat areas		-.343*	-.314	-.284		0.710*	0.731	0.753
Hilly areas		0	0	0		1.000	1.000	1.000
Road condition								
Good			-.092	-.094			0.912	0.910
Poor			0	0			1.000	1.000
Gender								
Male				-.555*				0.574*
Female				0				1.000
Age								
6 - 15				-.477				0.621
16 - 20				-.327				0.721
21 - 35				0				1.000
Literacy								
Yes				-.202				0.817
No				0				1.000
Regular Income								
Yes				-.403*				0.668*
No				0				1.000
Goodness-of-Fit	0.310	0.434	0.825	0.939				
Pseudo R-Squared	0.089	0.091	0.092	0.105				
Observations	390	390	390	390				

* $p < 0.05$, **$p < 0.01$

Table 6.7 Ordinal logistic regression models explaining the contribution of independent variables on the lateness for school

When locational characteristics were included in the model, the relationships between distance and lateness for school become stronger. The magnitude of the influence of less than 1.5kms distance category on lateness for school increased from β = -1.382 to -1.295 and the significance of the relationship is retained (Table 6.7, Model II). The probability of the children being late for school increased as households became more inaccessible due to hilliness.

As shown in Table 6.7, Model III, distance continues to have significant influence on lateness for school after controlling for road condition characteristics (β = -1.277 for the < 1.5km distance category) although road condition made no unique statistical contribution to the levels of being late for school. Model IV demonstrates that apart from distance (1.5 – 3.0km distance category, β = -.906; 3.0 – 6.0kms, β = -.414), gender (β = -.555) and regular income (β = -.403) made a statistically unique contribution to the levels of lateness for school at $p < 0.05$. It shows that male children were 1.7 times less likely to be late for school than female children. In addition, children from households with regular income were 1.5 times less likely to be late for school than those from households without regular income. However, the model demonstrated that distance to school (1.5 – 3.0km distance category, β = -.906) had a stronger unique contribution in explaining the levels of being late for school after controlling for socio-economic characteristics of the child (Table 6.7, Model IV).

Association of travel time groups and levels of lateness for school

Table 6.8 shows results from the statistical analysis on the association of travel time to school and lateness for school.

Travel Time Categories(minutes)		Mean Difference	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Less than 30	30 - 60	-.271	.135	.184	-.62	.08
	60 - 120	-1.047*	.138	.000	-1.40	-.69
	More than 120	-1.957*	.163	.000	-2.38	-1.54
30 - 60	Less than 30	.271	.135	.184	-.08	.62
	60 - 120	-.776*	.114	.000	-1.07	-.48
	More than 120	-1.686*	.144	.000	-2.06	-1.32
60 - 120	Less than 30	1.047*	.138	.000	.69	1.40
	30 - 60	.776*	.114	.000	.48	1.07
	More than 120	-.910*	.147	.000	-1.29	-.53
More than 120	Less than 30	1.957*	.163	.000	1.54	2.38
	30 - 60	1.686*	.144	.000	1.32	2.06
	60 - 120	.910*	.147	.000	.53	1.29

**Indicates the two groups are significantly different from one another at the $p < 0.05$ level*

Table 6.8 Multiple comparisons of travel time categories on levels of being late for school

The results from the one way between groups analysis of variance with post – hoc tests suggest a statistically significant difference in the number of occasions that individuals reported late for school for the four travel time ($F (3, 386) = 65.52$, $p < 0.001$). The effect size, calculated using eta squared (Cohen, 1988; Pallat, 2010) was 0.34 suggesting a large effect size. Cohen (1988) proposes guidelines for interpreting eta squared values as follows: 0.01= small effect, 0.06 = moderate effect and 0.14 = large effect. The results demonstrated that those who travelled for more than 60 minutes to school were more likely to be late for school than those who spent less than 60 minutes.

Outcome variable 3: School absenteeism

Descriptive Statistics

549 (34%) individuals reported to have been absent for school due to various reasons; out of which 336 (21%) were deemed responsive according to the study objective (accessibility and well being). Out of the 336 individuals who reported to be absent from school, 200 and 136 were attending primary school and secondary school respectively. There appears to be higher rates of absenteeism as travel times to school increases, 98 (25%) and 50 (33%) in the 60 – 120 and more than 120 minutes travel time categories respectively as shown in Table 6.9.

Moreover, out of the 336 individuals who reported that they were absent for school, 178 were from villages located in flat areas and 158 were from the villages in hilly areas.

		Number of individuals (%)
Independent variables		N = 336 (21%)
Gender	Female	175 (21%)
	Male	161 (21%)
Age group	6 - 15	188 (18%)
	16 - 20	130 (29%)
	21 - 25	18 (20%)
Type of School	Primary	200 (18%)
	Secondary	136 (29%)
Distance to school	< 1.5kms	115 (18%)
	1.5 – 3.0kms	105 (20%)
	3.0 – 6.0kms	69 (24%)
	> 6.0kms	47 (30%)
Travel time	< 30 minutes	76 (15%)
	30 - 60 minutes	112 (21%)
	60 - 120 minutes	98 (25%)
	> 120 minutes	50 (33%)

The number in brackets is the number of members who were absent for school as a percentage of the number who attended school

Table 6.9 Individuals who reported to have been absent for school

Statistical analysis

Ordinal logistic regression models

The ordinal logistic regression models are presented in Table 6.10. The bivariate regression results (Model I) also exhibit that the association between distance and school absenteeism is statistically significant. The Odds ratios (Model I) demonstrate that children from villages located at less than 1.5kms, 1.5 – 3.0kms and 3.0 – 6.0kms from school were respectively 4.9, 2.6 and 2.1 times less likely to be absent for school than those located at more than 6.0kms.

	Parameter estimates (β)				**Exponential of parameter estimates (ODDS RATIOS)**			
Independent variables	Model I	Model II	Model III	Model IV	Model I	Model II	Model III	Model IV
Distance (Kms)								
< 1.5	-1.586*	-1.575*	-1.573*	-1.583*	0.205*	0.207*	0.207*	0.205*
1.5 - 3.0	-.978*	-.963*	-.959*	-.972*	0.376*	0.382*	0.383*	0.378*
3.0 - 6.0	-.740*	-.731*	-.728*	-.737*	0.477*	0.481*	0.482*	0.479*
> 6	0	0	0	0	1.000	1.000	1.000	1.000
Topography								
Flat areas		-.108*	-.077*	-.094*		0.897*	0.926*	0.910*
Hilly areas		0	0	0		1.000	1.000	1.000
Road condition								
Good			-.679	-.682			0.507	0.506
Poor			0	0			1.000	1.000
Gender								
Male				-.292				0.747
Female				0				1.000
Age								
6 - 15				-.609				0.544
16 - 20				-.648				0.523
21 - 35				0				1.000
Literacy								
Yes				.094				1.099
No				0				1.000
Regular Income								
Yes				-.222				0.801
No				0				1.000
Goodness-of-Fit	0.643	0.234	0.119	0.047				
Pseudo R-Squared	0.079	0.082	0.089	0.094				
Observations	336	336	336	336				

** $p < 0.05$*

Table 6.10 Ordinal logistic regression models explaining the contribution of independent variables on school absenteeism

The relationship between distance and absenteeism became a bit stronger (β = -1.586 to β = -1.575 for the < 1.5km distance category) when locational characteristics were included in the model (Table 6.10, Model II). The probability of school absenteeism increased as households became more inaccessible due to hilliness.

Distance continues to have significant influence on school absenteeism after road condition characteristics were included in the model (β = -1.573; p < .05 for the less than 1.5km distance category) although road condition made no unique statistical contribution to the levels of school absenteeism. Model IV demonstrates that distance (less than 1.5km distance category, β = -1.583) and topography (β = -.094) made a unique statistical contribution to the levels of school absenteeism at p < 0.05. However, the model demonstrated that socio – economic characteristics made no unique contribution in explaining the levels of school absenteeism (Table 6.10, Model IV).

Association of travel time groups and levels of absenteeism

Table 6.11 shows results from the statistical analysis on the association of travel time to school and school absenteeism.

Travel Time Categories(minutes)		Mean Difference	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Less than 30	30 - 60	-.165	.137	.620	-.52	.19
	60 - 120	-.492*	.140	.003	-.85	-.13
	More than 120	-.937*	.167	.000	-1.37	-.50
30 - 60	Less than 30	.165	.137	.620	-.19	.52
	60 - 120	-.327	.127	.052	-.65	-.00
	More than 120	-.777*	.156	.000	-1.17	-.37
60 - 120	Less than 30	.492*	.140	.003	.13	.85
	30 - 60	.327	.127	.052	.00	.65
	More than 120	-.445*	.160	.029	-.86	-.03
More than 120	Less than 30	.937*	.167	.000	.50	1.37
	30 - 60	.771*	.156	.000	.37	1.17
	60 - 120	.445*	.160	.029	.03	.86

**Indicates the two groups are significantly different from one another at the p < 0.05 level*

Table 6.11 Multiple comparisons of travel time categories on levels absenteeism for school

The results from the one way between groups analysis of variance with post – hoc tests suggest a statistically significant difference in levels of absenteeism within the four travel time categories at $p < 0.05$ level; $F(3, 332) = 12.74$. The actual difference in mean scores between the groups is large (eta squared = 0.1) suggesting a moderate to large effect on absenteeism. The post comparisons test demonstrated that those who travelled for more than 120 minutes to school were more likely to be absent from school than those who spent less than 120 minutes.

Outcome variable 4: School examination failure

Descriptive Statistics

Table 6.12 demonstrates the number of individuals who reported to have failed in one or more examinations. Out of the 507 individuals who reported to have failed in one or more examinations, 264 were females and 243 males, 329 and 178 were attending primary school and secondary school respectively. There appears to be higher failure rate in the 16 – 20 age group and in the more than 120 minutes travel time category.

		Number of individuals (%)
Independent variables		507 (32%)
Gender	Female	264 (32%)
	Male	243 (31%)
Age group	6 - 15	310 (29%)
	16 - 20	169 (38%)
	21 - 25	29 (32%)
Type of School	Primary	329 (29%)
	Secondary	178 (38%)
Distance to school	< 1.5kms	171 (27%)
	1.5 – 3.0kms	168 (32%)
	3.0 – 6.0kms	99 (35%)
	> 6.0kms	69 (44%)
Travel time	< 30 minutes	135 (26%)
	30 - 60 minutes	175 (33%)
	60 - 120 minutes	141 (35%)
	> 120 minutes	56 (37%)

The number in brackets is the number of members who were absent for school as a percentage of the number who attended school

Table 6.12 Individuals who reported to have failed examinations

Statistical analysis

Correlation between (i) levels of lateness and examination failure and (ii) absenteeism and examination failures

As pointed out earlier, examination failure may be as a result of frequent lateness or/and absenteeism for school which leads to missing examinable lessons. This section therefore explores whether there was a correlation between (i) levels of lateness and the rate of examination failures and (ii) absenteeism and the rate of examination failures. Out of the 390 who reported late for school, 184 reportedly failed one or more examination and of the 507 individuals who reported to have failed exams 271 had been absent from school. The results on the relationship between levels of lateness and the rate of examination failures and levels of absenteeism and the rate of examination failures are as shown in Tables 6.13 and 6.14 respectively.

		Number of days/occasions of being absent for School	Number of days/occasions of failing school exams
Number of days/occasions of being late for School	Pearson Correlation	1	.201**
	Sig. (2-tailed)		.000
	N	184	184
Number of days/occasions of failing school exams	Pearson Correlation	.201**	1
	Sig. (2-tailed)	.000	
	N	184	184

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

Table 6.13 Correlation between levels of lateness for school and rate of examination failures

The results from Table 6.13 demonstrate a positive correlation at 0.01 level; $r = 0.201$, $n = 184$, $p < 0.001$ with more occasions of being late for school associated with high rates of examination failures. This suggests that lateness for school had an effect on school examination results. However, the Pearson correlation coefficient is much stronger between levels of absenteeism and rates of examination failures as demonstrated in Table 6.14.

		Number of days/occasions of being absent for School	Number of days/occasions of failing school exams
Number of days/occasions of being absent for School	Pearson Correlation	1	.555**
	Sig. (2-tailed)		.000
	N	271	271
Number of days/occasions of failing school exams	Pearson Correlation	.555**	1
	Sig. (2-tailed)	.000	
	N	271	271

Table 6.14 Correlation between levels of absenteeism and rate of examination failures

The results in Table 6.14 exhibit a positive correlation at 0.01 level; $r = 0.555$, $n = 271$, $p < 0.001$ with more occasions of being absent for school associated with high rates of examination failures.

Ordinal logistic regression models

Table 6.15 shows models from ordinal logistic regression analysis. The results also demonstrate statistical significant association between distance and rate of examination failure at $p < 0.05$ (Models I, II, III and IV). However, when lateness for school (Model V) and school absenteeism (Model VI) were introduced as mediators to assess the direct effects of distance separated from the indirect effects that were mediated through lateness for school and school absenteeism respectively, the impact of distance weakened (from $\beta = -1.076$ to $\beta = -1.011$) when lateness for school was considered (Model V) and to ($\beta = -.941$) when absenteeism was introduced (Model VI)). Moreover, the relationship between distance and examination failure was not statistically significant when absenteeism was introduced (Model VI) suggesting that examination failure was responsive to school absenteeism.

	Parameter estimates (β)						Exponential of parameter estimates (ODDS RATIOS)					
Independent variables	Model I	Model II	Model III	Model IV	Model V	Model VI	Model I	Model II	Model III	Model IV	Model V	Model VI
Distance (Kms)												
< 1.5	-1.503*	-1.520*	-1.511*	-1.557*	-1.525*	-1.298*	0.222*	0.219*	0.221*	0.211*	0.218*	0.273*
1.5 - 3.0	-1.077*	-1.027*	-1.032*	-1.076*	-1.011*	-.941	0.341*	0.358*	0.356*	0.341*	0.364*	0.390
3.0 - 6.0	-.067*	-.069*	-.056*	-.052*	-.082	.118	0.936*	0.933*	0.945*	0.949*	0.922	0.993
> 6	0.000	.000	.000	.000	.000	.000	1.000	1.000	1.000	1.000	1.000	1.000
Topography												
Flat areas		-.445*	-.400*	-.383*	-.297	-.356		0.641*	0.670*	0.682*	0.743	0.700
Hilly areas		0.000	0.000	0.000	0.000	0.000		1.000	1.000	1.000	1.000	1.000
Road condition												
Poor			-.141	-.143	.056	-.045			0.868	0.867	1.058	0.956
Good			0.000	0.000	0.000	0.000			1.000	1.000	1.000	1.000
Gender												
Male				-.178	.115	.162				0.837	1.122	1.176
Female				0.000	0.000	0.000				1.000	1.000	1.000
Age												
6 - 15				-.104	-.184	-.264				0.901	0.832	0.768
16 - 20				-.196	-.375	-.287				0.822	0.687	0.750
21 - 35				0.000	0.000	0.000				1.000	1.000	1.000
Literacy												
Yes				.223	.169	.061				1.250	1.184	1.063
No				0.000	0.000	0.000				1.000	1.000	1.000
Regular Income												
Yes				-.413	.397	.102				0.662	1.487	1.107
No				0.000	0.000	0.000				1.000	1.000	1.000
Goodness-of-Fit	0.146	0.134	0.122	0.098	0.011	0.067						
Pseudo R-Squared	0.044	0.051	0.063	0.074	0.103	0.095						
Observations	336	336	336	336	184	271						

** $p < 0.05$*

Table 6.15 Ordinal logistic regression models explaining the contribution of independent variables on rate of examination failure

Association of travel time groups and rate of examination failures

Table 6.16 shows results from the statistical analysis on the association of travel time to school and the rate examination failures.

Travel Time Categories(minutes)		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Less than 30	30 - 60	-.145	.072	.186	-.33	.04
	60 - 120	-.238*	.076	.010	-.43	-.04
	More than 120	-.496*	.100	.000	-.75	-.24
30 - 60	Less than 30	.145	.072	.186	-.04	.33
	60 - 120	-.092	.071	.567	-.28	.09
	More than 120	-.351*	.097	.002	-.60	-.10
60 - 120	Less than 30	.238*	.076	.010	.04	.43
	30 - 60	.092	.071	.567	-.09	.28
	More than 120	-.258*	.100	.048	-.52	.00
More than 120	Less than 30	.496*	.100	.000	.24	.75
	30 - 60	.351*	.097	.002	.10	.60
	60 - 120	.258*	.100	.048	.00	.52

*. *Indicates the two groups are significantly different from one another at the p < 0.05 level*

Table 6.16 Multiple comparisons of travel time categories on examination failure

The results suggest statistical significant difference in examination failure rates within the four travel time categories at $p < 0.05$ level; $F(3, 503) = 8.87$, $p < 0.001$. The calculated eta squared = 0.06 suggesting moderate effect of travel time on examination failure. The post comparisons test demonstrated that those who travelled for more than 120 minutes to school were more likely to fail examinations than those who spent less than 120 minutes.

6.4 Conclusions

This chapter has examined the influence of distance on school non-attendance. In addition, factors that influence reporting late for school and being absent for school and how the involvement of topographical and road network characteristics changed the strength of the unique contribution of distance in explaining school attendance and performance have also been explored in this chapter.

It has been demonstrated that longer distances to school do affect the number of individuals not attending or dropping out of school from this study area. It has also been shown that 97% of those who attended school went to school on foot. Furthermore, the study has established that school attendance was significantly influenced by distance to school and that hilliness slightly (not significantly) influenced school attendance. Condition of the road network did not influence school attendance. Children who were living far away from schools were more likely to be late and absent for school. In addition, children who travelled for more than 60 minutes to school were more likely to be late for school than those who normally spent less than 60 minutes and those who travelled for more than 120 minutes to school were more likely to be absent from school and more likely to fail school examination.

CHAPTER 7

Physical accessibility of rural health care facilities and health care seeking behaviour

7.1 Introduction

The current literature acknowledges there are multiple factors that influence health care utilisation, including characteristics of the individuals (Kutzin, 1993; Thaddeus and Maine, 1994; Vlassoff, 1994; Wagstaff, 2002; Yip et al., 2002) and their ability to access resources they may need in their pursuit to deal with their ill health (Thaddeus & Maine, 1994; Hjortsberg & Mwikisa, 2002; Hjortsberg, 2003; Thomas et al., 2005; O'Donnell, 2007). Accessibility to health care is concerned with the ability of a population to obtain a specified set of health care services. Many factors affect a population's ability to access appropriate levels of health care and these include: availability, socio – economic, gender, age, cultural beliefs and geography (Oliver & Mossialos, 2004). Geographic accessibility often referred to as spatial or physical accessibility is concerned with the complex relationship between the spatial separation of the population and the supply of health care facilities. Studies in developing countries have presented strong evidence that physical proximity of health service can play an important role in the use of primary healthcare (Stock, 1983; Perry & Gesler, 2000).

While it is important to look at many of the processes that affect health seeking behaviour in rural Malawi, this study focussed on physical accessibility constraints (e.g. distance/travel time, modes of transport, road condition and topography) to health care facilities and socio – demographic characteristics that may influence health care seeking e.g. gender, age, income and literacy. In this study, the geographic accessibility variables used were, distance, means of transport, travel time, cost of transport, road condition and topography.

Distance has been identified as key factor in the utilisation of health services in rural areas of developing countries. In the analysis of spatial dimensions of accessibility to general hospitals in Nigeria, Awoyemi et al. (2011) observed less utilisation of health services with longer distances. Buor (2003), in a study of primacy of distance in the utilisation of health services in Ghana concluded that distance superseded other factors that affect health service utilisation. However, in the analysis of health service utilisation, the distance impedance can not be identified in isolation. Some studies have attempted to relate distance to variables that have some bearing on it for example travel time and transport costs (Buor, 2003), also the influence of distance on vulnerable groups (Thomas et al., 2005). On the other hand, limited research has analysed the influence of distance on health service utilisation with recourse to terrain and associated transport means. For example, how strong would the distance impedance be if a patient comes from the highlands with steep slopes? Or, in rural areas in Sub-Saharan Africa; will the use of bicycles/bicycle ambulance be relevant in these areas? And for policy options and strategies, what interventions will be viable in these circumstances?

Travel time is associated with a number of issues that address access to health and medical services. These include distance (Haynes et al., 1999 and Schoeps et al., 2011), mode of transport and road condition (Buor, 2003). Whereas, the actual distance to a healthcare facility is easy to measure, it does not represent the actual time that one would take to travel to the health or medical facility due to other access barriers that may be involved. For example, a 70 kilometres journey to a health facility using motorized transport on a surfaced road might take 1hr, whereas a journey of 40 kilometres on a road in poor condition using the same means of transport might take over one hour.

The decision of whether to seek medical care or not depends on the health status of the individual and his/her opinion of the extent of health status improvement the medical care will bring. A logical assumption is that individuals suffering from more severe illnesses would seek health care more than those suffering from slight illnesses. In addition, threshold levels of pain that can be borne without seeking

medical care might vary from individual to individual and the individual's socio – demographic characteristics (e.g. gender, age and education) may determine where and how to seek the health and medical care. Moreover, due to poverty and distance in the developing countries, there is little drive to seek health care unless the individual falls sick (Atkinston et al., 1999; Hjortsberg, 2003).

Gender has become a subject for discussion as a determinant of health service use by government and non – government organisations. However, in developing countries there is still inadequate understanding of how gender influences health – seeking behaviour (Ahmed et al, 2000; Vlassoff & Garcia Moreno, 2002), access to services (Vlassoff, 1994), use of the services (Bour, 2003; Hjortsberg, 2003) and health outcomes (Ahmed et al 2000; Hjortsberg, 2003). The research findings related to gender and health that have been published produced contrasting results. Other studies could not find significant differences in the health of females and males and that patterns of health were more likely to vary with age and conditions rather than gender (McDonough et al., 2002). This is in contrast to some study findings that suggested variations in the pattern of health on gender (Arber & Khlat, 2002). Moreover, Emslie et al. (1999) found little differences between morbidity of men and women in the United Kingdom when paid employment was controlled for.

As regards healthcare seeking, some studies concluded that women, especially of reproductive age, were using health services more frequently than men (Cashin et al., 2002). On the contrary, there have been varying suggestions on healthcare seeking behaviour for women and men. Some studies have suggested a lower likelihood of women seeking healthcare than men due to social stigma associated with some health conditions (Fonck et al., 2002; Bashour & Mamaree, 2003). Moreover, some study findings also suggested that men are less likely to seek medical care than women for simple health conditions such as stress or depression (Galdas et al., 2005). In Africa, studies have also shown mixed patterns of health seeking by gender. For example, in a study in Zambia, women (particularly with low education level) were less likely to rush for medical care than men (Needman et al., 2001); whereas in another study in Ghana, it was shown that women were more likely to seek healthcare than men

(Danso – Appiah et al., 2004). A body of literature has also shown that gender affect the health care utilisation and is interrelated with some factors such as literacy and social economic status (Ahmed et al., 2000; Pillai et al., 2003; Bhan et al., 2005). It is also suggested that gender does not only affect on sickness reporting but also the decision to choose on the healthcare provider and how much to pay on medical services (Pokhrel et al., 2005).

Literacy is considered as an indicator of socio – economic status and is associated with gender, education and regular income (Sudha et al., 2003, Shieh & Halstead, 2009). Individuals with low literacy levels are not able to go through printed information with respect to health issues; in addition, they are not able to read medical instructions. Low levels of literacy have been shown to be an indicator of health (Bharmal, 2000) and health seeking behaviour (Lee et al., 2004; Ndiaye et al., 2005).

Education has been recognised as one of the socio – cultural factors in health development (Marmot, 1999; Kickbusch, 2001; Buor, 2003). Levels of education in developing countries, sub Saharan Africa in particular are generally lower than in developed countries and this is more evident with women than men (United Nations Development Programme, 2012). Institutional, economic and educational barriers lowers women's standard of living compared to that of men; as such, these socio – cultural factors impinge women in developing countries accessing appropriate health services thereby affecting their physical well being (Ojanuga & Gilbert, 1992; Cooper, 2002). Apart from the cultural, religious beliefs, societal norms and general lack of access to health and medical services, education has also been shown to be a determinant on the choice of the status of health and medical services especially in developing countries (Ojanuga & Gilbert, 1992; Buor, 2003; Hjortsberg, 2003, Nyamwaya, 2003). However, Tomlison (2003) argued that while education increases health education, it is not a guarantee that those with higher levels of education will always seek health and medical services. They are just as likely to succumb to misconceptions particularly when it involves socio – cultural and religious beliefs in addition to lack of access to information.

The age of the individual is a useful demographic health indicator and may also affect health service utilisation. In developing countries, the under five children and elderly are considered vulnerable to illnesses; whereas the middle age (18 – 25 years) are considered robust as they will likely engage themselves in high risk behaviours such as alcohol and sexual activities (Mishra et al., 2002). Andrews (2008) observed that many who contribute to this trend live in rural areas. The effects of age can be due to differences in cultural, religious beliefs, societal norms and socio – economic status as discussed in Henrard (1996), Arber & Cooper (1999), Mishra et al. (2002) and Waweru et al. (2003). Arber & Cooper (1999) observed that while women are more likely to live longer than men, older women are more likely to experience functional impairment in mobility and personal self – care than men of the same age. Moreover, de – Graft Aikins (2005) argued that the elderly may be more likely to use informal health care, traditional healers, medicine and spiritual healers not because of economic reasons but due to other factors such as habit, tradition or beliefs.

Health services in Malawi are provided by the Ministry of Health in the form of central hospitals, district hospitals, health centres, clinics and dispensaries. Health and medical services also are provided by private individuals, missionaries, non governmental and humanitarian organisations. In addition, there are many informal health service providers, for example traditional healers (who typically use herbs) and spiritual healers (who use spiritual forces). Furthermore, medicines can also be bought from pharmacies, shops and local vendors.

The predominant mode of transport to health service in rural Malawi is walking (NSO, 2010). However, of late there has been an influx of bicycle taxis especially in Malawi's rural growth centres. Whilst there have been negative incidences associated with bicycle taxis for example robbing of passengers and harassment of female passengers, bicycle taxis business is growing very fast as it is seen as the alternative to walking especially where health care facilities are very far. In comparison to public motorised transport, bicycle taxis are more attractive due to their low cost

(time and real cost). For longer distances to health care facility such as referral hospitals, use of motorised transport becomes appropriate.

This study focused on members who were sick/ill during the previous three months to the period when the interviews were conducted. Sickness is a feeling of not being normal and healthy and may be due to disease and a feeling of psychological or spiritual imbalance. In this study the focus was on the sickness due to diseases since disease is an objectively measurable pathological condition of the body for example, measles, malaria, tooth decay etc. (Institute of Medicine, 1996). These are the forms of illness that oftentimes require medical attention in rural areas of Malawi.

Health and medical services in Malawi are divided into formal and informal. The division into formal and informal is common in health care studies in developing countries (Mackian et al., 2004). Formal health services are described as those which are licensed to practice (hospitals, health centres and clinics). Informal health services include traditional healers, drug shops, vendors, home providers as demonstrated by Msiska et al. (1997). The use of one type of service over the other is a result of several factors including access related constraints and socio – demographic characteristics of both the individual and household (Buor, 2003).

The significance of this chapter is twofold. First, the study attempts to augment the body of knowledge that exist regarding access to health care in developing countries. Heath care utilization in developing countries is receiving more attention but tends to be focused on safe motherhood, child mortality rates, reproductive health and communicable diseases such as HIV/AIDS (United Nations General Assembly, 2000; United Nations Statistics Division, 2012; GoM, 2007; NSO, 2010). In developing countries, including Malawi there exists limited knowledge on the link between rural accessibility and health care seeking behaviour. Secondly, at policy level, information regarding rural physical accessibility and service utilisation can be used to prioritise accessibility interventions for example service location and service organisation e.g. the use of mobile healthcare provision points) that can improve health and medical care services offered especially where resources are limited.

This study therefore attempts to investigate accessibility factors that influence the use of health and medical services in rural Malawi. Specifically the study will attempt to address the following questions:

⇒ does distance to formal healthcare facilities have influence on the number of individuals who did not seek any formal medical services?

⇒ does distance to formal healthcare facility influence the type of health and medical services where members sought treatment? What about condition of the road network and topography?

⇒ does mode of transport influence the type of health and medical services from which members sought treatment?

7.2 Research Methods

This research draws on the analysis of data collected from a household survey conducted in 2011 in a sample of 30 villages located in Chikwawa District-rural Malawi. Chikwawa District is in the Southern Region of Malawi located about 50 km southeast of Blantyre, the commercial Capital of Malawi. The district lies along the lower flat basin of Shire River, which is along the Great African Rift Valley. Chikwawa has a population of 438,895 and 103,591 households (NSO, 2010).

The focus of this study was to find out the influence of distance on healthcare seeking behaviour. In order to do so, the study was divided into the following sections: sampling of the study villages and households, questionnaire administration and data analysis. There were two sampling phases for this study: The first phase involved sampling of villages in Chikwawa district. Study villages were selected based on levels of distance access deprivation as discussed in Chapters 3 and 4. The second sampling phase involved random selection of households during the household surveys. The household surveys were conducted after village identification surveys and survey questionnaire piloting. The sampling process, village identification process, questionnaire development and administration and data coding process are discussed in Chapter 3.

The village identification survey sought the following information: the number of healthcare facilities within a distance threshold of 6kms, the location of the villages and the general state of the road network. The household survey sought information on accessibility characteristics and individual and family level socio-economic characteristics. The respondents were asked about the following: gender and age of the members of the household, education level of the head of household, household's regular income, whether a member of household had ever fallen sick or not and for those who fell sick, whether they were able to seek medical care services or not; If yes where did they seek medical care services? What mode of transport did they use to visit the medical care facility, were they able to pay for the transport? If yes, what was the cost? how long did it take to reach the medical care facility? The outcomes

of this survey were individual level variables, and the unit of analysis considered in this chapter was the individual who fell sick. Some of the explanatory variables were strictly at the individual level (e.g. age and sex), others were at the household level (e.g. education level of head of household and wage employment) and still others were at the community or higher level (e.g. condition of the road network).

The variables considered in this survey included: distance to healthcare facility, one way travel time to healthcare facility, topography, road condition, mode of transport used, gender, age, level of education and regular income. Shortest path from village to healthcare facility was estimated using a standard GIS, TransCAD 4.8 (Caliper Corporation, 2005) tool as discussed in chapters 3 and 4. Distances were classified as less than 1.5kms, 1.5 – 3.0kms, 3.0 – 6.0kms, 6.0 – 10.0kms and more than 10kms. One way travel time to school was categorised as less than 30minutes, 30 – 60minutes, 60 – 120minutes, 120 – 240minutes and more than 240minutes.

Two location characteristics were considered in this study: Hilly/Flat and Poor/Good road network. The secondary data distinguished villages in hilly areas and flat areas and this was validated through the village survey exercise as discussed in chapters 3 and 5. Villages were either considered to be located in hilly areas or flat areas. Good condition of the road network also referred to as an "all-season road" is a road that is motorable all year round by the prevailing means of rural transport (often a pick-up or a truck which does not have four-wheel-drive) (World Bank, 2007). Predictable interruptions of short duration during inclement weather (e.g. heavy rainfall) were acceptable. Villages were identified by the condition of its road network as presented in chapter 5.

The education level completed by the head of the household was taken as a measure of educational stratification amongst the households. The levels were classified into two categories: (i) those that have had no formal education (illiterate), (ii) those that could at least read and write a letter (literate). In this study wage employment also referred to as regular income was measured at household level and the survey sought

information on whether there was a member of the household who was engaged in paid up employment; Yes or No.

In an attempt to check whether percentages of those who did not seek medical services increased with longer distances to formal health care facilities, individuals who reported to have been sick were grouped based on distances to the nearest formal health care facility and individuals who did not seek medical services were then selected from the groups. Percentages of those not seeking medical services against the total number of sick members in each distance category were then calculated. A formal healthcare facility is the one that is registered with the Medical Council of Malawi and is provided by the state, private practitioners and churches.

To explore whether distance to formal health care facilities influenced respondents to seek medical services from those facilities or from informal medical services, villages were classified according to distances to the nearest formal healthcare facilities. The household surveys observed the number of individuals who sought services from the formal services and from the informal services from the villages. In each distance category, the percentage of those who sought services from formal and informal medical services was calculated against the total number of sick persons who sought medical services.

To statistically estimate the magnitude of the influence that distance had on (i) not seeking medical services and (ii) seeking informal or formal medical services SPSS version 19.0 (SPSS, 2010) was employed to estimate a series of binary logistic regression models. Outcome variables considered were (i) whether medical services were sought or not and (ii) whether informal or formal medical services were sought. These variables were categorical and their relationship with the independent variables could not be modelled as a linear function of the independent variables (Long and Freese, 2006). The following were the binary logistic regressions considered:

$$In\left(\frac{y}{1-y}\right) = \alpha + \beta_P(P) + \varepsilon \text{ ....} \quad \text{Model (1)}$$

$$In\left(\frac{y}{1-y}\right) = \alpha + \beta_P(P) + \beta_L L + \varepsilon \text{ ....} \quad \text{Model (2)}$$

$$In\left(\frac{y}{1-y}\right) = \alpha + \beta_P(P) + \beta_L L + \beta_R R + \varepsilon \text{ ....} \quad \text{Model (3)}$$

$$In\left(\frac{y}{1-y}\right) = \alpha + \beta_P(P) + \beta_L L + \beta_R R + \sum \beta_S S + \varepsilon \text{ ....} \quad \text{Model (4)}$$

and for those who sought either informal or formal medical services;

$$In\left(\frac{y}{1-y}\right) = \alpha + \beta_P(P) + \beta_L L + \beta_R R + \beta_T T + \sum \beta_S S + \varepsilon \text{ ....} \quad \text{Model (5)}$$

where, y = Predicted event of not seeking formal medical services or seeking informal medical services, P = physical accessibility (distance to formal healthcare facility), L = location (flat or hilly areas), R = road condition (good or poor), T = mode of transport and S = Socio-demographic characteristics.

The first model was estimated with only one independent variable as the regressor variable. The second model was estimated after controlling for location factors, the third model was estimated after controlling for road condition factors, the fourth model was estimated after controlling for socio-demographic factors and the fifth model was estimated after controlling for modes of transport and socio-demographic factors.

7.2.1 Limitations

Informal medical services were not geo-referenced (traditional healers and local shops) as such consideration was only given to distances to formal healthcare facilities. In addition, there were also no geo-referenced positions of households instead village area centroids were employed to estimate distances from the villages to healthcare facility. In such areas, it was likely that the actual distance to formal healthcare facility for a specific respondent would deviate from the average with a

considerable error margin depending on how dispersed the households were and how large the village was.

7.3 Results

7.3.1 Characterisation of the study population

The total number of individuals who reported that they fell sick during the previous three months was 789, out of which 189 (24%) reported that they did not seek any medical services and 600 (76%) reportedly sought treatment as shown in Table 7.1.

		Number of individuals			
			Sought treatment		
Independent variables		**Never sought treatment**	Formal healthcare facilities	Informal medical services	**Total**
	Overall	189	264	336	789
Gender	Male	89	120	153	362
	Female	100	144	183	427
Age group	0 - 5	10	18	30	58
	6 - 15	40	26	56	122
	16 - 20	35	49	69	153
	21 - 35	42	66	65	173
	36 - 45	29	61	59	149
	46 +	33	44	57	134
Literacy	Yes	56	223	195	474
	No	107	41	124	272
Regular income	Yes	49	82	85	216
	No	122	182	210	514
Mode of transport	Walking	-	142	253	395
	Bicycle	-	91	73	164
	Motorised transport	-	31	10	41
Distance to the nearest formal health care facility (kilometres)	< 1.5	11	38	15	64
	1.5 - 3.0	13	37	17	67
	3.0 - 6.0	62	91	95	248
	6.0 - 10.0	47	76	146	269
	> 10	56	22	63	141
Travel times to the health care service (minutes)	Less than 30	-	61	232	293
	30 - 60	-	56	70	126
	60 - 120	-	85	34	119
	120 - 240	-	56	-	56
	More than 240	-	6	-	6
Unable to reach the facility	Yes	-	57	-	57
	No	-	207	336	543

Table 7.1 Number of individuals that reported being sick by independent variables

Of the 600 individuals who reportedly sought treatment, 264 (44%) sought treatment from formal medical services and 336 (56%) from informal medical services. Of the 264 individuals who sought medical services from formal health facilities, 120 (45%) were males and 144 (55%) females and of the 336 who sought informal medical services 153 (46%) were males and 183 (54%) females

As Table 7.1 shows, of those respondents that reported being literate, 418 (66%) stated a member of the household had been sick and sought treatment as compared to 165 (53%) of those that reported being illiterate. In addition, of the households headed by illiterate members, 107 (34%) households did not seek medical services as compared to 56 (9%) of those that reported being literate.

Of those households with regular income, 167 (48%) reported a member of the household fell sick and sought treatment as compared to 392 (65%) without regular income. 37 individuals that sought treatment reported that they were not able to reach the health care facility and all of them reported to have sought treatment from formal health care facilities.

7.3.2 Outcome variable 1: Individuals who fell sick and sought no medical services

Descriptive analysis

When members aged below 12 fall sick, they are always accompanied by their parents or guardians to the health care facility. If the trip is made on foot the women will carry the young children (below 5 years) on their backs whereas the males will carry them on their shoulders (Msiska et al., 1997). It then becomes tiresome with longer distances to the health facility for those carrying the children and also for the younger ones who walk to the facility while being escorted. As such, where formal health facilities are far and there is no other means of transport, members may choose not to seek any medical services when they get sick or they may opt to buy medicines from vendors/shops which are not prescribed (depending on the type of

medicine) for them. The question that this section attempt to address is: does percentage of not seeking formal medical services increase with longer distances to formal health care facility in this study area?

The total number of individuals who reported that they fell sick and did not seek any health care was 189 (24% of the total number of individuals who reportedly fell sick). There was no significant difference between the percentages of males 25% (89) and the females 23% (100) who reported to have not sought medical services when they fell sick (Table 7.1).

The results from the analysis as shown in Figure 7.1 demonstrate that the percentages of individuals who did not seek medical services increased with increasing distances to the formal health care facility. This implies that longer distances to formal healthcare facility influenced the number of individuals seeking formal medical services in this study area.

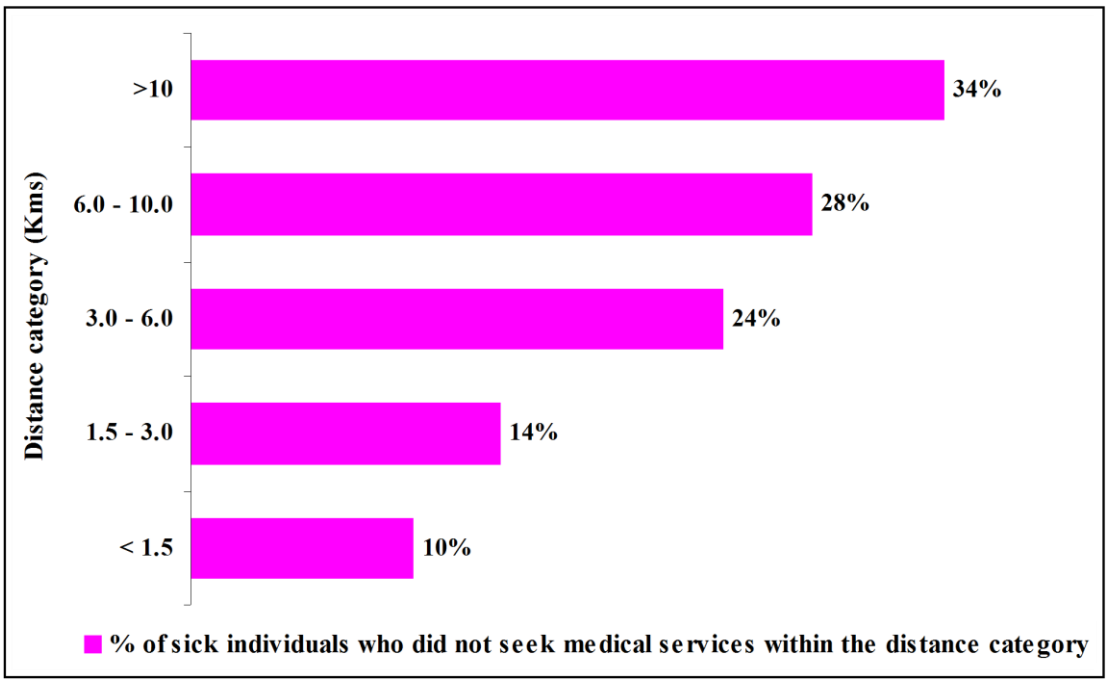


Figure 7.1 Percentage of sick individuals who did not seek medical services

In an attempt to check on the reasons why individuals who reported sick but did not seek medical services, the respondents were asked to state the reasons for not seeking

medical services. Out of 189 individuals who fell sick but did not seek medical services, 130 (69%) indicated that they did not seek medical services because the health facility was far. Of the 130 individuals, 118 (91%) had the nearest health facility located beyond 3km. 81(43%) reported that they did not seek medical services because of poor road condition to the health facility, 46 (24%) because there was no any other means of transport other than walking, 25 (13%) because they could not afford transport costs and 11 (6%) reported that they could not seek medical services because they did not see any need to that effect. This outcome again underscores the suggestion that longer distances to health care facilities do influence the number of people seeking medical services from those facilities in this study area.

Statistical analysis

Binary logistic regression

The binary logistic regression models as presented in Table 7.2 contained the following independent variables: distance, topography, road condition, gender, age, literacy and regular income. The full model containing all predictors was statistically significant, χ^2 (7, N = 453) = 211.53, p < 0.001) indicating that the model was able to distinguish the respondents who reported they sought and did not seek medical services.

The bivariate regression (presented in Table 7.2, Model I) demonstrate that the association between distance and seeking formal healthcare or not is statistically significant. The model shows that individuals from villages located at more than 10kms to formal healthcare facility were 4.3 times more likely not to seek formal healthcare than those located at less than 1.5kms. In addition, individuals located between 6 -10kms were 2 times more likely not to seek formal medical services than those located at less than 1.5kms. However, there was no statistical difference in healthcare seeking behaviour between members from 1.5 – 3.0kms and 3.0 – 6.0kms distance groups and those from less than 1.5kms distance group (Model I).

Independent variables	Odds ratios from binary logistic regression			
	Model I	Model II	Model III	Model IV
Distance (Kms)				
< 1.5	1.000	1.000	1.000	1.000
1.5 - 3.0	1.586	1.421	1.407	1.322
3.0 - 6.0	1.110	1.244*	1.229*	1.212*
6.0 - 10.0	1.973*	2.011*	2.048*	1.988*
> 10	4.317*	4.522*	4.561*	4.339*
Location				
Flat areas	-	1.000	1.000	1.000
Hilly areas	-	1.621*	1.658*	1.572*
Road condition				
Good	-	-	1.000	1.000
Poor	-	-	1.327*	1.203*
Gender				
Male	-	-	-	1.000
Female	-	-	-	.818
Age				
6 - 15	-	-	-	1.000
16 - 20	-	-	-	.997
21 - 35	-	-	-	.843
36 - 45	-	-	-	.758
46 +	-	-	-	3.421*
Literacy				
Yes	-	-	-	1.000
No	-	-	-	1.721*
Regular Income				
Yes	-	-	-	1.000
No	-	-	-	1.395

**P<0.05*

Table 7.2 Binary logistic regression models predicting the likelihood of not seeking medical services

When locational characteristics were included in the model, the relationships between distance and healthcare seeking behaviour became stronger. The odds ratio for the more than 10.0kms distance group increased from 4.317 to 4.522 and the significance of the relationship retained (Table 7.2, Model II). The probability of the individuals seeking formal medical services reduced as households became more

inaccessible due to hilliness. Moreover, individuals from villages located in hilly areas were 1.6 times more likely not to seek formal medical services that those from villages located in flat areas.

As shown in Table 7.2 (Model III), distance continues to have significant influence on not seeking formal healthcare services after controlling for road condition characteristics (OR = 4.561 for the > 10kms distance category). Road condition also made a unique statistical contribution to not seeking formal medical services. Individuals from villages with its road network in poor condition were 1.3 times more likely not to seek formal healthcare services than those from villages with its road network in good condition. Model IV demonstrates that apart from distance (> 10kms OR = 4.339), topography (OR = 1.572) and road condition (OR = 1.203); age (46 years+ OR = 3.421) and level of education (OR = 1.721) made a statistically unique contribution to not seeking formal medical services. It shows that individuals aged 46 years and above were 3.4 times more likely not to seek formal medical services than those aged between 6 and 15 years. In addition, individuals from households headed by illiterate members were 1.7 times more likely not to seek formal medical services than those households headed by literate members.

7.3.3 Outcome variable 2: Individuals who fell sick and sought treatment from formal services

Descriptive analysis

As stated earlier of the 600 individuals who reportedly sought treatment, 264 (44%) sought treatment from formal medical services and 336 (56%) from informal medical services. Of the 264 individuals who sought medical services from formal health facilities, 120 (45%) were males and 144 (55%) females and of the 336 who sought informal medical services 153 (46%) were males and 183 (54%) females as shown in Table 7.1.

As Table 7.1 shows, of those respondents that reported being literate, 233 (35%) stated a member of the household had been sick and sought treatment from formal facilities as compared to 195 (30%) of those that reported sought informal medical services. In addition, of the respondents that reported being illiterate, 41 (13%) sought formal medical services as compared to 124 (40%) of those that sought informal medical services. Of the respondents with regular income, 82 (24%) reportedly sought treatment from formal services compared to 85 (25%) who sought informal medical services. Moreover, of the respondents without regular income, 182 (30%) reportedly sought treatment from formal services compared to 210 (35%) who sought informal medical services.

Formal medical services were grouped into two: referral hospitals and healthcare centres (clinics and dispensaries). Informal medical services were also grouped into two: traditional healers and vendors/shops. These were the medical services that were commonly used in this study district. Figure 7.2 shows the number of individuals who consulted various medical services.

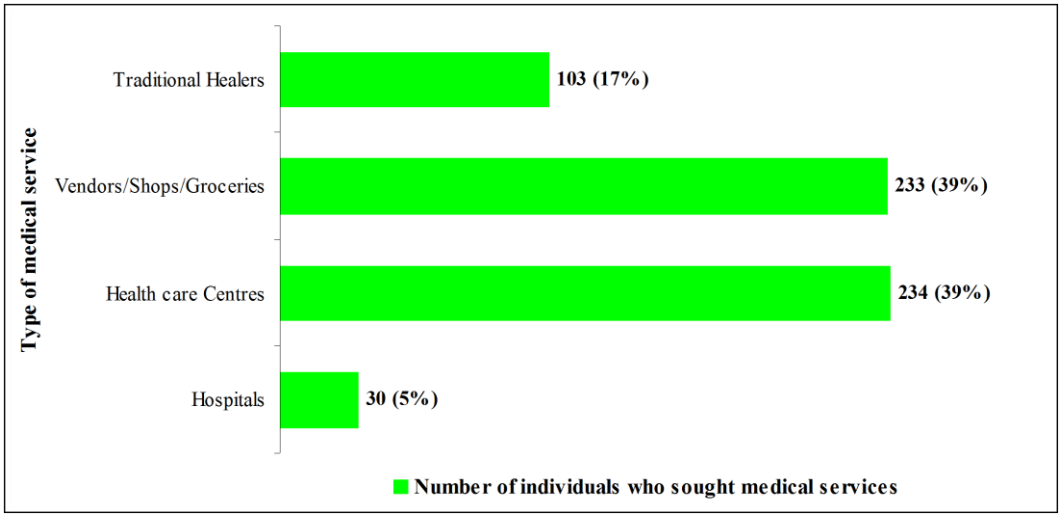


Figure 7.2 Number of individuals who sought medical services

As shown in Figure 7.2, there were 233 (39%) who sought medical services from shops/groceries to treat themselves (note that it is likely that this to a significant extent concerned illnesses that the same households may have experienced earlier, and probably also on earlier occasions may have visited a health care centre for

treatment, and now, with the same illness coming again, they opted only to buy medicine that maybe they were earlier prescribed to use in the same situation) and also 103 (17%) who sought medical services from traditional healers. However, more members 234 (39%) sought treatment from formal health care centres. In addition a total number of 47 members reported that they sought maternity medical services out of which 44 (94%) sought formal medical services and only 4 (6%) sought help from traditional services.

This section has demonstrated that more individuals (336) sought informal medical services than (264) who sought formal medical services. Considering that informal medical services (not regulated by health officials and that the medicine provided is not oftentimes prescribed by professional Doctors) are more widely spread and hence likely to be easily accessible, a question that one may ask is: does distance/travel time to health care facility influence the type of health or medical services sought by members from this study area? What about mode of transport? The following section will attempt to address these questions.

Distances and reported travel times to health care or medical services

The results in Figure 7.3 show that the percentages of those who sought medical services from formal sources reduced strongly with longer distances and in contrast, the percentages of those who sought medical services from informal sources increased the longer the distance to formal medical services.

It was not possible to trace precise distances to informal health services. However, the density of small vendors and traditional healers was much higher than that of formal healthcare facilities, so the conclusion appears to be justified that nearby informal healthcare service was chosen more and more, the further away (the less easily accessible) formal healthcare facilities were. Implicitly this also proves that if accessibility didn't play a role, the population in the study area had a clear preference for using official, formal healthcare.

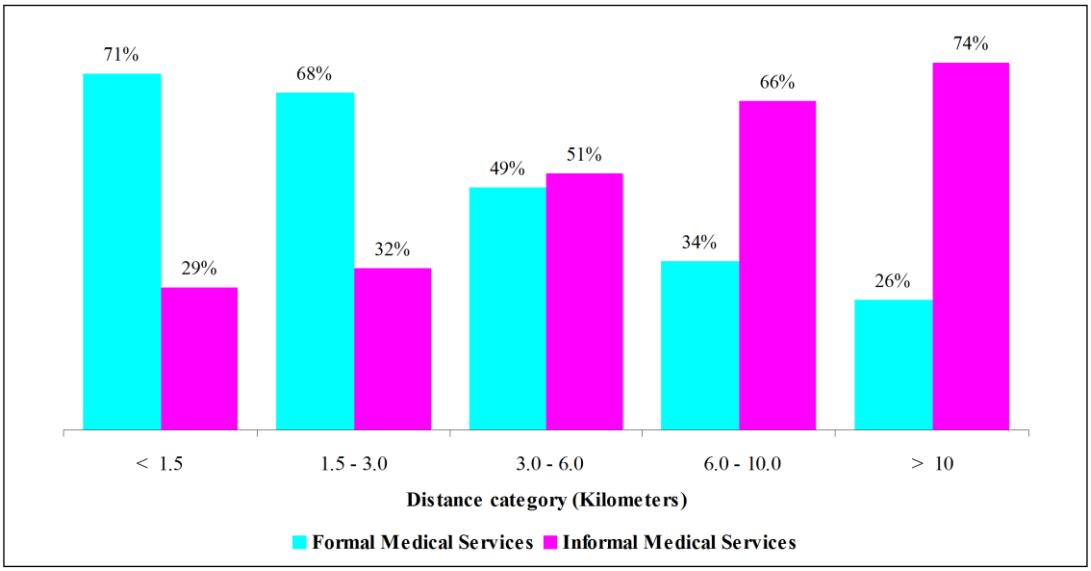


Figure 7.3 Percentages of individuals who sought medical services from formal and informal services as a function of distance to formal medical services

The results (34% and 26% from the 6.0 – 10.0 kilometres category and > 10 kilometres categories respectively) still seeking official/formal healthcare also shows that this substitution (of informal for formal healthcare) was up to a point only. Individuals still sought medical services from formal services even though the facilities were far. It is likely that this depended on the seriousness of the illness and the availability of other means of transport than walking, such as motorised transport or bicycles.

