



University of Fort Hare  
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**The implications of smallholder agricultural productivity  
growth for poverty alleviation in post-apartheid South  
Africa**

**By**

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## **DECLARATION**

I, Nontembiso Eugenia Dwesini hereby declare that the work contained in this dissertation is my own original work and that other scholars' work referred to here have been duly acknowledged. I also declare that this dissertation has not been submitted elsewhere for a degree.

**Signed:** .....

**Date:** .....

**Nontembiso Eugenia Dwesini**

## **DEDICATION**

To my loving and caring parents Mr Zwelibanzi Swartbooi Dwesini and Mrs Nomziwakhe Dwesini, the reason for my existence; my sisters and a brother. I gratefully and emotionally dedicate this Masters project to you. Thank you for being a gift and blessing from God

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## ABSTRACT

*The adoption of the Millennium Development Goal 1(MDG 1) of reducing the rate of poverty to half of the 1990-level by 2015 has been a challenge faced by the developing countries including South Africa. The foundations of democracy have to be continuously assessed so that the obstacles faced by South Africa as it strives towards sustainable democracy are addressed. With agricultural sector identified as having the potential to alleviate poverty compared to the mining sector, manufacturing sector and services sector, it faced the challenges that include: (i) accelerating agricultural productivity; (ii) reducing poverty and vulnerability; and (iii) narrowing rural-urban income disparities.*

*The identification of the critical linkages in the agricultural development framework allows for effective strategic planning, effective decision making and appropriate policy formulation. Expectedly, the sector has attracted considerable fiscal policy interest and public investments. The primary aim of this research study is to assess the extent to which smallholder agricultural productivity growth alleviates poverty in South Africa. The statistical and econometric techniques namely; Johansen technique of co-integration analysis (1995), analysis of covariance and correlation, Vector Error Correction Model, are employed in this research study. The data description, data sources, expected relationship between variables and indexation of data are done. The drivers and cause-effect relationships between agriculture and poverty reduction are investigated. The employed models allowed for an exploration of plausible future growth in agricultural elasticity of poverty and the possibility of reducing poverty level in South Africa. The data is obtained from the National Department of Agriculture from 1994 -2013. The analysis of the results strongly confirms that agricultural productivity has a significant inverse relationship to the levels of poverty in South Africa. The outcome of the analysis will contribute to improved decision making on the use of public funds in agriculture.*

**Key words:** Agricultural growth, public agricultural expenditure, rural development, poverty,

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

ARCH	Auto Regressive Conditional Heteroscedasticity
ASGISA	Accelerated and Shared Growth Initiative for South Africa
CASP	Comprehensive Agricultural Support Programme
CES	Constant Elasticity of Substitution
CD	Cobb-Douglas specification
DEA	Data Envelopment Analysis
ESID	Effective States and Inclusive Development
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
IDP	Internally Displaced People
IFSS	Integrated Food Security Strategy
INP	Integrated Nation Programme
MAFISA	Micro Agricultural Finance Initiative of South Africa
MDG	Millennium Development Goals
MFP	Multi Factor Productivity
MRTS	Marginal Rate of Technical Substitution
NIE	New Institutional Economics
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PEM	Protein-Energy Malnutrition
PFP	Partial Factor Productivity
PEM	Protein-Energy-Malnutrition
PLAAS	Poverty, Land and Agrarian Studies
TCE	Transaction Cost Economics
TFP	Total Factor Productivity
SSA	Sub-Saharan Africa

UN	United Nations
UNDP	United Nation Development Programme
UNICEF	United Nations Children's Fund
USDA	United States Department of Agriculture
VAR	Vector Auto Regression
VECM	Vector Error Correlation

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction and Background

Theodore Schultz began his acceptance speech for the 1979 Nobel Prize in Economics by stating that:

*“Most of the people in the world are poor, so if we knew the economics of being poor we would know much of the economics that really matters. Most of the world’s poor people earn their living from agriculture, so if we knew the economics of agriculture we would know much of the economics of being poor” (Schultz, 1979).*

The Oxford English Dictionary (1971) gives three meanings of hunger, namely, (i) the uneasy or painful sensation caused by want of food, craving appetite and exhausted condition caused by want of food; (ii) the want or scarcity of food in a country; and (iii) a strong desire or craving. Among these three definitions the world hunger is most defined by the second definition-the want or scarcity of food in a country. The Medline Plus Medical Encyclopaedia gives two types of malnutrition (under-nutrition): (i) the Protein-Energy Malnutrition (PEM) and (ii) the Micronutrient (vitamin and mineral) deficiency. The PEM is defined as the lack of calories and proteins when food is converted into energy measured in calories during the digestion process in our bodies. One of the functions of proteins is to provide essential amino acids; development and maintenance of muscles in our bodies. The debates on world hunger mostly relate to the PEM type of malnutrition.

The Food and Agriculture Organization (FAO) (2012) reports the figures on world hunger. It estimated that approximately 870 million people or one in eight people in the world suffered from chronic undernourishment in 2010-2012 periods. The developed countries, however, have about 16 million people undernourished. In Asia and the Pacific undernourished people decreased from 739 million to 563 million which is approximately 30 percent while the region decreased from about 23.7 percent to 13.9 percent. In Latin America and the Caribbean there was a decrease from 65 million hungry people in 1990-1992 to 49 million in 2010-2012 periods. This indicates a drop from 14.6 percent to 8.3 percent in undernourishment. Conversely, Africa shows an increase from 175 million to 239 million or one in four people is hungry in 2010-2012 periods. The sub-Saharan Africa achieved

progress up to 2007, the years that follow show a rise in hunger up to 2 percent per year. In the developed regions, however, there was an increase in hungry people from 13 million in 2004-2006 to 16 million in 2010-2012 periods.

The world agriculture showed an increase of 17 percent calories per person in production levels despite a 70 percent population increase. This increase in production levels is conceived to be sufficient to provide everyone in the world with at least 2,720 kilocalories (kcal) per day according to the FAO (2012) report. The main problem raised is that many people in the world do not have adequate land to grow, or income to buy enough food.

The Reconstruction and Development Programme document (RDP) states that land is a "basic need" of the people in South Africa (ANC, 1994). Agriculture is the main user of land worldwide, but accounts for only 4.5% of South Africa's GDP, and about 11% of formal employment opportunities (Verschoor, 2003). The structure of the agricultural economy with the land a central productive resource, ownership patterns where opportunities are unequal in the absence of alternative opportunities elsewhere in the economy need to be reviewed in South Africa (Bell, 1990; Van Zyl, Kirsten, and Binswanger, 1996). This view is evident in the case of the majority of black population living in the rural areas who have limited opportunities to develop skills so that they can participate in the modern, monetized economy in South Africa. The rising price of farmland in South Africa is a source of considerable concern since the early 2000s.

Evidence accumulates poverty to be the main cause of hunger. The causes of poverty include: (i) conflict; (ii) hunger itself; (iii) climate change; (iv) lack of resources; and (v) unequal income distribution. Giving an example using conflict and hunger factors: Towards the end of 2005, globally the number of refugees was very low in almost a quarter of a century. Although there was large-scale repatriation movements' refugees tend to increase because of violence in Iraq and Somalia. The total number of refugees under UNHCR's mandate exceeded 10 million by the end of 2008. This resulted in conflict-induced internally displaced people (IDPs) reach about 26 million worldwide by the end of the year (UNHCR 2008). Hunger causes poor health, low levels of energy, and even mental impairment, can lead to poverty by reducing people's ability to work and learn, thus leading to even greater hunger.

Globally, extreme poverty fell from 28% to 19% between 1990 and 2002 (Neigh, 2013). Unfortunately, the overall global progress has been uneven: Asia's achievement in lifting 250,000 people above \$1 a day mark is mainly due to India and China's economic advances, and 140 million more people in sub-Saharan Africa are living in poverty today despite a slight decline in the poverty rate (World Bank, 2014). The decline in the percentage rate of poverty globally is credited largely to economic growth. Extreme poverty is inextricably linked to chronic hunger: 800 million people in poor countries do not have enough food to meet their basic caloric needs (UN, 2014).

Extreme poverty and chronic hunger make human development much more difficult: Poverty leads to malnutrition and illness, which reduce incomes and economic productivity. This in turn exacerbates poverty and hunger because people cannot afford proper nutrition, primary health care and housing, to invest in their children's education, or own business (UNICEF, 2014). This "poverty trap" also impacts human development prospects on the macro level: without economic activity and tax base, the government cannot invest in its people and foreign investors are wary of financial commitments.

Literature explains the impact of growth on poverty as heterogeneous in nature: Firstly, poverty is explained to depend on the existing level of inequality: Other things being equal, a given level of growth would achieve the higher impact on poverty with the greater distribution-corrected rate of growth. Secondly, poverty is explained to depend on the "type" of growth considered, namely, industry-driven growth; export-driven growth; or average growth driven by growth in rural/agricultural areas and sectors. From this understanding the type of growth matters based on growth differentiation across areas and sectors that could affect inequality, and thus poverty in a country.

In the context of this research study average growth driven by growth in rural/agricultural areas and sectors is the matter of concern. Hence, the questions to be answered include: how can rural development co-operation be upgraded such that the implications of agriculture on poverty alleviation are recognized? By how much is a given rate of agricultural productivity growth reduces poverty in South Africa? In technical terms, what is "the agricultural productivity growth elasticity of poverty in South Africa"; by how much percentage will poverty decline with a given percentage increase in agricultural productivity growth in South Africa? What causes agricultural productivity growth? The focus will be especially on the smallholder agricultural productivity growth on poverty alleviation in South Africa.

Schultz (1964) suggested that irrespective of poverty levels caused by lack of access to assets, smallholder agriculture is responsive to price incentives and prone to adopt remunerative technological change opportunities. The smallholder (subsistence or semi-subsistence) sector consists of self-employed farmers producing staple food and some commercial goods. Simbi (1998) estimated that more than half agricultural population of 2.5 million people work at least part-time on smallholdings in South Africa. Subsistence and smallholder farming serve as safety nets for urban populations when jobs are lost what Owen called “farm-financed social welfare” (Owen, 1966). By linking subsistence farmers, particularly women farmers, to markets and transforming them into net sellers through initial capital endowments and sustained productivity gains in the farming system could be an effective short run instrument for world poverty alleviation.

“Poverty alleviation” entails the intervention strategies that address the symptoms of poverty through short-term strategies and which will to a limited extent solve the more long-term problems. These strategies are therefore faced with challenges that include: (i) ensuring access to food; (ii) many hungry people are landless or lack secure tenure; (iii) there are some marginal ecological regions with poor soils and high climatic variability that need to be improved; (iv) a green revolution is needed that increases productivity and improves environmental sustainability; (v) increased investment in research and develop better technologies and disseminate them through extension services and (vi) investments in infrastructure such as roads and storage systems.

At the UN Millennium Summit that was held in New York in September 2000 world leaders agreed to the set of Millennium Development Goals (MDGs) that include halving income-poverty and hunger; achieving universal primary education and gender equality; reducing under-5 mortality by two-thirds and maternal mortality by three-quarters; reversing the spread of HIV/AIDS; and halving the proportion of people without access to safe water. These targets are to be achieved by 2015 (UN, 2000). One of the most pressing problems that developing countries are faced with is poverty and hunger. Although developed countries are not concerned much about hunger and poverty, these two dimensions are a global concern and as a result they were listed as the Millennium Development Goal 1 (MDG1) by the UN. The (MDG1) emphasizes the challenge of reducing by half the proportion of the population living below the poverty line by 2015 (UNDP, 2010).

The World Bank Growth Report (Commission on Growth and Development 2008) gives 7% average annual GDP growth as a pre-condition for sustained progress in reducing poverty. This average annual GDP growth percentage was found in an examination of thirteen countries which since 1950 grew their economies at this rate or more for 25 years or longer. In consequence, the 7% average annual GDP growth was generally accepted as the required rate for many developing countries to achieve the MDG1. Fosu, (2009) suggested that such an agreement is a country-specific threshold that depends on the distribution of income inequality across the countries.

Poverty alleviation in South Africa is one of the primary objectives of social welfare policy (Republic of South Africa, 1997; Van der Berg, 1997). The Constitution of South Africa recognizes poverty and for this reason provides a section for social security. Section 27(1) (c) of the Constitution of South Africa stipulates that everyone has the right to have access to social security, including, if they are unable to support themselves and their dependants (RSA, 1996).

## **1.2 Problem statement**

### **a) The Background of the problem**

There is a recurrent theme in mainstream economic thinking on how poverty could be alleviated in the developing world. South Africa has a specific history which is inter-twined with the current poverty problem. Indeed, this history is informed by an ideology of inequality and differences between the races. This “reality” of racial exclusion was crafted via policies and legislation that in turn informed perspectives on poverty among the different races and classes in South Africa (Magasela, 2005). Apartheid had perpetuated income poverty and exacerbated income inequality in very obvious ways that include the fact that: African people (i) had been dispossessed of most of their land; (ii) faced restricted opportunities for employment or self-employment; (iii) were limited to low-quality public education and primary health care; and (iv) were physically confined in impoverished areas of the countryside or cities.

The Apartheid government budget focused spending on white residents, with very little expenditure directed towards education; health; housing; which are the examples of the basic needs of black residents (Momoniat, 1998). Poverty and unemployment were the features of life in most black South Africans. According to Gelb (2004), the 1950 Group Areas Act explicitly restricted firm ownership by Blacks to specified areas in cities and towns,

Regulations prevented Black entrepreneurs from owning more than one business, establishing companies or partnerships, or owning business premises, even in Black areas. The Land Act of 1913 forbade Africans from owning land in designated “White” areas, and resigned Africans to “reserves”, which accounted for about 7% (later extended to about 13% through the 1936 Native Trust and Land Act) of the total land area of South Africa. It is worth noting that the land in these African reserves was rocky and thus not conducive to farming. This means that the self-sufficient economy that indigenous groups relied on was severely compromised and their asset-based eroded.

In an attempt to solve the problem of poverty and inequality, the South African government adopted several programs such as Land reform; Black Economic Empowerment (BEE), Growth Employment and Redistribution (GEAR); Provincial Growth and Development Plan (PGDP); and Accelerated and Shared Growth Initiative for South Africa (ASGISA) among others (Manona, 2008). These programs promoted increased public expenditure on rural economic growth, increased agriculture-specific investment such as agricultural Research and Development (R&D), education, and infrastructural development in rural areas.

In addition, the government increased public-sector investment, especially in the realm of agriculture and rural development. According to the Presidency (2004), the proportion of public expenditure to GDP rose from less than 4% in 1994 to 6% of GDP in 2004. Accelerated and Shared Growth Initiative for South Africa (ASGISA) policy document states that public investment was planned to lie between 10% and 15% of GDP per year (The Presidency, 2004). This was unprecedented in South African history. Alemu (2010) also noted that there are conflicting results on whether fewer South Africans are poorer now than they were some years back. To resolve the conflict, an assessment of poverty elasticity to agricultural productivity growth has to be done.

The African governments and donors attempted broad strategies that include: (i) growth and trickle down in the 1960s, (ii) integrated rural development and basic human needs in the 1970s, (iii) structural adjustment and economic liberalization in the 1980s and 1990s, and (iv) participatory poverty reduction strategies to redress rural poverty. The persistent poverty problem in South Africa causes pessimism on the effects of the market-oriented policies and outward looking development strategies. The “Washington Consensus” that emerged in the late 1980s suggested strategies that include: (i) fiscal and monetary policies, (ii) greater

openness, (iii) security of property rights and (iv) privatization as the prescriptions for the economic progress (Williamson, 2000). But, poverty remains the problem in South Africa.

During the 1970s and early 1980s policy favoured import substitution industrialization with strong anti-agriculture price policy biases. The integrated rural development strategies designed to achieve the development objectives that include poverty and inequality reduction were difficult to implement. This was caused by low profitability of agriculture and state-led approaches. The state-led approaches favoured for development include: open economy industrialization to accelerate growth and cash transfers or welfare programs to reduce poverty.

South Africa focused on mitigating effects of poverty by expanding the social assistance grant strategy. The social assistance grant strategy has grown from one that covered 2.6 million persons to one that reaches to 14.1 million persons in 2010, with a high and explicit bias progressively targeted to children (UNDP, 2013). However, it must be noted that the strategy does not take into consideration other forms of pro-poor government investments such as developments in primary health care, housing, water and sanitation and electricity where targeted interventions are progressively directed towards the indigent populations.

#### **b) The Problem statement**

While South Africa is classified as a middle-income country, the society's income is unevenly spread. One important factor that contributes (but is not exclusively responsible for high inequality), is the high unemployment rate and low labour force participation rate. Not surprisingly, the employment to population ratio remains below the target set. "The main reason why South Africa's employment to population ratio is below the MDG1 target, is the high unemployment rate, hovering around 25%, going slightly below at times of boom, and marginally above in the recession" (UNDP, 2013). A low employment to population ratio results in an exceptionally large number of non-working people depending on each employed person in South Africa.

Despite the background in South Africa's persistent poverty problem and some different intervention strategies attempted to solve the problem, the current framework to achieve growth emphasises the strategies that include: (i) institutional reforms that expand opportunities for households, (ii) improve the access to engage in business and, (iv) improve the accountability of elected officials. The renewed attention to agriculture as a potential

sector for poverty alleviation faces the challenges that include: (i) accelerating GDP growth, (ii) reducing poverty and vulnerability, (iii) narrowing rural-urban income disparities, (iv) releasing scarce resources that include, water and land for use by other sectors; and (v) delivering multiplicity of environmental services.

It appears that these challenges that face agriculture have not yet been sufficiently empirically assessed. Only in 2010/11 that SatsSA assembled data for smallholder agriculture. Hence, we start an ongoing exercise to investigate the role played by smallholder agriculture to alleviate poverty in South Africa.

### **1.3 Objectives of the study**

The primary aim of this research study is to assess the extent to which smallholder agricultural productivity growth alleviates poverty in South Africa. The specific objectives are:

- (a) To review the poverty trends over the period 1994-2013 in South Africa
- (b) To review the smallholder agricultural productivity growth trends over the period 1994-2013 in South Africa.
- (c) To econometrically examine the variables that can alleviate poverty over the period 1994-2013 in South Africa.
- (d) To make policy recommendations based on the research findings.

### **1.4 Research question and Sub-questions**

This study is premised on the following questions:

#### **Research question:**

What is the contribution of agriculture, especially the smallholder agriculture on poverty alleviation in South Africa?

#### **Sub-questions:**

- (a) What are the poverty trends over the period 1994-2013 in South Africa?
- (b) What are the smallholder agricultural productivity growth trends over the period 1994-2013 in South Africa?
- (c) What is the agricultural productivity growth elasticity of poverty in South Africa?
- (d) What are the policy recommendations from this study?

## **1.5 Hypothesis**

The following hypothesis shall be tested:

H<sub>0</sub>: Poverty will not be alleviated by smallholder agricultural productivity growth in South Africa.

H<sub>1</sub>: Poverty will be alleviated by smallholder agricultural productivity growth in South Africa.

## **1.6 Significance of the study**

Based on evidence accumulated from literature that poverty is a multifaceted phenomenon, the intervention strategies geared towards poverty imply that facets which manifest it must be progressively and comprehensively assessed for the better lives of people. The assessment done could provide some policy recommendations based on empirical findings to help policy makers, unions, the government, NGOs and the citizens in South Africa. The results of this research study intend to serve this purpose.

Not only is this research study interested in the extent to which smallholder agricultural productivity growth alleviates poverty in South Africa but also to see South Africa advancing towards the overall world-wide poverty alleviation progress. The G-20 emphasised that the reduction of global poverty is integral to its framework for strong sustainable and balanced growth. It is on this basis that this study will contribute to the recurrent public and scholarly discourse on how poverty could be alleviated in South Africa.

## **1.7 Organization of the study**

Following Chapter 1 is Chapter 2 which provides theoretical background of the study. Chapter 3 provides the smallholder agricultural productivity growth trends in South Africa. Chapter 4 explains the Methodology and Estimation that shall be used in the study. Chapter 5 provides Analysis and Interpretation. Chapter 6 provides summary; conclusion and policy recommendations.

## CHAPTER 2

### THEORETICAL BACKGROUND OF THE STUDY

#### 2.1 Introduction

The primary aim of this study is to assess the extent to which smallholder agricultural productivity growth alleviates poverty in South Africa. This chapter is organised as follows: The first part of Section A provides Economic growth in South Africa, Poverty and Inequality in South Africa, Poverty trends in South Africa, and Income inequality. The second component provides Theoretical literature review that summarises the Classical paradigm of development economics, Modernisation theory, Basic needs strategy, Dependency theory, Functional form of the aggregate production, Cobb-Douglas production function, Constant Elasticity of Substitution (CES), Leontief function, Endogenous growth theory, Transaction costs theory, and Theoretical arguments from literature. Section B provides the Empirical review.

A twenty-year period of South Africa in democratic transition, allows the stock of growth performance to be taken so that the implications of future pro-growth policies are considered. This means that the foundations of democracy have to be assessed so that we understand the obstacles faced by South Africa as it strives towards sustainable democracy. Currently, most policy debates focus on poverty alleviation and inequality in South Africa. These debates are a concern on the democratic government promises that include: economic transition characterised by shared growth and access of the majority of the population to economic opportunities and jobs (ANC, 1994). In South Africa more than half agricultural population of 2.5 million is estimated to work at least part-time on smallholdings (Simbi, 1998). This implies that the extent of their participation in growth opportunities and jobs has to be assessed.

Delgado (1998) emphasized the importance of smallholder agriculture by highlighting the benefits that include: employment, human welfare, and political stability in a country. Growth in smallholder agriculture and poverty is found in “linkages” research to be stronger in agriculture than any other sector; and the highest multiplier effects are recognized (Mellor, 1995). It appears therefore that with improved growth performance linked to rural areas; and multiplier effects noted pro-poor growth in South Africa could be improved.

Agriculture has since occupied the centre-stage in achieving MDG1. Haggblade (2007) in Uganda; Govereh, Malawo, Lungu, Jayne, Chinyama and Chilonda (2009) in Zambia; Fan, Zhang, and Zhang (2002) in China; and Akroyd and Smith (2007) in six developing countries, strongly agree that rural economic growth and wide-spread poverty reduction require increased production in agriculture. Macheche (2004), Fan et al. (2002), Organisation for Economic Co-operation and Development (2006), and Van Zyl (2009), provide evidence that buttress this relationship among agriculture, income growth and poverty.

(Van Zyl, 2009) mentioned that the agricultural sector has both direct and indirect impact on economic development. The importance of agricultural sector goes well beyond its direct impact on rural incomes as it has both upstream or backward linkages on the supply side and downstream or forward linkages on the manufacturing side (Hirschman, 1958 and 1977; Macheche, 2002 and Van Zyl, 2009). Growth in agriculture does not only benefit the rural people; increased output in the rural areas has a direct bearing on the urban sector through its food price decreasing effect and creation of employment. In China, it was agricultural growth that enabled significant reduction in poverty during the period 1978 to 1997 (Fan et al., 2002). The agricultural sector has a high degree of interrelatedness with the other sectors that emerge as a consequence of both the demand and supply effects of inputs and outputs.

Summing up both the direct and indirect effects of agricultural growth, Van Zyl (2009) revealed that the relative contribution of agriculture to South Africa's Gross Domestic Product (GDP) is about 4% to 5%. With regard to the associated multiplier effects, the agricultural sector contributes much larger share than it directly provides. He also mentioned that in 1994, agricultural exports resulted in foreign exchange of R7 240 million. During the same year, the manufacturing industry contributed about 37% to GDP, of which 25% from agro-processing. Agriculture has a direct bearing on income growth, poverty reduction and overall economic growth. The agricultural sector's real contribution is far more substantial and crucial for sustained wealth creation, poverty alleviation, and welfare.

In 2005 the South African government produced its first national report on progress made towards achieving the MDGs. The report focuses on (i) economic growth (GDP); (ii) poverty reduction; (iii) gender equality; (iv) primary education and (v) maternal health. In terms of the report considerable progress towards the achievement of national development targets was made. At the same time there was a worrying trend in HIV and AIDS prevalence, while unemployment and inequality remained at high levels. The UNDP (2011) states that despite

the progress made in reducing poverty in South Africa, both poverty and inequality still have to be reduced. The framework for poverty reduction suggested by the UNDP is that the average per capita income growth in developing countries will have to be at 4% per annum compared to the past average of 3%. In addition, inequality will have to fall within countries such that the rate of decrease in the percentage of poor is at least 50% than the rate of growth. These are the examples of arguments that underpin the notion that expanding the levels of agricultural production and sales in the smallholder system in South Africa would have significant impact on a wide range of indices of progress.

## 2.2 Economic growth in South Africa

Agricultural productivity is the measure of performance that gives guide to efficiency of the sector (Thirtle et al (1993) & (2005), Kirsten et al (2003) and Conradie et al (2009). It is measured as the proportion of agricultural outputs to agricultural inputs. Its measures are Partial factor productivity (PFP), Multi factor productivity (MFP), and Total factor productivity (TFP). The measures of both MFP and TFP consist of combined effects of factors that include: economies of scale, new technologies, managerial skill and some changes in the organization of production to agricultural production.

According to Kirsten and Vink (2003) analysis of TFP for the period 1947-1996 an average increase in productivity is due to the increase in inputs used and output produced. The fluctuations that could happen are due to the increase in the value of capital which made labour to be cheap; deregulation of markets; and increase in inflation rate which make inputs to be expensive.

Table 2.1 below illustrates that during 1970–90 period South Africa’s economic growth is factor accumulation-driven and gains in TFP in the 1990s.

**Table 2. 1:** Economic growth by Labour; Capital; and TFP in South Africa

Period	Economic growth	Labour	Capital	TFP
1970s	3.21	1.17	2.54	- 0.49
1980s	2.20	0.62	1.24	0.34
1990s	0.94	- 0.58	0.44	1.07

**Source: Adapted from Fedderke 2002a**

From this table during the 1970s and 1990s economic growth is in terms of capital and labour input accumulation and contribution of technology is small. In the 1990s, however, the growth pattern is in terms of labour input that contributed negatively and capital input contributed relatively weakly to overall growth. It is an increase in technology that strongly contributed to output growth during the 1990s. The slower growth during this period is associated with restructuring and shedding of labour in mining towards a greater role for technology. As a result with declining employment, growth in labour inputs alone is negligible for economic growth. Additionally, the declining contribution of capital to overall growth during the same period is caused by a decline in investment rate.

The consistent feature across agriculture, mining, manufacturing, and services (main sectors) is that the contribution of labour towards output growth has a downward trend from the 1970s to 1990s. Considering the contribution of the capital stock towards output growth in agriculture, mining and services sectors, it declines for output growth, while in the manufacturing industry there is a slow increase. With technological progress contribution there is an improvement in agriculture, although it declines during the 1990s. In contrast, the mining sector has an upward trend similar to that of services with a low rate of technological progress. The manufacturing sector has a decline in the technological innovation throughout the 1990s. These results establish that technology contributes to economic growth and sectoral shifts affect the overall growth in South Africa.

**Table 2. 2:** South Africa’s real annual economic growth: 1990-2013

<b>Year</b>	<b>Growth rate</b>	<b>Year</b>	<b>Growth rate</b>
1990 -1994	0.0%	2008 – 2010	0.7
1994 – 2000	2.8	2011	3.6
2000 – 2004	3.5	2012	2.5
2004 – 2008	5.0%	2013	1.9

**Source: Adapted from Fedderke 2002a**

From this table growth started to gradually accelerate until 2007/8 global financial crisis, but momentum slowdown since then.

## **2.3 Poverty and Inequality in South Africa**

### **2.3.1 Poverty**

The South African government uses US\$2 a day or R524 a month per person (in 2008 prices, updated to 2010) as a guide to poverty line. Using this indicator, the proportion of people living below the poverty line was about 53% in 1995; which subsequently varied, reaching 58% in 2001 and declining to 48% in 2008. In international standards, this is a very high level of poverty. Poverty among women-headed households is higher than average poverty and women continue to earn less than men, even though differences in years of education have largely been narrowed. About 61% of women live in poverty, and 31% live in destitution, compared with 39% and 18% of men respectively. The decline in poverty since 1995 has been relatively small given the rise in per capita income, a growing economy and significant social policy interventions (Bhorat & Van der Westhuizen 2011a).

