



**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

A multi-level statistical modelling approach to multidimensional poverty alleviation in Namibia

By

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the Department of Mathematics and Statistics in the Faculty of Health and Applied Sciences

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DECLARATION

I, Rosalia Kashimbi Mwalundilange hereby declare that the work contained in the thesis entitled A multi-level statistical modelling approach to multidimensional poverty alleviation in Namibia is my own original work and that I have not previously in its entirety or in part submitted it at any university or other higher education institution for the award of a degree.

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- God the Almighty, who makes everything possible in my life.

DEDICATION

To my first born Serene Amour Chiwape Iyalo Simon

ABSTRACT

This thesis examined household demographic factors and how they influence poverty levels in Namibia. While most previous studies have used income and expenditure to define household socio-economic status levels, this study used a three poverty dimension approach namely health, education and living standard. This is because poverty is multidimensional. The data used came from the Namibia Household Income and Expenditure Survey (NHIES) of 2009/10. Initially, the Alkire Foster method was used to select variables for modelling. To identify key determinants of poverty classification, a binary logistic regression was used. In this case, the aim was to determine whether the predictors, age of household head, gender/sex of head of house, household size, household head educational level, physical location of the household (rural or urban), main language spoken in the household and ethnicity/region were associated with poverty. To measure the structural relationship among endogenous and exogenous variables, the study used structural equation modelling (SEM). To understand the relationship between causes of poverty, the study used multilevel structural modelling which is recommended for hierarchical data.

Results show that the variables: gender, education, age, language, household size, region and location are statistically associated with poverty.

The structural equation modelling standardised solutions indicate that location (urban/rural) defines poverty significantly with a load factor of 0.54 and a residue value of 0.70. Religion and age of head of household define poverty significantly with a load factor of 0.30 each and error value of 0.91 for all the two variables. The size of the household influenced poverty significantly with a load factor of 0.22 and an error value of 0.95; while the household's main language and gender of the head of household influenced poverty insignificantly with loads of 0.01 and -0.02 respectively.

Using the multilevel structural equation modelling, the results revealed that within level 1 and level 2 hierarchy, the household head was the most influential factor of poverty.

It can be deduced that the variables do significantly define poverty even though the error values are very high. High error values indicate that all the observed variables were difficult to measure. The latent endogenous variable, health, is influenced by poverty with a load factor of 0.44; while the latent endogenous variable education is influenced by poverty indirectly with a load factor of -0.72.

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CHAPTER 1

1.1. INTRODUCTION AND BACKGROUND TO THE PROBLEM

Given the multidimensionality nature of poverty data, its measurement should include a variety of factors and not that of income only (Perry, 2002). A poverty model can be defined as $F = v_1 + v_2 + v_3 + \dots + \phi + \varepsilon$ where F is poverty itself and v_1, v_2, v_3 , etc. are poverty dimensions. The ϕ represents covariates while ε is the measurement error or residuals. Focusing solely on income, as many studies have done, may miss important aspects of what it means to be poor (Nolan & Whelan, 2005). Poverty measures that are based exclusively on income are limited, given the difficulties in obtaining precise calculations of households' income, largely because of widespread misrepresentation of income by respondents in surveys (Willitts, 2006). The multi-dimensional nature of poverty has been recognised in international poverty studies, for instance, in a descriptive comparative analysis of European poverty, Heikkilä, Moisio, Ritakallio, Bradshaw, Kuivalainen, Hellsten and Kajoja (2006) argued that a measure of poverty based on income, subjective and material deprivations may be a more dependable measure of poverty than just income. However, such complexities require sophisticated methods to elicit meaning in the data.

An application of effective statistical modelling can provide a critical test bed in solving complex phenomena with nested data in poverty. A multilevel structural equation modelling is a combination of multilevel data plus structural equation modelling, which is necessary for valid statistical inference when the units of the observation form a hierarchy of nested clusters (Hox, 1998). Social research or studies are often a concern with problems that investigate the association between individuals and society at large. The general concept is that people interact with social connects to which they belong, and that the properties of these groups are somehow influenced by societal groups to which they belong, meaning that individuals are inclined to the social groups to which they belong and that the properties of the groups are in turn inclined to the individuals who together make that group.

Social groups are conceptualised as a hierarchy of individuals and groups, with persons and groups defined at distinct levels of this system. An individual can be defined as a level 1; this individual belongs to a household, level 2, the household in a community/village, level 3 as the community/village (level 4) in a constituency which belongs to a region (level 5) and so on. Naturally, such systems may be observed at a different hierarchy level, and as a result, they can have variables that define the individuals and variables that define the social groups, and this kind of research is referred to as multilevel research (Hox, 1998).

A multidimensional measure may include a wide range of indicator variables and influence levels to capture the complexity of poverty such as poor living standards, poor health, locality, disempowerment, lack of education, poor quality of work, lack of income and threat from violence (Alkire & Foster, 2011). Other indicators can comprise vulnerability to flooding or typhoons, quality of governance, remoteness, enforcement and property rights. According to Ringen (2011), income is just an indirect measure of poverty: poverty is experienced as the inescapable low consumption that denies people access to a normal way of living (Ringen, 2011). Moreover, Smith (2015) saw stigma and shame as inherent mechanisms of poverty. In another study, Anand and Sen (1997) argued that these are the result of people being unable to understand basic capabilities, as the absolute and universal manifestation of poverty. This view is constant with the priority given by individuals with direct knowledge of poverty. Therefore, it is the multiple aspects of poverty that seem to define a comprehensive experience of poor people.

Poverty may be viewed as a state of deprivation which can be well-defined in two terms, namely relative and absolute terms. However, the fundamental factors that cause poverty affect and relate to people differently in different ways which statistically constitute heterogeneity. For instance, a deprived household in an urban area would be affected in a different way to a poor household in a rural area. Thus it is essential that an appropriate solution to poverty mitigation would capture the nested nature of poverty.

Namibia, with an estimated income per capita of US\$5 693.13, was categorised as an upper-middle income country in 2009 (National Planning Commission, 2015). This comparatively high-income rank does not necessarily reveal the inequalities in income distribution in Namibian's general standard of living and quality of life. The GINI coefficient for Namibia was estimated at 0.5971 (Namibia Household Income and Expenditure Survey, 2009/2010) which infers that there is a very wide gap between the poor and the rich. Youth unemployment stands at 46%, with two regions namely Kunene and Zambezi having the highest levels of youth unemployment (Luqman, 2017). This shows that most Namibians are seriously deprived.

This study investigated the role of multilevel structures in poverty analysis from the Namibia Household Income and Expenditure Survey ((NHIES) 2009/2010). It demonstrated how a multilevel structural equation model can be applied to poverty analysis and highlights its usefulness in terms of assessing the effects of nested data structures on poverty. Just like factor analysis, structural equation modelling (SEM) reduces a huge number of variables to a smaller number of factors. However, the variables are conceptualised as observed manifestations of latent concepts. Each observed variable in a SEM always has an error term associated with it, which allows measurement error to be isolated and controlled in a way that is impossible with factor analysis.

Most importantly, a SEM requires a very strong theoretical reasoning before the model is specified (Walker et al., 2015).

Thus the investigator decides which observed variables are to be linked with which latent unobserved factors in advance. This will avoid the problems of instability and rotated solutions dominant in factor analysis.

1.2. Problem statement

Namibia has been classified as an upper-middle income country since 2009. This, relatively high-income status, however, does not resonate with the country's high GINI coefficient averaging 0.5971 which is among the highest in the world.

Empirical evidence indicates that the level of poverty in Namibia continues to escalate (Thobias, 2007) creating a deeper dichotomy with the upper middle-income status. This chasm makes it difficult to monitor, evaluate and consequently design poverty intervention programmes. This problem is further compounded by the linear approach to poverty analysis which tends to exclusively focus on singular deterministic observed variables such as income and nothing on latent variable influences from societies which are often nested in domains such as communities and regions, henceforth undercutting the effects of covariates in influencing poverty analysis outcomes. Poverty data is inherently heterogeneous and hierarchical and often nested in domains such as communities and regions. This is because poverty is relative to the environment and thus the need for a multidimensional analytical approach. For example, similar social causes of poverty are likely to affect household poverty differently in different communities and regions. No similar studies have adopted this approach and further, analysing poverty in nested domains delineates this study even further from the existing literature.

1.3. Research objectives

The main objective of the study is to analyse and suggest a multidimensional poverty framework.

This will be achieved by the following sub-objectives.

- 1.3.1 Identification of the predominant factors that influence poverty in Namibia,
- 1.3.2 Classification of these predominant factors (in 1) that influence poverty in Namibia,
and
- 1.3.3 Investigation of the causal relationships among the factors (in 1) between and within
nested data.

1.4. Research questions

The following are the research questions for the study:

- 1.4.1 What are the critical factors that influence poverty in Namibia?
- 1.4.2 What are the possible poverty class probabilities in Namibia?
- 1.4.3 What are the causal relationships among factors influencing multidimensional
poverty in Namibia?

1.5 Significance/Contribution of the study

The study sets a foundation for further research on statistical approaches to better reveal the continued causes and effects of poverty in a multidimensional structure; this is in order to evaluate help policies, strategies, and poverty alleviation programme implementations. It also provides ground to conduct further research based on nested data in Namibia, especially when viewing poverty in a multidimensional way.

1.6. Limitations of the study

A study of this kind cannot be completed without the researcher experiencing some constraints.

One of the major limitations was the use of secondary data instead of primary. The fact that the data was collected for a different purpose rather than the aims of the study, some variables were missing and some were not easily measurable. Because of the above mentioned reason, the study had to use the data of 2009/2010 NHIES instead of the 2016 which is the latest in the country.

1.7. The layout of the study

The study will be divided into five different chapters.

Chapter one covers the general introduction, including background of the study, statement of the problem, research objectives, research question of the study, significance of the study, limitations of the study and the layout of the study.

Chapter two examines some literature reviews including conceptual, theoretical, empirical review.

Chapter three is the methodology of the study and it is divided into; general introduction of the chapter, description of the research design and sources of data of the study.

Chapter four deals with the data presentation, analysis of the data and discussions of the results.

Lastly, chapter five gives the summary of the findings, conclusion and recommendation.

CHAPTER 2

REVIEW OF LITERATURE

2.1. Introduction

This chapter reviews relevant literature on poverty. It focuses on explaining what poverty is, measurements of poverty, a discussion of poverty situations in the world, Africa and Namibia. Furthermore, the chapter discusses the suggested determinants of poverty in Namibia, the effect of poverty on Namibia's economy, and finally, gives a summary of what the Namibian government and non-governmental organisations have attempt to eradicate poverty.

2.2. Poverty definitions

Poverty is a multidimensional concept that may involve a lack of resources with which to acquire a set of basic services and goods (Namibia Poverty Mapping, 2012). While most people generally recognise poverty immediately when they encounter it, they also often find it very difficult to define it. Experts share the very same struggle and hence definitions often reflect what can most readily be measured (Walker et al., 2015). According to the World Bank (2009), poverty comprise low income and also the inability to acquire basic services and goods necessary for survival with dignity. Poverty also includes low levels of education, health, no access to clean water and sanitation, lack of voice, inadequate physical security, insufficient capacity and opportunity to better an individual's life. Sengupta (2003) defines poverty as not only a lack of income to buy a minimum basket of goods and services but also the lack of basic capabilities to live in dignity as a human being. Sen (2015) goes further by defining poverty as a deprivation of basic capabilities of human beings.

Furthermore, Narayan (2000) defines poverty as lack of materials, insecurity, social isolation, well-being, psychological distress, lack of long-term planning horizons because the poor feeds hand to mouth, lack of freedom of choice and action, unpredictability, low self-confidence and also the state of not believing in oneself.

2.3. UN definition of poverty

The UN defines poverty as a denial of choices and as well as opportunities. It is also a violation of human dignity. It also means a lack of capacity to participate effectively in societies. It also means not having sufficient food to feed as well as clothes, not having a clinic or school to go to; not having the land for cultivation one's food or a job to earn money for living.

It means powerlessness, insecurity, and exclusion of individuals, households and at large, communities. It means vulnerability to violence, and implies living on marginal or fragile societies, without access to either clean water or proper sanitation (Gordon & Shandy, 2008).

2.4. Poverty definition in Namibia

In Namibia poverty is defined as the number of households that are unable to get sufficient resources to satisfy life's basic needs. They are thus counted as the total number of households living under a specified minimum level of income or below a national poverty cut (NHIES, 2009/10).

2.5. Types of poverty

Kankwenda, Legros & Ouedraogo (2000), state that poverty is relative, absolute or subjective. According to Kumar (2018) poverty is grouped into five types as discussed below.

2.5.1. Absolute poverty

This is regarded as the extreme kind of poverty which involves the lack of clean water, basic food, health as well as housing. Individuals in absolute poverty tend to struggle to live and they experience lots of child deaths from avoidable diseases like cholera, malaria and water-borne related diseases.

According to the Namibian Poverty Mapping (2012), absolute poverty is when an individual is unable to afford certain basic goods or services. According to Bekele (2004), in absolute poverty, individuals are defined as being poor when some basic needs are not satisfactorily fulfilled. In other words, it is the cost of a bundle of food items that are needed to ensure the fulfilment of a predetermined energy requirement and also other non-food basic requirements.

This type of poverty is usually the longest term in nature and it is often handed to individuals by the generations before them. In developed countries, this kind of poverty is usually not common.

2.5.2. Relative poverty

Relative poverty refers to a standard of living that is defined in terms of the expectations by the wider society in which people live, and it is a comparative measure of poverty. Consequently, individuals may be non-poor in absolute terms but may be considered poor relative to other members of their society (Namibia Poverty Mapping, 2012). This suggests that poverty is domain specific.

In relative poverty terms, an individual is regarded as poor if he/she has less than what others in the society have. The relative poverty line is the fraction of the mean or median income or percentiles of income distribution method employed. It is set either at one-half, one-third or two-thirds of the mean or median income or percentiles of the income distribution. The percentiles of income distribution involve the classification of the population into different quartiles depending on the proportion chosen.

This kind is common in relation to other families and members of society. For example, a family can be considered poor simply because they cannot afford to go for vacations, or it is not able to buy Christmas presents for children, or even cannot send their member(s) to the university.

Although they may have access to government support in terms of water, food, medicine, and free housing, they are regarded as poor just because the rest of the community has access to superior amenities and services.

The above method was criticised by many researchers. According to Ravallion (1992), there is a major weakness of this method; it is not clear whether the method is an indicator of poverty or if it is a measurement of income inequality. Moreover, it is extremely subjective as the results found are localised and that makes inter-societal comparison difficult.

2.5.3. Subjective poverty

In subjective poverty, the identification of the poor and those that are not poor depends on the subjective judgment of persons about what constitutes a socially acceptable minimum living standard in their own communities (Bekele, 2004). Therefore, unlike the other approaches, the subjective poverty line relies directly on the feeling and opinion of the concerned persons to determine the minimum level of income for themselves. The outcomes of this approach may at times be deceptive as it takes purely an account of a person's or group's own declaration about their position. These concepts underpin the multidimensionality of poverty.

2.5.4. Situational poverty (Transitory)

Families and individuals can be poor because of some misfortunes like floods, earthquakes or some serious illness. Individuals can help themselves out of this condition quickly if they are offered a bit of assistance since the cause of their condition was just one unfortunate event that is a natural cause.

2.5.5. Generational or chronic poverty

This is the more complicated types of poverty. It is when poverty is passed on to families and individuals from generations before them. This type is usually not easy to escape as people get stuck in it and they mostly have no access to tools that can help them get out of it.

General poverty takes numerous forms including, limited or lack of access to education and other basic services, lack of income, lack of productive resources to warranty sustainable livelihoods, ill health, hunger, and malnutrition, increased mortality and morbidity from illness; homelessness and poor housing; social discrimination and unsafe environments and exclusion. It's also characterised by a lack of participation in making a decision and in social, civil and cultural life (UN, 1995, p. 1).

2.6. The vicious circle of poverty

The vicious circle of poverty is a phenomenon that is used by most economics scientists. It simply means that poverty causes poverty. It is a concept that shows how poverty causes poverty as well as how it traps people in poverty. Without external interventions the circle is difficult to break. The figure 1 below shows a scenario of a vicious circle of poverty for a family in absolute poverty.

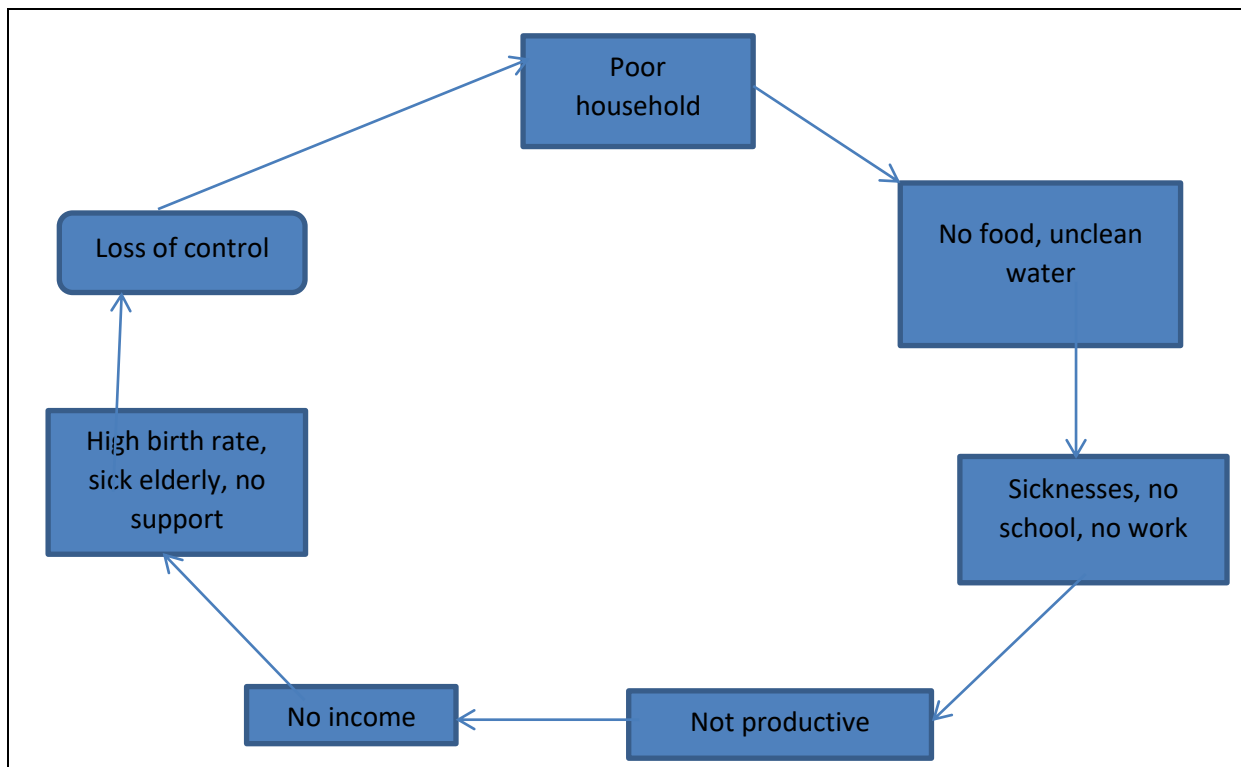


Figure 2.1: Vicious circle of poverty for a family in absolute poverty
(<http://www.eschooltoday.com/poverty-in-the-world/the-vicious-cycle-of-poverty.html>)

This vicious cycle shows a poor family with children and they have almost nothing to eat and have no access to health facilities. As a result, children are unhealthy and malnourished and this leads to many health complications. Therefore, they are unable to attend school no matter the distance. The children will grow up with no education or skills and thus they cannot do any economic activities.

A parent will die from unnecessary diseases as a result of no access to health facilities. The children will become orphans, and they also grow up and get married to poor people in poverty as themselves and they will have poor children.

This circle will continue in this family and only stops if there are some interventions from the government, NGOs, family members or good Samaritans who are better off to step in and give assistance (e.g. health, feeding, education, and shelter) to get the youth to perform some kind of economic activities to make a living. Without that, the cycle will continue for generation after generation and it is a trap that is very complicated to get out of.

2.7. Methods used to reduce poverty

Poverty is largely caused by human factors, thus, it cannot be completely eradicated. For a long time there has been a lot of poverty alleviation programmes designed to curb the vicious cycle of poverty in many households and communities in the world, especially the less developed countries. There are some remarkable results, but there is still a lot to be done. Poverty alleviation involves the strategic use of tools such as education, development of the economy, and income and wealth redistribution to improve the livelihoods of the poor. These are not the only tools in reducing the plight of poverty but they are among the common approaches.

2.7.1. Education

Quality education allows individuals to take advantage of opportunities around them. It helps people to get information, knowledge, and skills in life that are necessary to realise their potential.

Training educators, building schools, providing all necessary educational materials and making sure that children have access to education are vital features among other poverty alleviation programmes.

2.7.2. Health, food, and water

Programmes like these are aimed at feeding kids at school and providing health services to the kids and they as well tend to encourage parents to send their children to school, and making sure that they keep the children there. This is very important because children that have food to eat are

healthy and they are able to learn and in return they respond to the needs of the programme that is aimed at reducing poverty.

2.7.3. Provision of skills and training

The skilled youth can work in communities using the acquired skills. They can take part in economic activities which help them to earn some money to make a living and this will help them take care of their families and thereby improve their living standards.

2.7.4. Income and resources redistribution

It is important for every government to extend its development programmes such as bridges, roads and other economic facilities to rural areas. This makes it easy for goods and services as well as farm produce to move to and from the farming areas.

2.7.5. Common Government programs for poverty reduction

2.7.5.1. Old age grant

This is when a government of a country remit old age grants periodically to adults who have attained the age of 60 years; regardless of whether they work or not.

2.7.5.2. Disability grant

Disability grants are given to these who are certified by state medical officer as disabled. This grant is also received periodically.

2.7.5.3. Food bank

This is a programme aimed at addressing the urban and semi-urban poverty. It distributes food and non-food items to persons or households with less income generation per month.

With efforts in these areas mentioned above, in a short period, real improvements in the community will be seen and the living conditions of its people will drastically improve.

2.8. Measuring poverty

In measuring poverty, three steps need to be taken; firstly, defining an indicator of welfare. Secondly, set a minimum acceptable standard of that indicator. Last but not least, generate summary statistics to aggregate the information from the distribution of each welfare indicator relative to the poverty line (Akinyemi & Bigirimana, 2012).

In defining a welfare indicator, the most common approach is to measure economic welfare based on household consumption expenditure or income. The per capita measure of consumption expenditure is when income is divided by the household size. There are also non-monetary measures of individual welfare which can include indicators such as life expectancy, infant mortality rates in the region, and the proportion of spending devoted to food, housing, and children's school fees. Wellbeing is a broader concept as compared to economic welfare, which measures an individual's command over commodities.

The establishment of a minimum acceptable standard of each indicator helps to distinguish the poor from those that are not poor. It is necessary to achieve an adequate standard of living in a given country. The most commonly used indicator is the cost of basic needs approach. Firstly it estimates the cost of acquiring basic food for adequate nutrition which is usually 2,100 calories per person per day and then adds the cost of other essentials such as clothing as well as shelter (World Bank 2009, p. 42).

The last step on summary generating statistics to aggregate all indicators relative to the poverty line uses several indices. The econometric measure, referred to as the Foster-Greer-Thorbecke class of decomposable poverty indices (FGT indices), is the most popularly used.

It is used to addresses poverty in its three dimensions, namely poverty incidence, intensity, and severity among any given population. This is also the basis for calculating the poverty gap, poverty headcount and poverty severity (Squared Poverty Gap Index - SPGI) indices (Foster, Greer & Thorbecke, 1984). The headcount index measures the part of the population that is poor. This

method is popular simply because it is easy to measure and understand. The only shortcoming is that it does not show how poor the poor are. The poverty gap index measures the extent to which individuals fall below the poverty line as a proportion of the poverty line. However, the measure does not show changes in inequality among the poor people. The SPGI is the measure of the severity of poverty using the inequality among the poor. The FGT index has been used in a number of studies to generate overall poverty indices at national, sub-national, and/or socioeconomic levels of interest (Baker & Grosh, 1994).