Out of 600 individuals who sought medical services, a total number of 293 (49%) reported travel time of less than 30 minutes to the medical facility (Table 7.1). Out of the 293, 232 (79%) sought informal medical services; and out of the 232, 221 (95%) sought services from vendors/shops/groceries. Furthermore, Table 7.1 shows that no individual travelled for more than 120 minutes to seek informal medical services. It is likely that members opted for formal medical services where more time would be spent on travelling to informal medical service. This again supports the findings that the number of individuals seeking informal medical services increased with longer distances to the formal health care facilities in this study area. However, there were some individuals who spent 30 to 60 minutes (70) and more than one hour (34) to

reach informal medical services. Most of these individuals (93) sought medical services from traditional healers.

The travel times to the health care facility depend to some extent on the mode of transport used, the terrain and the condition of the road network. The following section attempts to examine whether mode of transport available/used by the members and cost of the transport influenced the type of medical services sought.

Mode of transport and reported transport costs to health care or medical services

As shown in Table 7.3, out of 600 individuals who sought medical service, a total number of 395 (66%) went to the health care facility on foot, 165 (27%) used bicycles and 41 (7%) used motorised transport.

		Type of health service				
Mode of Transport	**Description**	**Hospital**	**Healthcare facilities**	**Shops/ Groceries**	**Traditional Healer**	Total
On foot	**Count**	**6**	**136**	**193**	**60**	**395**
	% within mode of transport	2	34	49	15	100
	% within type of service	20	57	85	58	66
	% of Total	1	23	32	10	66
Bicycle	**Count**	**5**	**91**	**32**	**37**	**165**
	% within mode of transport	3	55	20	22	100
	% within type of service	16	38	14	35	27
	% of Total	0.8	15	5	6	27
Motorised Transport	**Count**	**19**	**12**	**3**	**7**	**41**
	% within mode of transport	47	30	7	16	100
	% within type of service	64	5	1	6	7
	% of Total	3	2	0.5	1	7
Total	**Count**	**30**	**239**	**228**	**103**	**600**
	% within mode of transport	5	40	38	17	100
	% within type of service	100	100	100	100	100
	% of Total	5	40	38	17	100

Table 7.3 Number of sick individuals who sought medical services using different means of transport

Out of the 395 individuals who walked to the medical service, 193 sought medical services from vendors/shops representing 85% of all individuals who sought medical services from vendors. This is perhaps because most of the shops that sold medicines

were locally located at short distances from the households within the villages. In addition, out of 41 individuals who used motorised transport, 19 members sought services from hospitals representing 64% of all members who sought medical services from hospitals. The two hospitals in the study district are located at the central business areas of the district and are far from most of the study villages. For longer distances, use of motorised means of transport almost becomes a necessity probably in combination with the seriousness of the illness that makes it necessary to consult the hospital. The Chi – square test for independence also indicated significant association between mode of transport and the type of medical services sought, χ^2 (1, n = 600) = 385, $p < 0.001$. The 6 individuals who walked to seek medical services from hospitals were from the same villages where the hospitals were located.

Bicycle and motorised transport were classified as owned and Hired/Public. Out of the 165 individuals who used bicycles to seek medical services, 125 (76%) used bicycle taxis and 40 (24%) used their own bicycles. Likewise, out of 41 individuals who used motorised transport 33 (80%) used public transport (mini buses and matola (informal public transport)). Table 7.4 shows the percentages of individuals who used hired bicycles and public motorised transport to seek medical services and associated transport costs.

		Type of health service				
Mode of Transport	**Cost**	**Hospital**	**Healthcare facilities**	**Shops/ Groceries**	**Traditional Healer**	**Total**
Bicycle	Less than K100.00	5%	62%	9%	24%	100%
	K100.00 - K200.00	1%	71%	-	28%	100%
	K200 - K500	-	68%	-	32%	100%
	More than K500	-	-	-	-	-
	Total	**3%**	**66%**	**5%**	**26%**	**100%**
Motorised Transport	Less than K100.00	50%	30%	10%	10%	100%
	K100.00 - K200.00	35%	45%	-	20%	100%
	K200 - K500	58%	26%	-	16%	100%
	More than K500	60%	20%	-	20%	100%
	Total	**49%**	**32%**	**2%**	**17%**	**100%**

Table 7.4 Percentages of sick individuals who sought medical services using different means of transport and their associated transport costs

Out of the 125 individuals who reported to have used bicycle taxis, 66% and 26% paid for bicycle taxis to health care facilities and traditional healers respectively and only 3% and 5% reported to have paid for bicycle taxi fare to hospital and shops respectively. The fares ranged from less than MK100.00[6] ($0.60) to K500.00 with 71% and 28% of those who paid between MK100.00 and MK200.00 seeking medical services from health care facilities and traditional healers respectively. In addition, for those who paid between MK200 – MK500.00, 68% and 32% sought medical services from health care facilities and traditional healers respectively. More individuals (49% and 32%) paid for motorised transport to hospitals and health care facilities. Some individuals also paid more than MK500.00 for transport to hospitals, health care facilities and traditional healers.

In rural areas of Malawi where 74% of the population still lives below the income poverty line of US$1.25 a day and 90 per cent below the threshold of US$2 a day (UNDP, 2009); it becomes more difficult to get money for transport costs when seeking medical services. However, based on the results from Table 7.4, individuals paid for bicycle transport and motorised transport to different types of medical services including traditional healers (informal medical services). In an attempt to find out why informal medical services were sought, the variable of cost of transport was rated very low. Out of 336 individuals who sought informal medical services, only 30 (9%) indicated transport cost to formal medical service was a reason for opting informal medical services. Therefore, based on these results it can be suggested that the cost of transport did not influence the type of medical service sought, rather individuals paid for transport to the medical service of their choice.

Statistical analysis

Results from a bivariate relationship between main independent variable (distance to formal health care facilities) and other independent variables are demonstrated in Table 7.5.

[6] MK100.00 (MK = Malawi Kwacha) was equivalent to $ 0.60 in 2011 (when the household surveys were conducted) @ the exchange rate of $1 = MK167.00

	Distance to formal healthcare facility	Gender	Age	Literacy
Distance to formal healthcare facility				
Gender	.018			
Age	.004	- .188*		
Literacy	.071*	.027	.016	
Regular income	.373**	.074	.002	.422*

** Correlation is significant at the 0.01 level, * correlation is significant at the 0.05 level (2 – tailed)

Table 7.5 Correlation between independent variables (distance, gender, age, literacy, and regular income)

As Table 7.5 shows, literacy is positively correlated with distance to formal healthcare facility. Households which were headed by illiterate members appear to live at longer distances to healthcare facilities than those households with literate household heads. Regular income was also positively correlated with distance to formal healthcare facilities suggesting that households with regular income appear to live closer to healthcare facilities than households with no paid up employment suggesting that household with paid up employment enjoy much higher degree of access to health services.

Binary logistic regression

The logistic regression model as presented in Table 7.6 contained the following independent variables (distance to school, topography, road condition, mode of transport, sex, age, literacy and regular income). The full model containing all predictors was statistically significant, χ^2 (8, N = 600) = 106.39, p < 0.001) indicating that the model was able to distinguish the individuals who sought treatment from informal and formal medical services.

The bivariate regression (presented in Table 7.6, Model I) demonstrate a significant association between distance and seeking of informal medical services. Individuals

from villages located at more than 10.0kms from formal healthcare facilities were 5.8 times more likely to seek informal medical services than those located at less than 1.5kms.

	Odds ratios from binary logistic regression				
Independent variables	**Model I**	**Model II**	**Model III**	**Model IV**	**Model V**
Distance (Kms)					
< 1.5	1.000	1.000	1.000	1.000	1.000
1.5 - 3.0	2.196	2.321	2.377	2.272	2.264
3.0 - 6.0	3.856*	3.884*	3.896*	3.869*	3.861*
6.0 - 10.0	4.943*	4.981*	4.998*	4.961*	4.953*
> 10	5.773*	5.861*	5.897*	5.811*	5.802*
Location					
Flat areas	-	1.000	1.000	1.000	1.000
Hilly areas	-	1.443*	1.488*	1.482*	1.476*
Road condition					
Good	-	-	1.000	1.000	1.000
Poor	-	-	1.401*	1.284*	1.281*
Mode of transport					
Walking	-	-	-	1.000	1.000
Bicycle	-	-	-	.276*	.268*
Motorised	-	-	-	.134*	.131*
Gender					
Male	-	-	-	-	1.000
Female	-	-	-	-	1.086
Age					
6 - 15	-	-	-	-	1.000
16 - 20	-	-	-	-	.515
21 - 35	-	-	-	-	.646
36 - 45	-	-	-	-	1.838*
46 +	-	-	-	-	2.426*
Literacy					
Yes	-	-	-	-	1.000
No	-	-	-	-	.697
Regular Income					
Yes	-	-	-	-	1.000
No	-	-	-	-	.844

*p<0.05

Table 7.6 Logistic regression models predicting the likelihood of seeking informal medical services (for those who reported sick and sought medical services)

When terrain characteristics were included in the model, the relationships between distance and enrolment became stronger. The magnitude of the effect of distance of more than 10.0 kms on seeking informal medical services increased from 5.773 to 5.861 and the significance of the relationship retained (Table 7.6, Model II). The

probability of the individuals seeking formal medical services reduced as households became more inaccessible due to hilliness. Individuals from villages located in hilly areas were 1.4 times more likely to seek informal medical services that those from villages located in flat areas.

As shown in Table 7.6, Model III, distance continues to have significant influence on not seeking formal healthcare services after controlling for road condition characteristics (OR = 5.897 for the > 10kms distance category). Road condition also made a unique statistical contribution to seeking informal medical services. Individuals from villages with its road network in poor condition were 1.5 times more likely to seek informal medical services than those from villages with its road network in good condition. Bicycles and motorised transport made statistically unique contribution to seeking formal medical services. These modes of transport were less likely to be used for informal medical services than walking (Table 7.6, Model IV). Model V demonstrates that apart from distance (> 10kms OR = 5.811), topography (OR = 1.476), road condition (OR = 1. 281) and mode of transport (bicycle OR = .268, motorised transport OR = .131); age (46 years+ OR = 2.426) made a statistically unique contribution to not seeking formal medical services. It shows that individuals aged 46 years and above were 2.4 times more likely to seek informal medical services than those aged between 6 and 15 years.

The influence of terrain, road condition and mode of transport on travel times to medical services

Whereas, the actual distance to a healthcare facility is easy to measure, it does not represent the actual time that one would take to travel to the health or medical facility due to other access barriers that may be involved. These include terrain, road condition and the mode of transport used. This section will attempt to examine whether terrain, road condition and mode of transport influenced the travel times to the medical services.

The results from the paired t – test for flat areas samples showed significant difference in travel times to medical services for individuals from poor and good road condition areas with a 95% confidence interval, t (227) = -14.323, $p < 0.0005$ (two – tailed). Similarly results from the hilly areas showed significant difference in travel times to health care facilities for individuals from poor and good road condition areas with a 95% confidence interval, t (121) = -19.536, $p < 0.0005$ (two – tailed). However, the estimated eta effect size for flat area (0.44) was smaller than the effect size for hilly areas (0.75). This implies that poor road condition influenced travel times to health care facilities in both flat areas and hilly areas; however the influence was more in the hilly areas than flat areas.

The results from a paired sample t –test show there was a significant increase in travel times to health care facilities for individuals in hilly areas with a 95% confidence interval, t (199) = -16.039, $p < 0.0005$ (two – tailed); the effect size calculated using eta squared (Cohen, 1988; Pallat, 2010) was 0.56 suggesting a large effect size[7]. This implies that, given the same distance to the health care facility it was more likely that members from hilly areas spent more time to reach the health care facility than those from flat areas may be due to reduced travel speeds as a result of steep slopes.

The other question examined in this study was: does mode of transport to the health care facility have any influence on travel times in this study area? it may be suggested that bicycle trips to health care facility take shorter time than trips on foot (assuming the characteristics of the routes used are the same).

Results in Table 7.7 show that at shorter distances (< 1.5kms), 71%, 83% and 100% of those who respectively used walking, bicycles and motorised vehicles as a means of transport to medical services accessed the medical services in less than 30 minutes. Of the 100%, 85% used private motorised vehicles and 15% used public transport. However, out of the individuals who used motorised transport, 78% used

[7] Cohen 1988 proposes eta effect size as follows: 0.01 = small effect, 0.06 = moderate effect and 0.14 = large effect

public transport to access health care facilities located at distances of more than 1.5kms.

Distance (kilometres)	Mode of Transport	Time of Travel to Health (minutes)					Total
		< 30	30 - 60	60 - 120	120 - 240	> 240	
< 1.5	On foot	71%	29%	-	-	-	**100%**
	Bicycle	83%	17%	-	-	-	**100%**
	Motorised transport	100%	-	-	-	-	**100%**
1.5 - 3.0	On foot	29%	61%	10%	-	-	**100%**
	Bicycle	41%	55%	4%	-	-	**100%**
	Motorised transport	43%	43%	14%	-	-	**100%**
3.0 - 6.0	On foot	2%	22%	50%	26%	-	**100%**
	Bicycle	8%	26%	46%	20%	-	**100%**
	Motorised transport	22%	57%	21%	-	-	**100%**
6.0 - 10.0	On foot	-	5%	44%	46%	5%	**100%**
	Bicycle	-	10%	48%	40%	2%	**100%**
	Motorised transport	17%	33%	25%	25%	-	**100%**
> 10	On foot	-	-	21%	68%	11%	**100%**
	Bicycle	-	3%	27%	63%	7%	**100%**
	Motorised transport	20%	20%	30%	30%	-	**100%**

Table 7.7 Percentages of individuals who sought medical services and travel times by mode and distance category

Individuals can walk or cycle from the household to the bus stop to get public transport. In some cases the distance from the point of interest (household) to the public transport access points can be more than 10kms. This explains why some individuals who used motorised public transport spent more than 120 minutes to access the medical service since the time includes time taken from the household to the motorised public transport access point and in vehicle travel times.

While 42% of those who used motorised public transport travelled for less than 30 minutes to the public transport access point, 21% reported to have travelled more than one hour to the motorised public transport access point. The analysis suggested that most of the individuals who spent more than one hour to the motorised public transport access points were from villages which were far from the access point and

those with their road network in poor condition. Some of the individuals reported to have spent more time in travelling to the access point than in vehicle.

Whereas the level of service at the public transport access points - i.e. average waiting time is critical for trips to some services such as markets (because of the load accompanying the passengers), waiting time was not found to be critical for trips to medical services. 77% of the individuals who used motorised public transport indicated to health services indicated that they did not wait for transport for over 30 minutes. In addition, most of the health care facilities (except traditional healers who mostly reside in remote locations) were located close to motorable road (for smooth transportation of medical resources) as such the contribution of the last mile[8] to the total travel time by motorised public transport was not significant in this study.

The study used a paired samples t – test to examine whether there were differences in travel times to medical services when the services were accessed on foot or by bicycle and the results are as shown in Table 7.8. The results from the hilly areas show no significant difference in travel times to medical services for individuals who travelled on foot and by bicycle with a 95% confidence interval, t (53) = -1.346, p = 0.181. Similarly, the results show no significant difference in travel times to medical services for individuals who travelled on foot and by bicycle from areas with its road network in poor condition; t (107) = -1.674, p = 0.096.

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Cycling time HILLY AREAS - Walking time HILLY AREAS	-.023	.194	.017	-.056	.011	-1.346	52	.181
Cycling time POOR ROADS - Walking time POOR ROADS	-.024	.208	.014	-.053	.004	-1.674	106	.096
Cycling time GOOD ROADS - Walking time GOOD ROADS	-.418	.612	.069	-.555	-.281	-6.067	57	.000

Table 7.8 Statistical results from paired t – test for cycling time and walking time

[8] Distance between public transport end point and the health care facility

However, the results from areas with its road network in good condition show significant differences, t (58) = - 6.067, $p < 0.0005$. Cycling uphill and on poor road surface reduces cycling speed and in some cases it is even faster to walk on muddy surfaced roads that using bicycles.

7.4 Conclusions

Generally, the relationships between healthcare facilities and the factors that determine the way they are used are different in different places, and depend quite strongly on local habits, rather than being universal. If one roughly knows the impact of accessibility on health care facility utilisation in one of the rural areas in Africa for example rural Ghana, it is still difficult to predict what it will be in e.g. rural Malawi, because other factors and behavioural characteristics can result in quite different utilisation patterns. This means that to come up with the most sensible approach to healthcare improvement in a certain area, the best thing to do is to analyse the patterns in the area at hand.

This study has shown that longer distances to formal health care facilities do influence the number of people seeking formal medical services and it is even stronger in highlands and areas with its road network in poor condition. In addition, this study has also shown that walking, cycling and motorised transport were used to access healthcare facilities in this study area; however walking was affected by long distances to health care facilities as such it was predominantly used for informal medical services. Cycling and motorised transport were mostly used for trips to formal medical care services. Moreover, the study has shown that cost of transport to health care service did not influence the type of medical service sought.

CHAPTER 8

Exploring the association of physical access to schools, labour input to farm tasks and water collection

8.1 Introduction

Labour is a key asset for household tasks in rural Malawi (Kutengule et al., 2011). The quality and quantity of labour available to the household in terms of numbers, education, skills and health constitute the human capital that is a necessity for household livelihood (Takane, 2008). In the context of Malawi's household food production where farm mechanisation is virtually non existent and all farm work is done manually, having access to necessary labour for agricultural activities directly affects household agricultural outputs and income. Household farm tasks in rural Malawi are carried out throughout almost the entire year. The types of labour used can be broadly classified into two categories: family labour and hired labour (in case of other families that can afford). Of these, family labour is the main source in the rural villages. Hired labour is frequently sought for tasks that require physical strength such as land preparation and weeding. These activities are undertaken either by members who have completed farm tasks for their own households or those who have not but would like to increase economic opportunities for their families.

Access to clean water is a primary need for rural households in Malawi. Water is needed for cooking, bathing and washing of utensils and clothing. Water sources in rural areas of Malawi are principally boreholes and open wells. Collecting water is a burden to most rural households since water is transported primarily by head loading and on foot and is widely done by female members of the household. The tradition in rural Malawi is that female households would normally go for water collection before joining their male partners for farm tasks. In some cases female members of the household engage in both household tasks while the male members are involved in drinking local beer (Kutengule et al. 2011). This underscores the imbalance in

household tasks involvement by gender in rural Malawi as pointed out in NSO (2011).

Labour input to household tasks involves all members of the household mostly those above 15 years of age. Some household members will either go for water collection task and then farm task or the other way round. School going members of the household in rural Malawi also contribute to domestic labour before or after school or both. Not only are they involved in family labour but also in hired labour. The labour input will to some extent depend on the availability of the family members and the amount of time spent on the household tasks. For school going members, the effort and time that is required to travel to school may influence the time available to perform other important tasks, such as farm work or water collection, or school attendance or both, particularly in circumstances where access to education and clean water is poor. Children who are involved in farm activities and water collection before starting off for school may sometimes be late for school or may trade – off school attendance with household tasks. Likewise, sometimes students whose schools are not nearby may not be involved in household tasks because they do not want to be late for school. This may affect the household in terms of labour input to farm activities.

Despite the important links between access to school, access to water and food production no studies have explicitly attempted to investigate whether members of households in rural Malawi give priority to the child attending school over doing some household tasks. In addition, there have not been any studies to examine whether there is any trade – off (in terms of time spent) between water collection and farm tasks at household level. The few studies that have been carried out in the Sub-Saharan Africa have focussed on access to agricultural markets (Dercon & Hoddinott, 2005), rural transport services (Bryceson & Howe, 1993; IT Transport, 1996; Nejadfard, 2000) and children mobility (Porter et al., 2011).

Therefore, this chapter seeks to explore the link between (i) physical access to school and involvement in farm tasks and water collection (for those who were attending

school) (ii) physical access to water and involvement of household members on farm tasks. Specifically, the chapter will address the following questions:

⇒ Does distance to school have any influence on (i) frequency of involvement in farm activities and water collection? (ii) time spent on these household tasks?

⇒ Do frequency and time spent on farm activities and water collection influence school attendance?

⇒ Does time spent on water collection influence the time spent on farm tasks?

8.2 Research methods

This chapter also draws on the analysis of data collected in a household survey conducted in 2011 in a sample of 30 villages located in Chikwawa District - rural Malawi. The study followed the sampling process, questionnaire development and administration and data coding process as discussed in Chapter 3 of this thesis.

The household survey sought data for school-going children who were involved in farm tasks and water collection before school. Among others, the data sought included: frequency of involvement in the particular task and the time spent on the task. The frequency was categorised as once a week, twice a week, thrice a week, four times a week and daily. A week in this study is defined as five working days. Time spent on farm activities was classified as less than 30minutes, 30 – 60minutes, 60 – 90minutes, 90 – 120minutes and more than 120minutes and the time spent on water collection was categorised as less than 15minutes, 15 – 30mintues, 30 – 45minutes, 45 – 60minutes and more than 60minutes. In addition the data collection also sought information on the other household tasks that were undertaken after the initial task and the time spent on those tasks for example farm work after water collection. For school children who were involved in farm tasks or water collection before school, or both, the survey sought information on the distances to school, time of travel to school, the frequency of involvement in the farm tasks and water collection and the time spent on these tasks. For all who were involved in farm tasks after water collection or vice versa, the information sought was the time spent on both engagements.

GIS, TransCAD 4.8 (Caliper Corporation, 2005) tool was employed to estimate the distance between village and schools. Almost all households in rural Malawi have farm plots close to the household compound. However, some households also have farm plots located far away from the household compound. In this case, school-going children are normally allocated those plots that are near the household compound while the rest of the household members work on those plots that are far from the compound (Takane, 2008). This arrangement is done to fully utilise the children's

labour input for household farm tasks. In this study it was assumed that school-children worked on plots close to home.

Using SPSS version 19.0 (SPSS, 2010), a series of bivariate analysis were performed to investigate the relationship between variables (time spent on farm activities and water collection, frequency of engagement in farm activities and water collection, lateness for school and absenteeism from school).

8.3 Results

8.3.1 School attendees involved in household tasks

Gender and household tasks

Out of 1596 school-going children, 454 (28%) were involved in farm tasks and 602 (38%) were involved in water collection. Of the 454 who were involved in farm activities, 384 (85%) were males and 70 (15%) females and of the 602 who were involved in water collection, 540 (90%) were females and 62 (10%) males. Figure 8.1 shows the gender distribution of members who attended school and were also involved in farm activities and water collection.

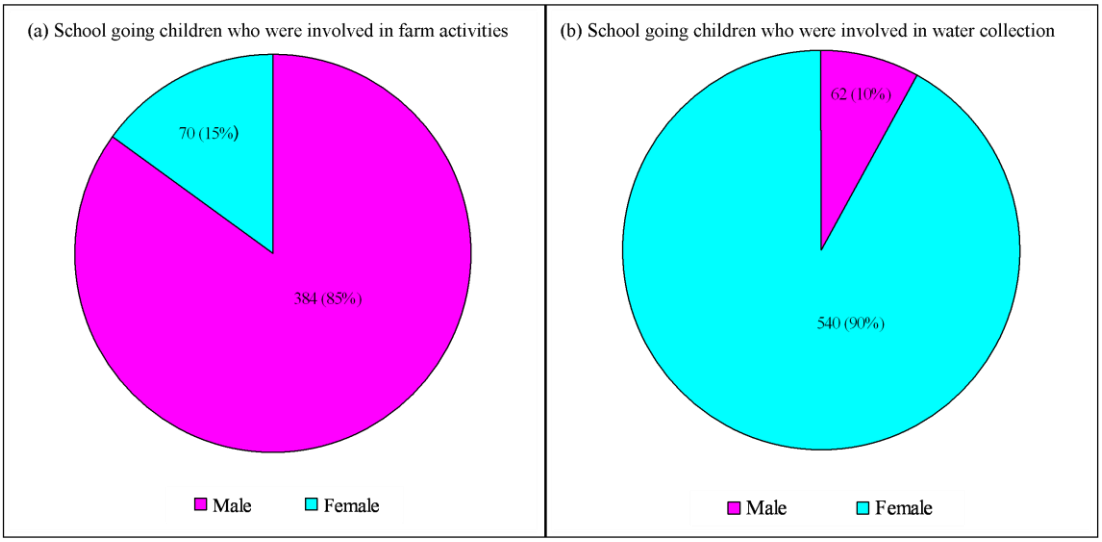


Figure 8.1 School going children involved in household tasks by gender

Frequency of involvement in household tasks

School-going children were asked on the frequency of engagement in farm activities and water collection per week. The results were as shown in Figures 8.2 and 8.3 respectively.

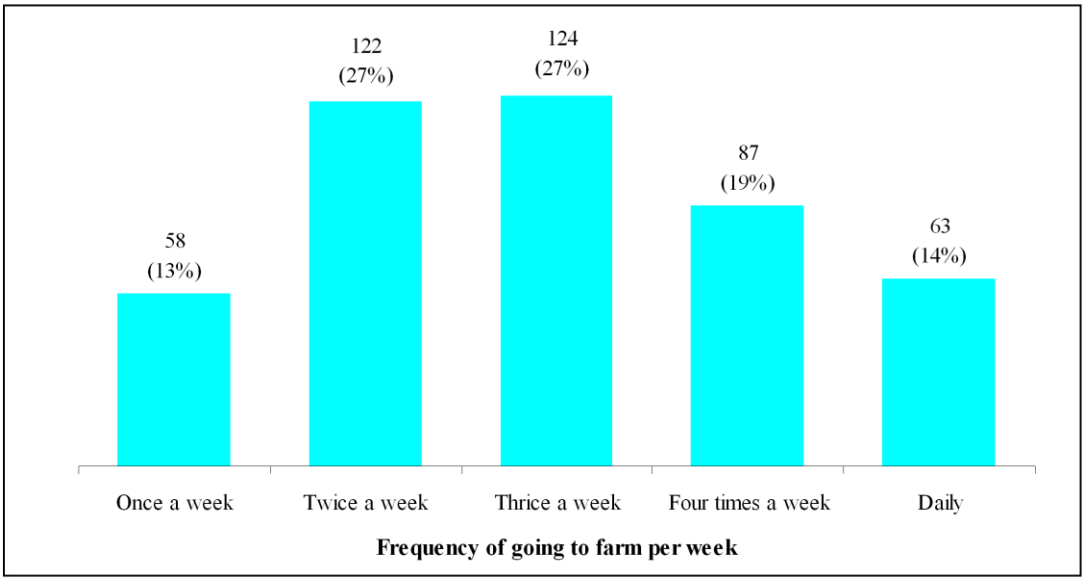


Figure 8.2 Frequency of going to farm per week

The frequency of going to farm ranged from once every week to daily and most members reported that they were engaged in farm activities thrice a week (124) and twice a week (122). In addition 63 members were daily involved in farm activities as shown in Figure 8.2.

Figure 8.3 shows the frequency distribution of members who were involved in water collection. Of the 602 members, 179 (30%), 165 (27%) and 133 (22%) reported to have collected water twice a week, thrice a week and four times a week respectively. 74 (12%) collected water on daily basis and only 51 (9%) collected water once every week.

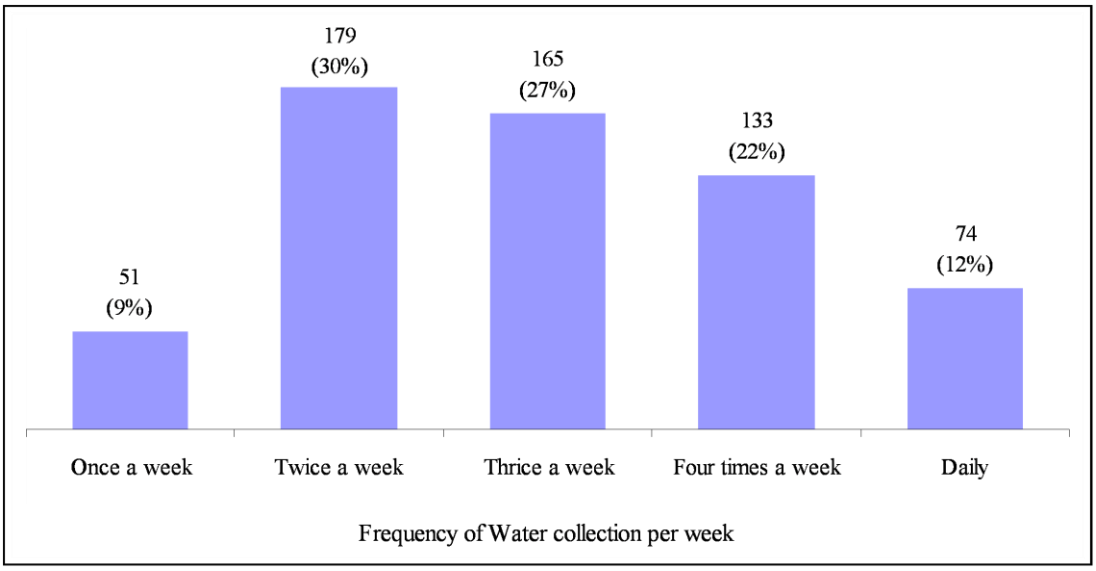


Figure 8.3 Frequency of water collection per week

Time spent on household tasks

Figures 8.4 and 8.5 demonstrate the response rates on time spent on farm tasks and water collection. This time is the total time spent on the activity before starting off for school, it includes travel time to the site, time spent on the activity and travel time back to the household; and for water collection, this is the total time for all trips (if there were more that one trip of water collection) before school.

Figure 8.4 shows the distribution of household members based on the time spent on farm activities. It shows that out of the 454 members, 346 (76%) spent between 60 and 120 minutes on farm activities before school. Very few members (10) spent less than 30 minutes on farm activities. In addition, 58 ((13%) spent between 30 – 60 minutes and 40 (9%) spent more than 120 minutes on farm activities before starting off for school.

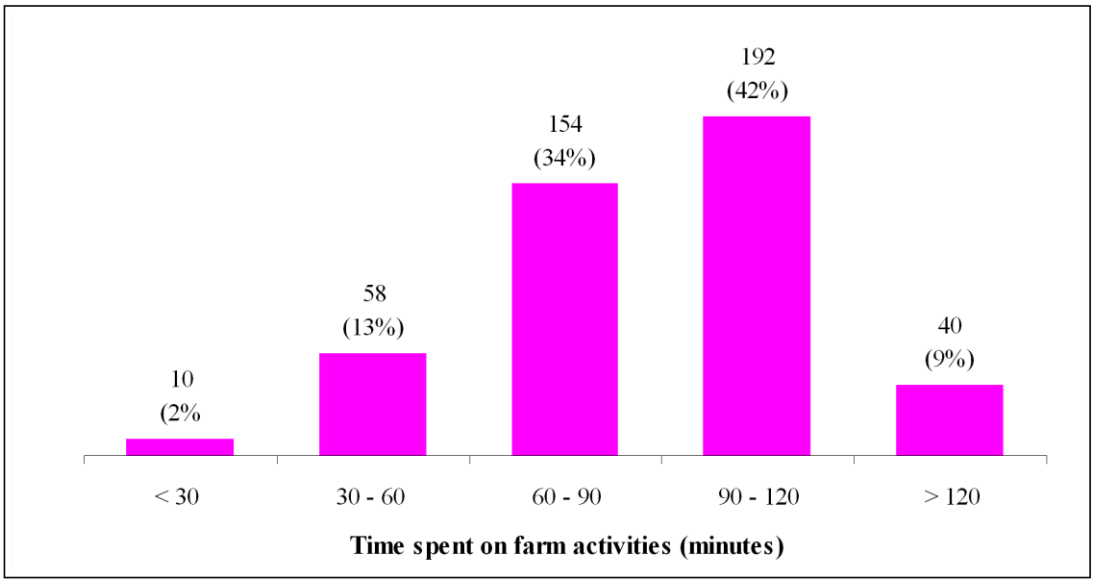


Figure 8.4 Number of school-going children based on time spent on farm activities

Figure 8.5 shows the distribution of household members who were attending schools but were also involved in collecting water for household use based on the time spent on water collection. It shows that out of 602, 526 (87%) spent less than 45 minutes in water collection before going to school. However there were also few members (7) who spent more than one hour in water collection.

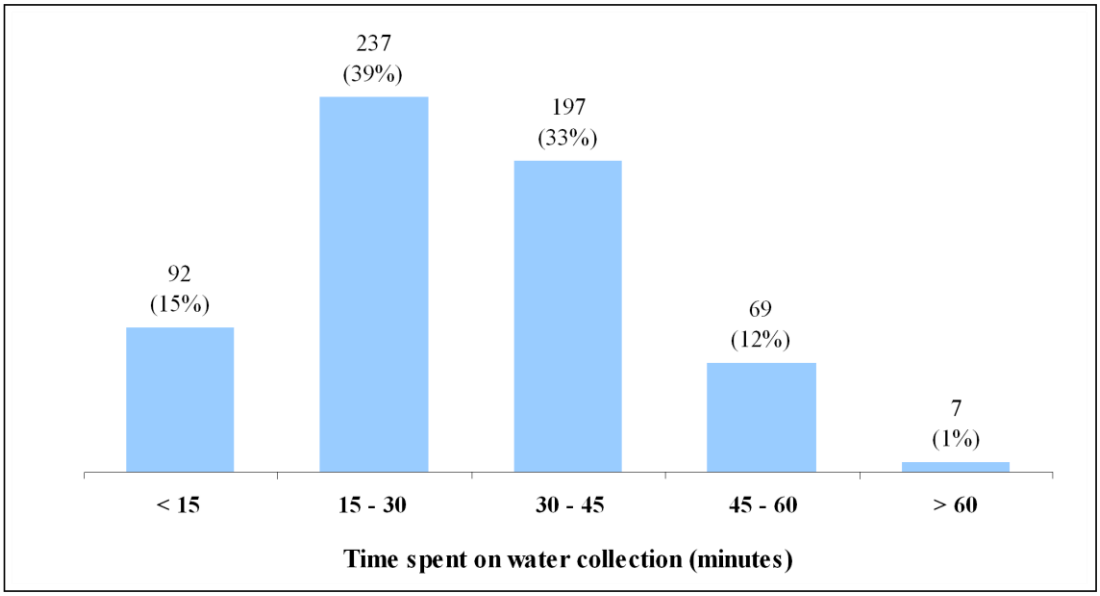


Figure 8.5 Number of school-going children based on time spent on water collection

8.3.2 Relationship between distance to schools, frequency of involvement in household tasks, time spent on household tasks and school attendance

In this study an attempt was made to explore whether distances to school were associated with the frequency of being involved in household tasks and the time spent on those household tasks. An attempt was also made to investigate whether there was a correlation between the time spent on household tasks and the levels of being late for schools. Likewise, the correlation between the time spent on the targeted household tasks and school absenteeism was also examined.

Relationship between distances and travel time to school and (i) frequency of involvement in household tasks and (ii) the time spent on the tasks.

This study attempted to investigate whether the effort of accessing the schools influenced (i) frequency of involvement in farm activities, (ii) time spent on farm activities, (iii) water collection frequency and (iv) time spent on water collection. The results from the analysis are as shown in Table 8.1.

		Frequency of going to Farm per week	Time spent on farm activities	Frequency of going to Water Source per week	Time spent on water collection
Distances to School	Spearman's rho Correlation	-.123**	-.153**	.054	-.057
	Sig. (2-tailed)	.006	.001	.120	.098
	N	454	454	602	602
Travel time to school	Spearman's rho Correlation	-.150**	-0.722**	0.065	-.038
	Sig. (2-tailed)	.001	.000	0.061	.271
	N	454	454	602	602

*** Correlation is significant at 0.01 levels (2 – tailed) * Correlation is significant at 0.05 levels*

Table 8.1 Correlation between distance, travel time to school and household task variables

The results demonstrate a significant negative correlation at 0.01 level between distance to school and (i) frequency of involvement in farm activities ($r = -0.123$, $n = 454$, $p = 0.006$) and (ii) time spent on farm activities ($r = -0.153$, $n = 454$, $p = 0.001$). In addition, the results also show a significant negative correlation between travel

time to school and (i) frequency of involvement in farm activities (r = -0.150, n = 454, p = 0.001) and (ii) time spent on farm activities (r = -0.722, n = 454, p < 0.0005). Note that the strength of the correlation between the time required to reach school and the time spent on farm labour is much higher than between distance to school and time spent on farm labour (r = -0.72 and r = -0.15). The likely reason for this difference is that time to school and farm labour time estimates are from the same data source (respondents estimates), while in the case of distance to school the distance between the village and the school is used (in the absence of exact location data for households within the village). Hence the actual distance to school for a specific respondent will deviate from the estimated distance depending on how dispersed the village is and how large it is. Consequently, the time to school is likely to better predict the real correlation.

On the contrary, the results showed no evidence of correlation between distance to schools and (i) water collection frequency (r = 0.054, n = 602, p = 0.120) and (ii) time spent on water collection (r = -0.057, n = 602, p = 0.098); also between travel time to school and (i) water collection frequency (r = 0.065, n = 602, p = 0.061) and (ii) time spent on water collection (r = -0.038, n = 602, p = 0.271).

The results suggest that school children who live closer to schools were more likely to frequently be involved in farm tasks and more likely to spend more time in the farm tasks than those who were far from schools. In addition, those who took more time to travel to school were less likely to spend more time on farm tasks before school. However, there were no differences in the likelihood of the frequency of water collection and time spent on water collection between members who were closer and far from schools.

Correlation between frequency of involvement in farm work and water collection and the time spent on the tasks.

Frequency of involvement in household tasks depends to some extent on the time spent on the task during a particular engagement. Some individuals would frequently

engage in a household task because they take less time on it, whereas others would spend more time on the task per particular engagement, however with limited frequency. An attempt was made to check whether there was a correlation between frequency of going to farm and time spent on the farm tasks and also water collection frequency and time spent in collecting water. The results were as shown in Table 8.2.

		Time spent on farm activities	Time spent on water collection
Frequency of going to Farm per week	Spearman's rho Correlation	.032	
	Sig. (2-tailed)	.475	
	N	454	
Frequency of going to Water Source per week	Spearman's rho Correlation		-.021
	Sig. (2-tailed)		.543
	N		602

Table 8.2 Correlation between frequency of involvement on household task and the time spent on those tasks

The results showed no evidence of correlation between both (i) the frequency of involvement in farm activities and time spent on the activities ($r = 0.032$, $n = 454$, $p = 0.475$) and (ii) water collection frequency and time spent on collecting water ($r = -0.021$, $n = 602$, $p = 0.543$) suggesting that in terms of time spent on a household task before school, there were no differences between those who were more or less frequently involved in those household tasks.

Correlation between school attendance and (i) frequency of involvement in household tasks and (ii) the time spent on the tasks.

An attempt was made to investigate the correlation between school attendance (measured by the levels of being late for school and absenteeism) and (i) frequency of involvement in farm activities and water collection and (ii) time spent on these activities. The results are as shown in Table 8.3.

		Frequency of going to Farm per week	Time spent on farm activities	Frequency of going to Water Source per week	Time spent on water collection
Level of being late for School	Spearman's rho Correlation	.310**	.27**	.061	.109
	Sig. (2-tailed)	.000	.000	.383	.117
	N	189	189	109	109
Level of absenteeism for School	Spearman's rho Correlation	.219**	.18*	.070	-.028
	Sig. (2-tailed)	.004	.018	.349	.712
	N	173	173	86	86

*** Correlation is significant at 0.01 levels;* Correlation is significant at 0.05 levels (2 – tailed)*

Table 8.3 Influence of involvement in household tasks on school attendance

The results show that out of 454 members who reported to have been involved in farm activities before school, 189 (42%) reported to have been late for school once or more than once. In addition, out of 602 members who reported to have been involved in water collection; 109 (18%) reported to have been late for school once or more than once. Moreover, out of those who were involved in farm tasks 173 (39%) reported to have been absent in one or more than once and out of those who collected water, 86 (14%) reported to have been absent once or more than once.

The results demonstrate a significant positive correlation between levels of being late for school and (i) frequency of engagements in farm tasks (r = 0.31, n = 189, p <0.0005) and (ii) time spent on farm activities (r = 0.27, n = 189, p <0.0005), suggesting that those individuals who were frequently involved in farm tasks were more likely to be late for school than those who were less frequently involved in the farm tasks. Likewise, individuals who spent more time on farm tasks were more likely to be late for school than those who spent less time. On the contrary, there was no evidence of correlation between levels of being late for school and (i) frequency of water collection (r = 0.061, n = 109, p = 0.383), and (ii) time spent on water collection (r = 0.109, n = 109, p = 0.117). Comparatively, the levels of being late for school were less for individuals who were involved in water collection than individuals who were involved in farm activities.

The results also show a significant positive correlation between levels of absenteeism for school and (i) frequency of engagements in farm tasks (r = 0.219, n = 173, p = 0.004) and (ii) time spent on farm activities (r = 0.18, n = 173, p =0.018), also suggesting that those individuals who were frequently involved in farm tasks were more likely to be absent for school than those who were less frequently involved in the farm tasks. Likewise, individuals who spent more time on farm tasks were more likely to be absent for school than those who spent less time. Again, there was no evidence of correlation between levels of absenteeism for school and (i) frequency of water collection (r = 0.07, n = 86, p = 0.349), and (ii) time spent on water collection (r = -.028, n = 86, p = 0.712). The levels of absenteeism for school were also less for individuals who were involved in water collection than individuals who were involved in farm activities.

Figure 8.6 shows the number of school-going children who were absent from school as a percentage of the number of members who attended school within the time-to-school category.

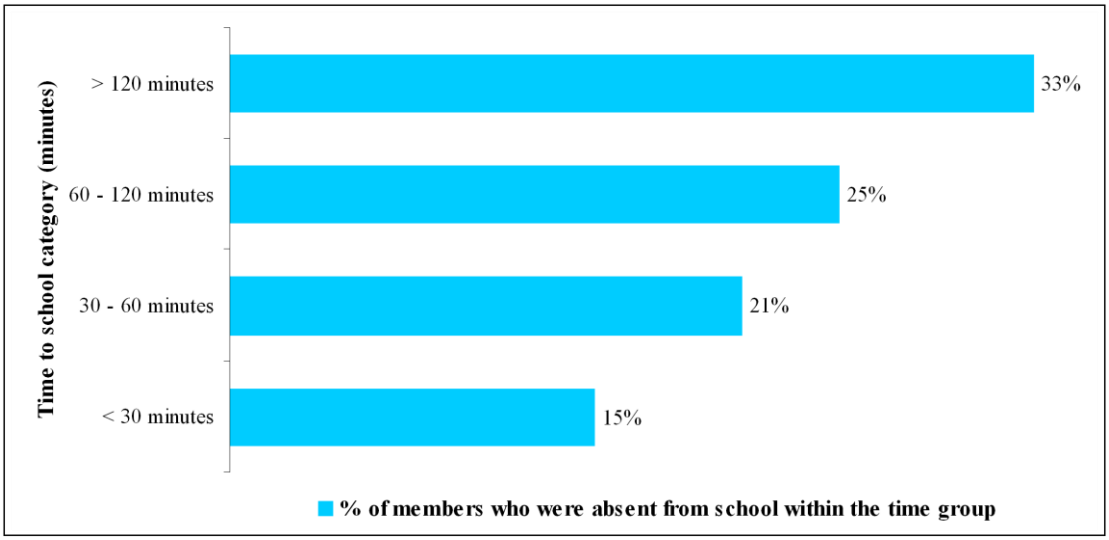


Figure 8.6 Members who were absent from school based on time-to-school category

It demonstrates that the percentages with absenteeism increases with higher time-to-school, however the increase is modest (33%) even for the highest time category. It is likely that even though long distance to school strongly reduces the labour input on

farm tasks that a child can give, nevertheless the majority of households give priority to the child attending school over doing farm labour.

Correlation between time spent on water collection and the time spent on farm tasks.

The total number of individuals who were involved in either water collection then farm tasks or farm tasks then water collection were 834, of whom 751 (90%) were females and 83 (10%) males. These exclude the members who were attending school but were also involved in water collection.

		Time spent on water collection
Time spent on farm tasks	Spearman's rho Correlation	-.055
	Sig. (2-tailed)	0.067
	N	834

Table 8.4 Correlation between time spent on farm tasks and time spent on water collection

The results from Spearman's rho correlation coefficient (Table 8.4) demonstrate no evidence of correlation between time spent on water collection and time spent on farm tasks ($r = -0.055$, $n = 834$, $p = 0.067$). Whereas time and effort is spent on water collection and other household chores, household female members in rural Malawi equally spend more time and effort on farming. Sometimes they wake up early in the morning to collect adequate water for household use before involvement in farm activities. This underscores the result of no evidence of correlation between time spent on water collection and time spent on farm tasks as both tasks were given enough time and effort.

8.4 Conclusions

This chapter has shown that among other household tasks subsistence farming and water collection were carried out by both adult household members and school-going children. It has been demonstrated that male school going children were mostly involved in farm tasks and female children were mostly involved in water collection.

Most school attendees were involved in farm tasks in more than once a week and spent more than one hour per particular involvement before attending school. Similarly, most school children were involved in water collection in more than once a week; however most of them spent less than 45 minutes before attending school.

The study exhibited negative correlation between distance to school and (i) frequency of involvement in farm tasks and (ii) time spent on farm tasks. However, there was no evidence of correlation between distance to school and (i) frequency of water collection and (ii) time spent on water collection. In addition, the study also demonstrated that individuals who were frequently involved in farm tasks were more likely to be late and absent for school. Likewise, individuals who spent more time on the farm tasks were more likely to be late or absent for school.

Chapter 6, section 6.3.3 demonstrated that distance influenced school absenteeism i.e. children from villages located at less than 1.5kms from school were 4.9 times less likely to be absent for school than those located at more than 6.0kms. It was also exhibited in Figure 7.6 that the percentages of school absenteeism (number of children who were absent for school from each time-to-school category as a percentage of the number of children who attended school from the same category) increased with higher time-to-school; however the increase was modest (less than 35%) even for the longest distance category. It is likely that even though long distance to school strongly reduced the labour input on farm tasks that a child could give, nevertheless the majority of households gave priority to the child attending school over doing farm labour.

On the contrary, there was no evidence of correlation between school attendance and (i) frequency of water collection and (ii) time spent on water collection. Furthermore, for those household members who were involved in water collection and then farm tasks; the study showed evidence of no correlation between time spent on water collection and time spent on farm tasks.

CHAPTER 9

Summary and conclusions

9.1 Introduction

The overall aim of this thesis was to investigate the effects of accessibility on quality of life in the rural communities of Malawi – Chikwawa District in particular. Specifically the thesis aimed to:

⇒ examine the accessibility of villages to a range of key services in Chikwawa District of rural Malawi

⇒ identify villages experiencing low levels of accessibility to multiple services.

⇒ explore the influence of accessibility on service utilisation and outcomes realised from utilising the services

⇒ investigate whether physical access to key services affects participation in other activities of importance to well – being.

This Chapter reviews the findings based on the reported in earlier chapters of this thesis, outlines the principal contributions of the thesis and places these findings in the context of existing literature, discusses the limitations of this research, outlines policy recommendations and areas for future research before drawing final conclusions.

9.2 Discussion of findings based on each chapter

9.2.1 Identifying villages with multiple dimensions of access deprivation using secondary data sources

Distance to the nearest opportunity of a specific kind is one of the simplest measures of accessibility. Many studies have used distance as an indicator of the level of accessibility to services. Communities located beyond a specific distance threshold

values to services are considered to experience a low level of accessibility (Geurs et al., 2001; Buor, 2003; Borzachiello et al., 2007).

This chapter measured accessibility from villages to key facility types (schools, water supply points, healthcare facilities, markets, trading centres and religious centres) drawing from the 2008 Malawi National Statistic Office and 2009 Roads Authority data sets. The approach taken was to measure accessibility directly from these geo-referenced databases. Firstly, the shortest path from each village to the nearest facility of each type was calculated through the road network using a standard GIS, TransCAD 4.8 (Caliper Corporation, 2005). Villages and facilities were connected to the nearest point on the road network using dummy links representing the centroid connectors to the network. Secondly, straight-line distances were calculated from each village to the nearest facility of each type to take account of the fact that a majority of trips to the facilities concerned are made on foot and often use off-road, more direct footpaths which were not included in the road network data. Villages were regarded as deprived of access to the facility type if the facility type was located beyond the specified distance threshold. Distance threshold values were defined following a synthesis of recommendations from studies by organisations as tabulated in Dennis (2000) and were as follows: 3.0, 1.0, 6.0, 6.0, 6.0, and 6.0 for primary schools, safe water supply points (boreholes and protected wells), health care facilities, markets, grinding mills and religious centres respectively.

The results of this work demonstrated that a large number of villages had key facilities located at distances beyond their threshold values. This is in line with findings from the MRTTP (2006) and NSO (2011), which found that most villages in rural districts of Malawi were far from key services, specifically healthcare facilities. In both studies villages which were far away from key facilities were identified through a distance threshold around the facility and the technique did not consider villages with multiple dimensions of access deprivation. However, this study employed a more detailed technique to examine the accessibility of the villages to a range of key services and to identify villages experiencing low levels of accessibility

by using both network and straight-line distances. The results showed that there were more villages whose facilities were beyond these threshold distances when road network distance measures were considered than when straight-line distances were used. The difference between the two approaches (network and straight-line distances) indicates that only looking at distances to facilities over the road network might lead to the overestimation of the level of service deprivation experienced by villages. Based on these results, it is suggested that comparison of road network and straight-line distances to services can be used as a technique to identify rural villages in Malawi that have services fairly close to them but lack a direct road connection (e.g. face significant detours in road network, perhaps caused by steep gradients or rivers).

Moreover, given the difference in the results of the two approaches, there is a strong incentive for villagers to seek and use trails and paths (where these exist) which do not form part of the mapped road network or that they would benefit from the existence of such trails.

9.2.2 Understanding the multidimensional village access deprivation using secondary and primary data

The previous chapter dealt with all the 326 villages in Chikwawa districts whereas this chapter dealt with a sample of 30 villages. This chapter attempted to address the gaps experienced from the secondary data analysis (chapter 4) by including primary data collected during the secondary data validation process. Therefore, this chapter attempted to deal with the same objectives addressed in chapter 4 as follows:

⇒ examine the accessibility of the villages to a range of key services

⇒ identify villages experiencing low levels of accessibility

In this chapter, accessibility was measured based on (i) distances from villages to the nearest facility type and distance to the nearest motorable road (ii) road network condition and (iii) topography.

The results showed that inequality exists in the distribution of access to existing facilities among the study villages. It was also demonstrated that the general state of road network in 63% of the study villages was poor. In addition, it was established that 60% of the study villages were located more than 2kms from the nearest motorable road at which public motorised transport could be accessed. Moreover, 90% of the villages had one or more basic services located beyond the threshold distance. Distance threshold values were defined as follows: 3.0, 1.0, 6.0, 6.0, 6.0 and 6.0 for primary schools, safe water supply points (boreholes and protected wells), secondary schools, health care facilities, markets and grinding mills respectively (Dennis, 2000).