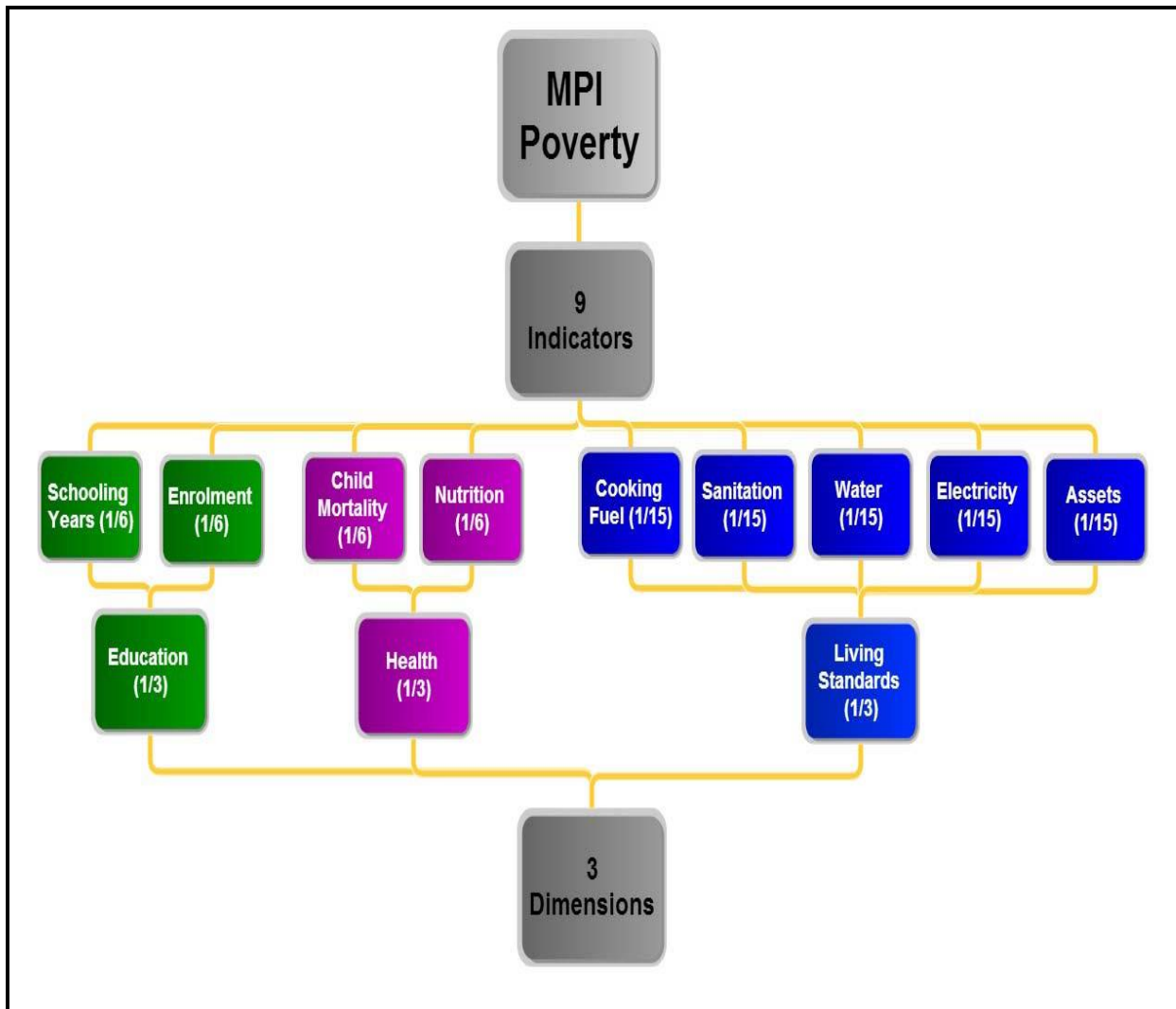
### **2.3.2 Poverty trends in South Africa**

Most studies that measure trends in poverty and inequality consider the measures of people's income and/or expenditure for the well-being. Such measurements of monetary values—"money-metric measures" are conceived to need some complementary dimensions. This exercise is done by examining changes in those dimensions that cannot be measured in monetary terms (May, 1988). This view is based on the notion that poor people characterise poverty by their experiences that include: lack of security, low wages, lack of jobs, poor nutrition, isolation from the community, little access to water and, poor educational opportunities. Such responses indicate that poverty is not determined by only income or wealth but includes several other dimensions. The multidimensional indices to measure poverty inform a focused policy making exercise. Using the post-Apartheid data allows for an approach that shifts from money-metric measures for the well-being to the one that consists of the combination of indicators that include: education; health and living standards (multidimensional poverty).

### **2.3.3 The composition of Multidimensional Poverty Index (MPI)**

The Multidimensional Poverty Index (MPI) approach use data from national household surveys (Alkire and Foster (2011). The MPI calculated for South Africa consists of three dimensions that relate to nine indicators, as shown in Figure 1 below. Each dimension has

equal weight and each indicator within a dimension is also equally weighted (weights in brackets). It must be noted that income is not included in the MPI.



**Figure 2. 1:** The composition of the Multidimensional Poverty Index

The threshold of each indicator determines whether a household is deprived or not in a particular indicator (Alkire et al (2011)). A household is deprived in each of the following indicators as follows: schooling years-when no household member has at least five years of education, enrolment-when one child of school-going age does not go to school, water- when someone has no piped water on site, child mortality-when a child died before age 15 and nutrition-when one person in the household is underweight ((Finn et al 2013).

The value for each household is calculated for each of the nine indicators to find the level of achievement or access in a particular dimension. Individuals in a household have the same MPI score for the analysis at the individual level. The value of an individual below an indicator's threshold value shows that an individual is "deprived" in that particular indicator.

The MPI is calculated as follows: Firstly, the multidimensional poverty headcount ratio (H) is calculated as the proportion of the population that is multidimensional poor. This means that H indicates the prevalence, of poverty where someone deprived in more than three indicators is included in the headcount. Secondly, the average proportion of nine indicators in which poor people are deprived (A) is calculated, which indicates the average intensity of poverty. Each of these two measures (H and A) allow the interpretations of trends, as will be discussed below. Therefore, the MPI is calculated by multiplying the multidimensional poverty headcount ratio by the average intensity poverty (H x A). In 1993 the money-metric poverty headcount ratio was calibrated such that its initial value is the same as the multidimensional poverty headcount which is 0.37.

### 2.3.4 The trend in poverty: comparing multidimensional and money-metric results

Table 2.3 below illustrates and compares multidimensional and money-metric poverty in South Africa in 1993 and 2010. The first column—the multidimensional headcount ratio illustrates that 37% of the population was multidimensional poor (about 14.5 million people) in 1993. By 2010 the ratio fell to 8% which means that about 4 million people were deprived in more than three of the nine indicators of multidimensional poverty.

Table 2. 3: A Comparison of Multidimensional and Money-metric results trends of poverty in South Africa: 1993 and 2010

<b>Table 1: Comparing poverty measures for South Africa for 1993 and 2010 Year</b>	<b>Multidimensional poverty headcount ratio (H)</b>	<b>Multidimensional poverty intensity (A)</b>	<b>MPI = HxA</b>	<b>% Severe</b>	<b>Money-metric poverty headcount ratio</b>
<b>1993</b>	<b>0.37</b>	<b>0.47</b>	<b>0.17</b>	<b>16.9</b>	<b>0.37</b>
<b>2010</b>	<b>0.08</b>	<b>0.39</b>	<b>0.03</b>	<b>1.1</b>	<b>0.28</b>

Source: Own calculations using weighted PSLSD (1993) and weighted NIDS wave 2 (2010-2011).

The second column shows that, the average intensity of poverty among the poor (A) fell from 47% of the nine indicators in 1993 to 39% in 2010. The 8% who remained multidimensional

poor in 2010 were deprived in fewer dimensions of poverty compared to 1993 on average. The sum of the changes in H and A indicate that in 2010 there were significantly fewer multidimensional poor people; and those who were still poor, were somewhat less poor compared to 1993.

The third column gives the value of MPI ( $H \times A$ ) which is the combined change that dropped from 0.17% in 1993 to 0.03% in 2010. This drop in overall multidimensional poverty was due to a significant fall in the MPI headcount ratio H.

Coming to the fourth column, severe poverty is defined as deprived in 50% or more of the indicators. This table shows a sizeable decline in the ratio of the population in severe poverty whereas close to 17% of the population was severely multidimensional poor in 1993.

The final column illustrates the money-metric headcount ratios for 1993 and 2010. Comparing the changes in the two headcount ratios from 1993 to 2010, there is a fall in the national incidence of multidimensional poverty from 37% to 8% (column 1), while the decline in the prevalence of money-metric poverty is from 37% to 28%. From these results there is a huge drop in multidimensional poverty-in absolute terms compared to money-metric poverty.

### **2.3.5 The sources of decline in Multidimensional poverty**

Figure 2.3 below shows a graphical presentation of the main causes for the decline in multidimensional poverty during 1993 and 2010. About half of the population was classified as water deprived in 1993 but this number halved by 2010. With a 10 percentage point fall from 57% to 47% in sanitation the gains were modest. In 1993 more than half of the population lived in houses without electricity but the number fell to one fifth by 2010. There was a fall in the health dimension in terms of mortality deprivation from 21% to 9% and a fall in nutrition deprivation from 11% to 3%. The deprivation indicator in the school enrolment falls to almost zero in 2010. This improvement in the education indicator is a major source of decline in multidimensional poverty since 1993.

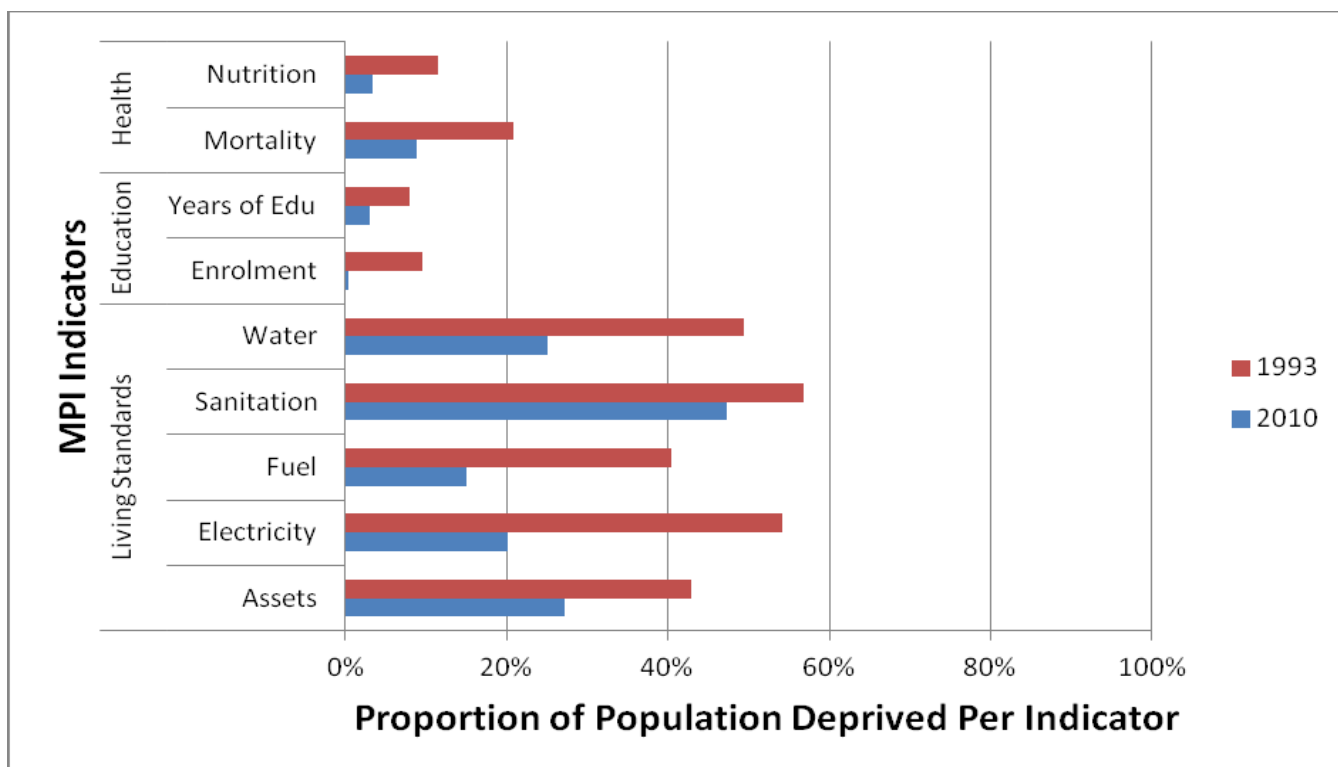


Figure 2. 2: The sources of deprivation among the population

### 2.3.6 The texture of poverty: the evolution of the MPI indicators

Figure 2.3 above shows the concentration of deprivation among the multidimensional poor (not among the population as a whole). In 1993 water, sanitation and electricity were the major indicators of multidimensional poverty—more than 80%. In 2010 sanitation and water remained the two indicators of greatest deprivation, with asset deprivation in the third place—above 80%. Generally, the living standards dimension remains the main source of deprivation.

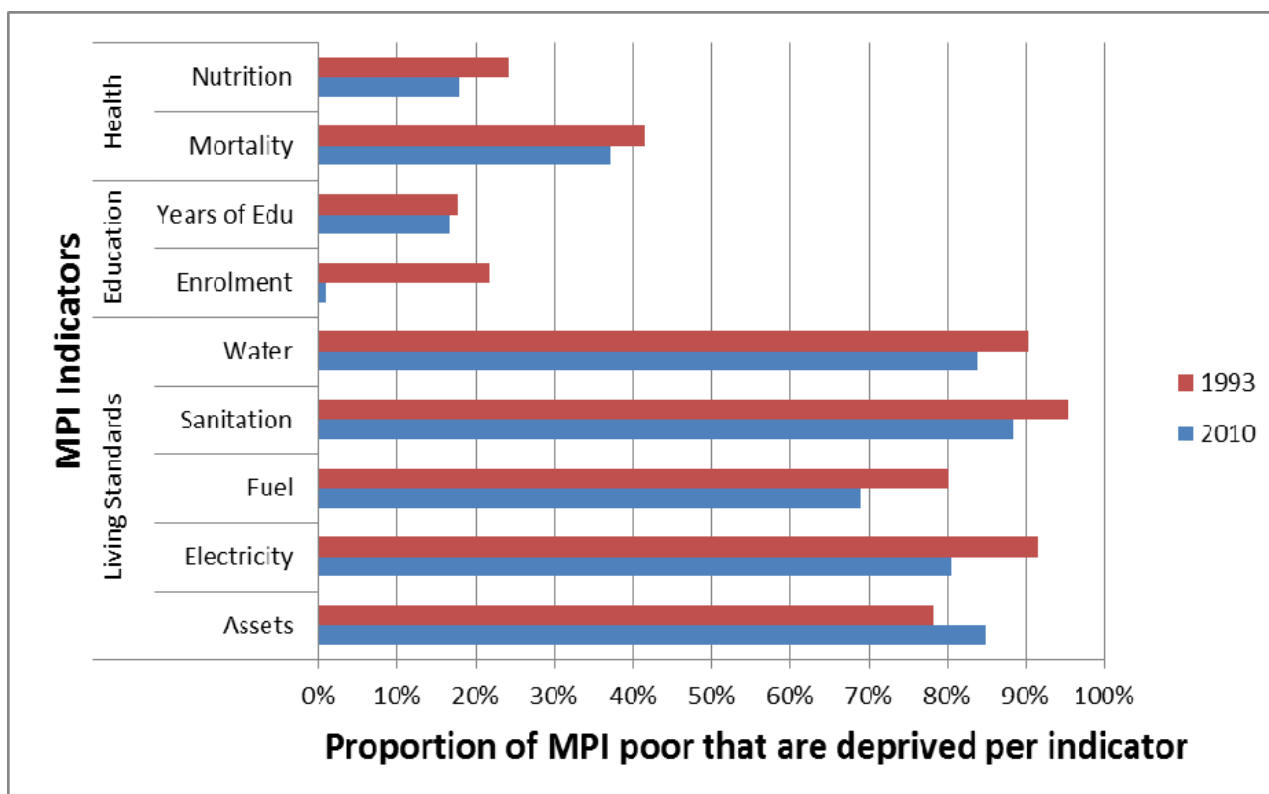


Figure 2. 3: The main areas of deprivation among the Multidimensional poor

Source: Own calculations using weighted PSLSD (1993) and weighted NIDS wave 2 (2010-2011).

The deprivation rate in household assets increased from 78% in 1993 to 85% in 2010/2011. This is due to the fact that in 2010/11 a lower proportion of multidimensional poor households reported owning a vehicle of some kind than in 1993.

In conclusion, there is a significant reduction in multidimensional poverty that is higher than a fall in money-metric poverty between 1993 and 2010. This outcome is brought about by significant increases in public expenditure to achieve the universal school enrolment, reduction in child mortality and expansion of access to services such as electricity and sanitation to poor communities. In consequence, what one could expect is a number of people entering the labour market to have better levels of education and health than in 1993. Specifically, the number should come from households that are better off in terms of water, electricity, and household assets. But, a significant increase in employment is not yet achieved in South Africa. The multidimensional improvements have not yet translated higher real earning for poor people. This is confirmed by the relatively small decline in the money-metric poverty headcount ratio in South Africa.

## 2.4 Agricultural productivity growth and the incidence of poverty

Agricultural productivity growth is synonymous to poverty reduction in rural areas (Fan et al., 2002 and DFID, 2005). Positive agricultural productivity growth is a panacea to poverty as the trend is widely reported in Asia, North America and Europe. There have been increases in public investments in modern scientific research for agriculture which led to yield breakthroughs and poverty reduction in the industrial countries during the 20<sup>th</sup> century. The growth of improved varieties, together with the increases in the use of fertilizers, chemical inputs, and irrigation, led to yield increases in Asia and Latin America, in the late 1960s (Hazell and Ramasamy, 1999). Lipton (2005) highlighted that poverty decreases recorded in the modern history of England, India and China resulted from increased productivity amongst smallholder farmers. Mwape (2009) reported almost the similar findings in Africa. Table 2.4 below illustrates the relationship between agricultural productivity growth and the prevalence of poverty.

Table 2. 4:Elasticity of poverty to agricultural GDP

Country	Elasticity
Ghana	-1.78
Kenya	-1.25
Uganda	-1.58
Zambia	-0.58
Ethiopia	-1.66

Source: Diao *et al.*, 2007

The opportunity cost between agricultural productivity growth and poverty prevalence relationship is found to be favourable in most countries. Mwape (2009) highlighted that this relationship is possible in the countries that achieved the Comprehensive African Agricultural Development Plan (CAADP) target of 10% growth in agricultural productivity.

Various studies attempted to analyse the relationship between agricultural productivity growth and prevalence in poverty in many countries. In South Africa, Machethe (2004) found that agricultural productivity growth plays a role in poverty reduction through increased wages, non-farm employment and low food prices although there are no exact estimates of

elasticity given. Also, Moyo (2007) suggested the promotion of agriculture as the sector that plays a role in poverty alleviation and inequality in rural South Africa. Seemingly, agricultural productivity allowed the poor countries to prosper. Almost none of the poor countries have achieved economic prosperity without first increasing agricultural production (DFID, 2005).

## **2.5 The key components of Agricultural transformation and Poverty reduction in developing countries**

China's experience is central to explain transformative effect of agricultural development on poverty levels. Fan et al., (2002) found that agricultural growth has significantly contributed to poverty reduction from 260 million in 1978 to 26 million in China in the year 2004. He further highlighted that the highest productivity growth which is highly correlated to agricultural growth from institutional and agricultural production changes is the outcome of rural reforms from 1978 to 1984 in China. The study by Fan et al. (2008) found that agricultural productivity gains led to poverty reduction in China between 1980 and 2000. Poverty fell from 27% to 5% between 1980 and 2000. This implies that agricultural-led growth areas benefit poor people.

Since the mid-1990s Mozambique employed increased production in agriculture as a strategy to reduce poverty. The agricultural sector is ranked the second largest contributor to GDP growth following the manufacturing sector between 1996 and 2003, accounted for about 1.7% out of 8.6%. The World Bank Statistics (2005) illustrates that agriculture's contribution to poverty reduction in Mozambique is the largest with no less than 11 of the 15 percentage points in total poverty reduction due to household-heads working in agriculture. However, both China and Mozambique had an unprecedented level of poverty reduction through agricultural growth experiences.

## **2.6 Lessons from the relationship between Agricultural productivity growth and Poverty reduction**

Christiansen and Demery (2006) mentioned that about 70% of poor people work in agriculture in Africa, hence acceleration of agricultural productivity growth is a potential instrument for income growth among the rural poor. Agriculture is the engine for growth and

poverty reduction meaning that investing in small-scale farm sector is the best mechanism to stimulate growth and reduce poverty. These relationships and the people practising agriculture make agriculturally-led growth pro-poor.

Increased agricultural productivity does not automatically lead to poverty reduction (DFID, 2005). There are country cases where increased agricultural productivity does not give significant reduction in poverty. Pasha and Palanivel (2004) found that growth must be pro-poor in order to have a positive effect on poverty reduction. Therefore, for agricultural productivity to contribute positively on poverty reduction, poor people should benefit.

The impact of agriculture on poverty reduction is not uniformed across the countries. As low income countries successfully develop, the contribution of agriculture on poverty reduction gets smaller (Thirlwall, 1995). Poverty reduction is likely to be an outcome of increased output in the non-agricultural sector. This implies to the direct impact that the agricultural sector will contribute to provide industrial inputs. Poverty reduction over the past 40 years has been closely related to both agricultural growth and the country's agricultural performance (Thirlwall, 1995).

Mwape (2009) recommends that countries in Africa need to accelerate economic growth, particularly in the agricultural sector to achieve the MDG 1. This implies that the associated relationship between agricultural growth and reductions in poverty are not particular to selected countries.

## **2.7 Income inequality**

Wilkinson and Pickett (2009) found that unequal societies tend to suffer most on socioeconomic indicators that include: (i) life expectancy; (ii) mental illness; (iii) obesity; (iv) educational performance; (v) teenage births; (vi) homicides; (vii) imprisonment rates; (viii) levels of trust; and (ix) social mobility. Banerjee; Dufio and World Bank (2005) suggested that an economy with a high level of poverty and/or inequality may fail to grow or may grow very slow. (Collier 1998; Sen 2000) found strong relationships between levels of inequality; violence; crime; the propensity of conflict and civil war.

Inequality in South Africa is reflected in the following ways:

- In 1995, the poorest 20% people earned on average R1 010 a year (in 2008 prices) while the richest 20% earned on average R44 336 a year. In 2008, the poorest 20% people earned R1 486 a year while the richest 20 percent earned on average R64 565 a year.
- In 1995, the poorest 20% of the population earned just 2.3 percent of national income, while the richest 20% earned 72%. By 2008, these figures were the same with the poorest earning 2.2% of income and the richest earning 70%.
- In 1995, the median per capita expenditure among Africans was R333 a month compared to whites at R3 443 a month. In 2008, the median expenditure per capita for Africans was R454 a month, and for whites was R5 668 a month.
- According to the Income and Expenditure Survey, the Gini coefficient, which measures the gap between the richest and poorest people, increased marginally from about 0.64 to 0.68 between 1995 and 2005. According to the AMPS data, the Gini coefficient was constant during this period about 0.67. South Africa remains one of the world's most unequal societies.
- Progress in changing the racial profile of earnings is only significant at the top of the income spectrum. The proportion of Africans in the top 20 percent of income earners increased from 39 percent in 1995 to 48 percent in 2009 (Bhorat & Van der Westhuizen 2011b). Inequality within the African population increased sharply highlighting the skewed distribution of opportunities (Leibbrandt et al 2010).

### **2.7.1 The patterns of Income distribution across countries**

Levy (2014) provides the analytical framework used across the Effective States and Inclusive Development (ESID) as a basis to distinguish among different political settlements. This framework distinguishes countries using three sets of variables: (i) whether the political arrangements are dominant or competitive; (ii) whether institutions are personalized or impersonal; and (iii) the extent of economic inclusion. The last set of variables—the extent of economic inclusion relate to the focus of this study.

Levy further used the three variables to distinguish six groups of countries using six dimensions: (i) Conflict; (ii) Dominant discretionary; (iii) Rule-by-law dominant; (iv) Personalized competitive; (v) Rule-of law-competitive; and (vi) Sustainable democracy. Table 2.3 below illustrates South Africa's case in these six dimensions.

Table 2. 5: Gini Coefficients of Inequality for eight countries, 2006

Country	Gini Coefficient	Country	Gini Coefficient
South Africa	0.67	Brazil	0.57
Zambia	0.55	Mexico	0.48
Kenya	0.48	United States (1996)	0.46
Thailand	0.42	Turkey	0.40

**Source: World Bank, Development Research Group**

From this table South Africa is the most unequal middle-income country globally. In terms of Levy’s framework explained above, South Africa falls under the dimension of “rule-of-law competitive than “sustainable democracy” dimension. According to Levy the rule-of-law competitive dimension refers to a country’s case where there are some limitations in the economic inclusion that threaten legitimacy and sustainability of the institutional order. On the other hand, unsustainable democracy dimension refers to a country’s case where political contestation plays out social consensus as to the legitimacy of the underlying political, social and economic order according to Levy.

Table 2.4 below compares South Africa’s income distribution with Brazil; Mexico; Thailand; and Turkey. The decision to consider these countries is based on: their similar average incomes; similar medium to large population size; similar development challenges; and similar levels of resources.

Table 2. 6: South Africa- middle – income country

	South Africa	Brazil	Mexico	Thailand	Turkey	United States
Population 2012 (millions)	51	198	117	67	74	314
<b>Per capita Gross domestic product (current \$; purchasing power parity)</b>						
1992	5.367	5.431	8.428	3.515	6.062	25.467
2002	7.195	7.449	11.221	5.465	8.093	38.123
2012	11.281	11.747	15.363	9.502	14.811	51.703

**Source: International Monetary Fund, World Economic Outlook**

From this table the per capita income between 1992 and 2012 was one-fifth in South Africa of that of the United States (high-income). An overview of the pattern of inequality based on Milanovic's data for the 2000/2002 period is shown in table 2.5 below.

**Table 2. 7: Aggregate Inequality 2000/2002 (% share of Gross Domestic Expenditure)**

	<b>South Africa (Final)</b>	<b>South Africa (Interim)</b>	<b>Brazil</b>	<b>Mexico</b>	<b>Thailand</b>	<b>Turkey</b>
Top 5%	42.1%	29.0%	33.7%	27.9%	19.8	23.1
Next 15%	32.2	34.0	29.8	28.2	27.1	26.5
Next 40%	20.2	28.3	28.4	32.5	36.0	35.3
Bottom 40%	5.5	8.7	8.1	11.4	17.1	15.1
Total	100%	100%	100%	100%	100%	100%

**Source: Milanovic; Statistics South Africa; Income and Expenditure of Households, 2000**

From this table, the two estimates for South Africa are both based on South Africa's Income and Expenditure Households Survey for the year 2000. This gives the reason why the final release of the data differed from an interim set of estimates the latter is the one used by Milanovic, hence the much higher levels of inequality than the interim. Using the final data and comparing the aggregate patterns, South Africa is the most unequal country of the middle income countries. Brazil's inequality is also high, with Turkey and Thailand less unequal. Mexico is in between. Table 2.6 below illustrates the South African data on expenditure distribution for 2005 and 2010.

**Table 2. 8: Trends in South African Income and Inequality, 2000-2010**

National real per capita income (Constant 2005 Rand)	<b>2000</b> <b>R29,798</b>	<b>2010</b> <b>R36,211</b>	<b>% change, 2000-2010</b> <b>21,5%</b>
Expenditure shares	In real per capita expenditure, by subgroup		
Top 5%	42.1%	37.5%	9.1%
Next 15%	32.2	32.8	24.3
Next 40%	20.2	22.8	38.0
Bottom 40%	5.5	69.0	52.2
Total	100%	100%	

**Source: Income and Expenditure of Households, 2000&2010; International Monetary Fund; World Economic Outlook**

## **2.8 Theoretical literature review**

The role of agriculture on economic development and poverty is amongst the debates in economics. Much of the literature focuses on structural transformation of economies in which economic activity is based on agriculture (least developed economies) and on industry and services sector dominated economies (high-income economies). A common approach to organise the discussion of the dominant paradigms and evidence is to build a chronological periodization and explain the important differences between them (Hettne, 1990 and Heyden, 1994). This approach is applied in the discussion that follows.

### **2.8.1 The Classical paradigm of development economics**

The classical development economics paradigm considers agricultural productivity to be the engine of industrialization; structural transformation; and aggregate growth in the economy. This paradigm is based on redistributive land reforms and rapid productivity growth in smallholder farming. According to this paradigm productivity in agriculture exhibit strong growth multiplier effects through inter sectoral and final demand linkages in the economy. This view is conceptualized from the contributions that agriculture can make to industrial development through the generation and transfer of surplus, and the creation of effective demand for industry in the domestic market (Morrisson and Thorbecke, 1990).

In terms of this paradigm the surplus concept include: (i) labour released from agriculture through productivity growth which contribute to industrial development; (ii) lower food prices; (iii) lower nominal wages for industrial employers as a result of technological change in agriculture; (iv) foreign exchange earned by agricultural exports and available to the central bank to import capital goods and intermediate products for industry; and (v) taxes levied on agriculture (land tax) or savings on agriculture (through low-priced deliveries or “invisible transfers”) through managed low prices via exchange rate and trade distortions that are invested in urban public goods and industry (Ranis and Fei, 1961; Lele and Mellor, 1981).