For non-monetary measures of poverty, the Human Poverty Index (HPI) developed by the United Nations Development Programme (UNDP) is the method commonly used. The HPI is a composite index of deprivations of basic human abilities in three important dimensions.

Lastly but not least is deprivation in economic provisioning from public and private income as measured by GDP per capita. Furthermore, the portion of people lacking access to safe water, health services, and others can be integrated to reflect local conditions (UNDP, 2005).

2.8.1. Poverty line

The most forward way to measure poverty is to calculate the portion of the population living below a certain set poverty line as the fraction of the total number of individuals in the society but again it is not easy to draw a line between the poor and the non-poor.

The World Bank gathers data on income from individuals around the world, and it defines absolute poverty as living on less than \$1.90 daily. This is measured in international dollars (in prices of 2011) that are adjusted for the fact that individuals in different countries are faced with a different price level. Over time it is expressed in real terms to adjust for price changes (Roser & Ortiz-Ospina, 2016).

2.8.2. Poverty headcount index

The headcount index measures the proportion of the population that is poor. Because it is easy to measure and understand it has become very popular but it does not indicate how poor the poor are.

For instance, in Sri Lanka, they use the Official Poverty Line (OPL) which was established by the Department of Census and Statistics to measure poverty (HIES, 2012).

Poverty headcount Index is the portion of the population living below the poverty line and it is widely used to measure poverty in Sri Lanka and other countries as well.

Mathematically, the head count index can be written as:

$H = \frac{x}{y} \times 100 \%$	2.1
---------------------------------	-----

where,

H= is the head count Index

X = is the number of people earning income below the poverty line

Y= is the total number of people in the population

2.8.3. Poverty Gap Index

A measure that finds the extent to which an individual falls below the poverty line as a proportion of the poverty line is known as the poverty gap index. The sum of these poverty gaps gives the minimum cost of eradicating poverty if transfers were perfectly targeted but this measure does not reveal changes in inequality among the poor.

The Poverty Gap Index also measures the depth of poverty in a region or country, based on the aggregate poverty shortfall of the poor comparative to the poverty line.

Head Count Index is not constantly sensitive to changes in the status of those already under the poverty line, hence it is inadequate in measuring the impact of specific policies on the poor. While on the other hand, the Poverty Gap Index increases with the distance of the poor under the poverty line, and thus gives a much better indication of the depth of poverty (HIES, 2012).

$$PG = \frac{1}{N} \sum_{i=1}^q \left(1 - \frac{X_i}{Z}\right) I(X_i \leq Z) = \frac{1}{N} \sum_{i=1}^q \left(1 - \frac{X_i}{Z}\right) \quad 2.2$$

$$SPGI = \frac{1}{N} \sum_{i=1}^q \left(1 - \frac{X_i}{Z}\right)^2 \quad 2.3$$

where,

$$I = 1 \text{ if } X_i < Z \quad \text{and} \quad I = 0 \text{ if } X_i \geq Z$$

PG = Poverty Gap

SPGI = Squared Poverty Gap Index

X_i = Real per capita expenditure

Z = is the Poverty line

q = portion of poor population

N = The total population

2.8.4. Squared Poverty Gap - (Poverty Severity) Index-SPGI

This method averages the squares of the poverty gaps comparative to the poverty line. This method is one of the Foster-Greer Thorbecke (FGT) class of poverty measures that is written as:

$$P_\alpha = \frac{1}{N} \sum_{i=1}^q \left(\frac{G_i}{z}\right)^\alpha \quad 2.4$$

where:

N = size of the sample,

z = poverty line,

G_i = poverty gap and

α = a parameter; when α is larger the index puts more weight on the position of the poorest.

Squared poverty gap index measures the severity of the poor. Moreover, it takes into account the inequality amongst the poor. Squared poverty gap index weights the PGI itself and thus gives more weight to the very poor individuals.

If the SPGI is higher, it means that the person/household is further away from the poverty line. But squaring the PG gives higher weight to the PG of the poorest since their PG will be with a higher value.

2.9. Poverty in the world

Poverty is defined as living on less than \$1.25 every day. According to United Nations' data, 836 million people still experience extreme poverty by earning less than \$1.25 a day. Poverty is not only a lack of sufficient amount of money but also not being able to sustain a sufficient livelihood. As a result of extreme poverty, people face a lack of education, hunger, social discrimination and extremely limited access to basic needs and services. Although, there are 836 million people classified as extremely poor, there are also millions of people who are earning just a little above \$1.25 or have a high chance of slipping right back into poverty (Eda & Mehmet, 2016).

The World Bank first published data on absolute poverty from 1981 onwards, but researchers tried to reconstruct information of the living standards of the past. A seminal paper written by Bourguignon and Morrison (2002) shows that there were two authors who reconstructed measures of poverty as far back as 1820. The poverty line of 1.90 US Dollar per day was started in 2015 and the 2002 paper used another measure of 1US Dollar per day that was used at that time.

In early 1820, a huge number of people lived in extreme poverty and only a few enjoyed higher living standards. The economic growth over the past 200 years completely changed the world and poverty dropped continuously over the last two centuries. This is a more remarkable change when considering that the population increased seven times over the same time. A world without economic growth with an increase in the population would result in less income for everyone, this

increase would have caused extreme poverty. But, the exact opposite happened. In a time of fast increasing population growth, more and more people were lifted out of poverty. In 1981 alone, more than 50% of the world's population lived in absolute poverty and this is now down to about 14%.

The first of the Millennium Development Goals set by the UN was to cut in half the population of individuals living in absolute poverty between 1990 and 2015 respectively.

A rapid economic growth meant that this goal was arguably the most important and was to be achieved in 2010 (Roser & Ortiz-Ospina, 2016).

The recent decrease of poverty is shown in figure 2.2 below; the figure shows the absolute number of poor people. It can be seen that the Americas and Europe left poverty behind even before 1981. Over the past 30 years, large parts of East Asia and the Pacific achieved a rapid economic growth and this meant that poverty has been fast decreasing there.

Figure 2.2 below shows the number of people who lived in extreme poverty by world regions (1981-2002):

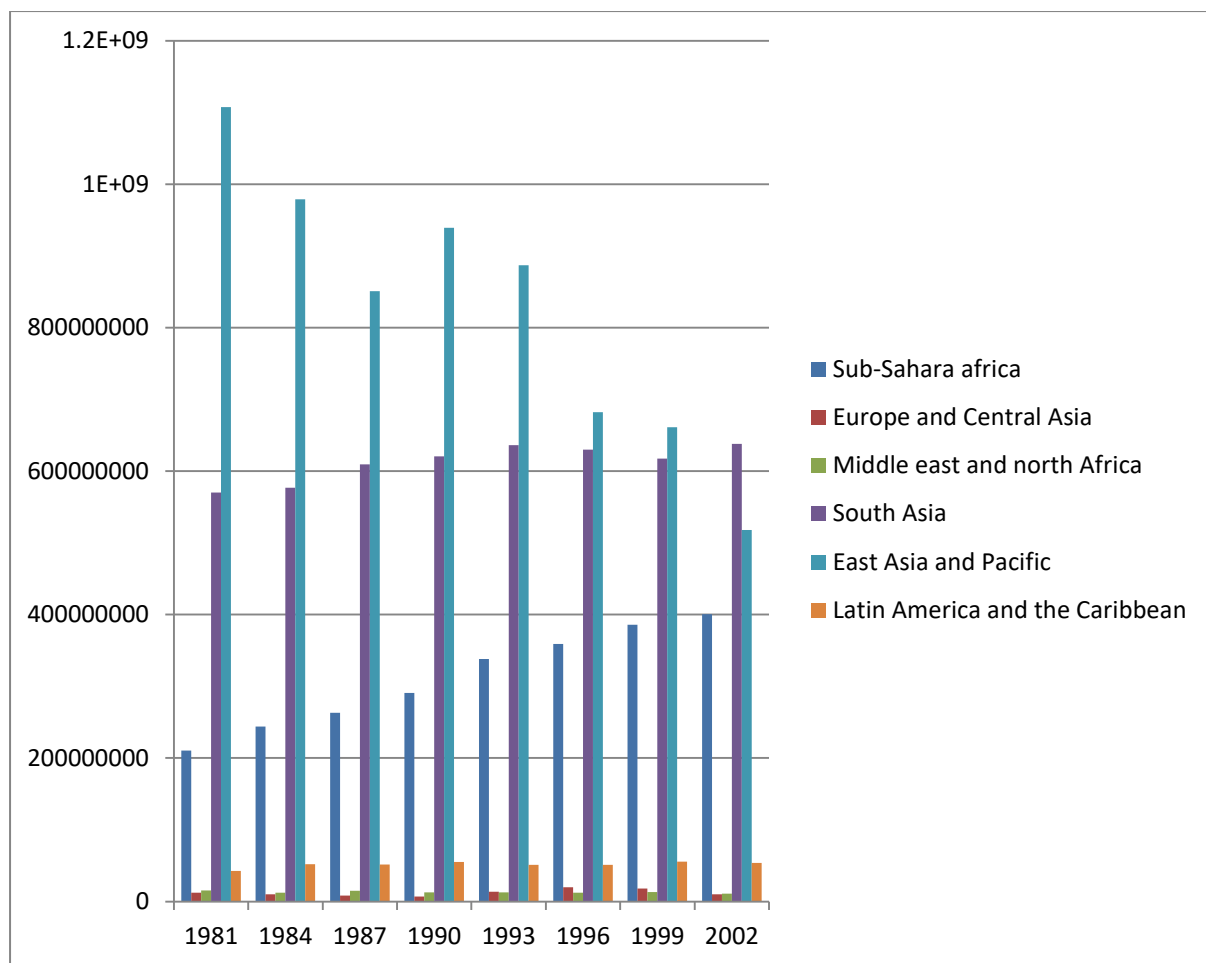


Figure 2.2: The number of people who lived in extreme poverty by world regions in 1981-2002 (UN Demography, 2003)

In figure 2.2 above, one can observe the declining share of some poor individuals, continent by continent.

The most outstanding achievement is that of the reduction of poverty in East Asia and Pacific. Poverty in the two continents drastically declined from 77% to 12% and this happened in the very populous part of the world.

According to the UN Development programmes (2003), the share of the population who lived in extreme poverty by world region, 1981 to 2012 is as shown is shown in figure 2.3 below:

Individuals in extreme poverty are defined as those living with less than 1.90\$ per day (in 2011 US Dollar).

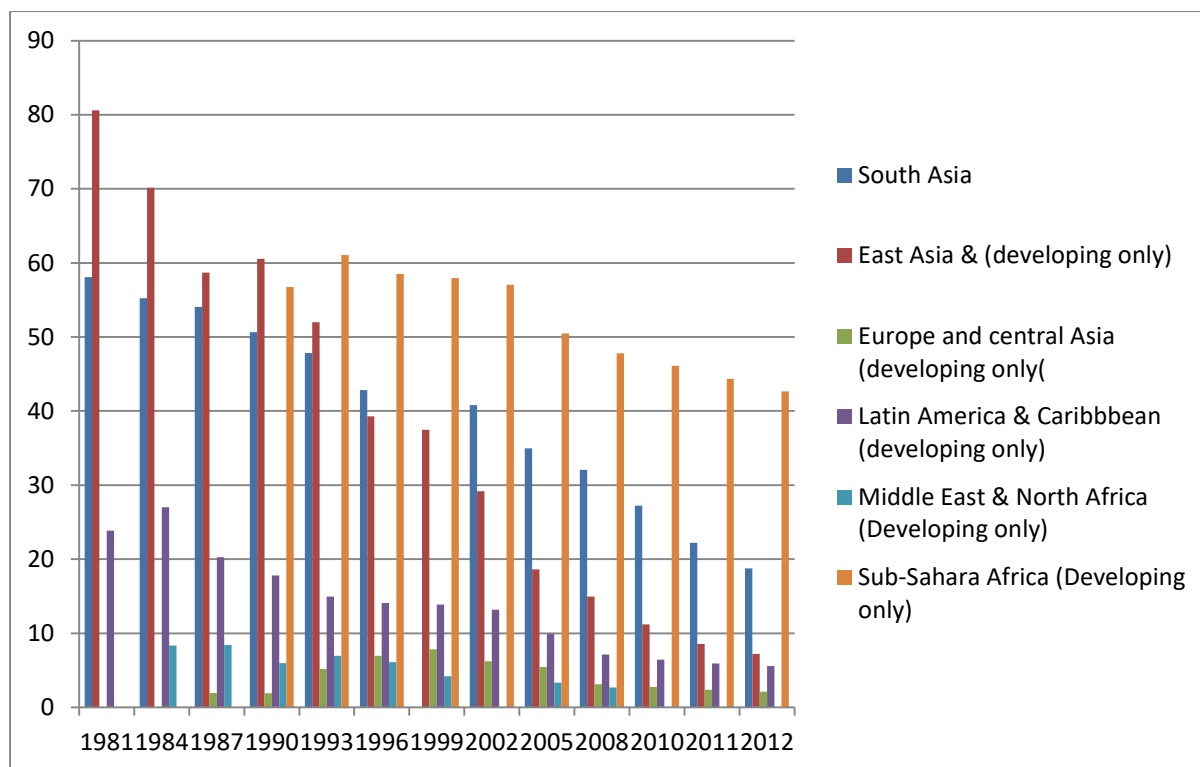


Figure 2.3: The share of the population who lived in extreme poverty by world region, 1981 to 2012
(UN Demography, 2003)

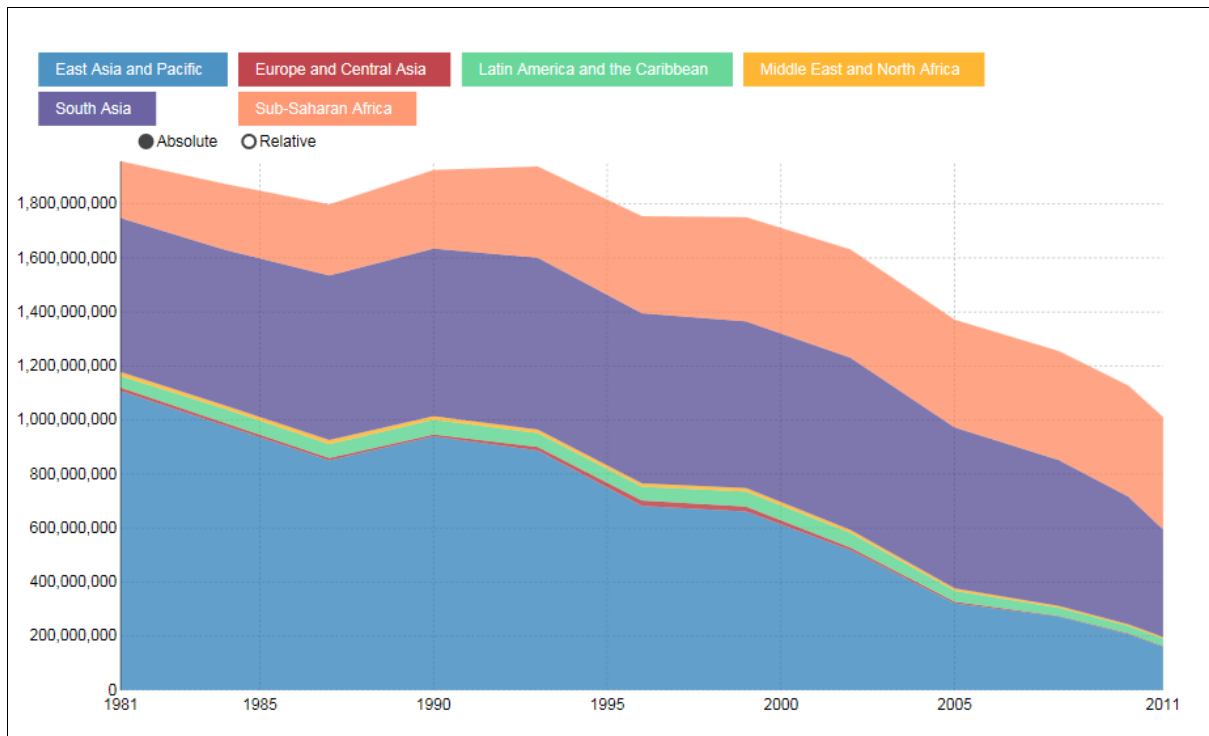


Figure 2.4: The Distribution of Poverty in the World from 1981 to 2011 (UN Development programmes, 2003)

From figure 2.4 above, it can be seen that around one billion people lived in extreme poverty. But the key question is that: where (continent) do these individuals live?

- 551 million of these individuals are in Asia
- 436 million of these individuals are in Africa
- 15 million of these individuals are in South America
- 5.9 million of these individuals are in North America
- 0.3 million of these individuals are in Europe
- 50 thousand of these individuals are in Oceania

Using a poverty line of 1.90\$ in 2011, the UN demographic of 2003 shows that the highest share of people who were in poverty was in Madagascar (82%), followed by the Democratic Republic of Congo (77%) and Burundi (78%). A portion of 21% lived in India and in China it was only 11%.

As governments and non-government organisations search for answers to the urgent problem of prevalent poverty and seek to eradicate its many negative effects, there is an urgent need to identify the causes of poverty in order to create sustainable change. Understanding the global causes of poverty is a vital part of the process of devising and implementing real solutions. Most researches and analysts would agree with no doubt that there is no single root cause of poverty (any form) everywhere throughout human history. However, even when taking into account the individual histories and circumstances of specific countries and regions, there are important trends in the causes of global poverty.

2.10. Major causes of poverty in the world

According to Williams (2013), the following are the major causes of poverty in the world:

- Many of the former colonised countries are the poorest nations in the world. These countries were former colonies, slave-exporting countries and territories from which natural resources have been systematically extracted for the benefit of colonising countries. Although there are notable exceptions like Australia, colonialism and its legacies have created the conditions that prevent many individuals from accessing education, land, capital and other resources that allow people to support themselves adequately.
- War and political instability: Both of these factors often have connections to histories of colonialism, but whatever the causes of political and war upheavals, it is clear that stability, safety and security are essential for subsistence, economic prosperity as well as growth. Without these basics, natural resources cannot be bounded collectively or individually, and no amount of education background, talent or even technological knowledge will allow people to work and reap the benefits of the fruits of their effort. Similarly, laws are in place to protect property rights and investments, and without legal protections, farmers will be

business owners and entrepreneurs and yet they cannot safely invest in a country's economy. It is an indicating sign that the many poorest countries if not all in the world have all experienced civil war and serious political disturbances at some point in the 20th century, and many of them have very weak governments that cannot protect their people against violence or related problems.

- **National debt:** Many poor countries have accumulated significant debt due to loans from wealthier nations and international financial institutions. Poor countries pay an average amount of \$2.30 in debt service for every \$1 received in grant aid. In addition to that, structural adjustment policies by organisations like the World Bank and the International Monetary Fund often request poorer nations to open their markets to outside businesses and investors, thereby increasing competition with local businesses and also undermining the potential development of local economies. In recent years, calls for debt reduction as well as forgiveness have been increasing as activists see this as a key means in the reduction of poverty. The United Nations has also made it a priority to examine the economic structural adjustment policies that are designed to put less pressure on vulnerable populations.
- **Discrimination and social inequality:** Inequality and poverty are two different things. Inequality is the difference in social status, wealth or opportunity between individuals or groups, which is a barrier to groups or individuals with lower social status from accessing the land, tools and other resources to support them. According to the United Nations Social Policy and Development Division "inequalities in income distribution and access to productive resources (such as land), basic social services (such as hospitals), markets and information have been on the rise worldwide".

This often causes and aggravates poverty. Gender discrimination has been a significant factor in holding numerous women and children everywhere around world in poverty.

- **Vulnerability to natural disasters:** In regions of the world that are already less wealthy, occasional or recurrent catastrophic natural disasters can cause a significant obstacle in eradicating poverty. For example, flooding in Bangladesh, droughts in most African countries and the 2005 earthquake in Haiti. All this brings vulnerability to countries and natural disasters are very devastating to the affected countries.

This makes people become refugees within their own countries, losing whatever they had, being forced out of their living spaces and becoming almost or completely dependent on other individuals for survival. For example, the Solomon Islands experienced an earthquake as well as a tsunami in 2007. Their losses from that disaster equalled 95% of the national budget. Without foreign aid assistance, governments in that country would have been unable to meet the needs of their people. These are only 5 causes of poverty. They are either internal or external; either natural or man-made. Just as there is no single cause of poverty, there is no single solution to it. However, understanding the ways that complex forces like these interrelate to create and sustain the conditions of widespread poverty is an important step in formulating comprehensive and effective policies to combat poverty around the world.

2.11. Impact of poverty

Poverty brings about numerous complications. The effects usually depend upon the kind/type of poverty.

Hunger, health and deaths

Absolute poverty is a result of extreme starvation, hunger and malnutrition. People become vulnerable to preventable diseases such as dysentery, cholera and tuberculosis. If these people cannot access health services such as hospital and medications, then the death rates can rise. Relative poverty may cause individuals to indulge in social evils such as prostitution, drugs and petty crimes as a means to meet their daily needs.

Economic

People in absolute poverty cannot afford even the basics such as food, water and shelter. In economic activities, they do not take part as they are not healthy. They do not send their young children to school and in return these youths do not get any skills. This results in economic failure of the community, which directly affects the whole region where they are. Furthermore, those living in relative poverty, who obtained a bit of training or education, are forced to move or migrate to urban areas in search of better lives in the cities. This deprives the rural areas of the man-power and makes their situation even worse. As they migrate into the cities, they mostly end up in slums, increase populations and put pressure on amenities in the cities.

2.12. Poverty in Africa

The poorest people are found in South Asia, Sub Saharan Africa and Latin America. These three parts of continents are known to have large areas of chronic poverty. In the last decades, joint efforts by governments and non-governmental organisations have improved the situation for many, but there is still a lot of poverty and something has to be done to eradicate poverty in these areas (Bartle, 2013).

2.13. Poverty in Sub-Saharan Africa

The sub-Saharan African region is the poorest in the world. In West and Central Africa, one in every six person is severely poor. It is estimated that between 28% and 38% of the absolute poor population in sub-Saharan Africa is estimated to be chronically poor, totalling between 90 and 120 million people (Bartle, 2013).

Here are some facts on the region:

- There are 22 countries in the region; 310 million people live in the 12 worst countries.
- 150 million individuals live on less than 1USD a day.

- Countries in this region include Guinea, Liberia, Angola, Mali, Somalia, Sudan, Zambia and Namibia.

2.14. The poorest

The world's absolute poor people often live in rural areas, and they often earn an income in the agricultural products meant for feeding. Rural households are more likely to be poor than urban households.

- **Poor or destitute**

People in this group tend to be the elderly, often widows with no assets. They may also include the disabled who are not empowered to come into the public economic domain. This groups always falls in the category of chronically and absolutely poor. They are mostly dependents because of health conditions that do not allow them to help themselves.

- **Dependents**

Poor households tend to have bigger families living together in small houses. They often have a greater share of dependents (non-working age), less education, no land, and less access to electricity and running water. Poor households have significantly fewer years of education whether one looks at the household-level average or the highest educational attainment of household heads.

- **Economically poor**

People in this category can move in and out of poverty but they are usually vulnerable to spells of personal shocks such as family deaths, illness, or job losses. General shocks such as fire, floods, droughts, conflicts or earthquakes can also cause this type of poverty. People in this group are usually not employed, but largely live in rural areas, working on small subsistence farms. About 60% of Africans who are poor tend to be in this category. They lack assets and access to services that can upgrade their economic development. Households with many children or dependents are more likely to be poor.

2.15. Factors that cause poverty

- **Income inequality**

Studies show that when a country grows economically, overall poverty should reduce. If the national income is not equally and fairly shared among all communities in the country, there is a risk that the country becomes poorer, and individuals will feel it most.

- **Conflicts and unrests**

Statistics show that 33% of societies in absolute poverty live in places of conflict. In the past, countries like Sri-Lanka and Rwanda suffered poverty as a result of years of civil and tribal wars. In recent years, Iraq and Afghanistan both went through difficult times of conflict of interest and thus poverty has stricken in these areas.

This leads to loss of human lives, diseases, hunger, violence, destruction of infrastructure and property, lack of economic investments and reduced quality of labour. Such communities lose foreign investments thus; wealth can never be created in such communities.