These findings demonstrate serious inadequacies in the provision of key facilities for the inhabitants of the study villages and also demonstrate the lack of well-maintained road infrastructure. The findings are in line with results from other studies that found that most rural communities of Sub-Saharan African countries are far from basic and socio – economic facilities (IT Transport, 1996; World Bank, 1999; Bryceson & Howe, 1993; Bryceson, 2002; MRTTP, 2006). Some study findings further showed that in addition to limited means of transport, over half of the rural roads in Sub – Saharan Africa are in poor condition and mostly impassable during the rainy season (Riverson & Carapetis, 1991; Riverson et al., 2010). This study reflected on a more detailed analysis to understand the multidimensionality of village access deprivation by examining village accessibility levels to a range of key services based on distance to the facility type, road network condition and topography and identified villages experiencing low levels of accessibility. Moreover, Bourguignon & Chakravarty (2003), Wagle (2007) and Alkire & Foster (2009) employed the same approach to measure multidimensional poverty however their analysis was based on household income as a variable.

9.2.3 The influence of school accessibility on school attendance and educational performance/achievement

This chapter was addressed by answering the following questions:

⇒ Does accessibility have influence on the number of individuals who have never attended school or dropped out of school?

⇒ Does accessibility have influence on levels of lateness, absenteeism for school?

⇒ Is school examination failure associated with levels of lateness and absenteeism for school

Drawing on data collected from a household survey conducted in 2011 in a sample of 30 villages located in Chikwawa District in rural Malawi, descriptive and statistical analyses were employed to answer these questions. The main independent (explanatory) variable considered was distance. Topography and the condition of road network were introduced into the analysis as dummy independent variables. It was hypothesised that hilly terrain and poor road network would result in lower speeds hence higher travel times consequently addition of topography and network condition variables would add explanatory power to the model.

The outcome variables investigated in this study were school non-attendance, levels of lateness for school, levels of absenteeism for school and examination failure rates. Distances were divided into four categories, the lower category was less than 1.5kms and the upper was more than 6.0kms. Travel time was also divided into four categories; the lower was less than 30 minutes and the upper more than 120 minutes.

Influence of distance on school non-attendance

Both the descriptive and statistical analyses demonstrated that distance influenced school non-attendance. The statistical analysis showed that distance was the strongest predictor of school non – attendance. Children from villages located at more than 6kms from schools were 4.6 times more likely not to enrol for school than those located at less than 1.5kms. This finding is in agreement with the results from a study

in Tanzania by Kondylis & Manacorda (2006) who concluded that distance to school contributed to school non-attendance

Influence of distance on school attendance and educational performance

The results suggested that there was a statistically significant relationship between distance and the number of occasions that individuals reported late for school and were absent for school. The ordinal logistic models demonstrated stronger unique contribution of distance in explaining the levels of being late for school and absenteeism for school. The results demonstrated that children from villages located at less than 1.5kms from school were respectively 4.0 and 4.9 times less likely to be late and absent for school than those located at more than 6.0kms after controlling for location factors, condition of road network and socio – economic characteristics. Moreover, it was demonstrated that hilliness slightly contributed in explaining the rate of lateness and absenteeism for school. The probability of the children getting late for school, absent for school and fail examinations increased as households became more inaccessible probably due to steep slopes. These results relate with findings from the Boris et al. (2007) study which found that distance to school and terrain in the mountainous region of Nepal increased the rate of lateness and absenteeism for school.

Moreover, this study exhibited that lateness, absenteeism and rate of examination were not statistically the effect of condition of the road network. This is in contrast to findings from many studies that indicated the lack of accessibility to schools caused by a deficient and ill-maintained rural road network contributed to school absenteeism and achievement of better education (Bigman & Deichmann, 2000; Nejadfard, 2000; Donnges C., 2003). Furthermore this study has demonstrated that rate of examination failure in this study area was responsive to school absenteeism.

The cited past studies that explored the influence of distance on school attendance and performance were based on secondary data sets and used different statistical tools. This study is distinct since it was based on secondary data sets and empirical

evidence from primary data sets and used ordinal logistic regression models to examine the influence of distance on school attendance and performance. Whilst Borzachiello et al. (2007) also employed straight-line distances and used binary logistic regression models to identify the impact of differences in spatial accessibility on the development of the built environment in cities and highlighted that distances to the main urban centres and infrastructure points influenced development of urban centres and utilisation of the services, their study focussed on urban districts, whereas the focus of this study was the rural setting.

9.2.4 Physical accessibility of rural health care facilities and health care seeking behaviour

This chapter was addressed by answering the following questions:

⇒ does distance to formal healthcare facility have influence on the number of individuals who reported being ill but did not seek any medical services?

⇒ does distance to formal healthcare facility influence the type of health and medical services where members sought treatment? What was the effect of the condition of the road network and topography?

⇒ does mode of transport influence the type of health and medical services from which members sought treatment?

Drawing on data collected from a household survey conducted in 2011 in a sample of 30 villages located in Chikwawa District in rural Malawi, descriptive and statistical analyses were employed to answer these questions. The main independent variables considered were distance and mode of transport to healthcare facilities. Topography and condition of road network were introduced into the analysis as dummy independent variables. It was hypothesised that hilly terrain and poor road network would result in lower speeds hence higher travel times consequently addition of topography and network condition variables would add explanatory power to the model.

The outcome variables investigated in this study were individuals who fell sick and sought no treatment and individuals who sought treatment. Distances were divided into five categories, the lower category was less than 1.5kms and the upper was more than 10.0kms. Travel times were also divided into five categories; the lower was less than 30 minutes and the upper more than 240 minutes.

Influence of distance to formal healthcare facilities on healthcare seeking behaviour

This study demonstrated that distance from the villages to the formal healthcare facility was the strongest predictor of not seeking medical services. Individuals from villages located at more than 10.0kms from healthcare facilities were 5 times more likely not to seek medical services than those located at less than 1.5kms. Descriptive statistics also indicated that longer distances to formal health care facilities influenced the number of individuals seeking formal medical services in this study area. The percentages of individuals who did not seek medical services increased with increasing distances to the formal health care facility agreeing with results from other studies such as Buor (2003) and Awoyemi et al. (2011).

The results from this study also showed that the percentages of those who sought medical services from formal sources reduced strongly with longer distances and in contrast, the percentages of those who sought medical services from informal sources increased with longer distances to formal medical services and it was even stronger in highlands and areas where the road network was in poor condition. In addition, this study found that walking was the predominant mode of transport to healthcare facilities in this study area agreeing with findings from the 2011 Malawi National Statistics Surveys. Moreover, the study demonstrated that bicycles and motorised vehicles were also used to access healthcare facilities in this study area. It showed that walking trips were mostly made to health care services which were nearby whilst bicycles and motorised vehicles were used for longer trips. The study also demonstrated that cycling was affected by highlands and poor condition of the road network and public motorised transport was mostly affected by the poor condition of

the road network. Furthermore, this study showed that cost of transport to health care service did not influence the type of medical service sought.

These findings relate to findings from other studies such as Haynes et al. (1999) and Schoeps et al. (2011) who demonstrated that long distances to healthcare facilities were not appropriate for walking, Gage & Calixte (2006), Boris et al. (2007) and Omole & Owoeye (2012) who demonstrated that cycling in mountainous areas is very difficult. Other studies also demonstrated how poor road condition affects access to formal healthcare facilities (Howe, 1997; Donnges, 2003; Edmonds, 2004; Johansson, 2006). However, in contrast to the findings from this study, the results from Buor (2003) study demonstrated that cost of transport to healthcare facilities influenced their utilisation.

Generally, the relationships between healthcare facilities and the factors that determine the way they are used are different in different places, and depend quite strongly on local habits, rather than being universal. If one roughly knows the impact of accessibility on health care facility utilisation in one of the rural areas in Africa for example rural Ghana, it is still difficult to predict what it will be in e.g. rural Malawi, because other factors and behavioural characteristics can result in quite different utilisation patterns. This means that to come up with the most sensible approach to healthcare improvement in a certain area, the best thing to do is to analyse the patterns in the area at hand.

9.2.5 Association of physical access to schools, labour input to farm tasks and water collection

This chapter was addressed by answering the following questions:

⇒ Does distance to school have any influence on (i) frequency of involvement in farm activities and water collection? (ii) time spent on these household tasks?

⇒ Do frequency and time spent on farm activities and water collection influence school attendance?

⇒ Does time spent on water collection influence the time spent on farm tasks?

Answers to these questions were based on data collected from a 2011 household survey conducted in a sample of 30 villages in Chikwawa District-rural Malawi. The variables considered were distance to school, travel time to school, time spent on household tasks (farm tasks and water collection) and the frequency of engagement on the household tasks.

The results showed that farm tasks and water collection were mainly related to men and women respectively. The results also exhibited a negative correlation between distance to school and (i) frequency of involvement in farm tasks and (ii) time spent on farm tasks. However, there was no evidence of correlation between distance to school and (i) frequency of water collection and (ii) time spent on water collection. In addition, the study also demonstrated that individuals who were frequently involved in farm tasks were more likely to be late and absent for school. Likewise, individuals who spent more time on the farm tasks were more likely to be late or absent for school. It is apparent that villages located close to schools benefited by (a) lower levels of absenteeism and (b) more time available for farm tasks.

The descriptive statistics on school attendance (Figure 8.6) showed that the percentages of absenteeism (number of children who were absent for school from each time-to-school category as a percentage of the number of children who attended school from the same category) increased with higher time-to-school; however the increase was modest (33%) even for the longest distance category. It is likely that even though long distance to school strongly reduced the labour input on farm tasks that a child was able to give, the majority of households gave priority to the child attending school over doing farm labour, apparently judging that the long term benefit from the education would be much higher than the short term value of the child's farm labour. This shows an optimistic and forward-looking attitude. The households and children were prepared to make a high investment in the school education.

On the contrary, there was no evidence of correlation between school attendance and (i) frequency of water collection and (ii) time spent on water collection. Furthermore, for those household members who were involved in water collection and then farm tasks, the study showed no evidence of correlation between time spent on water collection and time spent on farm tasks.

The findings of this chapter have highlighted fresh insight to the trade – offs between school attendance and involvement in farm tasks and water collection. This is limited in current studies and allows the unravelling of policy implications appropriate for child education in rural areas.

9.3 Research limitations

The following are the limitations of this research

i. There were no geo-referenced positions of households. Instead village area centroids were employed as reference points in the estimation of distances from the villages to services. The location of each village was represented by a point which lay at the centre of the village, whereas in reality a village has a certain size which depends on the number of houses and on how clustered these houses are. If the houses were not very clustered the total area covered by a village could well be 1-2km in radius. In this case the actual distance to the nearest facility for some households would be less (or more) than the measured distance. Unobserved intra-village variation in accessibility will be more pronounced for larger and lower-density villages. It was likely that the actual distance to school for a specific respondent would deviate from the average with a considerable error depending on how dispersed the households were and how large the village was.

ii. There are primarily three broad groups of factors that may affect the accessibility to services and these are: (i) geographical/physical (ii) social and (iii) institutional. Geographical barriers imply long distances to services.

Social barriers entail barriers that emanate from community and/or household characteristics in addition to gender, age (personal traits that can determine one's accessibility levels). Institutional barriers imply the lack of or low quality institutions. This research did not consider institutional barriers of access to services (rural infrastructure quality, unavailability of resources, unscheduled closures (in case of schools), etc) because data in this area was not collected due to financial limitations.

iii. Bearing in mind that demand shapes the provision of services to a community, this study did not attempt to assess whether the supply of services in the study area reflected the size or affluence of the population that utilize them. This is one of the measures of service accessibility. Different methods to compute demand – supply balance have been used by different researchers. Others used the ratio of population to the particular service (Handy & Niemeier, 1997; Ajala et al., 2005) while others used the impedance in terms of distance, time or money (Geurs & Ritsema, 2004, Borzacchiello et al., 2007). These approaches need two sets of data; one based on population (potential demand on service) and the other based on the availability of the particular service (potential supply). However, in this research, there was limited data to validate the measurement of the supply – demand balance. Nevertheless, this did not affect the results of this study since the focus of this study was on exploring the influence of physical accessibility constraints on access to basic and socio-economic services and the questions asked were related to access to services.

9.4 Policy implications

One of the findings of this study is that the mode of transport and the kind of infrastructure required to travel to schools were different from formal healthcare facilities. School trips were often on foot and likely "off-road" whereas a higher percentage of trips to formal healthcare facilities were made by motorised transport and on road network. Therefore, transport policies for Chikwawa district need not be

generalised for all services. Stemming from the findings and contributions of this thesis, the following are policies that can be made to achieve sustainable access to services thereby improving people's well being:

i. Walking is the most common means of travel in rural areas of Malawi not only for shorter trips but even for trips of up to 10kms. Often, many trips on foot use "off-road" trails (paths) that as much as possible follow a straight - line to the destination. The bicycle and the motorcycle (though not common due to high purchase prices) are the other modes of transport often used for off-road shortcuts**.** Public transport mainly operates on main and secondary roads to the District Business Centre and is for those who can afford to pay for the services. It has been highlighted in this study that a significant number of villages were closer to facilities when straight-line distances were used compared to road network distances. This indicates that it is important to carefully consider off-road local short-cut trails. To contribute positively in the long run to Chikwawa District mobility**,** it could be cost-effective to give special care to direct walking routes with all weather quality. Currently, off road, short-cut routes are not considered for maintenance by either Central or Local Government.

ii. This study also demonstrated that a large number of villages have facilities located beyond their generally recommended threshold distances as presented in Dennis (2000). Clearly, the District Planning Policy for Chikwawa District should develop a vision on the desirable spatial distribution of facilities in order to reduce the maximum required trip distance for most trips. It should also develop a vision on how the road and local trail network connectivity can be used as an instrument to support a balanced development of the district without a strong spatial segregation between activity centres and large parts of the population.

iii. Moreover, this study demonstrated that the majority of households were likely to give priority to the child attending school over doing farm labour, apparently judging that the long term benefit from the education would be

much higher than the short term value of the child's farm labour. The households and children were prepared to make a high investment in the school education. In order to match this investment from government side, it appears to be much better value for money to invest in the quality of the education in the schools (e.g. teacher quality, learning material) than to invest in reducing distance to schools by constructing more schools which would be smaller and of lower quality, or improving rural roads (this argument is not applicable in any case since most school trips are on foot and off-road anyway). Accessibility difficulties can apparently be managed by the households; the children go to school as a matter of first priority. However, the households cannot do anything about school quality; that is what the government has to bring in.

iv. On formal healthcare facilities, this study has shown that there is an unequal distribution of formal health facilities as well as low levels of physical accessibility to the healthcare facilities in the study area. To this end, in order to overcome the barrier of distance to the utilisation of formal health care services, the central and local governments in Chikwawa district should ensure equitable accessibility to health care delivery across the rural areas in the district by establishing additional public health centres and mobile clinics in the core rural areas. This will increase the proximity and accessibility of rural people to public health facilities. Moreover, many people will be able to access the facilities on foot thereby avoiding the problems they face due to poor condition of the road network and unavailability of modes of transport appropriate for longer distances. The government should also embark on several health programmes and campaign to educate the people on the benefits of utilizing improved health facilities.

Generally, transport policies for Chikwawa District should be a balanced mix, taking into account the actual modes of transport used, aiming at improved local "non-car" paths and footbridges alongside a cost-effective road network, and aim at encouraging a better spread of activity locations. Such a balanced mix could well

turn out to be cheaper as well as more effective than expanding the rural road network.

9.5 Research contributions

The main contribution of this research is an empirical investigation into the influence of physical accessibility on service utilisation in the context of access to schools and healthcare facilities in rural Malawi. The other contribution is the fresh insight to the trade – offs between school attendance and involvement in farm tasks and water collection which is limited in current studies. This research also contributes to the understanding that there is no single answer to lack of accessibility of services, but that a clever mix of different strategies is required depending on the local situation in a certain area.

9.6 Reflections for further research

- One of the objectives of this thesis was to explore the influence of accessibility on service utilisation. Although this objective was achieved the method only considered geographical and social dimensions as factors that may deter accessibility to services. However, an inclusion of institutional factors would allow stronger conclusions to be drawn. It is therefore suggested that future research should consider inclusion of institutional barriers that may deter access to services.

- One of the findings of this thesis was that most trips to schools were made on foot and more likely using tracks. The other finding was that the condition of the road network influenced travel times to services especially for longer trips regardless of mode of transport used. It is therefore suggested that future research should consider answering the following questions: to what extent have transport attributes (e.g. improved rural roads and village access tracks, elimination of local access barriers, access to low–cost means of transport) resulted in improved service accessibility in this

rural area of Malawi. And, if so, has this increased service utilisation? Moreover, has this produced a measurable improvement in local health and social and economic well-being? In other words, future research should focus on monitoring precise cause-effect relations over time i.e. do improved river crossings in footpaths to schools indeed reduce travel times in the rainy season, and does this positively affect school results? do improved road conditions indeed increase health centre utilisation frequency etc.? This asks for sustained research over a longer period of time.

9.7 Concluding remarks

This thesis had three main objectives to address. First, it identified the number of villages experiencing multiple dimensions of access deprivation. It showed that more villages were experiencing low levels of accessibility. Secondly, it explored the influence of accessibility on service utilisation and outcomes. It demonstrated that distance influenced school non-attendance and healthcare seeking behaviour. Then the thesis proceeded to investigate the tradeoffs between household tasks and school attendance. It exhibited that even though long distance to school strongly reduced the labour input on farm tasks that a child would give, the majority of households gave priority to the child attending school over doing farm labour, apparently judging that the long term benefit from the education would be much higher than the short term value of the child's farm labour.

References

Adler, T. AND Ben Akiva, M. (1979). A theoretical and empirical model of trip chaining behaviour. *Transportation Research* 13 B, 243-257

Ahmed S., Adams A., Chowdhury M., Bhuiya A. (2000). Gender, socioeconomic development and health-seeking behaviour in Bangladesh. *Social Science and Medicine;* 51(3): 361-71.

Airey, T. (1993). Local Level Rural Transport in Sub-Saharan Africa. IT Transport Ltd

Ajala O., Sanni L., Adeyinka S. (2005). Accessibility to health care facilities: A panacea for sustainable rural development in Osun State south-western Nigeria. *Journal of Human Ecology*, 18(2), 121-128.

Alkire, S. and Foster, J. (2009). Counting and Multidimensional Poverty Measurements. *Oxford Poverty and Human Development Initiative (OPHI) working paper No. 32.*

Álvarez-Díaz, Á., González, L. and Radcliff, B. (2010). The Politics of Happiness: On the Political Determinants of Quality of Life in the American States. *The Journal of Politics,* 72(3): 894 – 905.

Andrews G. (2008) Demographic and Health Issues in Rural Aging: A Global Perspective. *Journal of Rural Health*, 17(4), 323 – 327.

Arber, S., & Cooper, H. (1999) Gender differences in health in later life: the new paradox? *Social Science & Medicine,* 48(1), 61-76.

Arber S. & Khlat M. (2002) Introduction to 'social and economic patterning of women's health in a changing world', *Social Science and Medicine,* 54 (5), 643-647.

Atkins D. (2005) Using multilevel models to analyse couple and family data: Basic and advanced issues. Journal of Family Psychology, 19, 98 – 110.

Atkinson, S., Ngwengwe, A., Macwan'gi, M., Ngulube, T.J., Harpham, T., & O,Connel, A. (1999). The referral process and urban health care in Sub – Saharan Africa: the case of Lusaka, Zambia. Social Science & Medicine, 49(1), 27 – 38.

Austin, P.(2002) A comparison methods for analysing health – related quality of life measures, *Value in Health,* 5(4), 329 – 337.

Avila, M. and Gasperini, L. (2005) The MDGs and Sustainable Development in Sub-Saharan Africa: Challenges and Implications of Education for Rural People. *Paper presented at the Ministerial Seminar on Education for Rural People in Africa, FAO/IIEP/ADEA, 7 – 9th September, 2005*, Addis Ababa, Ethiopia.

Awoyemi T., Obayelu O. & Opaluwa H. (2011). Effect of Distance on Utilization of Health Care Services in Rural Kogi State, Nigeria. Journal of Human Ecology, 35(1), 1-9.

Babbie, E. (1998) The practice of Social Research, 8th ed. Wadsworth Publishing Company, Stamford, CT.

Baradaran, S. and Ramjerdi, F. (2001) Performance of Accessibility Measures in Europe. *Journal of Transportation and Statistics*; 4(2/3), 31 – 48

Barwell, I. (1996) Transport and the village: findings from African village-level travel and transport surveys and related studies. *World Bank Discussion Paper 344*, Washington, DC: World Bank

Bashour, H. & Mamaree, F. (2003) Gender differences and tuberculosis in the Syrian Arab Republic: patients' attitudes, compliance and outcomes. Eastern Mediterranean health Journal, 9(4), 757- 768.

Beaman. L., Dillon, A. (2011) Do Household Definitions Matter in Survey Design? Results from a Randomized Survey Experiment in Mali; *International Food Policy Research Institute*

Ben-Akiva, M. and Lerman, S. (1979), Discrete Choice Analysis: Theory ...Shapes Land-Use', *Journal of the American Planning Institute* 25, 73-6.

Ben – Akiva, M. and Lerman, S. (1985) Discrete Choice Analysis, Theory and Application to Travel Demand. *The MIT Press, Massachussettes*.

Ben-Akiva, M., Bowman, J. and Gopinath, D. (1996) Travel demand model system for the information era. Transportation, 23, 241-266

Bertolini, L., Clercq, F. le and Kapoen, L. (2005) Sustainable Accessibility: a conceptual framework to integrate transport and land use plan – making. Two test applications in the Netherlands and a reflection on the way forward. *Transport Policy*; 12(3), 207 – 220.

Bhan G., Bhandari N., Taneja S., Mazumder S., Bahl R.; Zinc Study Group (2005). The effect of maternal education on gender bias in care-seeking for common childhood illnesses. *Social Science and Medicine*, 60(4):715-724.

Bharmal F. (2000) Inequity and Health: Is Malnutrition really caused by Poor Nutrition? *The Journal of the Pakistan Medical Association*, 50(8), 273 – 275.

Bhat, C., Handy, S., Kockelman, K., Mahmassani, H., Chen, Q. and Weston, L. (2000) Development of an Urban Accessibility Index: Literature Review. Research project conducted for the Texas Department of Transportation. *Center for Transportation Research, University of Texas, Austin (TX), USA.*

Blayac, T. and Causse, A. (2001) Value of Travel Time: A Theoretical Legitimisation of Some Nonlinear Representative Utility in Discrete Choice Models. *Transportation Research B;* 35(4), 391-400

Bigman, D. and Deichmann, U. (2000) "Geographical Targeting: A Review of Methods and Approaches," in D. Bigman and H. Fofack, editors, Geographical Targeting for Poverty Alleviation: Methodology and Applications. World Bank.

Bird, K., McKay, A. and Shinyeka, I. (2007) Isolation and Poverty: the relationship between spatially differentiated access to goods and services and poverty. *Paper presented at International Workshop "Understanding and addressing Spatial poverty traps" Stellenbosch, South Africa.*

Birdsall N. & Orivel F. (2006). Demand for primary schooling in rural Mali: should user fees be increased? *EBSCOhost*, 4(3), 279-296

Birkin, M., Clarke G. et al. (1996). Intelligent GIS: Location decision and strategic planning: Cambridge Pearson Professional Ltd

Bollen, K. A., J. L. Glanville, and G. Stecklov. 2001. "Socioeconomic Status and Class in Studies of Fertility and Health in Developing Countries." *Annual Review of Sociology* 27: 153–185.

Boris A. P., Madhav A., Moshe S. (2007). Urban Growth in Nepal: Does Location Matter? Journal of Urban Studies, 44(5/6), 915– 937.

Borzachiello, M.T., Nijkamp, P. & Koomen, E. (2007) Accessibility and urban development: a grid based comparative statistical analysis of Dutch Cities. *A paper presented at the NECTAR Workshop 'Network Dynamics and Location Choice, Stuttgart, Germany: available at www.econpapers.repec.org*

Borzacchiello, M., Nijkamp, P. and Scholten, H. (2009) A logistic regression model for explaining urban development on the basis of accessibility: a case study of Naples. *International Journal of Environment and Sustainable Development*, 8(3/4), 300 – 313.

Bourguignon F. & Chakravarty S.R. (2003) The measurement of multidimensional poverty. Journal of Economic Inequality 1, 25–49.

Bowling, A. (1991) Measuring Health: A Review of Quality of Life Measurement Scales, *Open University Press, Milton Keynes*

Brown, V., Rawlinson, M., Hilles, N. (1981) Life satisfaction and chronic disease: exploration of a theoretical model. *Medcare*, 19, 301-327

Bryceson, D. and Howe, J. (1993) Rural household transport in Africa: reducing the burden on women? *World Development*, 21 (11), 1715–1728.

Bryceson, D. (2002) The Scramble in Africa: re - orienting rural livelihoods. *World Development, 30(5),* 725 – 739.

Bryceson, D. (2006) Ganyu casual labour, famine and HIV/AIDS in rural Malawi: causality and casualty. *Journal of Morden African studies*, 44(2), 173 – 202.

Bulpitt, C. and Fletcher, A. (1990) The measurement of quality of life in hypertensive patients: a practical approach. *British Journal of Clinical Pharmacology*, 30(3), 353 – 364

Buor, D. (2003) Analysing the primacy of distance in the utilization of health services in the Ahafo-Ano South district, Ghana. *International Journal Health Planning and Management*, 18(4), 293-311.

Burns, L. (1979) Transportation, Temporal, and Spatial Components of Accessibility. *Lexington Books, DC Heath and Company, Massachusetts, USA.*

Caliper Corporation (2005) TransCAD: Transportation GIS Software Reference Manual, Version 4.8, Newton, MA.

Campbell, A., Conversa, P., and Roadgers, W. (1976) The quality of American life: perceptions, evaluation and satisfaction. New York: Russel Sage Foundation

Carr, J., Thompson, P., and Kirwan, J. (1996) Quality of Life Measures. *British Journal of Rheumatology*, 35: 275 – 281

Cashin C., Borowitz M., Zuess O. (2002) The gender gap in primary health care resource utilization in Central Asia. *Health Policy Plan*, 17(3), 264-272.

Castella, J., Manh, P., Kam, S., Villano, L. and Tronche, N. (2005) *Journal of Applied Geography*, 25, 308 – 326.

Chakravarty, S., D'ambrosio, A. (2006) The Measurement of Social Exclusion. *Review of Income and Wealth*, 523, 377-398.

Chang H. & Liao C. (2011). Exploring an integrated method for measuring the relative spatial equity in public facilities in the context of urban parks. Cities, 28(5), 361 – 371.

Chen, X., Philip, B., Mitchell, M. and Wells, C. (2003) Regression with Stata. Los Angeles*: http://www.ats.ucla.edu/stat/stata/webbooks/reg/default.htm*

Chen, S. & Ravallion M. (2010). "The Developing World Is Poorer Than We Thought, but No Less Successful in the Fight Against Poverty," *The Quarterly Journal of Economics*, 125(4), 1577-1625

Cohen, J. (1988) Statistical power analysis for the behavioural sciences (2nd edn) Hillsdale, NJ: Lawrence Erlbaum Associates.

Cooper H. (2002) Investigating socio-economic explanations for gender and ethnic inequalities in health. *Social Science and Medicine*, 54(5), 693-706.

Cooper A., Page A., Foster L. and Qahwaji D. (2003). Commuting to school: Are children who walk more physically active? *American Journal of Preventative Medicine*, 25, 273–276.

Danso-Appiah A., De Vlas S., Bosompem K., Habbema J. (2004) Determinants of health-seeking behaviour for schistosomiasis-related symptoms in the context of integrating schistosomiasis control within the regular health services in Ghana. *Tropical Medicine and International Health*, 9(7), 784-794.

Das N., Mishra V. & Saha P. (2001) Does Community Access Affect the Use of Health and Family Welfare Services in Rural India?. National Family Health Survey Subject Reports Number 18: http://scholarspace.manoa.hawaii.edu/bitstream/

Dawson, J. and Barwell, I. (1993) Roads are not enough: new perspectives on rural transport planning in developing countries, Intermediate Technology Publications, London

Deichmann, U. (1999) Geographic aspects of inequality and poverty. Text for World Bank's Website on inequality, poverty and socio – economic performance: from *www.worldbank.org/poverty/inequal/index.htm.*

de Graft Aikins, A. (2005) Healer shopping in Africa: new evidence from rural-urban qualitative study of Ghanaian diabetes experiences, *Bristish Medical Journal, 331*(7519), 737.

de Jong T. & Ritsema van Eck J.R. (1996) Location profile - based measures as an improvement on accessibility modelling in GIS. *Journal of Computing, Environment and Urban Systems* 20(3), 181–190

de Langen, M. and Tembele, R. (2001) Productive and Liveable Cities: Guidelines for Pedestrian and Bicycle Traffic in African Cities. *Balkema Publishers, ISBN 9058091988, 9789058091987*

Deller, S., Tsai, T., Marcouiller, D. and English, D. (1999). The Role of Amenities and Quality of Life in Rural Economic Growth. *American Journal of Agricultural economics*, 83(2), 352 – 365

Dennis R. (2000) Rural Transport and Accessibility (RATP No1). *Geneva, International Labour Office, ISBN 92 – 2 – 111001 – X.*

Dercon, S. (2005) Poverty measurement, in Clark D.A. (ed.). *The Elgar Companion Development Studies.*

Dercon, S. and Hoddinott, J. (2005) Livelihoods, growth, and links to market towns in 15 Ethiopian villages. *FCND discussion papers 194, International Food Policy Research Institute (IFPRI); at http://www.ifpri.org/publications/livelihoods*

Dercon, S. (2006) Economic reform, growth and poor: Evidence from rural Ethiopia. *Journal of Development Economics*, 81(1), 1-24.

Devereux, J. (1999) Making Less Last Longer: Informal safety nets in Malawi. *IDS Discussion Paper, No. 373. Institute of Development Studies*, Brighton

Diener, E., Sandvik, E., Seidlitz, L. and Diener, M. (1993) The relationship between income and subjective well-being: relative or absolute? *Social Indicators Research* 28: 195-223.

Diener, E. and Suh, E. (1997) Measuring Quality of Life: Economic, Social, and Subjective indicators, *Social Indicators Research*, 40: 189–216

DiGuiseppi, C.; Roberts, I.; Li, L.; Allen, D. (1998). Determinants of car travel on daily journeys to school: cross sectional survey of primary school children. http://dx.doi.org/10.1136/bmj.316.7142.1426

Dixon-Fyler, K. (1998) Accessibility Planning and local development: the application possibilities of the IRAP methodology, RATP No. 2, ILO-Geneva

Donnges C. (2003). Improving access in rural areas. ILO ASIST AP; Rural Infrastructure Publication No. 1. Available from the following: http://www.ilo.org/wcmsp5/groups/public/bangkok/documents/publication/wcms_bk_pb_216_en.pdf

Donnges, C., Jagannath, O. and Chloe, P. (2005) Integrated Rural Accessibility Planning. International Labour Organization Regional Office for Asia and the Pacific: Bangkok.

Du H. & Mulley C. (2007) Relationship between Transport Accessibility and Land Value: Local Model Approach with Geographically Weighted Regression. Journal of the Transportation Research Board, 1977/2006, 197 – 205.

Dunkley, B., Helling, A. and Sawicki, D. (2004) Accessibility versus Scale: Examining the tradeoffs in Grocery Stores. *Journal of Planning Education and Research*, 23, 387 - 401.

Edmonds, G. (1998) Wasted time: the price of poor access. RATP No. 2, ILO-Geneva

Edmonds, G. (2004) Infrastructure and Poverty Alleviation. Paper prepared for the DAC task team on Infrastructure for Poverty Reduction. ILO ASIST AP.

Ellis, S. and Hine, J. (1995) The transition from non-motorised to motorised modes of transport, Transport Research Laboratory PA3144/96, Crowthorne, UK.

Ellis, F., Kutengule, M. & Nyasulu, A. (2003) Livelihoods and rural poverty reduction in Malawi. *Journal of World Development*, 31(9), 1495-1510.

Emslie, C., Hunt, K. & Macintyre, S. (1999) Problematizing gender, work and health: the relationship between gender, occupational grade, working conditions and minor morbidity in full-time bank employees. Social Science and Medicine, 48(1), 33-48.

Englund, H. (1999) The self in self interest: Land, labour and temporalities in Malawi's agrarian change. *Journal of Africa*, 69(1), 139-159

ENVIS Centre on Human Settlement (2009) *Quality of Life Indicators Monograph, World Environment Day*

Escobal, J. and Ponce, C. (2002) The benefits of rural roads: enhancing income opportunities for the rural poor. Lima GRADE, Working paper, 40-I. ISBN: 9972-615-25-I

Ettema, D. and Timmermans, H. (2007). Space-time Accessibility under Conditions of Uncertain Travel Times: Theory and Numerical Analysis. *Geographic Analysis, 39(2), 217-240.*

Farrington, J. and Farrington, C. (2005) Rural Accessibility, Social Inclusion and Social Justice: Towards Conceptualisation. *Journal of Transport Geography*, 13, 1-12.

FHI 360 (2009) Household Survey Guidelines on Education for use in the context of the IHSN Question Bank**:** EPDC Working Paper No. EPDC -09- 04 http://www.epdc.org/sites/default/files/documents/Household_Survey_Guidelines_on_Education.pdf

Foddy, W. (1993) Constructing questions for interviews and questionnaires: *Theory and Practice in Social Research.* Cambridge: Cambridge University Press

Fonck K., Mwai C., Ndinya-Achola J., Bwayo J., Temmerman M. (2002). Health-seeking and sexual behaviors among primary healthcare patients in Nairobi, Kenya. Sexually Transmitted Diseases, 29(2), 106 -111.

Gage A.J. & Calixte M. G. (2006). Effects of the physical accessibility of maternal health services on their use in rural Haiti. *Population Studies*, 60(3), 271-288.

Galdas, P., Cheater F., Marshall, P. (2005) Men and health help-seeking behaviour: literature review. *Journal of Advanced Nursing*, 49(6), 616-23.

Geertman, S. and van Eck, J. (1995) GIS and models of accessibility potential: an application in planning. *International Journal of Geographical Information Systems*, 9(1), 67 – 80.

Geurs, K. and Ritsema, van Eck J. (2001) Accessibility Measures: Review and Applications. *RIVM report 408505 006, National Institute of Public Health and Environment, Bilthoven*.

Geurs, K. and van Wee, B. (2004) Accessibility Evaluation of Land Use and Transport Strategies: Review and Research Directions. *Journal of Transport Geography*; 12, 127 – 140.

Goodal, B. (1987). *Dictionary of Human Geography. Harmondsworth**:** Penguin*

Gordon, A. (1997). Strengthening Research Linkages with Agricultural Markets in Sub-Saharan Africa, Mali Case Study; Discussion paper No. 97-3, ISNAR, The Hague.

Gould, P. (1969) Spatial Diffusion. *Resource Paper 17. Washington, DC: Association of American Geographers.*

Gregory, D., Johnston, R., Pratt, G., Watts, M. and Whatmore, S. (2009) *The Dictionary of Human Geography, 5th ed. John Wiley & Sons, Ltd, Chichester*

Griffiths, L., Parsons, T. and Hill, A. (2010) Self-esteem and quality of life in obese children and adolescents: A systematic review. *International Journal of Paediatric, 2010,* 5(4), 282–304.

Gupta N., Zurn P., Diallo K. & Dal Poz M.R. (2003). Uses of population census data for monitoring geographical imbalance in the health workforce: snapshots from three developing countries. *International Journal for Equity in Health*, 2(11), 413 – 427.

Hagerstrand, T. (1970) What about People in Regional Science? Papers of the Regional Science Association, 14, 7 – 21.

Handy, S. (1994) Highway Blues: Nothing a Little Accessibility Can't Cure, *Access*, 5, 3-7.

Handy, S. (1996) Methodologies for exploring the link between urban form and travel behaviour, *Transportation research Part D, Transport and environment*, 1(2), 151 -165.

Handy, S. and Niemeier, D. (1997) Measuring accessibility: An exploration of issues and alternatives. *Journal of the Environment and Planning A*, 29, 1175 – 1194.

Handy, S. and Kelly, J. (2001) Local Shopping as a Strategy for Reducing Automobile Travel. *Transportation*, 28 (4), 317-346.

Hansen, W. (1959) How Accessibility Shapes Land Use. *Journal of the American Institute of Planners*, 25(2), 73 – 76.

Hawthorne, G., Richardson, J. & Osborne, R. (1999) The Assessment of Quality of Life (AQoL) instrument: a psychometric measure of Health-Related Quality of Life. *Quality of Life Research,* 8(3), 209 – 224.

Haynes, R., Bentham, G., Lovett, A., & Gale, S. (1999). Effects of distances to hospital and GP surgery on hospital inpatient episodes, controlling for needs and provision. *Social Science & Medicine, 49*(3), 425-433.

Henrard, J. (1996) Cultural problems of ageing especially regarding gender and intergenerational equity, *Social Science and Medicine*, 43(5), 667-680.

Hewko, J., Smoyer K.E. & Hodgson M.J. (2002). Measuring neighbourhood spatial accessibility to urban amenities: does aggregation error matter? Environment and Planning A 34 (7), 1185 – 1206.

Hine, J. (1996) Rural road planning in developing countries, Oversees Unit, Transport and Road Research Laboratory, Crowthorne, Berkshire, UK.

Hjortsberg, C. & Mwikisa, C. (2002). Cost of access to health services in Zambia. *Health Policy and Planning*, 17(1), 71-77.

Hjortsberg, C. (2003). Why do the sick not utilize health care? The case of Zambia. *Health Economics*, 12, 755-770.

Hofman, J., Dzimadzi, C., Lungu, K., Ratsma, E. and Hussein, J. (2008) Motorcycle ambulances for referral of Obstetric emergencies in rural Malawi: Do they reduce, delay and what do they cost? *International Journal of Gynaecology and Obstetrics*, 102, 191 – 197.

Hon, K., Leung, T., Wong, K., Chow, C., Chuh, A. and Ng, P. (2008) Does age or gender influence quality of life in children with atopic dermatitis? *Clinical and Experimental Dermatology*, 33(6), 705–709.

Howe, J. (1995) Enhancing non-motorised transportation use in Africa – changing the policy climate, Transportation Rexearch Record 1487, Transportation Research Board, Washington.

Howe, J. (1996) Transport for the poor or the poor transport? IHE working paper IP-12, International Institute for Infrastructural, Hydraulic and Environmental Engineering, Delft, The Netherlands

Huang, M., Lu, E. (2007) The Two - Level Linear Modelling: Evidence from simulation Experiments. Paper presented at the annual meeting of the American Political Science Associations.

Hyndman J., D'Arcy C., Holman J. & Pritchard D. (2003). The influence of attractiveness factors and distance to general practice surgeries by level of social

disadvantage and global access in Perth, Western Australia. *Social Science and Medicine*, 53(12), 1599 – 1609.Instutute of Medicine (1996).

Institute of Medicine report, National Academy Press, Washington, D.C. Available: http://www.come-over.to/FAS/IOMsummary.htm

IT Transport (1996) Promoting Intermediate Means of Transport. SSATP Working Paper, Washington D.C: World Bank.

Johansson, S. (2006) Socio-economic impacts of road conditions on low volume roads from http://www.roadex.org/uploads/publications/docs.

Jones, P., Dix, M., Clarke, M., and Heggie I. (1983) Understanding travel behaviour, Gower, England

Jones K, Moon G. (1987) Health, disease and society. London, Routledge

Kahn M. (2002). A revealed preference approach to ranking city quality of life. *Journal of Urban Economics*, 38(2), 221 – 235.

Kickbusch I. (2001) Health literacy: addressing the health and education divide. *Health Promotion International*, 16(3), 289 – 297.

Kayira, C, Phiri, D., Chagunda, J, et al. (2006) The Ntchisi Social Economic Profile: Ntchisi DDP 2006 – 2009 report

Kingdon, G., and Knight, J. (2004) Subjective well-being poverty versus income poverty and capabilities poverty? *GPRG-WPS-003 Global Poverty Research Group* http://www.gprg.org/pubs/workingpapers/pdfs/gprg-wps-003.pdf

Kitamura, R. (1988) An evaluation of activity-based analysis. Transportation 15: 9 – 34.

Kleih, U. (1999). Community Access to Marketing Opportunities: Malawi Case Study. Natural Resources Institute

Kondylis F. & Manacorda M. (2012). School Proximity and Child Labor: Evidence from Rural Tanzania. Journal of Human Resources, University of Wisconsin Press, 47(1), 32-63.

Kuotcha, W., Ferguson, N., de Langen, M., Kululanga, G., Grimason, A. (2012) Identifying villages with multiple dimensions of access deprivation: the case of Chikwawa District in rural Malawi. World Transport Policy and Practice Journal, 18(1), 12-24.

Kutengule, M., Nucifora, A. & Zaman, H. (2011) Malawi Agricultural Development and Marketing Corporation Reform; Poverty and Social Impact analysis, World Bank retrieved from: http://siteresourworldb ank.org/INTPSIA/Resource/490023-1120841262639/ch12_malawi.pdf

Kutzin, J. (1993). Obstacles to women's access: issues and options for more effective interventions to improve women's health. Human Resources Development and Operations. Policy Paper No. 13, The World Bank

Kwan, M. (1998). Space – time and integral measures of individual accessibility: a comparative analysis using a point – based framework. *Geographical analysis*, 30(3), 191 – 216.

Kwan, M., Murry, T., Morton, E. and Tiefelsdorf M. 2003 Recent advances in accessibility research: representation, methodology and applications. *Journal of Geographical Systems,* 5, 129-138.

Landesman, S. (1996) Quality of life and personal life satisfaction: Definition and measurement issues. *Mental Retardation*, 24, 141–143.

Larsen, K. and Gilliland, J. (2008) Mapping the evolution of 'food deserts' in a Canadian city: Supermarket accessibility in London, Ontario, 1961–2005. *International Journal of Health Geographics,* 7, 1 - 16

Lee S., Arozullah A. and Cho Y. (2004) Health literacy, social support, and health: a research agenda. *Social Science and Medicine*, 58(7), 1309-1321.

Levinson, D. (2003) Perspectives on Efficiency in Transportation. *International Journal of Transport Management* (1)145-155.

Liu, S. & Zhu, X. (2004). An Integrated GIS Approach to Accessibility Analysis. *Transactions in GIS*, 8(1), 45–62.

Long, S., and Freese, J. (2006) Regression Models for Categorical Dependent Variables Using Stata. *Texas: StataCorp LP*.

Maas, C., Hox, J. (2004) Robustness issues in multilevel regression. Statistical Neerlandica, 58, 127 – 137

Maas, C., Hox, J. (2005) Sufficient sample sizes for Multilevel Modelling. *Methodology: European Journal of Research Methods for the Behavioural and Social Sciences, 1*, 85 – 91.

Mackian, S., Bedri, N., & Lovel, H. (2004) Up the garden path and over the edge: where might health-seeking behaviour take us? *Health Policy & Planning,* 19(3), 137-146.

McDonough P., Walters V., Strohschein L. (2002). Chronic stress and the social patterning of women's health in Canada. Social Science and Medicine, 54(5), 767-782.

Makri, M. & Folkesson, C. (1999). Accessibility Measures for Analyses of Land Use and Travelling with Geographical Information Systems; *Department of Technology and Society, Lund Institute of Technology, Lund University & Department of Spatial Planning, University of Karlskrona/Ronneby, Sweden*.

Malawi Government **(**2007) Malawi Growth and Development Strategy – from poverty to prosperity, *International Monetary Fund – IMF Country Report No. 07/55*

Malawi Rural Transport & Travel Program (MRTTP) Quarterly Report (2006). Ministry of Local Government and Rural Development, available at: *www.mlgrd.gov.mw, enquiries@ localgovt.mw.*

Marmot M. (1999) Epidemiology of socioeconomic status and health: are determinants within countries the same as between countries? *Annals of the New York Academy of Science*, 896, 16-29.

McColl, E., Jacoby, A., Thomas, L. Soutter, J. (2002) Design and use of questionnaires: A review of best practice applicable to surveys of Health Service Staff and patients, *British Journal of Clinical Governance* 7(3), 206 – 219.

McDonough P., Walters V., Strohschein L. (2002). Chronic stress and the social patterning of women's health in Canada. Social Science and Medicine, 54(5), 767-782.

Miller, H. (1999) Measuring space-time accessibility benefits within transportation networks: basic theory and computational procedures. Geographical Analysis, 31 187–212

Miller, K. (2005). Communication theories: Perspectives, processes, and contexts. New York: McGraw Hill.

Minot, N. (2005) Are poor, remote areas left behind in agricultural development: The case of Tanzania; *Markets, Trade and Institutional Division (MTID), Discussion*

Paper No. 90; Washington DC: International Food Policy Research Institute (IFPRI) – available at http://www.ifpri.org/publications.

Mishra G., Ball K., Dobson A., Byles J. & Warner-Smith P. (2002) Which aspects of socio-economic status are related to health in mid-aged and older women? *International Journal of behavioural medicine*, 9(3), 263-285.

Mobaraki O., Mohammadi J. & Zarabi A. (2012). Urban Form and Sustainable Development: The Case of Urmia City. *Journal of Geography and Geology*, 4(2), 1 – 12.

Montgomery, M. R., M. Gragnaloti, K. Burke, and E. Paredes. 2000. "Measuring Living Standards with Proxy Variables." Demography 37(2): 155–174.

Moseley, M., Harman, R., Coles, O. and Spencer, M. (1977) Rural Transport and accessibility: final report to the Department of Environment (Research Contract DG/64).

Moseley, M. (1979) Accessibility: The rural challenge, Methuen, London

Moser, G. (2009). Quality of life and sustainability: Towards person-environment congruity. *Journal of Environmental Psychology*, 29, 351 357

Msiska, R., Nangawe, E., Mulenga, D., Sichone, M., Kamanga, J., & Kwapa, P. (1997). Understanding lay perspectives: care options for STD treatment in Lusaka, Zambia. *Health Policy & Planning*, 12(3), 248-252.

National Statistics Office (NSO) Statistical yearbook (2008) Malawi National Statistics Office, available at: www.nso.malawi.net, enquiries @ statistics.gov.mw

National Statistics Office (NSO) Statistical yearbook (2010) Malawi National Statistics Office, available at: www.nso.malawi.net, enquiries @ statistics.gov.mw

National Statistics Office (NSO) Statistical yearbook (2011) Malawi National Statistics Office, available at: www.nso.malawi.net, enquiries @ statistics.gov.mw

National Statistics Office (NSO) Statistical yearbook (2012) Malawi National Statistics Office, available at: www.nso.malawi.net, enquiries @ statistics.gov.mw

Ndiaye P., Dia A., Diedgiou A., Dieye E. & Dione D. (2005) Socio-cultural determinants of the lateness of the first prenatal consultation in a health district in Senegal. *Sante Publique*, 17(4), 531-538.

Nejadfard, F. (2000) Rural travel and transport and economic development: Problems and prospects – examples from Malawi and Zimbabwe. *Proceedings of an ATNESA Workshop, South Africa.*

Needham D., Foster S., Tomlinson G., Godfrey-Faussett P. (2001) Socio-economic, gender and health services factors affecting diagnostic delay for tuberculosis patients in urban Zambia. *Tropical Medicine and International Health*, 6(4), 256-259.

Netuveli, G., Wiggins, R., Hildon, Z., Montgomery, S. and Blane, D. (2006) Quality of life at older ages: evidence from the English longitudinal study of aging (wave 1), *Journal of Epidemiology and Community Health*, 60(4), 357–363.

Nyamwaya D. (2003) Health promotion in Africa: strategies, players, challenges and prospects. *Health Promotion International*, 18 (2), 85-87.

Odoki, J. (1992) Accessibility- benefits analysis as a tool for transportation planning in developing countries, PhD Thesis, University of Trieste, Italy

Odoki, J., Kerali, H. and Santorini, F. (2003) An integrated model for quantifying accessibility-benefits in developing countries, *Transportation research, Part A*: Policy and practice, 35(7), 601 – 623.

Oh K. & Jeong S. (2007). Assessing the spatial distribution of urban parks using GIS. Landscape and Urban Planning, 82(1/2), 25 – 32.

Ojanuga D., Gilbert C. (1992) Women's access to health care in developing countries, *Social Science and Medicine*, 35(4), 613-617.

Oliver A. Mossialos E. (2004). Equity of access to health care: outlining the foundations for action. *Journal of Epidemiology Community Health,* 58,655-658

Omole, F. & Owoeye, J. (2012) Impact of Rocky Topography on Settlement Pattern and Housing Development in Idanre, Nigeria, *Mediterranean Journal of Social Sciences*, 3(3), 517 – 524.

O'Donnell, O. (2007) Access to health care in developing countries: breaking down demand side barriers. *Cad Saúde Pública*, 23(12), 2820-2834

Ortuzar, J. and Willumsen, L. (1994) Modeeling transport, 4nd ed., John Wiley and Sons, New York

Pallat J. (2010) SPSS Survival Manual: A step by step guide to data analysis using SPSS, 4th edn. McGraw – Hill

Perry, B. & Gesler, W. (2000) Physical access to primary health care in Andean Bolivia. *Social Science and Medicine*, 50, 1177-1188.

Pillai, R., Williams, S., Glick, H., Polsky, D., Berlin, J., Lowe, R. (2003) Factors affecting decisions to seek treatment for sick children in Kerala, India. *Social Science and Medicine*, 57(5), 783 -790.

Pinch, S. (1985). Cities and services. London: Routledge and Kegan Paul

Pokhrel S., Snow R., Dong H., Hidayat B., Flessa S., Sauerborn R. (2005) Gender role and child health care utilization in Nepal. *Health Policy*, 74(1), 100 -109.

Pooler J. (2002). Measuring geographical accessibility: a review of current approaches and problems in the use of population potentials, 18(3), 269–289.

Porter, G. (1995) The impact of road construction on women's trade in rural Nigeria. *Journal of Transport Geography*, 3 (1) 3 – 14.

Porter, G. (2002) Improving mobility and access for the off-road rural poor through Intermediate Means of Transport. *World Transport Policy and Practice* 8(4): 6-19.

Porter, G., Kathrin B. And Owusu-Acheampong, F. (2006) Getting to School-Achieving Universal Primary Education. *id21insights* 63: 3.

Porter, G., Hampshire K., Abane, A., Munthali, A., Robson, E., Mashiri, M. and Maponya, G. (2010) Where ghosts and lions roam: Learning from mobile ethnographies on a journey from school. *Children's Geographies,* 8(2), 91 – 105.

Porter, G. (2011) Children, Transport and Mobility - Sharing Experiences of Young Researchers in Ghana, Malawi, and South Africa: retrieved from: http://www.ifrtd.org/files/uploads/children_mobility_book_webversion.pdf

Rama, S. (2005) Children's Transport Issues. *The International Forum for Rural Transport and Development* at http://www.ifrtd.org/new/issues/children.php:

Ravallion, M. (1996) Issues in Measuring and Modelling Poverty, *Economic Journal*, 106, 1328-1344.

Riverson, J., and Carapetis, S. (1991) Intermediate Means of Transport In Sub-Saharan Africa Its Potential for Improving Rural Travel and Transport *(World Bank Technical Working Paper 161). Retrieved on November 29, 2010 from http://www4.worldbank.org/afr/ssatp/Resources/WorldBankTechnicalPapers/TP161.pdf*

Riverson, J., Gaviria, J. and Thriscutt, S. (2010) Rural Roads in Sub-Saharan Africa: Lessons from World Bank Experience; *World Bank Technical Paper 141: from http://www4.worldbank.org/afr/ssatp/Resources/WorldBankTechnicalPapers/TP141.pdf*

Roads Authority (RA) road network yearbook (2009) Malawi Roads Authority Office, enquiries @ ra.org.mw.