### **2.8.2 Modernisation theory: Poverty reduction through economic growth**

The modernisation paradigm was developed by economists in the 1950s and is informed by the programs of capital transfer from USA to Europe after the Second World War. The modern term used for those transfers is development or poverty-oriented development includes: poverty reduction, economic growth and social transformation. According to this theory poverty is the outcome of underdevelopment where the level of production in poor

countries fails to improve the welfare of the majority people. The theory suggests the massive modernisation of the factors of production as follows:

Through Rostow's phases of development, the economy takes off for economic growth at the national level, and "trickle down" it to the majority of the people to reduce poverty. According to this view reducing poverty is equivalent to modern economic growth which requires capital and technological transfer from the industrialised world. The relationships in the process are summarised as follows:

G → ST → PR

Where; G represents economic growth; ST represents social transformation; and PR represents poverty reduction. The shortcomings raised by literature in the Modernisation theory include: the emphasis on industrialisation proved that strategies failed to generate significant economic growth; the "trickle down" effect is very simplistic to deal with poverty problem; hence policy changes towards the "Basic needs" strategy was suggested.

### **2.8.3 Basic needs strategy**

ILO 1976 and Emmerij (1988) state the aim of the Basic needs strategy as to establish a consistent and systematic approach to development and poverty-reduction. Thus, the development of food-producing sectors and infrastructure support that include water supply; sanitation; health services; and education are emphasized. With regard to industrialisation, the Basic needs strategy supports labour-intensive mechanisms for poverty alleviation. Since this strategy is inconsistent, various donors defined it according to their own interpretations and interests. An example to this is that the Basic needs strategy of bilateral donor institutions concerned themselves with reducing poverty than with creating growth. This resulted in a large number of rural projects aimed at organising the producers in cooperatives, against private traders or against patrons who were thought to control the vital resources of the producers. A contrasting argument of Basic needs strategy is the integration of development policies that focus on growth to solve the poverty problem, and on poverty to generate growth. The various forms of the Basic needs strategy were in essence influenced by the dependency paradigm.

#### **2.8.4 The Dependency theory: Growth through reduction of poverty**

The Dependency theory is the direct opposite of Modernisation theory. The central point of this theory is that poverty in developing countries, contrary to what the Modernisation theory suggested, is rooted not in inefficient national production and the lack of growth, but in the international relations between the rich and the poor world. Rural poverty is conceived to be the result of structural inequalities between urban centre and rural periphery in this theory. The relationships in the process are summarised as follows:

ST  $\longrightarrow$  PR  $\longrightarrow$  G

Where; ST represents social transformation, PR represents poverty reduction, and G represents economic growth. Some critiques of the Dependency theory include that it is not really a development theory: its aim is to explain under-development, and is not clear how the various contributions to the theory could be translated into practise. With time, both Modernisation and Dependency theories are contradicted by empirical evidence which revealed the weaknesses of their assumptions. One of the major weaknesses raised by literature in the Dependency theory is the emphasis that poverty is a result of relations through exploitation in the international as well as the national level. At the national level it is assumed that a class society might not exist or to exist only in modified forms in most African countries. This often led Dependency theorists to consider relations of exploitation where they do not exist, or where the exploitative aspect is exaggerated according to the critiques.

#### **2.8.5 The Functional form of aggregate production**

The discussion on the Functional form of aggregate production in this section is on the different forms of aggregate production which are: the Cobb-Douglas production function, Constant Elasticity of Substitution and Leontief function.

##### **2.8.5.1 The Cobb-Douglas production function**

The Cobb-Douglas (CD) specification production function is used to model economic growth and estimate the total factor productivity (TFP) in studies that include: South Africa (Conway and Hunt, 1997, Fedderke, 2001, Du Toit and Moolman, 2003). The popularity of CD specification is attributed to Kaldor's (1961) "stylized fact" of growth which attests that factor income shares are constant; and the elasticity of substitution parameters equals unity.

One feature of the CD specification is that it can be linearized to estimate production parameters. The CD function is expressed as follows:

$$Q = AK_t^\alpha L_t^\beta;$$

Where; Q stands for production function; A stands for the technological change;  $K_t$  stands for the capital stock;  $L_t$  stands for the quality of labour inputs; and  $\alpha$  and  $\beta$  are the income elasticity of capital and labour respectively.

A degree of homogeneity in the CD specification is equal to  $\alpha + \beta$ . The elasticity of substitution is explained as the percentage change in the K/L ratio to the percentage change in the marginal rate of technical substitution ( $MRTS_{LK}$ ). In terms of the CD specification, the elasticity of substitution is always equal to unity.

Some researchers became sceptic about the elasticity of substitution being always equal to unity according to the CD specification. Hsing (1996) summarised the results of the estimates of the elasticity of substitution for USA using different data sets and various methodological approaches and disagree with the unitary figure. Antras (2004) suggests that the CD specification figure may be due to an omitted-variable bias caused by the assumption of Hick's neutral technical change. Duffy and Papageorgiou (2000) suggested that the aggregate elasticity of substitution varies with economic development. The inter-sectoral elasticities of substitution change along the transitional growth path affect the aggregate elasticity of substitution, according to these researchers.

### **2.8.5.2 The Constant Elasticity of Substitution (CES) function**

In response to the Cobb-Douglas orthodoxy, Arrow, Chenery, Minhas and Solow (1961) introduced the Constant Elasticity of Substitution (CES) production function. The CES with the Hicks-neutral technical change is expressed as follows:

$$Q_t = A_t (\delta L + (1 - \delta)K)$$

Where,  $Q_t$  is the level of output;  $L_t$  is the level of labour input;  $K_t$  is the level of capital inputs;  $\rho$  is the substitution parameter which is used to determine the elasticity of substitution ( $\sigma$ ), where  $\sigma = \frac{1}{1+\rho}$ ,  $A_t$  represents the homogenous technical change,  $A_0$  represents the initial level of technology and measures the proportionate change in output per time period when input levels are held constant.

The CES is a general form of the production function that can take the form of different production functions depending on the value of  $\rho$ . If  $\rho = 0$ , then the value of the elasticity of substitution ( $\sigma$ ) becomes unity. In this case, the CES is reduced to a Cobb Douglas function. If the value of  $\rho = -1$ , then the elasticity of substitution is equal to infinity. In this case the CES is reduced to a linear production function characterised by a straight line isoquant. The  $MRTS_{LK}$  and the elasticity of substitution are always equal to infinity. Thus, the CES becomes a Leontief if  $\rho$  tends to infinity (Lewis and Macdonald, 2004). The linear production function is expressed as follows:

$$Q_t = aK_t + bL_t$$

### 2.8.5.3 The Leontief function

The Leontief function is a form of production function that shows that inputs are used in fixed proportion ( $K/L$  is fixed) in the production process. The result in this case is that the elasticity of substitution is always equal to zero. The Leontief production function is expressed as follows:

$$Q = \min (K_t, L_t)$$

Based on the summary of different representations of the Functional form for the aggregate production functions above, the choice of the functional form depend on what the modeller expects the value of the elasticity of substitution to be in a given analysis, to avoid the misspecification problem. This means that the choice of production shall be a result of the estimation of the CES function, specifically the estimation of the elasticity of substitution.

### 2.5.6 Endogenous growth theory

The Endogenous growth theory is a challenge to Solow's neoclassical model. Solow's model proposes that technological change (economic growth) is exogenous and immune to any economic policies whereas Endogenous growth theory is attributed to endogenous technological change. The emphasis of the New growth theory is that although all factors may be subject to decreasing returns, the positive externalities associated with inputs such as technology; education; health; and infrastructure which have public good characteristics, can result in increasing returns at the aggregate level (Gylfason, 1999). The distinguishing feature of technology as an input is that it is neither a conventional good nor a public good; it is a non-rival, partially excludable good. Since the non-convexity of a non-rival good, perfect

competition is not supported. Thus, this model emphasizes knowledge and skills to be some of the key inputs in human development.

### **2.6.7 Transaction cost theory**

The Transaction Cost Economics (TCE) paradigm is part of the New Institutional Economics (NIE) (Hubbard, 1997; Clague, 1997; Poulton *et al*, 1998). Both the TCE and NIE are compiled on the article: “The Nature of the firm” (1937). This article suggests that economic activity does not occur in a frictionless environment, because of the costs of carrying out the exchange (Benham and Benham, 1998). The NIE acknowledges the role of institutions to explain and influence economic behaviour (the old institutional economics viewpoint) but argues that institutions can be analysed within the framework of neoclassical economics. In the NIE’s viewpoint the assumptions of neo-classical economics, namely, perfect information, zero transaction costs and rationality are relaxed, but self-seeking individuals to maximize an objective function which is subject to constraints hold (Matthews, 1986). The NIE represents “expanded economics” that focuses on the choices people make, while simultaneously allows pervasiveness of information and human limitations in the processing of information, evolution of norms, and willingness of people to form bonds of trust (Clague, 1997).

The market failure and incomplete markets that are caused by higher transaction costs and information asymmetries in developing countries cannot be explained by conventional neo-classical economics but by institutional analysis. Therefore, the TCE determines what type of institutions are needed (formal or informal) to improve the economic performance in developing countries.

#### **2.6.7.1 The concept of Transaction costs**

The enforcement and exchange of property rights involve transaction costs. Eggertson (1990) defines transaction costs as “the costs that arise when individuals exchange ownership rights for economic assets and enforce their exclusive rights”. In the context of this research study, only the transaction costs arising for individual agents or for basic economic units such as households are of interest. These transaction costs include expenses and opportunity costs, which are either fixed or variable, that arises from the exchange of property rights. The unobservable transaction costs which are implicit in nature are amongst the factors that could limit the participation of small-scale farmers in the market economy.

Hayes *et al* (undated) distinguish transaction costs in integrated agricultural markets from transaction costs in commodity markets. The former includes:

- The bureaucratic costs and distortions associated with managing and co-ordinating integrated production, processing and marketing.
- The value of time used to communicate with the participating farms and co-ordinate them.
- The costs of incentives employed to convince farmers to voluntarily participate in integrated production.
- The costs involved in establishing and monitoring long term contracts.
- The economies of scale forgone when large production replaces commodity production..

Key *et al* (2000) differentiates between fixed and proportional transaction costs as follows: The fixed transaction costs are uniformed regardless of the level of transactions made. This means that, the same costs are incurred once the decision to exchange products is made. In the context of this research study, the information costs to find the market will be the same regardless of whether the household sells more or less commodities. Thus, once the information about the market is found and contacts made with the buyer, a household can sell any amount without having to make extra attempts (expend extra costs) for information about the same market. On the other hand, proportional transaction costs vary with the level of, or the amount involved in the transaction process.

#### **2.6.7.2 Transaction costs in smallholder farming**

Transaction costs explain why a market might be “missing” in credit markets (Besley, 1994, Swaminathan, 1991), labour markets (Sen, 1966, 1981, Bardhan, 1984), land markets (Carter and Wiebe, 1980, Carter and Mesbah, 1993), as well as the product markets (Stiglitz, 1998, Holden and Biswanger, 1998). These market failures result in alternative institutional arrangements (Biswanger and Rosenzweig, 1986, Timmer, 1997, Delgado, 1999) that include sharecropping, interlinking and interlocking of markets (Bardhan, 1980, Clapp, 1988, Braverman and Stiglitz, 1982, Biswanger; Khandkar and Rosenzweig, 1998).

Transaction costs include costs resulting in the distance to markets, poor infrastructure, high marketing margins, imperfect information, supervision and incentive costs (Sadoulet and de Janvry, 1995). The smallholder farmers are usually found in remote areas far away from

service providers and consumers of their products. The distance to the market together with poor infrastructure, poor access to assets and information is manifested in high exchange costs. For smallholder farmers to participate in the agricultural market they have to determine who they will deal with, what the terms are, negotiations leading to bargaining conducted, a contract drawn up, and inspection done to make sure that the terms of the contract are observed (Hobbs, 1997; Coarse, 1937). These are the examples of the operations that are costly to prevent many transactions from taking place, which otherwise could have been carried out in a world in which the pricing system works without cost (Staal et al, 1987, Coarse, 1937).

Campbell (1978) illustrates the problem of transaction costs in market participation as follows: After deciding on price, one has to find a buyer. The longer one takes for the buyers the higher the search costs incurred, which are part of transaction costs. Also, transaction costs include advertising, telephone and transport costs and time spent. These extra costs of search and information may rise so high that they exceed the gap between the price at which one would be willing to sell (buy) and the price offered by the end user.

This summary of transaction cost theory illustrates that smallholder farmers could encounter some difficulties to participate fully in the agricultural markets and that tends to reduce their net benefits of agricultural product exchange.

### **2.6.8 Theoretical arguments from the literature**

The model of structural transformation demonstrates that in countries where 70 to 80% of the rural population derive income from agriculture, poverty reduction depends on agricultural productivity. Several researchers indicate that relatively land distribution patterns tend to generate higher rates of economic growth than highly concentrated ones (Johnston and Kilby, 1975; Mellor, 1976; Quan and Koo, 1985; and Deininger and Squire, 1998). These researchers based this view on the fact that broad-based agricultural growth tends to generate second-round expenditures in support of local non-tradable goods and services in rural areas and towns. In addition, they found that the multiplier effects that result tend to be much weaker when the source of agricultural growth is concentrated in relatively few hands (Gugerty and Timmer; 1999):

Gugerty and Timmer used a sample of 69 countries in which they found that in countries with initial “good” distribution of assets, both agricultural and non-agricultural growth benefit the

poorest households. But, in countries with “bad” distribution of assets, economic growth tends to be skewed towards the wealthiest households, and that cause the gap between rich and poor households to widen. In the latter group of countries, agricultural productivity is associated with greater increases in inequality than in non-agricultural growth. These findings establish that in a case where access to land is highly concentrated and where a sizeable part of the rural population lack sufficient land or education to earn a livelihood some special measures will have to be considered for the problem of persistent poverty (Ravallion, 1997). Thus the rate of growth could be affected by the distribution of assets in the agricultural sector, particularly land.

This summary on literature review presents a case for agriculture’s role to reduce poverty. Furthermore, a growing nonfarm sector could promote growth in the agricultural sector.

## **2.7 Empirical review**

### **2.7.1 International studies**

Literature illustrates that agricultural productivity increases in developed countries compared to less developed countries. This difference is due to the high investment in research and development, labour, land, capital, and improvement in the use of inputs that include machinery increases and fertilizers. Chang *et al* (2010) suggested that labour productivity in China increased by 4.13% whilst that of the United States was 7.16% during 1987-1994 periods. In less developed countries generally land productivity is higher compared to developed countries due to land reform policy. Essentially, growth in agricultural productivity depends on factors that include: technological changes, improved input use, efficiency and conservation of natural resources. In turn, these depend on investments in agricultural research, extension, and human capital.

Chang *et al* (2001) assessed how to promote agricultural productivity growth to achieve sustainable food security in Asia. The study focused on the role of investment, both in physical and human capital, to maintain and increase agricultural productivity. The methodologies used are both the PFP and TFP. The findings showed that agricultural productivity growth is promoted by improving labour productivity. The improvement in labour productivity in China was 0.68% per annum during 1961 to 1975, 4.37% per annum during 1975 to 1987, and 4.13% per annum during 1987 to 1994 periods. The per annum improvement in labour productivity in India during the same periods was 0.2%; 1.07% and

2.04% respectively. The per annum improvement in labour productivity over the period 1961 to 1994 was 7.41% and 7.16% in Japan and Korea respectively. Due to the improvement in labour productivity, the agricultural output growth for these countries, with the exception of Japan, remained positive from 1961 to 1994. The TFP for China surprisingly remained negative despite its growth in output and the PFP of labour and land. This is due to the output growth generated from the expansion of inputs, rather than productivity increases.

DFID (2004) examined the correlation between different rates of poverty reduction and differences in agricultural performance particularly, the rate of growth of agricultural productivity. They found the links between agriculture and poverty reduction through four “transmission mechanisms”: (i) direct impact of improved agricultural performance on rural incomes; (ii) impact of cheaper food for both urban and rural poor; (iii) agriculture’s contribution to growth and the generation of economic opportunity in the non-farm sector; and (iv) agriculture’s fundamental role in stimulating and sustaining mechanisms that depend on the extent to which agricultural productivity can be increased where it is almost needed.

Ligon and Sadoulet (2008) combine time series and cross-section data to estimate regression coefficients connecting consumer expenditures by decile to agriculture and non-agriculture GDP. Their findings are that agricultural sector growth is more important than non-agricultural sector growth for those households in the lower decile of the expenditure distribution, which are the poorer segments of the population. For richer households the findings are the opposite, the expenditure elasticity in non-agricultural growth is much higher than for agricultural growth. Based on these findings they concluded that agricultural sector growth is pro-poor.

Suryahadi (2008) investigated the relationship between economic growth and poverty reduction by differentiating growth and poverty into their sectoral composition and urban-rural location using data from Indonesia. They found that rural services growth reduced poverty in all sectors and locations, rural agriculture growth strongly reduces poverty in rural areas, and is the largest contributor on poverty in Indonesia. These findings implied that urban services growth had the largest effect on poverty in most sectors; and while agriculture growth in rural areas still played a major role in reducing poverty, policies that enabled strong growth in the services sector in both urban and rural areas would expedite poverty reduction.

### **2.7.2 Developed countries**

Chang *et al* (2001) investigated how to promote agricultural productivity growth so that sustainable food security is efficiently achieved in Asia and the Pacific. They focused on the role of investment both in physical and human capital; and maintaining an increasing agricultural productivity. The methodologies used are both the PFP and TFP. Their findings are that agricultural output growth remained positive from 1961 to 1994 with Japan the exception, compared to a decline during 1975-1987 in output and labour productivity growth in Australia and the United States.

Grant (2002) estimated agricultural productivity from regional accounts for twenty one regions in 1880/4, 1893/7 and 1905/9 in Germany. The estimates were derived from regional accounts for agricultural production and costs. The findings illustrated that productivity in East-Elbian agriculture was growing rapidly during the period of the study, and tend to converge on average in Germany. Productivity in Southern region was very slow showing that yield improvements were not limited to large farms and estates, but that smaller holdings also had access to new technology and improved husbandry methods. They concluded that there was a strong process of convergence which brought productivity up in the rural east to level equal to or above the national average. This convergence mechanism was associated with the spread of more advance agricultural techniques.

### **2.7.3 Developing countries**

Datt and Ravallion (1998) assessed the extent to which India's rural poor shared in agricultural growth. Combining data from 24 household sample surveys spanning 35 years with other sources, they estimated a model of the joint determination of consumption-poverty measures; agricultural wages; and food prices. They found that higher farm productivity brought both absolute and relative gains to poor rural households. A large share of the gains was via wages and prices, though these effects took time. The benefits to the poor were not confined to those near the poverty line.

Fulginiti *et al* (1998) assessed changes in agricultural productivity of eighteen developing countries over the period 1961–1985. The study used a nonparametric, output based on malmquist index and a parametric variable coefficient of Cobb-Douglas production function. They examine whether declining agricultural productivity in less developed countries was

due to use of inputs. Econometric analysis indicated that most output growth was imputed to commercial inputs like machinery and fertilizers.

Chavas (2001) assessed international agricultural productivity using nonparametric methods to estimate productivity indices. The assessment used FAO annual data on agricultural inputs and outputs for twelve developing countries between 1960 and 1994. Technical efficiency indices for time series analysis results suggested that in general the technology of the early 1990s was similar to the one in the early 1960s. This showed that the improvement in agricultural production was not because of technology but because of other inputs such as fertilizer and pesticides. The general empirical results indicated only weak evidence of agricultural technical change and productivity growth both over time and across countries. There was much evidence of strong productivity growth in agriculture over the last few decades corresponding to changes in inputs

Zepeda (2001) investigated agricultural investment and productivity in developing countries. The study used the indices or growth accounting techniques, econometric estimation of production relationships and nonparametric approaches models of production growth. They measure the change in output, identify the relative contribution of different inputs to output growth and identify the Solow residual or output growth not due to increases in inputs. The findings show a relatively weak relationship between physical capital and growth, compared to investment in technology and human capital.

Velazco (2001) assessed trends in agricultural production growth for the period 1950-1995. He identified factors that affect agricultural growth and investigated any underlying constraints. The study used a Cobb-Douglas production function and supply function to analyse data. The focus was on how changes in land, labour and fertilizer, the role of public and private investment, technological change, policy and political violence influenced Peru's agricultural sector. The finding of the agricultural growth estimation for the aggregate production function for 1970-1995 indicated that increasing agricultural employment would have the greatest impact on the output, followed by land, fertilizer and tractors.

They concluded that public and private investment are required to increase agricultural production. There is a relationship between public and private investment with the latter responding to increases in the former. However, only few people have large farms, while a

large group of the population has smallholdings and little or no education. The implication is that investment in human capital is an obstacle to the effectiveness of extension programmes and technological change. Improved inputs are only used in the coastal region where the large holdings are concentrated. The demand for tractors and agricultural machinery is also concentrated in the coastal region. The observation was that agricultural investment has been adversely affected by high inflation, the external debt crisis and hence lower availability of funds, as well as political violence.

Tripathi *et al* (2008) investigated the impact of labour, capital and land on agricultural productivity growth from 1967-70 to 2005-06 in India. A Cobb-Douglas production function was used to analyse data and the results indicated that output elasticity of land was 1.98, labour 1.06 and capital 0.15 and when added up they gave a sum greater than one. This meant that all inputs had positive and significant influence on agricultural productivity growth.

Kiani *et al* (2008) measured TFP in the crops sub-sector and analysed the relationship between productivity and agricultural research expenditures during 1970-2004 in Pakistan. They used Tornqvist-Theil index method for measuring TFP for outputs and inputs in 24 fields and horticulture crops. The results indicated that TFP index for crops sub-sector improved over time at an average annual growth rate of 2.2%. The reason for this improvement was growth in productivity over the previous 35 years. The general conclusion drawn was that investment in agricultural research played an important part in productivity growth. Mechanization and development of roads infrastructure also had a positive significant effect on TFP.

## **2.7.4 Studies in Africa and South Africa**

The empirical evidence in this section starts with the studies in Africa and studies in South Africa follows.

### **2.7.4.1 Studies in Africa**

Wiebe *et al*, (2001) assessed the impact of agricultural policies and investment on productivity in sub-Saharan Africa especially in Zimbabwe and South Africa. The study compared the effects of agricultural policies and investments on commercial and smallholder agriculture using previous studies. The results indicated that land productivity grew in both countries. In Zimbabwe it increased by an average of 1.3% and in South Africa by an average

of 0.6% per year. Labour productivity increased in South Africa by an average of 1.3% while it decreased by 0.7% in Zimbabwe per year. In both countries previous government interventions favoured European farmers over African farmers. TFP growth for commercial sector in Zimbabwe was at about 4.0% in the 1970s and 1980s and in South Africa it grew by 1.3% between 1947 and 1991, accelerating to 2.9% in the final decade leading to independence. TFP in Zimbabwe's communal sector grew by 8.1% in the early 1980s and fell by 2.7% since there was a reduction in spending for costly post-independence policies supporting smallholder production. Commercial agriculture in South Africa, demonstrated the potential benefits of investment in infrastructure, human capital and research.

In their study on "Agricultural policy, Investment and Productivity in sub-Saharan Africa (SSA)", they indicated that an expected increase in output from improved infrastructure and price policies were difficult to quantify, but such improvements were probably prerequisites to make possible the increases in productivity from the use of conventional inputs and research. Other important constraints to agricultural productivity were the quality and availability of education, research and extension services, as well as institutional uncertainties that weaken incentives to invest in the maintenance or improved land quality.

They concluded that education of rural labour force and agricultural research is needed to improve the future prospects for productivity growth in SSA. That being the case agricultural production has been increasing in SSA at over 2% per year. Land productivity increased by an average of 1.9% between 1950 and 1993 and labour productivity declined by an average annual rate of 1.0% between 1980 and 1995. The levels of physical capital, livestock, fertilizer, and non-conventional inputs have also changed, contributing to an estimated 11.3% annual increase in TFP between 1961 and 1991.

Kibaara *et al* (2008) analysed trends in agricultural productivity using a nationwide household panel survey in Kenya. The study examined productivity changes for maize, tea, coffee, sugarcane, cabbages, Irish potatoes and dairy. They used descriptive analysis to show trends in partial productivity and a Cobb-Douglas production function was used for productivity analysis. The results showed an impressive growth in maize and dairy sub sector productivity, maize growth was due to increased percentage of smallholder households using fertilizer, adoption of improved seeds and the availability of fertilizer retail outlets.

Dairy sub sector growth was mainly due to increased investment in dairy production and production of fodder crops. Sugar cane and coffee productivity declined mainly due to management challenges. Cabbage and Irish potato productivity fluctuated over the panel period, and did not show any meaningful trend. In general, Kenya's agricultural productivity indicated a rise. It has been found that in order to sustain productivity growth and encourage farmers to increase production and productivity of major enterprises, farmers will require an improvement in innovative financial services

Ajao (2008) examined changes in agricultural productivity in Sub-Saharan Africa (SSA) countries during the period 1961-2003 in the context of diverse institutional arrangements. He used the Data Envelopment Analysis (DEA) method to measure Malmquist index of TFP. A decomposition of TFP measures assessed whether the performance of factor productivity was due to technological change or technical efficiency change. Furthermore, they examined the effect of other variables such as land quality, malaria, education, control of corruption and government effectiveness. The results indicated that Burkina Faso, Cote d'Ivoire, Kenya and Djibouti were the four countries with the highest TFP growth; Lesotho, Sierra-Leone and Swaziland had negative TFP growth, which was due to decline in technical efficiency. The average TFP growth over the whole period was 1.8% per annum. The observed increase in TFP was due to technological change rather than technical efficiency change, since efficiency change decreased by 0.06% while the technological change increased on average by 2.3% during the reference period. All variables included in the model had significant impact on TFP except government effectiveness.

#### **2.7.4.2 Studies in South Africa**

Thirtle, Bach and Van Zyl (1993) conducted the TFP study that focused on productivity of commercial sector in South Africa. The data on small scale farmers was not available in the Census of Statistics Department then. Their finding was that TFP grew at an average rate of 1.3 per cent per annum from 1947-1991. This was mainly due to reduction in the cost of 21 labour input as it was abundant and cheap. During these years tax concessions and credit policies made labour cheap and capital more expensive. As a result such changes led to both growth of productivity and increasing employment, resulting in the improvement of social welfare.

A study conducted by Thirtle, Piesse and Gouse (2005), which updated the study of Thirtle, Helmke Sartorius von Bach and Van Zyl (1993), concurred with the findings of Kirsten and Vink (2003). The results of their study showed that between 1993 and 1999 TFP had been fluctuating. Conradie, Piesse and Thirtle (2009) compared the level of aggregating statistics for calculating productivity at district, regional and national level using data from Western Cape Province for the period 1952-2002. They found that over these five decades agricultural production in the province grew twice as fast as in the country but varied per region. In the Karoo growth of productivity was negative whereas in Boland and Breed River Valley it grew above 2%. This was due to the fact that Boland and Breede had extensive irrigation scheme. The study also showed that national estimates are not giving precise picture of productivity but provincial, regional and magisterial can show such details. Regional analyses show a particular enterprise, so that one can deduce whether field crops or animals are more productive. It has been found in regions that field crops and horticulture have more growth than animal rearing.

Poonyth, Hassaan, Kirsten and Calcaterra (2001) stated that agricultural productivity is less than productivity of non-agricultural sector. However, the growth of productivity of agriculture overtime is important for rural development and growth of other sectors in the economy. Thus, other sectors depend on agriculture for inputs and therefore if productivity of agriculture declines this will mean the productivity of other sector will also decline.

Liebenberg *et al*, 2010 studied South African agricultural production and productivity patterns. They documented and discussed developments regarding aggregate inputs, output and productivity. They found that agricultural output growth had lagged behind the rest of Africa in recent decades. Composition of output had also changed, with higher-valued horticultural crops gaining market share at the expense of staple crops and livestock products. The composition of input use had changed too. There was a substantial increase in the use of material inputs and capital inputs while the use of labour had declined. Results indicated that land productivity grew at an average rate of 2.49% per year from 1911 to 2008, slightly slower than the corresponding rate of labour productivity growth, which averaged at 2.83% per year. (MFP grew by 1.49% on average per year from 1947 to 2008. MFP was stagnant during 1989 to 2008, owing to a decline in the rate of output growth couple with an increase in the rate of input use in agriculture. With the evidence presented, investments and the incentive structures that affect agricultural research and development were suggested.

Lopez and Anriquez (2004) quantitatively assessed the three channels by which agricultural growth reduces poverty: (i) its effects on the real wage of unskilled workers (and/or its possible effect in reducing their unemployment); (ii) the direct impact of agricultural growth on the income of poor farmers; and, (iii) the effect of real food prices. They concluded that agricultural growth tends to improve the measures of poverty significantly with headcount falling around 7.3% as a result of a 4.5% increase in agricultural output. Also, the economy-wide effects occur via food prices and especially the labour market are quantitatively important in the direct income effects on farmers are almost negligible.