- **Location and adverse ecology**

The location of countries plays an important role, and some communities within a country can make people poor. Ecological and geographic factors such as deserts, mountains, swamps and the like can also make life conditions unbearable in many places. This is why some rural areas are poorer compared to others, even if they are in the same country.

- **Natural disasters**

Floods, droughts, hurricanes and other unexpected natural events cause deaths, illnesses and loss of income. For instance in Ethiopia, there were 15 droughts (and famines) between 1978 and 1998 and that led to the displacement, death and injuries of more than one million people. In these cases, the poor become poorer.

- **Disability and ill health**

Poverty can also get worse if communities are affected by diseases such as HIV/AIDS and malaria. Diseases cause deaths and children are left as orphans and sometimes they have to fend for themselves as they may not even have care givers. Household wealth can also drain quickly when members are living with disability.

- **Inherited of poverty**

Families that have had a vicious lifetime of poverty tend to pass on the condition to their children. They cannot afford the cost of education for their children and these children grow with no skills. Such children end up working on the same family farms as their parents; get married within the poor society into families with similar conditions. They in turn pass on the condition to their own children.

- **Education, training and skills**

Individuals who are educated or have some form of training or skills are in a better position to apply the skills, ideas and knowledge into fixing basic problems and upgrading their livelihoods.

They are able to plan, follow instructions and also to access information, tools and support that can improve their living standards. In the absence of training, skills or education, people can hardly help themselves.

- **Gender discrimination**

In many African communities, governments have been fighting for gender equality. In African countries, girls are still not allowed to be in school and families prefer to invest in boys' education than in educating girls. Women are also not allowed to do major economic activities and to not take part in any decision makings. This ideology negatively impacts the well-being of women and the girl child.

2.16. Poverty in Namibia

Namibia has a population of approximately 2 113 077 people, 57% of the inhabitants live in rural areas and 33% live in urban. Over the period of 2001 to 2011, the population growth rate declined from 2.6 % per annum to 1.4 %, while the fertility rate also declined from 4.1 children per woman to 3.6 children per woman (Namibia Poverty Mapping, 2012). Five years back, the Namibian economy registered an average growth rate of 4.3%. However, with a high unemployment rate of 29.6%, poverty incidences of 26.9%, and HIV prevalence of 16.9%, a large percentage of the Namibian population remains vulnerable (Poverty and Deprivation in Namibia, 2015). Moreover, 65% of the total population falls within the age category of 15 years and above. Of these, 71% comprise the labour force (Namibia Poverty Mapping, 2012). The UNDP Human Development Report in 1998 indicated a Gini coefficient of 0.67 for Namibia, which is the highest value ever recorded worldwide.

A Gini coefficient measures the income inequality as well as the wealth distribution of a country, where a value of zero indicates absolute equality and a value of one is absolute inequality (National Poverty Reduction Action Programme, 2002). Currently the GINI coefficient for Namibia is at 0.56 (NHIES, 2015/16), and this still marks extreme inequality and poverty among the people.

In the year 2009, Namibia, with an estimated annual Gross National Income (GNI) per capita of US\$5 693, was classified as an upper-middle income country. This fairly high income status masks extreme poverty as well as inequalities in income distribution, general living standards and quality of life (Poverty and Deprivation in Namibia, 2015). The Government of the Republic of Namibia has been facing the challenges brought about by increasing poverty; that is why in December of 1998, the Government developed a Poverty Reduction Strategy (PRS) for the first time.

This strategy contained three areas of concern. Firstly, it examined how to foster more equitable and efficient delivery of public resources, in the context of Namibia's commitment to regional decentralisation for poverty reduction countrywide. Secondly, it looked at how to accelerate

equitable agricultural expansion, including considerations of food security and other crop development options, and last but not least, the options for non-agricultural economic empowerment, including an emphasis on informal and self-employment options (National Poverty Reduction Action Programme, 2002).

Thereafter, the Government of the Republic of Namibia has consistently formulated policies and programmes to address developmental challenges which include poverty reduction. The fourth National Development Plan (NDP4) clearly outlines the development objectives and priority programmes to be implemented over the fiscal period from 2012 to 2017 respectively. The three overall goals of the NDP4 are to achieve high and sustained economic growth, employment creation, and increase income equality.

The Government of the Republic of Namibia is committed to achieving the Millennium Development Goals (MDGs) and other international development goals and objectives. A main objective of the national policy formulation and planning process, and consonance with the aspiration of achieving the MDGs, is eradication of poverty.

According to the Namibia Poverty Mapping (2012), in 1998, the government adopted the poverty reduction strategy and an action plan, while in more recent year (2012), the National Rural Development Policy was also adopted. The aim of the rural development policy was to promote systematic and coordinated development planning, and answer to the development challenges faced by rural populations. Promoting service delivery within the decentralised levels of governance in regions and constituencies was the central objective of the Rural Development Policy. This policy was developed in furtherance of the decentralisation policy. The Rural Development Policy was further developed to drive economic growth and, importantly, create jobs and thus address poverty.

2.17. Poverty in Namibia

In the past, Namibia recorded some notably high rates of poverty. Over the past 23 years, Namibia has experienced a substantial reduction in poverty due to improved poverty reduction policies, strategies and plans, and the implementation thereof. National incidences of poverty declined from 37.9% to 26.9% over the period 2001 to 2011. This means that Namibia registered a general decrease of 11% in poverty (Namibia Poverty Mapping, 2012). Although great steps have been made in Namibia to reduce poverty, inequality in wealth distribution is being slowly reduced and unemployment rates, especially among the youth, remain notably high (Jauch, 2012). Hunger remains a serious challenge, especially in the time of droughts in some parts of the country, which has caused increased malnutrition and reports of children and adults dying from hunger in two of the country's regions (Namibia Poverty Mapping, 2012).

Although Namibia adopted the reduction of poverty as one of its national objectives during the formulation of the First National Development Plan (NDP1), it is important to note that Namibia chose to work towards the reduction of poverty over its alleviation or eradication. This is practical because the issues of alleviation and eradication are either poorly focused or sometimes even unrealistic. The 'alleviation' of poverty usually refers to efforts to lighten the burden on those individuals who are living in poverty. Its focus is often on the provision of services whilst the 'eradication' of poverty implies the complete absence of poverty which is almost impossible or unpractical. Instead, the reduction of poverty, whilst possibly is in danger of being too modest, is a more realistic outcome.

According to the National Poverty Reduction Action Programme (2002), poverty has different measurements, the most common being the one based on consumption only. The National Planning Commission (2015) classifies a household as being 'relatively poor' if it devotes over 60% of the household income of expenditure to food.

Those that are 'extremely poor' are those where household income expenditure exceeds 80 %. Using these definitions, 47% of Namibian households were relatively poor while 13% were extremely poor in 1994 according to the NHIES. However, since consumption alone does not determine the quality of life, other dimensions such as education, health and interaction with the society can be used to know the extent to which people suffer from poverty. In 1998, 12% of children were found to be underweight and 29% of people did not reach the age of 40 years. These are indications of individuals being poor health wise. Furthermore, 19% of adults (more than 15 years old) were illiterate, meaning that they are 'education-poor'. In addition, 28% of the population had to walk long distances to the nearest shop and to get public transport, and 29% had no access to a radio. These are indications of being 'participation-poor'.

These dimensions of poverty are often interlinked in that households suffering from one dimension of poverty are often suffering from another dimension, for instance ill health and unemployment often go together.

The dimensions of poverty differ by region. Inhabitants of the Caprivi (now Zambezi region) have the shortest life expectancy so far in the country, being 39.8 years in comparison to the national average of 52.4 years. Adult illiteracy rates were found to be lowest in Omaheke (64 %) and Kunene (64.3 %), while the national average stands at 81%. School enrolment rates are lowest in Omaheke (71.1 %) and Otjozondjupa (71.4%) in comparison to the national average of 85%. Households in Omusati, Oshana and Kunene have the worst access to water supply, with 68.3%, 61% and 46.8% respectively. Finally, despite having the best health services, Kunene has the highest proportion of underweight children (18.5%). Eighty five percent of consumption-poor households are located in the rural areas of the country, making their living from subsistence farming primarily in the northern and north-eastern communal areas. However, poverty incidences are also found in the southern regions of the country, where income inequality is higher than other regions.

The gap in average rural to urban income and living standards gives a strong reason for rural to urban migration as evidenced by the growth of informal settlements in outskirt areas of almost all urban centres in the country. Furthermore, poverty is concentrated among groups which were historically disadvantaged. Huge income disparities also exist between language groups. The income per-capita in households with the mother tongue as German is N\$27,878, in comparison to N\$1,416 for Oshiwambo speaking persons. Moreover, female-headed households are more likely to be poor than male-headed households. Social and cultural conditions in the Namibian society maintain women's unequal status just like most other African countries, especially in terms of their rights to resources and access to decision-making (National Poverty Reduction Action Programme 2001-2005, 2002).

2.18. Measurements of poverty in Namibia

2.18.1. Poverty lines in Namibia

According to NHIES (2012), poverty is defined as the number of households that are not able to command sufficient resources to satisfy their basic needs. They are counted as the total number of households living below a specified minimum level of income or below a country's poverty line. The food poverty line estimates for the year 2009/2010 in Namibia was N\$ 204.05, with the lower bound poverty line estimated at N\$ 277.54 and the upper bound poverty line at N\$ 377.96, respectively. And earlier in 2003/2004, Namibia moved from the use of the conventional food consumption ratio to the use of the cost of basic needs (CBN) approach as a measure of the poverty threshold in the country. Poverty thresholds are mainly useful for the creation of the poverty mapping, poverty profile, estimating deprivation indices, implementing poverty social impact analysis on the poor and the vulnerable individuals, re-evaluating and exploring the determinants of poverty and ultimately guiding policy interventions aimed at reducing poverty as stipulated in the National Development Plans, Vision 2030 and in the Millennium Development Goals (NHIES, 2012).

Namibia's estimated poverty lines for 2003/2004 and 2009/2010

Poverty line	2003/2004	2009/2010
Food poverty line	127.15	204.05
Lower bound poverty line: "severely poor"	184.56	277.54
Upper bound poverty line: "poor"	262.45	377.96

Figure 2.5: Namibia's estimated poverty lines (NHIES, 2009/2010)

2.18.2. Poverty situations in Namibia

The information below is based on information obtained in the Namibia Poverty Mapping (2012). Poverty mapping is considered important because it gives detailed descriptions of the spatial distribution of trends in poverty at regional levels and constituency levels (Namibia Poverty Mapping, 2012). Their report combined the 2003/04 and 2009/10 Namibia Household Income and Expenditure Survey (NHIES) data, and those of the 2001 and 2011 Namibia Population and Housing Census data. They combined this data with an objective of estimating poverty levels for the thirteen regions at the time and 107 constituencies of Namibia. But according to Namibia Poverty Mapping (2012), in the past, poverty estimates were done using the NHIES data alone.

The table 2.1 shows that Namibia registered an overall decline in the incidences of poverty by 11% points over the 2001 to 2011 period, with the national incidence of poverty declining from 37.9% to 26.9% over this period. Currently about 568 418 individuals are estimated to be poor.

The greatest declines were listed in the northern regions of Omusati, Ohangwena, Kunene and Oshikoto, as well the eastern area of Omaheke. However, two regions (Khomas and Zambezi) registered increases of 7.2% points and 1.2% points respectively. In 2011, out of the thirteen regions, seven regions (Omusati, Otjozondjupa, Oshikoto, Ohangwena, Zambezi, Kunene, and Kavango) had poverty incidences that were highly above the national rate of 26.9 %.

Title: Poverty statistics in Namibia over the period of years (2001 and 2011)

Region	2001	2011	Change
Zambezi	32.0	39.3	7.2
Erongo	9.3	6.3	-3.0
Hardap	20.4	17.2	-3.2
Karas	18.0	14.5	-3.4
Kavango	57.9	53.2	-4.8
Khomas	3.4	4.6	1.2
Kunene	53.7	38.9	-14.8
Ohangwena	62.8	35.3	-27.5
Omaheke	41.6	26.2	-15.5
Omusati	50.9	28.6	-22.2
Oshana	28.3	21.1	-7.1
Oshikoto	57.3	42.6	-14.7
Otjozondjupa	30.4	27.5	-2.9
Namibia	37.9	26.9	-11

Table 2.1: Namibia poverty statistics of 2001 and 2011 (NHIES, 2009/2010)

Figure 2.6 below gives the spatial distribution of the incidence of poverty by region in 2011. It can be seen that in both 2011 and 2001, Kunene, Ohangwena, Zambezi, Oshikoto and Kavango had more than one third of their population classified as poor.

Poverty in Namibia still bears a different rural face, with the poorest regions being those in which the majority of the population lives in rural areas. The regions with the lowest incidences of poverty are Erongo and Khomas. Although poverty incidences in Khomas increased between 2001 and 2011, the region still has the least incidence of poverty with only 5% of its population living under the poverty line. Karas, Erongo, Hardap and Oshana also recorded low levels of poverty.

Erongo region does not only have most of the existing mines but also borders the Atlantic Ocean which produces fish, a major export commodity for Namibia. The Namib Desert is also found there and it is an important tourist destination. Indeed in 2011 Erongo recorded the second highest tourist arrivals in the country, with about 345 000 visitors.

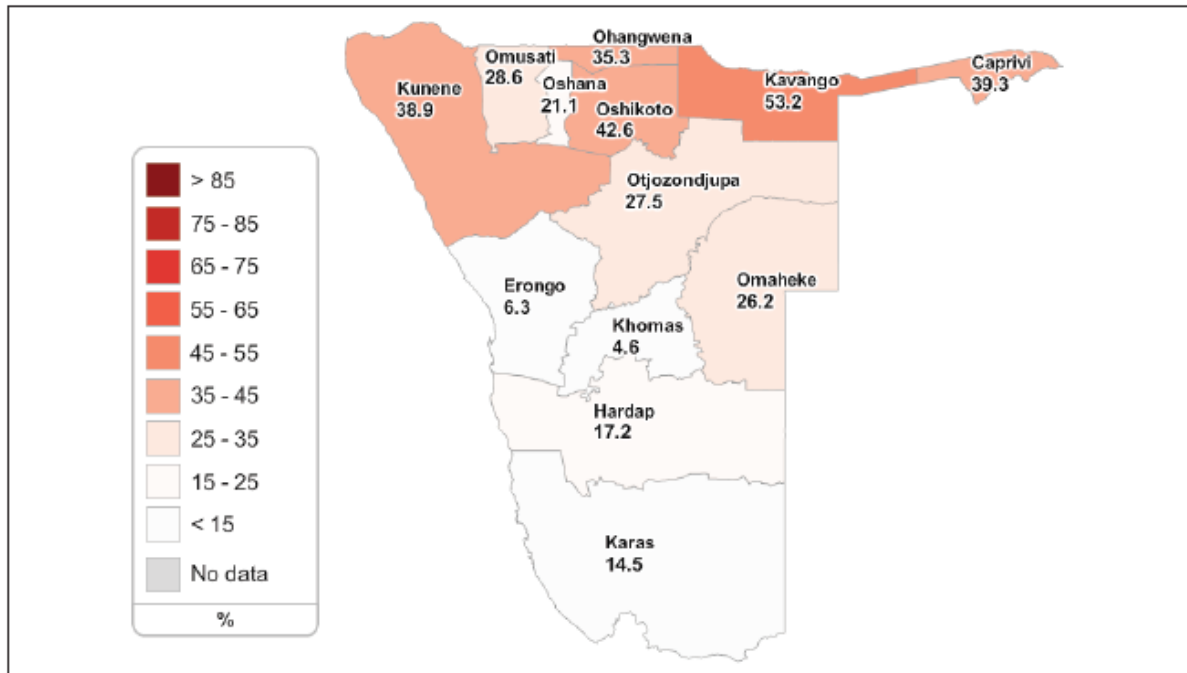


Figure 2.6: Namibia's regional poverty statistics of 2011 (NHIES, 2012)

Although there was a general decrease in the incidence of poverty at the national level, there were also marked differences in the recorded changes in the incidence of poverty across regions in 2001; the poorest region was Ohangwena followed by the Kavango, Oshikoto, Omusati and Kunene, with more than half of the individuals being classified as poor in these regions.

By 2011, however, the condition had changed with only Kavango (at 53 %) having more than half of its inhabitants classified as poor in terms of regional ranking. The situation has changed, with Kavango being the poorest region followed by Oshikoto, Zambezi, Kunene and Ohangwena. Amazingly, Omusati region has fallen out of the 5 highest poverty headcount rate regions, while Zambezi has joined this group. Over the years 2001 to 2011, Omusati region experienced a decrease

of 22% points in the incidence of poverty, moving from as high as 51% in 2001 to a low of 29% in 2011.

The decrease in the poverty headcount rate was in Omusati region. The rate declined in almost all regions, with Ohangwena, Oshikoto, Kunene and Omaheke regions registering the highest decrease. For instance, the poorest region in 2001 was Ohangwena region but it later recorded a remarkable reduction in the poverty headcount rate of 28% points during the period under consideration. Two regions (Zambezi and Khomas) recorded increases in the incidence of poverty over the 2001 to 2011 period, with the incidence of poverty in these regions increasing by 7.3% and 1.2%, respectively. Although Khomas was the least poor region at both the 2001 and 2011 time points, its poverty levels increased slightly between these two points.

Regional poverty aggregates, as presented above, often mask wide intraregional variations. Beyond the regions, there exist wide variations in incidence poverty reported across the 107 constituencies of Namibia.

While, at the regional levels, the highest incidence of poverty was reported in Kavango region (53%), at constituency level, the highest incidence of poverty was reported in Epupa constituency in Kunene region, with 69% of the population classified as poor, while the lowest incidence was reported in Windhoek East constituency in Khomas region, with only 0.1% of the population being classified as poor.

In Namibia, the absolute poverty for the past 17 years or so has decreased by 40% from unprecedented high levels of around 70% to around 28% (Namibia Poverty Mapping, 2012). Of the estimated 568 418 poor people in Namibia, 21% are found in Kavango region while Ohangwena and Oshikoto account for 15% and 14% of the poor, respectively.

According to the 2009/2010 Namibia Household Income and Expenditure Survey (NHIES), a person is said to be in absolute poverty if his/her annual consumption is less than N\$4,535.52. Current statistics indicate that 26.9 per cent of the 2.2 million population lives in absolute poverty.

Poverty by sex in Namibia

Incidences of poverty by the gender of the head of the household are shown in the figure below. It indicates poverty in female headed households is as high as 22% while the male headed households this is pegged at 18%. Households headed by females also have a larger incidence of severe poverty with 11 percent compared to 9 percent for male headed households. Comparing these results with the 2003/2004 survey it shows that poverty levels have fallen from 30% to 22% for female headed households and from 26% to 18% for male headed households, respectively. The incidence of severely poor households has also decreased from 15% to 11% for female headed households and from 13% to 9% for male headed households. Nevertheless of these reductions in both the incidences of poverty and the incidence of severely poor households, poverty still remains disproportionately higher in female headed households.

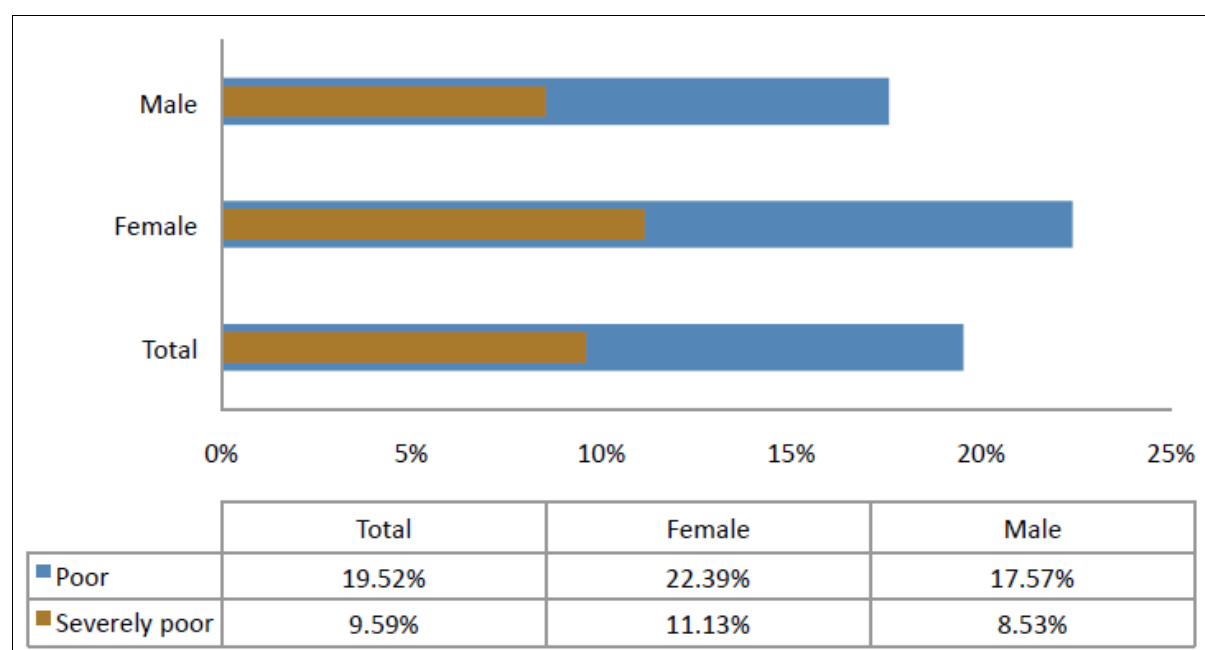


Figure 2.7: Poverty statistics by gender in Namibia (NHIES 2009/2010)

Poverty by age

Differences in poverty status across the age of the household heads are presented in the Figure below. Poverty is fairly low for households where the head of the household is between 16 and 34 years of age. Poverty incidences are high for households where the household head is between the age of 35 and 54 and it is relatively higher as well where the head of the household is 55 years or older. This means that the older the household head, the higher the chance of that household to be in poverty. Regardless of the trend observed between the age of the head of household and the incidence of poverty, age does not certainly cause poverty since other variables that may lead to poverty can also be linked with age.

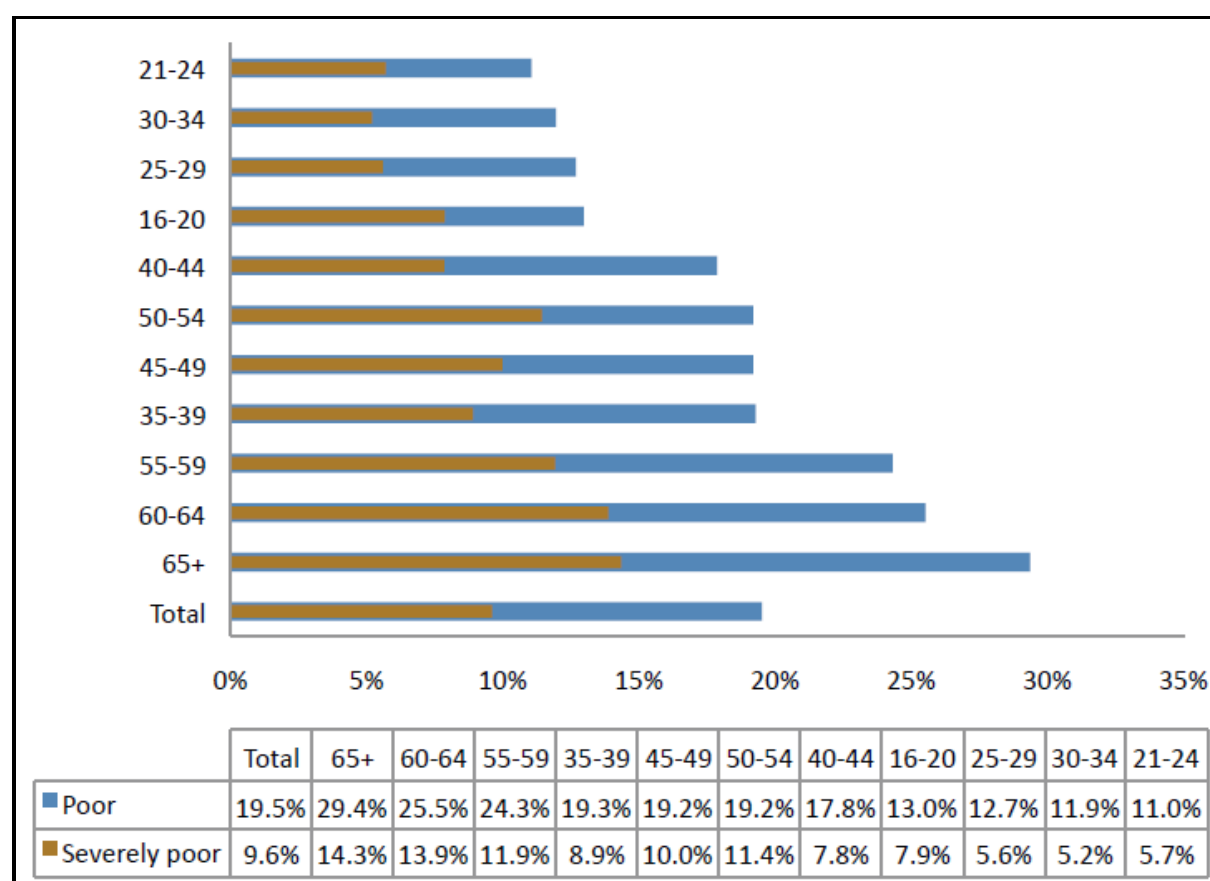


Figure 2.8: Poverty statistics by age in Namibia (NHIES 2009/2010)

Poverty by location

Figure 2.9 indicates that the poor are excessively located in rural areas. About 27 percent of rural households are poor, compared to 10% for urban households. The incidence of severely poor households is also much higher among rural households, where 14% of the households were found to be severely poor compared to 4% in urban areas.