Roberts, P., Shyam, K. and Cordula R. (2006) Rural Access Indicator: A Key Development Indicator. *Washington, D.C.: The World Bank.*

Robinson, T., Emwanu, T., Rogers, D. (2007) Environmental approaches to poverty mapping: an example of Uganda. *Information Development,* 23(2/3), 205 – 215.

Rogers, D., Emwanu, T., Robinson, T. (2006) Poverty mapping in Uganda: An analysis using remotely sensed and other environmental data. *PPLPI working paper No 36 Rome: Food and Agricultural Organisation of the United Nations.*

Ross, C. and Willigen, M. (1997) Education and the Subjective Quality of Life, *Journal of Health and Social behaviour*, 38, 275 – 297.

Sahn D, Stiffel, D. (2000) Poverty comparisons over time and across countries in Africa. *World Development,* 28: 2123-2155

Sahn D, Stiffel, D. (2003) Urban-rural inequality in living standards in Africa. *Journal of African economies*, 12, 564-597

Sahn, D. E., and D. C. Stifel. 2003. "Exploring Alternative Measures of Welfare in the Absence of Expenditure Data." *Review of Income and Wealth* 49(4): 463–89.

Sahn D., Younger S. (2006). Robust Multidimensional Poverty Comparisons, *Economic Journal* 116, 514: 943-968

Scheurer, J. and Porta, S. (2006) Centrality and Connectivity in Public Transport Networks and their Significance for Transport Sustainability in Cities. *World Planning Schools Congress, Mexico DF.*

Scheurer, J. and Curtis, C. (2007) Accessibility Measures: Overview and Practical Applications. Impacts of Transit Led Development, *Working Paper No 4*.

Schimek, P. (1996) Household motor vehicle ownership and use: how much does residential density matter? *Transportation Research Record*, 1552, 120–125.

Schoeps, A., Gabrysch, S., Niamba, L., Sié A., & Becher, H. (2011) The Effect of Distance to Health-Care Facilities on Childhood Mortality in Rural Burkina Faso *American Journal of Epidemiology*, 173(5), 492-498.

Sen, A. (1987) The Standard of Living. Cambridge: Cambridge University Press

Shen, Q. (1998). Location characteristics of inner-city neighbourhoods and employment accessibility of low-wage workers. *Environment and Planning B: Planning and Design,* 25(3) 345 – 365.

Shieh C. & Halstead J. (2009). Understanding the impact of health literacy on women's health. *Journal of Obstetric, Gynecologic and Neonatal Nursing*, 38(5), 601- 610.

Sieber, N. (1997). Economics of Approperiate Agricultural Transport – A broader approach towards on-farm and market transport. Paper presented at an East Africa Regional Project Planning Workshop, Kenya.

Social Exclusion Unit, (2003). Making connections: *Final report on Transport and Social Exclusion*

SPSS Inc. (2010). SPSS Base 19.0 for Windows User's Guide. SPSS Inc., Chicago IL.

Stead, D. and Marshall, S. (2001) The Relationships between Urban Form and Travel Patterns. *An International Review and Evaluation*; *EJTIR,* 1(2), 113 – 141.

Stock, R. (1983) Distance and the utilization of health facilities in rural Nigeria. *Social Science and Med*icine**,** 17, 563-570.

Sudha, G., Nirupa C., Rajasakthivel, M., Sivasusbramanian, S., Sundaram, V., Bhatt S., et al (2003) Factors influencing the care-seeking behaviour of chest symptomatics: a community-based study involving rural and urban population in Tamil Nadu, South India. *Tropical medicine and International health*, 8(4), 336-341.

Takane, T. (2008) Labour use in smallholder agriculture in Malawi: Six village case studies. *African Study Monographs*, 29(4), 183-200.

Talen, E (1997) The social equity of urban service distribution: an exploration of park access in Pueblo, Colorado, and Macon, Georgia, *Journal of Urban Geography*, 18(6), 521 – 541.

Talen, E. & Anselin, L. (1998) Assessing spatial equity: an evaluation of measures of accessibility to public playgrounds, *Environment and Planning A*, 30, 595 – 613.

Talen E. (2001) Traditional Urbanism Meets Residential Affluence: An Analysis of the Variability of Suburban Preference. *Journal of the American Planning Association*, 67(3), 199-216.

Thaddeus, S. & Maine, D. (1994) Too far to walk: maternal mortality in context, *Social Science and Medicine*, 38(8), 1091-1110

Thomas, A., John, S., Wilbert, M. and James, M. (2005) Access to Transportation and Health Care Utilization in the Rural Region, *Journal of Rural Health*, 21(1), 31 – 38.

Tilman D., Cassman K., Matson P., Naylor R. & Polasky S. (2002). Agricultural sustainability and intensive production practices. *Nature*, 418(2), 671 – 677.

Tomlinson L. (2003) Patient and practitioner literacy and women's health: a global view from the closing decade 1990-2000, *Ethnicity and Disease*, 13(2), 248-58.

Tsou K., Hung Y. & Chang Y. (2005). An accessibility-based integrated measure of relative spatial equity in urban public facilities. Cities 22(6), 424 – 435

UNICEF, (2012) Malawi's Annual Report: Avaialble at http://www.unicef.org/malawi/overview.html

Unesco, 2012 Living conditions in the world, Unesco institute of statistics

United Nations Development Indices (2009) Human Development report Retrieved from *http://hdr.undp.org/en/media/HDR_2009*

United Nations Development Plan (2011) Human development report. Retrieved from *http://hdr.undp.org/en/media/HDR_2011_EN_Table4.pdf*

United Nations General Assembly (2000) Resolutions adopted by the general assembly: United Nations Millennium Declaration, A/RES/55/2 from http://www.un.org/millennium/declaration/ares552e.pdf

United Nations Statistic Division (2012) The Millennium Development Goals Report: Goal 4, Reduce Child Mortality. Retrieved from

http://unstats.un.org/unsd/mdg/Resources/Static/Products/Progress2012/Goal4_Addendum.pdf

Ureta, U. (2008) To move or not to move? Social exclusion, accessibility and daily mobility among low-income population in Santiago, Chile, *Mobilities*, 3, 269 – 289.

Vandenbulcke, G., Steenberghen, T. And Thomas, I. (2009) Mapping accessibility in Belgium: a tool for land-use and transport planning? *Journal of Transport Geography*, 17(1), 39 – 53.

van Wee, B., Hagoort, M. and Annema, J. (2001) Accessibility measures with competition, *Journal of Transport Geography*, 9, 199 – 208.

Vasconcellos E. A. (1997) Rural transport and access to education in developing countries: policy issues. Journal of Transport Geography, 5(2), 127 – 136.

Vlassoff, C. (1994) Gender inequalities in health in the third world: uncharted ground. *Social Science and Medicine*, 39(9), 1249-1259.

Vlassoff C. & Moreno G. (2002) Placing gender at the centre of health programming: challenges and limitations. *Social Science & Medicine*, 54(11), 1713-1723.

Wagle U. (2007). Multidimensional Poverty: An alternative measurement approach for United States. *Social Science Research*, 37, 559 – 580.

Wagstaff, A. (2002) Poverty and health sector inequalities" *Bulletin of the World Health Organization*, 80, 97-105

Wash P. Milon J. & Scrogin D. (2011). The Spatial extent of water quality benefits in urban housing markets. *Land Economics*, 87(4), 628-644

Waweru, L., Kabiru, J., Mbithi, J., & Some, E. (2003) Health status and health seekingbehaviour of the elderly persons in Dagoretti Division, Nairobi, *East African Medical Journal*, 80(2), 63-68.

Westelius (1972) The individual's pattern of travel in urban area. Research report, National Sweedish Institute for Building Research, Stockholm

Whitehead M. (1990). The concepts and principles of equity and health. World Health Organisation, Health Policies and planning discussion Paper from http://whqlibdoc.who.int/euro/-1993/EUR_ICP_RPD_414.pdf

Windle, J. and Cramb, R. (1997) Remoteness and rural development: economic impacts of rural roads on upland farmers in Sarawak, *Malaysia Asia Pacific Viewpoint,* 38(1), 37 – 53.

WHO (2008) World Health Statistics, World Health Organisation: Available at http://www.who.int/gho/publications/world_health_statistics/EN_WHS08_Full.pdf

World Bank (1999). Rural Travel and Transport Project, Washington D.C: World Bank

World Bank (2007) Africa development indicators, 2008/2009: The potential, The problem, The Promise; the International Bank for Reconstruction and Development. *Washington DC: The World Bank*

Yip A.M., Kephart G. & Veugelers P.J. (2002) Individual and neighbourhood determinants of health care utilization: Implications for health policy and resource allocation, *Canadian Journal of Public Health*, 93(4), 303-7.

Yoshida N. & Deichmann U. (2009) Measurements of Accessibility and its Applications, *Journal of Infrastructure Development*, 1, 1 – 16.

Young, A. (2010), "The African Growth Miracle", mimeo, London School of Economics

APPENDICES

Appendix A1: Village questionnaire

VILLAGE NAME:……..T/A……

VILLAGE INFORMATION (To be collected from village official/any informed person)

FOR CROSS CHECK: Fill one set from the Village Official and one set from any Informed Person

A: Area, Population and road condition

A1	What is the total area of this village (sq. km)?		
A2	What is the population of this village?		
A3	How many Households are in this Village?		
A4	Generally, how is the condition of the roads/paths in this area?		
A5	Are there any mobility problems in this area? IF YES Specify		
A6	Do these specific problems have any effects on access to;	**Yes**	**No**
	Schools?		
	Safe drinking water points?		
	Markets?		
	Grinding Mills?		
	Health facilities?		
	Economic, social and religious facilities?		
A7	How many motorized transport pass through this area per day?		
A8	Interviewer to establish the nearest all weather road and estimate the distance		**km**

B: Schools

How many schools are in this area?	***Primary Schools***	***Secondary Schools***

(Interviewer to establish location on a map)

C: Safe Drinking Water

How many safe drinking water points are in this area?	***Boreholes***	***Community Taps***	***Protected Wells***

(Interviewer to establish location on a map)

D: Markets

How many markets/trading centres are in this area?	***Indoor Businesses***	***Outdoor Businesses***

(Interviewer to establish location on a map)

E: Grinding Mills

How many Grinding mills are in this ***Only Grinding*** ***Only Milling*** ***Grinding & Milling***

area?			

(Interviewer to establish location on a map)

F: Health Facilities

How many of these health facilities are in this area?

Hospital	
Health Centre	
Clinic	
Dispensary	
Antenatal	
Traditional Healers	
Pharmacy/Shops	
Mobile Clinic	
Other - specify	

(Interviewer to establish location on a map)

G: Economic, Social and Religious facilities

How many of the following are in this area?

Post Office	
Bank	
Court	
Community Hall	
Church/Mosque	
Pub/Bottle store/Tavern	
Police Post	

(Interviewer to establish location on a map)

Appendix A2: Household questionnaire

Day……..Date……..Name of Interviewer……

Village…….. Traditional Authority……..

PART 1: HOUSDEHOLD INFORMATION

A: Characteristics of Household Members

Item	Questions, Instructions and responses											Go To
A1	**How many people live in this household?** □ ***Anthu amene amakhala panyumbapa pano ndi angati?*** ***Member Line Number (Indicate Name e.g. HH, Spouse, Son1, etc)***		***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	
A2	**How old is [MEMBER]?*Ali ndi zaka zingati?***												
	0 - 5 years	***1***	□	□	□	□	□	□	□	□	□	□	
	6 - 15 years	***2***	□	□	□	□	□	□	□	□	□	□	
	16 - 20 years	***3***	□	□	□	□	□	□	□	□	□	□	
	21 - 35 years	***4***	□	□	□	□	□	□	□	□	□	□	
	36 - 45 years	***5***	□	□	□	□	□	□	□	□	□	□	
	Above 46 years	***6***	□	□	□	□	□	□	□	□	□	□	
A3	**Is the [MEMBER] male or female?**												
	Male	***1***	□	□	□	□	□	□	□	□	□	□	
	Female	***2***	□	□	□	□	□	□	□	□	□	□	
A4	**What is the[MEMBER]'s relationship to the head of Household? *Pali chibale chanji ndi oyang'anira nyumba?***												
	Head	***1***	□	□	□	□	□	□	□	□	□	□	
	Spouse	***2***	□	□	□	□	□	□	□	□	□	□	
	Son/Daughter	***3***	□	□	□	□	□	□	□	□	□	□	
	Grandchild	***4***	□	□	□	□	□	□	□	□	□	□	
	Brother/Sister	***5***	□	□	□	□	□	□	□	□	□	□	
	Parent	***6***	□	□	□	□	□	□	□	□	□	□	
	Other relative	***7***	□	□	□	□	□	□	□	□	□	□	
	Not related	***8***	□	□	□	□	□	□	□	□	□	□	
	B - Household members economic characteristics												
B1	**Is any [MEMBER] involved in any activity that brings regular income? *Alipo amgwira nchito yobweretsa ndalama?***												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	**B5**
	Member Line Number (Indicate Name)		***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	
B2	**What does[MEMBER] do?*Kodi mumakagwira ntchito yanji?***												
	Private business	***1***	□	□	□	□	□	□	□	□	□	□	
	Parastatal	***2***	□	□	□	□	□	□	□	□	□	□	
	Public/Government	***3***	□	□	□	□	□	□	□	□	□	□	

	Mission/NGO	***4***	□	□	□	□	□	□	□	□	□	□	
	Self Employed	***5***	□	□	□	□	□	□	□	□	□	□	
	Mlimi	***6***	□	□	□	□	□	□	□	□	□	□	
	Estate	***7***	□	□	□	□	□	□	□	□	□	□	
B3	**What is the main activity?** ***Ntchito yake inali yotani?***												
	Agriculture, forestry, fishing	***1***	□	□	□	□	□	□	□	□	□	□	
	Mining and quarrying	***2***	□	□	□	□	□	□	□	□	□	□	
	Manufacturing	***3***	□	□	□	□	□	□	□	□	□	□	
	Electricity, water, other utilities	***4***	□	□	□	□	□	□	□	□	□	□	
	Construction	***5***	□	□	□	□	□	□	□	□	□	□	
	Wholesale & retail marketing, hotel/restaurants	***6***	□	□	□	□	□	□	□	□	□	□	
	Transport and communication	***7***	□	□	□	□	□	□	□	□	□	□	
	Finance and business	***8***	□	□	□	□	□	□	□	□	□	□	
	Social and Community Services	***9***	□	□	□	□	□	□	□	□	□	□	
B4	**How was the[MEMBER] paid?** ***Kodi malipiro ake anali wotani?***												
	Mlimi - not paid	***1***	□	□	□	□	□	□	□	□	□	□	
	Wages, salary	***2***	□	□	□	□	□	□	□	□	□	□	
	Payment in kind	***3***	□	□	□	□	□	□	□	□	□	□	
	Casual(hourly, daily), Ganyu	***4***	□	□	□	□	□	□	□	□	□	□	
	Unpaid family business eg bus worker	***5***	□	□	□	□	□	□	□	□	□	□	
	Self employed	***6***	□	□	□	□	□	□	□	□	□	□	
	Tenant	***7***	□	□	□	□	□	□	□	□	□	□	
B5	**Does[MEMBER] own a cellular phone in working condition?** ***Kodi muli ndi lamya ya mmanja?***												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	
B6	**Does[MEMBER] own a radio in working condition?** ***Kodi muli ndi wailesi?***												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	
B7	**Does[MEMBER] own a Bank Account?** ***Kodi muli ndi account ku Bank?***												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	
B8	**Over the past 3 months did[MEMBER] pay for motorized transport(matola, mini bus fare or taxi fare?**												
	Alipo anakwera galimoto lolipira miyezi itatu yapitayi?												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	
B9	**Over the past 3 months did[MEMBER] pay for non - motorized transport(njinga,ngolo?**												
	Alipo anakwera njinga kapena ngolo yolipira miyezi itatu yapitayi?												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	
	C - Household health characteristics												
C1	**Does [MEMBER] have any disability?** ***Alipo olumala?***												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	**C3**
C2	**What is the [MEMBER]'s diability?** ***Kodi ndi olumala bwanji?***												

	Can't walk - problems with legs	*1*	□	□	□	□	□	□	□	□	□	□	
	Can't see	*2*	□	□	□	□	□	□	□	□	□	□	
	Can't hear	*3*	□	□	□	□	□	□	□	□	□	□	
C3	**During the past 3months, has [MEMBER] suffered from an illness or injury?**												
	Kodi mwezi wapitawu alipo amene anadwala kapena kuvulala?												
	Yes	*1*	□	□	□	□	□	□	□	□	□	□	
	No	*2*	□	□	□	□	□	□	□	□	□	□	
C4	**If yes, did [MEMBER] consult any healthcare provider?**												
	Alipo anakafuna chithandizo kuchipatala? kapena kwa sing'anga miyezi itatu yapitayi?												**Part 2: Sec 2.1**
	Yes	*1*	□	□	□	□	□	□	□	□	□	□	
	No	*2*	□	□	□	□	□	□	□	□	□	□	
C5	**If no above; did [MEMBER] consult any traditional healer or shop for medical services?** ***Ngati sanakafuna chithandizo kuchipatala anapita kwa sing'anga kapena anagula makhwala ku shop?***												**Part 2: Sec 2.20**
	Yes	*1*	□	□	□	□	□	□	□	□	□	□	
	No	*2*	□	□	□	□	□	□	□	□	□	□	
C6	**If No above, why did [MEMBER] not consult the medical care? *Chifukwa chiyani simunafune chithandizoku chipatala?*MULTIPLE RESPONSE**												
	There was no need	*1*	□	□	□	□	□	□	□	□	□	□	
	Cost of medical services too expensive	*2*	□	□	□	□	□	□	□	□	□	□	
	Health facilities too far	*3*	□	□	□	□	□	□	□	□	□	□	
	No means of transport	*4*	□	□	□	□	□	□	□	□	□	□	
	Can not afford transport costs	*5*	□	□	□	□	□	□	□	□	□	□	
	Other - Specify		□	□	□	□	□	□	□	□	□	□	

D - Household Education Characteristics

	Member Line Number		***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	
D1	**Can[MEMBER] read in either Chichewa or English?**												
	Kodi alipo angathe kuwerenga mu chichewa kapena chizungu?												
	Yes	*1*	□	□	□	□	□	□	□	□	□	□	
	No	*2*	□	□	□	□	□	□	□	□	□	□	
D2	**Can[MEMBER] write a simple sentence in Chichewa or English?**												
	Kodi alipo angathe kulemba mu chichewa kapena chizungu?												
	Yes	*1*	□	□	□	□	□	□	□	□	□	□	
	No	*2*	□	□	□	□	□	□	□	□	□	□	
D3	**Has[MEMBER] ever attended school? *Kodi munapitapo ku sukulu?***												
	Yes	*1*	□	□	□	□	□	□	□	□	□	□	
	No	*2*	□	□	□	□	□	□	□	□	□	□	**D9**
D4	**What is the highest level of education[MEMBER] attended? *Kodi analekeza kalasi yanji?***												
	Junior Primary(up to standard 5)	*1*	□	□	□	□	□	□	□	□	□	□	
	Senior Primary(Standrad Eight)	*2*	□	□	□	□	□	□	□	□	□	□	
	Junior Secondary(Up to Form 2)	*3*	□	□	□	□	□	□	□	□	□	□	
	Senior Secondary(Up to Form 4)	*4*	□	□	□	□	□	□	□	□	□	□	
	College(Vocational, Teachers, Technical)	*5*	□	□	□	□	□	□	□	□	□	□	
	University	*6*	□	□	□	□	□	□	□	□	□	□	

D5	**What is the highest qualification [MEMBER] completed?** ***Mayeso otsiriza amene ankhoza ndi ati?***												
	Primary School Leaving Certificate	***1***	□	□	□	□	□	□	□	□	□	□	
	Junior Certificate	***2***	□	□	□	□	□	□	□	□	□	□	
	Malawi School Certificate of Education	***3***	□	□	□	□	□	□	□	□	□	□	
	Grade 1,2,3 /City & Guilds Certicate/	***4***	□	□	□	□	□	□	□	□	□	□	
	Diploma	***5***	□	□	□	□	□	□	□	□	□	□	
	Degree	***6***	□	□	□	□	□	□	□	□	□	□	
	None	***7***	□	□	□	□	□	□	□	□	□	□	
D6	**Did[MEMBER] attend School last year?** ***Kodi alipo anapita ku Sukulu chaka chatha?***												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	**D8**
D7	**What level did[MEMBER] attend last school year?** ***Kodi amaphunzira kalasi yanji?***												
	Junior Primary	***1***	□	□	□	□	□	□	□	□	□	□	
	Senior Primary	***2***	□	□	□	□	□	□	□	□	□	□	
	Junior Secondary	***3***	□	□	□	□	□	□	□	□	□	□	
	Senior Secondary	***4***	□	□	□	□	□	□	□	□	□	□	
	College	***5***	□	□	□	□	□	□	□	□	□	□	
	University	***6***	□	□	□	□	□	□	□	□	□	□	
D8	**Is[MEMBER] currently attending school?** ***Alipo akupita ku Sukulu masiku ano?***												**Part 2: Sec 1**
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	
D9	**If No why is[MEMBER] not currently attending school? Chifukwa chiani sapita ku Sukulu?MULTIPLE RESPONSE**												
	Completed School	***1***	□	□	□	□	□	□	□	□	□	□	
	Is working	***1***	□	□	□	□	□	□	□	□	□	□	
	Too old/Too young	***1***	□	□	□	□	□	□	□	□	□	□	
	Too far away	***1***	□	□	□	□	□	□	□	□	□	□	
	Too expensive	***1***	□	□	□	□	□	□	□	□	□	□	
	Useless/no benefit	***1***	□	□	□	□	□	□	□	□	□	□	
	Uninteresting	***1***	□	□	□	□	□	□	□	□	□	□	
	Illness	***1***	□	□	□	□	□	□	□	□	□	□	
	Failed Exam	***1***	□	□	□	□	□	□	□	□	□	□	
	Got married/pregnancy	***1***	□	□	□	□	□	□	□	□	□	□	
	Lack of food in household	***1***	□	□	□	□	□	□	□	□	□	□	
	Others reasons	***1***	□	□	□	□	□	□	□	□	□	□	

E - Household Vehicle Ownership

E1	**Does any of the household members own any of the following in good working condition?** ***Kodi pakhomo pano pali zothandizira kuyendera izi?***			
		Yes	**No**	
	Bicycle - *Njinga yakapalasa*	□	□	Others - Specify
	Motor Cycle - *Njinga yamoto*	□	□	
	Car - *Galimoto*	□	□	
	Animal Cart - *Ngolo*	□	□	
	Tractor - *Thirekitale*	□	□	

PART 2: HOUSEHOLD ACCESS TO FACLITIES

Section 1 - Access to Education

Item	Questions, Instructions and responses											Go To
	Member Line Number(Indicate Name)	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	
1.1	**Where does[MEMBER] go to school?** ***Kodi amaphunzira kuti?***											
	Note: Interviewer to establish from the village information if it is within the village or not											
1.2	**What level of education is[MEMBER] currently attending?** ***Kodi ali kalasi yanji?***											
	Junior Primary	***1***	□	□	□	□	□	□	□	□	□	□
	Senior Primary	***2***	□	□	□	□	□	□	□	□	□	□
	Junior Secondary	***3***	□	□	□	□	□	□	□	□	□	□
	Senior Secondary	***4***	□	□	□	□	□	□	□	□	□	□
	College	***5***	□	□	□	□	□	□	□	□	□	□
	University	***6***	□	□	□	□	□	□	□	□	□	□
1.3	**Normally by what means does[NAME] go to school?** ***Kodi nanga amagwritsa ntchito chiyani?***											
	During Dry Season											
	Walking	***1***	□	□	□	□	□	□	□	□	□	□
	Oxcart	***2***	□	□	□	□	□	□	□	□	□	□
	bicycle - *panjinga*	***3***	□	□	□	□	□	□	□	□	□	□
	motor bike - *Njinga ya moto*	***4***	□	□	□	□	□	□	□	□	□	□
	public transport - *matola kapena mini bus*	***5***	□	□	□	□	□	□	□	□	□	□
	private pickup/ truck - *galimoto yakwathu*	***6***	□	□	□	□	□	□	□	□	□	□
	Other (specify)											
	During Wet Season											
	Walking	***1***	□	□	□	□	□	□	□	□	□	□
	Oxcart	***2***	□	□	□	□	□	□	□	□	□	□
	bicycle - *panjinga*	***3***	□	□	□	□	□	□	□	□	□	□
	motor bike - *Njinga ya moto*	***4***	□	□	□	□	□	□	□	□	□	□
	public transport - *matola kapena mini bus*	***5***	□	□	□	□	□	□	□	□	□	□
	private pickup/ truck - *galimoto yakwathu*	***6***	□	□	□	□	□	□	□	□	□	□
	Other (specify)											
1.4	**Normally how long does it take [NAME] to get there?** ***Kodi amatenga nthawi yaitali bwanji?***											
	During Dry Season											
	Less than 30 minutes	***1***	□	□	□	□	□	□	□	□	□	□
	30 - 60minutes	***2***	□	□	□	□	□	□	□	□	□	□
	60 - 120 minutes	***3***	□	□	□	□	□	□	□	□	□	□
	More than 120 minutes	***4***	□	□	□	□	□	□	□	□	□	□
	During Wet Season											
	Less than 30 minutes	***1***	□	□	□	□	□	□	□	□	□	□

	30 - 60minutes	***2***	□	□	□	□	□	□	□	□	□	□	
	60 - 120 minutes	***3***	□	□	□	□	□	□	□	□	□	□	
	More than 120 minutes	***4***	□	□	□	□	□	□	□	□	□	□	
1.5	**Does[MEMBER] face any of these problems on the way to school?** ***Kodi amakumana ndi zinthu izi popita kusukulu?***												
	School too far - *kwatalika*	***1***	□	□	□	□	□	□	□	□	□	□	
	No bridge to access the school - *palibe mlatho*	***2***	□	□	□	□	□	□	□	□	□	□	
	No road to the school - *palibe nsewu*	***3***	□	□	□	□	□	□	□	□	□	□	
	Bad condition of footpath to the school - *msewu owonongeka*	***4***	□	□	□	□	□	□	□	□	□	□	
	No means of transport to access the school - *palibe choyendera*	***5***	□	□	□	□	□	□	□	□	□	□	
	Not safe on the way to the school - *Kuopa achiwembu*	***6***	□	□	□	□	□	□	□	□	□	□	
	Was involved in HH task – *Ntchito zapankhomo*	***7***	□	□	□	□	□	□	□	□	□	□	Part:2 Sec 3
	Other/specify												
1.6	**If YES to the above, have these problems ever caused[MEMBER] to be late to school?** ***Kodi munachedwapo chifukwa cha mabvuto amenewa?***												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	
1.7	**If YES how many occasions were you late for school?** ***Ngati munachedwa, kanali kangati?***												
	Once - *Kamodzi*	***1***	□	□	□	□	□	□	□	□	□	□	
	Twice - *Kawiri*	***2***	□	□	□	□	□	□	□	□	□	□	
	Thrice - *katatu*	***3***	□	□	□	□	□	□	□	□	□	□	
	Four times - *kanayi*	***4***	□	□	□	□	□	□	□	□	□	□	
	More than four times - *kuposera kanayi*	***5***	□	□	□	□	□	□	□	□	□	□	
1.8	**Have these problems ever caused[MEMBER] to miss school?** ***Kodi munayamba mwalephera kupita ku sukulu chifukwa chamabvutowa?***												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	
1.9	**If YES how many occasions did you miss school?** ***Ngati munajomba kangati?***												
	Once - *Kamodzi*	***1***	□	□	□	□	□	□	□	□	□	□	
	Twice - *Kawiri*	***2***	□	□	□	□	□	□	□	□	□	□	
	Thrice - *katatu*	***3***	□	□	□	□	□	□	□	□	□	□	
	Four times - *kanayi*	***4***	□	□	□	□	□	□	□	□	□	□	
	More than four times - *kuposera kanayi*	***5***	□	□	□	□	□	□	□	□	□	□	
1.10	**How much does it cost[MEMBER] to travel to school?** ***Kodi zimatenga ndalama zingati pa transport?***												
	No cost	***1***	□	□	□	□	□	□	□	□	□	□	
	Less than K100.00	***2***	□	□	□	□	□	□	□	□	□	□	
	K100 - K200	***3***	□	□	□	□	□	□	□	□	□	□	
	More than K200.00	***4***	□	□	□	□	□	□	□	□	□	□	
1.11	**And does this cost affect the likelihood of travelling to the school?** ***Kodi mtengowo umapangitsa kuti musapite?***												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	
1.12	**Have[MEMBER] failed any school examination ?** ***Kodi munalepherapo mayeso awa?***												
	Yes	***1***	□	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	□	

1.13	**If YES how many examination did [MEMBER] fail?** ***Ngati munalephera mayeso angati?***		
	One - *amodzi*	***1*** □ □ □ □ □ □ □ □ □ □ □	
	Twoe - *awiri*	***2*** □ □ □ □ □ □ □ □ □ □ □	
	Three -*katatu*	***3*** □ □ □ □ □ □ □ □ □ □ □	
	More than three: oposa atatu	***4*** □ □ □ □ □ □ □ □ □ □ □	
1.14	**Overall, are you satisfied with your access to primary schools in this area?**		
	Kodi muli okhutira ndi momwe mufikira ku sukulu za pulaimale mdera lino?		
	Very satisfied	***1*** □	
	Fairly satisfied	***2*** □	
	Not very satisfied	***3*** □	
	Not at all satisfied	***4*** □	
	If "not very" or "not all" satisfied then give reasons……..**.....** ……..……..**..** ……..		
1.15	**Overall, are you satisfied with your access to secondary schools in this area?**		
	Kodi muli okhutira ndi momwe mufikira ku sukulu za sekondale mdera lino?		
	Very satisfied	***1*** □	
	Fairly satisfied	***2*** □	
	Not very satisfied	***3*** □	
	Not at all satisfied	***4*** □	
	If "not very" or "not all" satisfied then give reasons……..……..**.....** **.** ……... … ……. **.**		

Section 2 - Access to Health Care Facilities

Item	Questions, Instructions and responses											Go To
	Member Line Number (indicate name)		***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	
2.1	**Which of these health facilities has [MEMBER] visited in the last 3 months?** ***Ndi zipatala ziti anapita miyezi itatu yapitayi?***											
	District Hospital	***1***	□	□	□	□	□	□	□	□	□	□	
	Health Centre	***2***	□	□	□	□	□	□	□	□	□	□	
	Dispensary	***3***	□	□	□	□	□	□	□	□	□	□	
	Clinic	***4***	□	□	□	□	□	□	□	□	□	□	
	Maternity Unit	***5***	□	□	□	□	□	□	□	□	□	□	**2.12**
	Other - specify	***6***											
	Note: Interviewer to establish if these facilities are on the village base maps from the village information questionnaire												
2.2	**What were the reasons for visiting the facility?** ***Munapitilanji kuchipatala?*** **Multiple answers permitted**												
	for medical treatment	***1***	□	□	□	□	□	□	□	□	□	□	
	for health education messages	***2***	□	□	□	□	□	□	□	□	□	□	
	check up	***3***	□	□	□	□	□	□	□	□	□	□	
	to visit patients	***4***	□	□	□	□	□	□	□	□	□	□	
	other - specify	***5***											
	Note: use separate forms to 2.10 if 2.1 has multiple answers												
2.3	**How often did[MEMBER] visit[FACILITY]?** ***Kodi munapita kangati?***												
	Once	***1***	□	□	□	□	□	□	□	□	□	□	
	Twice	***2***	□	□	□	□	□	□	□	□	□	□	
	Three times	***3***	□	□	□	□	□	□	□	□	□	□	
	More than 3 times	***4***	□	□	□	□	□	□	□	□	□	□	
2.4	**How did [MEMBER] normally travel to [FACILITY]?** ***Amagwiritsa ntchito chiani?***												
	During Dry Season												
	Walking	***1***	□	□	□	□	□	□	□	□	□	□	
	Oxcart	***2***	□	□	□	□	□	□	□	□	□	□	
	wheel barrow	***3***	□	□	□	□	□	□	□	□	□	□	
	HandCart	***4***	□	□	□	□	□	□	□	□	□	□	
	bicycle - *panjinga*	***5***	□	□	□	□	□	□	□	□	□	□	
	motor bike - *Njinga ya moto*	***6***	□	□	□	□	□	□	□	□	□	□	
	public transport - *matola/mini bus*	***7***	□	□	□	□	□	□	□	□	□	□	
	private pickup/ truck - *galimoto*	***8***	□	□	□	□	□	□	□	□	□	□	
	Ambulance	***9***	□	□	□	□	□	□	□	□	□	□	
	Other (specify)												
	During Wet Season												
	Walking	***1***	□	□	□	□	□	□	□	□	□	□	
	Oxcart	***2***	□	□	□	□	□	□	□	□	□	□	
	wheel barrow	***3***	□	□	□	□	□	□	□	□	□	□	
	HandCart	***4***	□	□	□	□	□	□	□	□	□	□	
	bicycle - *panjinga*	***5***	□	□	□	□	□	□	□	□	□	□	
	motor bike - *Njinga ya moto*	***6***	□	□	□	□	□	□	□	□	□	□	
	public transport - *matola/mini bus*	***7***	□	□	□	□	□	□	□	□	□	□	

	private pickup/ truck - *galimoto*	***8***	□	□	□	□	□	□	□	□	□	□
	Ambulance	***9***	□	□	□	□	□	□	□	□	□	□
	Other (specify)											
2.5	**How long did it normaly take[MEMBER] to reach the [FACILITY]? *Imatenga nthawi yaitali bwanji?***											
	During Dry Season											
	Less than 30 mininutes	***1***	□	□	□	□	□	□	□	□	□	□
	30 - 60 minutes	***2***	□	□	□	□	□	□	□	□	□	□
	60 - 120 minutes	***3***	□	□	□	□	□	□	□	□	□	□
	120 - 240 minutes	***4***	□	□	□	□	□	□	□	□	□	□
	More than 240 minutes	***5***	□	□	□	□	□	□	□	□	□	□
	During Wet Season											
	Less than 30 mininutes	***1***	□	□	□	□	□	□	□	□	□	□
	30 - 60 minutes	***2***	□	□	□	□	□	□	□	□	□	□
	60 - 120 minutes	***3***	□	□	□	□	□	□	□	□	□	□
	120 - 240 minutes	***4***	□	□	□	□	□	□	□	□	□	□
	More than 240 minutes	***5***	□	□	□	□	□	□	□	□	□	□
2.6	**Did[MEMBER] face any of the following problems on the way to[FACILITY]? *Kodi amakumana ndi mabvuto awa?***											
	Facility too far - *kwatalika*	***1***	□	□	□	□	□	□	□	□	□	□
	No bridge to access the facility - *palibe mlatho*	***2***	□	□	□	□	□	□	□	□	□	□
	No road to the facility - *palibe nsewu*	***3***	□	□	□	□	□	□	□	□	□	□
	Bad condition of footpath to the facility - *msewu owonongeka*	***4***	□	□	□	□	□	□	□	□	□	□
	No means of transport to access the facility - *palibe choyendera*	***5***	□	□	□	□	□	□	□	□	□	□
	Not safe on the way to the facility - *Kuopa achiwembu*	***6***	□	□	□	□	□	□	□	□	□	□
	Other/specify											
2.7	**Did this/these problems affect the health of[MEMBER] detrimentally? *Kodi izi zinaonjeza kudwalako?***											
	Yes	***1***	□	□	□	□	□	□	□	□	□	□
	No	***2***	□	□	□	□	□	□	□	□	□	□
2.8	**Did[MEMBER] face any of the following problems at the[FACILITY]? *Kodi amakumana ndi mabvuto awa kumaloko?***											
	High cost of medical services	***1***	□	□	□	□	□	□	□	□	□	□
	Too long to wait	***2***	□	□	□	□	□	□	□	□	□	□
	No shelter	***3***	□	□	□	□	□	□	□	□	□	□
	Health workers do not show up	***4***	□	□	□	□	□	□	□	□	□	□
	No drugs	***5***										
	Others(Specify)											
2.9	**Did this/these problems affect the health of[MEMBER] detrimentally? *Kodi izi zinaonjeza kudwalako?***											
	Yes	***1***	□	□	□	□	□	□	□	□	□	□
	No	***2***	□	□	□	□	□	□	□	□	□	□
2.10	**How much did it cost[MEMBER] to travel to this[FACILITY] *Kodi zimatenga ndalama zingati pa transport?***											
	No cost	***1***	□	□	□	□	□	□	□	□	□	□
	Less than K100.00	***2***	□	□	□	□	□	□	□	□	□	□
	K100.00 - K200.00	***3***	□	□	□	□	□	□	□	□	□	□
	K200 - K500	***4***	□	□	□	□	□	□	□	□	□	□

	More than K500	***5***	□	□	□	□	□	□	□	□	□	□
2.11	**And did this cost affect the likelihood of travelling to this[FACILITY]?** ***Kodi mtengowo umapangitsa kuti musapite?***											
	Yes	***1***	□	□	□	□	□	□	□	□	□	□
	No	***2***	□	□	□	□	□	□	□	□	□	□
2.12	**By what means did a member of your household travel to maternity unit? during pregnancy during the last 12 months?** ***Kodi anyenda pachiani popita ku maternity kuti akawapime?***											
	During Dry Season											
	Walking	***1***										
	Oxcart	***2***										
	wheel barrow	***3***										
	HandCart	***4***										
	bicycle - *panjinga*	***5***										
	motor bike - *Njinga ya moto*	***6***										
	public transport - *matola/mini bus*	***7***										
	private pickup/ truck - *galimoto*	***8***										
	Ambulance	***9***										
	Other (specify)											
	During Wet Season											
	Walking	***1***										
	Oxcart	***2***										
	wheel barrow	***3***										
	HandCart	***4***										
	bicycle - *panjinga*	***5***										
	motor bike - *Njinga ya moto*	***6***										
	public transport - *matola/mini bus*	***7***										
	private pickup/ truck - *galimoto*	***8***										
	Ambulance	***9***										
	Other (specify)											
2.13	**How long did it normaly take to reach the maternity unit? Imatenga nthawi yaitali bwanji?**											
	Mode of transport Line Number		***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	
	During Dry Season											
	Less than 30 mininutes	***1***	□	□	□	□	□	□	□	□	□	□
	30 - 60 minutes	***2***	□	□	□	□	□	□	□	□	□	□
	60 - 120 minutes	***3***	□	□	□	□	□	□	□	□	□	□
	120 - 240 minutes	***4***	□	□	□	□	□	□	□	□	□	□
	More than 240 minutes	***5***	□	□	□	□	□	□	□	□	□	□
	During Wet Season											
	Less than 30 mininutes	***1***	□	□	□	□	□	□	□	□	□	□
	30 - 60 minutes	***2***	□	□	□	□	□	□	□	□	□	□
	60 - 120 minutes	***3***	□	□	□	□	□	□	□	□	□	□
	120 - 240 minutes	***4***	□	□	□	□	□	□	□	□	□	□
	More than 240 minutes	***5***	□	□	□	□	□	□	□	□	□	□
2.14	**Did[MEMBER] face any of the following problems on the way to maternity unit?** ***Kodi amakumana ndi mabvuto awa?***											
	Facility too far - *kwatalika*	***1***										
	No bridge to access the facility - *palibe mlatho*	***2***										

	No road to the facility - *palibe nsewu*	***3***										
	Bad condition of footpath to the facility - *msewu owonongeka*	***4***										
	No means of transport to access the facility - *palibe choyendera*	***5***										
	Not safe on the way to the facility - *Kuopa achiwembu*	***6***										
	Other/specify											
2.15	**Did this/these problems affect the health of member/ baby detrimentally? *Kodi izi zinaonjeza kudwalako?***											
	Yes	***1***										
	No	***2***										
2.16	**Did[MEMBER] face any of the following problems at the maternity unit? *Kodi amakumana ndi mabvuto awa kumaloko?***											
	High cost of medical services	***1***										
	Too long to wait	***2***										
	No shelter	***3***										
	Health workers do not show up	***4***										
	No drugs	***5***										
	Others(Specify)											
2.17	**Did this/these problems affect the health of member/baby detrimentally? *Kodi izi zinaonjeza kudwalako?***											
	Yes	***1***										
	No	***2***										
2.18	**How much did it cost to travel to this the maternity unit? *Kodi zimatenga ndalama zingati pa transport?***											
	No cost	***1***										
	Less than K100.00	***2***										
	K100.00 - K200.00	***3***										
	K200 - K500	***4***										
	More than K500	***5***										
2.19	**And did this cost affect the likelihood of travelling to this maternity unit? *Kodi mtengowo umapangitsa kuti musapite?***											
	Yes	***1***										
	No	***2***										
2.20	**What other means of healthcare (AltFACILITY) did [MEMBER] use when sick? *Kodi munakatemga chithandizo kuti?***											
	Traditional Healer	***1***	□	□	□	□	□	□	□	□	□	□
	Pharmacy/Shop	***2***	□	□	□	□	□	□	□	□	□	□
	Other - specify ***Note: Interviewer to establish where these facilities are if used from the village information questionnaire***											
2.21	**How many times did members visit the facility during the past 3 months**											
	Once	***1***										
	Twice	***2***										
	3 times	***3***										
	More than 3 times	***4***										
2.22	**By what means did member of your household normally travel to [AltFACILITY]?**											
	Altenative Health Facility Line Number (indicate Name)	***1***	***2***	***3***								
	During Dry Season											

	Walking	***1***	□	□	□
	Oxcart	***2***	□	□	□
	wheel barrow	***3***	□	□	□
	HandCart	***4***	□	□	□
	bicycle - *panjinga*	***5***	□	□	□
	motor bike - *Njinga ya moto*	***6***	□	□	□
	public transport - *matola/mini bus*	***7***	□	□	□
	private pickup/ truck - *galimoto*	***8***	□	□	□
	Ambulance	***9***	□	□	□
	Other (specify)				
	During Wet Season				
	Walking	***1***	□	□	□
	Oxcart	***2***	□	□	□
	wheel barrow	***3***	□	□	□
	HandCart	***4***	□	□	□
	bicycle - *panjinga*	***5***	□	□	□
	motor bike - *Njinga ya moto*	***6***	□	□	□
	public transport - *matola/mini bus*	***7***	□	□	□
	private pickup/ truck - *galimoto*	***8***	□	□	□
	Ambulance	***9***	□	□	□
	Other (specify)				
2.23	**How long did it take for the member to reach the[AltFACILITY]?**				
	During Dry Season				
	Less than 30 mininutes	***1***	□	□	□
	30 - 60 minutes	***2***	□	□	□
	60 - 120 minutes	***3***	□	□	□
	120 - 240 minutes	***4***	□	□	□
	More than 240 minutes	***5***	□	□	□
	During Wet Season				
	Less than 30 mininutes	***1***	□	□	□
	30 - 60 minutes	***2***	□	□	□
	60 - 120 minutes	***3***	□	□	□
	120 - 240 minutes	***4***	□	□	□
	More than 240 minutes	***5***	□	□	□
2.24	**What problems, if any, did members of your household face on the way to[AltFACILITY]?**				
	Facility too far - *kwatalika*	***1***	□	□	□
	No bridge to access the facility - *palibe mlatho*	***2***	□	□	□
	No road to the facility - *palibe nsewu*	***3***	□	□	□
	Bad condition of footpath to the facility - *msewu owonongeka*	***4***	□	□	□
	No means of transport to access the facility - *palibe choyendera*	***5***	□	□	□
	Not safe on the way to the facility - *Kuopa achiwembu*	***6***	□	□	□
2.25	**Did this/these problems affect the health of member detrimentally? *Kodi izi zinaonjeza kudwalako?***				
	Yes	***1***	□	□	□
	No	***2***	□	□	□

2.26	**What problems, if any, did members of your household face at the[AltFACILITY]?**					
	High cost of medical services	***1***	□	□	□	
	Too long to wait	***2***	□	□	□	
	No shelter	***3***	□	□	□	
	Health workers do not show up	***4***	□	□	□	
	No drugs	***5***	□	□	□	
	Others(Specify)					
2.27	**Did this/these problems affect the health of member detrimentally? *Kodi izi zinaonjeza kudwalako?***					
	Yes	***1***	□			
	No	***2***	□			
2.28	**How much did it cost travelling to this [AltFACILITY]? *Kodi zinatenga ndalama zingati pa transport?***					
	No cost	***1***	□	□	□	
	Less than K100.00	***2***	□	□	□	
	K100.00 - K200.00	***3***	□	□	□	
	K200 - K500	***4***	□	□	□	
	More than K500	***5***	□	□	□	
2.29	**And did this cost affect the likelihood of travelling to this [AltFACILITY]? *Kodi mtengowo umapangitsa kuti musapite?***					
	Yes	***1***	□	□	□	
	No	***2***	□	□	□	
2.30	**Overall, are you satisfied with your access to healthcare facilities in this area?**					
	Kodi muli okhutira ndi momwe mufikira kumalo a zaumoyo mdera lino?					
	Very satisfied	***1***				
	Fairly satisfied	***2***				
	Not very satisfied	***3***				
	Not at all satisfied	***4***				
	If "not very" or "not all" satisfied please give reasons…….……					
	……					
	……...					
	……					
	……					

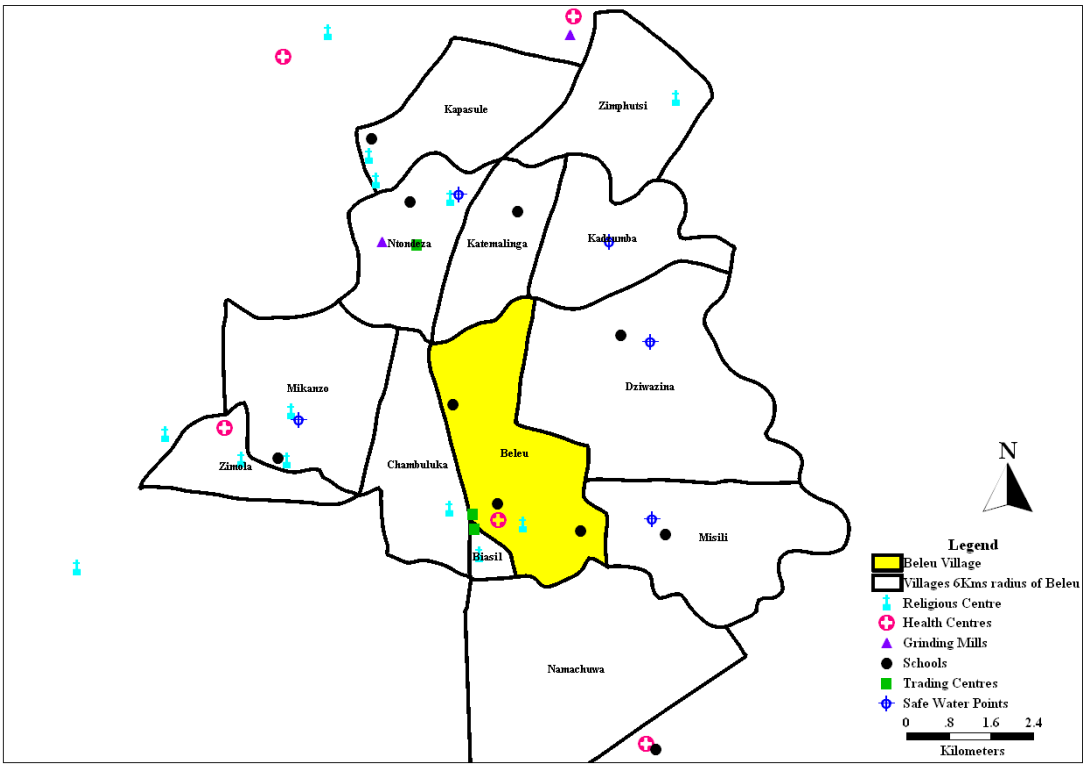
Section 3 - Household tasks

Item	Questions, Instructions and responses											Go To
	Member Line Number(Indicate Name)	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	
3.1	**Did any [MEMBER] of the household participate in the following before school?**											
	Farm activities - *kumunda*	***1***	□	□	□	□	□	□	□	□	□	
	Water collection - *kutunga madzi*	***2***	□	□	□	□	□	□	□	□	□	**3.9**
	Other (specify)											
3.2	**How often did [MEMBER] participate in farm tasks? *Kodi munakagwira ntchito mowirikiza bwanji?***											
	Once a week - *kamozi pa mulungu*	***1***	□	□	□	□	□	□	□	□	□	
	Twice a week - *kawiri pamulungu*	***2***	□	□	□	□	□	□	□	□	□	
	Thrice a week - *katatu pamulungu*	***3***	□	□	□	□	□	□	□	□	□	
	Four times a week - *kanayi pamulungu*	***4***	□	□	□	□	□	□	□	□	□	
3.3	**How much time would [MEMBER] normaly spend in the farm activities before school?**											
	Kodi mumatenga nthawi yaitali bwanji kumundako?											
	Less than 30 minutes	***1***	□	□	□	□	□	□	□	□	□	
	30 - 60 minutes	***2***	□	□	□	□	□	□	□	□	□	
	60 - 90 minutes	***3***	□	□	□	□	□	□	□	□	□	
	90 - 120 minutes	***4***	□	□	□	□	□	□	□	□	□	
	More than 120 minutes	5	□	□	□	□	□	□	□	□	□	
3.4	**How much time does [MEMBER] normally spend to travel to school?**											
	Kodi imatenga nthawi yochuluka bwanji kukafika kusukulu?											
	Less than 30 minutes	***1***	□	□	□	□	□	□	□	□	□	
	30 - 60minutes	***2***	□	□	□	□	□	□	□	□	□	
	60 - 120 minutes	***3***	□	□	□	□	□	□	□	□	□	
	More than 120 minutes	***4***	□	□	□	□	□	□	□	□	□	
3.5	***Has [MEMBER] been late for school because of involvement in farm activities?***											
	Kodi munachedwapo kusukulu chifukwa chakulima?											
	Yes	***1***	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	
3.6	**If yes, how many times was [MEMBER] late for school? *Kodi kanali kangati?***											
	Once - *Kamodzi*	***1***	□	□	□	□	□	□	□	□	□	
	Twice - *Kawiri*	***2***	□	□	□	□	□	□	□	□	□	
	Thrice - *katatu*	***3***	□	□	□	□	□	□	□	□	□	
	Four times - *kanayi*	***4***	□	□	□	□	□	□	□	□	□	
	More than four times - *kuposera kanayi*	5	□	□	□	□	□	□	□	□	□	
3.7	**Has [MEMBER] ever missed school because of farm work? *Kodi munalephera kupita kusukulu chifukwa chakumunda?***											
	Yes	***1***	□	□	□	□	□	□	□	□	□	
	No	***2***	□	□	□	□	□	□	□	□	□	
3.8	**If yes, how many times was [MEMBER] absent for school? *Kodi kanali kangati?***											
	Once - *Kamodzi*	***1***	□	□	□	□	□	□	□	□	□	
	Twice - *Kawiri*	***2***	□	□	□	□	□	□	□	□	□	