Bresciani and Valdes (2007) based their analysis on three channels that they found to link with agricultural growth and poverty: 1) labour market; 2) farm income; and 3) food prices. This study provides a theoretical framework to investigate the quantitative importance of these three channels. Their findings are reported from six country case studies. They concluded that when both direct and indirect effects of agricultural growth are taken into account, growth is more poverty reducing than is growth in non-agricultural sectors. In addition they emphasized that agriculture's contribution on poverty reduction is consistently greater than is agriculture's share of GDP. In this study, agriculture's contribution is through the labour market channel.

Montalvo and Ravallion (2009) assessed whether the pattern of China's growth mattered to poverty reduction using a new provincial panel data set constructed for this purpose. The econometric tests supported the view that the primary sector (mainly agriculture) has been the main driving force in poverty reduction over the period since 1980. It was the sectoral unevenness in growth process, rather than in geographic unevenness, that handicapped poverty reduction. China has had great success in reducing poverty through economic growth but this happened despite the unevenness in its sectoral pattern of growth.

Valdes and Foster (2010) assessed the importance of agriculture on poverty reduction, largely through its impact on overall economic growth, drawing on evidence from Latin America and other developing regions. The econometric evidence strongly suggested that the agricultural sector contributed to growth more than its share of GDP, certainly in Latin America but also elsewhere. Cross-country studies showed that on average in the developing world, agriculture tended to have an impact on both national growth and poverty reduction that is greater than its simple share of national GDP. The results reinforced the argument against taxing

agriculture relative to other sectors. And also that in assigning government expenditures to public goods one should take into account the relationship between agricultural growth and the subsequent non-agricultural growth.

De Janvry and Sadoulet (2010) presented evidence both on sectoral and household levels. Results showed that rural poverty reduction had been associated with growth in yields and in agricultural labour productivity, but that this relation varies sharply across regional contexts. GDP growth originating in agriculture induces income growth among the 40 percent poorest, which is in the order of three times larger than growth originating in the rest of the economy. The strength of agriculture came not only from its direct poverty reduction effect but also from its potential strong growth linkage effects to the rest of the economy. Decomposing the aggregate decline in poverty into rural contribution, urban contribution, and population showed that rural areas contributed more than half of the observed aggregate decline in poverty. Finally, using the example of Vietnam, they showed that rapid growth in agriculture opened pathways out of poverty for farming households. While the effectiveness of agricultural growth in reducing poverty is well established, the effectiveness of public investment in inducing agricultural growth is still incomplete and conditional or context.

Christiaensen (2011) conducted an empirical study that focuses on poverty as opposed to growth alone. Their argument is that the contribution of a sector to poverty reduction is depend on its own growth performance, its indirect impact on growth in other sectors, the extent to which poor people participate in the sector, and the size of the sector in the overall economy. Bringing together these different effects using cross country econometric evidence indicated that agriculture is significantly more effective in reducing poverty among the poorest of the poor (as reflected in the \$1-day squared poverty gap). It is also up to 3.2 times better at reducing \$1-day headcount poverty in low-income and resource rich countries (including those in Sub-Saharan Africa), at least when societies are not fundamentally unequal.

Conradie et al (2007) examined regional agricultural productivity in the Western Cape Province in South Africa. Various patterns of technological growth by and even within regions were found. Extensive animal rearing had lower growth than field crops, which in turn was worse than horticulture. Product switching to higher-valued outputs can be identified at the disaggregated level, as the impact of productivity change within a subsector. Their analysis is however based upon observations for 1993, 1998 and 2002, and the nature

of this data precludes more than generalised observations. While technological change usually contributes to an increase in productivity, in South Africa, where infrastructural constraints are the norm, this is not always the case.

## **2.8 Chapter summary**

This chapter has presented a review of relevant literature to the relationship between agricultural productivity and poverty alleviation, an analysis that will prove to be the cornerstone in understanding the remainder of this research study. Some of the important aspects that were covered in this chapter include the concepts such as agricultural productivity, agricultural transformation, and multidimensional poverty index.



## CHAPTER 3

### SMALLHOLDER AGRICULTURAL PRODUCTIVITY GROWTH TRENDS

#### 3.1 Introduction

The purpose of this chapter is to identify and define smallholder production as a poverty alleviation strategy, agricultural productivity and the related concepts, including efficiency, and profitability. Also the chapter provides contextual information on the trends in agricultural productivity in South Africa.

#### 3.2 Definition of key terms

The definition of key terms assists to give a clear understanding on how a concept is used in the context of the study as will be shown below.

##### 3.2.1 Agricultural productivity

Dharmasiri M. (2009) outlined that ‘Agricultural Productivity’ is defined and interpreted by different scholars that include: Agriculturalists, Agronomists, Economists and Geographers. In Agricultural geography and Economics agricultural productivity agricultural productivity is defined as “output per unit of input” or “output per unit of land area”. The improvement in agricultural productivity is generally considered to be the result of a more efficient use of the factors of production, namely, physical, socioeconomic, institutional and technological aspects.

Singh and Dhillon (2000) suggested that the “yield per unit” indicate agricultural productivity. Most scholars criticized this suggestion pointing out that it considers only land as a factor of production. Therefore, they suggested that agricultural productivity contains all factors of production that include: (i) labour; (ii) capital; (iii) farming experiences; (iv) fertilizers; (v) availability and management of water; and (vi) other biological factors. The use of marginal return per agricultural unit is suggested to represent the real picture than the average return per unit.

Shafi (1984) suggested that agricultural productivity defines the “ratio of the index of local agricultural output to the index of total input used in farm production”. It is, therefore, a measure of efficiency in input utilization during production, other things being equal. In this context agricultural productivity refers to the returns from arable land or cultivable land unit.

Dewett and Singh (1966) defined "agricultural efficiency as productivity expressing the varying relationship between agricultural produce and one of the major inputs, such as land, labour or capital, while other complementary factors held constant". This expression reveals that productivity is a physical component rather than a broad concept. Saxon observed that productivity is a physical relationship between output and the input which gives rise to that output (Quoted in Saxon, 1965).

Considering these examples of different definitions and views, agricultural productivity is examined in this research study from the productivity of land, labour and capital. The productivity of land is a very important factor in agriculture because it is the most permanent and fixed factor among the three categories of input namely, land, labour and capital. Specifically, land as a unit basis articulates yield of crop in terms of output to provide the foodstuff for the nation and secure employment opportunities for the rural community. Productivity of land may be raised by applying input packages consisting of improved seeds, fertilizers, agro-chemicals and labour intensive methods (Fladby, 1983). Also, the productivity of land could be improved by applying crop diversification/multi cropping in a season on the same land as practised by the farmers of Mahaweli system 'H' area (Dharmasiri, 2008) and by adopting year round mix-cropping system on the same land as done by vegetable farmers of Nuwaraeliya district (Dharmasiri, 2010). Furthermore, improving land productivity involves ruminants, such as cattle, sheep and goats. Although rangelands are being grazed to even exceeding the carrying capacity, there is a large unrealized potential for feeding agricultural residues to ruminants, which have a complex digestive system that enables them to convert roughage, which humans cannot digest into animal protein.

Productivity of labour determines the income of the population engaged in agriculture. In general, it may be expressed by the hours or days of work needed to produce a unit of a product. Shafi (1984) mentioned that labour productivity is measured by the total agricultural output per unit of labour. This explanation relates to the single most factor of production, is intuitively appealing and relatively easy to measure. On the other hand, labour productivity is a key determinant of living standard, measured as per capita income. This perspective is significant policy relevance. However, per capita income partially reflects the productivity of labour in terms of the personal capacities of workers or the intensity of their efforts (OECD, 2001). In Agricultural geography, the labour productivity has two major important aspects.

Firstly, it profoundly affects national prosperity. Secondly, it principally determines the standard of living of the agricultural population.

Capital in terms of purchase of land, development of land, reclamation of land, drainage, irrigation purpose, livestock, feeds, seeds, agricultural implements and machineries, crop production, chemicals is being given priority as a factor for enhancing agricultural productivity. Jamison and Lau (1982) and Alderman *et al.* (1996) examined the relationship between the level of education and wage with the crop production. A study conducted by Fafchamps and Quisumbing (1998) also identifies how various facets of human capital affect crop production in Pakistan.

### **3.2.1.1 Perspectives of Agricultural productivity**

Land is a permanent and fixed factor among other factors of production such as labour and capital. Agricultural productivity of land is explained by production of crops in terms of output or yield per unit of land. The productivity of labour has also taken an important role in agricultural economics. It is somewhat a controversial concept than land productivity (Shafi, 1984). Labour input vs. agricultural output is an important parameter of determining productivity of labour. The total labour force-number of hours scarified for farming and market value of labour are very important factors of labour productivity. However, agricultural labour productivity may be enhanced through training, and increase of incentives or wages just to mention a few. Working capital may be utilized for the purchase of: (i) land (ii) land reclamation (iii) drainage (iv) irrigation purposes (v) livestock purchase (vi) feeds (vii) seeds (viii) fertilizers (ix) chemicals (x) agricultural implements and (xi) machinery (tangible goods) in the agricultural production process. Increase in the tangible capital such as high yielding varieties, fertilizers, pesticides, herbicides, agricultural instruments and machinery could enhance agricultural productivity in any unit of land. But farmers have to identify the optimum level to maximize farm productivity. Agricultural productivity is a measure of farming efficiency. Efficiency refers to the properties and qualities of various inputs, the manner in which they are combined and utilized in production.

Agricultural productivity is frequently associated with the attitude towards work, thrift, industriousness and aspirations for high standard of living (Singh and Dhillon, 2000). Some communities are much more efficient in maintaining a higher level of farm productivity by their own inherited special characteristics. In general, agricultural productivity is influenced by physical, socio-economic and technological factors. Earlier the role played by physical

factors attracted much interest. Nowadays, the importance of natural factors has been depleted while the dynamic factors like technology and socio-economic factors are in the fore front. Yet, people have minimal control over the physical environment such as rain, duration and intensity of sunlight, soil quality and timing of water availability.

There is, therefore, no single mechanism that can be set for all situations in terms of the highest production. However, attempts are being made to control some of the physical factors by using technology. Increasing soil quality by adding chemical fertilizers, farming by irrigable water, controlling pests by chemicals and increasing production by high yielding varieties (HYV) are the examples of the achievements of currently. In developing countries, using poor farm technology results in low land productivity. As a result, the difference between farmers using advanced farm technology and those who does not has currently acquired a social significance. Yet, the climax of agricultural productivity of farmers is far off in the developing countries while some developed nations have gone far ahead in this context.

### **3.2.1.2 Measuring Agricultural productivity**

The agricultural development of a country or region is closely related to the production of crops. From time to time, considerable efforts are made to increase production and productivity level. The measurement of agricultural productivity helps to know the areas that are performing rather lesser or higher efficient in comparison with the nearby areas. With this understanding agricultural development plans could be formulated to overcome the regional inequalities, ascertain the land quality and the real cause of agricultural backwardness of an area.

Several scholars attempted to quantify agricultural productivity. Kendall introduced the ranking coefficient for measuring agricultural productivity in 1939. This ranking coefficient was used by Stamp (1958) for international comparisons. Enyedi (1964) devised new techniques for determining the index of productivity coefficient in agriculture. J.L. Buck developed a new technique related to grain equivalent per head of production known as the Grain equivalent index. It was further modified by E.de Vries in 1967 (Quoted in Singh and Dhillon, 2000). Bhatia (1967) introduced a productivity evaluation index that considered all physical and human factors combined to produce agricultural crops. Sapre and Deshpande (1964) introduced a weighted rank index for measuring agricultural productivity.

Shafi (1984) introduced the agricultural productivity coefficient index using calorie values relating to each crop. Jasbir Singh (1972) introduce a new technique for calculating agricultural efficiency by expressing the per unit area carrying capacity. Hussain (1976) developed a technique to measure agricultural productivity where he converted agricultural production into monetary values of a regional unit in production. Kawagoe et al. 1985 used a production function approach to measure agricultural productivity among different countries.

Vanloon, Patil and Hugar (2005) developed an indicator for measuring crop production by using primary product yield or conventional yield. Dharmasiri (2009) measured agricultural productivity in Sri Lanka using Cobb-Douglas Function. These are the examples of methods used to measure agricultural productivity with different formulae and components. Each model has different data requirements and is suitable for addressing different questions with strengths and weaknesses.

Apart from these methodologies, there are three different types of economic models that have been used for measuring agricultural productivity: (1) growth accounting technique, (2) econometric estimation of production relationships and (3) nonparametric models. Each model can be used to measure aggregate agricultural output with different data requirements and suitable for addressing different questions with strengths and weaknesses. The discussion that follows explains each of the following types of economic models.

Growth accounting technique involves compiling detailed accounts of inputs and outputs, aggregating them into input and output indices to calculate Total Factor Productivity (TFP) index. Goksel and Ozden (2007) have applied the TFP with Cobb-Douglas production function to analyse agricultural productivity in Turkey. The Cobb-Douglas production function (Cobb and Douglas, 1928) which will be utilized in this analysis is widely used to represent the relationship of output to inputs i.e. input-output relationship.

Nonparametric models use linear programming techniques to calculate TFP. An advantage of the nonparametric approach is that it does not impose restrictive assumptions on production technology. The major disadvantage is that since the models are not statistical, they cannot be statistically tested or validated.

The econometric estimation of production relationships, which will be applied in this research study, is based on either the “production function” or the “cost function”. An

advantage of this model is that it permits quantifying the marginal contribution of each input to aggregate production. For example, we can determine the impact of one-percent increase in fertilizer use on overall agricultural production, holding all other inputs constant. Many researchers use the Cobb-Douglas production function, despite some of its limitations.

Jorgenson *et al.* (1987) used a cost function approach for each major sector of the US economy to estimate the rates of sectoral productivity growth. He concluded that productivity growth has been more rapid in agriculture than in other sectors. Lewis *et al.* (1988) used a production function approach to calculate productivity growth rates for agriculture and for the remaining Australian economy (industry plus service). He concluded that the rate of productivity growth in agriculture had been higher than for the remaining economy. All these three models have strengths and weaknesses. The use of growth accounting technique imposes several strong assumptions about technology. A disadvantage is that the statistical methods cannot be used to evaluate their reliability.

The econometric model e.g. Cobb-Douglas function has the advantage of permitting hypothesis testing and calculation of confidence intervals to test reliability of the estimations. This model clearly measures the marginal contribution of each input to aggregate agricultural output. If the functional form is more flexible, a further advantage is that fewer restrictive assumptions about technology are imposed. A disadvantage of the econometric model is that it requires more data than the other models. Given this understanding, different methodologies for measuring agricultural productivity would give dissimilar results. Each and every formula has inherited weaknesses.

### **3.2.2 Smallholder farmers**

Smallholder farmers are defined in various ways depending on context, country and ecological zone. This explains interchangeable use of the term ‘smallholder’ with ‘small-scale’, ‘resource poor’ and ‘peasant farmer’. Dixon, Abur and Watterbach (2005) raised that the term smallholder farmers only refers to their limited resource endowment relative to other farmers in the sector. This view is incorporated in the definition by Ellis (1988). Todaro (1989) defines smallholder farmers as owning small-based plots of land on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labour. These definitions have a similar theme in the characteristics of smallholder farmers, namely

constraints in the land and labour. This research study considers these definitions of smallholder farmers.

The National Department of Agriculture (NDA, 2005) suggests that the major characteristics of production system of smallholder farmers are of simple, outdated technologies, low returns, high seasonal labour fluctuations and women playing a vital role in production. In addition, Dixon *et al* (2005) suggests that most smallholders have diverse sources of livelihood including significant off-farm income yet are still vulnerable to economic and climatic shocks. Smallholder farmers differ in individual characteristics, farm sizes, resource distribution between food and cash crops, livestock and off-farm activities, their use of external inputs and hired labour, the proportion of food crops sold and household expenditure patterns. These differences and constraints highlighted are typical characteristics of smallholder farmers in South Africa. It is important to note that with all these differences, smallholder farmers do contribute to the economy in different forms. The role of smallholder agriculture makes it significant to be either ignored or treated as just another small adjusting sector of the market economy (Delgado 1998).

### **3.3 An overview of South Africa's Agricultural Sector**

The Agricultural sector in South Africa deals with the production of crops and livestock, as well as fisheries. The development of Agricultural sector leads to the rise in human society, with the husbandry of domesticated animals and plants. This development creates a reliable source of food that enables the development of more densely populated and stratified societies. Agriculture encompasses a wide variety of specialties and techniques, including the ways to expand land suitable for growing plants, thereby providing more water-channels and other forms of irrigation. Cultivation of crops on arable land and the pastoral herding of livestock on rangeland remain at the foundation phase of agriculture. Agriculture is classified by forestry and fisheries in South Africa. South Africa's agricultural production has been on an increasing trend in the past decade as Figure 3.1 and 3.2 illustrate below.

#### **3.3.1 The Contribution to Gross Domestic Product (GDP)**

South Africa's agricultural contribution to Gross Domestic Product (GDP) was 4% in 2002 and continues to decline until 2.6% in 2012 as shown in Figure 3.1 below. The Agriculture sector plays an important role within the South African economy by providing food and

intermediate commodities to other industries such as manufacturing. Although its contribution to GDP declined in the past decade, agriculture remains crucial to the economy.

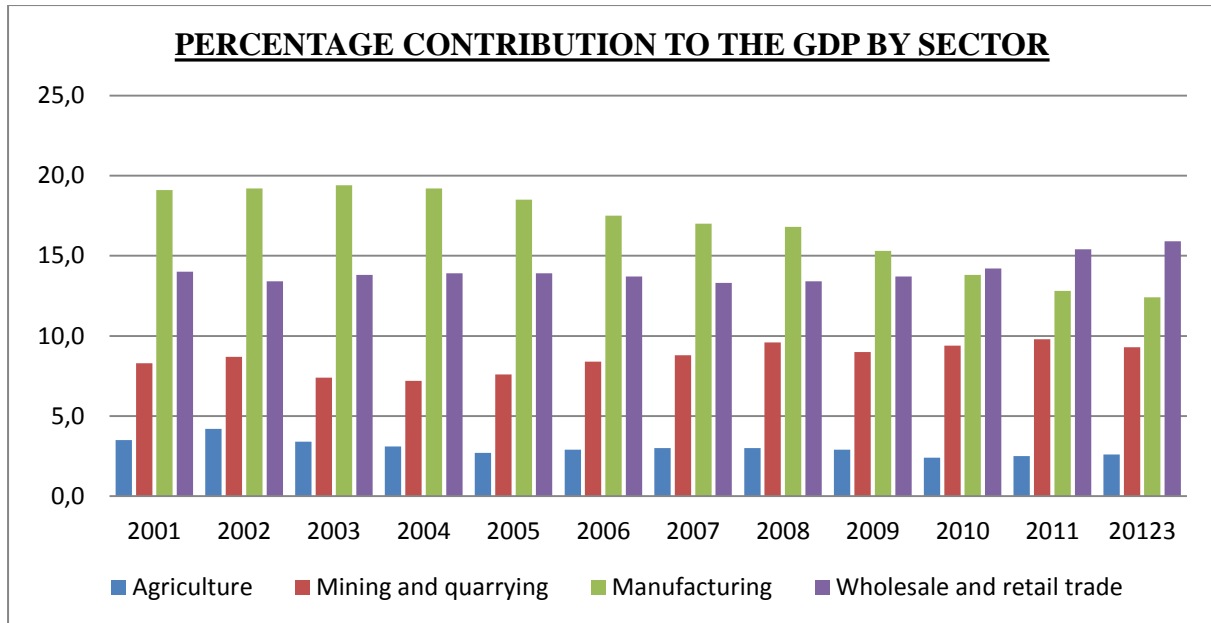


Figure 2. 4: Percentage contribution to gross domestic product (GDP) by sector

**Source: Department of Agriculture Forestry and Fisheries, 2013.**

Agriculture is the foundation of developing economies including South Africa. Therefore, healthy agricultural industries that contribute to the country's gross domestic product (GDP), food security, social welfare, job creation, and ecotourism are crucial while adding value to raw materials. However, the health of agricultural sector depends on the sustainability of farming methods. Farming practices must therefore not only protect the long-term productivity of land, but must also ensure profitable yields and the well-being of farmers and farm workers.

The National Department of Agriculture, Forestry and Fisheries are involved in improving agricultural production and minimizing the cost in inputs of farmers for decades. Kirsten *et al* (2003) highlighted that the South African government supported farmers with debt consolidation subsidies, crop production loans, drought relief, and acted as a supporter of consolidated debt in the eighties and early nineties. The main purpose of this government intervention is to increase productivity of farmers. The support however changed around the

mid-nineties when government reduced funding to commercial sector in bid to improve the efficiency and productivity of the sector.

The South African government also supported the small-scale farmers and continued even at the initiation of democracy. This was done through homeland consolidation and trust land purchases. The creation of land reform process increased the ownership of land for production in 2000, promulgation of new Water Act of 1998 which increased access to water by land owners in rural areas, revival and upgrading of old water scheme infrastructure in rural areas (Vink *et al*, 2002).

### **3.3.2 The Gross value of Agricultural production**

The value of field-crop production is relatively low mainly as a result of decreases in the production of field crops as shown in Figure 3.2 below. Maize production and all winter crops, except for canola have a huge impact on low levels of agricultural production in South Africa (DAFF, 2013). Maize production decreased by 5.2% in 2011/12 production year, wheat and barley decreased by 6.7% to 4.5%. However, field crop production has been on an increasing trend in the past decade but at lower levels. Horticultural products have been on an increasing trend in the last decade. The lower levels of the value of horticultural production are mainly attributed to decreases in the production of deciduous fruit and vegetables (DAFF, 2013). With reference to vegetables, onions and tomatoes there was a largest decrease of 4.3% and 4.6% respectively. The value of animal production has been increasing at relatively high levels compared to other agricultural products. Animal production increased by 3.6% as a result of increases in fresh milk (7.2%), number of stock slaughtered (6,2%),, as well as poultry meat (3,1%) (DAFF, 2013).

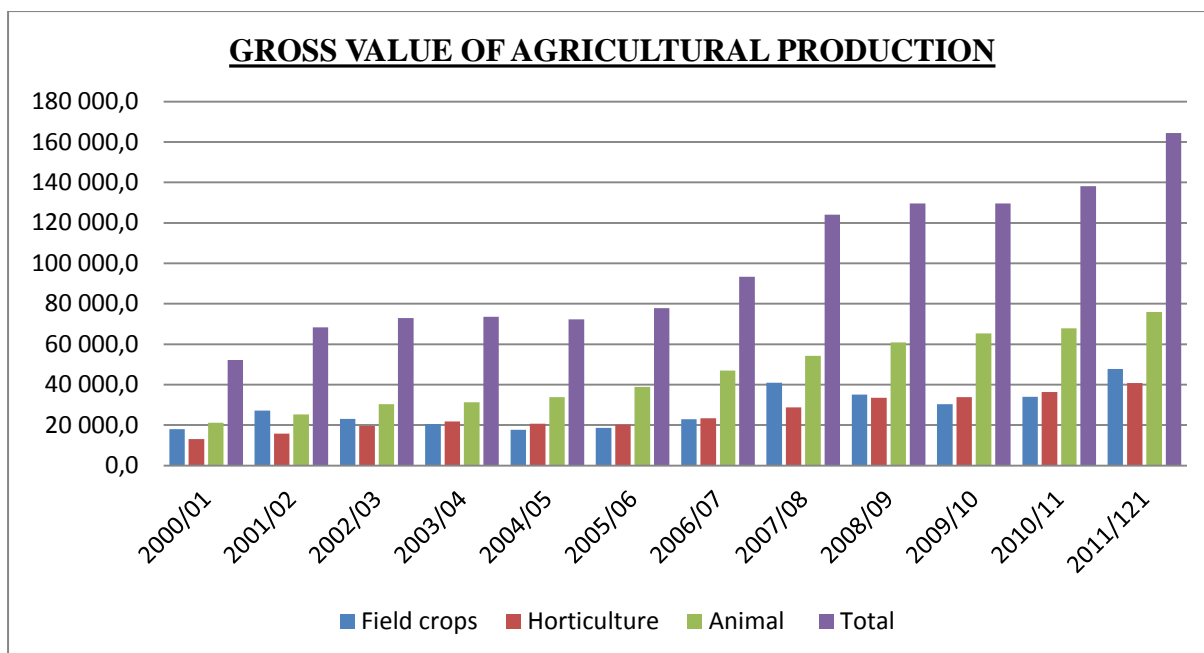


Figure 2. 5: Gross Value of Agricultural Production

**Source: own calculations, data from DAFF, 2013**

The total gross value of agricultural production, total production during the production season valued at the average basic prices received by producers, for 2012/13 was about R162 360 million, compared to R139 672 million the previous year. This increase can be attributed mainly to an increase in the value of animal products.

### 3.4 South Africa's Agricultural Productivity

Agricultural productivity refers to the output produced by a given level of input(s) in the agricultural sector of a given economy (Fulginiti and Perrin 1998). More formally, agricultural productivity can be defined as “the ratio of the value of total outputs to the value of total inputs used in farm production” (Olayide and Heady 1982). The measures of productivity can be divided into partial; multi; and total measures depending on the number of inputs under consideration.

Mahlangu and du Toit (2011) quoted that agricultural productivity measures the performance and provides a guide for the efficiency of the sector. The United States Department of Agriculture (USDA, 1980) stated that agricultural productivity statistics are important to identify the source of economic growth.

## TRENDS OF AGRICULTURAL PRODUCTIVITY IN SOUTH AFRICA

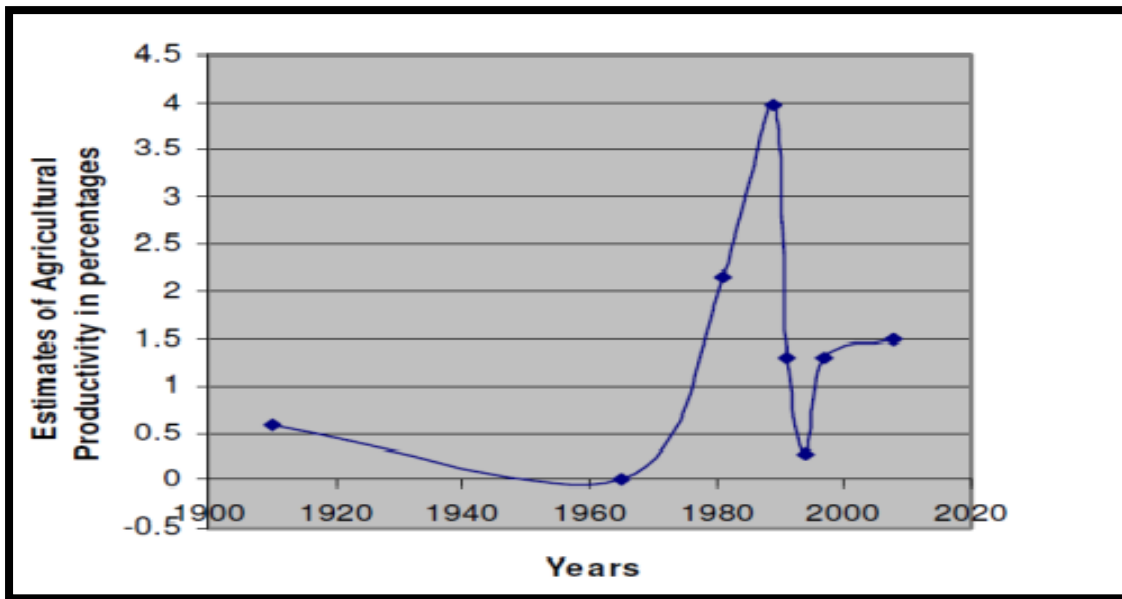


Figure 2. 6: Agricultural Productivity estimates in South Africa

*Source: Ramaila, Mahlangu and du Toit, 2011*

### 3.4.1 Factors affecting Agricultural productivity

According to Hui-Chang and Lydia (2011) economists consider mostly the role of conventional inputs such as land, labour, physical capital, water and chemical inputs to explain productivity growth. This consideration led economists to examine the role of human capital and public goods, such as education, agricultural research and extension and publicly provided infrastructure according to them. The rationale to also consider research is the belief that investment in research result in the increase of knowledge, which, in turn, either facilitate the use of existing knowledge or generate new technology. Technological advances, whether resulting from changes in input quality or how inputs are combined, lead to productivity gains. Education, training and extension also increase productivity by increasing people's knowledge and skill base, which are essential for technology adoption and efficient use of inputs. Public infrastructure, on the other hand, increases productivity by facilitating the exchange of goods and services.

#### 3.4.1.1 Technological change

Technological change is recognized as one of the most important source of productivity growth (Antle and Capalbo, 1988). It refers to the changes in the production process that come about from the application of innovation and newly acquired scientific knowledge,

technical and management skills. Technological change increases agricultural productivity either by shifting the production frontier upward so that more measured output can be produced with the same amount of inputs or by moving closer to the production frontier so that the same amount of output can be produced with a smaller amount of inputs. Better organizational and management skills not only improve input-output combinations but enable producers to respond more quickly to changing market circumstances (Alston, Norton and Pardey, 1995).