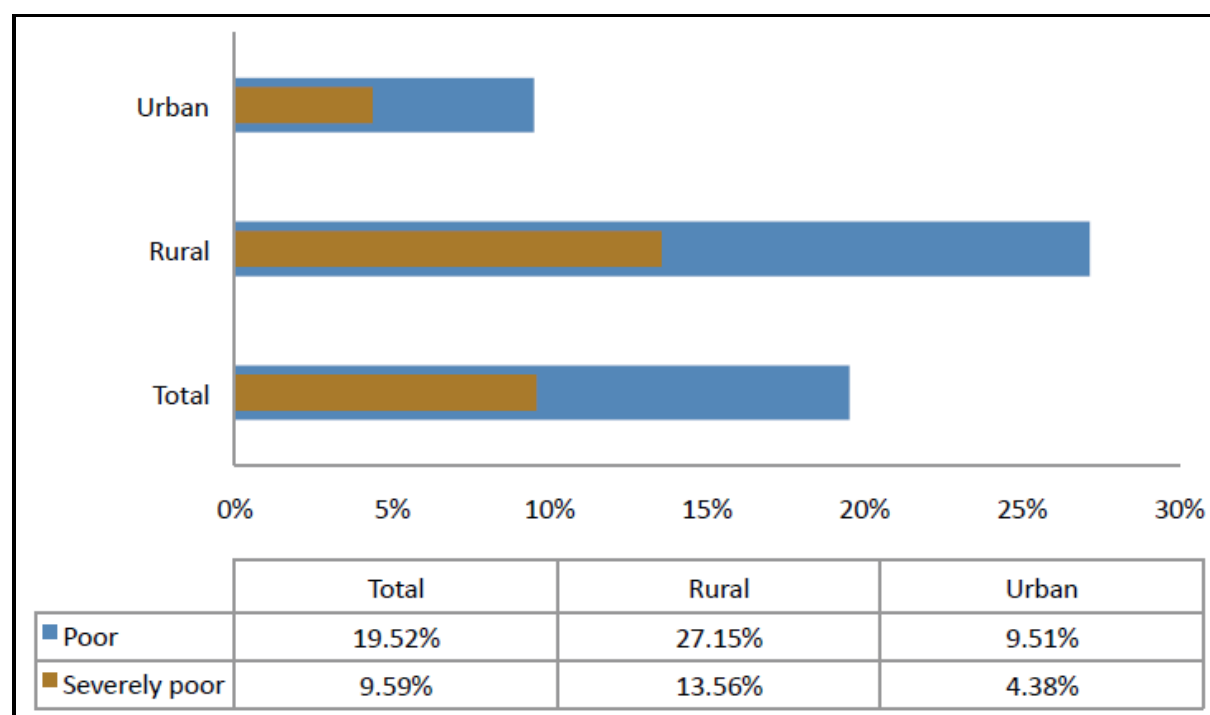


Figure 2.9: Poverty statistics by location in Namibia (NHIES 2009/2010)

Poverty by region

Poverty varies greatly between Namibia's thirteen administrative regions as can be seen below. The highest incidences of poverty were recorded in Kavango region where 43% of the households are poor and 24% are severely poor. In the Caprivi region, 42% of the households were recorded as poor with 26% being severely poor. Poverty incidence is lowest in Erongo where 5% of the households are poor and 2% are severely poor. Poverty is also found to be very low in the Khomas region with 8% of households considered to be poor and 3% are found to be severely poor.

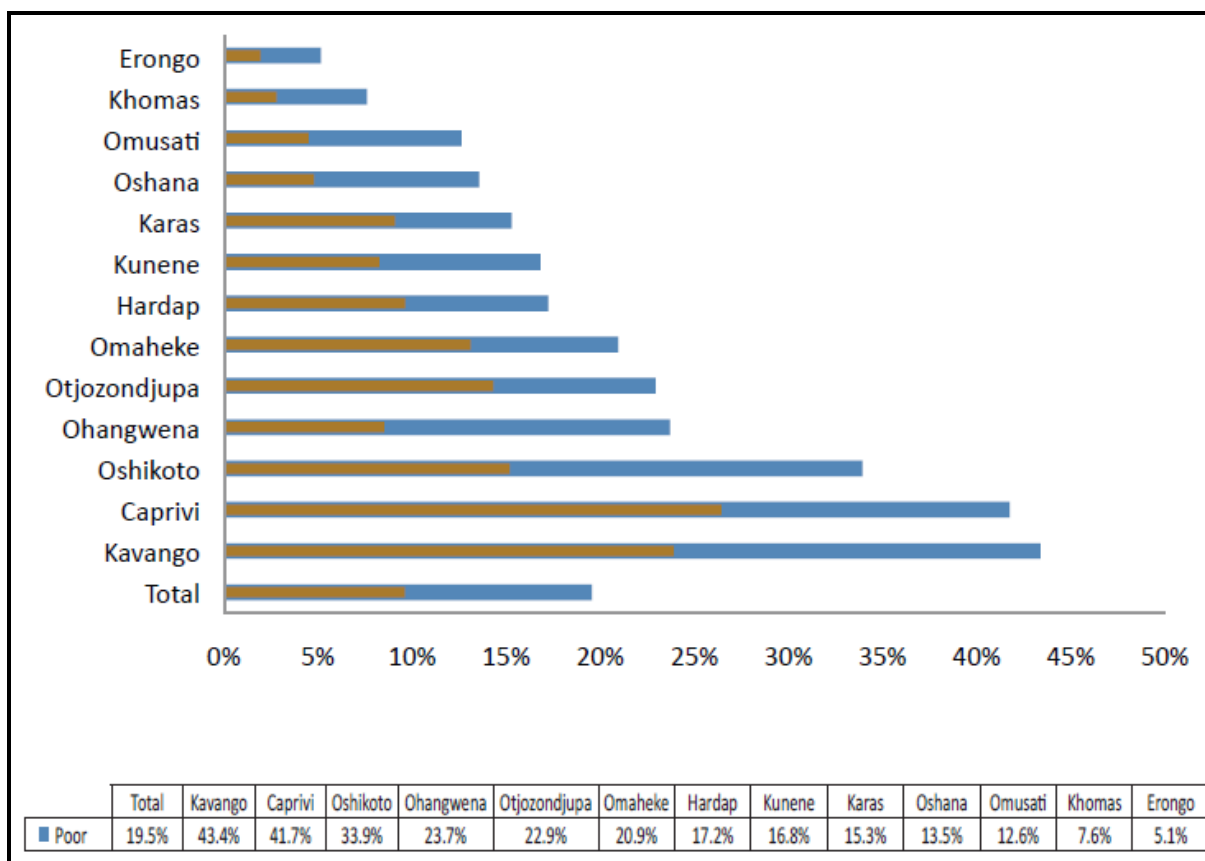


Figure 2.10: Poverty statistics by region in Namibia (NHIES 2009/2010)

Namibia recorded a general decline in the poverty incidences of 11% between the 2001 and 2011 period, with the national incidence of poverty falling from 37.9% to 26.9% over the same period.

Between 2009 and 2010 about 568 418 individuals were estimated to be poor.

The greatest declines were also registered in the northern regions of Omusati, Kunene, Ohangwena and Oshikoto, as well as the eastern region of Omaheke. However, two regions namely Zambezi and Khomas registered an increase of 7.2% and 1.2%, respectively. In 2011, out of the thirteen regions, seven regions (Otjozondjupa, Ohangwena, Kunene, Oshikoto, Omusati, Zambezi and Kavango) had poverty incidences that were way above the national rate of 26.9%.

Title: Decline of poverty statistics in Namibia by Region (Period 2001-2011)

Region	Poverty Headcount Rate		
	2001	2011	Change
Zambezi	32.0	39.3	7.2
Erongo	9.3	6.3	-3.0
Hardap	20.4	17.2	-3.2
Karas	18.0	14.5	-3.4
Kavango	57.9	53.2	-4.8
Khomas	3.4	4.6	1.2
Kunene	53.7	38.9	-14.8
Ohangwena	62.8	35.3	-27.5
Omaheke	41.6	26.2	-15.5
Omusati	50.9	28.6	-22.5
Oshana	28.3	21.1	-7.1
Oshikoto	57.3	42.6	-14.7
Otjozondjupa	30.4	27.5	-2.9
Namibia	37.9	26.9	-11

Table 2.2: Decline of poverty statistics by region in Namibia (Namibia Poverty Mapping, 2012)

Poverty by language

Figure 2.11 below presents the poverty incidence results by main language spoken by the people in a household. The households with the highest incidence of being both poor and severely poor households are those where Khoisan is the main language spoken. High poverty levels were also recorded among the following groups: Caprivi and Rukavango speaking households.

Whilst these are fighting poverty, households where Afrikaans is the main language spoken in the household recorded the lowest poverty incidence.

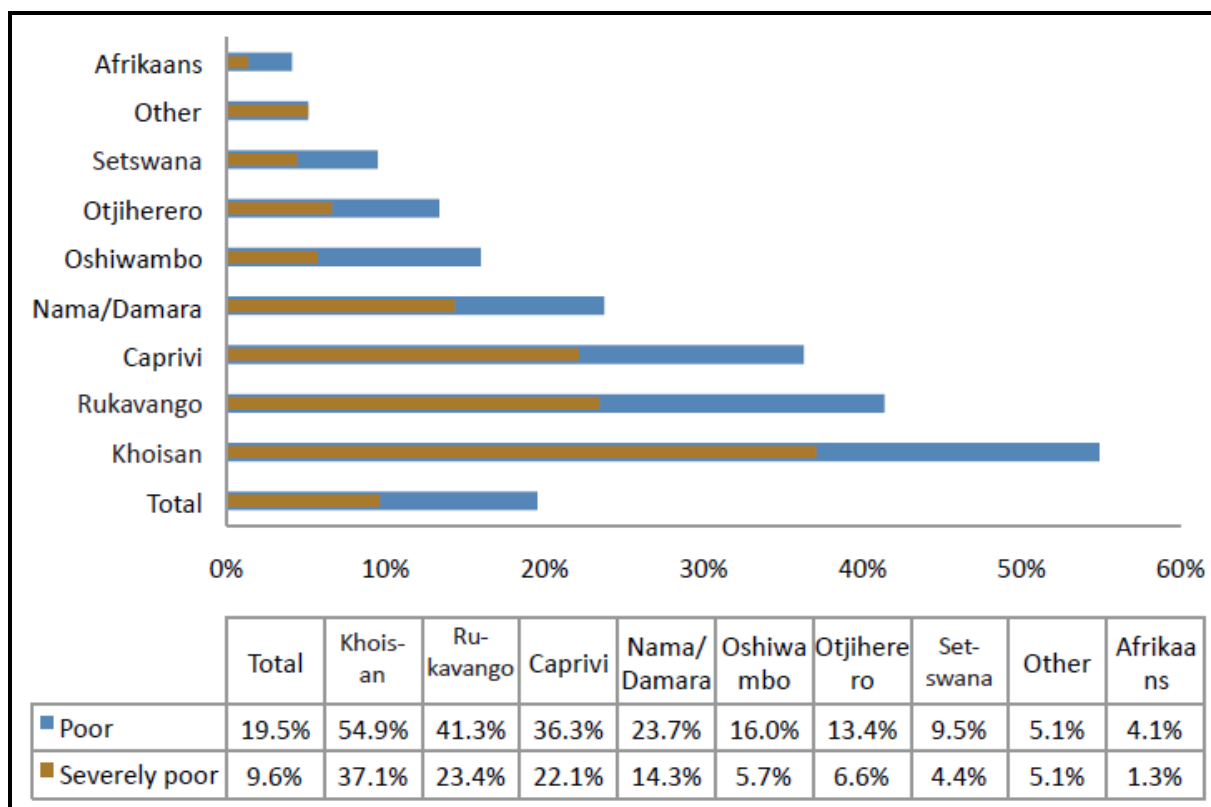


Figure 2.11: Poverty statistics by language in Namibia (NHIES 2009/2010)

Another way of looking at the poverty levels is using the language groups. It takes into account the population size of groups and as well indicates how much each group adds to the total number of the poor in Namibia.

Figure 2.12 below shows that the households where Oshiwambo is the main language spoken in the household contributes greatest to national poverty, with 38%, while Rukavango speaking households add 25% to national poverty, followed by Nama/Damara with 15%, Caprivi with 9% and last but not least Otjiherero with 6%. Some smaller language groups such as Khoisan and Setswana contribute only 4% and 0.1% respectively to the total poverty of the country.

There was a general decrease in the national shares of poverty across the main language spoken in the households, excluding households speaking Caprivi languages. For example, the share of poverty of the Oshiwambo speaking households declined from 50% in 2003/2004 to 38% in 2009/2010.

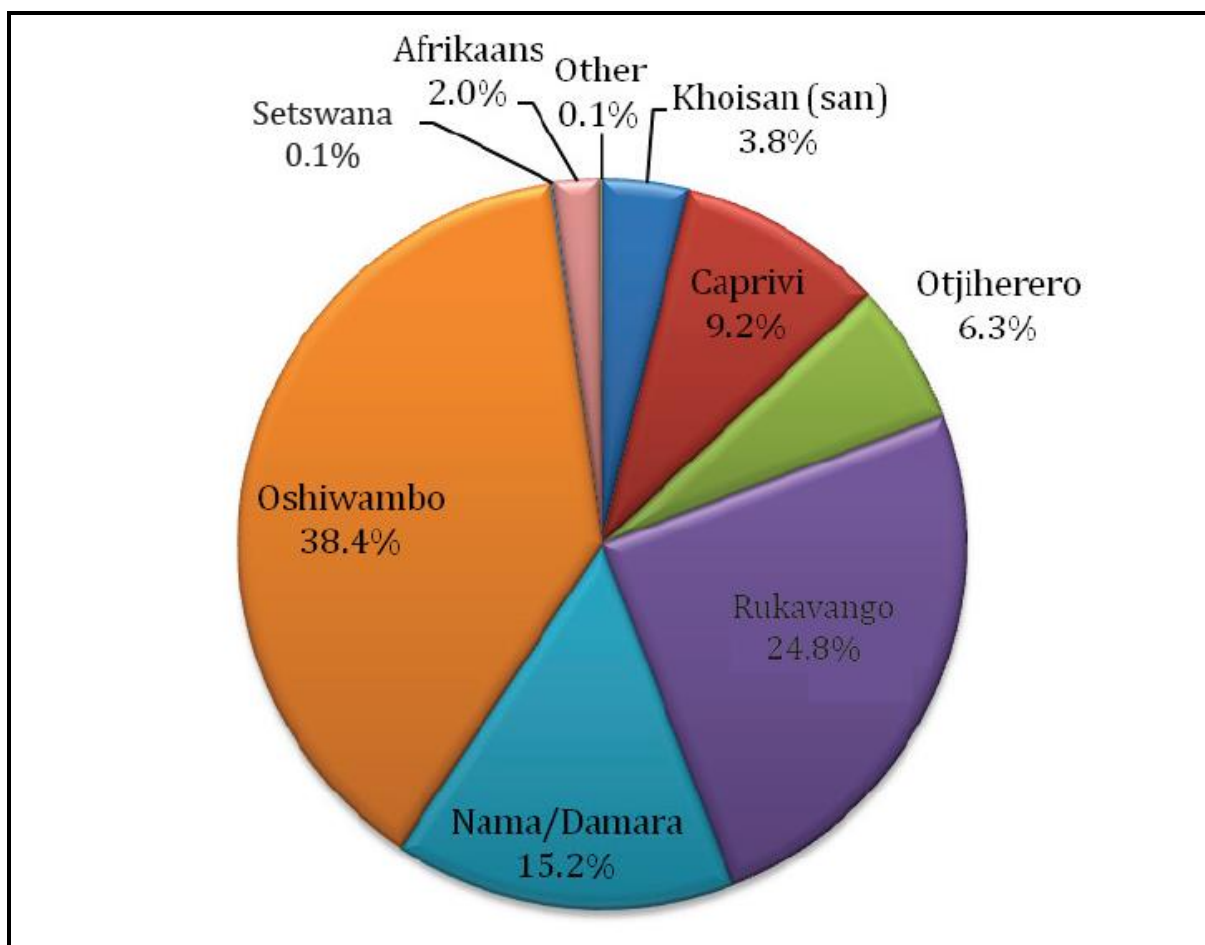


Figure 2.12: Poverty statistics by languages whose poverty levels are the highest in Namibia (NHIES 2009/2010)

Poverty and education

The association between the level of education of the head of household and household poverty can be seen in the figure 13 below. The highest poverty incidence was found in households whose head had no formal education, where 34% of the households are found to be poor and 18% are found to be in severe poverty. The poverty incidences dropped to 26% and 11% when the household head has primary or secondary education, respectively.

The incidence of poverty therefore declines as the level of education of the household head increases, to the extent that households whose heads have tertiary education have very low chances of poverty.

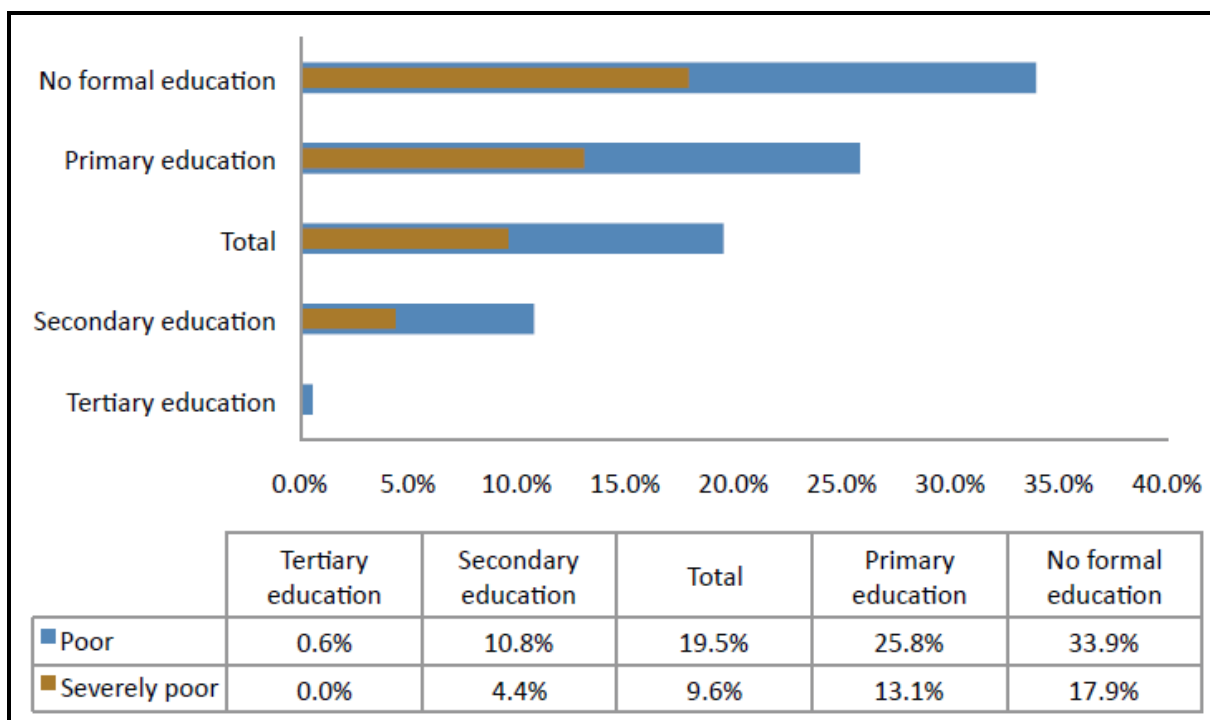


Figure 2.13: Poverty statistics by education in Namibia (NHIES 2009/2010)

Poverty by main source of income

Correlation between poverty and main source of income are also shown in the graph below. Households whose main source of income is pensions have the highest level of poverty while lowest poverty levels of poverty are found in those households whose main source of income is wages or salaries or business. The incidence of poverty of households that rely on pension was 33% and for households which rely on subsistence farming was 31%, and lastly among wage and salary earning households it was 10%.

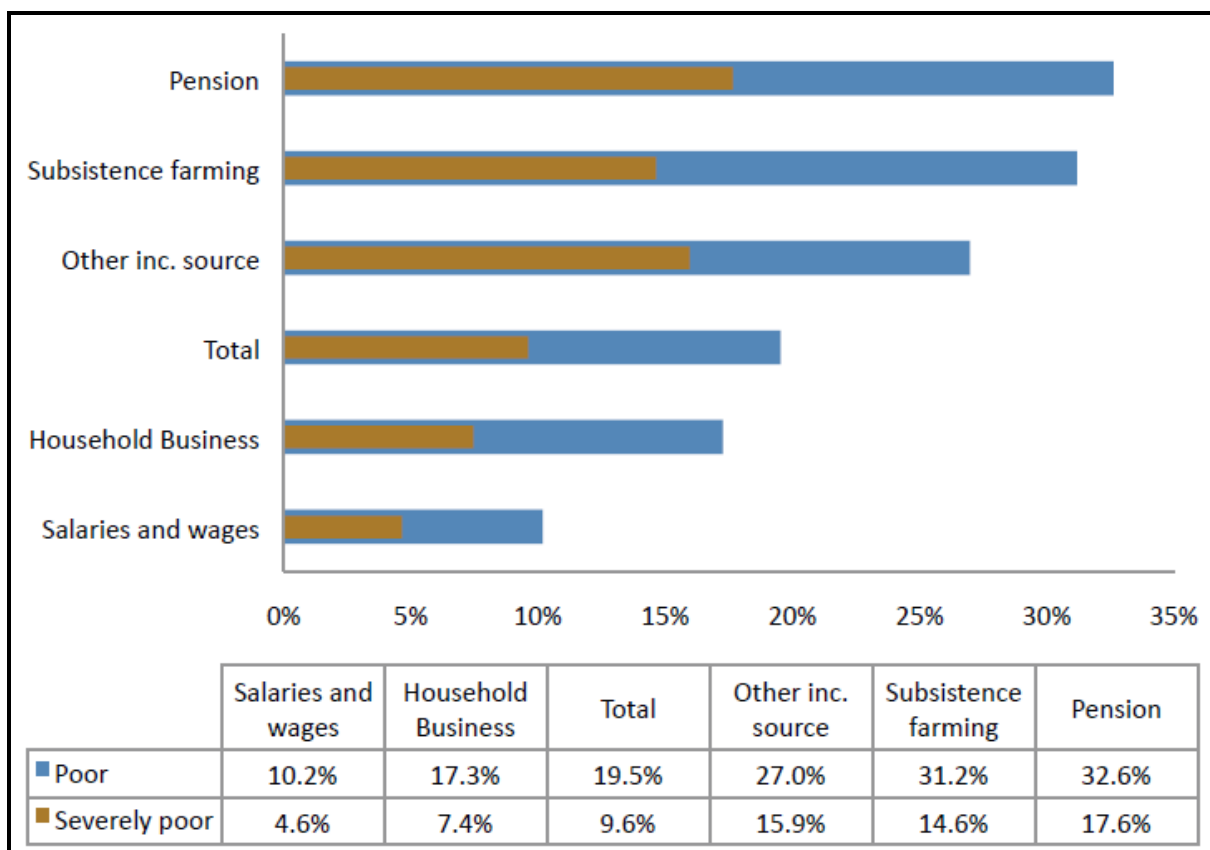


Figure 2.14: Poverty statistics by income in Namibia (NHIES 2009/2010)

Poverty for households with children and orphans

Incidence of poverty and the severity of poverty by composition of households is shown in the figure below. In households where there are quite a number of children, the poverty incidence is quite higher than the national average and poverty is also very high in households with orphans (34%). The same pattern applies among the severely poor households.