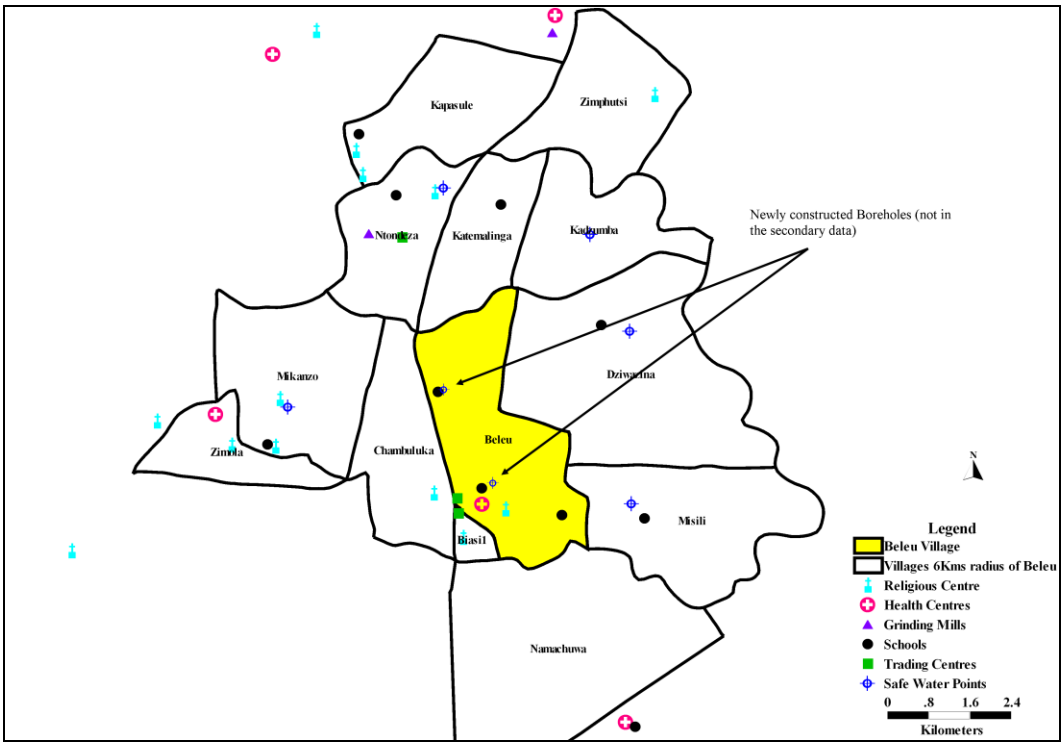
	Thrice - *katatu*	***3***	□	□	□	□	□	□	□	□	□	□
	Four times - *kanayi*	***4***	□	□	□	□	□	□	□	□	□	□
	More than four times - *kuposera kanayi*	5	□	□	□	□	□	□	□	□	□	□
3.9	**How often did [MEMBER] participate in water collection? *Kodi munatunga madzi mowirikiza bwanji?***											
	Once a week - *kamozi pa mulungu*	***1***	□	□	□	□	□	□	□	□	□	□
	Twice a week - *kawiri pamulungu*	***2***	□	□	□	□	□	□	□	□	□	□
	Thrice a week - *katatu pamulungu*	***3***	□	□	□	□	□	□	□	□	□	□
	Four times a week - *kanayi pamulungu*	***4***	□	□	□	□	□	□	□	□	□	□
3.10	**How much time would [MEMBER] normaly spend in collecting water before school?**											
	Kodi mumatenga nthawi yaitali bwanji kotunga madzi?											
	Less than 15 minutes	***1***	□	□	□	□	□	□	□	□	□	□
	15 - 30 minutes	***2***	□	□	□	□	□	□	□	□	□	□
	30 - 45 minutes	***3***	□	□	□	□	□	□	□	□	□	□
	45 - 60 minutes	***4***	□	□	□	□	□	□	□	□	□	□
	More than 60 minutes	5	□	□	□	□	□	□	□	□	□	□
3.11	**How much time does [MEMBER] normally spend to travel to school?**											
	Kodi imatenga nthawi yochuluka bwanji kukafika kusukulu?											
	Less than 30 minutes	***1***	□	□	□	□	□	□	□	□	□	□
	30 - 60minutes	***2***	□	□	□	□	□	□	□	□	□	□
	60 - 120 minutes	***3***	□	□	□	□	□	□	□	□	□	□
	More than 120 minutes	***4***	□	□	□	□	□	□	□	□	□	□
3.12	***Has [MEMBER] been late for school because of invovement in water collection?***											
	Kodi munachedwapo kusukulu chifukwa chotunga madzi?											
	Yes	***1***	□	□	□	□	□	□	□	□	□	□
	No	***2***	□	□	□	□	□	□	□	□	□	□
3.13	**If yes, how many times was [MEMBER] late for school? *Kodi kanali kangati?***											
	Once - *Kamodzi*	***1***	□	□	□	□	□	□	□	□	□	□
	Twice - *Kawiri*	***2***	□	□	□	□	□	□	□	□	□	□
	Thrice - *katatu*	***3***	□	□	□	□	□	□	□	□	□	□
	Four times - *kanayi*	***4***	□	□	□	□	□	□	□	□	□	□
	More than four times - *kuposera kanayi*	5	□	□	□	□	□	□	□	□	□	□
3.14	**Has [MEMBER] ever missed school because of water collection?**											
	Kodi munalephera kupita kusukulu chifukwa chotunga madzi?											
	Yes	***1***	□	□	□	□	□	□	□	□	□	□
	No	***2***	□	□	□	□	□	□	□	□	□	□
3.15	**If yes, how many times was [MEMBER] absent for school? *Kodi kanali kangati?***											
	Once - *Kamodzi*	***1***	□	□	□	□	□	□	□	□	□	□
	Twice - *Kawiri*	***2***	□	□	□	□	□	□	□	□	□	□
	Thrice - *katatu*	***3***	□	□	□	□	□	□	□	□	□	□
	Four times - *kanayi*	***4***	□	□	□	□	□	□	□	□	□	□
	More than four times - *kuposera kanayi*	5	□	□	□	□	□	□	□	□	□	□
3.16	**Is any [MEMBER] normally involved in water collection and then farm activities? Alipo amatunga madzi kenako kumunda?**											
	Yes	***1***	□	□	□	□	□	□	□	□	□	□
	No	***2***	□	□	□	□	□	□	□	□	□	□
3.17	**If yes, how much time does [MEMBER] normally spend for water collection?**											

	Mumatenga nthawi yaitali bwanji kutunga madzi?		
	Less than 15 minutes	***1*** □ □ □ □ □ □ □ □ □ □	
	15 - 30 minutes	***2*** □ □ □ □ □ □ □ □ □ □	
	30 - 45 minutes	***3*** □ □ □ □ □ □ □ □ □ □	
	45 - 60 minutes	***4*** □ □ □ □ □ □ □ □ □ □	
	More than 60 minutes	5 □ □ □ □ □ □ □ □ □ □	
3.18	**How much time does [MEMBER] normally spend on farm activities?** ***Mumatenga nthawi yochuluka bwanji kumunda?***		
	Less than 30 minutes	***1*** □ □ □ □ □ □ □ □ □ □	
	30 - 60 minutes	***2*** □ □ □ □ □ □ □ □ □ □	
	60 - 90 minutes	***3*** □ □ □ □ □ □ □ □ □ □	
	90 - 120 minutes	***4*** □ □ □ □ □ □ □ □ □ □	
	More than 120 minutes	5 □ □ □ □ □ □ □ □ □ □	

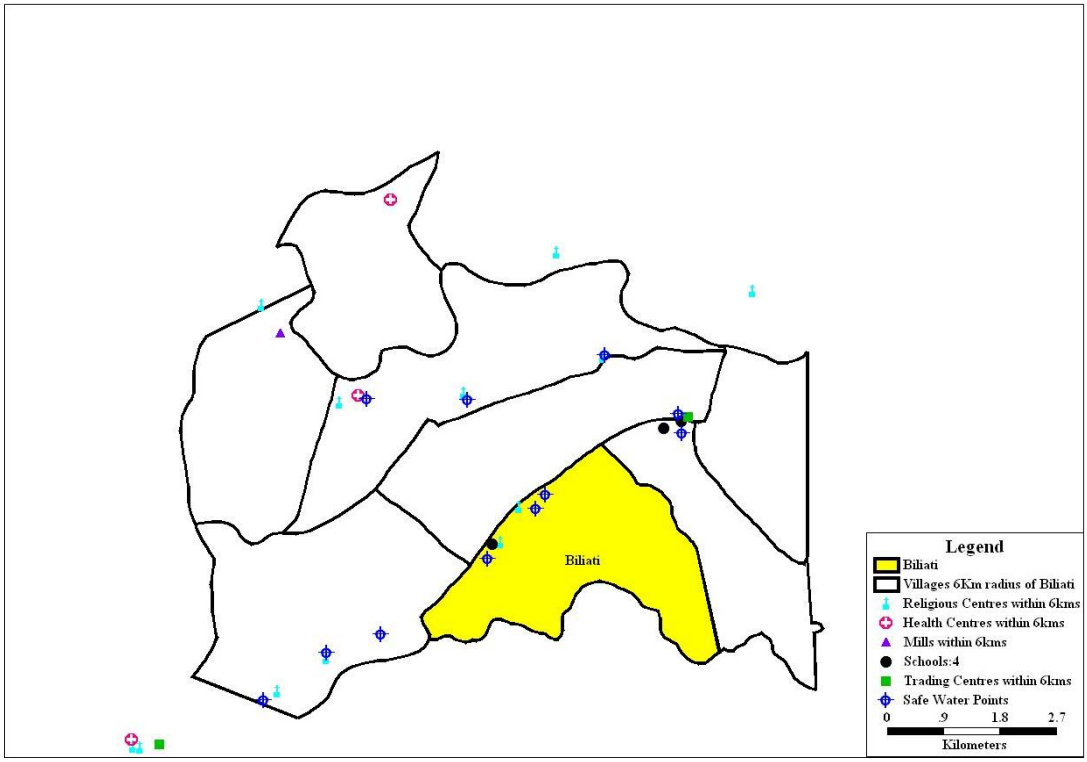
Appendix B: Study villages



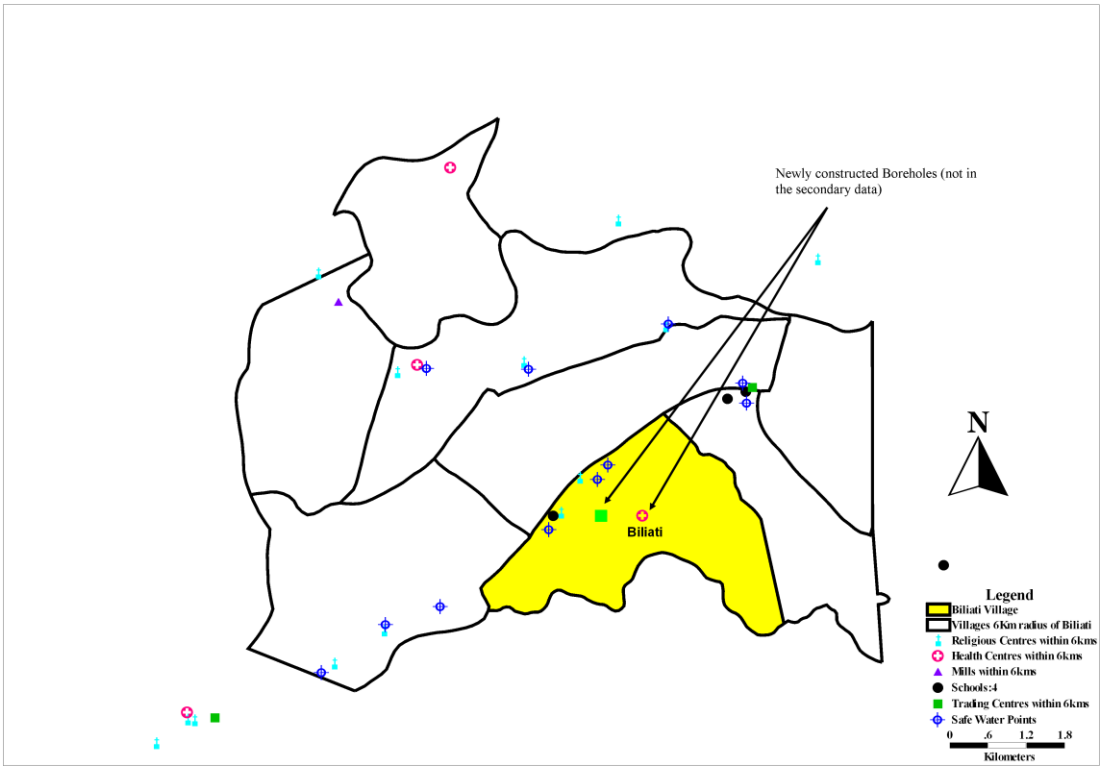
Facilities within Beleu Village from secondary data information



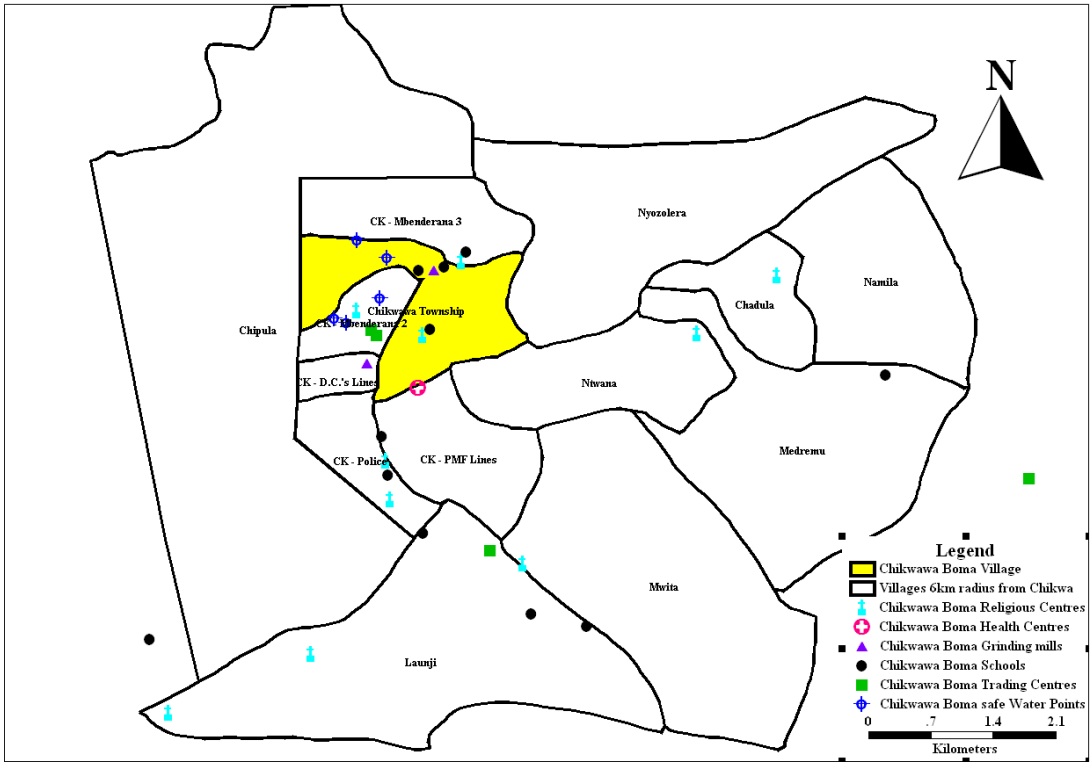
Facilities within Beleu Village after the validation process



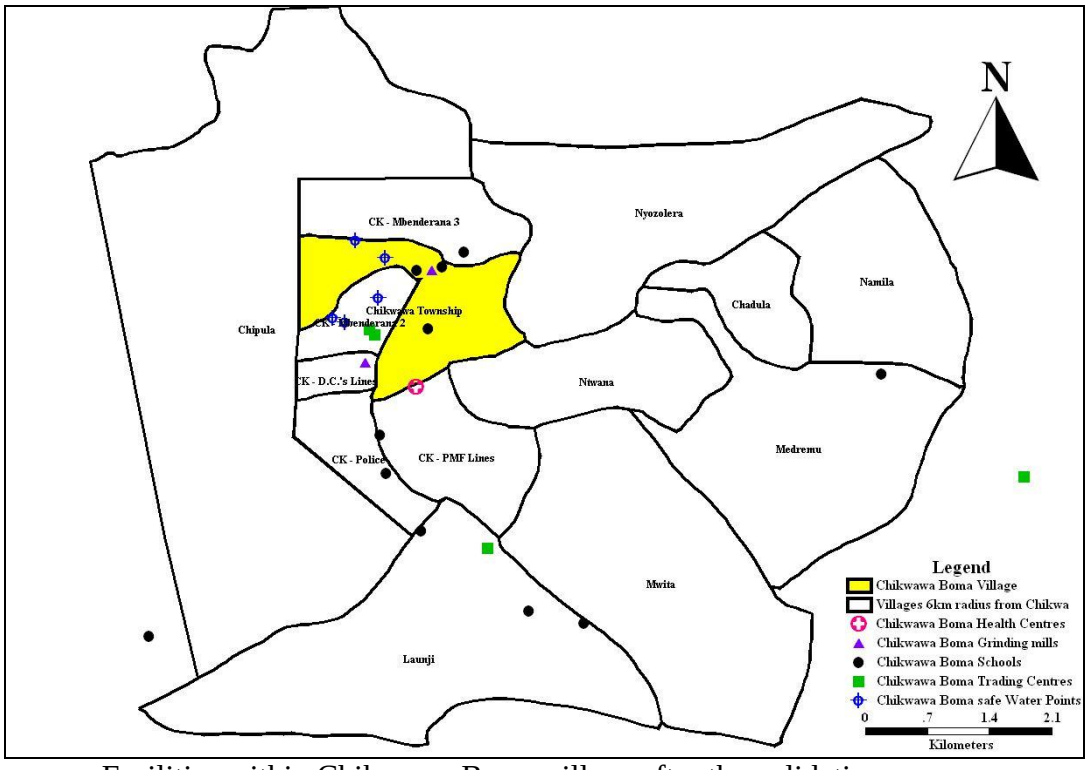
Facilities within Biliati Village from secondary data information



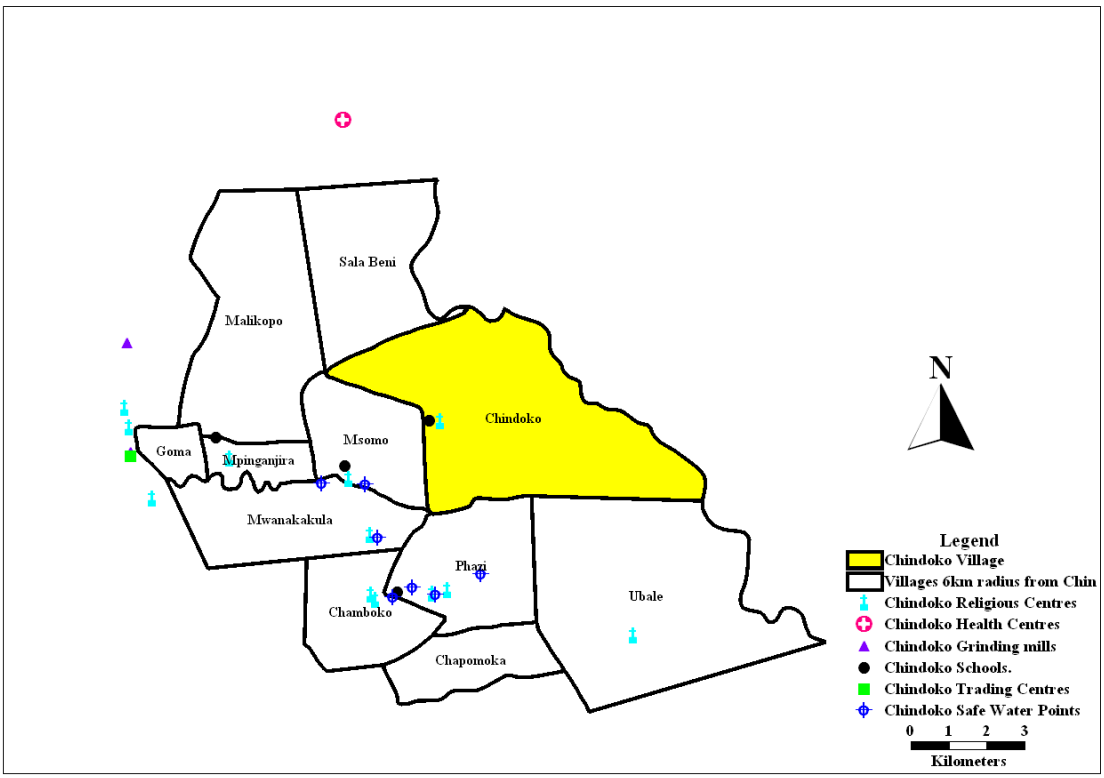
Facilities within Biliati Village after the validation process



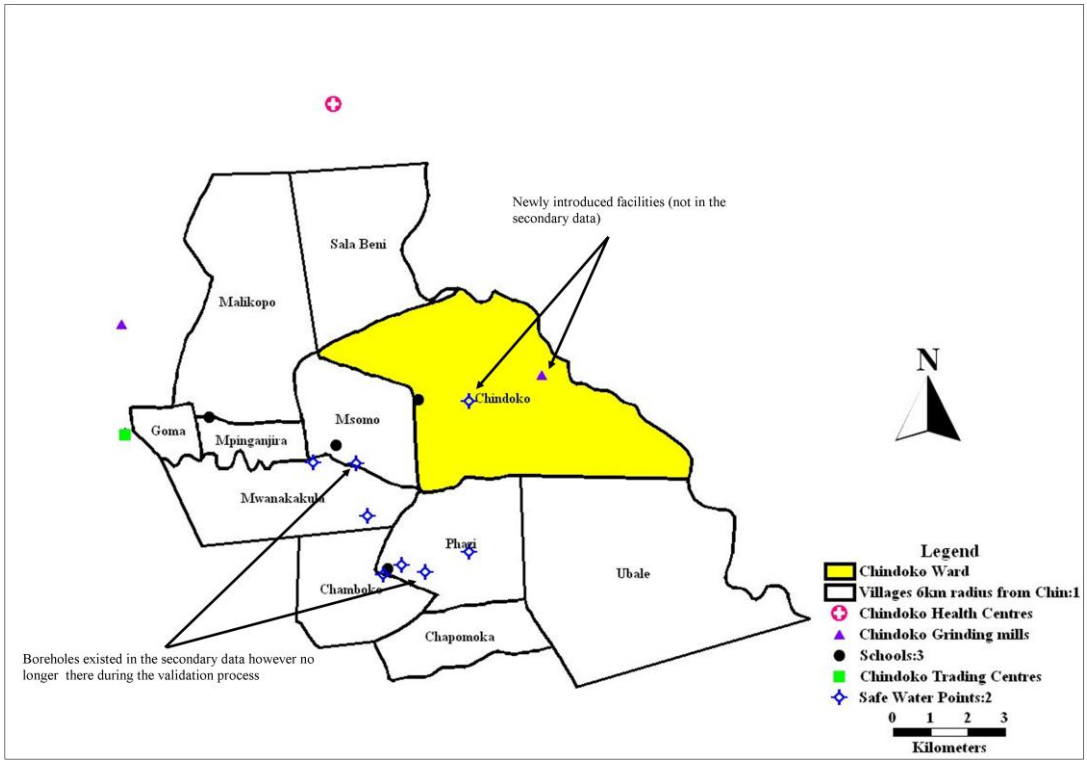
Facilities within Chikwawa Boma village from secondary data information



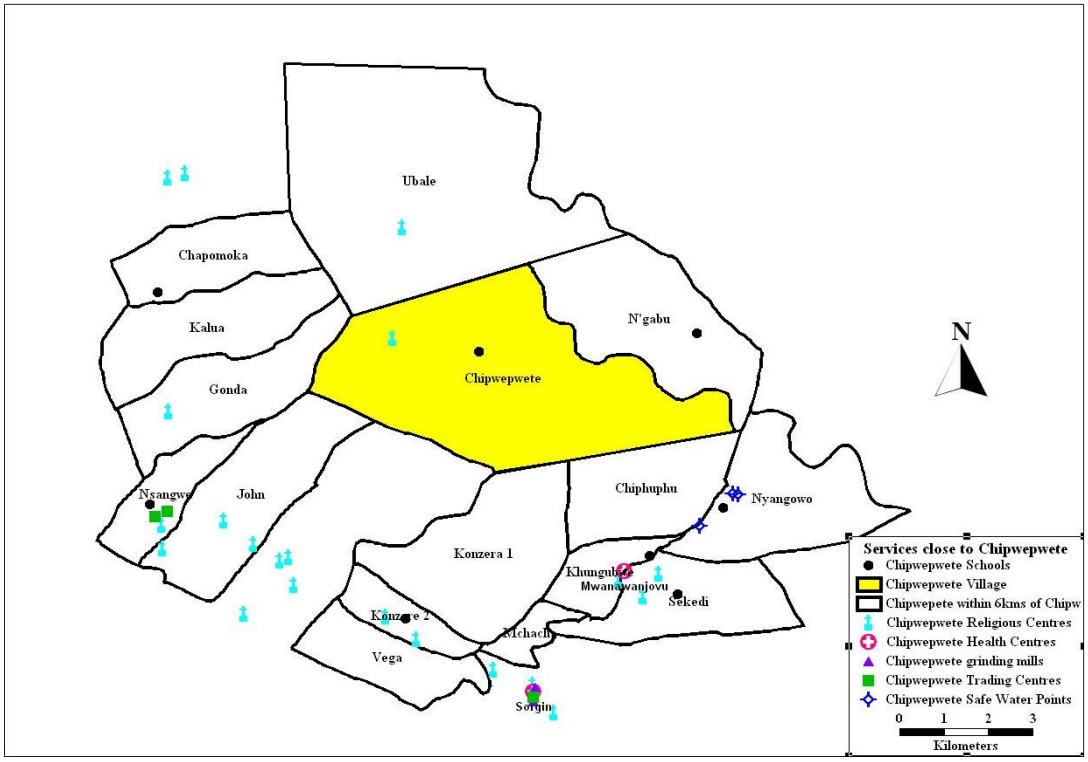
Facilities within Chikwawa Boma village after the validation process



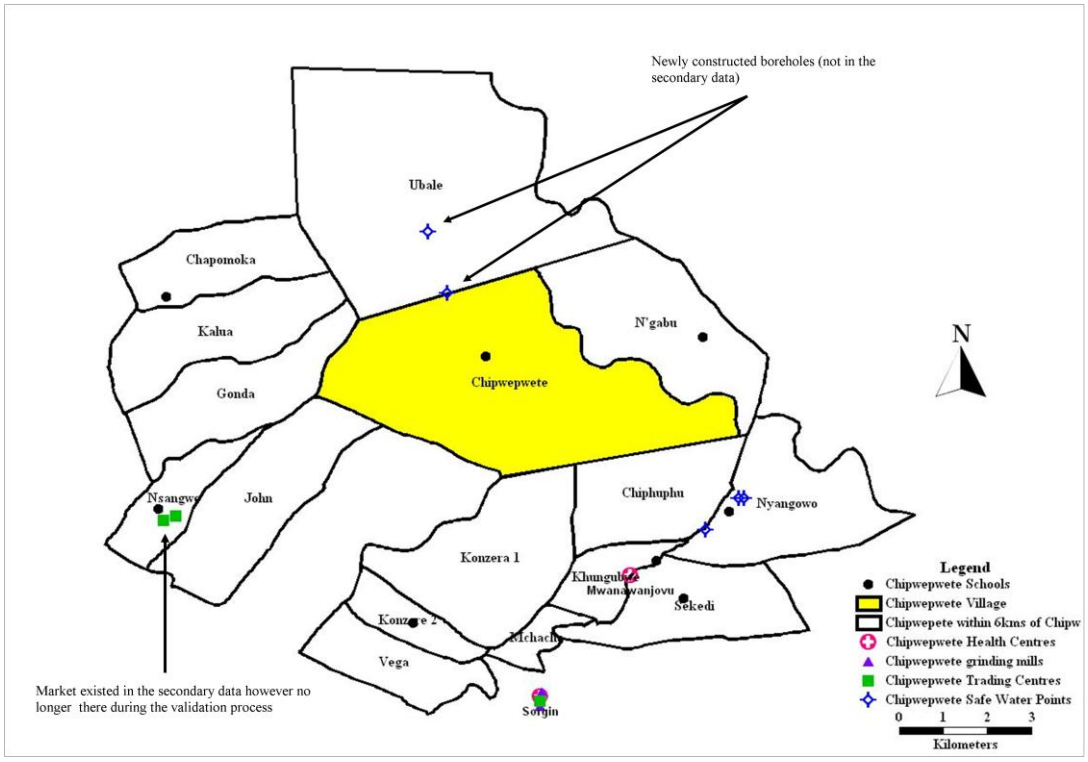
Facilities within Chindoko village from secondary data information



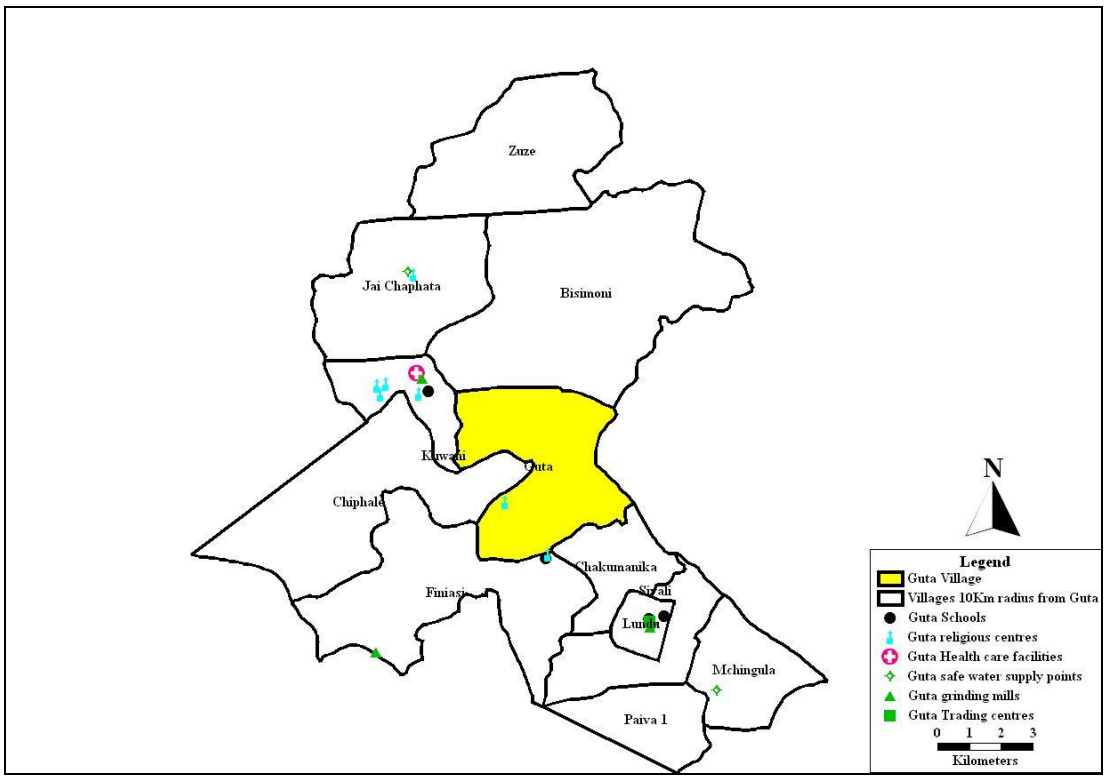
Facilities within Chindoko village after the validation process



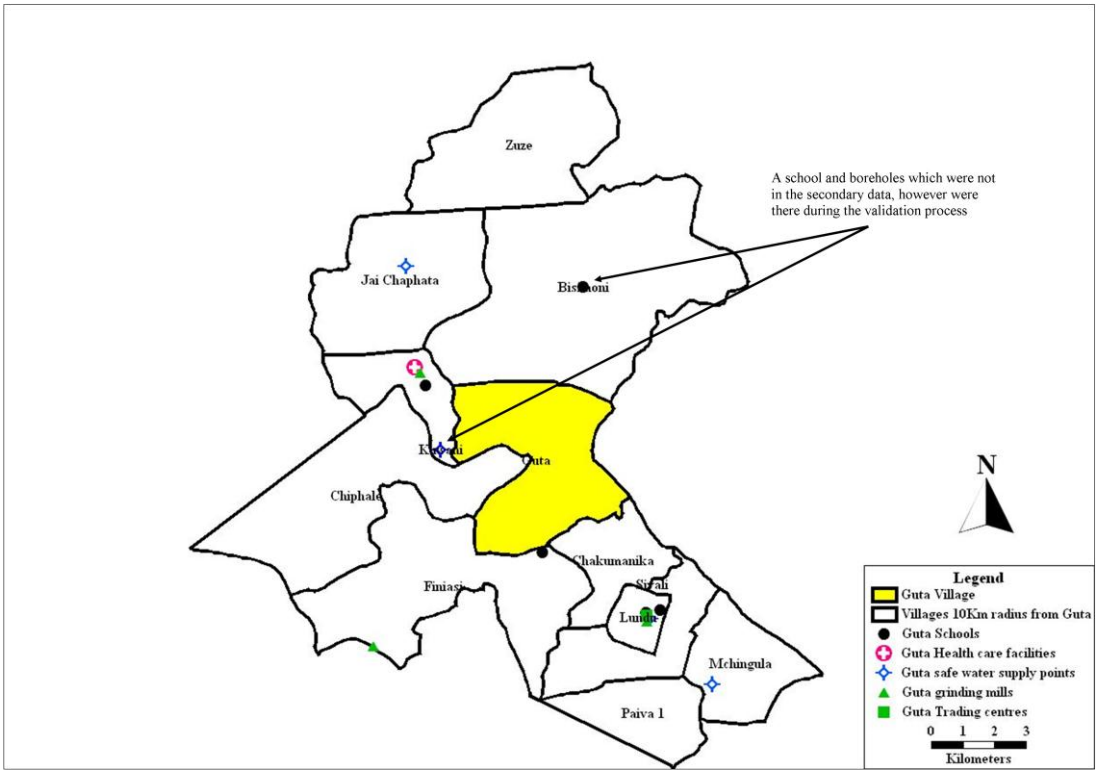
Facilities within Chipwepwete village from secondary data information



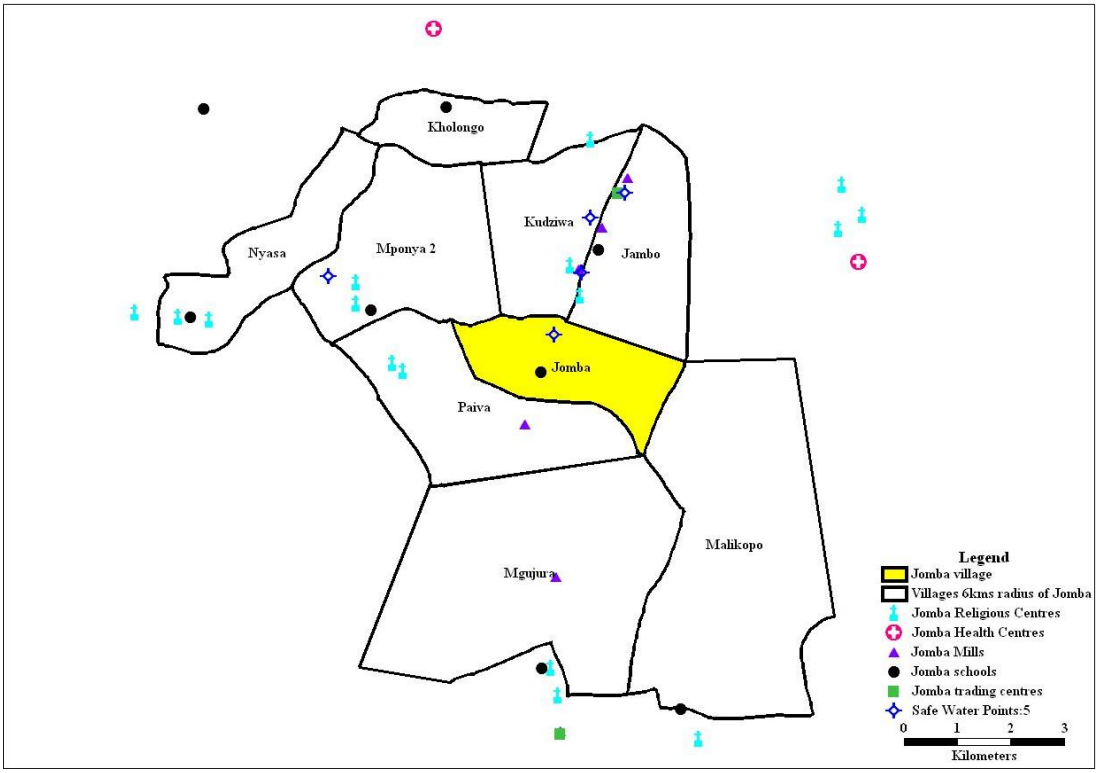
Facilities within Chipwepwete village after the validation process



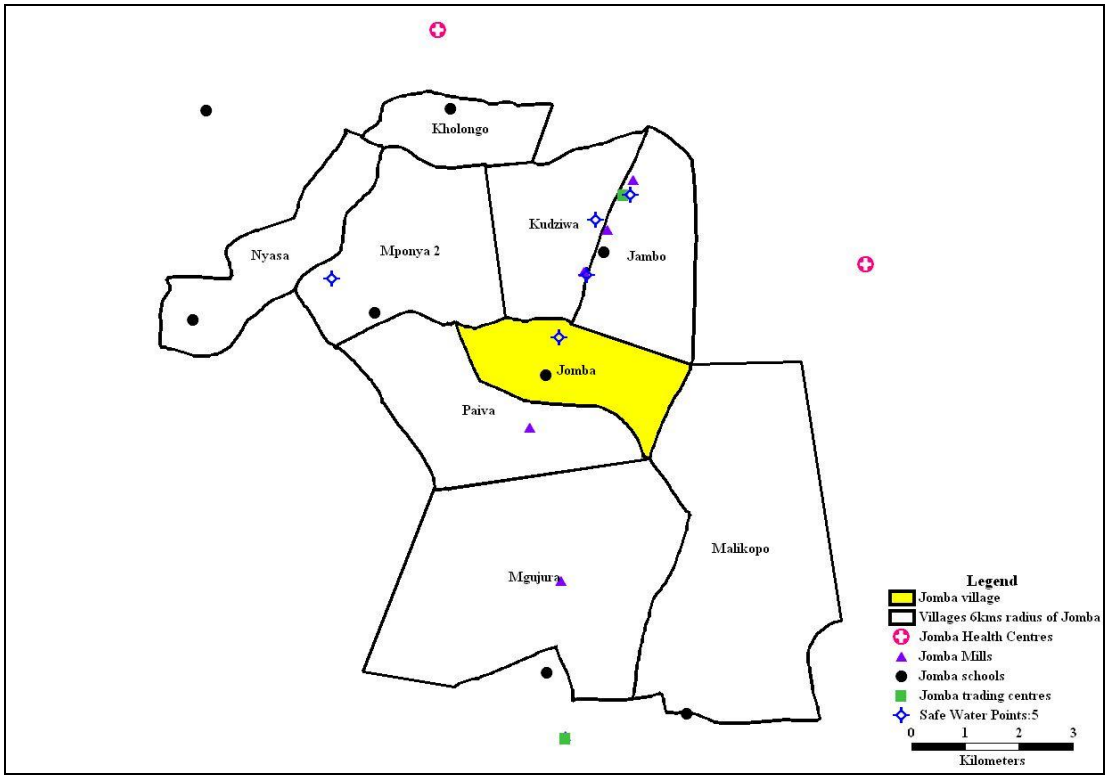
Facilities within Guta village from secondary data information



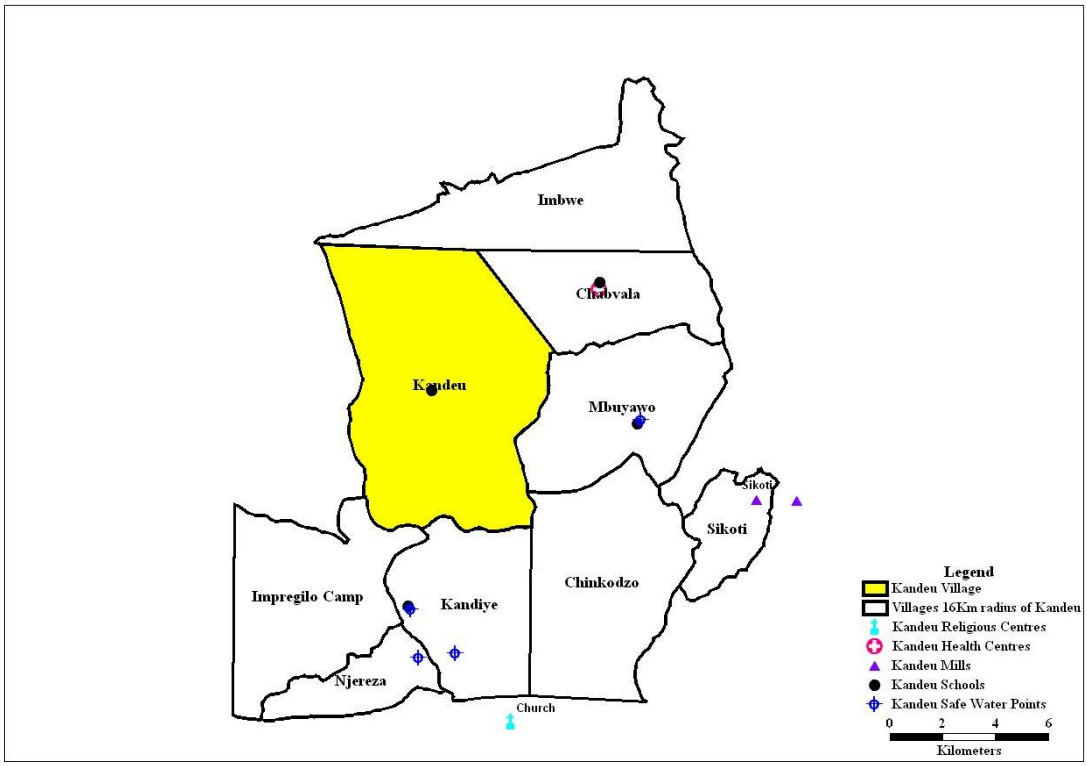
Facilities within Guta village after the validation process



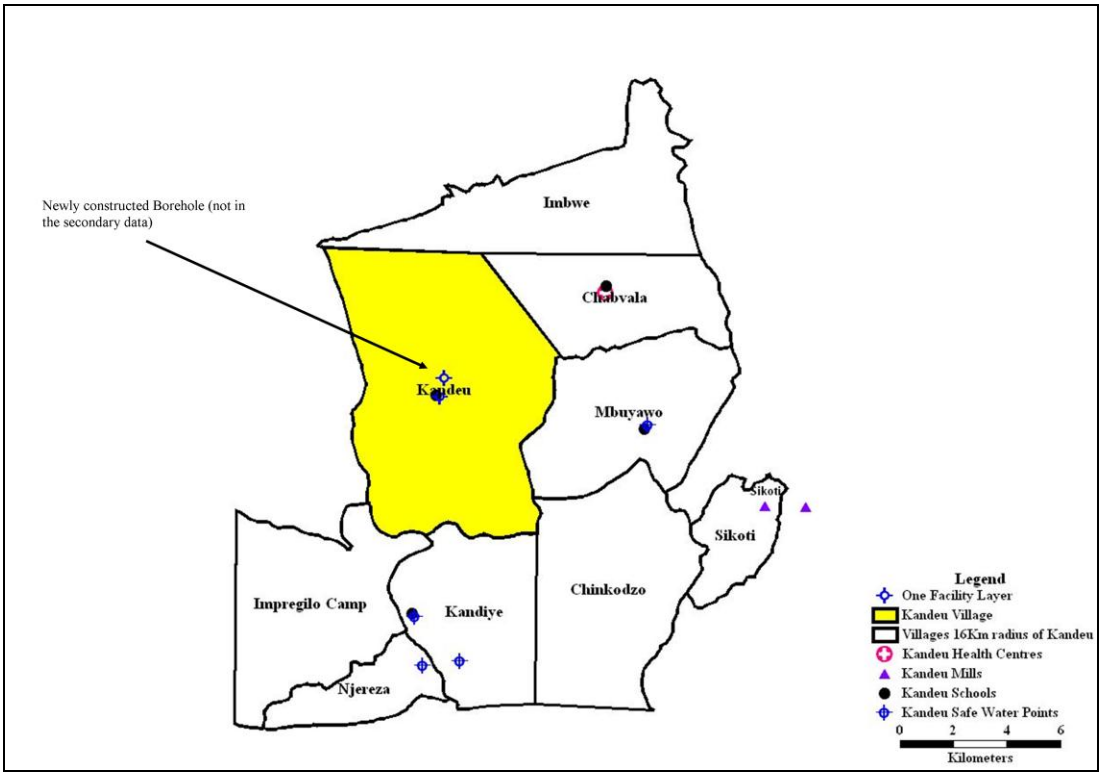
Facilities within Jomba village from secondary data information



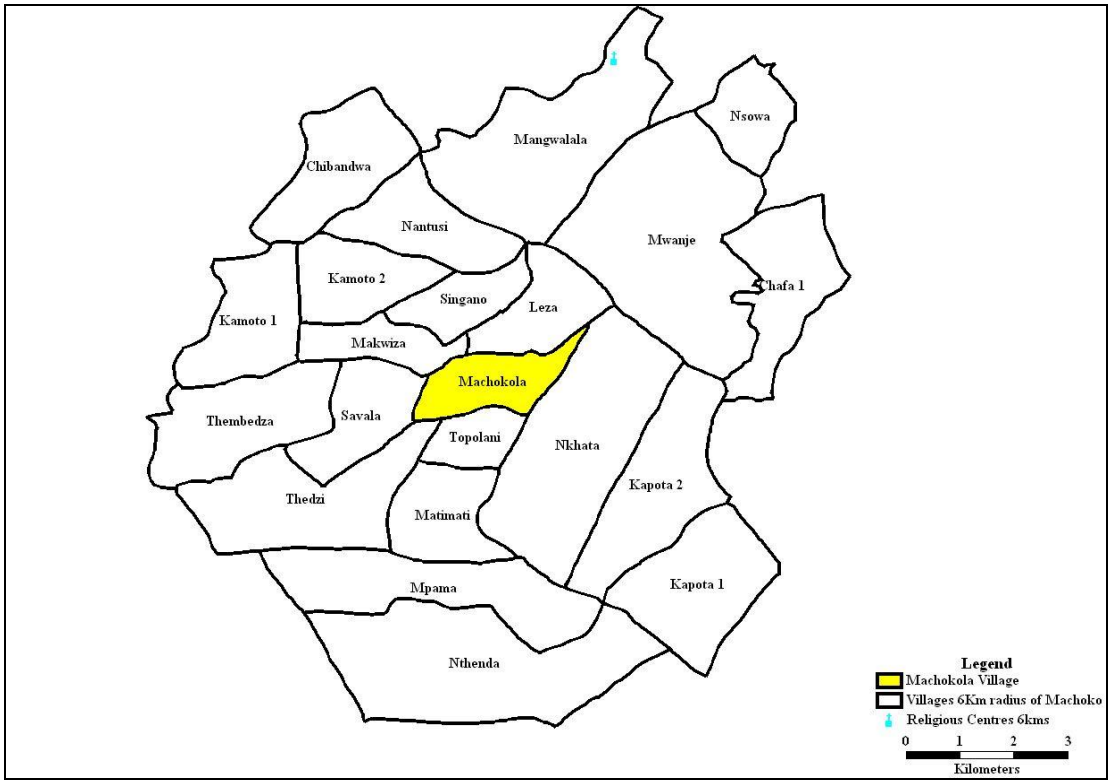
Facilities within Jomba village after the validation process



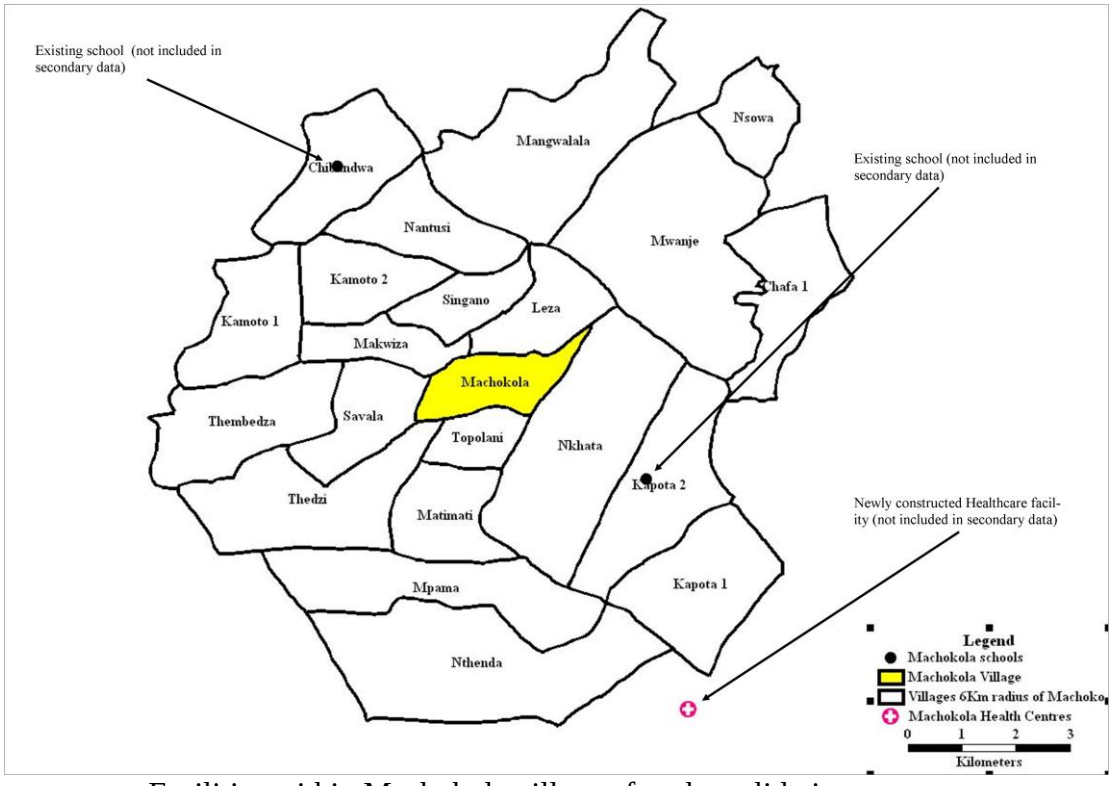
Facilities within Kandeu village from secondary data information