While generation of new technology or knowledge comes from investment in research and development, adoption of technology involves investment by the potential users in both physical and human capital (Antle and Capalbo, 1988). Therefore, adoption of technology depends principally on their applicability and significant returns of the innovation. However, there may be a long lag between development, adoption and productivity gains.

Since better-educated farmers are found to be more likely to adopt new technology, human capital is a pre-condition for technology adoption and hence productivity growth. Furthermore, if adoption of new technology requires additional investment, lack of access to credit and additional inputs may prevent or slow down technology adoption. Finally, because potential users of new technology often differ in the agronomic-ecological conditions in which they operate, new technology may require adaptive research before it can be transferred successfully to different locations. These impediments in technology adoption means that careful planning and provision of necessary infrastructure are essential to capture the full benefits of new technology.

#### **3.4.1.2 Agricultural research and extension**

Agricultural extension, also known as agricultural advisory services, plays a crucial role in promoting agricultural productivity, increasing food security, improving rural livelihoods, and promoting agriculture as an engine of pro-poor economic growth (International Food Policy Research Institute (IFPRI), 2014). Extension as a rural support service is needed to meet the new challenges that agriculture is confronted with: changes in the global food and agricultural system, including the rise of supermarkets and the growing importance of standards and labels, growth in non-farm rural employment and agribusiness, constraints imposed by HIV/AIDS, and other health-related challenges that affect rural livelihoods, and deterioration of the natural resource base and climate change.

### 3.4.1.3 Human capital

Human capital refers to knowledge, experience and skills possessed by people involved in the production process. It is influenced directly by education, training and extension. The importance of human capital lies on the fact that it has a significant impact on the adoption and utilization of technology, which in turn, affect the allocation of resources and productivity. A well-trained and educated labour force is said to be in a better position to assess changing conditions and make necessary adjustments. This ability becomes more important in increasingly deregulated and global economy where changes in the commodity markets are frequent and quick responses are required. Table 1 below illustrates employment in South Africa's agricultural sector.

Number of workers	Sep. '06	Sep. '07	Sep. '08	Sep. '09	Sep. '10	Sep. '11	Sep. '12
	1 000						
<b>Workers in agriculture, hunting, forestry and fishing</b>	1 088	1 041	767	653	640	624	661
<b>Skilled agriculture<sup>1</sup></b>	432	341	99	72	76	61	67
<b>Total employment<sup>2</sup></b>	12 800	13 306	13 655	13 844	12 975	13 318	13 645

Table 2. 9: Employment in South Africa's Agricultural sector

**Source: DAFF, 2013**

The concept of investment in human capital covers not only investment in formal schooling, post-school, and on-the-job training, but also investment in the form of improved health and family care. Social capital, on the other hand, refers to one's ability to utilize social networks and institutions. Social status, education and the range of social institutions available can influence one's social capital. Social capital is important in that it affects access to physical capital, land title, credit and cooperatives, all of which have implications for resource allocation and, hence, productivity.

### 3.4.1.4 Policy Reform and Prices

The importance of policy reform is increasingly viewed as fundamental for agricultural productivity gains, especially in countries where government intervention in agriculture is strong. Removing market distortions and allowing market signals to be transmitted to producers is the main objective of structural adjustment programmes by international organizations. This is an attempt to assist the economies in transition and countries in debt. Land reform and most land policies, which assign property rights to users so that efficient and

responsible use of resources can take place, are the examples in which changes in policy can have a significant impact on productivity.

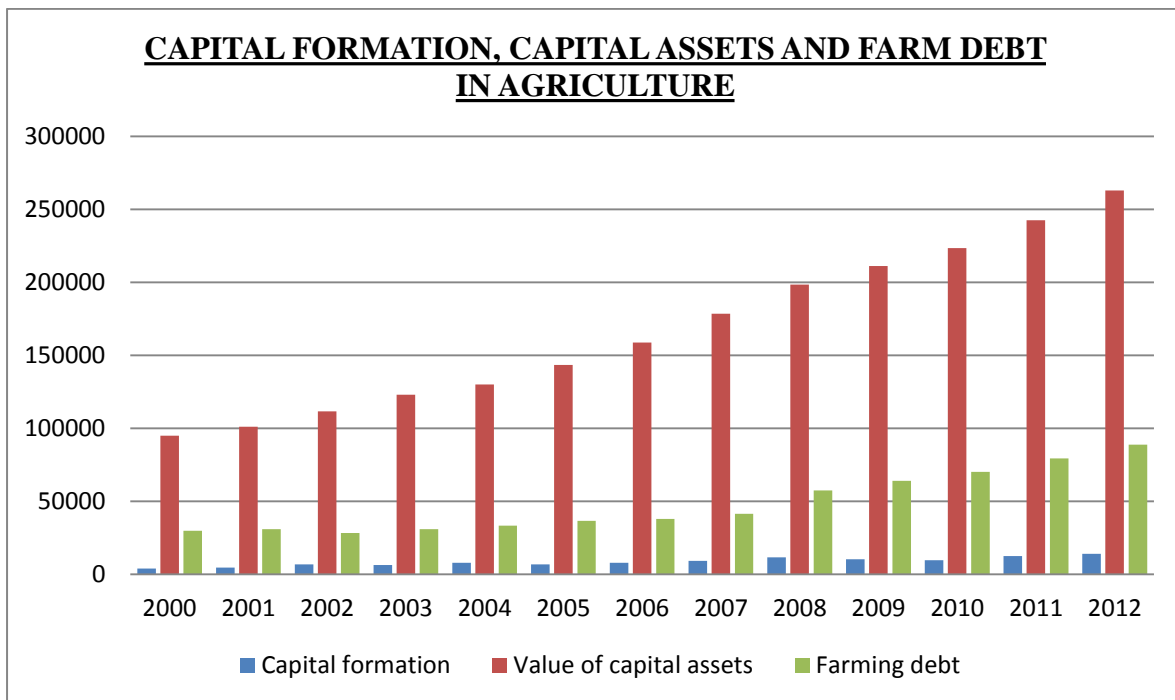


Figure 2. 7: Gross capital formation, value of capital assets and farm debt

Source: DAFF 2013,

### 3.4.1.5 International trade

Facilitated by improvements in transportation, communication and technology, trade is also an important factor in diffusing new products and new technologies. South Africa is a developing country that depends entirely on the agricultural sector which plays a principal role in its economic growth and development. Figure 3.4 below, presents South Africa's agricultural bilateral trade with the world. Let alone the slight decrease in 2009 due to global financial crisis, South Africa's total agricultural trade progress has been on an increasing trend in the past decade.

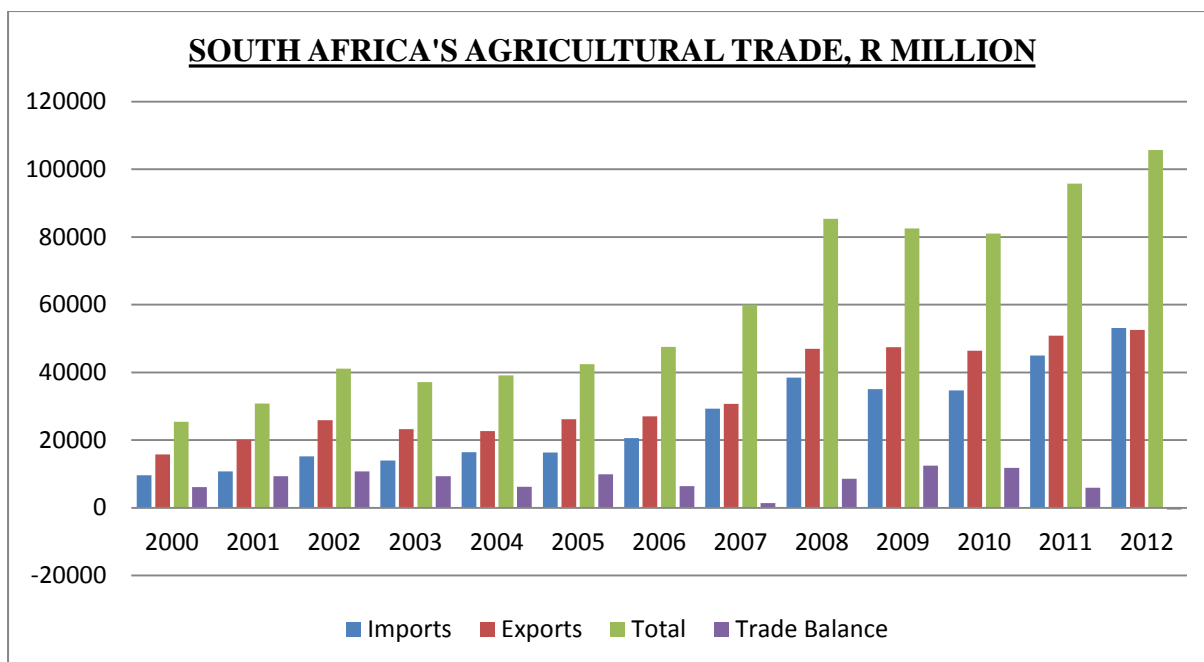


Figure 2. 8: South Africa’s Agricultural Trade

**Source: DAFF, 2013**

The current account balance has been fluctuating at very low levels and South Africa experienced a trade balance only in 2012. South Africa is an open economy, however, the opening of an economy does not come without risks, particularly where macro-economic, financial and lending policies are not well in place.

### 3.4.1.6 Natural resources

Natural resources are the determinants of food supply. Degradation of natural resources, such as land and water, undermines production capacity and threatens sustainability of the natural ecosystem (Pinstrup-Andersen and Pandya-Lorch, 1998). Land degradation has been severe across the world in the past few decades. One major contributing factor to land degradation is the overuse and misuse of irrigation water (Anderson, 1994). Government policies provide access to markets and credit for land improvement and technology could reduce misuse of water resources. Therefore, agricultural research is a critical input into sustainable agricultural development, particularly related to land and water management issues. Only about 13% of South African soil is suitable for cultivation and 22% can be classified as high-potential land (South Africa Web, 2012). About 1.3 million hectares are under irrigation scheme. South Africa faces a challenge of unavailability of fresh water. However, the country is looking towards other Southern African countries for its water, but the risks of international dependency on such a priority resource are high. Other possible sources, such as

desalination of seawater and water from icebergs, may be viable options in future; currently they are too expensive to exploit.

The government intended to redistribute 30% of agricultural land to black South Africans by 2014 in order to address the racial imbalances in the ownership. By June 2009 only 6.7 hectares was transferred. The Western Cape’s Institute for Poverty, Land and Agrarian Studies (PLAAS) experts recently noted that the level of support for new, small and cash-strapped farmers who live on re-distributed land are extremely poor. This report could have adverse effects on South African agricultural output. Figure 3.5 below, presents the utilization of agricultural land in South Africa. More than 80% of the agricultural land is allocated to the farm land with the development of the former farmland receiving the highest percentage. However, farmland and grazing land are prioritized.

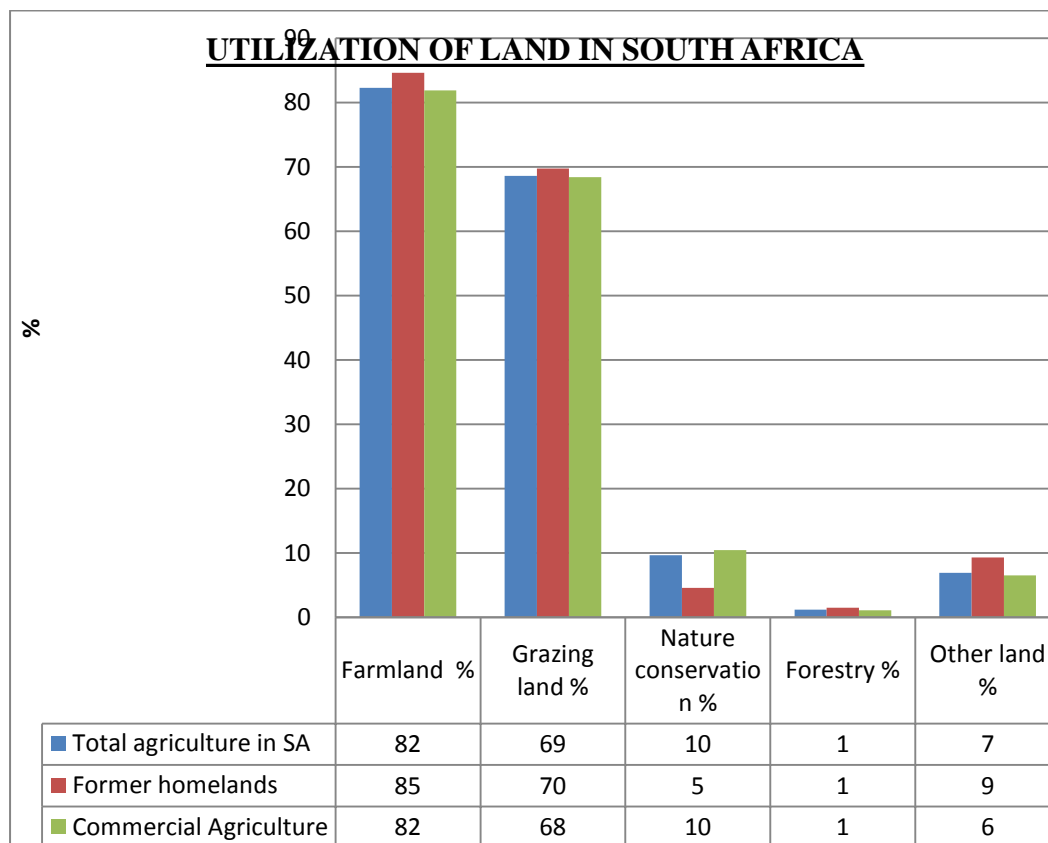


Figure 2. 9: Utilization of agricultural land in South Africa

Source: DAFF, 2013

Table 2. 10: Representation of the total number of farming units across the nine provinces of South Africa.

Land-use patterns	Western Cape	Northern Cape	Free State	Eastern Cape	KwaZulu-Natal	Mpumalanga	Limpopo	Gauteng	North West	Total
<b>2007: Total commercial farming units</b>										
Number	6 653	5 128	7 473	4 006	3 574	3 523	2 934	1 773	4 902	39 966
<b>2002: Total commercial farming units</b>										
Number	7 185	6 114	8 531	4 376	4 038	5 104	2 915	2 206	5 349	45 818
<b>1996: Total commercial farming units</b>										
Number	9 759	6 730	11 272	6 338	5 037	4 675	7 273	2 342	7 512	60 938
Hectares	9 766 969	29 734 978	11 342 502	10 327 660	4 068 401	4 544 012	5 488 613	756 946	6 179 490	82 209 571
<b>1993: Small-scale farmers in former homelands<sup>3</sup></b>										
Number	*	*	32 400	310 400	414 000	89 100	299 300	*	147 400	1 292 600
<b>Irrigation – hectares</b>										
Crops & orchards	286 004	188 903	137 887	188 901	131 033	129 308	161 127	29 372	101 593	1 354 128

**Table 2: Number of farming units and land utilisation by dominant branches of agriculture<sup>1</sup> per province in the South Africa**

**Source: Department of Agriculture Forestry and Fisheries, 2013**

### **3.5 Food security in South Africa**

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (Johannes John-Langba, 2011). This is an international definition that includes: (i) the availability of food that is nutritious and safe, and (ii) an assured ability to procure and acquire food of good quality in a socially acceptable way (e.g. without resorting to emergency food supplies, scavenging, stealing or similar coping strategies). On the other hand, food insecurity emerged as a global crisis following the global economic meltdown. According to the report of Food and Agriculture Organization (FAO, 2004) and the World Health Organization (WHO, 2011) on the state of food insecurity in the world, more than 814 million people in developing countries are undernourished. About 204 million people in the sub-Saharan African countries including South Africa.

Despite the political and economic advances in South Africa since 1994, there are problems of poverty, unemployment, global economic crisis, steep food and fuel prices, high-energy tariffs and increasing interest rates. These adverse conditions placed severe pressure on ordinary South Africans already struggling to meet their basic household needs. Thus, a proper definition of the term “food insecurity” and measures that are suitable in the South African context need to be known. Food insecurity exists when food is not easily accessible and households have difficulty to secure adequate food. In recent years particular attention was paid on access to food and its measurement. This stems from the realization that even when food is available in markets, it may not be accessible to specific households. A large proportion of South Africans perceive themselves to lack enough income to meet all their household needs. “Access” is defined as a household’s ability to acquire enough food of sufficient quality, to have all of its members meet their nutritional requirements, and lead productive lives.

#### **3.5.1 Food security challenges in South Africa**

In 2002 the South African Department of Agriculture published the Integrated Food Security strategy that outlined five key areas considered to be the major food security challenges in South Africa, namely:

- **Inadequate Safety Nets:** Poor households are characterized by few income-earners, and many dependents. Many households are often primarily dependent on migrant remittances and social security grants, making them vulnerable to food insecurity.
- **Weak Support Networks and Disaster Management Systems:** South Africa does not yet have a structured system of dealing with food security disasters, such as droughts or floods. These disasters, which occur at regular intervals, can substantially threaten the food security position of agriculture-based households.
- **Inadequate and Unstable Household Food Production:** Hunger and malnutrition in South Africa stem from insufficient, unstable food supplies at the household or intra-household level. The majority of producers in the former homelands are unable to feed their families from their narrow production base. Government assistance is often a major source of income for these households.
- **Lack of purchasing power:** The majority of households in South Africa lack cash to purchase food. Underlying this problem is the limited scope of income opportunities, especially in the rural areas.
- **Poor Nutritional Status:** One child under the age of six years (translating to about 1.5 million children) is stunted due to chronic malnutrition.

Achieving food security for all has recently moved to the forefront of the policy agenda internationally with many role players rising to the challenge. The University of Stellenbosch established a strategic Food Security Initiative (FSI) aimed at improving knowledge of food security situation in South and Southern Africa in order to inform policy and practice in this field.

### 3.5.2 Consumption of food

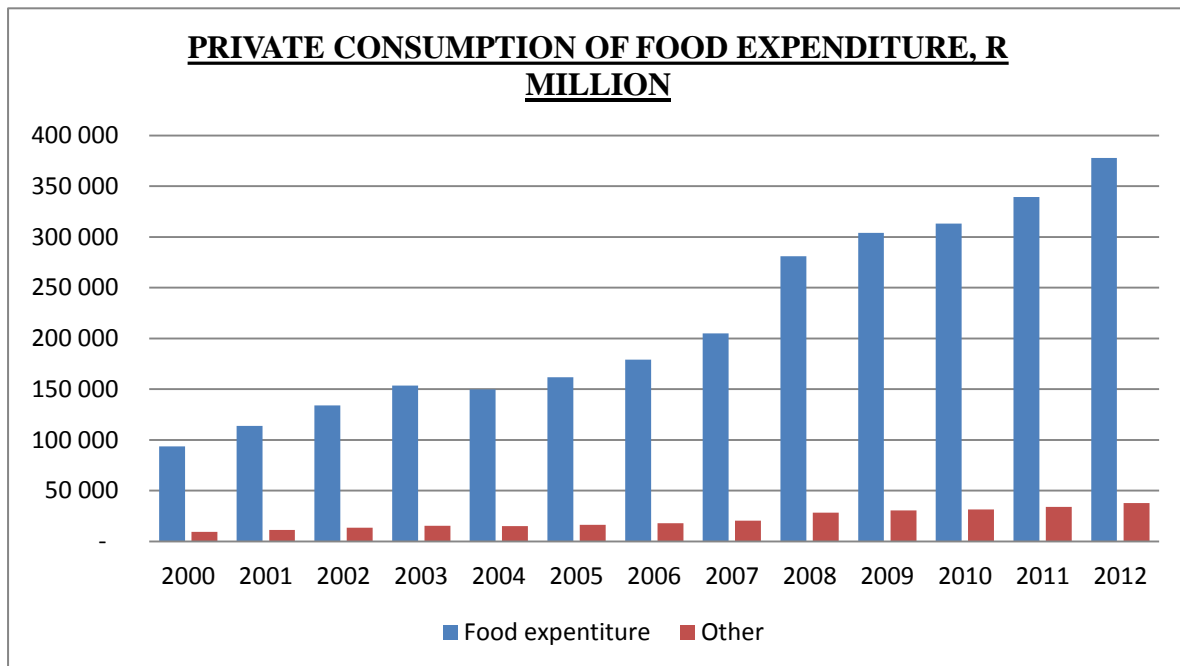


Figure 2. 10: Private consumption on food expenditure

Source: DAFF, 2013

### 3.6 Government's response mechanisms on Food insecurity

The government's main response on food insecurity challenges was to develop a framework to combat food insecurity. This was initially integrated into the Reconstruction and Development Programme (DoA, 2000). The framework was accepted by the government of national unity in 1994 and later revised and formed part of policy documents such as the Agriculture White Paper (1995). Various government departments attempted to combat food insecurity, malnutrition, and poverty within the context of a decline in farm and urban employment, the continuing decline of the remnants of subsistence agriculture, and the HIV/AIDS pandemic (Senefeld and Polsky, 2005).

#### 3.6.1 The Integrated Nutrition Programme (INP) of 1995: Department of Health

The Integrated Nutrition Program (INP) is one of the key strategic health program to decrease morbidity and mortality rates as well as to prevent and manage malnutrition. The programme is recommended by the Nutrition Committee, appointed by the Health Minister in 1995, Dr NC Zuma (Dept. Health, 2005).

The INP is preceded by the formation of a National Nutrition and Social Development Programme (NNSDP) in 1990. The Primary School Nutrition Program in 1994 then followed

which is relatively successful until corruption and mismanagement of resources occurred later.

### **3.6.2 The Integrated Food Security Strategy (IFSS) of 1996: Department of Agriculture**

The worldwide food and security summit held in Rome in 1996 views the amalgamation of 185 countries in the expedition of halving poverty by the year 2015. This is one of the eight Millennium Development Goals (MDGs). Since then the South African government fabricated the Integrated Food Security Strategy (IFSS) by making use of a partnership made by existing experienced members of the national, provincial and local government, universities, NGOs and community based structures. A somewhat hierarchical structure is devised to operationalize the strategy which tried to provide production resources for those who are food insecure or, where that was not possible, stimulating economic activities that would give people more purchasing power to buy nutritious and safe food.

### **3.6.3 The Comprehensive Agricultural Support Programme of 2005**

The Comprehensive Agricultural Support Programme (CASP) is an initiative involving a range of government departments and incorporates the Household Food Production Programme (HFPP). The HFPP is targeted at those households who fail to access surplus food. The programme spent about R22 million of the R30 million budgeted for the 2005-6 financial year on 273 projects with just over 17 000 beneficiaries receiving surplus food aid. The CASP also focused on skills and knowledge transfer, financial and marketing advice with the aim to promote wealth through agriculture and improve national and household food security, amongst others. The CASP initiatives include Micro Agricultural Finance Initiative of South Africa (MAFISA) of 2006, and one home one garden of 2009.

## **3.7 Chapter conclusion**

Agriculture plays a major role in the economy of many developing countries, as it is a significant source of nourishment to citizens and a means of livelihood for the most vulnerable members. As a consequence, agricultural productivity growth is amongst the important policy goals for concerned governments and development agencies. Increasing agricultural productivity requires one or more of the following: (i) an increase in output and input with output increasing proportionately more than inputs; (ii) an increase in output while inputs remain the same; (iii) a decrease in both output and input with input decreasing more; or decreasing input while output remains the same.

Increasing inputs in order to expand output involves raising both the quality and quantity of inputs, examples of which would include: (i) the mechanization of agricultural processes, (ii) use of high yield varieties, (iii) use of fertilizers, (iv) irrigation in areas where rainfall is inadequate, and (v) use of agrochemicals such as herbicides and pesticides. Though all of the aforementioned activities have the potential for productivity enhancement, smallholder farmers, who account for the vast majority of farmers in developing countries, often cannot afford these investments due to their limited resources and restricted access to credit.

## CHAPTER 4

### METHODOLOGY AND ESTIMATION TECHNIQUE

#### 4.1 Introduction

This chapter describes the analytical framework that will be used in this research study based on the literature reviewed earlier. The main focus is to assess the extent at which agricultural productivity growth alleviates poverty in South Africa. The first section presents model specification followed by data sources, testing for stationarity and lastly model estimation.

#### 4.2 Model specification

This study will follow Cervantes-Godoy and Dewbre (2010) model. Cervantes-Godoy (2010) examined the Economic Importance of Agriculture for Poverty Reduction. This research study will modify their model and come up with the following model:

$$P_t = \beta_0 + \beta_1 AGR + \beta_2 GVT + \beta_3 UNE + \beta_4 CNS + \beta_5 GDP + \varepsilon \dots\dots\dots 4.1$$

Where

$P_t$  is the number of people living below the poverty datum line at time  $t$ ,

AGR is the agricultural productivity,

GVT is the government expenditure in agriculture at time  $t$ ,

UNE is the unemployment rate in agriculture at time  $t$ ,

CNS is the consumption of agricultural products,

GDP is the gross domestic product in agriculture, and

$\varepsilon$  in an error term

In order to boost the strength of the model and avoid spurious regression it is very important to carry out log transformation of the variables (Brooks, 2006).

$$\ln P = \beta_0 + \beta_1 \ln AGR + \beta_2 \ln GVT + \beta_3 \ln UNE + \beta_4 \ln CNS + \beta_5 \ln GDP + \varepsilon \dots\dots\dots 4.2$$

Equation 4.2 is a representative of equation 4.1 above in a logarithmic form, where;  $\ln$  represents the log value of each variable.

#### 4.3 Specification of variables

For the effectiveness of policy making, debates, planning strategies, interventions and market of agricultural commodities it is important to select reliable estimates of the long-run relationship between the variables. The policy making focus need to be strengthened in poverty and agriculture relations by empirical evidence in developing countries. Silver & Wallace (1988) alludes that misspecification of the model or model specification errors might

give the misleading information and bias regression results. Specification error that is sometimes overlooked is the interaction between the regressors, that is, multiplicative effect of one or more regressors on the regressand. In developing an empirical model, the following are the most common specification errors mostly overlooked (Gujarati & Porter, 2009):

- Omission of a relevant variable
- Inclusion of an unnecessary variable
- Adoption of a wrong functional form
- Errors of measurement
- Incorrect specification
- Assumption that an error term is normally distributed

Now, the variables that are included in the model presented in Equation 4.1 and 4.2 are discussed in detail.

#### **4.4 Definition of variables**

##### **4.4.1 Poverty Level (P)**

Poverty datum line reflects the number of people who live below the poverty datum line. There is a representation of the cost of a given standard of living that must be attained for a person not to be considered as poor. A poverty line can be used to measure both absolute and relative poverty by measuring the median income of people living below a certain income quintile. Figure 4.1 below presents the statistics of South Africans living below the poverty line from 1994 to 2013.

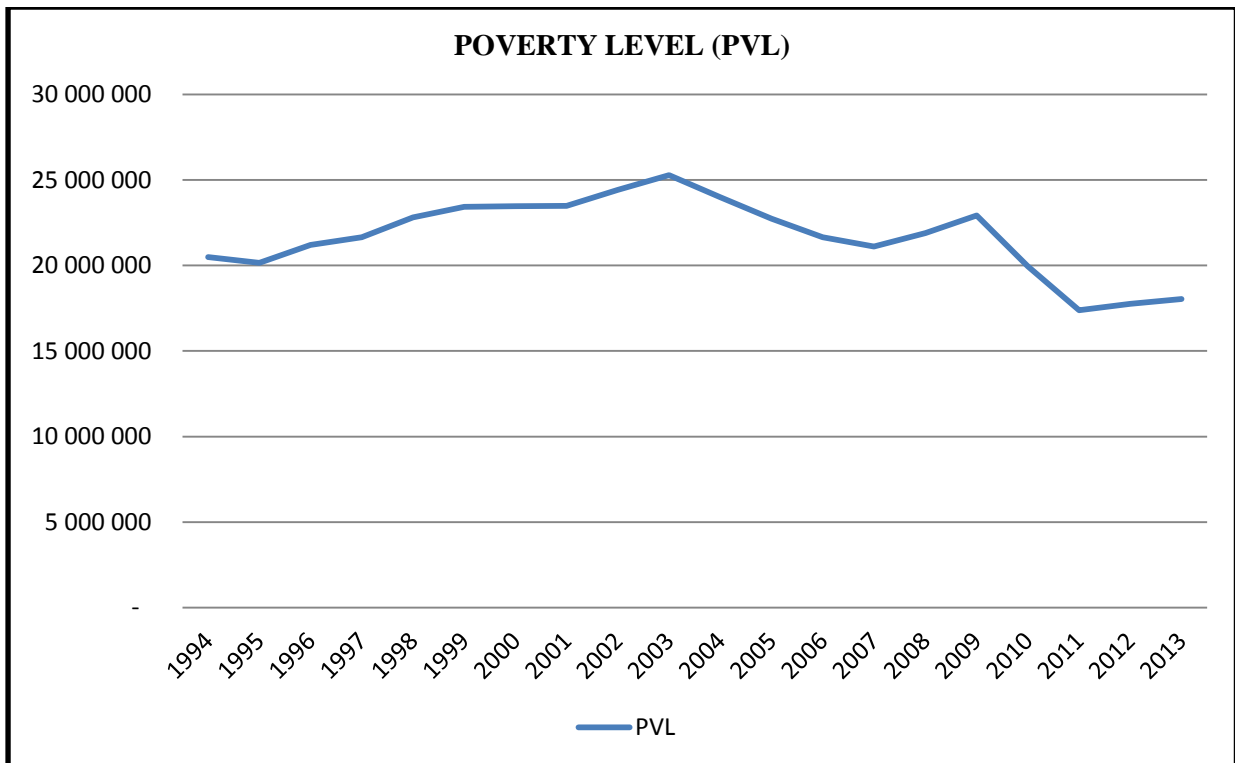


Figure 2. 11: People Living Below the Poverty Line

Source: Quantec data 2013.