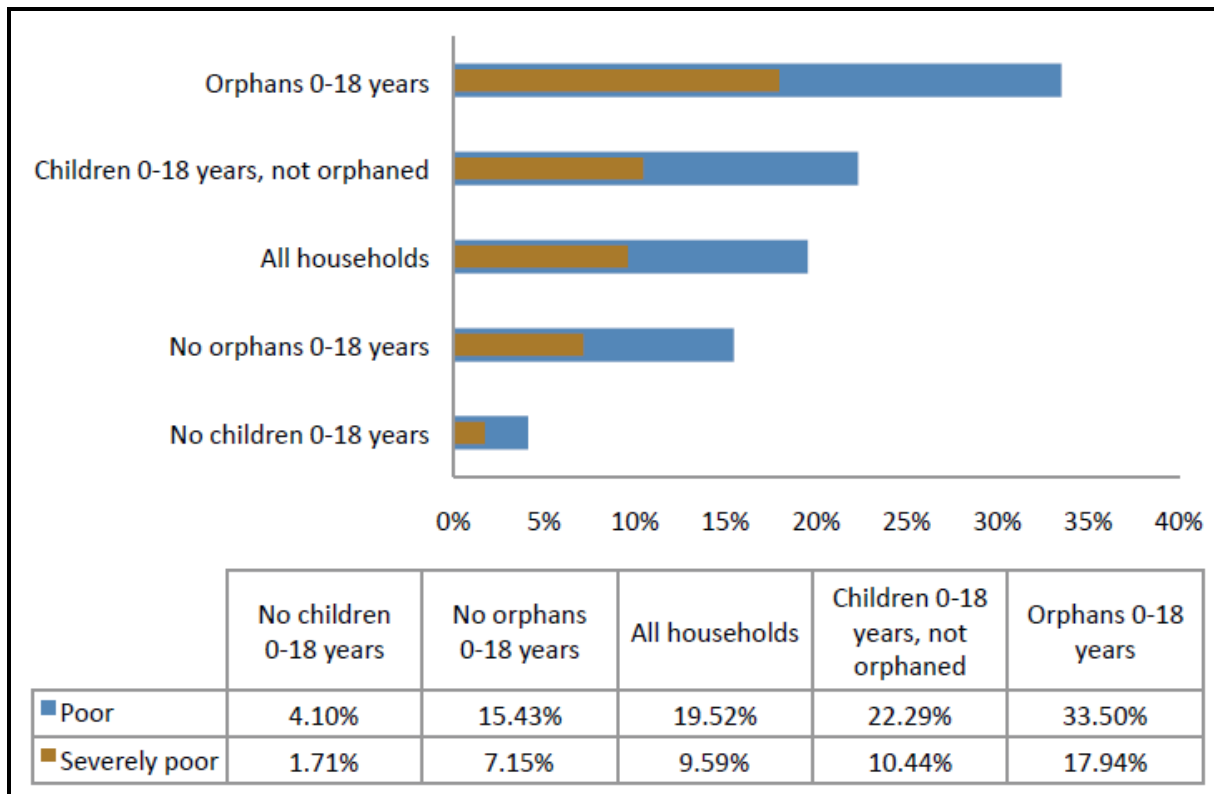


Figure 2.15: Poverty statistics for households with children and orphans in Namibia (NHIES 2009/2010)

Effect of poverty on Namibia's economy

The rise in the poverty rate in a developing country like Namibia can cause serious threats to the economic stability and peace of the nation. Generally, poverty has a major impact on the living conditions of people and it affects the unity of families. Poverty causes hopelessness in people and this can result in other social evils such as violence, crime, alcoholism, prostitution and family break ups. Poverty also increases the risk of homelessness.

Rises in the costs of living also make poor people less able to afford basic items. Poor individuals usually spend a greater part of their budgets on food than their richer counterparts. In return, poor households and those near the poverty line can be mainly vulnerable to increases in food prices.

2.19. Structural equation modelling-SEM

In order to match the social theory of poverty, rigorous mathematical and statistical tools need to be used. This section discusses the tools and techniques used.

Structural equation modelling (SEM) is a statistical technique that allows mostly social scientists and researchers to quantify and test scientific theories (Pugesek, Tomer, & Von Eye, 2003). Structural equation modelling (SEM) refers to a diverse set of mathematical models, computer algorithms and statistical methods that fit networks of constructs to data. Structural equation modelling is a general, chiefly linear, cross-sectional statistical modelling technique. It is a multivariate statistical analysis method that is used to analyse structural relations. This technique is the combination of factor analysis and multiple regression analysis and it is used to analyse the structural relations between measured variables and unmeasured (latent) constructs. Statistically, it signifies an extension of general linear modelling (GLM) procedures such as the ANOVA as well as multiple regression analysis. One of the primary benefits of SEM is that it can be used to study the relations among latent (unmeasured) constructs that are indicated by multiple measures. It is also applied to both experimental and non-experimental data, as well as cross-sectional and longitudinal data. SEM takes a confirmatory (hypothesis testing) approach to the multivariate analysis of a structural theory, one that stipulates causal relations among multiple variables (Lei & Wu, 2007). SEM can be seen as a combination of regression analysis (including systems of simultaneous equations) and factor analyses (Hans, 2007).

Latent variables are variables that are not directly observable or measured. Latent variables are indirectly observed or measured, and hence they are inferred from a set of observed variables that we actually measure using tests, surveys, and so on. The observed, measured, or indicator variables are a set of variables that we use to infer the latent variable or construct.

Variables, whether they are observed or latent, can also be defined as either independent or dependent.

An independent variable is which is not influenced in anyway by any other variable in the model. A dependent variable is which that can be influenced by another variable in the model.

SEM techniques are considered to be a major component of applied multivariate statistical analyses and they are used by economists, biologists, educational researchers, medical researchers, marketing researchers and a variety of other social and behavioural scientists. Although the statistical theory that underlies the techniques was developed decades ago, a considerable number of years passed before SEM could receive the widespread attention it holds recently. One reason for the latest attention is the availability of specialised SEM programmes (e.g. LISREL, EQS, AMOS, Mplus, RAMONA, Mx, and SEPATH). Another reason has been the publication of several introductory and advanced writings on such as the journal devoted exclusively to SEM entitled *Structural Equation Modelling: A Multidisciplinary Journal* (Pugesek et al. , 2003).

There are at least four main reasons for the popularity of SEM. The first reason suggests that researchers are becoming more aware of the essentials of using multiple observed variables to better understand their area of scientific researches. A second reason involves the greater appreciation given to the validity and reliability of outcomes from measurement instruments. Specifically, measurement error has become a major concern in many disciplines, but measurement error and statistical analysis of data have been treated separately. Structural equation modelling techniques clearly take measurement error into account when statistically analysing data. A third reason refers to how structural equation modelling has developed over the past 30 years, especially the ability to analyse the more advanced theoretical SEM model. Finally, SEM software programmes have become increasingly user friendly.

The two goals of SEM:

- 1) To appreciate the patterns of association/covariance among a set of variables
- 2) To explain variance as much as possible with the model specified (Kline, 1998).

SEM is affected by:

Measurement scale, restriction of range in the data values, outliers, missing data, non-normality and nonlinearity of data affect the variance/covariance among variables and thus can influence the SEM analysis.

- **Measurement scale**

Measurement scale of the variables needs to be taken into consideration when computing statistics such as correlations, means and variances.

- **Missing data**

The missing data on one or more variables needs to be put into consideration as this can disturb SEM results. Cases may be lost with list wise deletion, whereas pairwise deletion is mostly problematic (e.g., sample sizes differences), and therefore modern imputation methods are highly recommended.

- **Outliers**

Outliers also need to be considered as they can affect statistics such as correlations, means and variances. This statistics can be deleted, explained or accommodated. They can be detected by methods such as box scatterplots, plots, histograms or even frequency distributions.

- **Linearity**

Variables must be linearly related because if they are not linearity related this can reduce the degree of correlations. This can also be noticed by simply plotting a scatterplots. This can be overcome by either deleting outliers or by transformation.

- **Non-normality**

Non-normality may also affect results of SEM statistics. This is important and needs to be put under consideration. Non-normality can be detected by multivariate tests, univariate tests, and kurtosis and skewness statistics. Therefore, it can be dealt with by additional sampling, transformations, normalising scores, bootstrapping or alternative methods of estimation.

SEM analysis follows logical sequence of 5 steps or processes: model specification, model identification, model estimation, model testing, and model modification.

Major applications of structural equation modelling include:

1. *Causal modelling, or path analysis*, hypothesises causal relations among variables and tests the causal models with a linear equation system. Causal models may involve either latent variables, manifest variables or both;
2. *Confirmatory factor analysis*, is like an extension of factor analysis in which specific hypotheses about the structure of the inter-correlations and factor loadings are both tested;
3. *Second order factor analysis*, a variation of factor analysis in which the correlation matrix of the common factors is itself factor analysed to provide second order factors;
4. *Regression models*, an extension of linear regression analysis in which regression weights may be constrained to be equal to each other, or to specified numerical values;
5. *Covariance structure models*, which hypothesises that a covariance matrix has a certain form. For instance, one can test the hypothesis that all variables have equal variances with this method;
6. *Correlation structure models* hypothesise that a correlation matrix has a certain form. A simple example is when a researcher hypothesises that the correlation matrix has the structure of a circumplex (Wiggin, Steiger, & Gaelick, 1981).

Many other different kinds of models fall into any of the above categories, so structural modelling as an enterprise may be very difficult to characterise. Most SEM can be expressed as path diagrams. Consequently even beginners to SEM can perform complicated analyses with minimum knowledge or training.

2.20. General considerations of SEM

Let m variables be observed upon n units. The m variables are further divided in J blocks or subsets of k_j variables which are supposed to be relevant for defining the phenomenon. Each of these J blocks is meant to describe a theme of the general concept. We shall label these blocks by X_j and they shall be considered as matrices with dimension $(n \times k_j)$. As mentioned earlier above, structural models deal with either observed variables (manifest variables) or latent variables (unobserved variables) or sometimes both. Since the latent variables are not observed, they exist because of the relationship they have with the observed variables. A structural model needs 2 types of models: the outer model (measurement model) which connects the observed (manifest) variables to the latent variables and inner model (structural model) which connects unobserved variables between them.

2.20.1. The measurement model (outer model)

When the blocks are determined, the relationship between latent variables and manifest variables must be specified and it should correspond to the X_j blocks. There are three ways: the formative way, the reflective way and the Multiple effect Indicators for Multiple Causes way.

In the reflective way, the observed variables are known to be like the “reflection” of their latent variables (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005). Each manifest variable is related to its latent variable as follows:

$$x_{jh} = \pi_{jh}^0 + \pi_{jh} \xi_j + \varepsilon_{jh} \quad \forall h = 1, \dots, k_j \quad 2.5$$

π_{jh}^0 = Constant term; π_{jh} = regression coefficient; ε_{jh} = residual term. The formative way here is that the latent variables represent the “reflection” of the manifest variables which belong to block X_j , and they are thus a result of these (Tenenhaus et al., 2005). In this type, the latent variable is a linear function of the manifest variables which generate it:

$$\xi_j = \sum_{h=1}^{k_j} \varpi_{jh} x_{jh} + \delta_j; \quad 2.6$$

ϖ_{jh} ($h = 1, \dots, k_j$) = Multiple regression coefficients of ξ_j on; δ_j = residual term.

2.20.2. The structural model (inner model)

The structural model (inner model) as opposed to the measurement model which deals with the relationships between latent variables and their manifest, the structural model deals with the mode of estimation between the latent variable (Stan & Saporta, 2001). The relationships between latent variables have a form:

$$\xi_j = \beta_j^0 + \sum_{i=1}^J,_{i \neq j} \beta_{ji} \xi_i + \zeta_j \quad \forall_j = 1, \dots, J \quad 2.7$$

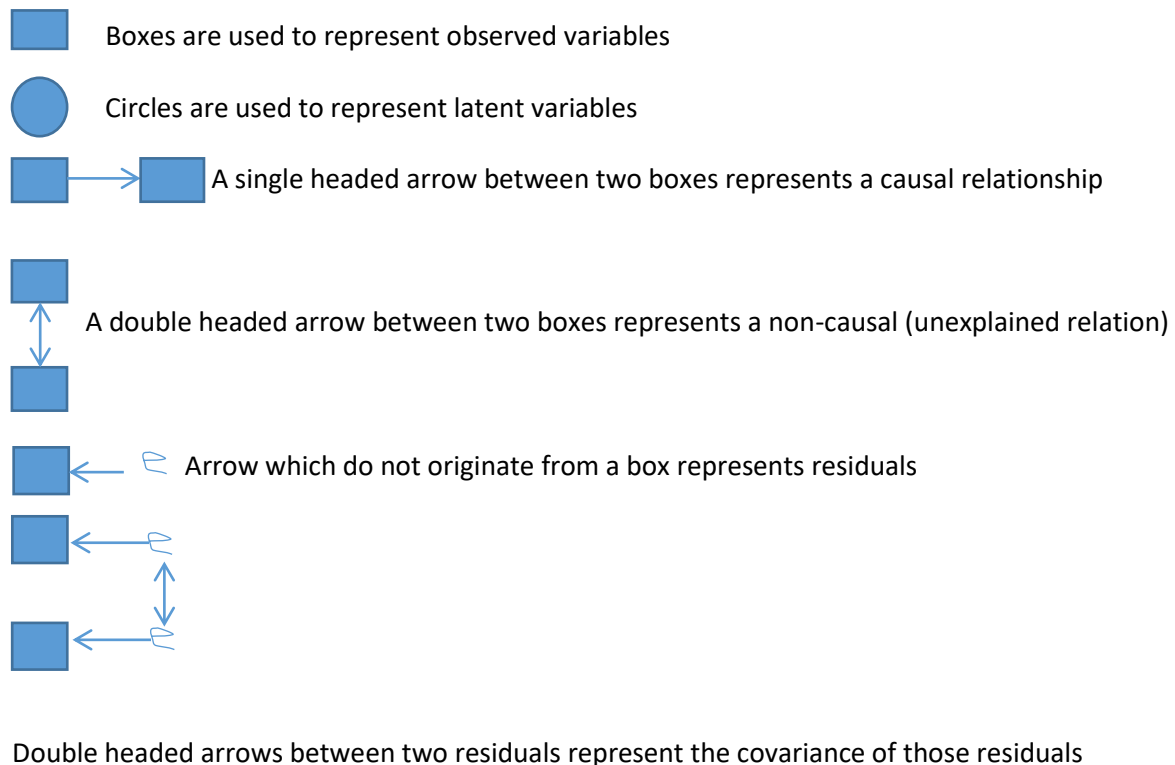
β_j^0 = is the constant term;

β_{ji} = is the regression coefficient;

ζ_j = is the residual term.

Wold (1996) formalised the concept of partial least squares. Wold's (1996) algorithm involved estimating the latent variables (inner estimate and outer estimate) and the structural equations by ordinal Least Squares multiple regression with an iterative process. The correlation coefficient between the latent and manifest variables lies between ± 1 (Stan & Saporta, 2001).

SEM Notations



2.21. Multilevel models

Multilevel models also known as nested data models, hierarchical linear models, mixed models, random coefficient, random parameter models, random-effects models, or split-plot designs, are statistical models of parameters that differ at more than one level. Multilevel regression models are used when the data of the concept in question is hierarchical with elementary units at level one nested in clusters at level two, which in turn may be nested in (super) clusters at level three, and so on. The random effects or latent variables are interpreted as a latent heterogeneity at the different levels which prompt dependence among all lower-level units that belong to a higher-level unit (Rabe-Hesketh & Skrondol, 2009).

2.21.1. Uses of multilevel models

Multilevel models have become popular and have been used extensively in many fields of study. The models have been used extensively in many fields including in geographical research and education research to estimate the variance separately between students between within the same school. In psychological research applications, the multiple levels can be items in instruments, individuals, and families.

In sociological research applications, they can be used to examine individuals fixed within regions or even countries. In organisational psychology studies, data from individuals is nested within functional units or teams.

2.21.2. Alternative ways of analysing hierarchical data

There exists other ways on how hierarchical data can be analysed as well, though some have some limitations. First, if a look into the traditional statistical techniques, one can disaggregate higher order variables to the lower or individual level, and then carry an analysis at this individual level. There is a problem with this approach though as it violates the independence assumption, and this can lead to biased results which is known as the fallacy of atomistic.

An alternative is to analyse hierarchical data is through a random-coefficients model. This method assumes that each group has a different regression model, with its own slope and intercept. Because different groups are sampled, the model then assumes that the slope and intercept are also randomly sampled from a group of different populations with different slopes and intercepts. This allows the analysis in which one can assume that intercepts are allowed to vary while the slopes are fixed. However, this presents can cause a problem, as group components are independent between groups but dependent within groups while individual components are independent.

This also allows the analysis in which the slopes are random but the correlations of the error terms are dependent on the values of the individual level variables.

Thus, the problem of using a random-coefficients model in order to analyse nested or hierarchical data is that it's still not possible to perform it on higher order variables.

2.22. Multilevel models and structural equation modelling (SEM)

The popularity of multilevel modelling and structural equation modelling (SEM) is an outstanding feature of quantitative research in the behavioural, social and medical sciences. Although they were developed separately and for different purposes, structural equation modelling and multilevel modelling have significant communalities as both the approaches include unmeasured or latent variables or random effects to explain, and therefore induce correlations among variables (Rabe-Hesketh & Skrondol , 2009).

2.22.1. Multilevel structural equation modelling:

A multilevel structural equation modelling is a synthesis of structural equation modelling and multilevel models is an important method required for valid statistical inference when the elements of observation form a hierarchy of nested clusters and some of these variables of interest are not singularly measured but are measured by a set of items (fallible instruments) (Hox, 1995).

Multilevel structural equation modelling also allows researchers to examine or explore exciting research questions which could not be validly addressed. For example, we can look at an important question that arises in education: does student ability depend on teacher quality? Multilevel structural equation models can be specified using either multilevel regression models or structural equation models as the starting point. There are a lot of advantages of using the multilevel regression approach which includes the fact that missing data are easily accommodated and data need not be balanced.

Social research often concerns problems to investigate the relations between individuals and the society they live in. As it is generally known, individuals interact with social connects to which they belong and also that the property of these groups can be influenced by social groups to which they

belong. This means that those individuals are influenced by the social groups to which the individuals belong and in return that group's properties are influenced by individuals that make up that group.

Generally the social groups and individuals are conceptualised as a hierarchical system of groups and individuals, and with this individuals and groups are defined at different levels of this hierarchical system. Usually, such systems may be observed at separate hierarchical level, and as a result these variables may describe the individuals and variables that describe the social groups; this is the kind of research that is now known to as multilevel research (Hox, 1995).

The arguments for the use of multilevel models to analyse hierarchical data are well known (Hox, 1995). When units are clustered the ordinal regression analysis are not suitable since the underlying hypothesis of independence of the observations will be violated.

2.22.2. Single-level factor model

The general linear model has been extended to allow complex nested data structures. The multilevel model (MLM) can be expressed as a set of equations operating at two different levels. For a continuous measure y assessed on individual i nested within group j , the level one equation can be expressed as:

$$y_{ij} = \beta_{oj} + \sum_{p=1}^p \beta_{pj} x_{pij} + r_{ij} \quad 2.8$$

where:

β_{oj} is the level one intercept within group j ,

β_{pj} is the regression coefficient of y_{ij} on the p^{th} variable x within group j , and

r_{ij} is the residual for individual i within group j .

Given that the slope and intercept coefficients varies randomly over the group and that it can be regressed upon one or more level 2 variables denoted w such that;

$$\beta_{0j} = \gamma_{00} + \sum_{q=1}^0 \gamma_{0q} w_{qj} + u_{0j}, \quad 2.9$$

$$\beta_{pj} = \gamma_{p0} + \sum_{q=1}^0 \gamma_{pq} w_{qj} + u_{pj}, \quad 2.10$$

where γ s represent the coefficients that are fixed for the regression of the random intercepts and slopes from the level one equation (e.g., β_{0j} and β_{pj}) on the level-2 predictor w_j , and u_{0j} and u_{pj} represent the related level two residuals.

The level two equations can be substituted into the level 1 equation to obtain the much reduced form expression. In matrix terms the level one and level two equations can be expressed as follows:

$$y_j = X_j \beta_j + r_j, \quad 2.11$$

$$\beta_j = W_j \Gamma + u_j, \quad 2.12$$

That can be reduced to the form

$$y_j = X_j W_j \Gamma + X_j u_j + r_j, \quad 2.13$$

where y_j is the response vector for group $j = 1, 2, \dots, J$, X_j is the designed matrix for the set of all level one predictors, W_j is the design matrix for the set of level 2 predictors, Γ is the vector of fixed regression coefficients, and u_j and r_j are the vectors of level two and level one residuals, respectively (Curran, 2003). But more importantly, it is assumed that the residuals and random effects are independent and multivariate normally distributed as

$$r_j \sim N(0, \sum_{rj})$$

$$u_j \sim N(0, T).$$

The covariance matrix of the random effects T is usually unstructured while the residuals are constrained to be independent and homoscedastic (i.e., $\sum_{rj} = \sigma^2 I_{Nj}$), although these specific forms of T and \sum_{rj} are often for convenience and are usually not required. The MLM provides a flexible and powerful analytic framework for testing a variety of interesting questions in the social sciences.

Since the nesting in the data is modelled clearly through the disaggregation of the level one and level two covariance structures, the model results in unbiased coefficients and more accurate standard errors. Importantly, disaggregated effects may be estimated by including predictors in either of the levels. These two advantages combined make the MLM the most important analytic tool for the applied researcher (Curran, 2003).

The factor model can be defined either directly or through the above covariance structure. Below is an example of an 'independent clusters' two factor model (where each indicator measures one common factor) for $I=6$ which is:

$$\underbrace{\begin{bmatrix} \nu_{1j} \\ \nu_{2j} \\ \nu_{3j} \\ \nu_{4j} \\ \nu_{5j} \\ \nu_{6j} \end{bmatrix}}_{\nu_j} = \underbrace{\begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \\ \beta_5 \\ \beta_6 \end{bmatrix}}_{\beta} + \underbrace{\begin{bmatrix} 1 & 0 \\ \lambda_{21} & 0 \\ \lambda_{31} & 0 \\ 0 & 1 \\ 0 & \lambda_{52} \\ 0 & \lambda_{62} \end{bmatrix}}_{\Lambda} \underbrace{\begin{bmatrix} \eta_{1j} \\ \eta_{2j} \end{bmatrix}}_{\eta_j},$$

The first three sets of indicators measure the first factor and the remaining indicators measure the second factor. A path diagram for this model is given as seen on independent clusters in the two factor model figure below, where the latent variables are represented with circles and the observed variables are represented with rectangles. For continuous observed variables, the long arrows represent linear relationships between the responses and their common factors and the short arrows represent linear relationships between the responses and their unique factors. The other response types in the short arrows represent residual variability, while the long arrows represent possibilities of nonlinear relationships depending on the link function that follow, for instance a Poisson distribution or Bernoulli (Rabe-Hesketh & Skrondol, 2004).