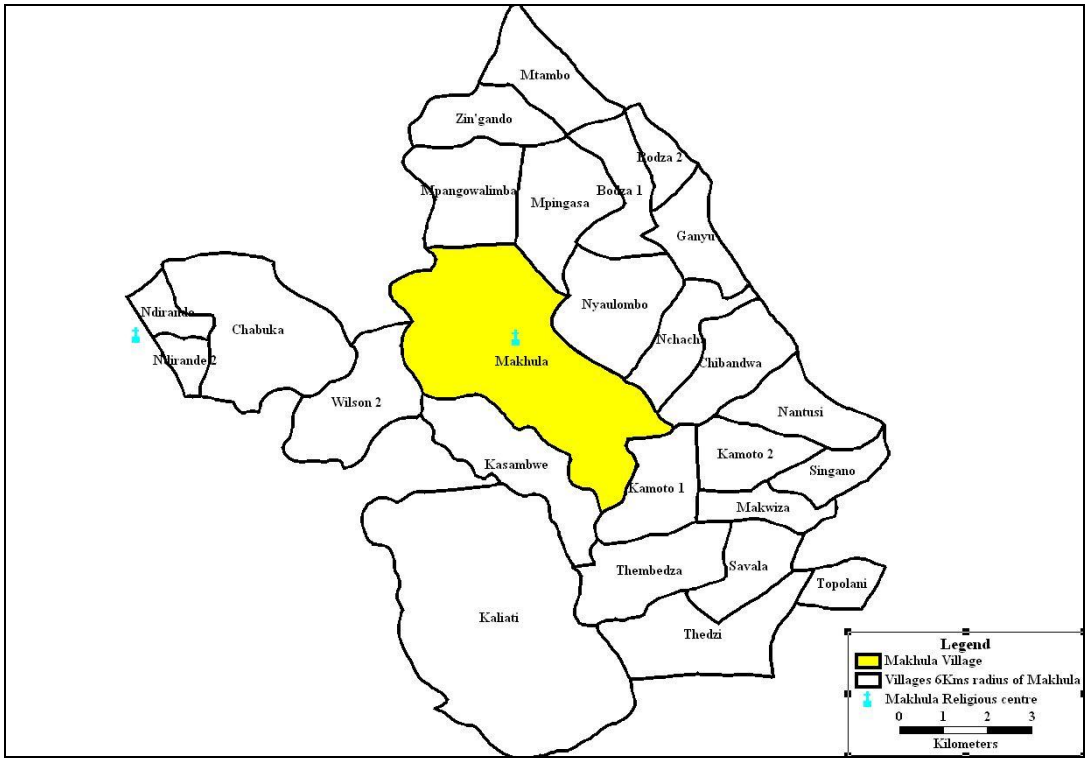
Facilities within Kandeu village after the validation process



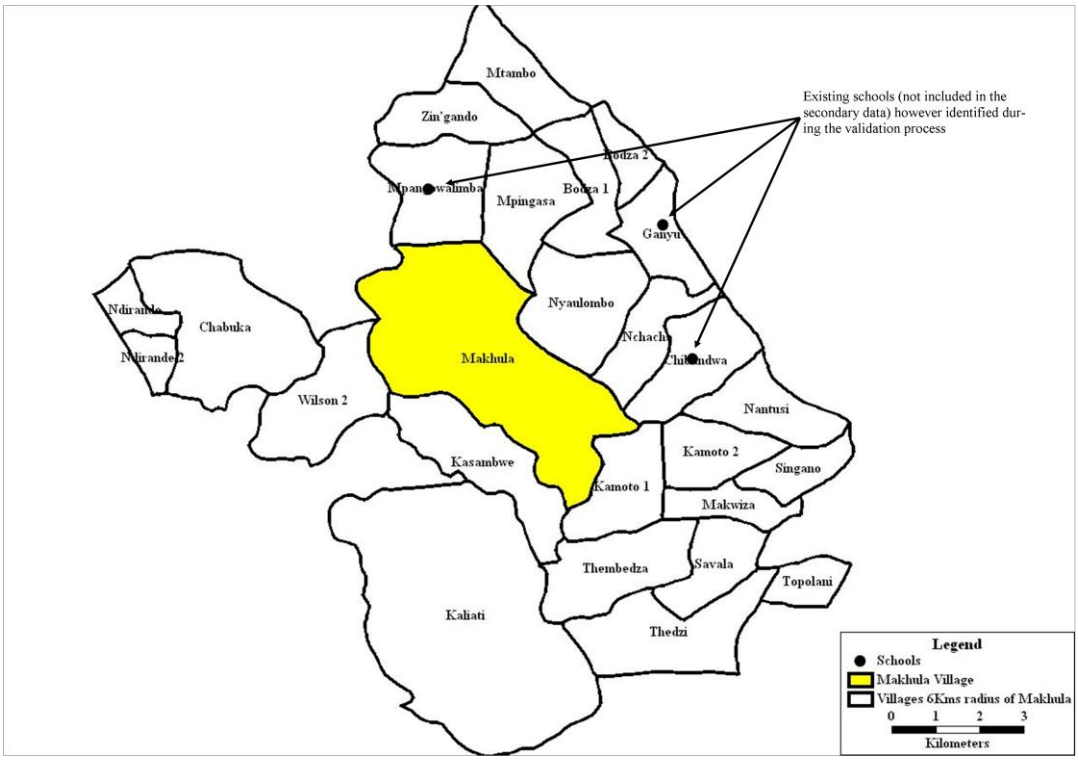
Facilities within Machokola village from secondary data information



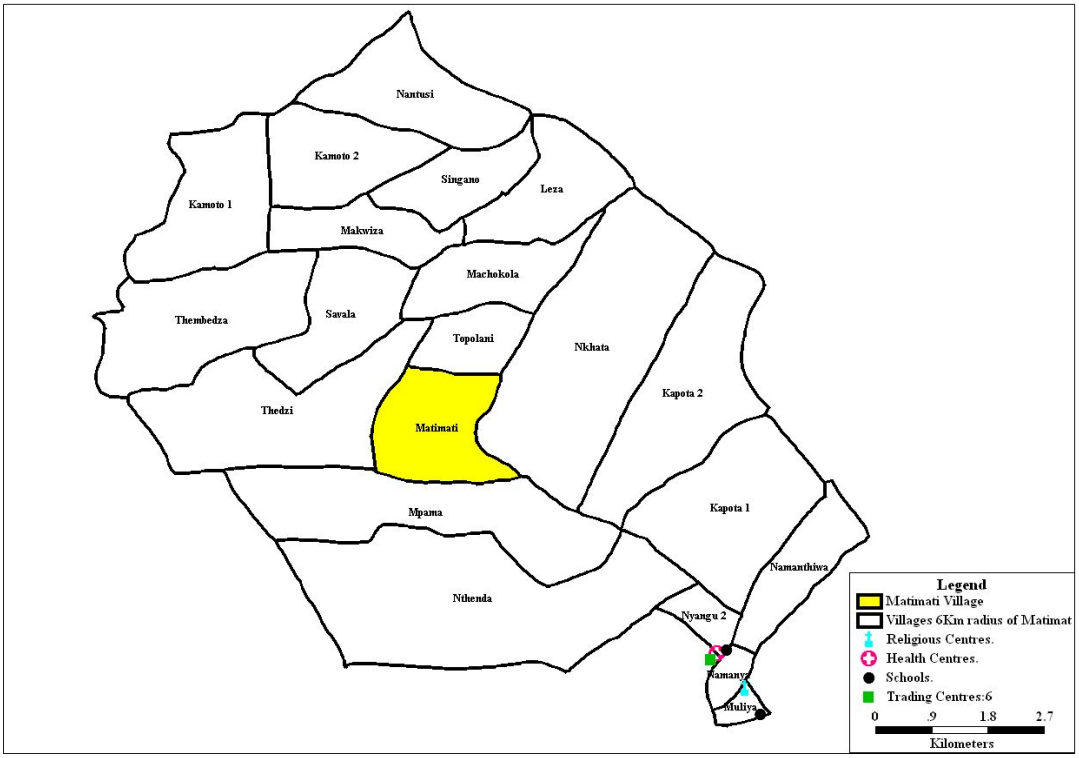
Facilities within Machokola village after the validation process



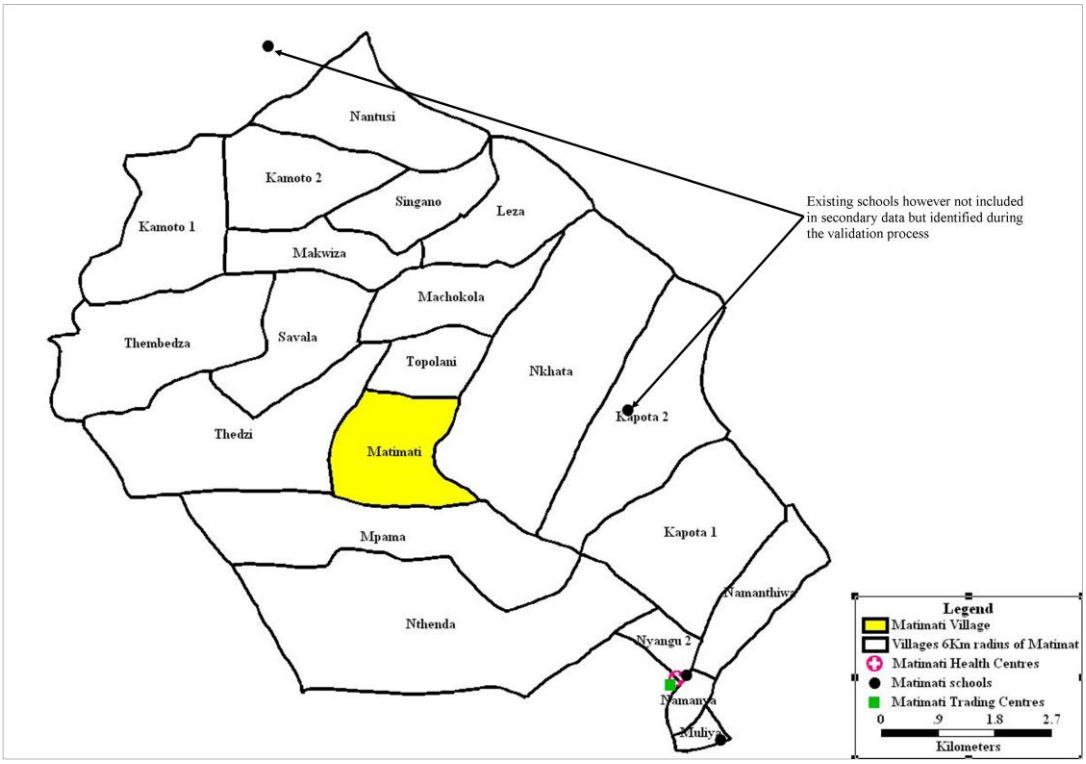
Facilities within Makhula village from secondary data information



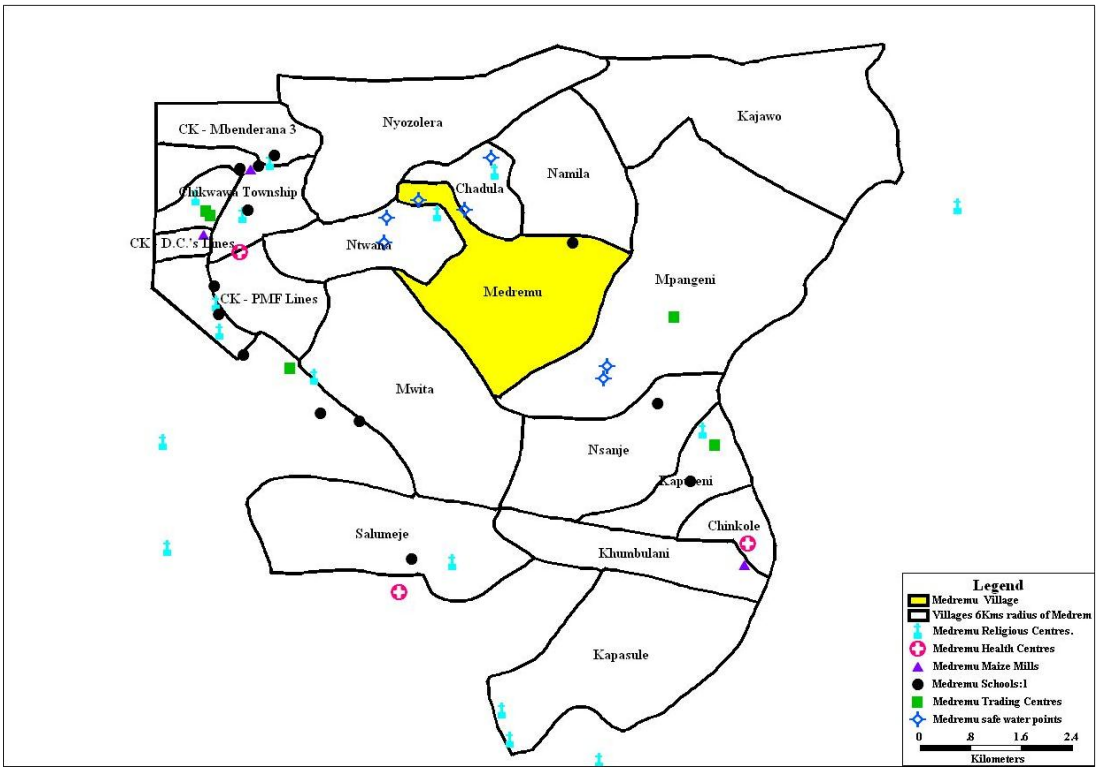
Facilities within Makhula village after the validation process



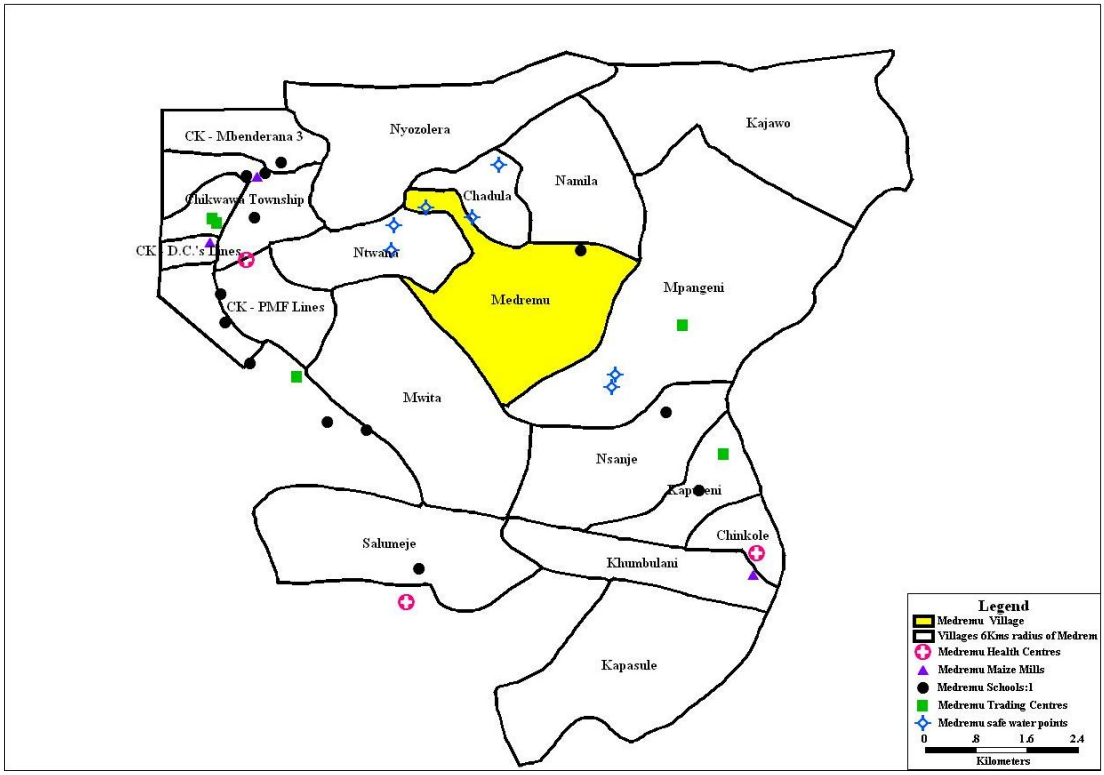
Facilities within Matimati village from secondary data information



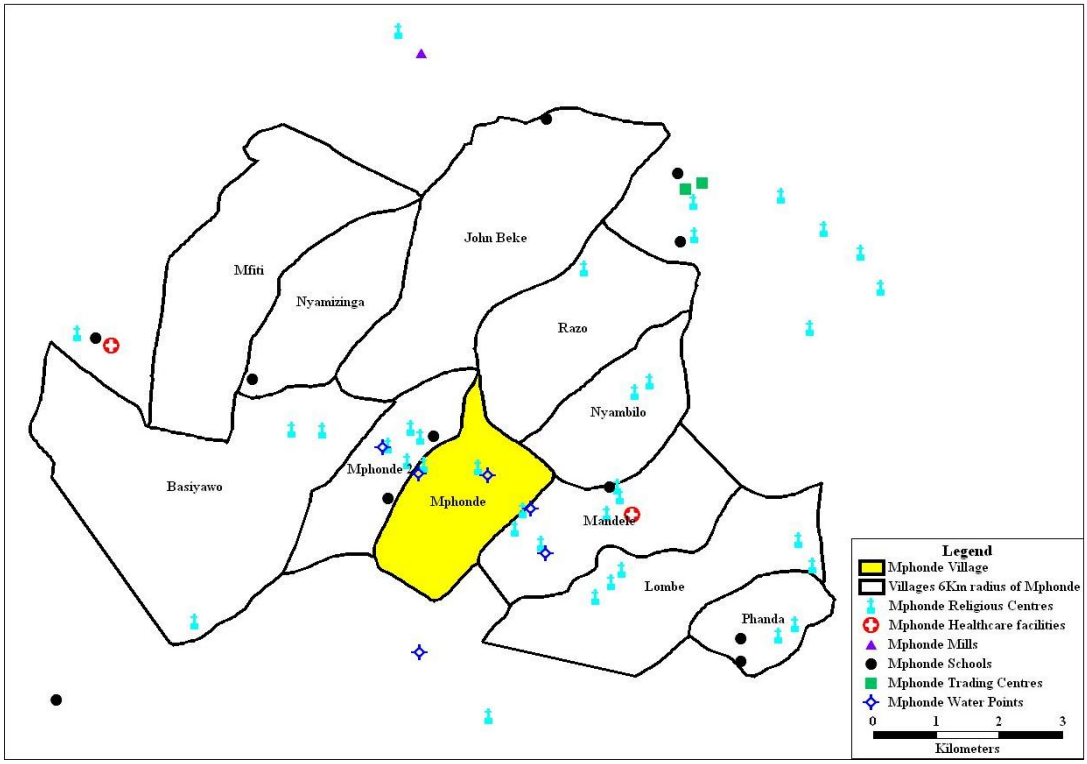
Facilities within Matimati village after the validation process



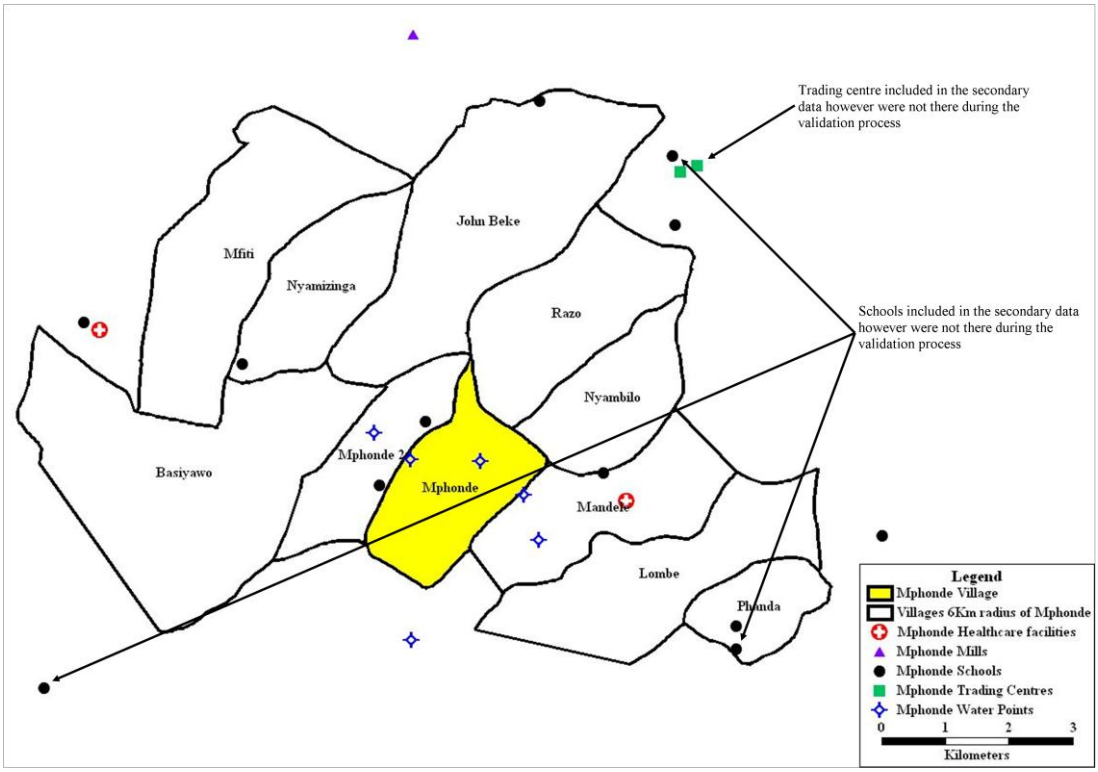
Facilities within Medremu village from secondary data information



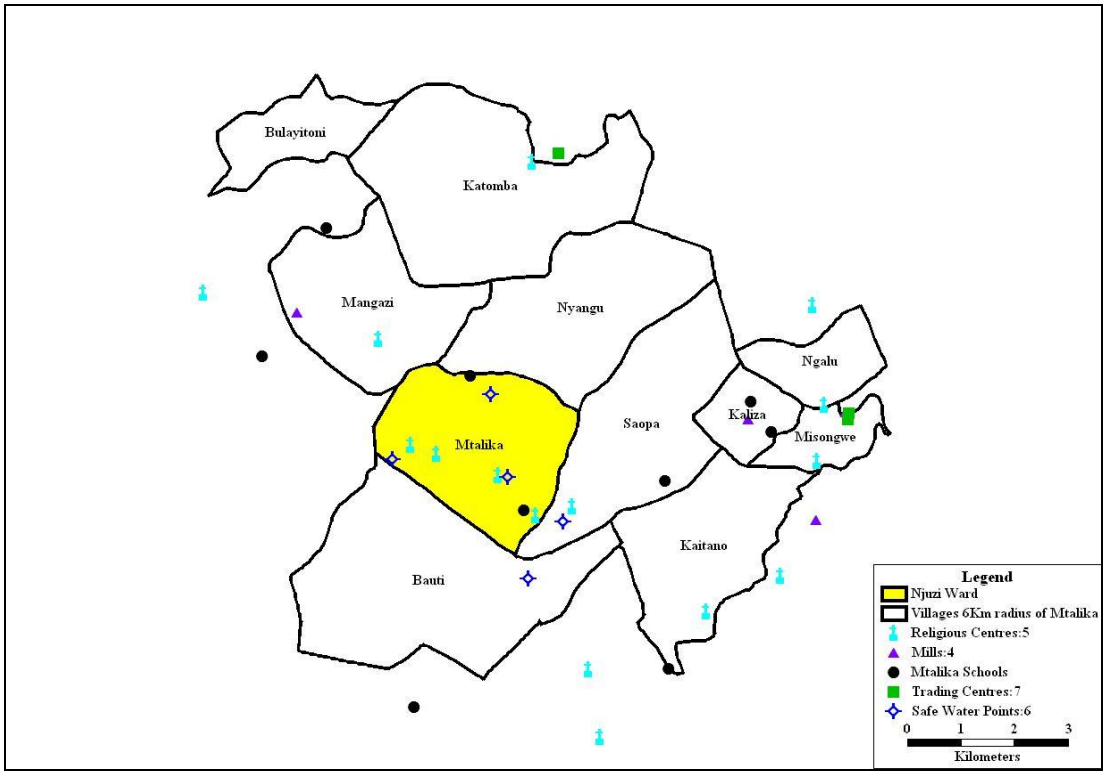
Facilities within Medremu village after the validation process



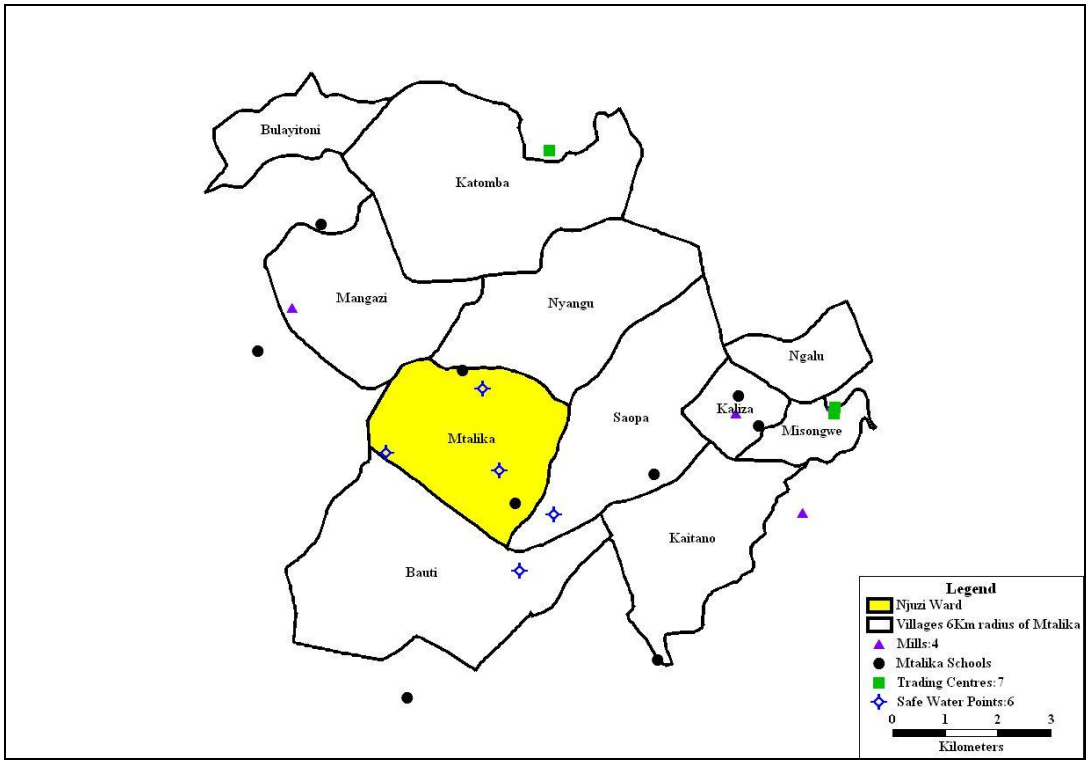
Facilities within Mphonde village from secondary data information



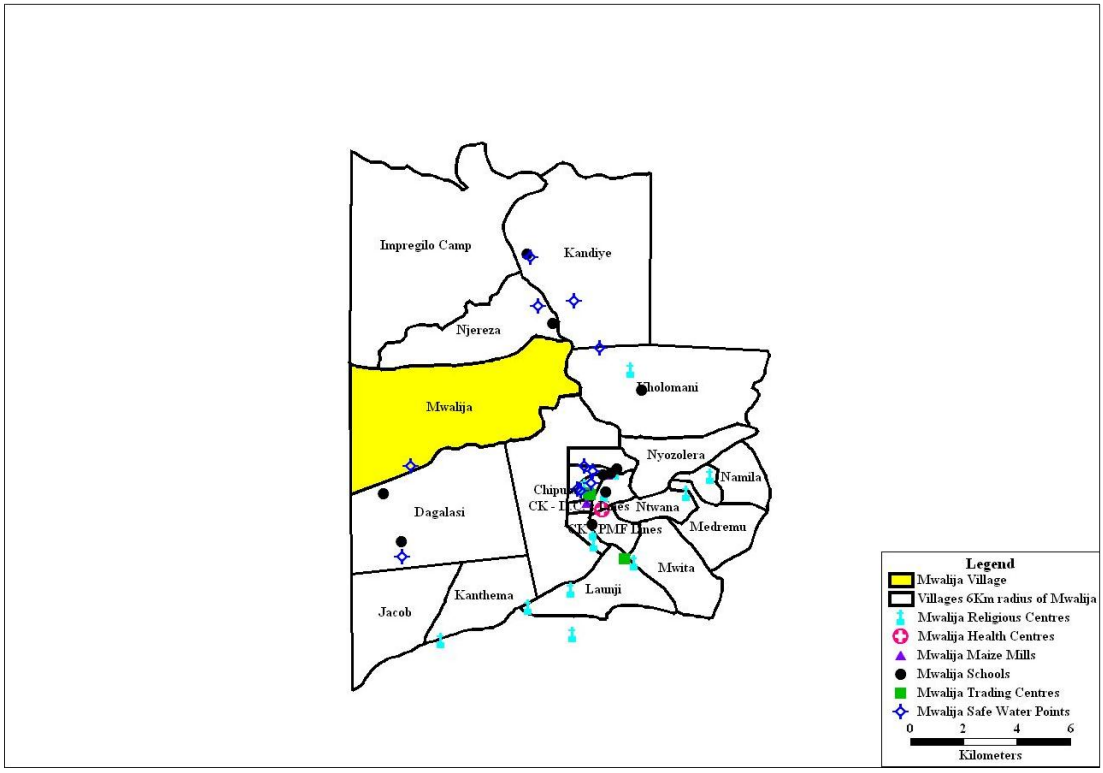
Facilities within Mphonde village after the validation process



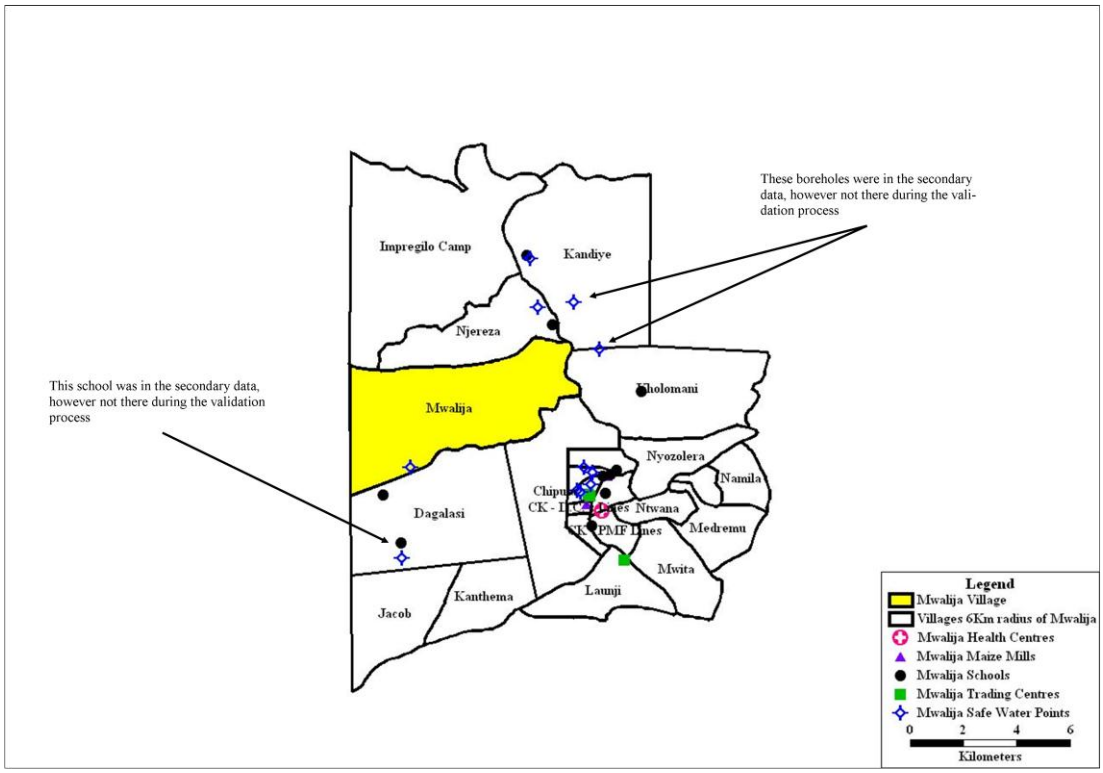
Facilities within Mtalika village from secondary data information



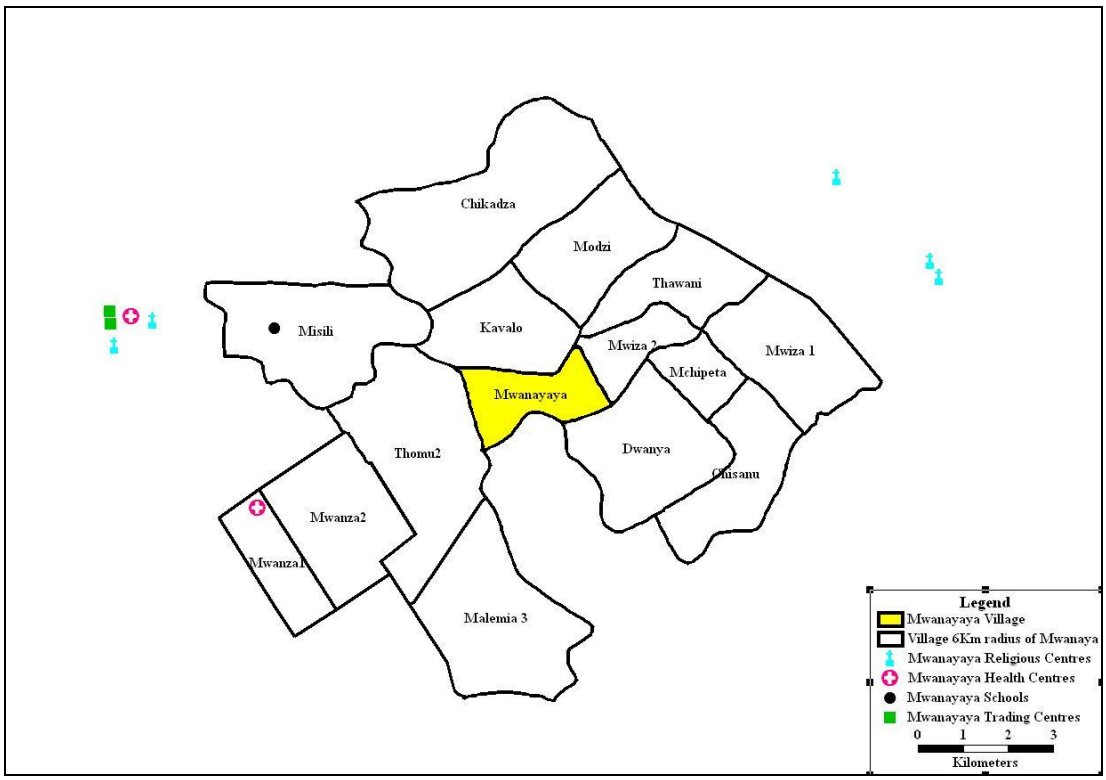
Facilities within Mtalika village after the validation process



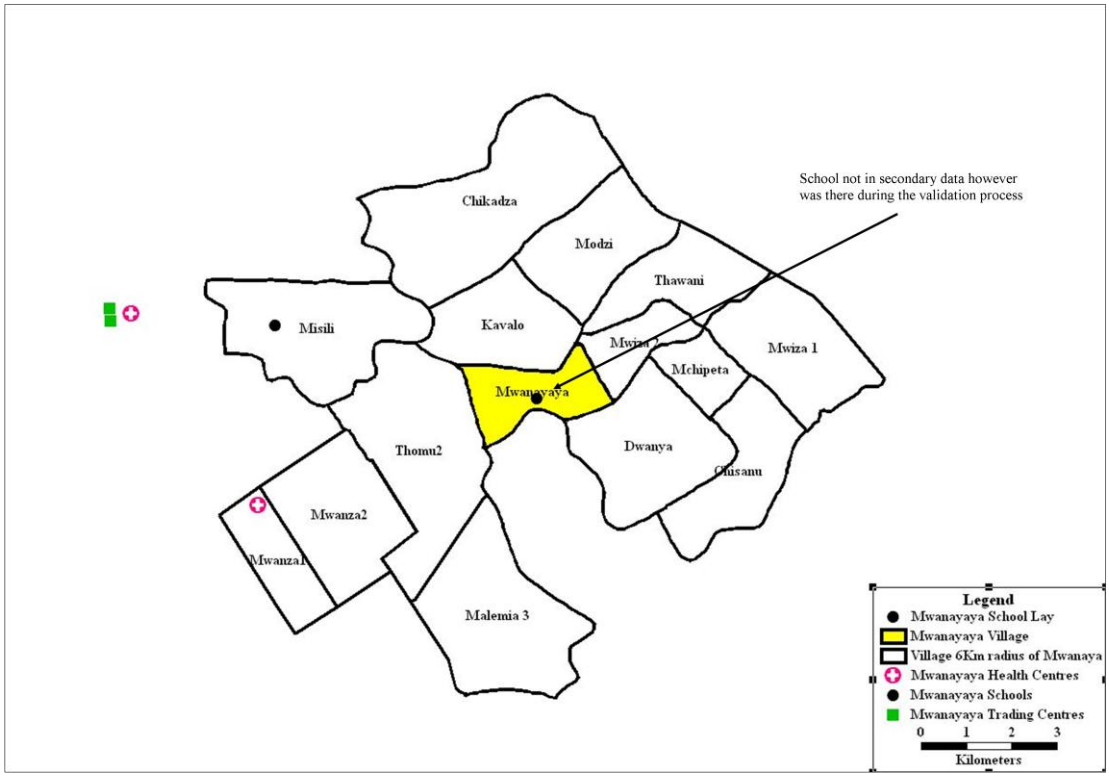
Facilities within Mwalija village from secondary data information



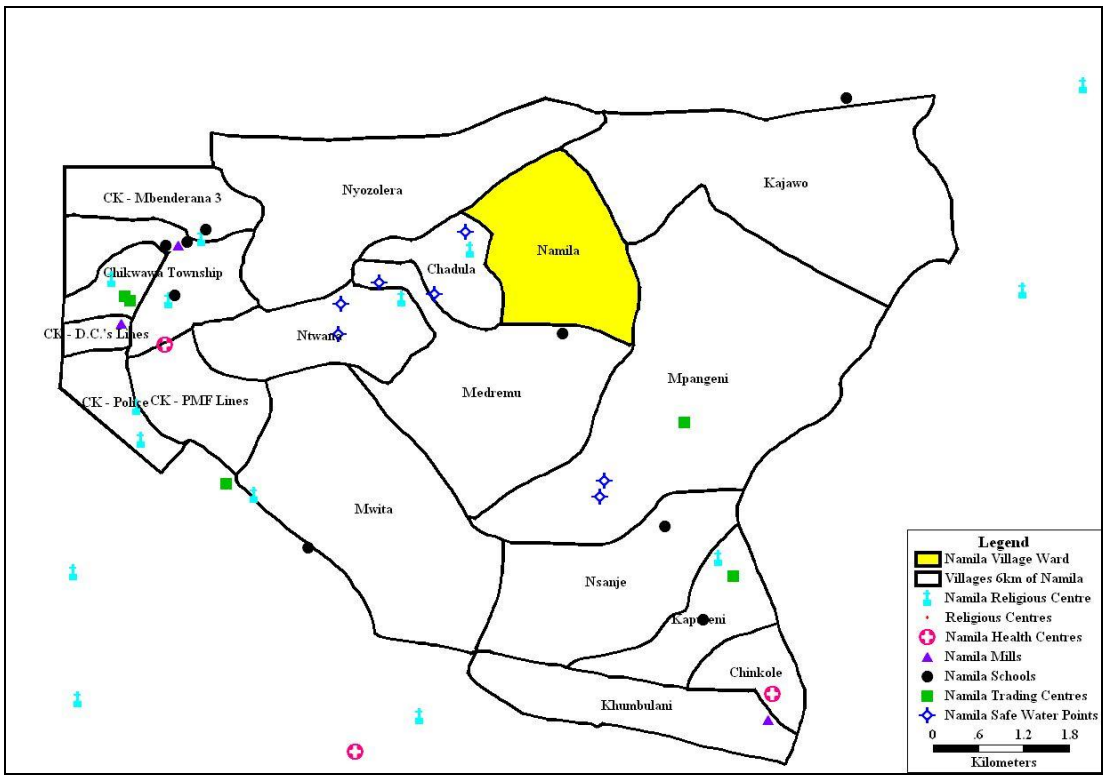
Facilities within Mtalika village after the validation process



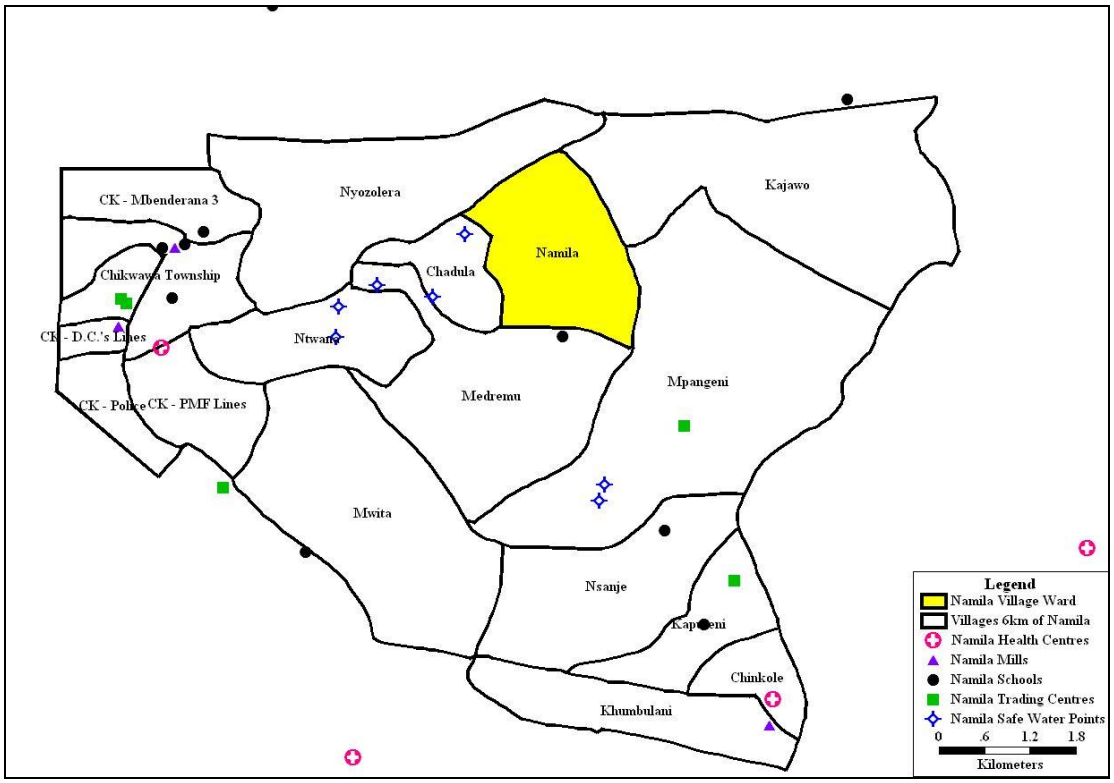
Facilities within Mwanayaya village from secondary data information



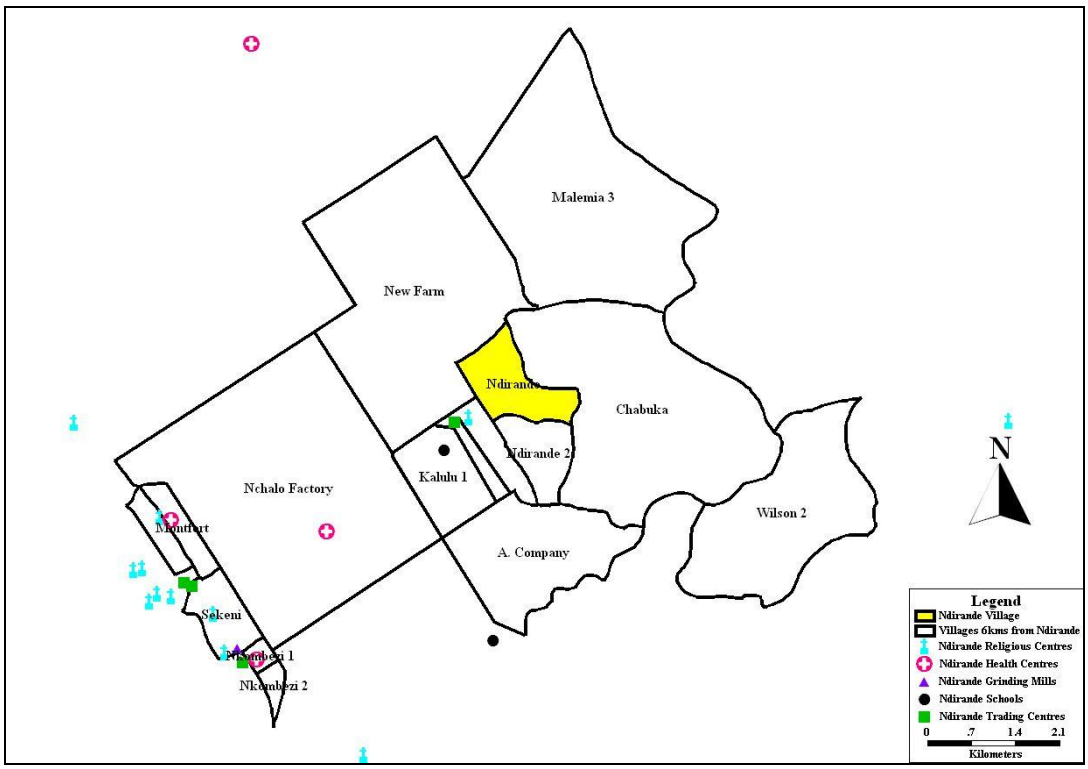
Facilities within Mwanayaya village after the validation process



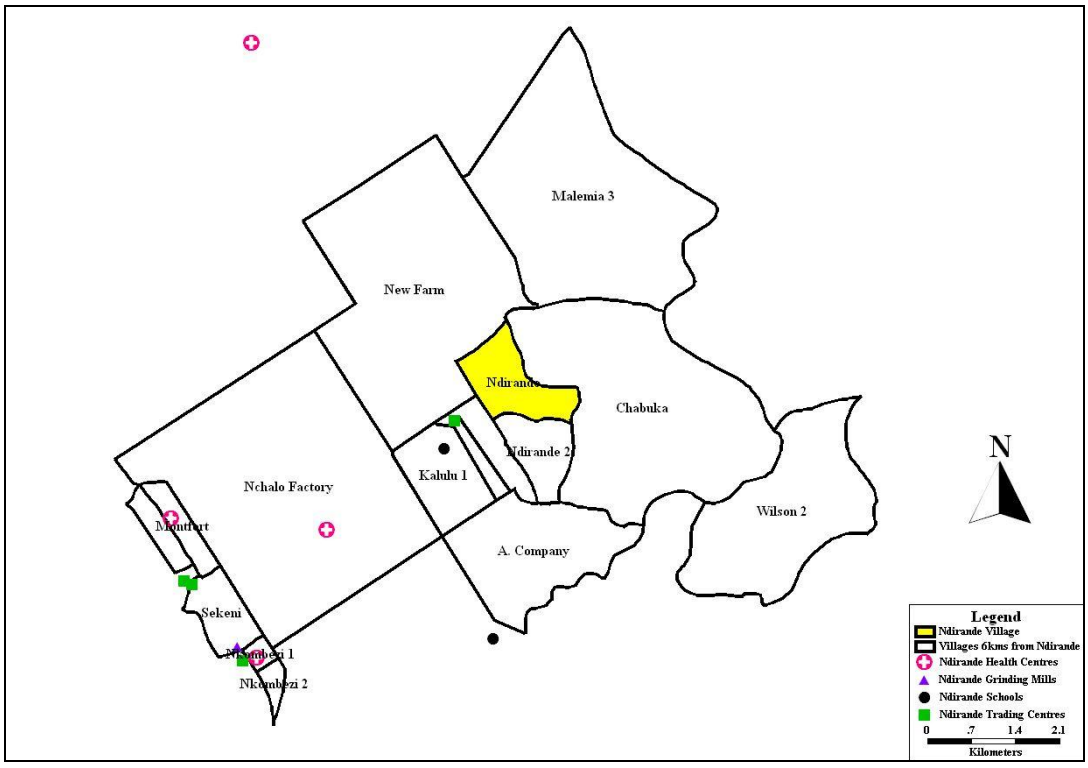
Facilities within Namila village from secondary data information



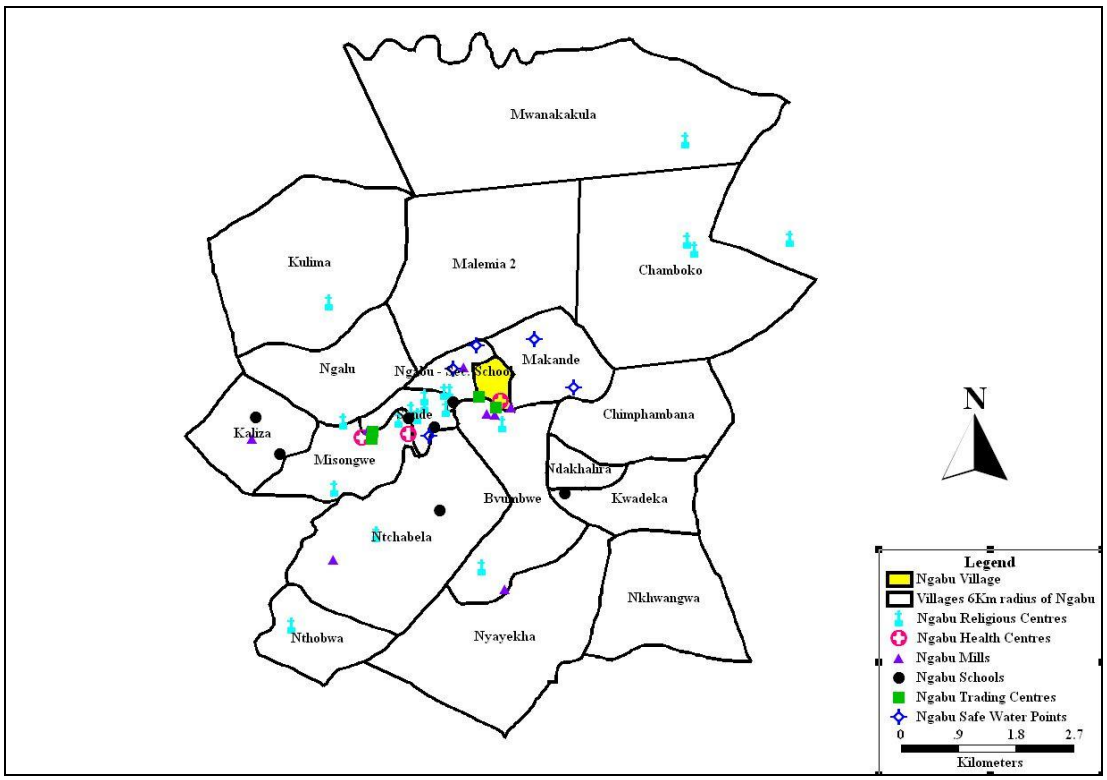
Facilities within Namila village after the validation process