As shown in Figure 4.1 above, although the statistic of people living below the poverty line has decreased in the past three years, the statistics is still very high.

#### 4.4.2 Government expenditure in agriculture (GVT)

Government expenditure can be simply defined as the amount that the government spends in a given period of a year. Government expenditure or government spending on goods and services includes all government consumption and investment but excludes transfer payments made by the state. Figure 4.2 below, presents the expenditure of the South African government in agriculture since 1994.

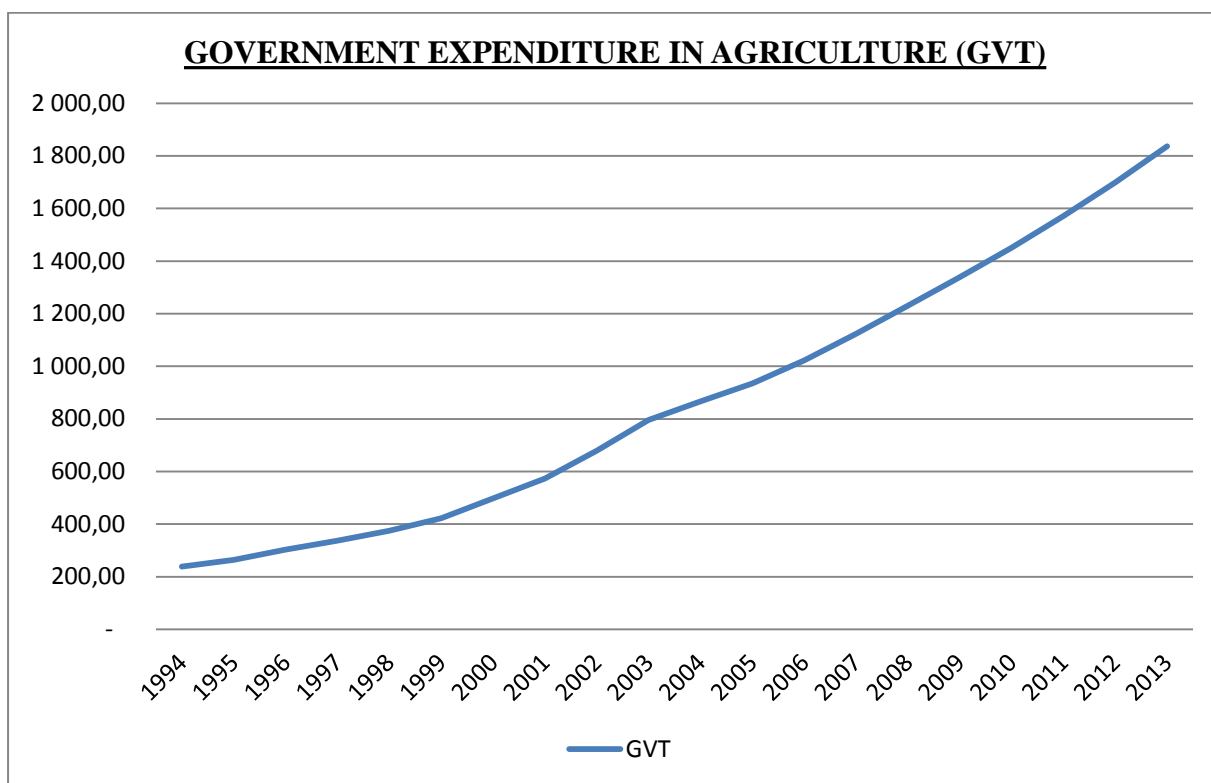


Figure 2. 12: Government Expenditure on Agriculture

**Source: Quantec data, 2013**

In Figure 4.2 above, the South African government has been increasing spending in agriculture throughout the period.

#### **4.4.3 Employment in agriculture**

Unemployment rate can be defined as the percentage of the work force that is unemployed at any given date. Unemployment rate is then obtained by expressing the number of unemployed persons as a percentage of the total number of people willing and able to work, the so-called labour force. In Figure 4.3 below, employment in agriculture is represented by the number of farm employees and domestic workers in farms.

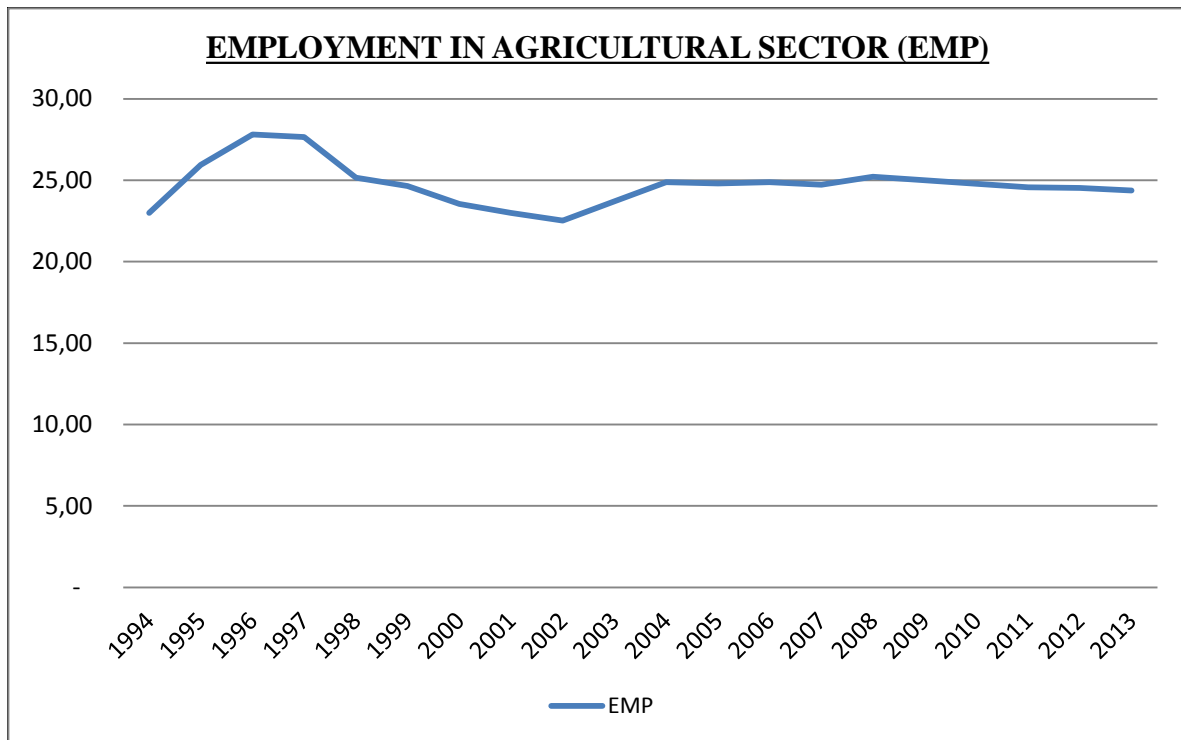


Figure 2. 13: Employment in Agricultural

**Source: Abstract of agricultural statistics, 2013**

#### **4.4.4 Agricultural Productivity (AGR)**

Figure 4.4 below presents the agricultural productivity in South Africa (TFP) from 1994 through to 2012. The trend in TFP shows that before 1998, productivity grows mainly due to the continued growth of output but little change in inputs. From that period employment declined as combined harvesters were introduced to field crop production, favourable tax breaks encouraged greater capital intensity, and agriculture's share of GDP decreased.

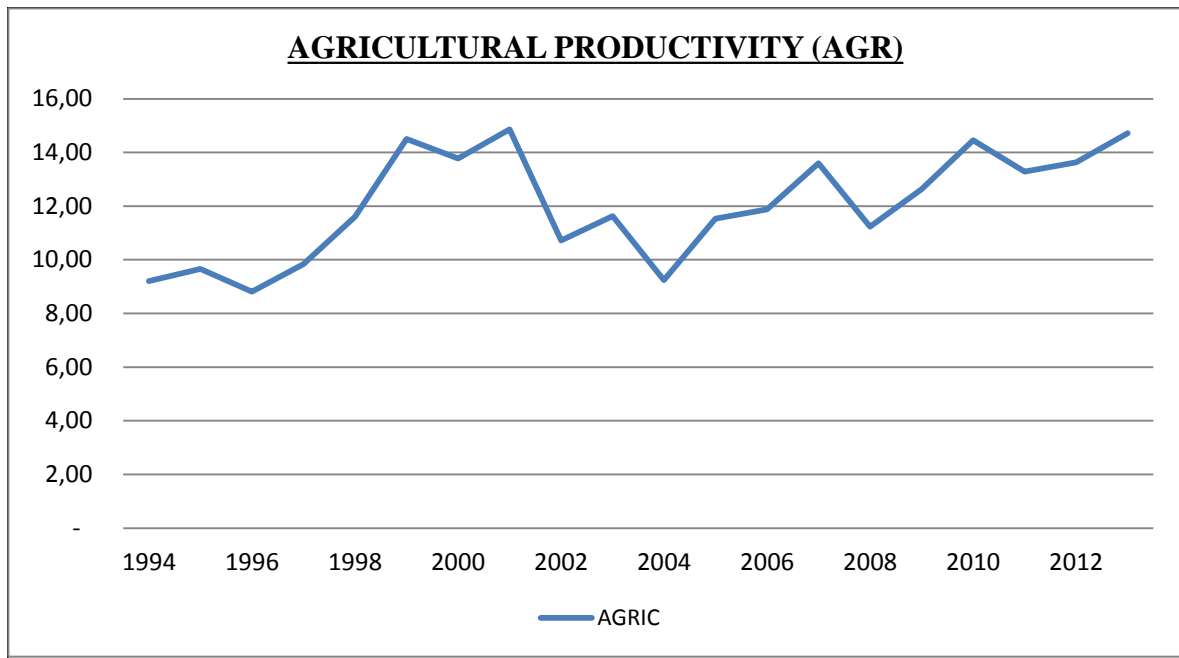


Figure 2. 14: Agricultural Productivity in South Africa

**Source: Abstract of agricultural statistics, 2013**

Output level recovered after the severe drought in the early 1990s increased through to 2000. TFP continued to grow over this period despite an increase in the use of inputs, in this case as a result of the relatively faster growth in the horticultural sector which rapidly increased its use of intermediate inputs. It is expected that productivity would have increased until 2002, when the currency had reached its lowest point, and flattened thereafter. However, TFP growth in South African agriculture seems to be mainly the result of the reduction in the number of farm workers, as is the case in the developed countries. Yet in the developed countries labour is scarce and hence expensive, whereas in South Africa is abundant. Therefore productivity increases in agriculture are at odds with the policy of trying to decrease rural unemployment and thus poverty.

The dual nature of South African agriculture sector and developed commercial sector coexists with large numbers of subsistence farmers. Smallholder farmers, predominantly black are still located mostly in the former homelands, are an impoverished sector dominated by low-input, labour intensive production methods. Up to 2.5 million households subsist in this sector, are relegated to farming on 13% of available agricultural land (OECD, 2006). The South African government has implemented a wide range of policies to support black farmers, either as smallholders or as commercial farmers, since 1994. These include area-wide programs to address critical needs such as infrastructure development (e.g. the Integrated Sustainable

Rural Development Strategy), food security (e.g. the Integrated Food Security and Nutrition Programme), and environmental care (e.g. the National Land Care Programme), farmer support services (e.g. The Comprehensive Agricultural Support Programme or CASP and the MAFISA programme to provide rural financial services), and direct support through land reform and black economic empowerment or AgriBEE.

The macro-level evidence of the impact of these programmes is limited. Small farmers continue to provide only a small proportion of marketed agricultural output in South Africa, hence increases in productivity will take a while to show in the macro data, while there are no separate data for the output of black commercial farmers. However, there is a wide range of unreliable evidence on the successes and failures of these programmes, including their productivity effects.

There is a considerable argument that small farmers, especially new farmers, are experiencing difficulties in improving productivity. This shows a need to focus on post-settlement support for smallholder farmers such as training, provision of financial resources and infrastructure development.

#### 4.4.5 Consumption of agricultural products (CNS)

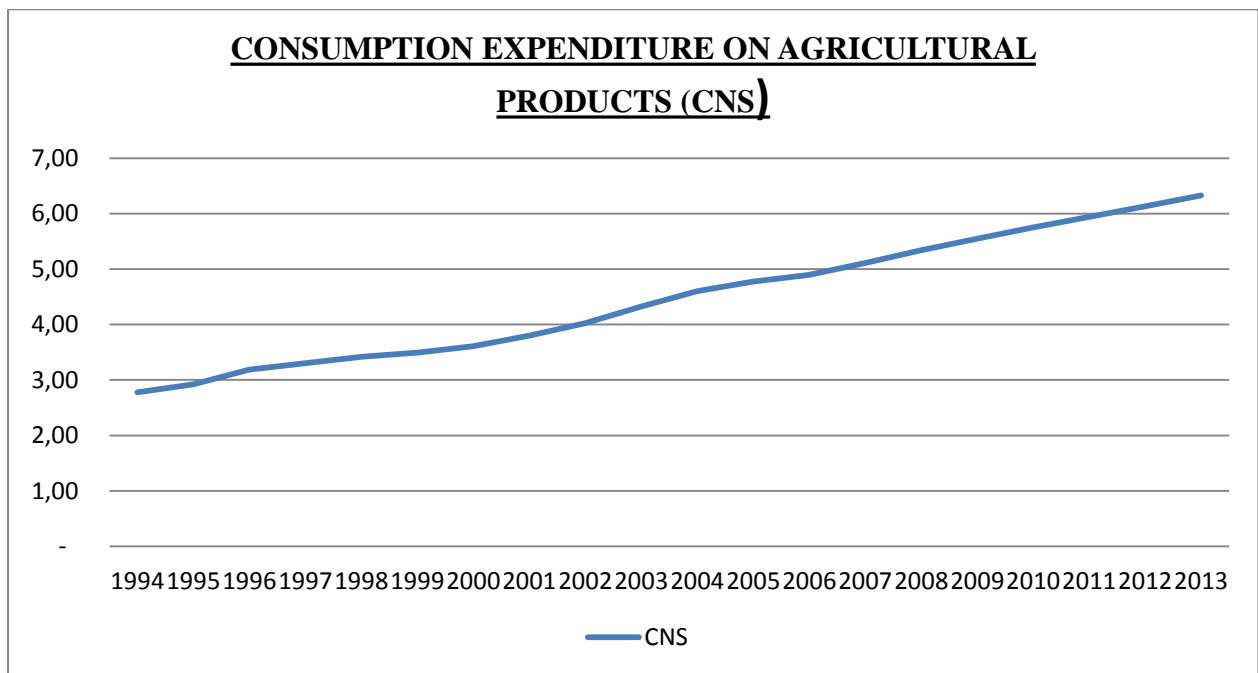


Figure 2. 15: Consumption of agricultural products (CNS)

Source: Abstract of Agricultural Statistics, DAFF

#### 4.4.6 Gross Domestic Product of Agricultural sector (GDP)

The Gross domestic product is the market value of all officially recognized final goods and services produced within a country in a year, or other given period of time.

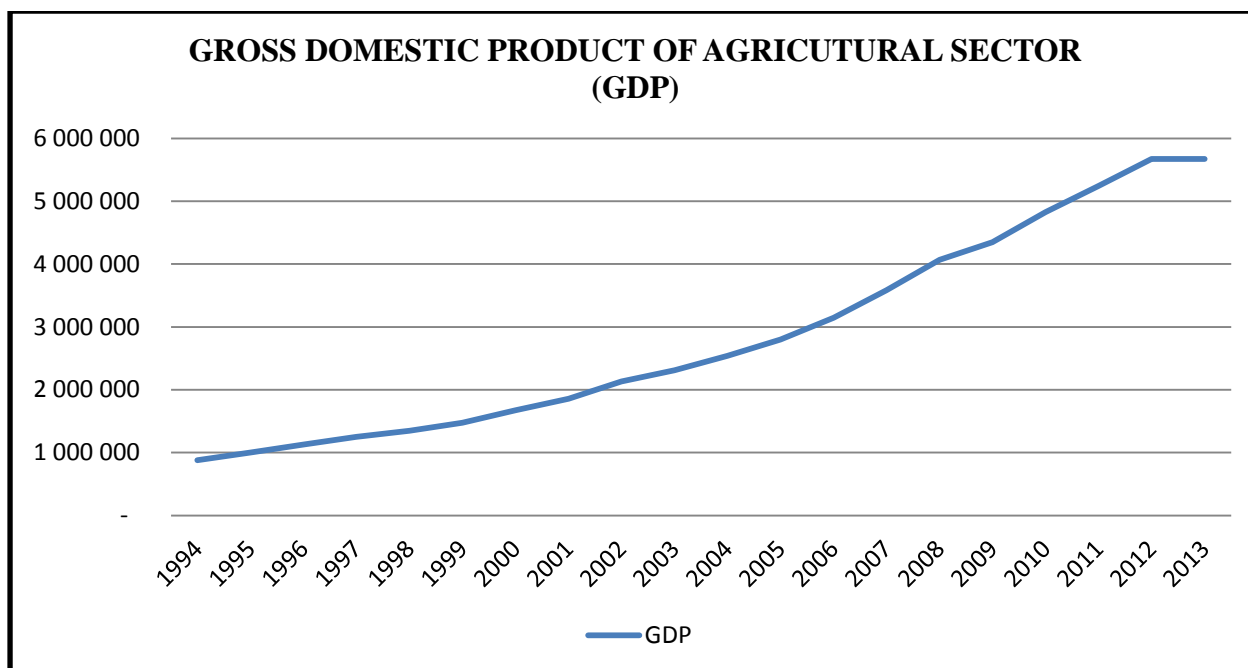


Figure 2. 16: Gross Domestic Product of Agricultural Sector

Source: Abstract of Agricultural Statistics, DAFF

#### 4.4.7 An error term ( $\xi$ )

An error term,  $\xi$ , represents the influence of all other variables excluded in the model Harris (1995). The excluded variables are presumed to be random such that  $\xi$  has the following statistical properties: (i) has zero mean ( $E(\xi) = 0$ ); (ii) has constant variance ( $E(\xi_t^2) = \delta^2$ ) and (iii) is uncorrelated with its own parts ( $E(\xi_t \xi_{t-1}) = 0$ ). If these assumptions hold, the estimators such as the OLS will give an unbiased estimate of the parameter coefficients of the model.

#### 4.5 Expected priori

Agricultural productivity – is expected to have a negative relationship. An increase in agricultural productivity is expected to lead to an increase in income for those who are employed in the agricultural sector and this will consequently lead to a reduction in poverty. Increases in agricultural productivity can also indirectly lead to a reduction in poverty through the reduction in food insecurity.

Government expenditure in agriculture – is expected to have a negative relationship. An increase in government expenditure in agriculture will lead to more employment in public sector projects and this leads to more income which will then lead to a reduction in poverty. .

Unemployment rate in agriculture – is expected to have a positive relationship. An increase in unemployment in agriculture will lead to an increase in the poverty rate. When there are more unemployed people, we expect those people to have less income and this leads to an increase in poverty.

Gross Domestic Product in agriculture – the sign of the GDP in agriculture is expected to be negative. An increase in GDP is expected to increase employment, lead to more income resulting in the reduction in poverty. This will establish a negative reduction between GDP and poverty.

#### **4.6 Data Sources**

The data will be obtained mainly from South African Reserve Bank, StatsSA and other government sources. Real figures will be used. The study will use quarterly data from 1994 to 2013.

#### **4.7 Estimation Techniques**

The study will first conduct the covariance and correlation tests and proceed to the unit root test to examine whether the variables are stationary or not. After the stationary test the cointegration test will be performed. It is after the cointegration test that we can either perform the VAR or the VECM. In estimating the VAR, we will take into account a combination of macroeconomic theory and statistical results. Macroeconomic variables are very often non-stationary in levels. Thus, a vector autoregressive (VAR) based co-integration tests using the methodology developed in Johansen (1995) will be employed. But first the VAR lag selection criteria will be employed, followed by the Johansen cointegration test and then the Vector Error Correction model. These estimation techniques are explained below.

##### **4.7.1 Analysis of Covariance (ANOVA) and correlation analysis**

Covariance measures how much two variables change together and the strength of the relationship between variables. Analysis of covariance (ANCOVA) is a general linear model which blends ANOVA and regression. It evaluates whether means of a dependent variable are equal across levels of a categorical independent variable, while statistically controlling for the effects of other continuous variables that are not of primary interest known as covariates. Therefore, when performing ANOVA, the dependent variable means are adjusted to what they would be if all groups were equal on the covariance.

In probability theory and statistics, the mathematical concepts of covariance and correlation are very similar. They describe the degree to which two random variables tend to deviate from their expected values in similar ways. If  $X$  and  $Y$  are two random variables, with means  $\mu_X$  and  $\mu_Y$ , and standard deviations  $\sigma_X$  and  $\sigma_Y$ , respectively, then their covariance and correlation are as follows:

$$\text{Covariance: } \sigma_{xy} = E[(X - E[X])(Y - E[Y])]$$

$$\text{Correlation: } \rho_{xy} = E[(X - E[X])(Y - E[Y])] / (\sigma_x \sigma_y)$$

In these equations  $E$  is the expected value operator. The correlation is dimensionless while covariance is in units obtained by multiplying the units of the two variables. The covariance of a variable with itself (i.e.  $\sigma_{XX}$ ) is called the variance and is more commonly denoted as  $\sigma_X^2$ , the square of the standard deviation. However, the correlation of a variable with itself is always 1, except in the degenerate case where the two variances are zero, in which case the correlation does not exist.

In the case of a time series analysis which is stationary, both the means and variances are constant over time ( $E(X_{n+m}) = E(X_n) = \mu_X$  and so on). However, in this instance the covariance and correlation are functions of the time difference and are depicted as follows:

$$\text{Cross-covariance: } \sigma_{xy}(m) = E[(X_n - \mu_x)(Y_{n+m} - \mu_y)]$$

$$\text{Cross-correlation: } \rho_{xy}(m) = E[(X_n - \mu_x)(Y_{n+m} - \mu_y)] / (\sigma_x \sigma_y)$$

Although the values of the theoretical covariances and correlations are linked in the above equations, the probability distributions of sample estimates of these quantities are not linked in any simple way and they generally need to be treated separately. These distributions depend on the joint distribution of the pair of random quantities  $(X, Y)$  when the values are assumed independent across different pairs. In a time series, the distributions depend on the joint distributions of the whole time-series.

#### 4.7.2 Testing for Unit Root

A series is referred to as stationary if its mean and variance are constant over time. The covariance between two time periods should depend on the distance or lag between the two time periods, not on the time at which the covariance is calculated” (Gujarati, 2003). A series that is not stationary is referred to as non-stationary. A series is also said to be integrated and

is denoted as  $I(d)$ , where  $d$  is the order of integration. The order of integration refers to the number of unit roots in the series. Simply, it is the number of differencing operations it takes to make a variable stationary.

The standard Ordinary Least Squares (OLS) method is based on the assumption that the data series are stationary (Jongwanich, 2006). This means that the data series grow over time in a fairly steady, constant manner, reflecting smoothly evolving economic forces. Columbus (2001) concurs with this assertion by arguing that the direct application of OLS to non-stationary data produces regressions that are misspecified and spurious in nature. If the data is not stationary, differencing can be used to create a stationary series with the same volatility as the original series. This research study will first test data for stationarity applying one formal measure of unit root, which is the Augmented Dickey Fuller (1980) and the Phillips Perron test.

Gujarati & Porter (2009) indicated that, unit root is widely used to test for stationarity or non-stationarity more especially in the last decade. To avoid any prejudice outcomes which may result from non-stationary variable the following has to be done: the variable has to be tested for stationarity, investigate how many times the variable has to be differenced to result in a stationary series. If it happens that the data is non-stationary, differencing the data to remove non stationary trend is recommended. The differencing of the variables will also avoid the spurious regression model.

Harris (1995) argued that, a variable that has undergone a unit root test is non-stationary unless it forms a stationary cointegration relationship by combining with non-stationary series but regressions involving the series can provide false existence of a meaningful economic relationship. The process of testing the unit root is not straight forward; the following are the issues that arise when testing the unit root:

- The possibility that the D.G.P may include a stochastic or deterministic time trend.
- D.G.P may be more complicated than AR (1) process and may involve Moving Average (M.A.) terms.
- When working with finite samples and small observations the tests may be biased towards accepting the null hypothesis of non-stationarity when the DGP is stationary but close to having a unit root.

- Undetected structural breaks in the series may lead to under-rejecting of the null hypothesis.
- Quarterly data might also be tested for seasonal unit roots in addition to the under-rejecting of the null hypothesis.

It is necessary to consider the properties of the processes that generate time series variables even if the model is estimated using a single equation like the Ordinary Least Squares (OLS) or a systematic estimator (Harris, 1995). Following the data generation process presented above, variable  $y_t$  is generated by the first order autoregressive process:

$$Y_t = p_{t-1} + \mu_t \dots\dots\dots 4.3$$

In Equation 4.3 above, the variable  $y_t$ , depend on the last period's value  $y_{t-1}$  plus the disturbance term  $u_t$  the variables  $y_{t-1}$  and  $\mu_t$  include all random influences. In the equation, the variable  $y_t$  will be stationary if  $|p| < 1$ . When  $p = 1$ , the variable  $y_t$  is not stationary. A stationary series tends to return to its mean value and fluctuate around the mean with a more or less constant range. The non-stationary series has a different mean at different points in time and the variance increases with the sample size.

**4.7.2.1 Dickey-Fuller (DF) and Augmented Dickey Fuller (ADF) tests**

The Dickey-Fuller (DF) is the most common and simplest procedure to test the presence of a unit root. This approach tests the null hypothesis that the series contains a unit root meaning that it is not stationary against the alternative stationarity. The following is the simplest form of the DF test:

$$Y_t = p_a y_{t-1} + \mu_t \dots\dots\dots 4.4$$

Or

$$(1-L)y_t = \Delta y_t = (p_a - 1)y_{t-1} + \mu_t \quad \mu_t \sim IID(0, \sigma^2) \dots\dots\dots 4.5$$

The following is the hypothesis to be tested when testing the unit root:

$$H_0 : p_a = 1 \dots\dots\dots 4.6$$

$$H_1 : p_a < 1 \dots\dots\dots 4.7$$

Equation 4.5 above is the most advantageous and simple procedure to follow when testing  $(p_a - 1) = p^*_a = 0$ ; especially when a more complicated AR( $p$ ) processes is considered in the second form of the test. To test the hypothesis, a standard t- test approach is used. Under non-stationarity, the statistic computed does not follow a standard t-distribution but the Dickey-Fuller distribution. Brooks (2006) elaborated that, there are models under the null hypothesis and the alternative hypothesis that can be based on the following three cases:

- (i)  $H_0 : y_t = y_{t-1} + \mu_t$  .....4.8  
 $H_1 : y_t = py_{t-1} + \mu_t, p < 1$  .....4.9
- (ii)  $H_0 : y_t = y_{t-1} + \mu_t$  .....4.10  
 $H_1 : y_t = py_{t-1} + \mu + \mu_t, p < 1$  .....4.11
- (iii)  $H_0 : y_t = y_{t-1} + \mu_t$  .....4.12  
 $H_1 : y_t = py_{t-1} + \mu + \lambda_t + \mu_t, p < 1$  .....4.13

Where hypotheses in (i) being the test for a random walk against a stationary autoregressive process of order one AR(1), (ii) a test for a random walk against stationary AR(1) with drift and (iii) a test for a random walk against stationary AR(1) with drift and deterministic time trend. The null hypotheses for all the three tests can also be written as  $\Delta y_t = \mu_t$ . When testing for unit root using Equation 4.4 and 4.5 above, the assumption that  $y_t$  is the simple first order autoregressive process with a zero mean and no trend component is taken into account. It is also assumed that in the DGP at time  $t = 0$ ,  $y_t$  also equal to zero.