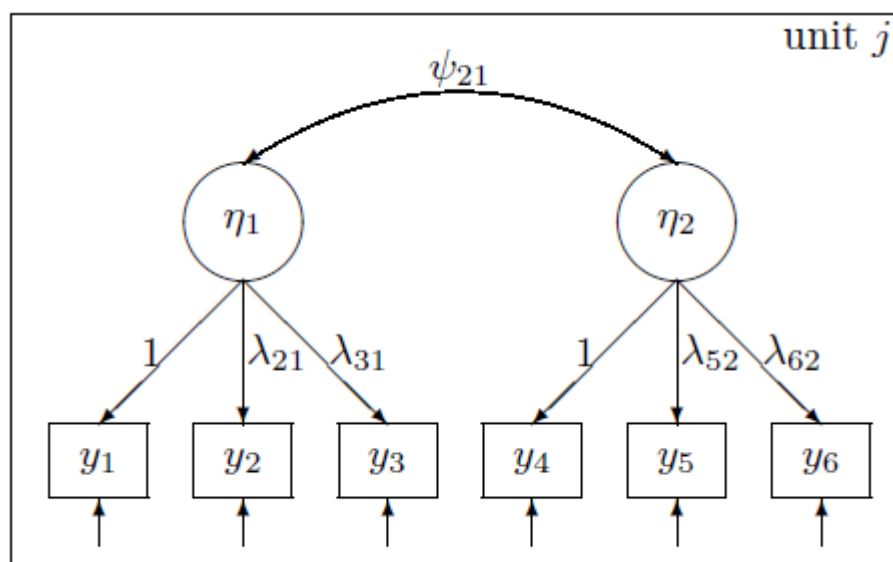


Figure 2.16: Independent clusters two-factor model (Rabe-Hesketh et al., 2004)

2.22.3. Two level factor models

Multilevel factor models are typically used if the subjects of interest are clustered in one way or another. A simple example will be a household which is clustered in region.

2.22.4. Within and between formulation

The two level factor model for subjects j in clusters k is often formulated in terms of the between cluster and within cluster covariance matrices, B and W , respectively (Longford & Muthen, 1992).

For continuous latent or observed responses, the following two stage formulation may be used.

The path diagram of two-level factor model in between and within formulations is illustrated in figure 2.17 below:

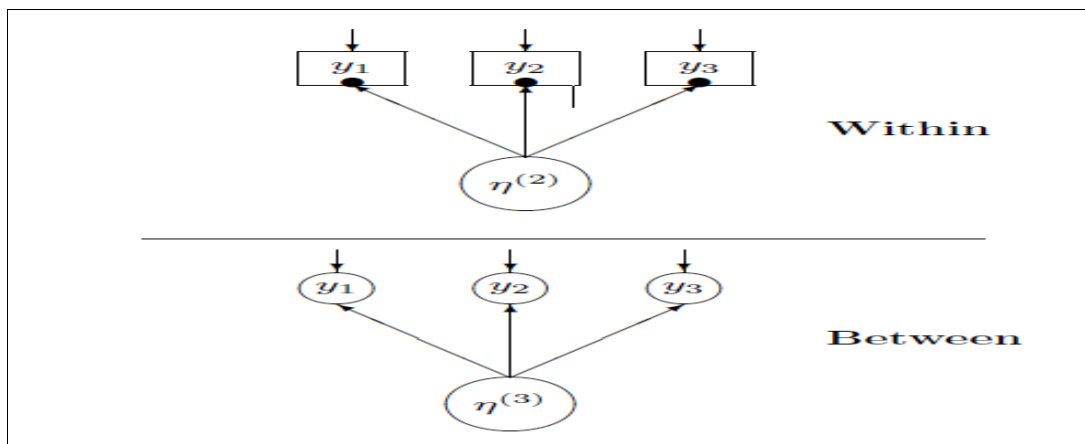


Figure 2.17: SEM Within and between formulation (Rabe-Hesketh et al., 2004)

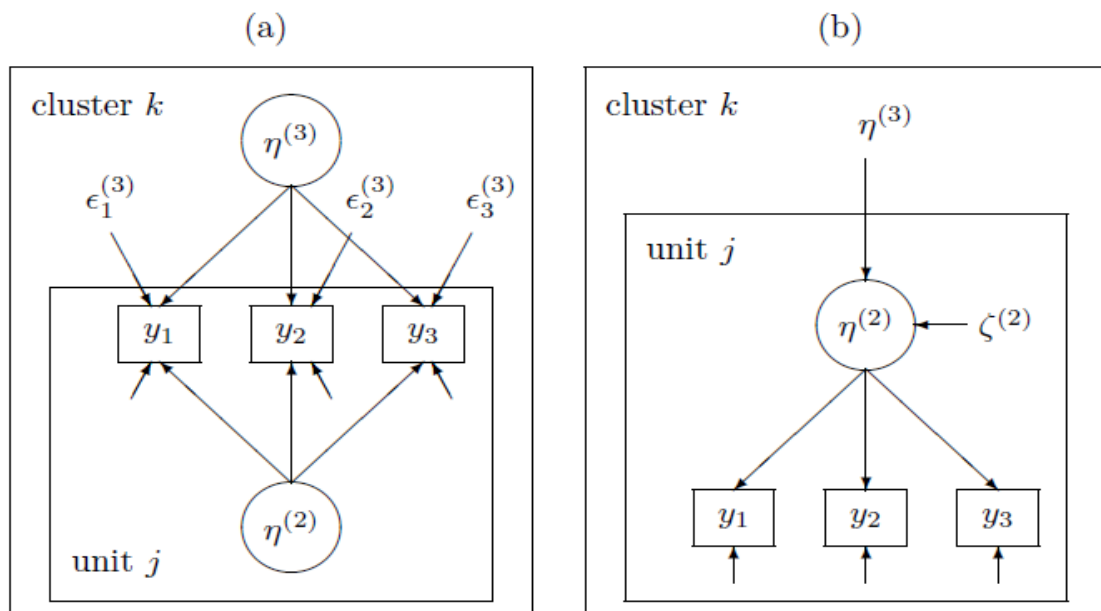


Figure 2.18: A general two-level factor model (a) and variance components factor model (b)

(Rabe-Hesketh et al., 2004)

There are different ways in which multilevel structural equation models can be specified. The most and common approach is the traditional two way stage approach described for factor models. In this case different structural equation models are specified for the between and within covariance matrices (Lee & Shi, 2001). The most recent application of this method in education was described by Everson and Millsap (2004). In contrast, the approach encouraged in this study is based on including unobserved variables in generalised linear mixed models or random coefficients. One possibility is to specify a conventional random coefficient model but let the response variable be an unmeasured variable, for example ability. The intercept and possible effects of covariates are specified as varying randomly between clusters (Fox & Glas, 2001). This extension of the unidimensional variance components factor model includes covariates and possible random covariates coefficients. The model may include direct paths from cluster level latent variables to subject level latent variables. While similar models can often be specified through separate models for the between and within covariance matrices, they also require a big number of constraints, including those of the nonlinear constraints (Rabe-Hesketh & Skrondol, 2004). Moreover, the simpler structure would not be seemingly from separate diagrams for the between and within models. Remaining within the random coefficient framework, one can also let covariates be the latent variables. If these covariates are some specific clusters, the model may include responses varying at many different levels. This situation of accommodating within framework is suggested by Goldstein and McDonald (1988), also suggested continuous responses. Fox and Glas (2003) describe a model where both cluster level and subject level covariates are latent and where the measurement models are known as the item response models. Unfortunately, the traditional two stage formulations cannot handle responses fluctuating at different levels. This may be seen as rather a limitation of the multilevel structural equation model. Rabe-Hesketh et al. (2004) developed the Generalized Linear Latent and Mixed Modelling (GLLAMM) framework which involves the response model and a structural model. The response model has the form as seen below:

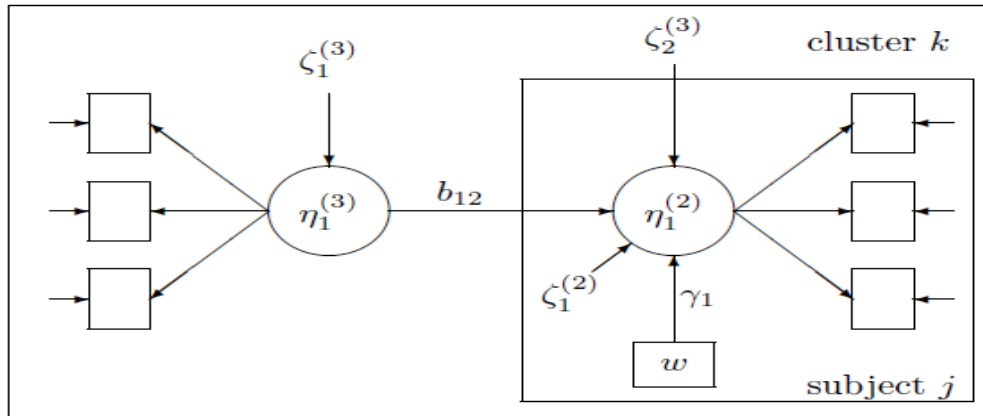


Figure 2.19: Generalized Linear Latent and Mixed Modelling (GLLAMM)- Response model (Rabe-Hesketh et al., 2004)

Multilevel structural equation model with latent dependent variable and latent covariate at level 2

Source: Skrondal and Rabe-Hesketh, 2004

L levels of nesting

$$v = \mathbf{x}\beta + \sum_{i=2}^L \sum_{m=1}^{M_i} \eta_m^i \mathbf{z}_m^i \lambda_m^i$$

2.14

Indices for units at different levels were omitted for notational simplicity. The above model allows specification of measurement models or both, random coefficient models or as hybrid model (Rabe-Hesketh et al., 2004).

2.22.5. Uses of multilevel models

Multilevel models have been used in geographical research as well as education research; it is used to estimate distinctly the variance between pupils in a school, and the variance between the schools; while in sociology the multilevel model is used to examine individuals fixed within regions or even countries. For organisational psychology researches, data from individual persons must often be nested within teams or any other functional units.

2.23. Alkire Foster (AF) method

The Alkire Foster (AF) method was developed by Sabina Alkire and James Foster at Oxford Poverty and Human Development Initiative (OPHI). It is a flexible technique for measuring wellbeing or poverty. It incorporates different indicators and dimensions to create measures that are specific to particular contexts. This simply means that the AF method can be used in different ways:

- **Poverty and wellbeing measures:** The Alkire Forster method can be used to create regional, national or even international measures of wellbeing or poverty by incorporating indicators and dimensions that are made to fit the context. It has been widely used to measure poverty. Countries like Colombia Mexico and Bhutan have used the AF to create their national measures of poverty and individual well-being.
- **Monitoring and evaluation:** The AF method is also a great tool that is used to monitor the effectiveness of different types of programmes over a period of time. For instance, to monitor the effectiveness of a fair-trade programme, a measure can be designed to look at criteria such as wages, quality of produce, length of contract, number of people, timeliness of delivery, and so on; this will show which programme is doing best and in which area.
- **Target poor individuals as beneficiaries of services or conditional cash transfers:** The AF method can also be used in order to target individuals for public service programmes or conditional cash transfers (CCTs) against all set criteria.

2.24. Linear Structural Relations-LISREL

Linear structural relations (LISREL), is a statistical software package used mostly in structural equation modelling for latent and manifest variables.

LISREL was developed in the 1970s by Karl Jöreskog, then an Educational scientist at Testing Service in Princeton, New Jersey and Dag Sörbom, later both professors at Uppsala University in Sweden.

LISREL is an application provided by windows for performing structural equation modelling as well as other related linear structure modelling (e.g. multilevel linear and non-linear modelling, multilevel structural equation modelling, etc.).

LISREL for window is helpful in importing the external data in various formats like SPSS, MS Excel, etc. as a PRELIS system file (PSF). The software uses graphic files with the default extension called PTH (path) in order to capture the path diagram. It is also very useful in fitting the measures model to the data.

LISREL handles a wide array of models and problems. These may include;

- Models with measurement error
- Non recursive models
- Helping in solving multivariate analysis problems
- Useful for working on multiple group comparisons
- Useful in the tests of constraints (e.g. a subset of coefficients equals zero, parameters are equal across all populations, two or more coefficients equal each other)
- Confirmatory factor analysis models
- Ordinal regression
- Hierarchical linear models

- This software can be used in the decomposition of certain effects that are mostly done manually by the researcher. In some so much complicated models, however, the decomposition of these effects can be quite difficult.
- One of the qualities that are common in the LISREL model is that the models neglect the means and also regard all variables to be centred within their group means. This, in turn, results in having the models with zero means. This is usually done in order to lighten the complexity in the analysis.
- When a multiple group model is being worked on with the help of LISREL, then it will always give the same output of the process as is obtained by running a regression with some dummy variables in SPSS.
- Furthermore, the tool helps the researcher in providing a fairly flexible and influential means for the examination of several group differences. The tool also provides indicative information called modification indices which help the researcher in identifying the equality of constraints.

However, recently LISREL has found its purpose in statistical applications no longer limited to SEM only.

The latest LISREL for Windows includes the following applications;

- LISREL for modelling structural equation
- PRELIS for basic statistical analyses and data manipulations
- MULTILEV for hierarchical linear and non-linear modelling
- SURVEYGLIM for generalised linear modelling
- CATFIRM for formative inference-based recursive modelling for categorical response variables.
- CONFIRM for formative inference-based recursive modelling for continuous response variables
- MAPGLIM for generalised linear modelling for multilevel data

CHAPTER 3

RESEARCH DESIGN

This chapter gives a detailed description of the methodology employed in this study. Section 3.1. gives details on the data used and Section 3.2. Focuses on the data analysis method used to identify determinants of poverty.

3.1. The data

Data analysis was conducted on secondary data which were obtained from the Namibia Household Income and Expenditure Survey (NHIES) 2009/10 from the Namibia Statistics Agency (NSA). The targeted population was all the households of Namibia, in both rural and urban areas. The population living in institutions, such as hospitals, police barracks, hostels and prisons were part of the survey as well. The aim of the NHIES survey was to collect data on consumption, income and expenditure patterns of households and also other variables linked to socio-economic and demographic characteristics of a household.

The sample design for the survey was a stratified two-stage probability sample, where the first stage units were geographical areas designated as the Primary Sampling Units (PSUs) and the second stage units were the households. The sample frame is stratified first by region followed by urban and rural areas within region. In urban areas further stratification is carried out by level of living which is based on geographic location and housing characteristics. The first stage units were selected from the sampling frame of PSUs and the second stage units were selected from a current list of households within each selected PSU, which was compiled just before the interviews. PSUs were selected using probability proportional to size sampling coupled with the systematic sampling procedure where the size measure was the number of households within the PSU in the 2001 Population and Housing Census.

The households were selected from the current list of households using systematic sampling procedure. The sample size was designed to achieve reliable estimates at the region level and for urban and rural areas within each region. However the actual sample sizes in urban or rural areas within some of the regions may not satisfy the expected precision levels for certain characteristics. The final sample consists of 10 660 households in 533 PSUs. The selected PSUs were randomly allocated.

The study incorporated historical and ethnography approaches. Historical approaches focus on objective evaluation and a systematic collection of the data related to previous occurrences in order to test hypotheses that concern the causes, effects as well as the trends of these events that may assist to explain present occurrences and anticipate future occurrences. These aspects were covered through the Akira and Foster method. Ethnography approaches focus on the sociology of meaning through field remark of socio-cultural phenomena (Udemans, 2013). Typically, the ethnographer focuses on a community at large (JHA, 2014). This was underscored by the use of the multilevel modelling.

The NHIES data was analysed and the output interpreted according to the flow chart in the figure 3.1 below. The fit index from the output model was saved in a database for later use so that it can be replicated as new data becomes available. This can be illustrated in the figure below:

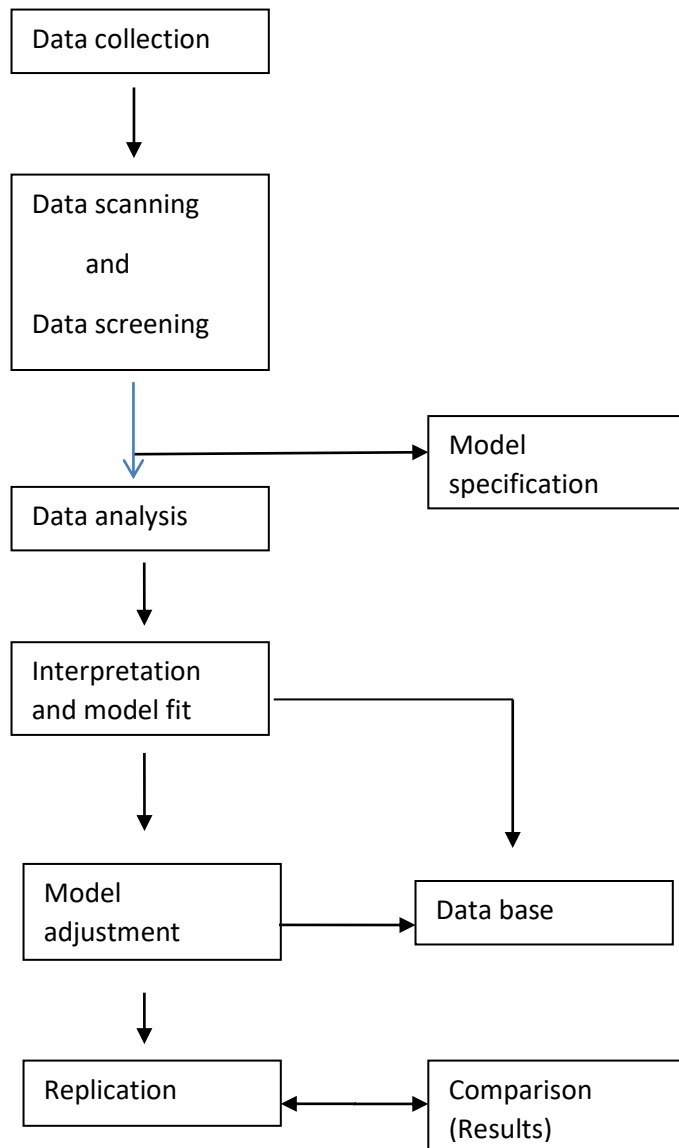


Figure 3.1: Flow chart of the statistical analysis

3.2. Data analysis method

Firstly, the study identified the poverty dimension following the Alkire and Foster method. According to this methodology, poverty falls into the three dimensions as seen in figure 3.2 below:

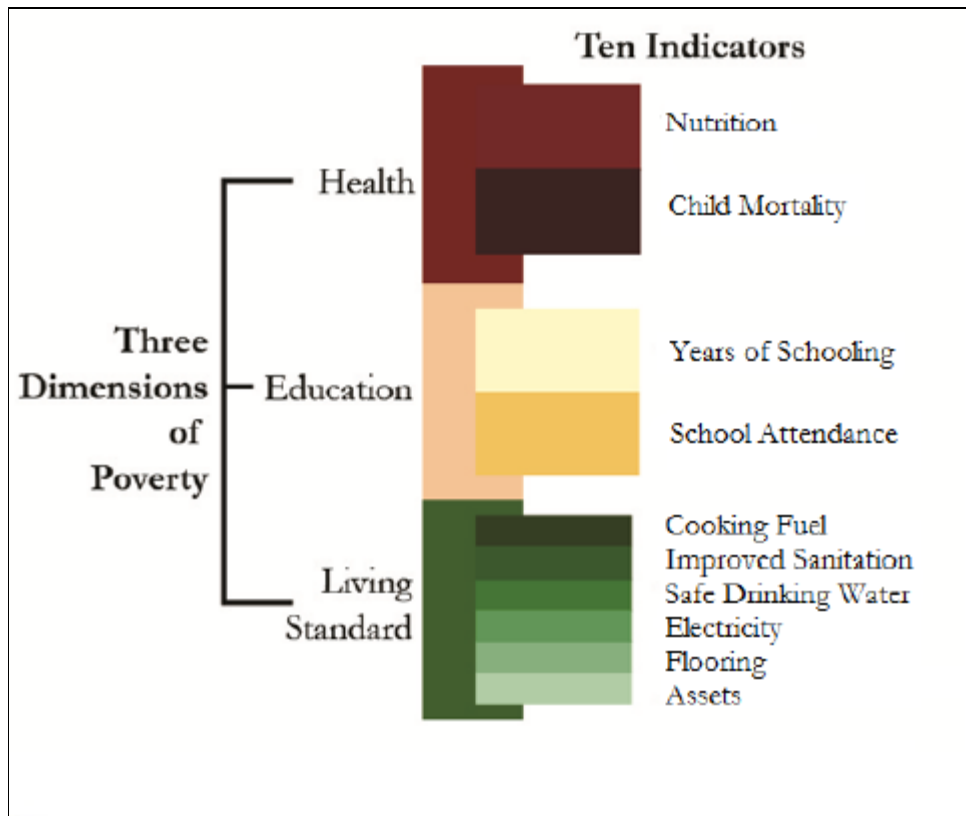


Figure 3.2: The dimensions of Poverty (Alkire & Foster, 2011)

Secondly, from measures identified by the Alkire and Forster method, the study also sought to determine whether the predictors age of household head, gender/sex of head of house, household size, household head's educational level, physical location of the household (rural or urban), main language spoken in the household and ethnicity/region were associated with poverty. To achieve this, the study used binary logistic regression. The binary variable of the household being poor or non-poor was collected during NHIES Survey. The NHIES survey is a survey that collected data on income, consumption and expenditure patterns of households, in accordance with methodological principles of statistical enquiries, which are linked to demographic and socio-economic characteristics of households. A Household Income and Expenditure Survey is the sole source of

information on expenditure, consumption and income patterns of households, which is used to calculate poverty and income distribution indicators.

A Logistic regression model is given by

$$\text{logit}(p) = \ln \left[\frac{p}{1-p} \right] = \beta_0 + \beta_1 V_1 + \beta_2 V_2 + \cdots + \beta_7 V_7 \quad 3.1$$

Where V_1, V_2, \dots, V_7 , were predictor variables that included age of household head, gender/sex of head of house, size of the household, educational level of the head of household, household location (rural or urban), main language spoken in the household and ethnicity/region respectively, and p denoted the probability that the household was poor.

Thirdly, the study combined the variables by Alkire and Forster method as well as the identified seven variables above to measure the structural relationship among endogenous and exogenous variables. To achieve this, the study used structural equation modelling (SEM).

The Standard Structural Equation Model

There are two important equations that describe the general SEM: the measurement equation and the structural equation. The measurement equation is given as

$$y = v + \Lambda \eta + \varepsilon \quad 3.2$$

Where:

y - is a $p \times 1$ vector of p-observed variables,

v - is a $p \times 1$ matrix of measurement intercepts,

Λ - is a $p \times k$ matrix of factor loadings relating the p-observed variables to the k-latent factors,

η - is a $k \times 1$ matrix of latent factor scores, and ε is a $p \times 1$ vector of residuals.

The structural equation is then defined as

$$\eta = \mu + \beta\eta + \zeta \quad 3.3$$

Where:

η is defined as before,

μ is a $k \times 1$ vector of latent factor means and intercepts,

β is a $k \times k$ matrix of regression coefficients among the latent factors

ζ is a $k \times 1$ vector of residuals.

Finally, equation 15 can be substituted into Equation 14 to express the reduced form expression for y such that

$$y = v + \Lambda(\mu + \beta\eta + \zeta) + \varepsilon \quad 3.4$$

Opening up the brackets, and a simple rearrangement

$$y = (v + \Lambda\mu) + (\Lambda\beta\eta) + (\Lambda\zeta + \varepsilon) \quad 3.5$$

Figure 3.3 below illustrates a general framework of the SEM, where the Y s are the predominant factors and the X is the manifest variable.