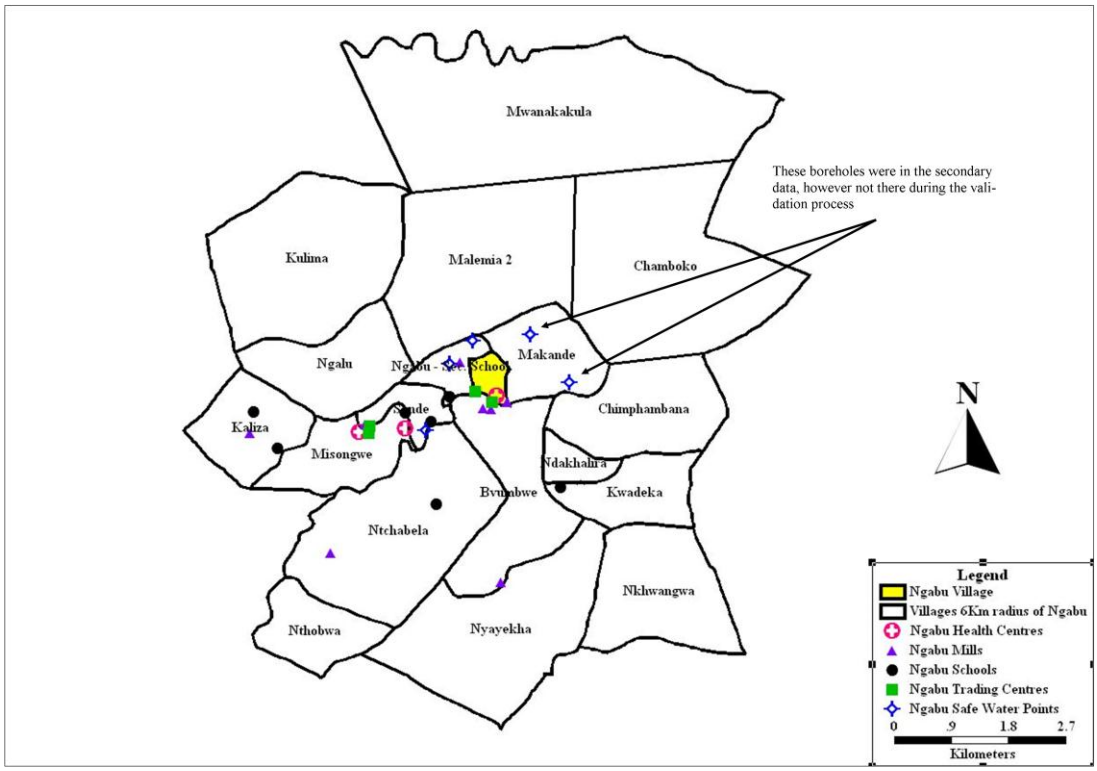
Facilities within Ndirande village from secondary data information



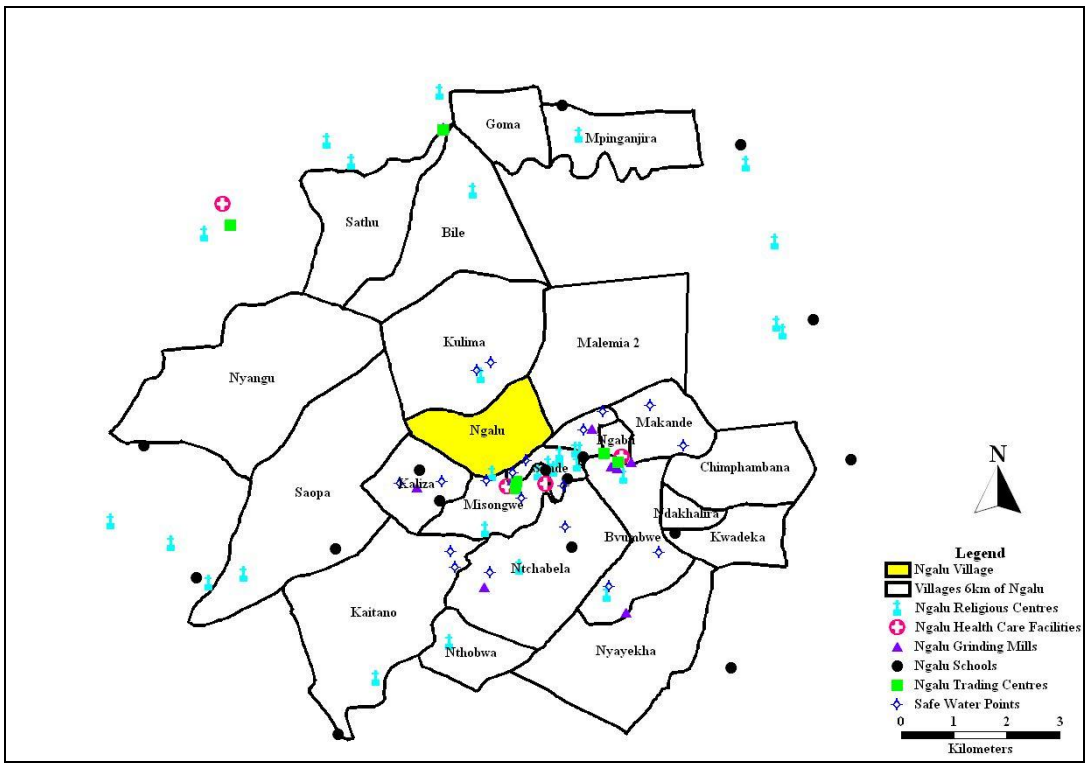
Facilities within Ndirande village after the validation process



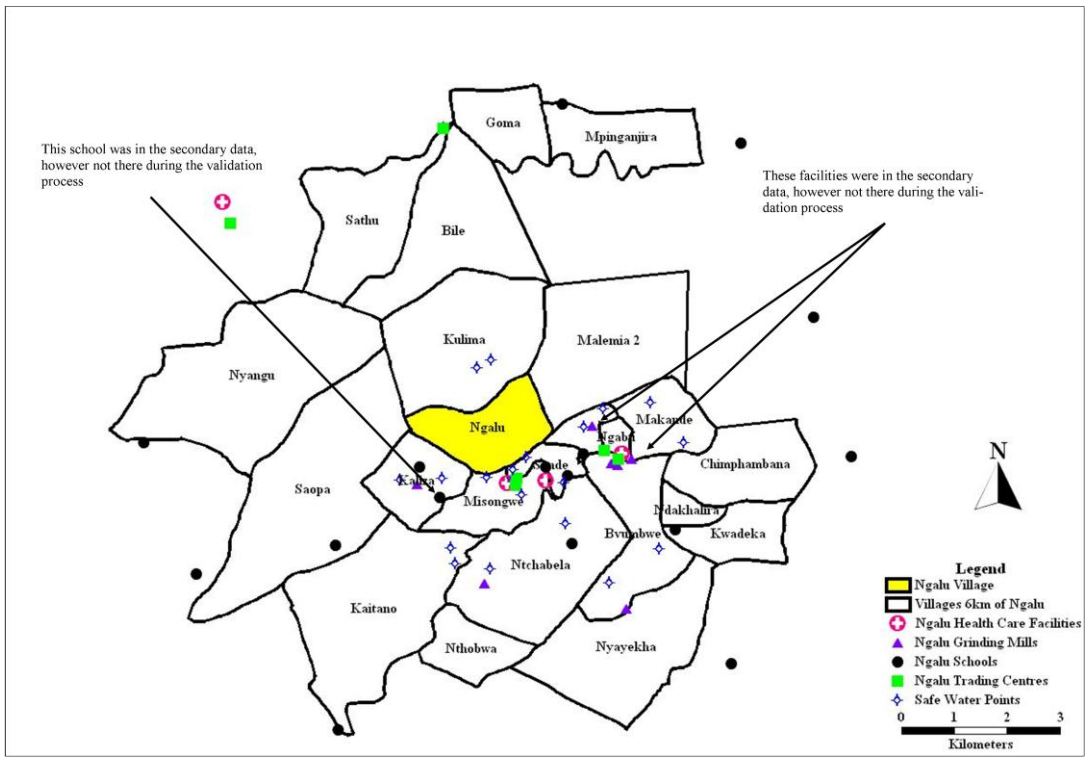
Facilities within Ngabu village from secondary data information



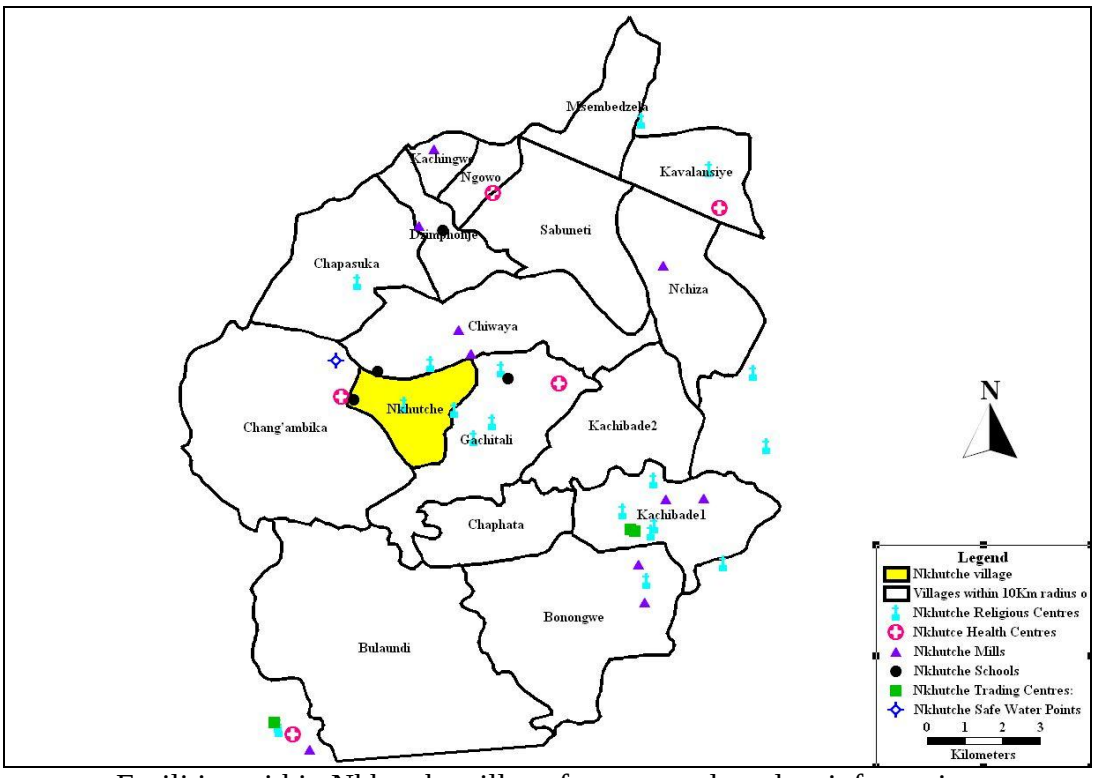
Facilities within Ngabu village after the validation process



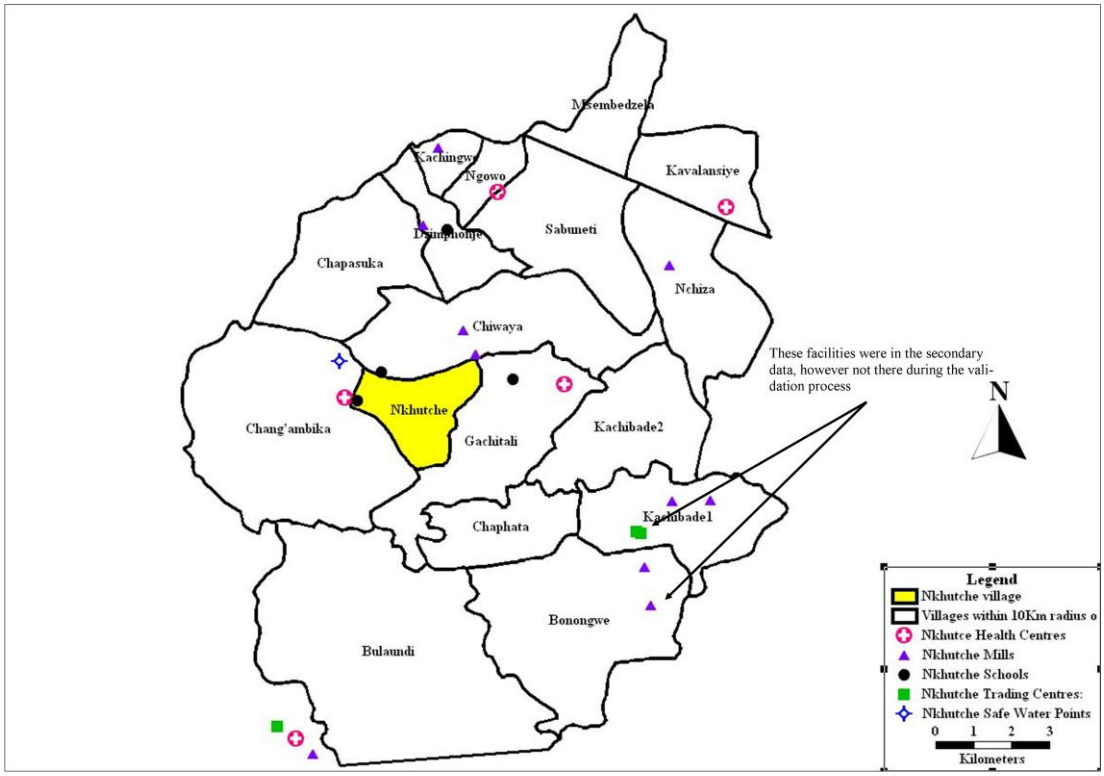
Facilities within Ngalu village from secondary data information



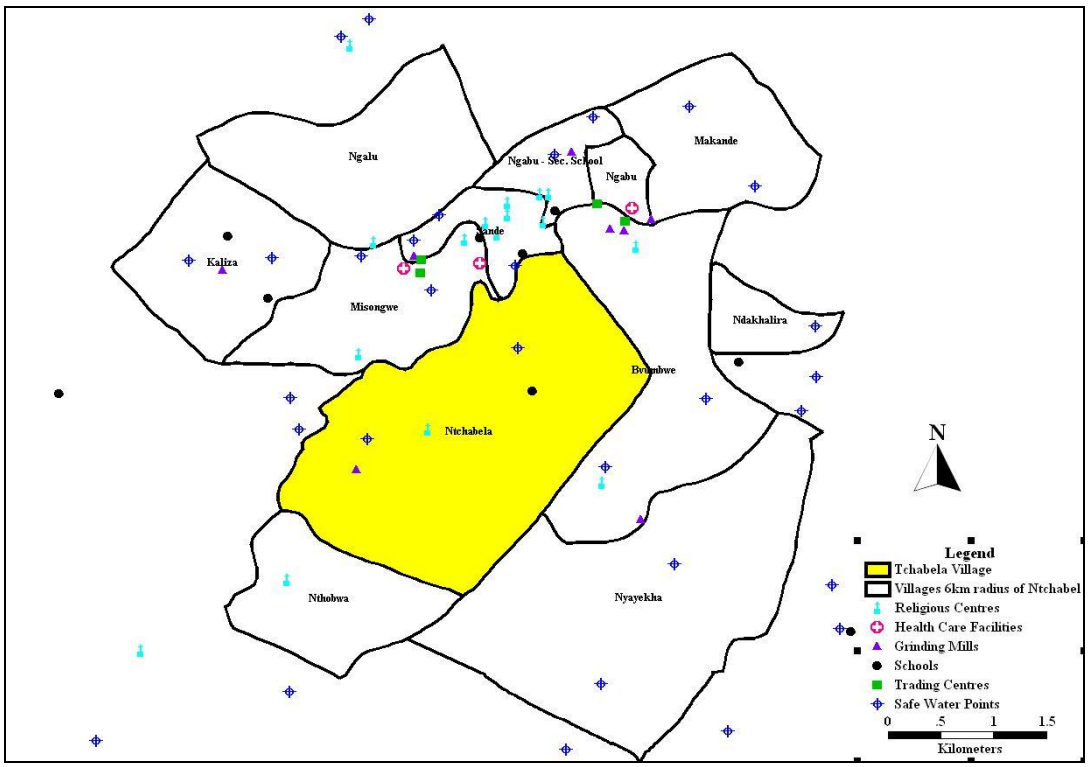
Facilities within Ngabu village after the validation process



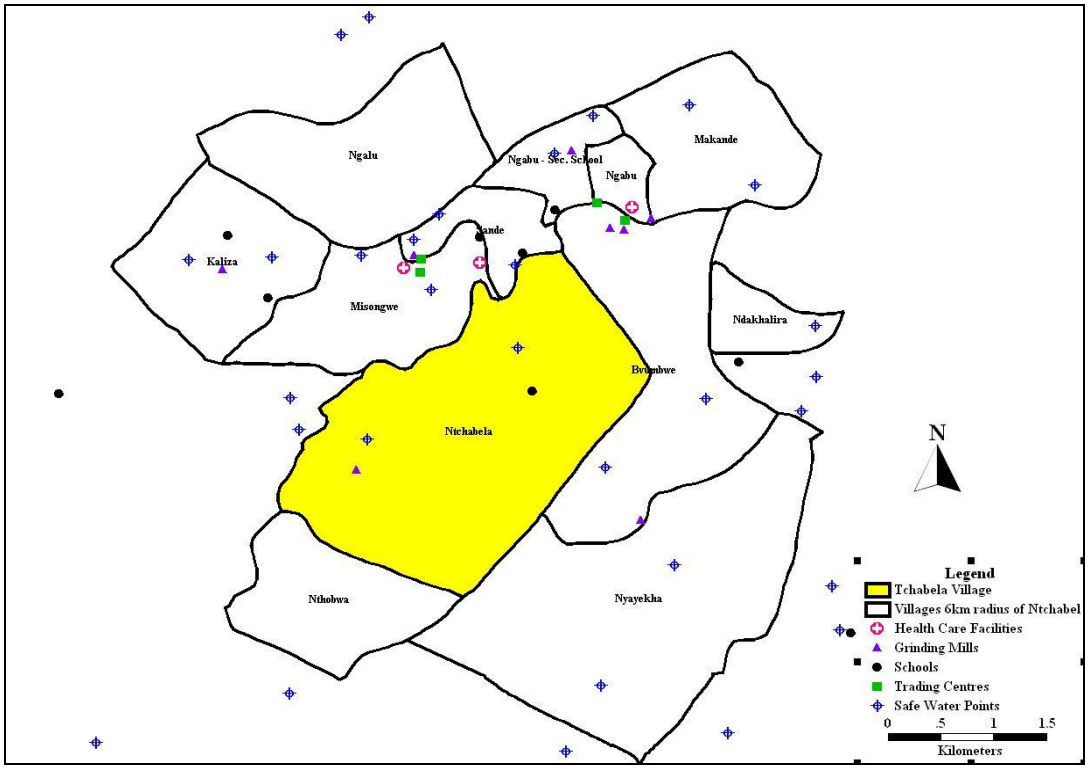
Facilities within Nkhutche village from secondary data information



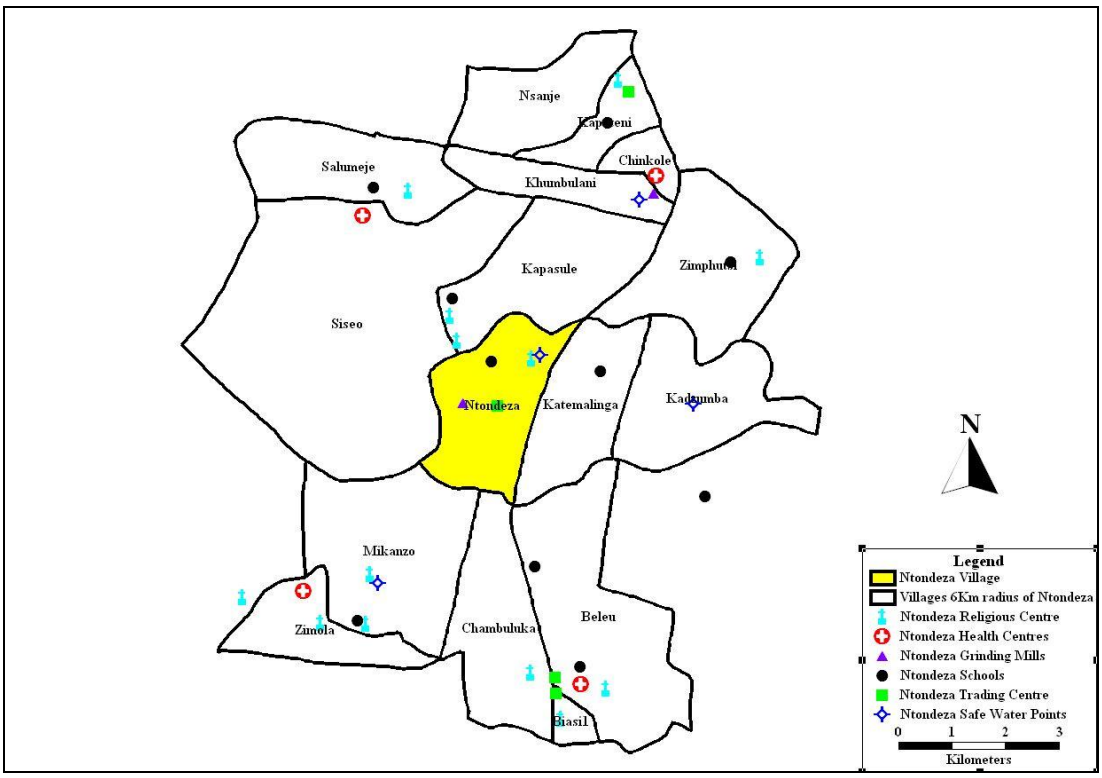
Facilities within Nkhutche village after the validation process



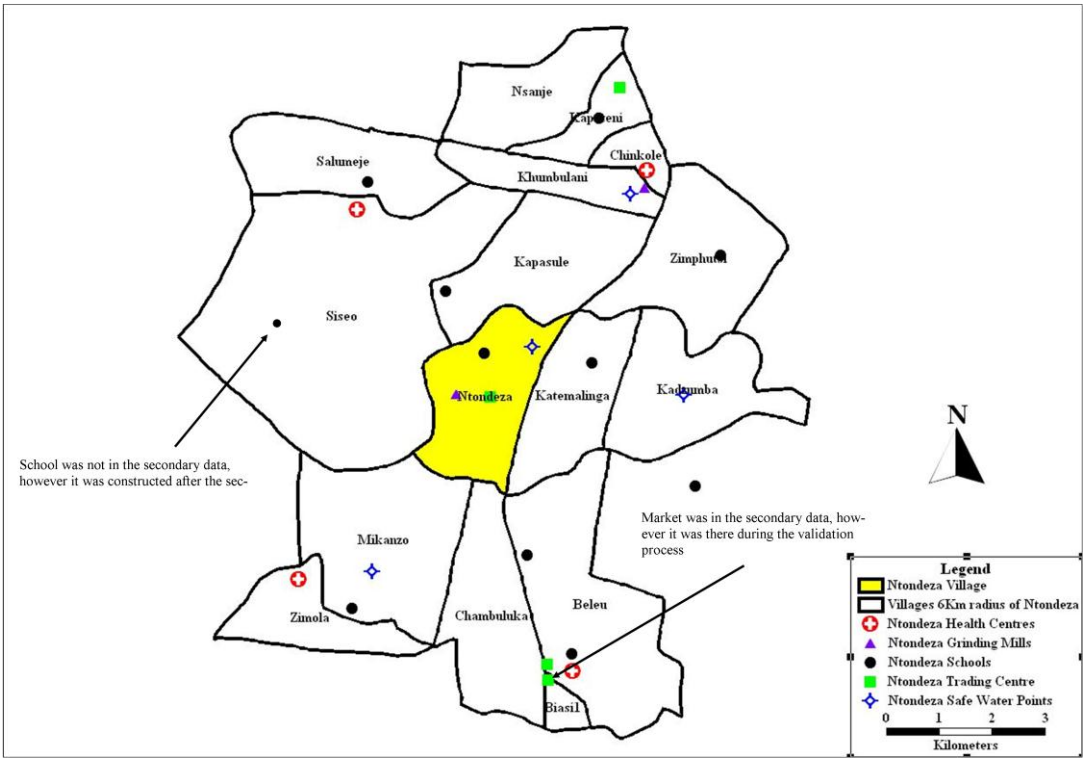
Facilities within Ntchabela village from secondary data information



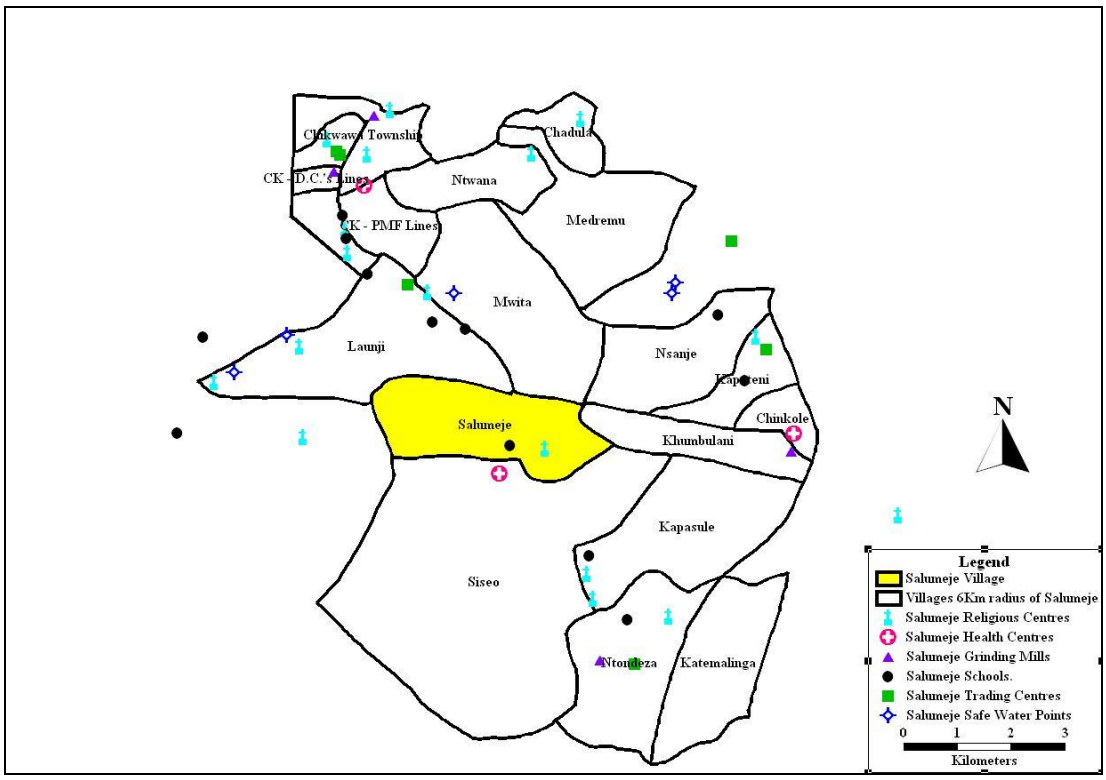
Facilities within Ntchabela village after the validation process



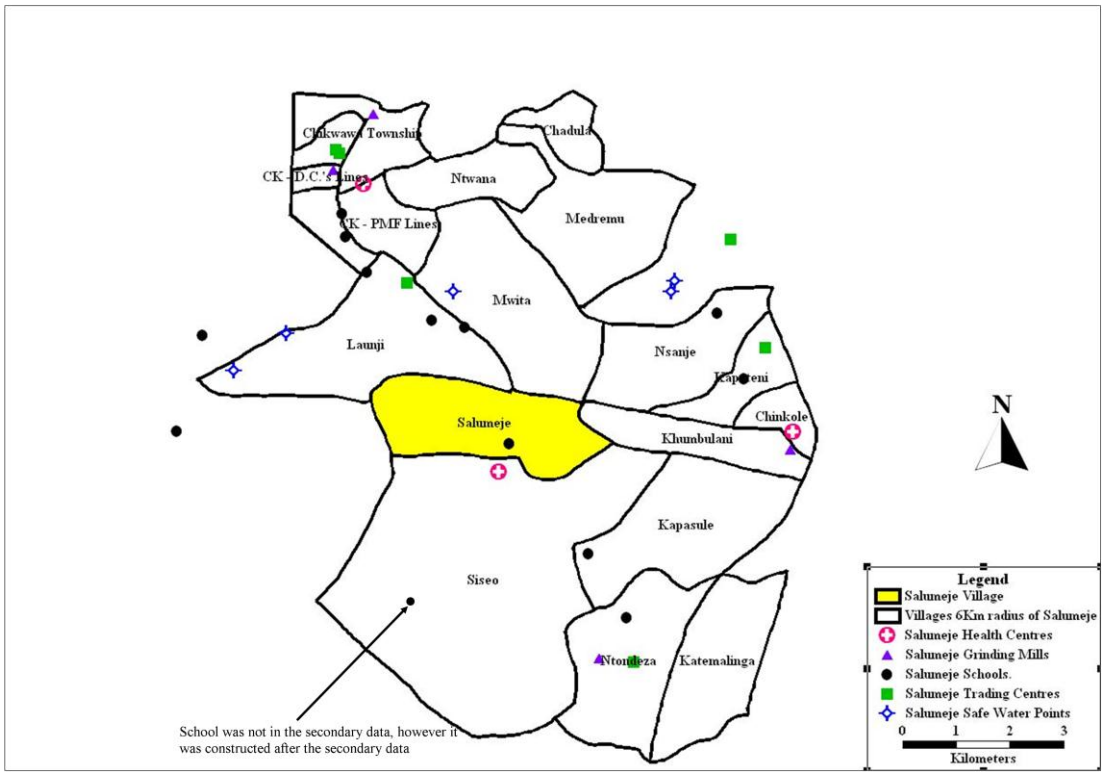
Facilities within Ntondeza village from secondary data information



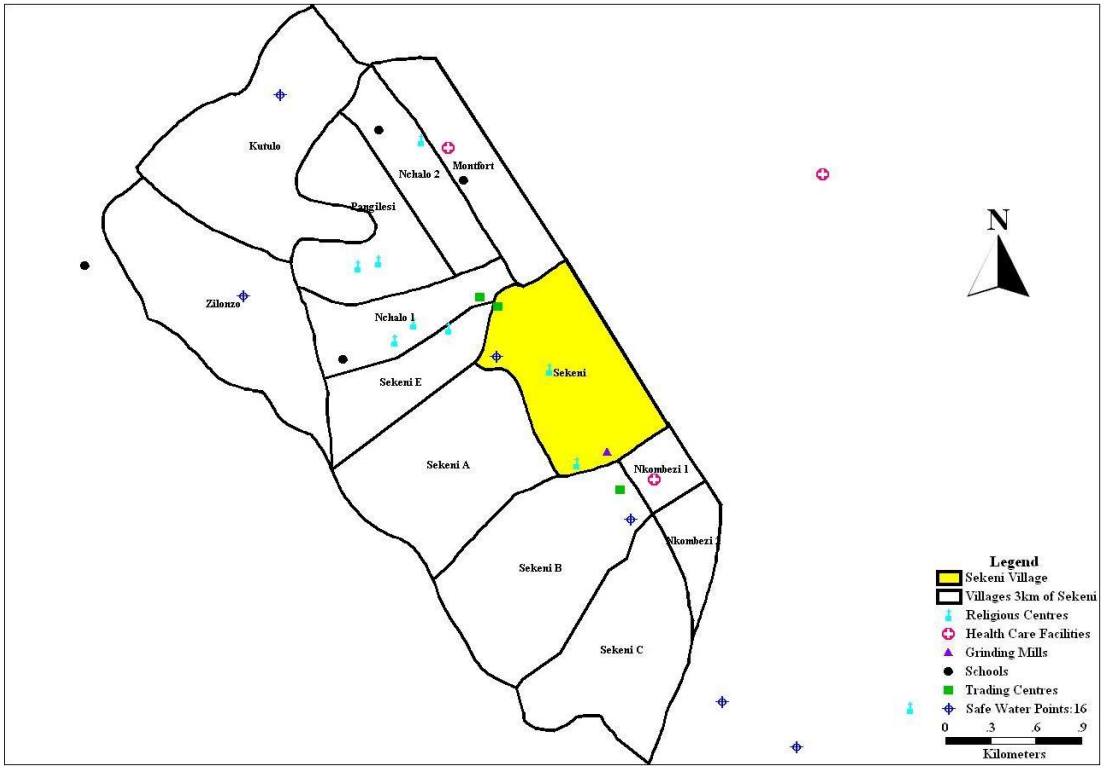
Facilities within Ntondeza village after the validation process



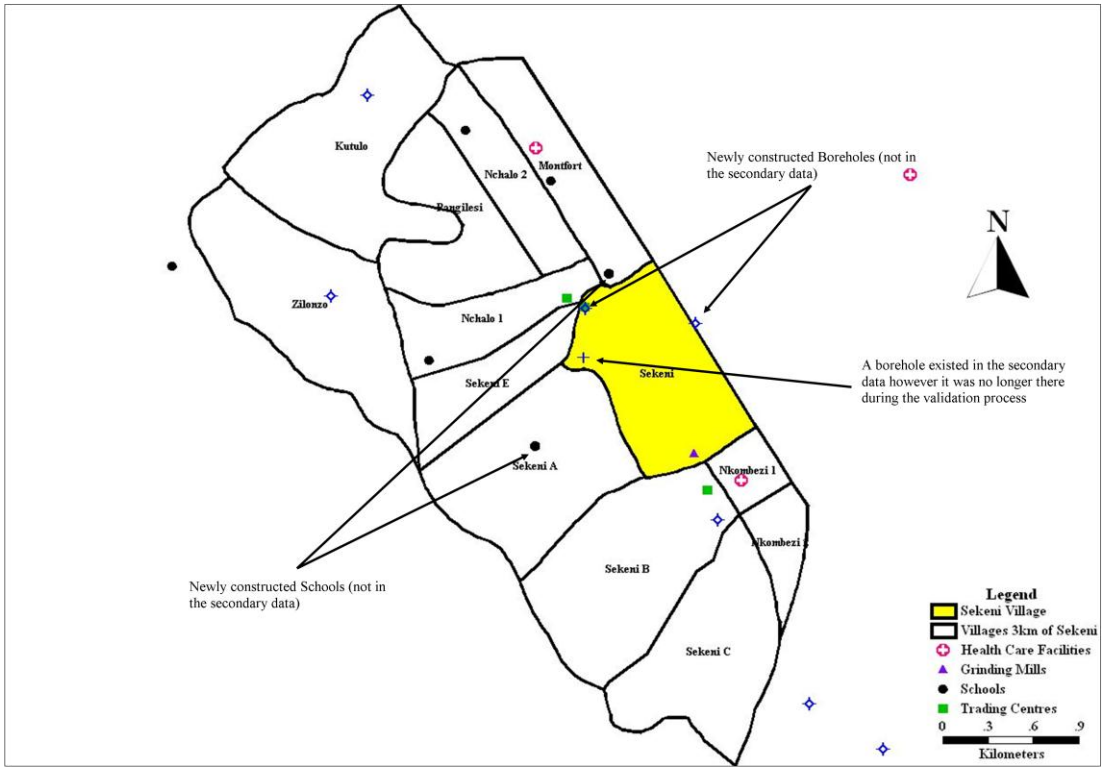
Facilities within Salumeje village from secondary data information



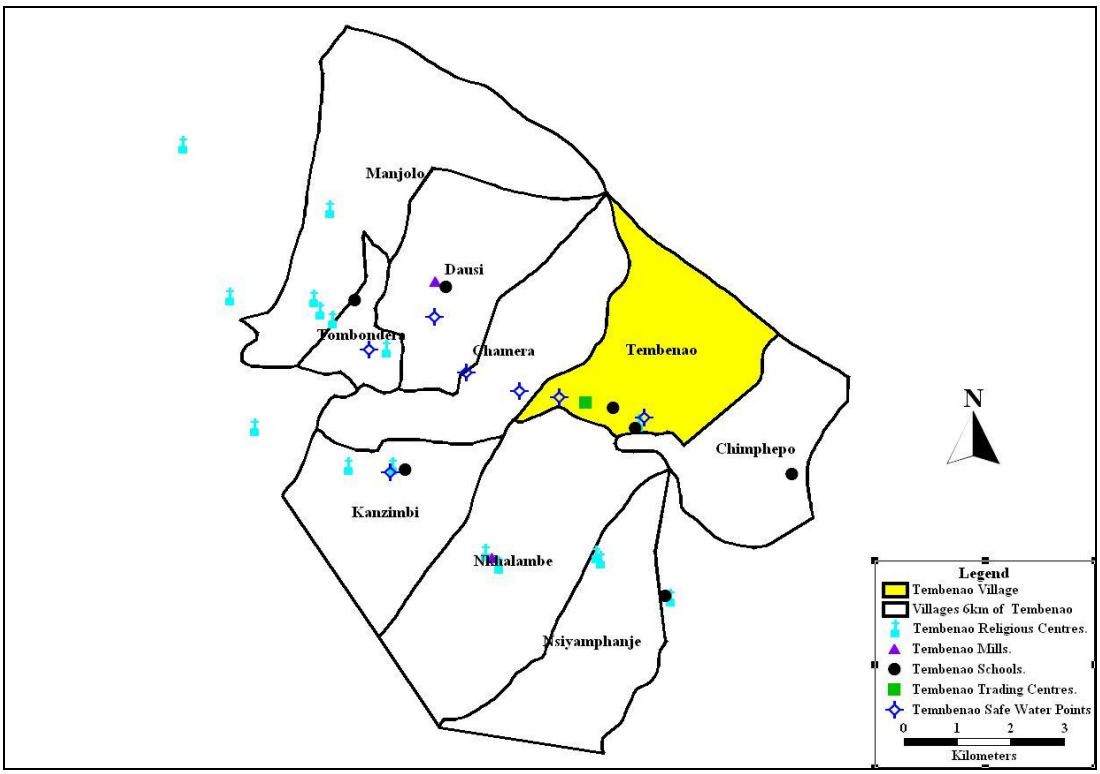
Facilities within Salumeje village after the validation process



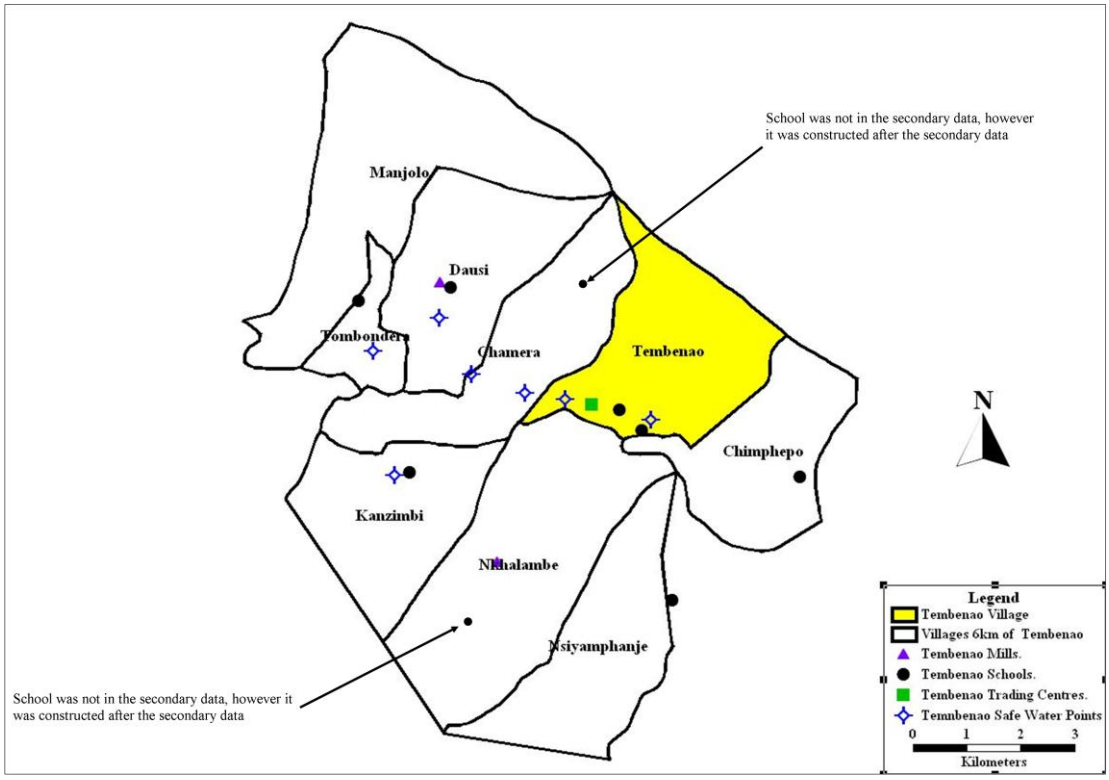
Facilities within Sekeni village from secondary data information



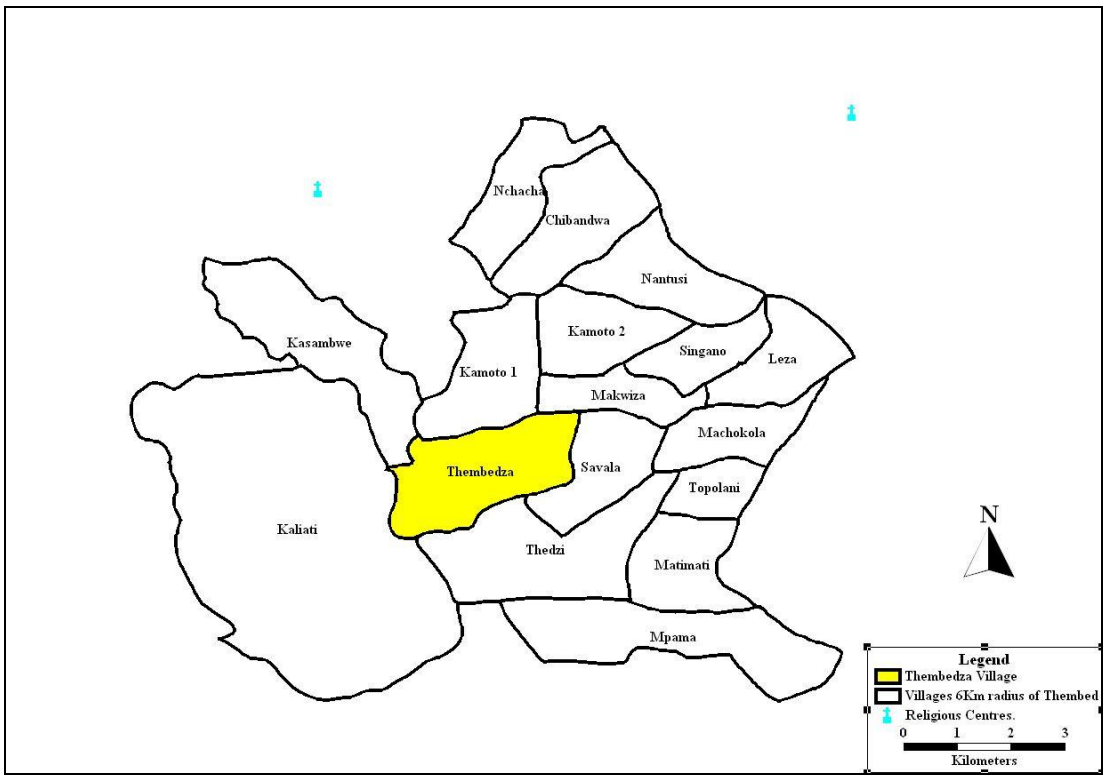
Facilities within Sekeni village after the validation process



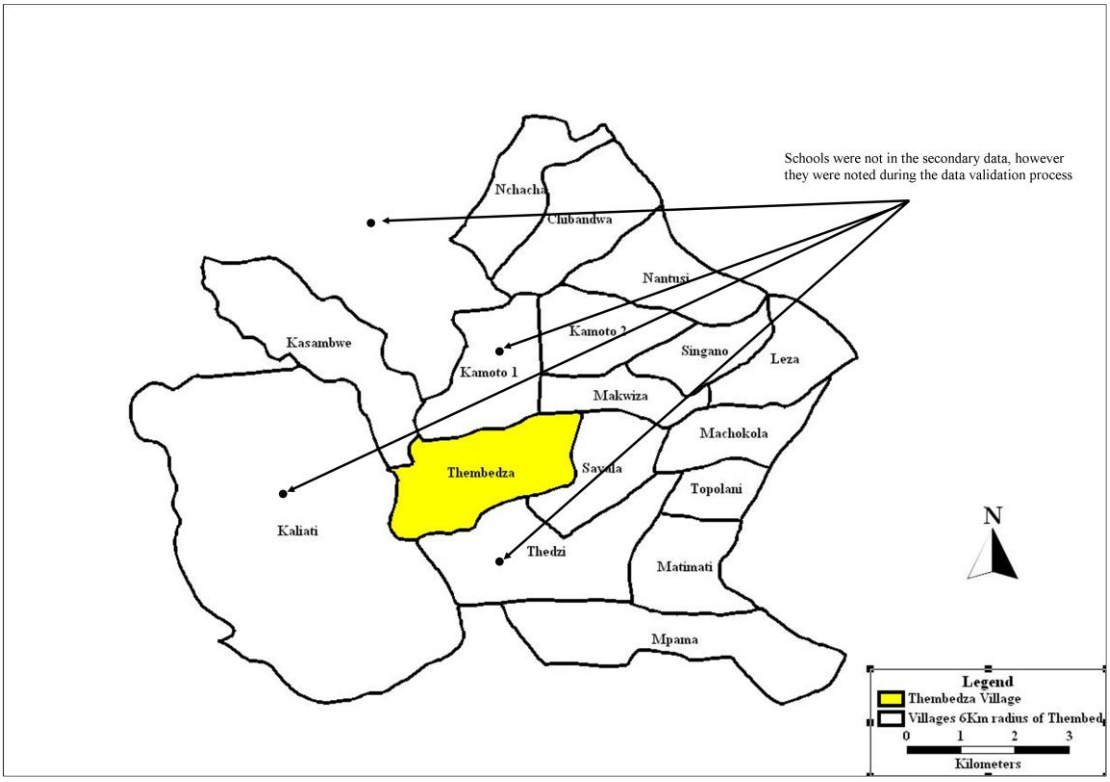
Facilities within Tembenao village from secondary data information



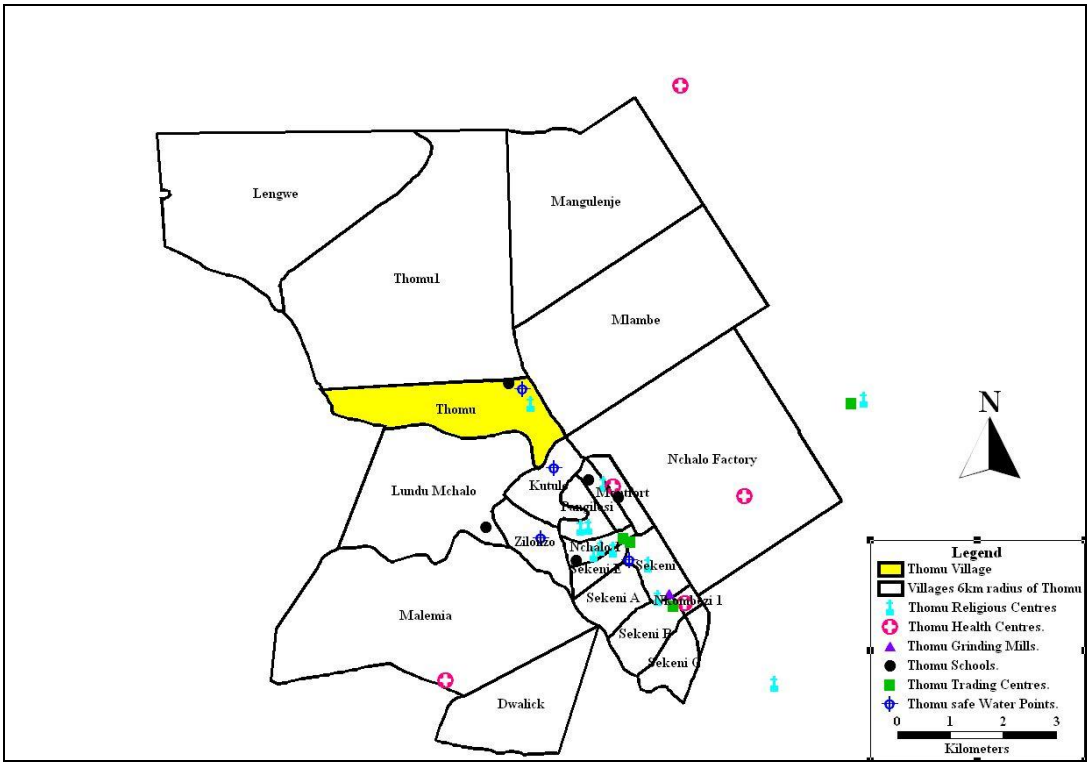
Facilities within Tembenao village after the validation process



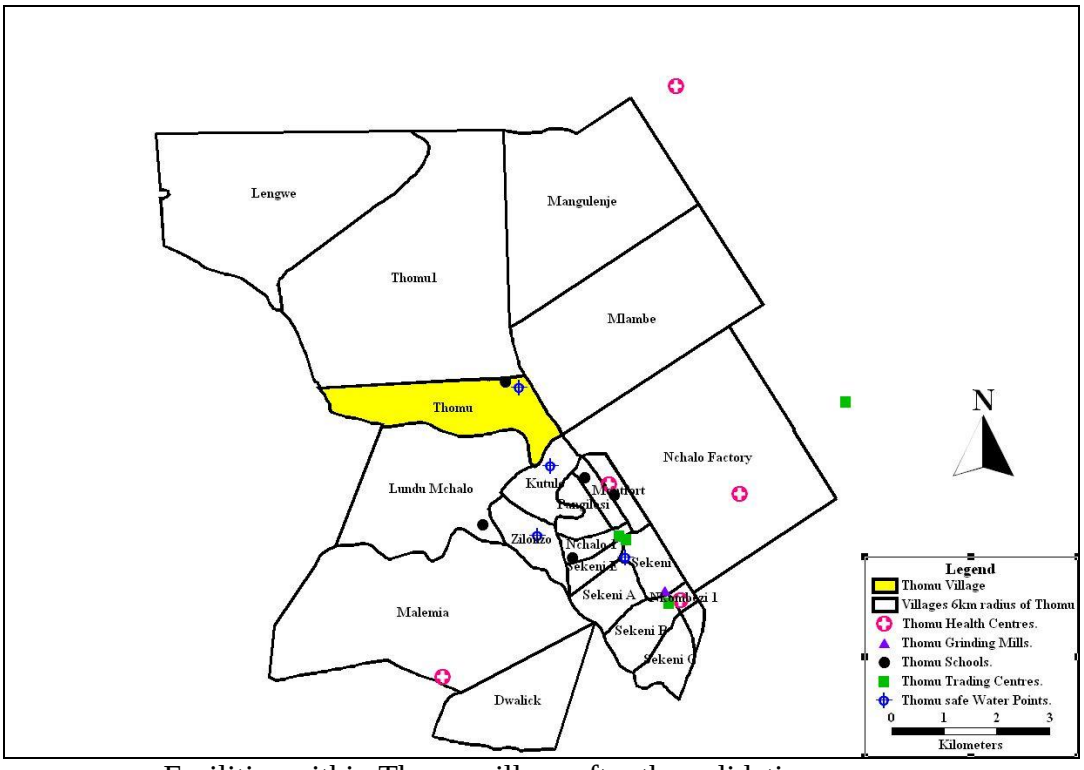
Facilities within Tembenao village from secondary data information