Where  $y_t$  follows an AR ( $p$ ) process and the simple AR (1) model is used, the error term will be autocorrelated to compensate for the misspecification of the dynamic structure of  $y_t$ . Assuming that  $y_t$  follows the  $p$ th order autoregressive process, the following equation is estimated:

$$y_t = \psi_1 y_{t-1} + \psi_2 y_{t-2} + \dots + \psi_p y_{t-p} + \mu_t \dots\dots\dots 4.14$$

When testing the null hypothesis, the computed DF t-statistics can be compared against the critical values and this is valid for only large samples.

When conducting the DF test the assumption is that  $\mu_t$  is not correlated. Hence the autocorrelated errors will invalidate the use of the DF distributions. Harris (1995) mentioned that Dickey and Fuller (1970) developed another test known as the Augmented Dickey-Fuller test. The test is done by augmenting the three models ((i), (ii) and (iii)) above by adding the lagged values of the dependent variable  $\Delta y_t$ . When the following ADF test equation is

estimated, it is crucial to test the null hypothesis of a stochastic trend against the alternative of a deterministic trend:

$$\Delta y_{t-1} = \psi^* y_{t-1} + \sum_{i=1}^{p-1} \psi_i^* y_{t-i} + \mu + y_t + \mu_t \quad \mu_t \sim IID(0, \sigma^2) \dots\dots\dots 4.15$$

In Equation 4.15 above,  $\mu_t$  is a white noise error term and  $\psi^* = (\psi_1 + \psi_2 \dots + \psi_p) - 1$ . If  $\psi^* = 0$ ,  $y_t$  contains the unit root. The model can be extended to allow for moving-average (MA) parts in the  $\mu_t$ . The MA is said to be present in the error term in various time series after the first differencing. In the error term AR and MA components are developed by Said and Dickey in 1984 as quoted by Harris (1995), they can be approximated by an AR(k) process. Where k is large enough to allow a good approximation to an unknown ARMA (p,q) process ensuring the  $\mu_t$  is a ‘white noise’. The Said-Dickey approach can be estimated replacing the lag-length of (p-1) with k increases in sample size at suitable rate.

By adding an unknown of lagged first difference of the regressand, the autocorrelated omitted variables enters the error term by default. ADF test is comparable to the simple DF test. It is very important to select the appropriate lag length because few lag lengths may result in over rejecting the null hypothesis when it is true (Type I error), but at the same time too many lag lengths may reduce power of the test. Studenmund (1997) suggested that, an appropriate testing strategy is based on the Augmented Dickey-Fuller test with a generous lag structure which allows for both constant and trend terms which then follows the sequential testing strategy. It is very important to take into account that if there is an evidence of structural breaks in the time series, the testing procedure has to be amended.

**4.7.2.2 The Phillips-Perron (PP) unit root test**

The main assumption of the DF test is that the error term  $\mu_t$  is independently and identically distributed (Gujarati, 2003). The ADF test adjusts the DF test to take care of the possible serial correlation in the error term by adding the lagged difference terms of the regressand. The Phillip-Perron test uses the non-parametric statistical methods in order to take care of the serial correlation in the error term without adding the lagged difference terms.

### 4.7.3 Lag selection criteria

When running regressions on time-series data, it is often important to include lagged values of the dependent variable as independent variables. “In technical terms the regression becomes a vector autoregression (VAR). For example, when trying to sort out the determinants of poverty, it is likely that last year's poverty is correlated with this year's poverty. If this is the case, poverty lagged for at least one year should be included on the right-hand side of the regression” (Sjo, 2008). Estimating the lag length of autoregressive process for a time series is a crucial econometric exercise in most economic studies. This research study will employ the VAR lag order selection to select the lags.

### 4.7.4 Cointegration analysis and Error correction model (ECM)

Dickey-Fuller and Augmented Dickey-Fuller tests are explained for the unit root test comparatively above. We now consider testing the data for cointegration. Various methods are proposed for testing cointegration in the literature: The Engle-Granger (EG) procedure, Augmented Engle-Granger test, and Johansen technique are the most common methods used for cointegration. In this research study we consider the Johansen technique as discussed below.

#### 4.7.4.1 Co-integration analysis

The purpose of co-integration tests is to determine whether the variables in the model are co-integrated or not. Testing for co-integration is necessary to check if the model has empirically meaningful relationships. If variables have different trends processes, they cannot stay in fixed long-run relation to each other, implying that the model cannot be modelled in the long-run. The preferred test for co-integration is Johansen's test. Co-integration will be tested in this research study to determine the need of using a Vector Error Correction model (VECM).

The Johansen technique is regarded as an essential tool for applied economics and econometricians wishing to estimate time series models (Greene, 2002). Testing for co-integration is mandatory because of the implication that non-stationary variables can lead to spurious regressions unless one co-integration vector is present (Harris, 2005). The Johansen approach starts by defining a vector  $z_t$  of  $n$  potential endogenous variables. The following is the model  $z_t$  as an unrestricted vector autoregression (VAR) with up to  $k$ -lags of  $z_t$ :

$$z_t = A_1 z_{t-1} + \dots + A_k z_{t-k} + u_t \quad u_t \sim IN(0, \Sigma) \dots\dots\dots 4.16 .$$

In Equation 4.16 above,  $z_t$  is  $(n \times 1)$  and each of  $A_i$  is an  $(n \times n)$  matrix parameter. The VAR model used above is advocated by Sims in 1980 (Studenmund, 1997). The model estimates the variations among regressors without imposing a priori restrictions and is in reduced form. The Ordinary Least Squares (OLS) is regarded as an efficient and precise method to estimate Equation 4.16 above since the equation consists of common set of lagged regressors.

Brooks (2002) emphasized that, in order to use the Johansen test, the VAR model used in Equation 4.16 has to be turned to the Vector error correction model (VECM). Therefore, Equation 4.16 can be rearranged to be in the Vector Error Correction (VECM) form as follows:

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \dots + \Gamma_{k-1} \Delta z_{t-k+1} + \Pi z_{t-k} + \mu_t \dots \dots \dots 4.17$$

Where  $\Gamma_i = - (I - A_1 - \dots - A_i)$ ,  $(i = 1, \dots, k - 1)$  and  $\Pi = - (I - A_1 - \dots - A_k)$ . Equation 4.17 above contains information on both the short-run and the long-run adjustment to changes in  $z_t$ , via the estimation of  $\Gamma_i$  and  $\Pi$  respectively.  $\Pi = \alpha\beta'$ , where  $\alpha$  represents the speed of adjustment to disequilibrium, while  $\beta$  represents a matrix of long-run coefficient. When  $z_t$  is assumed to be a vector of non-stationary  $I(1)$  variables, it is said that all the variables in Equation 4.17 which involve  $\Delta z_{t-1}$  are  $I(0)$  while  $\Pi z_{t-k}$  must also be stationary for  $\mu_t \sim I(0)$  to be a white noise (Green, 2002).

Harris (1995) described three instances whereby the requirement that  $\Pi z_{t-k} \sim I(0)$  is met, namely:

- a) When variables in Equation 4.16 are stationary implying that there is no spurious regression problem and the appropriate modeling strategy is to estimate standard Sims type VAR.
- b) When there is no cointegration at all implying that there are no linear combination of  $z_t$  that are  $I(0)$ , as a result  $\Pi$  is an  $(n \times n)$  matrix of zero. A model is a VAR in first difference involving no long-run elements in this case, and

- c) When there exist up to  $(n - 1)$  co-integration relationships. In this case  $r < (n - 1)$  co-integration vectors exist in  $\beta$  together with  $(n - r)$  non-stationary vectors.

The co-integration vectors in  $\beta$  enter equation 4.20 or that  $\Pi z_{t-k}$  would not be  $I(0)$  implying that the last  $(n - r)$  columns of  $\alpha$  are insignificantly small. Determining how many  $r < (n - 1)$  co-integration vectors exist in  $\beta$  is equivalent to testing which columns of  $\alpha$  are zero. As a result, testing for co-integration amounts to the rank of  $\Pi$  (i.e. finding the number of  $r$  linearly independent columns in  $\Pi$ ).

#### 4.7.4.2 Testing the order of co-integration of variables

When using time series data it is assumed that the data is not stationary, the unit root tests are said to be unreliable; therefore, co-integration relationship has to be found in order to avoid the problem of spurious regression (Harris, 2005). When there exist a mix of  $I(0)$ ,  $I(1)$ , and  $I(2)$  in the model, co-integration may be present. Stationary  $I(0)$  variables play a vital role in establishing a sensible long-run relationship between non-stationary variables. In Multivariate model, for every stationary variable included, the number of co-integration equations increase correspondingly. In the case where the stationary  $I(0)$  variable is stationary by itself, it forms a co-integration relation on its own and consequently forms a linearly independent relationship.

If the variables in a model require to be differenced twice to induce stationarity, it does not preclude the possibility of stationary relationship in the model. The application of Johansen approach is designed to handle  $I(1)$  and  $I(0)$  variables and will not provide the necessary stationary vectors. If  $I(2)$  variables exist in the model, they must be replaced with  $I(1)$  variables or else be differenced. Keeping in mind that,  $I(2)$  variables in a model help in formulating the correct approach to estimating co-integration relationships. The Johansen approach also provides an alternative means of testing for unit roots in each variable.

#### 4.7.4.3 Testing for and estimating co-integrating system

When  $r < (n - 1)$  co-integration vectors are present in  $\beta$ , testing for co-integration amounts to find the number of  $r$  linearly independent columns in  $\Pi$  which is equivalently testing that  $(n - r)$  columns of  $\alpha$  are significantly small. Johansen's maximum likelihood approach amounts to reduced rank regression which provide  $n$  variables  $\lambda_1 > \lambda_2 > \dots > \lambda_n$  in ascending order, their corresponding eigenvectors  $V = (v_1, \dots, v_n)$ , where each eigenvector,  $v$ , has a corresponding

eigenvalue. The magnitude of  $\lambda_i$  is a measure of how strongly the co-integration relations  $v_i'z_t$  are correlated with the stationary part of the model. The  $(n - r)$  combinations found in the Johansen approach indicate the non-stationary combinations. For the eigenvectors to correspond to the non-stationary parts of the model,  $\lambda_i = 0$ , for  $i = r + 1, \dots, n$ .

When testing the presence of  $r$  co-integration vectors, the following hypothesis has to be tested:

$$H_0 : \lambda_i = 0 \quad i = r + 1, \dots, n \dots\dots\dots 4.18$$

In Equation 4.18 above, only the first eigenvalues are non-zero. The null hypothesis can be tested using the trace statistic as follows:

$$\lambda_{\text{trace}(r)} = - 2 \log (Q) = - T \sum \log (1 - \lambda_i) \quad r = 0, 1, 2, \dots, n - 2, n - 1. \dots\dots\dots 4.19$$

Where,  $Q =$  (restricted maximized likelihood divided by the unrestricted maximized likelihood). Another test of significance of the largest  $\lambda_r$  is the maximal-eigenvalue or the  $\lambda$ -*max* statistic, this test is in the following form:

$$\lambda_{\text{max}(r+1)} = - T \log (1 - \lambda_{r+1}) \quad r = 0, 1, 2, \dots, n - 2, n - 1 \dots\dots\dots 4.20$$

Equation 4.20 above tests the  $r$  co-integrated vectors against the alternative that  $r + 1$  exists. And  $\hat{\lambda}_i$  represents the estimated value for the  $i^{\text{th}}$  ordered value eigenvalue from the  $\Pi$  matrix. It should be noted that the larger  $\hat{\lambda}_i$  is, the larger and negative will be the  $\log (1 - \lambda_{r+1})$  and the larger will be the test statistic. A significantly non-zero eigenvalue indicates a significantly co-integrated vectors and each eigenvalue is associated with different co-integrated vector.

The  $\lambda_{\text{trace}}$  tests the null hypothesis that the number of co-integrating vectors is less than or equal to  $r$  against that they are more  $r$ . The test starts with  $p$  eigenvalues and then consecutively the largest is removed. The  $\lambda_{\text{max}}$  performs the separate tests on each eigenvalue and has its null hypothesis that the number of co-integrating vectors is  $r$  against the alternative of  $r+1$ .

The co-integration test is interpreted as follows: if the test statistic is greater than the critical value, the null hypothesis that there are  $r$  co-integrating vectors in favour of the alternative

hypothesis that there are  $r+1$  (for  $\lambda_{trace}$ ) or more than  $r$  (for  $\lambda_{max}$ ) is rejected. The test is accomplished under the null,  $r = 0, 1, \dots, g-1$  so that the hypotheses for  $\lambda_{max}$  are as follows:

$H_0 : r = 0$	versus	$H_1 : 0 < r \leq g$
$H_0 : r = 1$	versus	$H_1 : 1 < r \leq g$
$H_0 : r = 2$	versus	$H_1 : 2 < r \leq g$
...	...	...
$H_0 : r = g-1$	versus	$H_1 : r+g$

The first step engages a null hypothesis of no co-integrating vectors and when the null hypothesis is rejected there are no co-integrating vectors and the test would be complete. In cases where  $H_0:r=0$  is rejected the null hypothesis that there is one co-integrating vector ( $H_0 : r = 1$ ) will be tested and proceed until  $r$  value increase up to the null hypothesis is no longer rejected.

#### 4.7.5 Vector Error Correction Model (VECM)

A VECM is a restricted VAR designed for use with non-stationary series that are known to be co-integrated. Sjo (2008) held that the VECM has co-integration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their co-integrating relationships while allowing for short-run adjustment dynamics. The co-integration term is known as the correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments estimated.

When long-run co-integration relationships are obtained using the Johansen approach, at this stage we can reformulate our model and estimate the Vector Error Correction Model (VECM) with the inclusion of the error correction term as follows:

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \Gamma_2 \Delta z_{t-2} + \Gamma_3 \Delta z_{t-3} + \alpha(\beta'_1 z_{t-1} + \beta'_2 z_{t-1}) + \psi D_t + u_t \dots\dots\dots 4.21$$

In Equation 4.21 above,  $z_t$  may enter the error correction term with a lag of  $t-1$  or  $t-k$  since they can be shown to be equal. The OLS is an efficient way to estimate equation 4.21 if a common set of regressors exist. All variables in the model are now  $I(0)$ , the statistical inference using the standard t-test and F-test is suitable.

The Error Correction Model is interpreted as follows;  $Z$  is supposed to change between  $t-1$  and  $t$  as a result of changes in the independent variables. It should be noted that in Equation 4.21 above, the error correction term  $\beta'_1 z_{t-1} + \beta'_2 z_{t-1}$  appears with a lag.  $Z$  defines the long-term relationship between variables  $Z$  and  $D$  and the short-run relationship is described by  $\Gamma_1$ ,  $\Gamma_2$  and  $\Gamma_3$  between changes in  $Z$  and  $D$ .  $\alpha$  is the strict definition that measures the proportion of the last period equilibrium error and it describes the speed of adjustment back to equilibrium.

#### 4.7.6 General to Specific Modeling (GETS)

During the implementation of the Johansen approach, the study will follow the so called General to specific (GETS) modeling. The GETS model selection contrast with the LSE approach to econometric modeling, commonly used in time series models. The model involves: 1) the formulation of a General Unrestricted Model (GUM) that is said to be congruent with the data and the application of a testing down process, 2) eliminating the variables with coefficients that are non-statistically significant and 3) leading to a simpler specific congruent model that encompasses rival models. Owen (2002) highlighted that, GETS model selection was suggested by Henry and various authors as against the traditional approach called the Specific to general approach.

#### 4.7.8 Vector autoregressive model (VAR)

Brooks (2002) alludes that the VAR models are popularized in econometrics by Sims in 1980 as natural generalisation of univariate autoregressive models. The VAR regression models can be considered as a kind of hybrid between the univariate time series and simultaneous equation models. The VARs are an alternative to largest-scale simultaneous equations and structural models.

The simple case that can be entertained is a bivariate VAR, where there are two variables namely;  $y_{1t}$  and  $y_{2t}$ . Both  $y_{1t}$  and  $y_{2t}$  current values depend on different combinations of the previous  $k$  values and error terms. The following equation is estimated:

$$Y_{1t} = \beta_{10} + \beta_{11} y_{1t-1} + \dots + \beta_{1k} y_{1t-k} - \alpha_{11} y_{2t-1} + \dots + \alpha_{1k} y_{2t-k} + u_{1t} \dots\dots\dots 4.22$$

$$Y_{2t} = \beta_{20} + \beta_{21} y_{2t-1} + \dots + \beta_{2k} y_{2t-k} - \alpha_{21} y_{1t-1} + \dots + \alpha_{2k} y_{1t-k} + u_{2t} \dots\dots\dots 4.23$$

Where  $u_{it}$  is a white noise disturbance term with  $E(u_{it}) = 0$ , ( $i = 1, 2$ ),  $E(u_{1t}u_{2t}) = 0$ . An important feature of VAR is its flexibility and the ease of generalization. Thus, the model can be extended to encompass moving average errors, which is the multivariate version of an ARMA model known as VARMA model. The model could be expanded to include  $g$  variables,  $y_{1t}, y_{2t}, y_{3t}, \dots, y_{gt}$ , each of which has an equation.

The VAR model is also useful as the compactness with which the notation can be expressed. For instance, where  $k = 1$ , each variable depends only upon the immediate previous values of  $y_{1t}$  and  $y_{2t}$  plus an error term. This could be expressed as follows:

$$Y_{1t} = \beta_{10} + \beta_{11} y_{1t-1} + \alpha_{11} y_{2t-1} + u_{1t} \dots\dots\dots 4.24$$

$$Y_{2t} = \beta_{20} + \beta_{21} y_{2t-1} + \alpha_{21} y_{1t-1} + u_{2t} \dots\dots\dots 4.25$$

or more compactly as:

$$\begin{matrix} Y_{1t} & = & \beta_{10} & + & \beta_{11} y_{1t-1} & + & u_{1t} & \dots\dots\dots & 4.26 \\ g \times 1 & = & g \times 1 & & g \times g & g \times 1 & g \times 1 & & \end{matrix}$$

In Equation 4.26 above, there is  $g = 2$  variable in the model. Extending the model to  $k$  lags of each variable in each equation is also easily accomplished using this notation as follows:

$$\begin{matrix} Y_{1t} & = & \beta_{10} & + & \beta_{11} y_{1t-1} & + & u_{1t} & + \dots + & \beta_{1k} y_{1t-k} & + & u_{1t} & \dots 4.27 \\ g \times 1 & = & g \times 1 & & g \times g & g \times 1 & g \times 1 & & g \times g & g \times 1 & g \times 1 & \end{matrix}$$

The model could be extended further to include first difference terms and co-integrating relationships.

#### 4.7.8 Diagnostic tests

The Diagnostic tests validate the parameter estimation outcomes achieved by the estimated model whereby the stochastic properties of the model include: residual autocorrelation, heteroskedasticity and normality are checked. The multivariate extension of the residual tests will be applied in this research study.

##### 4.7.8.1 $R^2$ and the adjusted $R^2$ criteria

Gujarati & Porter (2009) alluded that an important property of  $R^2$  is that it is a non-decreasing function of the number of regressors that are in the model not unless the added variable is

perfectly collinear with the other regressors. Thus, an increase in the number of regressors results in an increased  $R^2$  and never decrease. Equation 4.30 below represents the  $R^2$  criteria:

$$R^2 = ESS/TSS = 1 - RSS/TSS = 1 - \frac{\sum \hat{u}_i^2}{\sum y_i^2} \dots\dots\dots 4.30$$

In Equation 4.30 above,  $\sum y_i^2$  is independent of the number of variables added. RSS and  $\sum \hat{u}_i^2$  depend on the number of regressors present in the model. If the number of variables increases,  $\sum \hat{u}_i^2$  is likely to decrease thus,  $R^2$  will increase. When comparing two regression models with the same dependent variable but different regressors, a model with highest  $R^2$  will be selected.

$R^2$  is the measure of the goodness of fit in the regression model. Gujarati & Porter (2009) allude that  $R^2$  lies between 0 and 1. The closer it is to 1 the better the fit. But there are problems with  $R^2$  namely; 1) it measures the sample goodness of fit, that is how close estimated value is to actual value in a given sample. 2) when comparing two or more  $R^2$ 's, the regressand must be the same. 3)  $R^2$  cannot fall when more variables are added to the model. Therefore,  $R^2$  can be maximized by simple adding more variables to the model but this may also increase the variance of forecast error.

To compare the two  $R^2$  terms, the number of regressors in the model must be taken into account. This can be done when the alternative coefficient of determination is considered. The following Equation 4.31 shows the alternative coefficient of determination (adjusted  $R^2$ ):

$$R^{-2} = 1 - \frac{\sum \hat{u}_i^2 / (n-k)}{\sum y_i^2 / (n-1)} \dots\dots\dots 4.31$$

Where: k = the number of parameters in the model including the intercept. The term adjusted means adjusted for the df associated with the sum of squares entering in Equation 4.31 where  $\sum \hat{u}_i^2$  has n-k df in the model, the intercept term and  $\sum y_i^2$  has n-1 df. Equation 4.31 can also be written as follows:

$$R^{-2} = 1 - \frac{\delta^2}{S_y^2} \dots\dots\dots 4.32$$

Where  $\delta^2$  is the residual variance, an unbiased estimator of true  $\delta^2$  and  $S_y^2$  is the sample variance of Y. By substituting Equation 4.30 to 4.31, it is easy to see that  $R^{-2}$  is related to  $R^2$ , the following equation shows the substitution:

$$R^{-2} = 1 - (1-R^2) \frac{n-1}{n-k} \dots\dots\dots 4.33$$

In Equation 4.33 above, it is apparent that (1) for  $k > 1$ ,  $R^{-2} < R^2$  which implies that as the number of regressors increase, the adjusted  $R^2$  increase less than  $R^2$  and adjusted  $R^2$  can be negative although  $R^2$  is necessarily nonnegative. If adjusted  $R^2$  is negative, it is taken as zero. It should be noted that the adjusted  $R^2 \leq R^2$  shows that the adjusted  $R^2$  penalizes for adding more regressors. The adjusted  $R^2$  will increase only if the absolute t value of the added variable is greater than 1. For comparative purposes, it is better to use the adjusted  $R^2$  as a better measure for  $R^2$  but for the comparison to be valid the regressand must be the same.

In Theil's view; it is better to use adjusted  $R^2$  than  $R^2$  because  $R^2$  tends to give an over optimistic picture of the fit of the regression, particularly, when the number of regressors are not very small compared to the number of observations.

#### 4.7.8.2 Akaike Information Criterion (AIC)

The idea of imposing a penalty for adding more regressors to the model has been carried further in the AIC criterion, which is defined as:

$$AIC = e^{2k/n} \sum \frac{\hat{u}_i^2}{n} = e^{2k/n} \frac{RSS}{n} \dots\dots\dots 4.34$$

Where  $k$  is the number of regressors including the intercept and  $n$  is the number of observations. For mathematical convenience, equation 4.34 can be written as:

$$\ln AIC = \frac{2k}{n} + \ln \frac{RSS}{n} \dots\dots\dots 4.35$$

Where  $\ln AIC$  = natural log of AIC and  $2k/n$  = penalty factor. But some software packages define AIC only in terms of its natural log so there is no need to put  $\ln$  before AIC. AIC imposes a harsher penalty than adjusted  $R^2$  for adding more regressors in the model. When comparing two or more models, a model with the lowest value of AIC should be selected.

One advantage of AIC is that it is not only useful for only in-sample but also out-sample forecasting performance of a regression model. Also, it is useful to determine the lag length in an AR(p) model.

#### 4.7.8.3 Schwarz information criteria (SIC)

Similarly to the AIC, the SIC criterion is defined as follows:

$$SIC = n^{k/n} \frac{\sum \hat{u}_i^2}{n} = n^{k/n} \frac{RSS}{n} \dots\dots\dots 4.36$$

Equation 4.36 can be written in a log form as follows:

$$\ln SIC = \frac{k}{n} \ln n + \frac{RSS}{n} \dots\dots\dots 4.37$$

Where,  $[(k/n) \ln n]$  is the penalty factor. SIC imposes a harsher penalty than AIC. The lower the value of SIC the better the model. SIC can also be used to compare in-sample or out-sample forecasting performance of a model.

#### 4.7.8.4 Durbin Watson d test

The most preferred test for detecting serial correlation is the Durbin-Watson  $d$  statistics developed by the statisticians Durbin and Watson (Brooks, 2006). The Durbin-Watson  $d$  test is defined as:

$$d = \frac{\sum_{t=2}^T (\hat{u}_t - \hat{u}_{t-1})}{\sum_{t=2}^T (\hat{u}_t - \hat{u}_{t-1})} \dots\dots\dots 4.38$$

Equation 4.38 above is regarded as the ratio of the sum of square differences in successive residuals to the RSS. An advantage of the  $d$  statistic is that it is based on the estimated residuals, which are computed in the regression analysis. Hence it is a common practice to report the Durbin-Watson  $d$  along with  $R^2$ , adjusted  $R^2$ ,  $t$  and  $F$ . E-views (1997) alludes that Durbin-Watson should at least be equal to 2.

### 4.8 Chapter summary

This chapter presented the research methodology and the estimation technique of this research study. The objective of this chapter is to give the analytical framework and the

model that will be followed during the estimation. The data generation process and stationarity test methods for time series analysis are described. The statistical and econometric techniques namely; Johansen technique of co-integration analysis, analysis of covariance and correlation, Vector error correction model, that will be followed during the analysis are discussed. The data description, data sources, the expected relationship between variables and the indexation of the data are discussed.

## CHAPTER 5

### EMPIRICAL ANALYSIS AND FINDINGS

#### 5.1 Introduction

The previous chapter reviewed research methodology and technique that will be used in this research study. This is an attempt to provide answers and evidence on theories set out in the previous chapters by presenting the results of the empirical analysis using the model specified in chapter 4. The organization of the chapter is as follows: the preliminary data examination, the covariance and correlation analysis, the unit root tests, integration analysis, Granger Causality analysis, as well as the results of the analysis.

#### 5.2 The Preliminary data examination

In this research study all variables are plotted in logarithmic form with their levels against time. This helps to determine the behaviour of the variables overtime and to detect any gaps and omitted variables. According to Brooks (2006), this procedure is important before carrying out any form of analysis in order to detect any data capturing errors, check possible structural breaks and have an idea of trends and stationarity.

Figure 5.1 below presents the graphs of data plotted in logarithm form. In table 5.1 below GDP represents the Gross Domestic Product, AGRIC represents the agricultural productivity, PVTL represents the number of people living below the poverty line, UNEMP represents the unemployment, GVT is the government expenditure, and PPP represents the Purchasing Power Parity.

The Agricultural productivity which is the number of people below the poverty line as well as the unemployment rate variables display considerable fluctuations throughout the period. This gives a clue on the relationship that could be expected between the two variables. However, GDP, government expenditure and the purchasing power parity upsurge steadily through time.

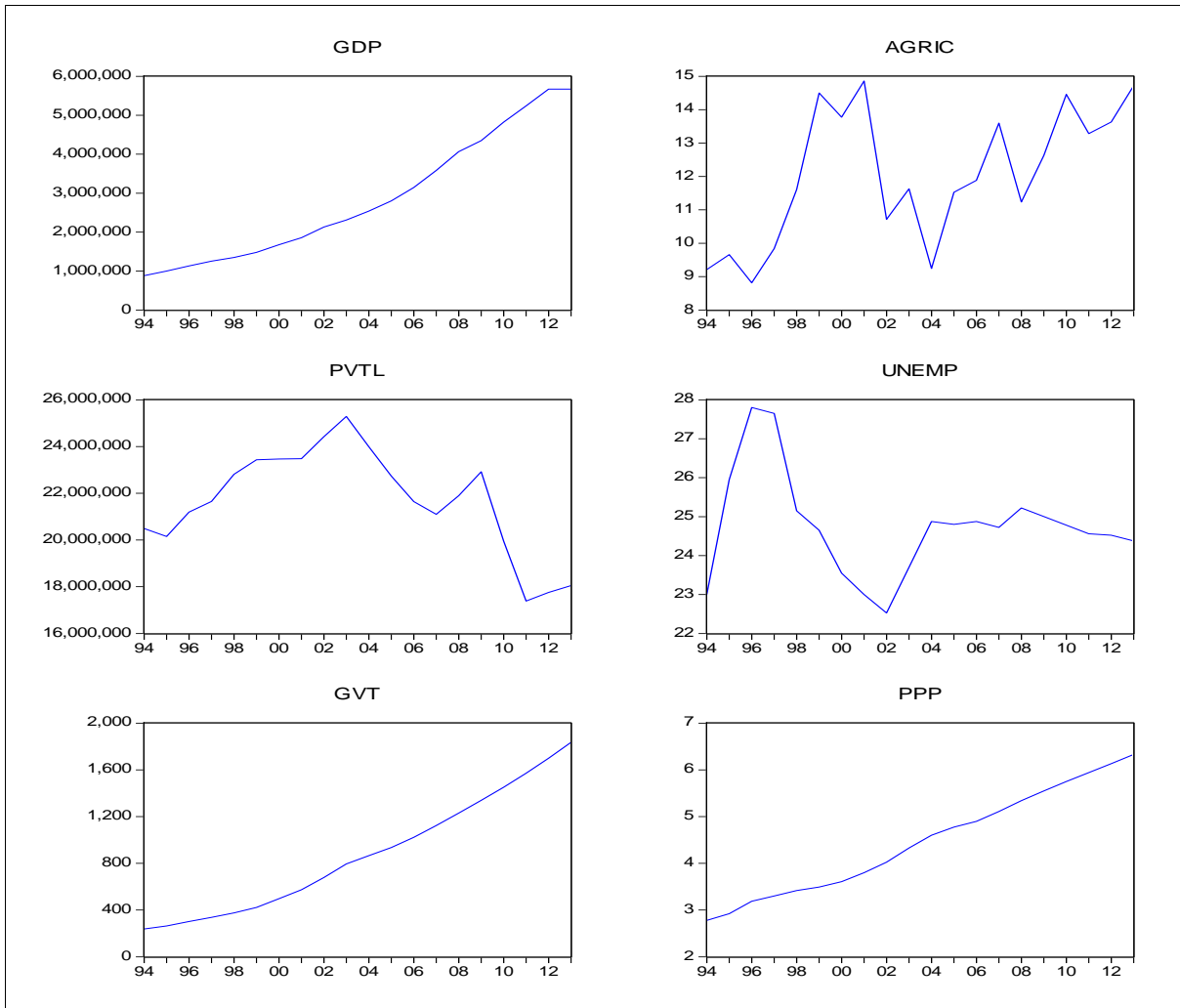


Figure 2. 17: Preliminary data examination

Source: own calculation using E-Views 6

## 5.2 Analysis of Covariance (ANOVA) and correlation analysis

Covariance measures how much two variables change together and the strength of the relationship between them. It evaluates whether the means of a dependent variable are equal across the levels of a categorical independent variable, while statistically controlling for the effects of other continuous variables that are not of primary interest, known as covariates.