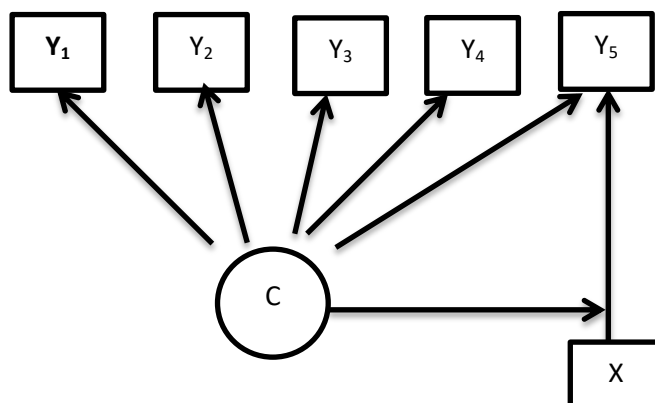


Figure 3.3: A general model of SEM on Poverty

In Figure 3.3, C are the poverty classes, X are the categorical variables (e.g. gender/sex of head of house etc.), Y_1 age of household head, Y_2 size of the household, Y_3 educational level of the head of household, Y_4 household location (rural or urban), Y_5 main language spoken in the household, and Y_6 ethnicity/region.

Lastly, to understand the relationship amongst the unmeasured causes of poverty, the study used multilevel modelling. The multilevel modelling approach is used in the analysis of data that have a clustered or hierarchy structure (Hox, 2005). Poverty is one of the concepts that have a clustered or hierarchy structure.

A multilevel equation model was used to determine whether covariates such as age of household head, gender/sex of head of house, size of the household, educational level of the head household, household location (rural or urban), main language spoken in the household and ethnicity/region had significant influence on poverty based on Level 1 and Level 2 clusters which were house-hold and region clusters. The units at level one might be for example a household that will be nested in clusters at level two, which might be the location (urban/rural) of the household, which in turn may be nested in (super) clusters at level three (e.g. Region), and so forth.

The multilevel model (MLM) can heuristically be expressed as a set of equations operating at two levels (Curran, 2002). For a continuous measure y assessed on individual i nested within group j , the level-1 equation can be expressed as

$$y_{ij} = \beta_{0j} + \sum_{p=1}^p \beta_{pj} x_{pij} + r_{ij} \quad 3.6$$

β_{0j} - is the level-1 intercept within group j ,

β_{pj} - is the regression of y_{ij} on the p^{th} variable x within group j , and

r_{ij} - is the residual for individual i within group j .

Given that the intercept and slope coefficients vary randomly over the group, these can be regressed upon one or more level-2 variables denoted w such that

$$\beta_{oj} = \gamma_{00} + \sum_{q=1}^Q \gamma_{0q} w_{qj} + u_{oj} \quad 3.7$$

$$\beta_{pj} = \gamma_{p0} + \sum_{q=1}^Q \gamma_{pq} w_{qj} + u_{pj} \quad 3.8$$

Where the γ s represents the fixed coefficients for the regression of the random intercepts and slopes from the level-1 equation (e.g., β_{oj} and β_{pj}) on the level-2 predictor w_j , and u_{oj} and u_{pj} represent the associated level-2 residuals. This two-level expression is for heuristic purposes only, and the level-2 equation may be substituted into the level-1 equation to create the reduced form expression.

In matrix terms we can generally express the level-1 and level-2 equations as follows:

$$y_j = X_j \beta_j + r_j \quad 3.9$$

$$\beta_j = W_j \Gamma + u_j \quad 3.10$$

This is reduced to the form

$$y_j = X_j W_j \Gamma + X_j u_j + r_j \quad 3.11$$

Where:

y_j - is the response vector for group $j = 1, 2, \dots, J$, X_j is the design matrix for the set of level-1 predictors (including a column vector of 1s for the intercept),

W_j - is the design matrix for the set of level-2 predictors (also including a column vector of 1s for the intercept),

Γ - is the vector of fixed regression coefficients, and u_j and r_j are the vectors of level-2 and level-1 residuals respectively (Curran, 2002).

The statistical software packages that was used to accomplish the objectives of the study are SPSS and Linear Structural RELations (LISREL) packages, and the study used version 9.1 (2014).

CHAPTER 4

RESULTS

4.1. INTRODUCTION

Primarily, this chapter presents the results of Logistic Regression Model, SEM and the multilevel statistical modelling. Secondly, the outcomes of each model are discussed in details.

4.2. BINARY LOGISTIC REGRESSION ANALYSIS

To identify the key determinants of poverty, the study first computed a dichotomous variable indicating whether the household is poor or non-poor. That is,

$$poverty = \begin{cases} 0 & \text{non poor} \\ 1 & \text{poor} \end{cases}$$

We determined whether the predictors age of household head, gender/sex of head of house, size of the household, educational level of the head household, household location (rural or urban), main language spoken in the household and ethnicity/region was associated with poverty dynamics.

4.3. Binary logistic regression output

The final model that was fit to the data was given by, as presented in equation 3.1 above

$$\text{logit}(p) = \beta_1 V_1 + \beta_2 V_2 + \beta_3 V_3 + \beta_4 V_4 + \beta_5 V_5 + \beta_6 V_6 + \beta_7 V_7$$

where V_1 is the gender/sex of the head of house household, V_2 is the level of education for the head of the household, V_3 is the age of the head of the household, V_4 is the main language spoken in the house hold, V_5 is the size of the household, V_6 is the region where the household is located and lastly V_7 is the location (urban/rural) of the household.

Table 4.1: Binary logistic regression output

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1 ^a	Sex of head of household (female/male)	0.147	0.009	290.223	1	0.000	1.159	1.139	1.179
	Tertiary			7530.261	3	0.000			
	No formal education	3.656	0.059	3855.224	1	0.000	38.722	34.501	43.459
	Primary	3.370	0.059	3310.094	1	0.000	29.068	25.916	32.604
	Secondary	2.846	0.059	2365.973	1	0.000	17.217	15.352	19.310
	Head aged 25-34			679.989	5	0.000			
	Head aged 14-24	0.056	0.020	7.864	1	0.005	1.057	1.017	1.099
	Head aged 35-44	-0.172	0.014	155.492	1	0.000	0.842	0.819	0.865
	Head aged 45-54	-0.313	0.015	455.409	1	0.000	0.731	0.711	0.753
	Head aged 55-64	-0.148	0.016	89.767	1	0.000	0.862	0.836	0.889
	Head aged 65+	-0.062	0.015	17.001	1	0.000	0.939	0.912	0.968
	European languages			2240.099	10	0.000			
	Caprivi languages	1.162	0.092	157.962	1	0.000	3.197	2.667	3.832
	Otjiherero	1.209	0.081	224.918	1	0.000	3.350	2.861	3.924
	Rukavango	1.811	0.081	498.177	1	0.000	6.116	5.216	7.170
	Nama/Damara	1.152	0.080	205.397	1	0.000	3.163	2.702	3.703
	Oshiwambo	1.090	0.080	185.801	1	0.000	2.976	2.544	3.481
	Setswana	-1.400	0.235	35.624	1	0.000	0.247	0.156	0.390
	Afrikaans	0.300	0.084	12.700	1	0.000	1.349	1.144	1.591
	Khoisan	1.217	0.084	209.620	1	0.000	3.377	2.864	3.982
	Other African	1.252	0.119	111.405	1	0.000	3.497	2.772	4.412
	Other languages	3.165	0.246	165.935	1	0.000	23.701	14.642	38.365

Table 4.2: Binary logistic regression output continues...

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
a.	1 - 5 persons			48.739	2	0.000			
	6 - 10 persons	0.062	0.009	43.016	1	0.000	1.064	1.045	1.084
	11 - 15 persons	-0.013	0.019	0.460	1	0.498	0.987	0.952	1.024
	Central regions			4087.289	9	0.000			
	Hardap	0.419	0.027	241.784	1	0.000	1.520	1.442	1.603
	Karas	-0.097	0.026	14.414	1	0.000	0.907	0.863	0.954
	Kavango	0.539	0.026	433.014	1	0.000	1.714	1.629	1.803
	Kunene	0.150	0.023	41.646	1	0.000	1.162	1.110	1.217
	Ohangwena	0.231	0.021	116.400	1	0.000	1.259	1.208	1.313
	Omusati	0.352	0.021	290.954	1	0.000	1.423	1.366	1.481
	Oshana	0.710	0.022	1079.180	1	0.000	2.035	1.950	2.123
	Oshikoto	0.964	0.020	2341.815	1	0.000	2.623	2.523	2.728
	Caprivi	0.683	0.050	183.989	1	0.000	1.980	1.794	2.186
	Urban/Rural area(1)	1.612	0.014	13688.477	1	0.000	5.013	4.879	5.150
	Constant	-7.082	0.097	5379.265	1	0.000	0.001		
a. Variable(s) entered on step 1: Sex of head of household, educational attainment of head, age group, language grouped, size grouped, political regions grouped, urban/rural area.									

4.3.1. Gender and poverty incidences

The results show that there are high levels of poverty in the households that are headed by males as compared to those headed by female.

4.3.2. Education level and poverty incidences

The level of education of head of household shows that the heads of households with no formal education are 39 times likely to be in poverty as compared to the households headed by university graduates. Not only that but also the results show that households headed by heads with primary education only are 29 times likely to live in poverty as compared to households headed by university graduates. Furthermore, households headed by heads with secondary education only are 17 times likely to be in poverty as compared to households headed by university graduates. This shows that the head of household's education significantly explains the status of the household. The educated the head of household the less likely they will experience poverty.

4.3.3. Age of household and poverty incidences

The results show that households headed by much young heads of the age categories between the ages of 14 to 24 are more likely to experience poverty as compared to the reference category (24-35). The age of the head of the household shows that the households headed by youthful heads are less likely to live in poverty as compared to households headed by pensioners.

4.3.4. Main language spoken in the household and poverty incidences

Households headed by other languages heads are 24 times likely to live in poverty as compared to household headed by European language speaking heads. Others households that are more likely to live in poverty are those headed by Rukavango heads, Herero, Caprivi, Khoisan, Nama Damara and Oshiwambo headed respectively as compared to households headed by European language speaking heads. Last but not least, the results show that households headed by Africans and Setswana are less likely to live in poverty.

4.3.5. Household size and poverty incidences

The results show that as the household size increases, the more likely the household lives in poverty as compared to small size households

4.3.6. Region and poverty incidences

Households found in the following regions are likely to experience high levels of poverty as compared to central regions (Komas, Erongo, Omaheke and Otjozondjupa) and they are Oshana, Oshikoto, Caprivi, Hardap, Kavango, Omusati, Ohangwena and Kunene.

4.3.7. Location (rural/urban) and poverty incidences

Households in rural areas are 5 times more likely to experience poverty as compared to urban households.

4.4. The structural equation modelling

According to Alkire Foster methods, poverty is divided into three dimensions. The study employed the same categorisation to construct a path diagram to understand the relationship between unmeasured causes of poverty.

Table 4.2: SEM descriptive statistics results

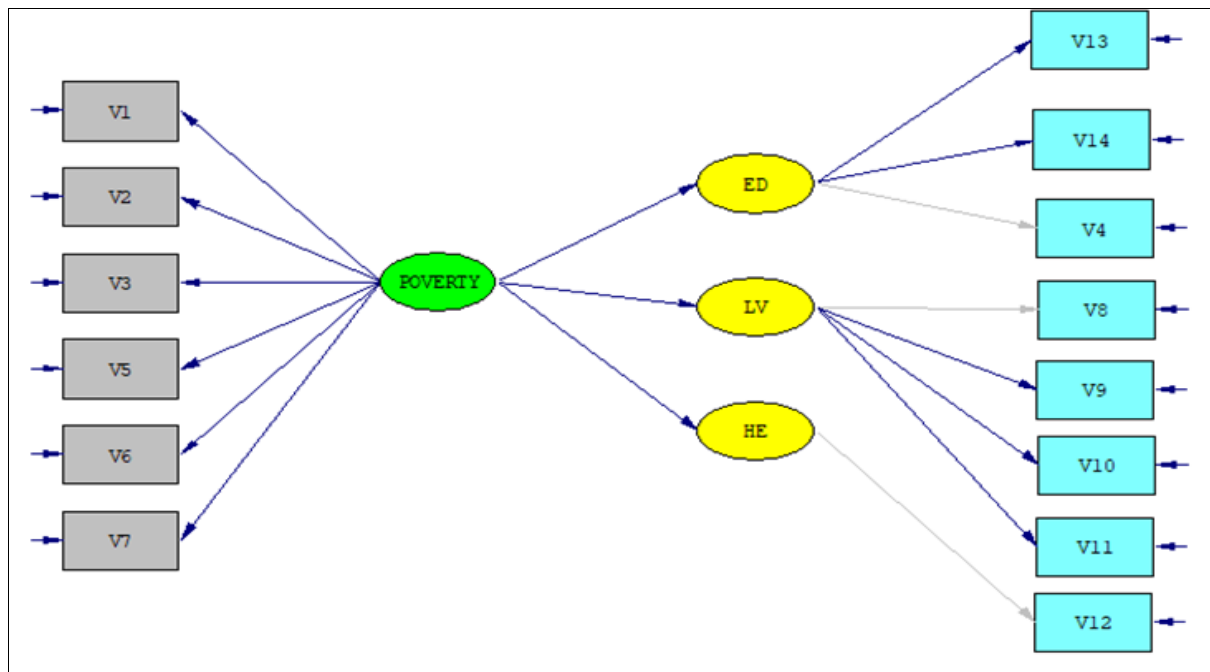
Descriptive Statistics			
	Mean	Std. Deviation	N
Political regions grouped	4.25	3.123	436795
Urban/Rural area	56.60	48.554	436795
Language grouped	2.19	4.513	436795
Educational attainment of head	2.44	.912	427513
Age group	3.43	1.721	433249
Sex of head of household	1.62	.764	436795
Household size grouped	1.38	.568	436795
Materials used for floor	1.97	.704	436795
Energy for cooking grouped	3.6214	3.01827	436795
Source of drinking water grouped	1.84	6.212	436795
Toilet facility grouped	2.6383	1.78110	436795
Distance in km to hospital/clinic	2.04	.800	436795
Distance in km to primary school	2.17	1.618	436795
Distance in km to high school	3.60	2.169	436795

Table 4.3: The covariate matrix used in the code:

1													
.474	1												
0.001	-.005	1											
-.174	-.404	-.004	1										
.211	.283	-.019	-.402	1									
-.077	-.014	.005	.056	-.079	1								
.147	.165	-.008	-.189	.301	-.053	1							
.163	.136	.009	-.009	.111	-.034	.117	1						
.288	.416	-0.001	-.301	.169	-.024	.129	.038	1					
.038	.075	-.004	-.034	-.011	-0.001	0.001	.052	.026	1				
.367	.537	0.002	-.376	.160	-.030	.135	.044	.374	.047	1			
.240	.527	.017	-.282	.139	.036	.066	-.005	.259	.071	.337	1		
-0.001	.409	0.000	-.233	.030	.075	-.049	-.048	.186	.069	.199	.547	1	
.228	.693	0.002	-.369	.154	.033	.071	.047	.325	.067	.424	.584		
	.570	1											
Means	4.25	56.60	2.19	2.44	3.43	1.62	1.38	1.97	3.6214	1.84	2.6383		
	2.04	2.17	3.60										
Standard deviations		3.123	48.554	4.513	0.912	1.721	0.764	0.568	0.704	3.01827			
	6.212	1.78110	0.800	1.618	2.169								

After the matrix has been established, then a code has to be formulated. Firstly you may want to draw a conceptual diagram as follows, depending on how you would like to correlate the variables.

In this study, this is how the 14 variables were correlated.



ED- education

LV- living standard

HE- heath

Figure 4.1: Conceptual diagram for 14 variables used in the study

Table 4.4: SEM LISREL code

```

Poverty Dimensions
Observed Variables: V1 V2 V3 V4 V5 V6 V7 V8 V9 V10 V11 V12 V13 V14
Correlation Matrix
1
.474    1
0.001  -.005    1
-.174  -.404  -.004    1
.211   .283  -.019  -.402    1
-.077  -.014   .005   .056  -.079    1
.147   .165  -.008  -.189   .301  -.053    1
.163   .136   .009  -.009   .111  -.034   .117    1
.288   .416  -0.001  -.301   .169  -.024   .129   .038    1
.038   .075  -.004  -.034  -.011  -0.001  0.001   .052   .026    1
.367   .537   0.002  -.376   .160  -.030   .135   .044   .374   .047    1
.240   .527   .017  -.282   .139   .036   .066  -.005   .259   .071   .337    1
-0.001 .409    0.000  -.233   .030   .075  -.049  -.048   .186   .069   .199   .547    1
.228   .693   0.002  -.369   .154   .033   .071   .047   .325   .067   .424   .584
.570    1
Means 4.25   56.60  2.19   2.44   3.43   1.62   1.38   1.97   3.6214  1.84   2.6383
      2.04   2.17   3.60
Standard deviations  3.123  48.554  4.513  0.912  1.721  0.764  0.568  0.704  3.01827
                   6.212  1.78110  0.800  1.618  2.169

Sample Size: 231
Latent Variable: ED LV HE POVERTY

Relationships:
V8 V9 V10 V11 = LV
V4 V13 V14 = ED
V12 = HE
ED LV HE = POVERTY
V1 V2 V3 V5 V6 V7 = POVERTY
Let the errors of ED LV and HE correlate
Path Diagram
End of Problem

```

Where:

- ED - Educational variable
- HE - Health variable
- LV - living standard variable
- V1 - Region
- V2 - Rural/Urban
- V3 - language spoken in the household (main)
- V4 - Education level of head of household
- V5 - Age of head of household
- V6 - Gender of head of household
- V7 - Size of the household
- V8 - Material used for flooring
- V9 - Main source of cooking
- V10 - Main source of drinking water
- V11 - Toilet facility used by household members
- V12 - Distance to hospital/clinic (km)
- V13 - Distance to primary school
- V14 - Distance to high school

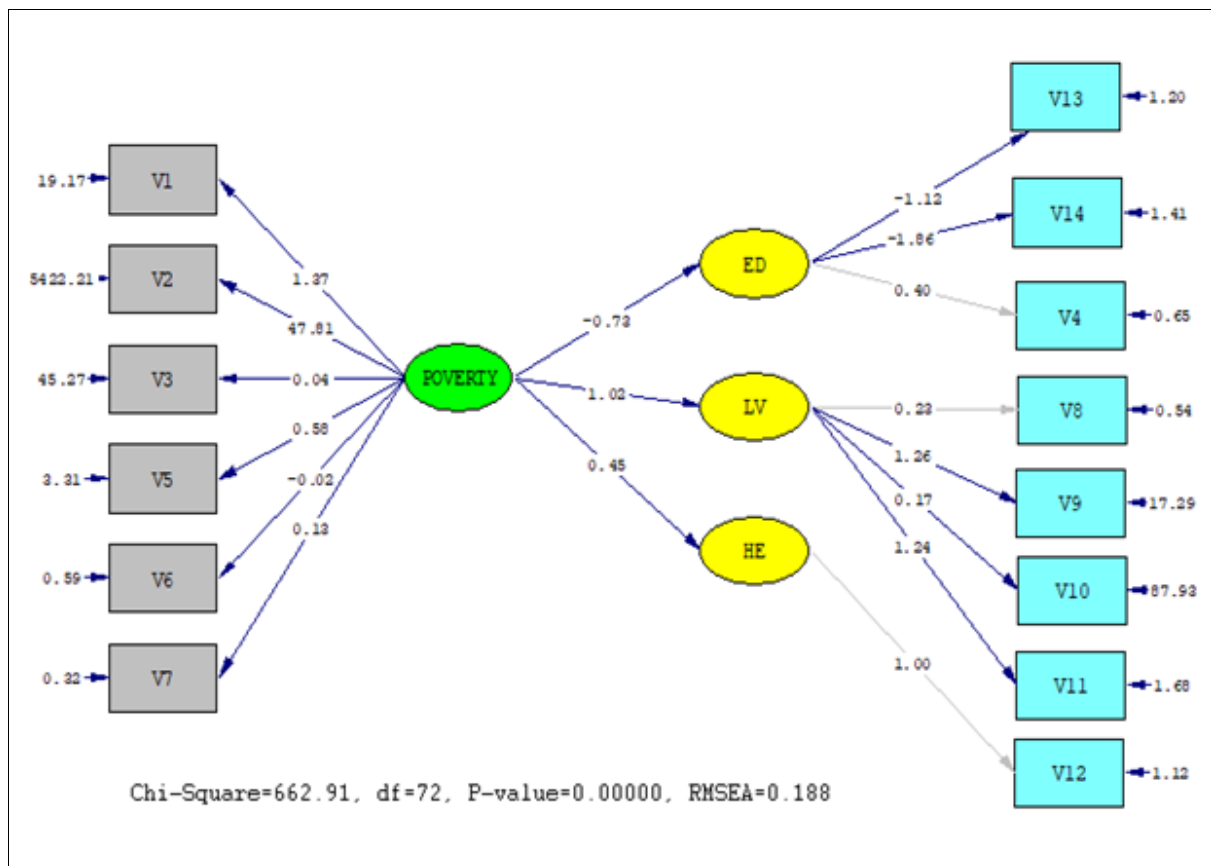
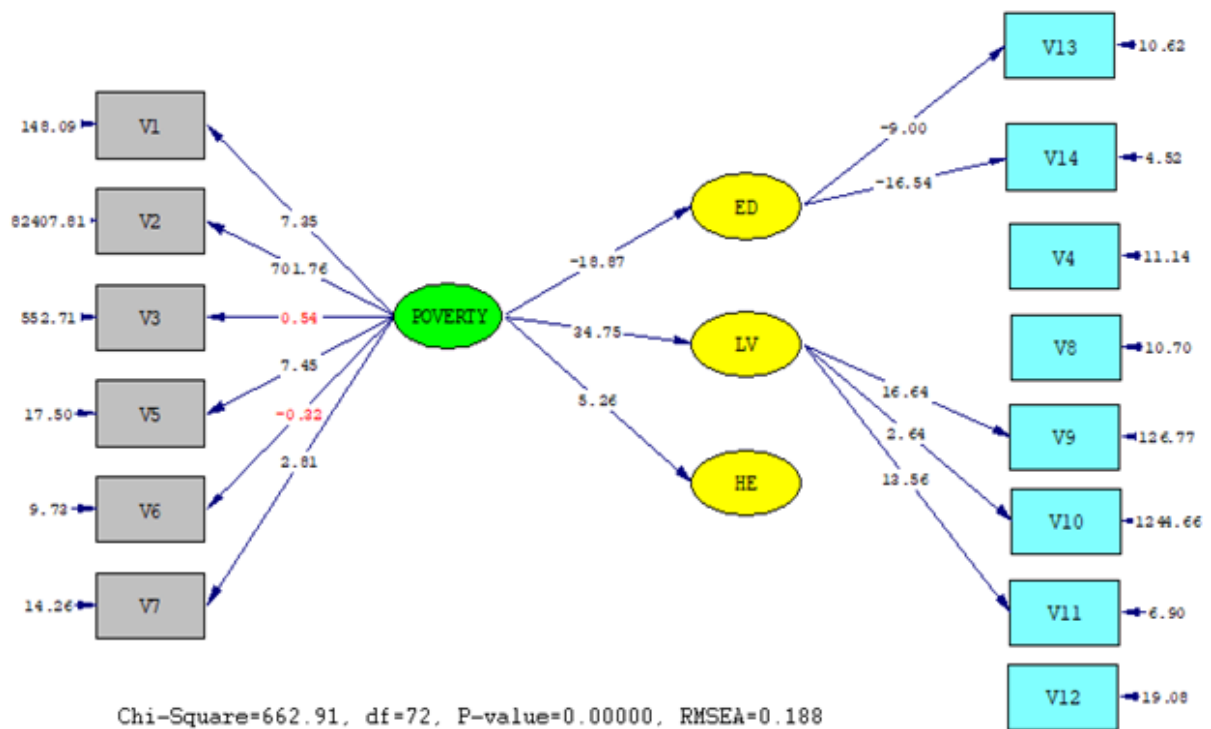


Figure 4.2: SEM estimates output



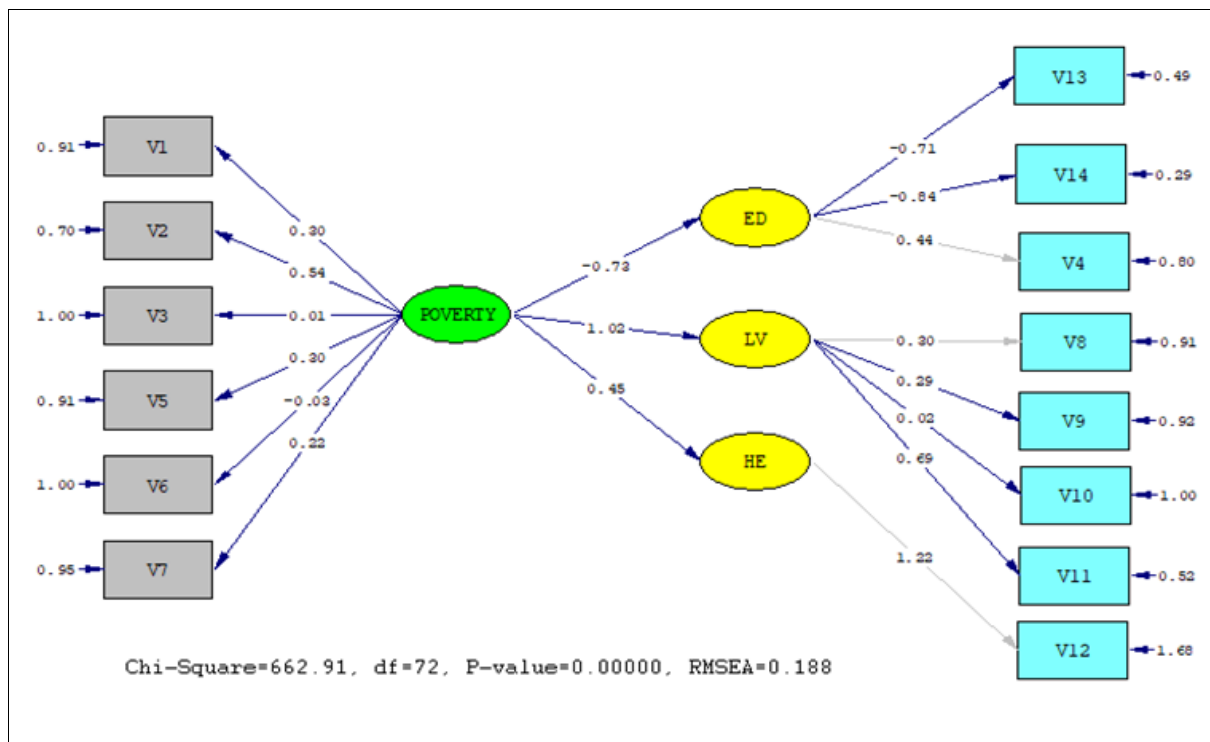


Figure 4.3: SEM standardised output

From the computer programme output (figure 23), the standardised solutions indicate that location (urban/rural) defines poverty significantly with a load factor of 0.54 and error value of 0.70. Region and the age of head of household define poverty significantly with a load factor of 0.30 each and error value of 0.91 for all the two variables. Size of the household defines poverty significantly with a load factor of 0.22 and error value of 0.95. While the main language spoken in the household and the sex of the head of household defines poverty insignificantly with the loads of 0.01 and -0.02 with the error values of 1 each. From these results, we can deduce that the measurement variables significantly define poverty even though the error values are very high. High error values indicate that all the observed variables were difficult to measure. The latent endogenous variable health is influenced by poverty with a load factor of 0.44. While the latent endogenous variable education is influenced by poverty indirectly with a load factor of -0.72. Education is significantly defined by the level of education of the head of household with a load factor of 0.44 and error value of 0.80. Living standard is significantly defined by toilet facility used by the head of household, material used for

flooring, main source of cooking and main source of drinking water with loads of 0.69, 0.30, 0.29 and 0.02 with load factors of 0.52, 0.91, 0.92 & 1 respectively.