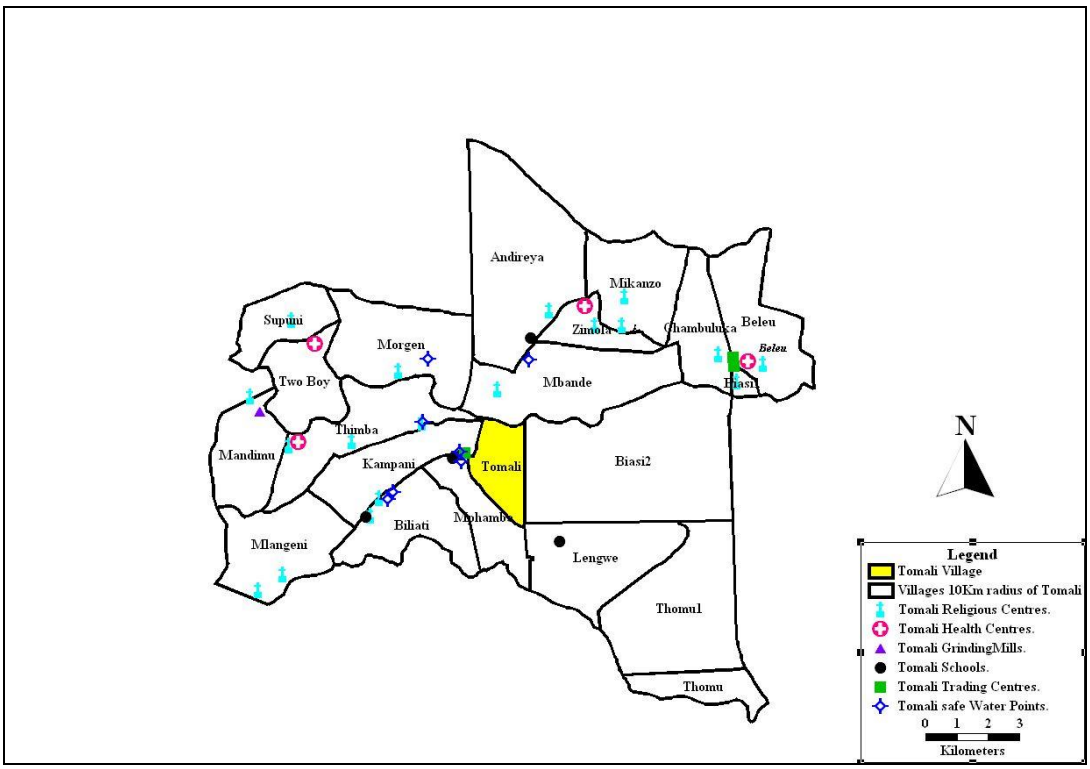
Facilities within Thembedza village after the validation process



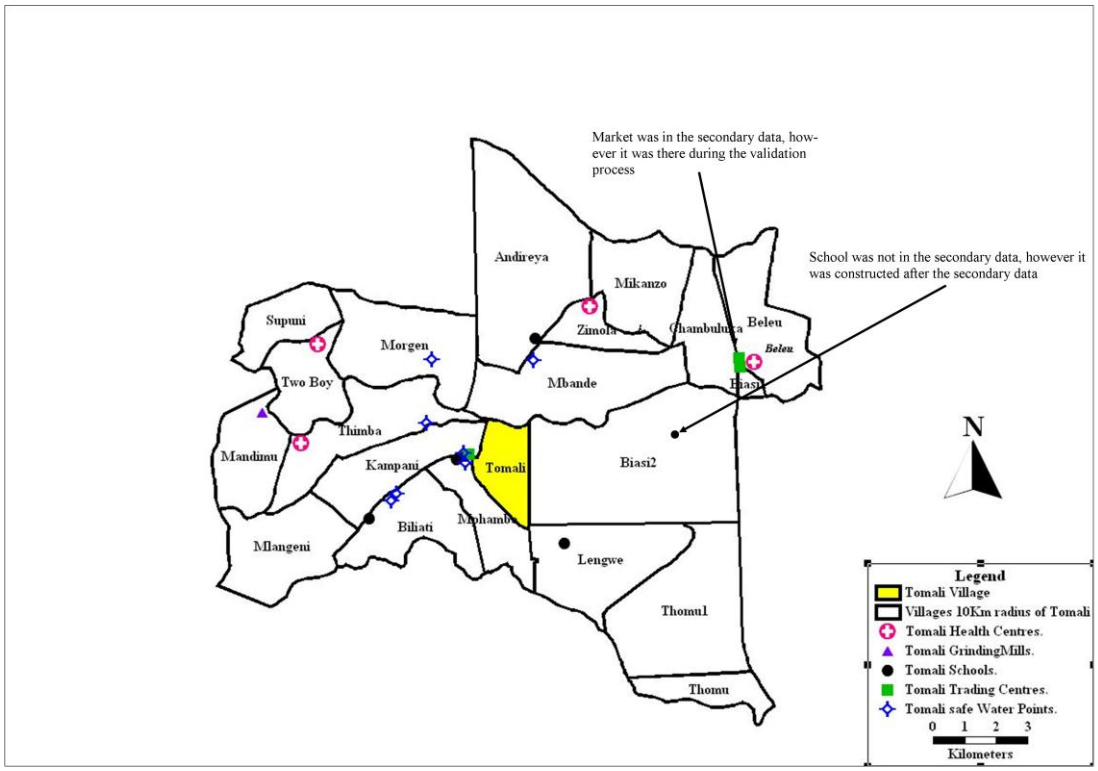
Facilities within Thomu village from secondary data information



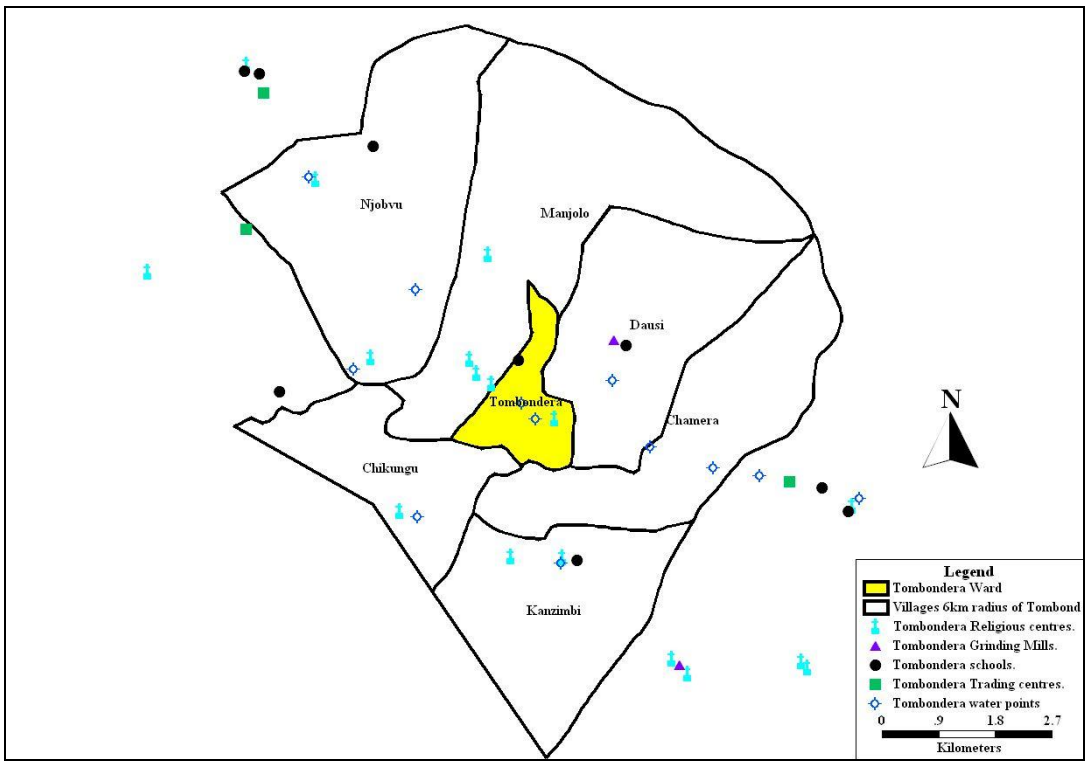
Facilities within Thomu village after the validation process



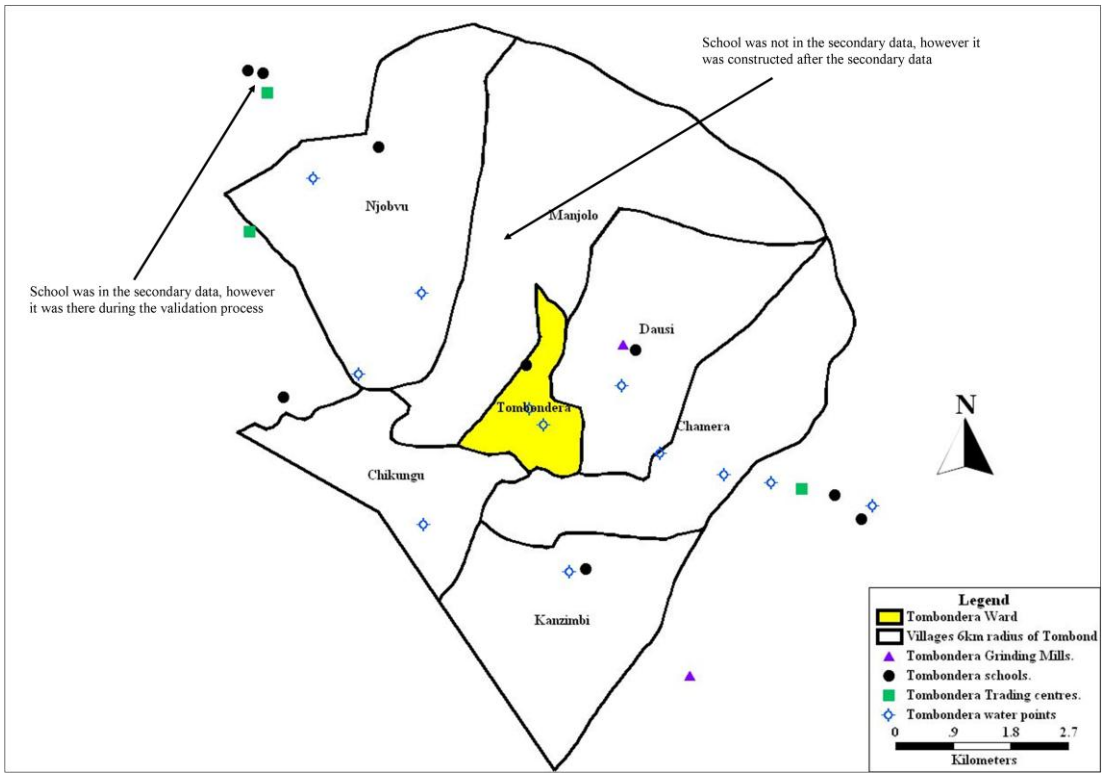
Facilities within Tomali village from secondary data information



Facilities within Tomali village after the validation process



Facilities within Tombondera village from secondary data information



Facilities within Tombondera village after the validation process

Appendix C: Distances to the nearest facility type

Code	Village Name	To Primary School	To Secondary School	To Water Supply Point	To Health care Facility	To Trading Centre	To Grinding Mill	To Religious Facility
1	A. Company	2.37		4.67	5.3	6.01	4.92	6.10
2	Andireya	4.11		1.64	3.21	4.25	5.49	4.39
3	Baptoni	3.59		2.64	10.11	14.60	6.86	5.10
4	Basiyawo	1.9		4.81	6.29	4.77	4.04	4.71
5	Bauti	4.04		2.96	8.14	10.62	3.54	0.39
6	Beka	3.78		4.02	12.45	18.89	11.15	9.39
7	Beleu	1.2	2.1	5.61	2.51	11.02	1.21	4.38
8	Biasi1	1.21		3.91	0.98	12.74	2.34	5.51
9	Biasi2	5.43		7.26	6.85	5.71	5.83	8.26
10	Bile	4.3		1.1	5.36	11.21	9.01	8.72
11	Biliati	4.73	7.12	7.81	9.48	14.29	3.07	4.77
12	Binya	0.89		3.22	4.41	9.72	5.18	1.26
13	Bisimoni	1.94		8.64	14.25	8.02	8.13	7.42
14	Bodza	12.55		5.41	5.54	5.37	10.99	4.21
15	Bodza 1	2.6		19.26	16.22	8.75	6.08	2.33
16	Bodza 2	0.9		22.34	14.13	5.97	2.85	2.78
17	Bonongwe	3.5		5.92	9.16	5.09	2.49	0.46
18	Bulasha	9.6		7.89	13.45	7.76	3.90	4.20
19	Bulaundi	5.02		5.62	4.53	7.87	4.01	4.31
20	Bulayitoni	1.29		1.67	3.75	2.36	6.18	1.14
21	Butiza	5.11		3.93	8.13	3.51	9.13	2.34
22	Bvumbwe	0.81		2.72	2.1	9.66	3.86	10.27
23	Cattle Ranch	5.61		1.65	7.73	13.26	10.93	5.54
24	Chabuka	4.07		9.91	9.8	9.96	1.19	0.84
25	Chabvala	0.87		5.29	1.57	6.16	5.34	4.99
26	Chadula	2.92		0.44	6.77	6.54	6.22	3.59
27	Chadzuka	2.46		2.82	6.44	2.59	2.70	5.14
28	Chagambatuka	1.5		8.47	8.49	1.17	1.28	4.20
29	Chakumanika	2.54		2.71	8.25	2.21	2.32	5.24
30	Chamboko	0.83		0.5	4.3	9.71	9.06	7.03
31	Chambuluka	1.54		5.63	2.63	8.88	8.15	8.82
32	Chamera	3.31		2.18	3.93	4.93	5.80	5.67
33	Chang’ambika	2.88		3.54	2.24	5.95	5.29	2.34
34	Chang'ambika2	4.23		2.48	4.83	1.36	2.21	1.00
35	Chapasuka	7.17		6.77	6.53	3.58	3.06	2.54
36	Chaphata	9.13		9.72	8.64	7.23	1.80	2.27
37	Chapomoka	2.19		1.69	9.26	10.45	4.28	5.60
38	Chapudzika	2.82		6.12	10.46	10.02	3.06	6.23
39	Chatenga	3.78		2.7	4.28	7.17	1.63	3.18
40	Chibandwa	4		15.05	6.93	6.40	3.45	5.23
41	Chideu	1.1		1.32	6.31	7.46	4.50	4.21
42	Chikadza	2.5		10.48	7.8	4.96	0.89	2.45
43	Chikungu	3.64		2.07	6.36	2.53	0.97	1.20
44	Chikuse	0.74		6.36	8.5	5.05	5.16	8.07

45	Chimphambana	2.53		1.66	2.4	22.71	19.98	20.28
46	Chimphepo	2.19		2.63	3.1	14.41	10.35	11.91
47	Chinangwa 2	4.57		5.1	10.6	9.04	4.98	6.54
48	Chindoko	5.37	8.4	5.94	11.13	10.09	10.12	10.45
49	Chinkodzo	3.49		7.73	11.62	15.78	13.50	5.91
50	Chinkole	1.47		2.18	2.6	12.00	10.49	6.59
51	Chiphale	3.68		7.01	11.14	14.85	12.57	4.98
52	Chiphuphu	4.16		5.93	8.63	11.64	9.36	0.78
53	Chipondeni	2.17		2.47	3.34	11.30	10.31	2.70
54	Chipula	1.88		1.44	2.2	7.46	5.18	3.13
55	Chipwepwete	1.78	6.9	6.77	7.23	11.45	5.16	3.78
56	Chiromo	2.8		6.54	6.57	3.78	11.46	7.77
57	Chisanu	2.6		18.54	12.57	4.11	16.11	2.69
58	Chithumba	1.34		5.07	1.38	6.06	13.88	4.85
59	Chitsa	12.87		18.72	19.18	2.08	16.30	2.16
60	Chitsulo	2.64		5.99	7.15	2.59	12.97	1.38
61	Chitungwani	2.65		2.79	5.36	7.19	15.92	3.06
62	Chiwaya	2.2		7.56	2.95	10.47	13.45	8.50
63	Chokankunene	2.04		2.29	2.54	5.69	6.38	5.18
64	Chufuwi	2.49		4.64	10.96	4.02	5.45	4.66
65	CK - D.C.'s Lines	1.46		0.92	1.5	1.2	0.9	0.85
66	Chikwawa Boma	1.43	0.97	0.48	1.33	0.78	1.47	0.51
67	CK - Mbenderana 2	1.22		0.78	1.54	0.92	1.88	0.90
68	CK - Mbenderana 3	0.81		0.83	2.66	1	1.3	1.25
69	CK - PMF Lines	1.08		2.64	2.49	1.6	2.1	1.60
70	CK - Police	1.35		2.05	1.41	0.66	0.93	1.10
71	Dagalasi	3.6		3.67	10.05	10.34	7.67	3.87
72	Dausi	3.11		3.8	5.86	7.90	4.99	0.87
73	Dwalick	2.5		2.04	3.29	4.72	2.43	1.99
74	Dwanya	1.7		17.56	7.58	4.69	4.67	3.00
75	Dzimphonje	0.35		6.77	1.55	2.13	2.11	1.99
76	Dziwazina	3.36		2.07	4.99	1.89	7.45	1.16
77	Finiasi	3.21		9.78	12.86	5.69	7.99	5.21
78	Finishi 1	6.01		6.92	8.68	3.92	3.84	1.77
79	Finishi 2	5.08		5.99	7.75	3.18	3.04	3.08
80	Gachitali	4.16		6.76	3.66	2.42	2.50	3.44
81	Ganyu	3.4		16.99	4.2	1.87	1.96	2.90
82	Goma	1.54		0.85	8.46	1.43	1.36	1.68
83	Gonda	5.46		2.1	9.49	12.63	10.48	2.75
84	Gusutu	4.56		4.99	7.4	14.28	12.71	2.68
85	Guta	5.52	11.61	6.66	6.44	12.58	11.91	3.18
86	Impregilo Camp	3.9		7.8	14.89	8.45	7.26	4.05
87	Jackson	2.27		2.09	7.1	10.96	7.64	3.27
88	Jacob	3.17		1.85	10.7	10.30	7.61	3.09
89	Jai Chaphata	4.73		7.15	5.55	6.97	5.70	1.53
90	Jambo	1.05		1.32	6.66	3.05	1.36	2.87
91	January	2.47		3.24	4.93	5.27	1.24	1.91
92	Jasi	4.21		4.45	8.65	5.85	1.24	2.12
93	Jemuse	8.38		6.6	8.51	1.66	2.15	3.58
94	John	6.56		10.06	14.51	7.03	7.52	5.35
95	John Beke	3.64		3.37	8.11	5.15	5.64	4.41
96	Jomba	2.56	6.8	1.74	7.17	5.03	4.31	3.99

97	Jonasi	6.26		8.18	5.4	5.01	8.40	3.97
98	Kabwatika	1.87		1.52	6.75	10.89	13.22	9.66
99	Kachibade1	1.92		1.47	5.9	2.30	6.58	1.26
100	Kachibade2	4.14		4.4	3.66	2.75	5.42	1.71
101	Kachikila	3.14		1.68	2.72	1.49	4.92	1.06
102	Kachingwe	2.56		7.9	4.29	21.72	21.40	2.15
103	Kadzumba	2.36		1.29	7.14	13.84	16.83	3.61
104	Kaitano	4.22		2.97	4.56	14.20	17.20	4.63
105	Kajawo	2.17		5.82	7.13	14.50	14.18	5.78
106	Kalaundi	2.5		21.37	12.4	8.22	6.03	3.20
107	Kaliati	2.6		19.87	18.75	8.00	8.61	2.25
108	Kaliza	0.45		0.68	1.96	8.53	11.53	0.07
109	Kalua	5.83		3.62	11.2	10.13	12.34	1.30
110	Kalulu 1	0.89		5.23	2.62	6.69	9.68	1.02
111	Kalulu 2	2.3		7.02	4.78	4.96	9.76	3.26
112	Kalulu Company	1.15		6.01	3.54	3.34	8.15	1.66
113	Kalusa	3.55		5	3.26	10.62	10.56	4.43
114	Kamoto 1	2.3		15.5	14.38	9.15	8.83	0.83
115	Kamoto 2	1.9		12.5	13.2	4.60	8.60	1.83
116	Kampani	2.15		2.37	7.78	5.35	5.29	0.67
117	Kandeu	2.28	9.2	16.21	23.3	7.09	6.77	2.14
118	Kandiye	3.94		2.81	16.71	4.12	6.07	0.98
119	Kanthema	3.43		2.63	8.28	5.39	5.07	3.45
120	Kanzimbi	2.92		3.26	6.54	4.27	3.95	2.33
121	Kapasule	5.31		5.19	3.58	2.62	2.30	1.12
122	Kapota 1	5.56		6.43	13.8	2.05	1.73	1.76
123	Kapota 2	6.65		7.52	12.2	4.29	3.97	1.83
124	Kaputeni	0.4		1.1	1.98	4.10	4.14	2.73
125	Kasambwe	18.67		19.53	18.41	4.69	1.62	2.04
126	Katemalinga	1.4		2.9	6.02	0.90	0.88	0.77
127	Katomba	3.11		2.62	1.53	1.76	1.92	1.27
128	Kavalo	3.2		13.86	13.88	1.90	1.76	1.67
129	Kholomani	4.2		4.64	10.49	2.22	1.66	1.41
130	Kholongo	1.84		1.37	3.16	1.14	1.78	1.46
131	Khongodzo	1.14		1.27	8.57	1.58	1.57	0.83
132	Khonkhwa	3.46		2.62	3.74	0.44	1.04	0.78
133	Khumbulani	4.31		4.22	2.62	6.10	5.18	5.37
134	Khundu	5.6		4.48	6.15	4.01	3.09	3.51
135	Khungubwe	1.42		2.9	4.21	2.03	1.47	1.64
136	Konzera 1	5.53		5.93	5.24	3.06	2.51	2.67
137	Konzere 2	0.9		0.67	4.19	1.58	2.02	2.10
138	Kudziwa	0.99		1.27	6.6	2.49	2.20	2.41
139	Kulima	3.9		3.56	3.24	2.72	3.16	3.24
140	Kusala	2.21		1.87	3.43	1.48	1.40	1.88
141	Kutulo	1.78		0.99	2.52	4.16	4.09	1.58
142	Kuwani	0.76		8.81	1.4	5.94	5.87	3.13
143	Kuwani 2	3.55		0.99	3.59	4.43	4.86	0.65
144	Kwadeka	3.03		0.67	2.94	6.40	6.33	1.30
145	Kwataine	3.3		5.07	5.1	2.02	5.64	2.31
146	Launji	1.61		2.47	4.4	9.94	13.55	6.73
147	Lazalo	2.86		1.85	3.37	8.29	7.37	2.45
148	Lengwe	2.58		7.38	9.26	6.24	5.95	6.16

149	Leza	3.4		11.78	10.66	5.32	5.00	5.03
150	Lombe	2.49		1.3	1.57	7.34	7.28	3.12
151	Lundu	0.64		1.29	6.35	12.38	12.45	5.08
152	Lundu Mchalo	7.6		7.43	10.32	11.51	12.52	1.90
153	Lunkhwe	3.73		2.24	3.38	5.77	4.28	4.64
154	Machokola	5.2	10.1	9.79	8.66	1.72	8.21	3.64
155	Mafumbi	2.7		7.14	7.17	8.62	8.10	6.08
156	Makande	2.21		1.43	1.45	2.76	3.25	2.38
157	Makhula	8.84	11.2	27.31	16.19	3.35	7.40	3.04
158	Makwiza	2.4		11.82	10.7	1.77	4.62	2.24
159	Malemia	7.02		1.57	1.62	2.54	3.56	3.01
160	Malemia 2	3.35		2.57	2.6	2.40	2.45	2.65
161	Malemia 3	3.8		10.07	9.36	0.64	0.69	0.89
162	Malikopo	4.48		5.45	7.73	1.73	6.01	0.85
163	Mandalika	1.32		2.17	5.81	1.19	5.48	0.51
164	Mandele	0.81		1.07	0.48	1.13	4.48	0.63
165	Mandimu	1.7		1.98	3.23	2.81	3.05	1.57
166	Mangazi	2.78		1.24	2.8	0.78	3.82	1.25
167	Mangulenje	3.6		4.91	3.65	2.18	2.26	2.46
168	Manjolo	3		3.69	5.75	6.61	6.66	3.45
169	Matimati	6.3	8.77	7.17	6.04	3.30	13.35	2.74
170	Mbande	4.67		5.65	5.42	3.62	6.30	4.28
171	Mbuyawo	4.18		3.73	5.2	15.59	13.60	7.39
172	Mbwanda	3.02		0.54	5.57	7.63	7.68	5.15
173	McDe	6.5		20.8	12.83	9.62	9.67	7.14
174	Mchacha	2.26		0.67	1.97	18.79	26.17	20.23
175	Mchingula	4.52		4.5	4.1	18.45	25.84	19.90
176	Mchipeta	3.4		16.09	8.12	10.27	9.95	4.69
177	Medremu	1.36	3.41	2.47	7.45	11.76	11.44	7.66
178	Mfiti	2.97		5.88	4.34	10.43	10.11	8.09
179	Mganadi	3.88		8.12	3.35	22.22	21.90	15.27
180	Mgujura	3.04		3.62	9.95	5.11	13.57	6.55
181	Mikanzo	2.72		1.07	2.97	15.88	23.26	17.32
182	Misili	3.5		4.44	6.76	14.41	21.80	15.86
183	Misongwe	1.06		0.7	0.74	13.19	20.58	14.64
184	Mkanyoza	3.79		3.44	5.63	11.26	18.64	12.70
185	Mlambe	4.62		5.44	4.63	5.89	13.28	7.34
186	Mlangeni	3.72		2.41	4.53	6.08	13.47	7.53
187	Modzi	2.6		12.18	12.21	7.23	14.62	8.68
188	Mondrade	1.84		2.21	5.82	10.74	18.12	12.19
189	Montfort	0.39		2.3	0.54	11.41	18.80	12.86
190	Morgen	5.24		0.9	5.32	9.87	17.26	11.32
191	Mosezi	0.98		1.78	5.94	4.10	15.81	3.67
192	Mpama	2.4		6.98	5.86	4.58	12.51	6.02
193	Mpangeni	2.9		2.79	5.45	0.80	11.89	2.24
194	Mpangowalimba	2.5		23.68	18.71	9.39	16.78	10.84
195	Mphamba	3.28		3.96	9.25	6.44	8.36	7.88
196	Mphonde	2.7	2.7	1.26	17.15	8.70	16.09	10.15
197	Mphonde 1	1.23		0.92	3.71	10.70	18.08	12.14
198	Mphonde 2	1.49		2.79	5.06	5.34	8.41	6.79
199	Mphuka	0.58		3.08	5.88	6.68	1.94	4.18
200	Mpinganjira	1.54		1.25	6.83	6.75	0.79	4.25

201	Mpingasa	2.3		22.86	17.74	6.12	1.20	1.17
202	Mpobvu	4.95		5.38	8.18	10.50	5.58	2.04
203	Mponya	2.36		2.65	11.48	11.04	6.12	2.58
204	Mponya 2	1.93		2.6	6.11	2.42	8.23	3.21
205	Msomo	1.09		1.27	8.78	4.36	7.76	2.23
206	Mtalika	1.81	8.87	0.82	5.46	4.03	5.16	1.73
210	Mtambo	6.08		20.31	11.41	12.14	4.04	2.30
211	Mtemela	4.74		10.07	13.96	10.10	4.26	3.89
212	Muonda	5.65		4.57	5.98	9.70	2.16	2.68
213	Muyaya	4.26		4.6	6.75	12.21	4.11	1.41
214	Mwalija	5.87	7.26	6.22	11.38	10.14	9.22	2.77
215	Mwanakakula	3.56		2.01	8.38	2.80	5.62	4.00
216	Mwanayaya	5.98	9.67	17.04	2.6	2.55	6.78	3.75
217	Mwanza1	1.5		7.54	1.55	3.66	8.52	2.93
218	Mwanza2	2.61		9.21	2.66	11.19	8.76	6.86
219	Mwita	1.66		1.69	4.86	10.26	10.96	2.26
220	Mwiza 1	6.02		18.1	15.06	7.00	14.80	6.53
221	Mwiza 2	1.3		15.04	7.39	3.15	10.95	5.06
222	Namachuwa	1.91		7.83	21	2.93	9.41	2.99
223	Namanya	1.8				4.22	4.86	2.85
224	Namanya 1	4.32		3.31	4.07	6.83	8.50	1.34
225	Namila	1.9	4.3	1.58	9.08	3.23	11.03	5.14
224	Nantusi	1.4		12.53	7.2	7.47	12.95	8.44
225	Nchacha	32		15.07	8.9	8.26	10.34	5.84
226	Nchalo 1	1.74		1.56	3.12	7.51	9.84	6.28
227	Nchalo 2	0.55		1.54	1.58	4.77	7.98	2.98
228	Nchalo Factory	2.31		4.22	1.3	6.34	9.58	5.70
229	Nchembere	3.35		5.19	4.8	6.17	5.75	1.69
230	Nchiza	4.85		5.22	5.31	4.31	3.39	1.84
231	Ndakhalira	2.98		0.85	1.9	2.12	5.38	1.50
232	Ndakwera	4.48		2.88	3.5	0.77	7.06	1.06
233	Ndirande	2.06	7.7	7.9	4.74	2.66	6.82	3.17
234	Ndirande 2	1.85		6.49	4.24	10.26	10.96	1.12
235	Ndombo	1.8		6.19	5.07	8.17	7.93	3.56
236	New Farm	3.27		6.88	4.88	7.83	8.53	2.83
237	N'gabu	3.4		6.69	4.2	9.16	9.47	5.88
238	Ngabu - Sec. School	1.41		0.67	1.45	10.68	9.86	9.65
239	Ngabu	0.89	0.5	1.14	0.48	1.75	0.88	1.90
240	Ngalu	2.61	1.4	1.83	1.96	1.72	1.67	1.27
241	Ngowo	2.21		6.63	0.61	1.55	2.74	1.01
242	Njereza	1.4		3.26	10.35	1.12	1.74	1.73
243	Njiza	3.2		1.14	2.8	1.09	0.60	1.32
244	Njobvu	1.56		1.17	3.14	0.46	1.08	1.07
245	Njobvuyalema	2.95		4.87	7.31	0.64	0.66	0.48
246	Nkhalambe	4.23		4.57	7.25	1.96	0.85	0.98
247	Nkhata	9.61		10.48	9.35	4.24	3.59	2.44
248	Nkhutche	2.95	3.3	6.38	6.44	3.51	9.05	2.79
249	Nkhwangwa	5.59		1.05	5.59	0.62	2.20	1.94
250	Nkhwangwa 1	1.56		7.43	7.05	5.12	4.69	2.69
251	Nkhwazi	3.54		3.97	6.38	5.36	3.44	5.61
252	Nkombezi 1	2.71		0.91	0.41	4.40	2.48	4.65
253	Nkombezi 2	3.6		1.02	1.98	1.53	0.77	1.84

254	Nkwana	1.9		15.31	1.42	2.19	5.22	1.84
255	Nsangaya	9.63		5.72	5.86	2.80	5.32	1.60
256	Nsangwe	1.73		2.15	8.51	4.51	7.03	0.54
257	Nsanje	2.01		2.71	3.36	6.24	9.22	1.65
258	Nsiyamphanje	1.19		4.5	11.63	2.06	3.21	2.37
259	Ntapanduwa	1.59		5.5	7.96	3.08	7.30	2.18
260	Ntembeta	6.26		5.31	8.1	0.45	1.74	0.76
261	Nthenda	4.79		5.66	4.54	1.08	5.30	3.58
262	Nthobwa	3.36		1.78	4.35	6.35	9.33	1.75
263	Ntondeza	1.87	4.8	4.03	5.89	9.65	8.84	8.63
264	Ntwana	3.39		1.35	5.06	14.19	13.37	13.16
265	Nyambilo	3.47		2.36	6.7	14.45	16.96	7.42
266	Nyamizinga	3.84		2.19	7.42	22.60	21.78	21.58
267	Nyangu	3.91		5.43	5.63	8.23	10.74	5.03
268	Nyangu 2	2.1		1.88	0.76	15.11	9.84	9.70
269	Nyasa	2.97		3.43	6.7	23.30	15.01	13.73
270	Nyaulombo	13.2		20.6	4.9	22.67	14.59	12.34
271	Nyayekha	3.37		1.85	4.93	5.92	7.49	3.20
272	Nyozolera	4.17		1.47	8.77	3.49	4.24	3.20
273	Paiva	4.09		3.89	9.32	7.43	9.83	5.36
274	Paiva 1	2.71		5.84	6.38	6.24	11.97	5.94
275	Paiva 2	3.64		2.1	8.33	7.35	13.62	7.05
276	Pangilesi	0.98		1.9	2	1.61	5.03	2.27
277	Patalowa	4.09		5.6	8.09	1.87	5.81	2.41
278	Phanda	1.42		1.14	4.97	2.62	8.92	2.32
279	Phazi	3.66		1.66	7.21	2.29	6.29	1.99
280	Razo	2.4		0.74	5.78	1.65	6.83	1.35
281	Sabuneti	3.49		7.07	3.24	1.41	7.71	1.11
282	Sala Beni	4.67		5.19	5.16	6.37	12.67	6.07
283	Salumeje	1.67	1.78	3.01	1.6	4.69	7.98	4.97
284	Sande	0.76		1.02	1.65	7.21	13.50	7.72
285	Sanjaka	2.2		2.59	2.5	5.34	11.62	5.85
286	Saopa	3.02		2.26	4.53	9.67	15.97	9.38
287	Sathu	4.84		1.45	8.27	15.67	13.74	9.93
288	Savala	0.9		12.34	11.22	12.28	10.36	8.61
289	Sekeni	2.2	9.4	0.84	3.24	3.42	15.72	3.12
290	Sekeni A	3.19		1.83	4.22	5.98	9.46	5.68
291	Sekeni B	3.97		2.32	3.28	23.18	21.25	11.95
292	Sekeni C	4.1		1.03	2.17	26.23	29.02	1.02
293	Sekeni E	2.08		1.9	3.65	24.05	23.56	6.44
294	Sezu	7.89		4.89	8.62	23.13	21.52	8.18
295	Singano	1.6		10.96	9.83	18.85	16.92	10.11
296	Siseo	3.48		5.58	3.11	19.36	17.44	8.88
297	Siyali	1.68		2.33	4.8	16.84	14.92	7.97
298	Supuni	3.36		1.43	3.45	13.98	12.06	7.60
299	Ntchabela	1.5	1.9	1.47	2	2.10	7.10	0.90
300	Tembenao	2.6	7.31	2.63	3.68	17.89	15.97	6.93
301	Thawani	1.8		14.26	6.29	19.91	17.98	6.25
302	Thayo	2.91		2.14	5.15	16.07	14.14	7.33
303	Thedzi	0.7		14.28	13.15	6.25	5.82	3.82
304	Thembedza	6.6	11.1	16.96	15.84	4.59	12.66	1.58
305	Theta	1.82		0.69	5.37	6.87	4.95	3.40

306	Thimba	3.58		3.67	3.23	10.27	8.35	6.79
307	Thomu	4.24	9.43	4.05	6.94	8.95	7.03	4.45
308	Thomu1	4.18		4.79	7.12	8.34	6.42	4.87
309	Thomu2	3.2		7.38	4.3	3.58	5.60	3.89
310	Thudzi	1.24		2.15	2.54	4.97	7.00	3.28
311	Tomali	3.35	4.2	4.04	9.33	4.10	16.21	5.65
312	Tombondera	0.83	5.6	0.65	1.1	17.11	15.19	2.07
313	Tonkhwe	4.83		4.24	11.91	14.62	22.00	14.66
314	Topolani	4.5		8.31	7.19	19.51	26.90	12.88
315	Two Boy	1.07		2.37	1.6	21.78	24.57	4.77
316	Ubale	6.74		7.16	12.68	21.25	24.05	6.49
317	Vega	2.02		1.97	5.31	18.17	23.30	8.80
318	Waya Nkhazi	2.26		2.88	3.2	13.97	21.35	14.01
319	Wilson 1	6.56		6.99	8.49	11.45	18.83	12.89
320	Wilson 2	5.79		9.66	9.39	15.91	23.30	10.37
321	Zilonzo	1.49		1.31	3.12	21.27	20.26	6.30
322	Zimola	2.12		1.09	1.2	21.79	20.69	6.72
323	Zimphutsi	1.48		2.78	2.81	7.42	6.13	5.69
324	Zin'gando	1.8		21.64	11.67	5.17	3.88	3.45
325	Zosuma	4.79		3.49	3.83	6.72	7.24	2.33
326	Zuze	6.96		4.19	9.49	9.22	11.66	1.52

Appendix D: Distances to the nearest motorable road

Study Village	Distance (Kms)
Beleu	0.4
Biliati	5.6
Chikwawa Township	0.2
Chindoko	5.5
Chipwepwete	4.2
Guta	2.3
Jomba	3.3
Kandeu	5.7
Machokola	6.1
Makhula	8.2
Matimati	8.6
Medremu	1.6
Mphonde	1.4
Mtalika	2.6
Mwalija	1.8
Mwanayaya	9.4
Namila	1.9
Ndirande	0.7
Ngabu	0.1
Ngalu	1.7
Nkhutche	4.7
Tchabela	2.2
Ntondeza	1.6
Salumeje	1.3
Sekeni	11.4
Tembenao	2.2
Thembedza	3.1
Thomu	2.3
Tomali	1.4
Tombondera	6.7

Appendix E: Dimensions of access deprivation

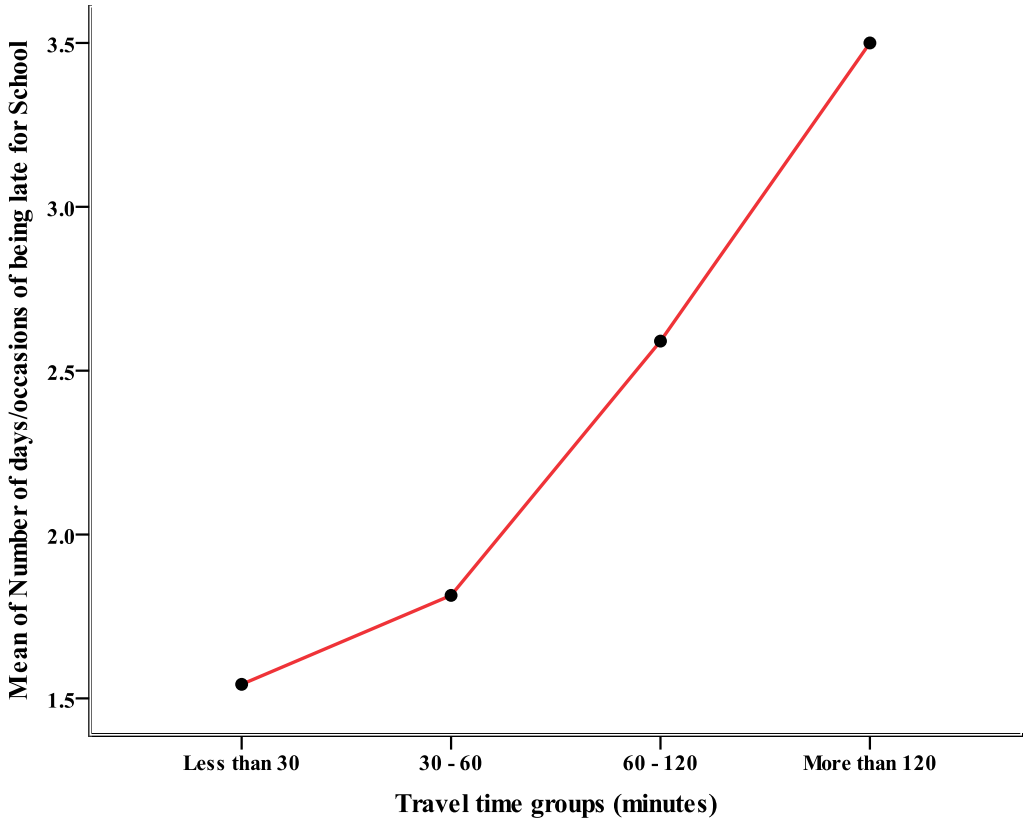
Study Village	k	l
Beleu	0	0
Biliati	5	1
Chikwawa Township	0	0
Chindoko	5	1
Chipwepwete	5	1
Guta	3	1
Jomba	3	1
Kandeu	4	2
Machokola	7	2
Makhula	7	2
Matimati	7	2
Medremu	1	0
Mphonde	1	1
Mtalika	2	1
Mwalija	2	2
Mwanayaya	6	2
Namila	3	1
Ndirande	3	0
Ngabu	0	0
Ngalu	1	0
Nkhutche	2	2
Tchabela	2	0
Ntondeza	2	1
Salumeje	2	0
Sekeni	6	1
Tembenao	2	1
Thembedza	6	2
Thomu	6	2
Tomali	3	1
Tombondera	6	1

Appendix F: Statistical school outcome outputs

Age group (Years)		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
6 - 15	16 - 20	-.525*	.117	.000	-.80	-.25
	21 - 35	-.900*	.211	.000	-1.40	-.40
16 - 20	6 - 15	.525*	.117	.000	.25	.80
	21 - 35	-.375	.218	.199	-.89	.14
21 - 35	6 - 15	.900*	.211	.000	.40	1.40
	16 - 20	.375	.218	.199	-.14	.89

**Indicates the two groups are significantly different from one another at the p < 0.05 level*

Multiple comparisons of age groups on levels of being late for school

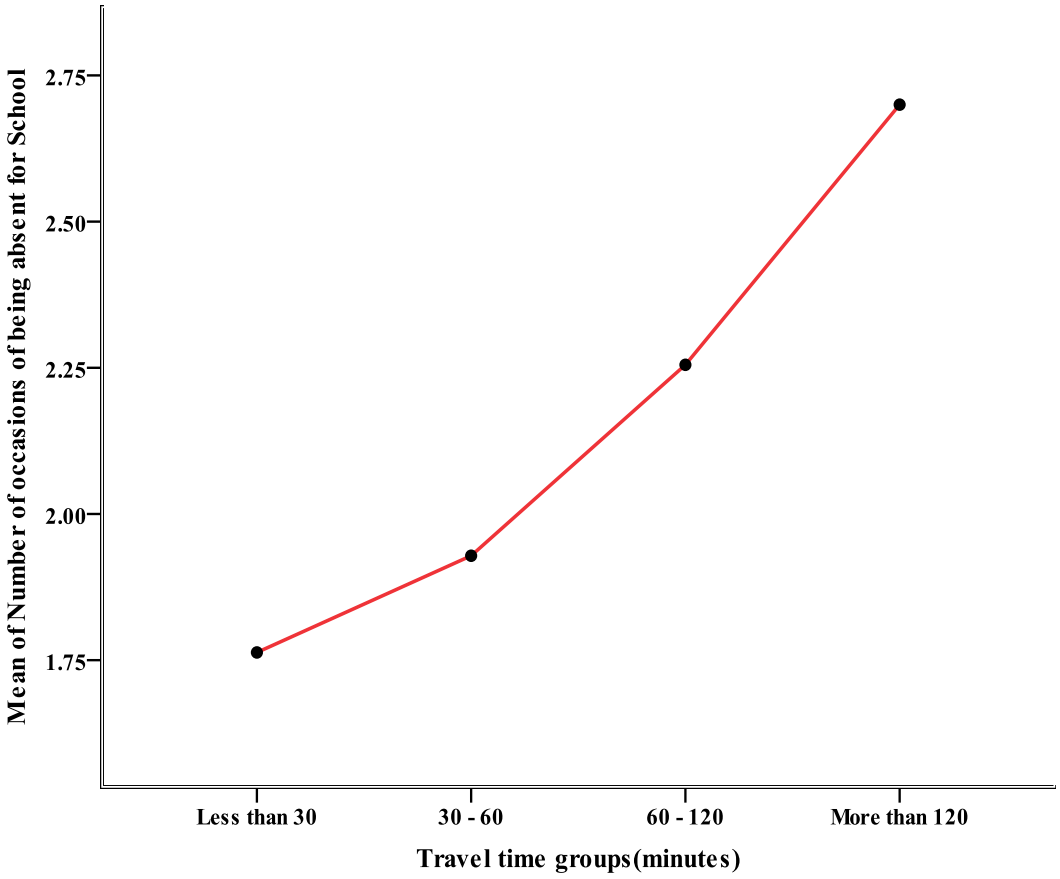


Mean scores for levels of being late for different time groups

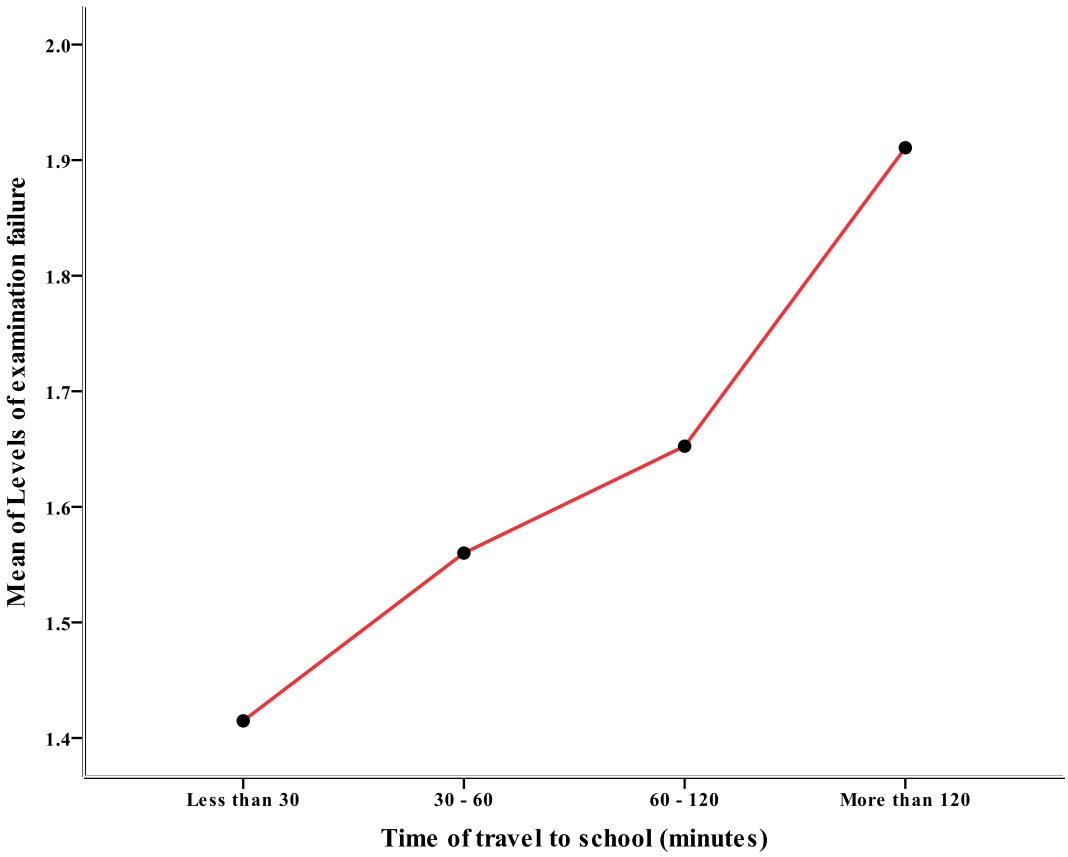
Age group (Years)		Mean Difference	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
6 - 15	16 - 20	-.279*	.108	.028	-.53	-.02
	21 - 35	-.770*	.234	.003	-1.32	-.22
16 - 20	6 - 15	.279*	.108	.028	.02	.53
	21 - 35	-.491	.238	.100	-1.05	.07
21 - 35	6 - 15	.770*	.234	.003	.22	1.32
	16 - 20	.491	.238	.100	-.07	1.05

**Indicates the two groups are significantly different from one another at the p < 0.05 level*

Multiple comparisons of age groups on levels of absenteeism for school



Mean scores for levels of absenteeism for different time groups



Mean scores for levels of examination failures for different time groups

Coefficients: a, b

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	Sex	.451	.069	.286	6.518	.000	.315	.587	.866	.315	.129	.203	4.930
	Distances to School	.457	.068	.439	6.703	.000	.323	.591	.902	.323	.133	.091	10.961
	School Type	.377	.154	.221	2.440	.015	.073	.680	.900	.123	.048	.048	20.888
	Age	.011	.106	.007	.108	.914	-.198	.221	.873	.005	.002	.081	12.274
2	Sex	.453	.068	.287	6.656	.000	.319	.586	.866	.321	.131	.210	4.768
	Distances to School	.458	.068	.440	6.743	.000	.324	.591	.902	.324	.133	.092	10.888
	School Type	.387	.123	.226	3.131	.002	.144	.629	.900	.157	.062	.075	13.397

Coefficients a, b

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	Sex	.327	.067	.207	4.850	.000	.194	.459	.866	.240	.090	.189	5.278
	Distances to School	-.035	.094	-.034	-.375	.708	-.219	.149	.902	-.019	-.007	.043	23.426
	School Type	.077	.151	.045	.511	.610	-.220	.374	.900	.026	.009	.044	22.605
	Age	.026	.100	.017	.257	.797	-.171	.222	.873	.013	.005	.081	12.279
	Time to school	.692	.096	.716	7.200	.000	.503	.881	.925	.345	.134	.035	28.610
2	Sex	.330	.066	.209	4.984	.000	.200	.460	.866	.246	.093	.196	5.107
	Distances to School	-.033	.093	-.032	-.358	.721	-.217	.150	.902	-.018	-.007	.043	23.311

	School Type	.100	.123	.058	.812	.417	-.142	.341	.900	.041	.015	.067	14.974
	Time to school	.692	.096	.716	7.205	.000	.503	.881	.925	.344	.134	.035	28.599
3	Sex	.333	.066	.211	5.071	.000	.204	.462	.866	.250	.094	.199	5.032
	School Type	.087	.118	.051	.742	.459	-.144	.318	.900	.038	.014	.073	13.772
	Time to school	.667	.066	.690	10.172	.000	.538	.796	.925	.459	.189	.075	13.358
4	Sex	.347	.063	.220	5.554	.000	.224	.470	.866	.271	.103	.218	4.577
	Time to school	.706	.038	.730	18.417	.000	.631	.782	.925	.683	.341	.218	4.577

Coefficients a, b

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	Sex	1.365	.040	.866	34.165	.000	1.287	1.444	.866	.866	.866	1.000	1.000
1	Age	1.340	.038	.873	35.239	.000	1.265	1.415	.873	.873	.873	1.000	1.000
1	School Type	1.536	.038	.900	40.718	.000	1.462	1.611	.900	.900	.900	1.000	1.000
1	Distances to School	.939	.023	.902	41.227	.000	.894	.984	.902	.902	.902	1.000	1.000
1	Time to school	.895	.019	.925	48.093	.000	.858	.931	.925	.925	.925	1.000	1.000