Correlation is another way to determine how two variables are related. It conveys whether the variables are positively or inversely related and the degree to which the variables tend to move together. If the correlation is 1, then the variables have a perfect positive correlation. Table 5.1 below presents the analysis of covariance and correlation of the variables.

Covariance	YEAR	GDP	AGRIC	PVTL	UNEMP	GVT	PPP
YEAR	33.25000						
GDP	3.406249	0.350186					
AGRIC	0.583172	0.058557	0.028013				
PVTL	-0.264275	-0.025826	-0.003526	0.010653			
UNEMP	-0.048264	-0.004674	-0.003402	-0.001092	0.002655		
GVT	3.684526	0.378792	0.062770	-0.023571	-0.006567	0.413703	
PPP	1.455740	0.149544	0.023913	-0.010601	-0.001632	0.162320	0.064194
Correlation	YEAR	GDP	AGRIC	PVTL	UNEMP	GVT	PPP
YEAR	1.000000						
GDP	0.998231	1.000000					
AGRIC	0.604255	0.591223	1.000000				
PVTL	-0.444050	-0.422852	-0.204107	1.000000			
UNEMP	-0.162449	-0.153284	-0.394487	-0.205259	1.000000		
GVT	0.993440	0.995193	0.583082	-0.355070	-0.198164	1.000000	
PPP	0.996412	0.997403	0.563893	-0.405396	-0.125002	0.996043	1.000000

Table 2. 11: Analysis of covariance (ANOVA) and correlation

**Source: Own calculations on E-Views 6**

In Table 5.1 above, the correlation is 1, indicating a perfect correlation between the variables.

### 5.3 The Unit root test

The results for unit root test are obtained by loading the data in “E-views”, where the ADF tests type is selected with no intercept and trend. The model is differenced twice with the selection of lag length 2 of the dependent variable in a regression equation. The results are presented in Table 5.2 below.

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.853896	0.0000
Test critical values:		
1% level	-2.717511	
5% level	-1.964418	
10% level	-1.605603	

:

#### :Augmented Dickey Fuller test (ADF test)

Lag Length: 1 (Automatic based on SIC, MAXLAG=4)

\*MacKinnon (1996) one-sided p-values.

Source: own calculation using E-Views 6

In Table 5.2 above, the ADF test statistic is more negative than the critical value and hence the null hypothesis of a unit root is convincingly rejected (E-Views 6, 2007). Thus, the dependent variable of the regression is stationary.

Table 5.3 below presents the unit root test results in Phillip-Perron test. As with the ADF test results presented in Table 5.2 above, the PP-test statistic is more negative than the critical value. Therefore, the null hypothesis of a unit root test will be rejected (E-Views 6, 2007). Therefore, the dependent variable of the regression is stationary. The model is lagged once with no intercept and trend but differenced twice.

Table 2. 12: Phillip-Perron test (PP test)

Bandwidth: 15 (Newey-West using Bartlett kernel)

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-6.568621	0.0000
Test critical values:		
1% level	-2.708094	
5% level	-1.962813	
10% level	-1.606129	

\*MacKinnon (1996) one-sided p-values.

Source: own calculation using E-Views 6

In both the ADF and Phillips-Perron unit root tests in Tables 5.2 and 5.3 above, the similar results of rejecting the null hypothesis are presented and are both stationary. Thus, the coefficient of standard errors can be examined.

### 5.3 Co-integration analysis

Table 5.4 below presents the Co-integration tests results following Johansen procedures during the test. The Johansen VAR test is done with intercept, no trend in CE as presented below. In Table 5.4 below the trace test and Max-eigenvalue tests both indicate one co-integrating equation at 5% confidence level. The Eigenvalue of 0.50 is less than the critical value of 3.84 at 5%. Therefore, the null hypothesis of no co-integration vectors cannot be rejected in both equations. However, the co-integration relationship between the variables exists at the 5% significant level. The MacKinnon p-value is statistically significant at 5%.

## 5.4 The Vector error correction model (VECM)

The Vector error correction model gives the distinction between long-run and short run equations before interpreting the results of the VECM.

### Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.504354	12.63408	3.841466	0.0004

### Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.504354	12.63408	3.841466	0.0004

### : Cointegration test results

#### Source: own calculation using E-Views 6

Trace tests / Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

impacts of the agricultural productivity. It is desirable to identify the two co-integrating Table 5.5 below presents the estimated results for VECM:

### Vector Autoregression Estimates

	PVTL
PVTL(-1)	0.848231 (0.25741) [ 3.29519]
PVTL(-2)	-0.480964 (0.24604) [-1.95484]
C	10.61310 (5.99307) [ 1.77090]
GDP	-0.137060 (0.34908) [-0.39264]
AGRIC	-0.119238 (0.11435) [-1.04276]
UNEMP	0.038277 (0.66656) [ 0.05743]
GVT	0.689836 (0.57710) [ 1.19534]
PPP	-1.552231 (1.47975) [-1.04898]
R-squared	0.894538
Adj. R-squared	0.820714
Sum sq. resids	0.021611
S.E. equation	0.046487
F-statistic	12.11722
Log likelihood	34.98360
Akaike AIC	-2.998178
Schwarz SC	-2.602457
Mean dependent	16.89387
S.D. dependent	0.109789

**Table 5.5: Vector E**

**Source: own calculations on E-Views6**

When co-integrating equations presented in Table 5.5 above, the co-integration of the error correction term PVTL(-2) carry the correct negative sign with the t-value of -0.48. The GDP, AGRIC and PPP error correction terms also carry the correct negative sign. However, this

confirms that the equation constitutes the co-integration relationship in the co-integrating vectors. The diagnostic checks of the VECM model in Table 5.5 above demonstrate the strength of the model as shown by the good values of R-squared (89%), Akaike AIC (-2.998), Schwarz SC (-2.602) and the F-statistic (12.117).

### 5.5 The Impulse response analysis

The Impulse response analysis reveals the wealth of information in response of each independent variable. Figure 5.4 below presents the results of the Impulse response analysis performed on the VECM regression above.

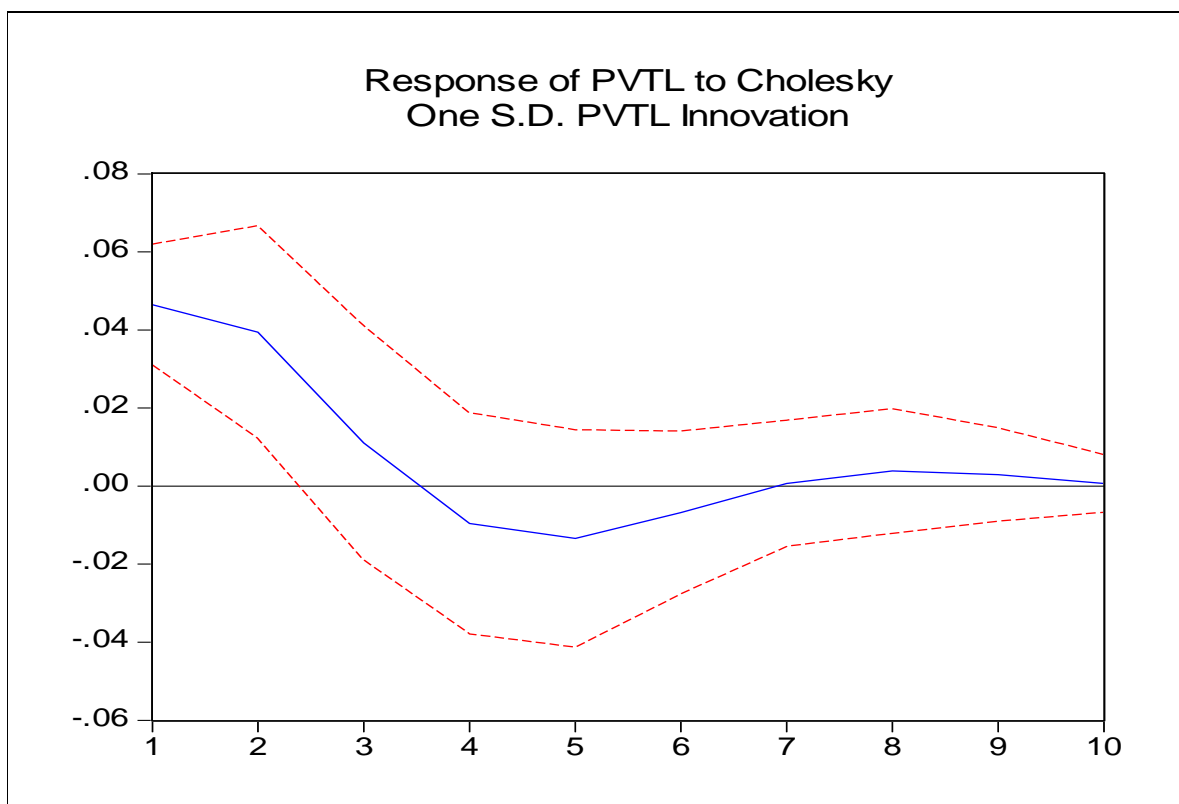


Figure 2. 18: Impulse response Analysis

**Source: own calculation using E-Views 6**

Since the research study focuses on poverty levels, only the responses of the variables presented in Figure 5.2 above are demonstrated. All the impulse responses show a dynamic response to one S.D. PVTL innovation and the graphical representation of the variables.

### 5.6 The Residuals

Figure 5.4 below shows the graphical presentation of the residuals of the dependent variable.

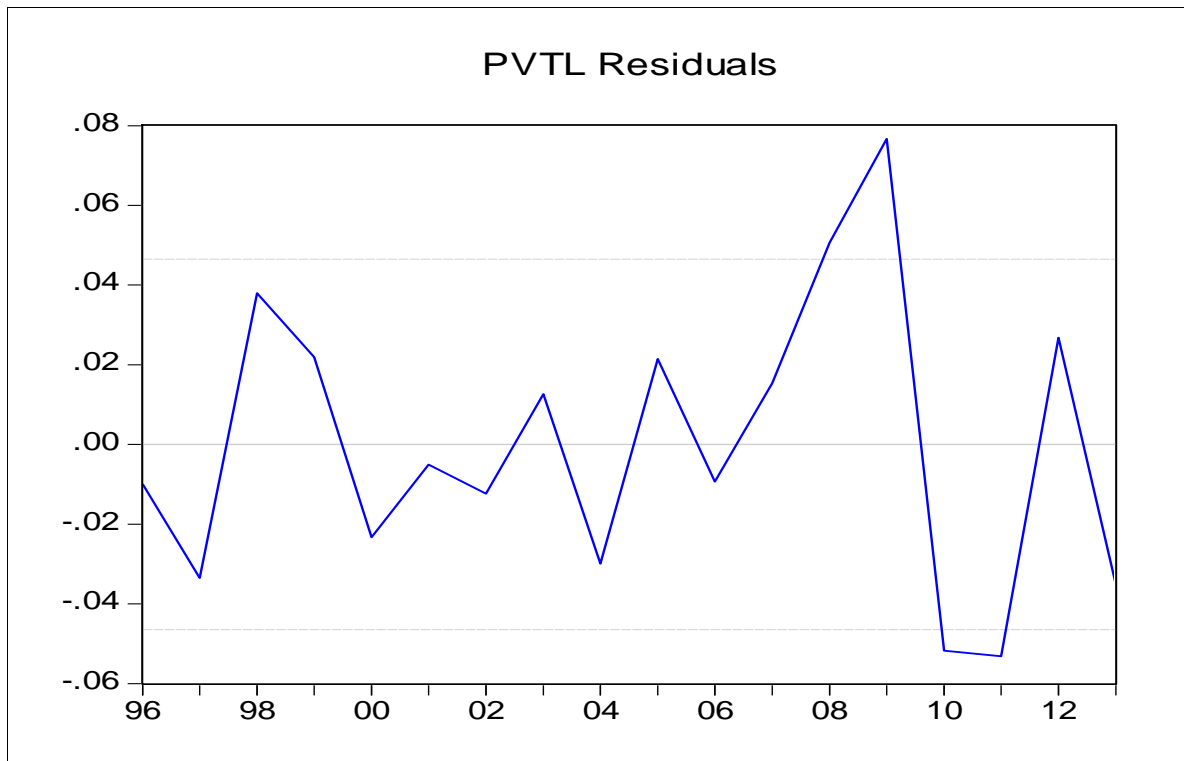


Figure 2. 19: Residuals

**Source: own calculation using E-Views 6**

In Figure 5.2 above, the goodness of fit of the co-integrating vectors is confirmed, however, the residuals of the dependent variable varies around the mean.

### 5.7 The Pairwise Granger causality tests

When the endogenous and exogenous variables are co-integrated, it is highly recommended that there must be some Granger causality relationship in at least one direction. During the Granger causality test, two lags are used and the null hypothesis in each case is that the variable under consideration does not Granger cause the other variable. Table 5.6 below presents the Granger causality relationship test estimates.

Sample: 1994 2013. Lags 1

<b>Null Hypothesis:</b>	<b>Obs</b>	<b>F-Statistic</b>	<b>Prob.</b>
AGRIC does not Granger Cause GDP	19	1.24611	0.2808
GDP does not Granger Cause AGRIC		1.76409	0.2028
PVTL does not Granger Cause GDP	19	1.84480	0.1932
GDP does not Granger Cause PVTL		4.49375	0.0500
UNEMP does not Granger Cause GDP	19	0.86389	0.3665
GDP does not Granger Cause UNEMP		1.48944	0.2400
GVT does not Granger Cause GDP	19	2.98721	0.1032
GDP does not Granger Cause GVT		0.35782	0.5581
PPP does not Granger Cause GDP	19	0.28367	0.6016
GDP does not Granger Cause PPP		3.76871	0.0700
PVTL does not Granger Cause AGRIC	19	0.23067	0.6375
AGRIC does not Granger Cause PVTL		0.63774	0.4362
UNEMP does not Granger Cause AGRIC	19	0.86748	0.3655
AGRIC does not Granger Cause UNEMP		12.2897	0.0029
GVT does not Granger Cause AGRIC	19	1.37031	0.2589
AGRIC does not Granger Cause GVT		12.7733	0.0025
PPP does not Granger Cause AGRIC	19	1.78777	0.1999
AGRIC does not Granger Cause PPP		1.2E-05	0.9973
UNEMP does not Granger Cause PVTL	19	0.12405	0.7293
PVTL does not Granger Cause UNEMP		0.80391	0.3832
GVT does not Granger Cause PVTL	19	4.47632	0.0504
PVTL does not Granger Cause GVT		1.86465	0.1910
PPP does not Granger Cause PVTL	19	4.87427	0.0422
PVTL does not Granger Cause PPP		0.19068	0.6682
GVT does not Granger Cause UNEMP	19	1.54764	0.2314
UNEMP does not Granger Cause GVT		4.98508	0.0402
PPP does not Granger Cause UNEMP	19	1.44661	0.2466
UNEMP does not Granger Cause PPP		3.97134	0.0636
PPP does not Granger Cause GVT	19	8.15031	0.0115
GVT does not Granger Cause PPP		11.3108	0.0040

## **Table 5.6: Pairwise Granger Causality Tests**

**Source: own calculation using E-Views 6**

In Table 5.6 above, the results of the first equation shows that the null hypothesis of agricultural productivity Granger-cause the gross domestic product is rejected. This implies that, causality is running from gross domestic product to the agricultural productivity (GDP  $\rightarrow$  AGRIC). To all the equations presented in table 5.3 above, the null hypothesis that one variable Granger-cause the other is rejected. However, this implies that there exist a dynamic relationship between the variables and that causality exists between the variables. Therefore, an increase in any other variable not included in the models will change the level of independent variables.

### **5.8 Results of the regression**

Equation 4.1 of the previous chapter is estimated. We now present the actual results of the estimated equation, the performance of the model is enhanced by differencing and inclusion of lags. This section gives the practical evidence on what have been presented in the preceding sections.

#### **5.8.1 Interpretation of the results**

As shown by the results presented in Table 5.4 below, an ARCH method is employed to get the results and the dependent variable is poverty level (denoted by PVTL). During the specification of ARCH method, the order of ARCH (1) and GARCH (1) with GARCH (symmetric) are selected.

Dependent Variable: PVT  
Method: ML - ARCH (Marquardt) - Normal distribution  
Sample: 1994 2013  
Included observations: 20

Variable	Coefficient	Std. Error	z-Statistic	Prob.
GVT	2.738722	0.405937	6.746674	0.0000
UNE	-2.286000	0.128385	-17.80581	0.0000
AGR	-0.157899	0.108634	-1.453502	0.1461
GDP	0.180681	0.067611	2.672381	0.0075
PPP	-7.348684	0.806459	-9.112284	0.0000
Variance Equation				
C	0.000432	0.000230	1.876221	0.0606
RESID(-1)^2	-0.356544	0.233681	-1.525773	0.1271
GARCH(-1)	1.305893	0.269744	4.841234	0.0000
R-squared	0.828409	Mean dependent var		16.88720
Adjusted R-squared	0.794980	S.D. dependent var		0.105893
S.E. of regression	0.100738	Akaike info criterion		-2.251184
Sum squared resid	0.121779	Schwarz criterion		-1.852891
Log likelihood	30.51184	Hannan-Quinn criter.		-2.173433
Durbin-Watson stat	1.657160			

**Table 5.4: Regression results**

**Source: own calculation using E-Views 6**

In table 5.4 above the Durbin Watson statistics is 1.7 which is close to 2. R-squared is 82% (0.82) and the adjusted R-squared is 79% (0.79) confirming the Goodness-of-fit of the estimated equation. An ARCH (Autoregressive Conditional Heteroscedasticity) test is obtained by regressing the squared residuals from the model on their first lag and a constant. The model with the lowest Akaike Info Criterion of -2.25 and Schwarz criterion of -1.85 is selected. This is because the low value of Akaike and Schwarz criterion confirm the robustness of the model (Gujarati and Porter, 2009).

Our analysis now focus on the variables of interest namely, poverty level (PVTL), agricultural productivity (AGRCD), unemployment (UNEMP), government expenditure (GVT), gross domestic product (GDP) and the purchasing power parity (PPP). In Table 5.3 above, the number of people living under poverty is the dependent variable which has a negative significant relationship with agricultural productivity, AGRIC has the coefficient of -0.16. The size of the coefficient implies that a 1% change in poverty level in South Africa is caused by a 16% change in agricultural productivity, ceteris-paribus.

Government expenditure (GVT) has the positive sign showing the positive significant relationship with poverty. However, the positive relationship is not expected. If the government expenditure increased by 2.7% poverty will also increase by 1%.

Unemployment (UNEMP) has a negative sign, confirming the inverse relationship with the dependent variable, poverty (PVTL). However, a 2.3% in unemployment result in 1% change in poverty.

Gross Domestic Product (GDP) has the positive sign which shows the positive relationship between GDP and poverty levels. The positive relationship is not expected and not supported by the economic theory. The coefficient indicates that 18% change in the GDP result in 1% change in the poverty level.

### 5.8.2 Actual versus fitted results



Figure 2. 20: The actual versus fitted results.

Source: own calculation using E-Views 6

In Figure 5.5 above where the actual versus fitted results are compared, the robustness of the model is confirmed. The stationarity of the variables in the estimated equation and the significance of the EGARCH also confirm the robustness.

### **5.9 Chapter conclusion**

This chapter presents the results of the empirical findings based on the objectives of the research study as stated in chapter 1. This is achieved by examining the preliminary data to determine the behaviour of variables overtime. The analysis of covariance and correlation is also done to test the relationship between the variables.

The ADF and P-P tests are performed to test for stationarity and both tests revealed that the dependent variable of the regression is stationery. This leads to the coefficient of standard errors estimated. To examine whether there is a long-term relationship among the variables, a Johansen co-integration technique is applied. The residual method applied shows that a long-term relationship between variables exists and the variables are co-integrated. This also indicates that the residuals of the regression are stationary.

The analysis of the results presented in Table 5.4 above strongly confirm that agricultural productivity has a significant inverse relationship to the levels of poverty in South Africa. To estimate the equation, ARCH and HARARCH models are applied. All the variables are statistically significant and the relationship with the dependent variable is positive.

## CHAPTER 6

### CONCLUSION, POLICY RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

#### 6.1 Introduction

This chapter summarizes the results, conclusion and make policy recommendations as well as suggestions for further research. The primary aim of this research study is to assess the extent to which agricultural productivity growth alleviates poverty in South Africa. The specific objectives are: 1) To review the poverty trends over the period 1994-2013 in South Africa. 2) To review the smallholder agricultural productivity growth trends over the period 1994-2013 in South Africa, 3) To econometrically examine the variables that alleviated poverty over the period 1994-2013 in South Africa, and 4) To make policy recommendations based on research findings. This research study has successfully achieved its primary aim of assessing the extent to which agricultural productivity growth alleviates poverty in South Africa. This primary aim is achieved through the achievement of the specific objectives. A time series analysis data from 1994 to 2013 is selected for the estimation of the model.

The principal variables of interest are poverty and agricultural productivity. Other variables included in the model are Gross domestic product in agriculture, Government expenditure in agriculture, Employment in agriculture, and Consumption of agricultural products. In terms of the economic theory the Government expenditure in agriculture is expected to be inversely related to the poverty levels in a country. This means that an increase in Government expenditure in agriculture will lead to more employment in public sector projects and this result in more income which will then lead to a reduction in poverty levels in a country. The Gross domestic product in agriculture is expected to be inversely related to the poverty levels in a country. This means that an increase in GDP is expected to increase employment, lead to more income and resulting in the reduction of poverty in a country. Unemployment rate in agriculture is expected to be positively related to the poverty levels in a country. This means that an increase in unemployment will lead to an increase in the poverty rate in a country. When there are more unemployed people, those people will have less income and this leads to an increase in poverty levels in a country. Agricultural productivity is expected to be inversely related to the poverty levels in a country. An increase in agricultural productivity will lead to an increase in income for those who are employed in the agricultural sector and this will consequently lead to reduction in poverty levels in a country. An increase in

agricultural productivity can also indirectly lead to a reduction in poverty through the reduction in food insecurity.

## **6.2 Policy recommendations**

In contrast to the economic theory just highlighted above, our findings in this research study are that: the Government expenditure in agriculture (GVT) is positively related to the poverty levels in South Africa, the Gross domestic product (GDP) in agriculture is positively related to the poverty levels in South Africa, Unemployment in agriculture (UNEMP) is inversely related to the poverty levels in South Africa and the Agricultural productivity (AGRIC) is inversely related to the poverty levels in South Africa. This relationship conforms to the economic theory.

However, these findings indicates that irrespective of the South African government intervention strategies in an attempt to increase agricultural productivity growth explained earlier, there is still more government expenditure required in the agricultural sector. If that is the case in the South African agricultural sector, then the intensity in poverty levels is high. With an additional increase in the South African government expenditure in agriculture such that: the GDP in agriculture is negatively related to the poverty levels and the unemployment rate in agriculture is positively related to the poverty levels, a price will be paid to the majority poor people in the country. In addition, South Africa will be advancing towards the overall world-wide poverty alleviation progress. The G-20 emphasized that the reduction of global poverty is integral to its framework for strong sustainable and balanced growth. This is one of the arguments for the significance of this research study mentioned in Chapter 1.

## **6.3 Suggestions for further research**

Agricultural productivity is affected by the factors that include: (i) the cost of production, (ii) land prices, (iii) access to arable lands, (iv) market access, and (v) gross value of production. The research that covers the above listed factors may be more relevant to the circumstance of small as well as the large scale farmers. For further research, there are other examples of approaches that can be used to address the topic as highlighted in the Empirical review component in chapter 2 of this research study.

#### **6.4 Conclusion**

From the literature reviewed in this research study some conclusions can be drawn about the driving forces behind agricultural productivity growth in South Africa. Potential growth due to expansion of land under cultivation or increased input use, with the exception of machinery, is limited. The African continent faces the infrastructure deficit problem. Technological progress and infrastructure development are among the key factors to promote growth, driven by agricultural research and extension and improvements in human capital. Policy reforms, on the other hand, while extremely important, may provide only a one-shot boost to agricultural productivity, unlike agricultural research and extension from which the contribution to productivity is long lasting.

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### Annexure 1 (logarithmic form)

	<b>GDP</b>	<b>AGR</b>	<b>PVT</b>	<b>UNE</b>	<b>GVT</b>	<b>CNS</b>
1994	13.69	2.22	16.84	3.14	5.47	1.02
1995	13.82	2.27	16.82	3.26	5.57	1.07
1996	13.94	2.18	16.87	3.33	5.71	1.16
1997	14.04	2.29	16.89	3.32	5.82	1.19
1998	14.12	2.45	16.94	3.22	5.93	1.23
1999	14.21	2.67	16.97	3.20	6.05	1.25
2000	14.33	2.62	16.97	3.16	6.21	1.28
2001	14.43	2.70	16.97	3.14	6.35	1.33
2002	14.57	2.37	17.01	3.11	6.52	1.39
2003	14.65	2.45	17.05	3.17	6.68	1.46
2004	14.75	2.22	16.99	3.21	6.76	1.53
2005	14.85	2.44	16.94	3.21	6.84	1.56
2006	14.96	2.48	16.89	3.21	6.93	1.59
2007	15.09	2.61	16.86	3.21	7.02	1.63
2008	15.22	2.42	16.90	3.23	7.11	1.68
2009	15.29	2.54	16.95	3.22	7.20	1.71
2010	15.39	2.67	16.81	3.21	7.28	1.75
2011	15.47	2.59	16.67	3.20	7.36	1.78
2012	15.55	2.61	16.69	3.20	7.44	1.81
2013	15.55	2.69	16.71	3.19	7.52	1.85

## ANNEXURE 2

	<b>GDP</b>	<b>AGRIC</b>	<b>PVL</b>	<b>EMP</b>	<b>GVT</b>	<b>CNS</b>
1994	880 288	9.21	20 492 803	23.00	238.50	2.78
1995	1 000 704	9.66	20 152 366	25.95	263.74	2.92
1996	1 130 944	8.81	21 192 886	27.80	302.25	3.19
1997	1 254 334	9.84	21 651 415	27.65	337.11	3.30
1998	1 349 748	11.61	22 813 875	25.15	375.23	3.42
1999	1 477 746	14.50	23 434 702	24.65	422.48	3.49
2000	1 676 436	13.77	23 467 451	23.55	497.74	3.61
2001	1 856 432	14.86	23 476 765	23.00	573.25	3.80
2002	2 131 392	10.72	24 417 611	22.53	679.25	4.02
2003	2 310 300	11.63	25 285 535	23.70	795.17	4.33
2004	2 541 200	9.24	23 993 661	24.88	865.98	4.60
2005	2 802 134	11.53	22 733 150	24.80	934.78	4.77
2006	3 144 638	11.88	21 642 865	24.88	1 022.17	4.90
2007	3 584 150	13.60	21 100 225	24.73	1 123.27	5.11
2008	4 066 414	11.23	21 894 908	25.22	1 229.84	5.34
2009	4 349 026	12.63	22 918 718	25.00	1 338.92	5.55
2010	4 824 982	14.46	19 952 621	24.78	1 450.22	5.75
2011	5 242 758	13.28	17 390 015	24.56	1 571.12	5.94
2012	5 670 174	13.63	17 759 260	24.52	1 699.10	6.13
2013	5 670 183	14.72	18 047 706	24.37	1 835.92	6.33