Table 4.5: SEM measurement equation output

Measurement Equations		
Measured variables	Latent variable	Root mean square (R^2)
V1- Region	Poverty	0.0893
V2 - Urban/rural		0.297
V3 - Language spoken		0.000
V5 - Age of head of household		0.0909
V6 - Gender of head of household		0.000666
V7- Size of the household		0.0490
V8 - Material used for flooring	Living standard	0.0917
V9 - Main source of cooking		0.0838
V10 - Main source of drinking water		0.000344
V11 - Toilet facility used by household members		0.478
V12 - Distance to hospital/clinic (km)	Health	0.676
V4 - Education level of head of household	Education	0.197
V13 - Distance to primary school		0.509
V14 - Distance to high school		0.710

Table 4.6: SEM structural equation output

Structural Equations			
Measured variables	Latent variable	Root mean square (R^2)	$T - values$
Education	Poverty	0.534	
Living standard		1.037	
Health		1.000	

Table 4.7: SEM Goodness-of-Fit Statistics output

Goodness-of-Fit Statistics	
Chi square p-value	0.000
Root Mean Square Error of Approximation (RMSEA)	0.988
NFI	0.123
CFI	0.112
Goodness of Fit Index (GFI)	1.016
Adjusted Goodness of Fit Index (AGFI)	1.023

In this study, we focused on the following indices namely; GFI, NFI, RFI, CFI and RMSEA. These indices are widely used because they give useful information about the model fit and error variance in the data generating process (DGP) when they are interpreted together (Miles & Shevlin, 1998).

Chi-square assesses overall fit and the discrepancy between the sample and fitted covariance matrices. The recommended cut-offs that indicate a good fit for the chi square is $p > 0.05$. For this model with a p value = 0.0000 means that the model does not fit the data well.

Goodness of fit index (GFI) is the proportion of variance accounted for by the estimated population covariance. The recommended cut-offs that indicate a good fit is $GFI \geq 0.95$ and for the adjusted fit index (AGFI) ≥ 0.90 (Miles & Shevlin, 1998). For this study, we have a model that indicates a good fit as the GFI is approximately 1. The same applies to the adjusted fit index.

A Normed Fit Index (NFI) of ≥ 0.123 indicates that the model of interest improves the fit by 12% which is a poor fit for the model.

Comparative Fit Index (CFI) is a revised form of NFI and this compares the fit of a target model to the fit of an independent model and a good fit should be $CFI \geq 0.90$. The fit index for the study is found to be 0.112.

Root Mean Square Error of Approximation (RMSEA) is a parsimony-adjusted index. Values closer to 0 represent a good fit $RMSEA < 0.08$. The study found an $RMSEA = 0.98$

4.5. Multilevel modelling

The ultimate part of the analysis was to test if there was variability in *poverty* levels using the constructs measured in the SEM model. The variables included poverty parceled by the indicators V1-V7, education parceled by V4-V13, living standards parceled by V8-V10. The education variable was dropped from the models because it was insignificant and negative in the SEM model. From the PRELIS system file, a snapshot of the input is shown below: Model 1 is the baseline (intercept only),

followed by the added effects of gender, and finally the added effects of *living* and *health* status (health).

Table 4.8: Multilevel code

Model 1 (intercept only)

TITLE=Analysis of Survey data;

SY=poverty.psf;

ID1=urban;

ID2=rural;

RESPONSE=poverty;

FIXED= constant;

RANDOM1=constant;

RANDOM2=constant;

Model 2 (intercept + gender)

TITLE=Analysis of Survey data;

SY=poverty.psf;

ID1=urban;

ID2=rural;

RESPONSE=poverty;

FIXED= constant living;

RANDOM1=constant;

RANDOM2=constant;

Model 3 (intercept + gender + marital)

TITLE=Analysis of Survey data;

SY=income.psf;

ID1=state;

ID2=region;

RESPONSE=income;

FIXED= constant living health;

RANDOM1=constant;

RANDOM2=constant;

The PRELIS program results for the three analyses are summarized in Table 4.9 below. The baseline model (intercept only) provides the initial breakdown of level 1 and level 2 error variance. The multilevel model for the added effect of living is run next. The chi-square difference between Model 1 and Model 2 yields chi-square = 5.40, which is statistically significant at the .05 level of significance. *Living*, therefore does help explain variability in *poverty*. Finally, *health* is added to the multilevel model, which yields a chi-square difference between Model 2 and Model 3 of chi-square = 1.18. The chi-square difference value is not statistically significant; therefore, *health* status does not add any additional significant explanation of variability in *poverty*.

Table 4.9: Summary Results for Multilevel Analysis of *Poverty*

Multilevel Model	Model 1	Model 2	Model 3
Fixed Factors	Intercept Only	Intercept + Gender	Intercept + Gender + Marital
Intercept Only(B_0)	11.096 (.099)	11.37 (.15)	11.24 (.19)
Living (B_1)		-0.42 (.16)	-0.43 (.16)
Health (B_2)			.19 (.17)
Level 1 error variance (e_{ij})	.47	.41	.40
Level 2 error variance (u_{ij})	.03	.07	.08
Deviance (-2LL)	22144.29	22138.89	22137.71
Df	3	4	5
Chi-square Difference (df = 1)		5.40	1.18

Note: $\chi^2 = 5.64$, df = 1, p = .05.

The results revealed that it is the living standards variables that cause significant variability in poverty levels than the health variable. This may imply that indeed poverty is relative to the environment such as the state of the neighbourhood, which can be explained further by urban and rural settings. Thus, classifying poverty using income may overlook the hierarchical aspect and thus result in inaccurate interventions. This could be, to some extent the reason why Namibia is classified as middle-income state and yet it is one of the most unequal countries in the world with a GINI coefficient of 0.56. This research has provided some insight into one of the critical areas of understanding and thus measuring poverty. This could help explain why there have been tremendous challenges in addressing poverty in Namibia. Poverty should be treated as a concept that is not only multifaceted but nested and whose heterogeneous factors should be explored with advanced statistical models, unlike relying on a simple measure of income as a determinant.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

What are the critical factors that influence poverty in Namibia?

The study has identified the following factors to be the critical ones influencing poverty in Namibia. The age of household head, gender/sex of head of house, household size, household head's educational level, physical location of the household (rural or urban), main language spoken in the household and ethnicity/region.

According to the Alkire and Foster methods second dimension (Education), years of schooling/highest level of education of the head of the household is a good measure of poverty. In this study the similar results are found that the household level of education has a big influence on the wellbeing of the household. The logistic regression shows that household's whose heads have no formal education are 39 times likely to be in poverty as compared to the households headed by university graduates. In fact the study found that all factors identified in this study contribute to poverty significantly.

What are the possible poverty class probabilities in Namibia?

All measurement variables defines poverty significantly as seen on page 91. Though all variables have high standard errors. High standard errors indicate that all the observed variables were difficult to measure. Probabilities can be seen on page 91.

What are the causal relationships among factors influencing multidimensional poverty in Namibia?

The structural equation shows a path diagram for the relationship between the variable. The results shows that all the variables used in the study relates to each other.

As it can be seen figure 4.1, 4.2 and 4.3, some variables do not influence poverty directly. They influence poverty through other variables which are directly measured. The study sought to measure poverty in a multi-dimensional way and this has been achieved.

In conclusion it was shown that female headed household are less prone to poverty as compared to males. Therefore, empowering women in the country will bring a significant change. The results further show that an increase in educational attainment of head of household has a great effect on reducing the chance that a household is poor. This however does not correspond with what the NHIES results of 2009/2010 found. It found that poverty in female headed households is as high as 22% while the male headed households this is pegged at 18%. Thus in-depth study should be done to find out which of the two groups (male or female) should be targeted to reduce the poverty in households.

The logistic model further reveals that a rural family as compared to an urban family has a high likelihood of being poor. The urban/rural variable is statistically significant and thus this variable increases the odds of a household being poor significantly. The results of NHIES 2015/2016 found similar results as well. Rural areas are mostly affected by poverty.

The other demographic factors that increase the probability of being poor are the region, age of the household head and size of household. Ethnicity is another vital variable as households in rural areas are five times likely to be poor compared to urban households. In the African continent, most countries' governments regard the provision of formal housing, water and sanitation services as only naturally urban services, but as the countries develop it would not be wrong for the rural population

to strive towards having piped water, have flush toilets and also good housing characteristics (UNICEFNamibia, 2010).

The results further show that some groups in Namibia whose main language spoken in the household is Rukavango, Herero, Caprivi, Khoisan, Damara Nama and Oshiwambo are more likely to live in poverty.

The bodies mandated to reduce poverty in the country should conduct more research to know the poverty thresholds but this should not only be based on income but on all identified poverty determinants. Poverty thresholds are mainly useful for the creation of poverty mappings, poverty profiles, assessing deprivation indices and implementing poverty social impact analysis on the vulnerable and the poor, re-evaluating and exploring determinants of poverty and finally guiding policy interventions meant at reducing poverty. A profile of poverty sets out the major truths of poverty and examines the pattern of poverty to see how it differs by;

- Community characteristics (e.g. villages without and with a school, etc.),
- Geography (by urban/rural, region, mountain/plain, etc.), and
- Household and individual characteristics (e.g. educational level).

A well-presented poverty outline can be very useful in assessing how an economic change is likely to affect aggregate poverty (Haughton & Khandker, 2007). Last but not least, the analysis of poverty serves several purposes: firstly, is the cognitive, that is, to know the poverty profiles. Secondly, analytic, this is to understand the causal relationship among the factors that causes poverty. Last but not least, for policy making, this includes designing interventions as well as monitoring and evaluation purposes (Coudouel, Hentschel & Wodon, 2006).

So far analyses have centred on the cognitive so as to know the situation. The problem with this approach is that it is only centred on knowing the situations or knowing the profiles of poverty in a country but does not go deep as to why the situation persists as well as evaluating the policies put in place to alleviate poverty.

A comparison with past approaches shows that dimensional scores are more suitable for identifying specific needs of the population in the battle against poverty (Ningaye, Alexi & Virginie, 2012).

Therefore, the study recommends that government and non-governmental organisations should come up with policies that can ensure a reduction of the plight of the poor people in Namibia. These policies should target the affected groups. People in rural areas, un-educated head of households, households headed by young individuals as well as regions that are mostly affected by poverty. It should also be understood that poverty is unique to households, communities as well as regions. Policies should be made in a way that, it properly solving the specific needs of a household, community or region.

Measuring poverty in monetary terms does not solve the problem as poor people are affected in many ways. It can be infrastructure wise, living standards and lack of basic needs. Poverty is multidimensional and solution to it should also be done in a multidimensional way.

More studies of this nature should be carried out to help the people who are affected in different ways. This is the only way the country can find out what each community or region needs to escape poverty. Most countries have moved away from using cost of basket and poverty lines as the method of measuring the poor.

This study had one of the major limitations, which was the use of secondary data instead of primary. The fact that the data was collected for a different purpose rather than the aims of the study, some variable were missing and some were not easily measurable. Because of the above mentioned the study had to use the data of 2009/2010 NHIES instead of the 2015/16 which is the latest in the country. Future research may try to carry a similar study using primary data, as with secondary data you may not be able to explicitly have all variables required to complete the study.

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Appendix 1: SEM Program code and results

Poverty Dimensions

Observed Variables: V1 V2 V3 V4 V5 V6 V7 V8 V9 V10 V11 V12 V13 V14

Correlation Matrix

1

.474 1

0.001 -.005 1

-.174 -.404 -.004 1

.211 .283 -.019 -.402 1

-.077 -.014 .005 .056 -.079 1

.147 .165 -.008 -.189 .301 -.053 1

.163 .136 .009 -.009 .111 -.034 .117 1

.288 .416 -.001 -.301 .169 -.024 .129 .038 1

.038 .075 -.004 -.034 -.011 -.001 0.001 .052 .026 1

.367 .537 0.002 -.376 .160 -.030 .135 .044 .374 .047 1

.240 .527 .017 -.282 .139 .036 .066 -.005 .259 .071 .337 1

-.001 .409 0.000 -.233 .030 .075 -.049 -.048 .186 .069 .199 .547 1

.228 .693 0.002 -.369 .154 .033 .071 .047 .325 .067 .424 .584 .570 1

Means 4.25 56.60 2.19 2.44 3.43 1.62 1.38 1.97 3.6214 1.84 2.6383 2.04 2.17 3.60

Standard deviations 3.123 48.554 4.513 0.912 1.721 0.764 0.568 0.704 3.01827 6.212 1.78110

0.800 1.618 2.169

Sample Size: 231

Latent Variable: ED LV HE POVERTY

Relationships:

V8 V9 V10 V11 = LV

V4 V13 V14 = ED

V12 = HE

ED LV HE = POVERTY

V1 V2 V3 V5 V6 V7 = POVERTY

Let the errors of ED LV and HE correlate

Path Diagram

End of Problem

Sample Size = 231

Poverty Dimensions

Covariance Matrix

	V4	V8	V9	V10	V11	V12
	-----	-----	-----	-----	-----	-----
V4	0.832					
V8	-0.006	0.496				
V9	-0.829	0.081	9.110			
V10	-0.193	0.227	0.487	38.589		
V11	-0.611	0.055	2.011	0.520	3.172	
V12	-0.206	-0.003	0.625	0.353	0.480	0.640
V13	-0.344	-0.055	0.908	0.694	0.573	0.708
V14	-0.730	0.072	2.128	0.903	1.638	1.013
V1	-0.496	0.358	2.715	0.737	2.041	0.600
V2	-17.890	4.649	60.964	22.621	46.440	20.470
V3	-0.016	0.029	-0.014	-0.112	0.016	0.061
V5	-0.631	0.134	0.878	-0.118	0.490	0.191
V6	0.039	-0.018	-0.055	-0.005	-0.041	0.022
V7	-0.098	0.047	0.221	0.004	0.137	0.030

Covariance Matrix

	V13	V14	V1	V2	V3	V5
	-----	-----	-----	-----	-----	-----
V13	2.618					
V14	2.000	4.705				
V1	-0.005	1.544	9.753			
V2	32.131	72.982	71.875	2357.491		
V3	--	0.020	0.014	-1.096	20.367	
V5	0.084	0.575	1.134	23.648	-0.148	2.962
V6	0.093	0.055	-0.184	-0.519	0.017	-0.104
V7	-0.045	0.087	0.261	4.550	-0.021	0.294

Covariance Matrix

	V6	V7
	-----	-----
V6	0.584	
V7	-0.023	0.323

Total Variance = 2451.640 Generalized Variance = 35853278.487

Largest Eigenvalue = 2365.680 Smallest Eigenvalue = 0.277

Condition Number = 92.434

Poverty Dimensions

Number of Iterations = 50

LISREL Estimates (Maximum Likelihood)

Measurement Equations

$$V4 = 0.400*ED, \text{ Errorvar.} = 0.652, R^2 = 0.197$$

Standerr (0.0587)

Z-values 11.113

P-values 0.000

$$V8 = 0.233*LV, \text{ Errorvar.} = 0.538, R^2 = 0.0917$$

Standerr (0.0504)

Z-values 10.681

P-values 0.000

$$V9 = 1.257*LV, \text{ Errorvar.} = 17.290, R^2 = 0.0838$$

Standerr (0.0757) (0.137)

Z-values 16.602 126.491

P-values 0.000 0.000

$$V10 = 0.174*LV, \text{ Errorvar.} = 87.926, R^2 = 0.000344$$

Standerr (0.0660) (0.0708)

Z-values 2.635 1241.961

P-values 0.008 0.000

$$V11 = 1.239*LV, \text{ Errorvar.} = 1.677, R^2 = 0.478$$

Standerr (0.0916) (0.243)

Z-values 13.527 6.889

P-values 0.000 0.000

$$V12 = 1.000*HE, \text{ Errorvar.} = 1.118, R^2 = -0.676$$

Standerr (0.0587)

Z-values 19.036

P-values 0.000

V13 = - 1.117*ED, Errorvar.= 1.205 , R² = 0.509

Standerr (0.124) (0.114)

Z-values -8.985 10.601

P-values 0.000 0.000

V14 = - 1.856*ED, Errorvar.= 1.408 , R² = 0.710

Standerr (0.112) (0.312)

Z-values -16.501 4.508

P-values 0.000 0.000

V1 = 1.371*POVERTY, Errorvar.= 19.173 , R² = 0.0893

Standerr (0.187) (0.130)

Z-values 7.339 147.774

P-values 0.000 0.000

V2 = 47.806*POVERTY, Errorvar.= 5422.212 , R² = 0.297

Standerr (0.0683) (0.0659)

Z-values 700.243 82229.242

P-values 0.000 0.000

V3 = 0.0359*POVERTY, Errorvar.= 45.273 , R² = 0.000

Standerr (0.0660) (0.0821)

Z-values 0.544 551.517

P-values 0.587 0.000

V5 = 0.576*POVERTY, Errorvar.= 3.314 , R² = 0.0909

Standerr (0.0774) (0.190)

Z-values 7.438 17.461

P-values 0.000 0.000

V6 = - 0.0198*POVERTY, Errorvar.= 0.588 , $R^2 = 0.000666$

Standerr (0.0612) (0.0606)

Z-values -0.323 9.708

P-values 0.746 0.000

V7 = 0.129*POVERTY, Errorvar.= 0.321 , $R^2 = 0.0490$

Standerr (0.0458) (0.0225)

Z-values 2.806 14.225

P-values 0.005 0.000

Structural Equations

ED = - 0.731*POVERTY, Errorvar.= 0.466 , $R^2 = 0.534$

Standerr (0.0387) (0.0218)

Z-values -18.867 21.336

P-values 0.000 0.000

LV = 1.018*POVERTY, Errorvar.= -0.0368 , $R^2 = 1.037$

Standerr (0.0293) (0.0161)

Z-values 34.754 12.290

P-values 0.000 0.022

HE = 0.448*POVERTY, Errorvar.= -0.651 , $R^2 = 1.000$

Standerr (0.0852) (0.0586)

Z-values 5.256 11.117

P-values 0.000 0.000

Error Covariance for HE and ED = -0.257

(0.0349)

-7.373

Error Covariance for HE and LV = -0.034

(0.0168)

-2.023

Correlation Matrix of Independent Variables

POVERTY

1.000

Covariance Matrix of Latent Variables

ED LV HE POVERTY

ED 1.000

LV -0.744 1.000

HE -0.585 0.422 -0.451

POVERTY -0.731 1.018 0.448 1.000

Log-likelihood Values

	Estimated Model	Saturated Model
	-----	-----
Number of free parameters(t)	33	105
-2ln(L)	7915.146	7252.232
AIC (Akaike, 1974)*	7981.146	7462.232
BIC (Schwarz, 1978)*	8094.745	7823.686

*LISREL uses $AIC = 2t - 2\ln(L)$ and $BIC = t\ln(N) - 2\ln(L)$

Goodness-of-Fit Statistics

Degrees of Freedom for (C1)-(C2)	72
Maximum Likelihood Ratio Chi-Square (C1)	662.913 (P = 0.0000)
Browne's (1984) ADF Chi-Square (C2_NT)	291.561 (P = 0.0000)
Estimated Non-centrality Parameter (NCP)	590.913
90 % Confidence Interval for NCP	(512.235 ; 677.050)
Minimum Fit Function Value	2.870
Population Discrepancy Function Value (F0)	2.558
90 % Confidence Interval for F0	(2.217 ; 2.931)
Root Mean Square Error of Approximation (RMSEA)	0.988
90 % Confidence Interval for RMSEA	(0.175 ; 0.202)
P-Value for Test of Close Fit (RMSEA < 0.05)	0.000
Expected Cross-Validation Index (ECVI)	3.155

90 % Confidence Interval for ECVI	(2.815; 3.528)
ECVI for Saturated Model	0.909
ECVI for Independence Model	3.395
Chi-Square for Independence Model (91 df)	756.138
Normed Fit Index (NFI)	0.123
Parsimony Normed Fit Index (PNFI)	0.0975
Comparative Fit Index (CFI)	0.112
Incremental Fit Index (IFI)	0.136
Critical N (CN)	36.673
Root Mean Square Residual (RMR)	522.158
Standardized RMR	0.145
Goodness of Fit Index (GFI)	1.016
Adjusted Goodness of Fit Index (AGFI)	1.023
Parsimony Goodness of Fit Index (PGFI)	0.697

The Modification Indices Suggest to Add the

Path to	from	Decrease in Chi-Square	New Estimate
V8	ED	8.6	0.16
V13	HE	8.3	-0.25

The Modification Indices Suggest to add an Error Covariance

Between	and	Decrease in Chi-Square	New Estimate
V5	V4	21.6	-0.47
V7	V5	12.2	0.24

Time used 0.156 second