AGRICULTURAL CONTRIBUTION TO ECONOMIC GROWTH AND DEVELOPMENT IN RURAL LIMPOPO PROVINCE: A SAM MULTIPLIER ANALYSIS

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Declaration

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Dedication

This thesis is dedicated to the entire family (Edith Mukhethiwa Hlengani, Lavhelesani Moureen Hlengane, Mujaji Hlengani, Takalani Hlenagni, Alexia Azwinndini Hlengani, Tshilidzi Hlengane, Musimeki Edith Fhatuwani and Halatedzi Ramigo) that stood by me from day one. Without their support, encouragement and love all of this could not have been possible. The word of God that live within me gave me strength to finish the race that I started- Joshua 1: 1-8.

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Abstract

The agricultural sector in Limpopo contributes approximately 2.2% to the provincial GDP. Agriculture can play an important role in contributing to economic growth, through agricultural production and job creation as a result of its linkages with the rest of the economy. Consequently, it can play a significantly role in reducing poverty. This study examines the potential agricultural contribution to economic growth and development in Limpopo. It starts with a literature review of the province's sectoral development and growth. Most importantly, it examines two stages of poverty alleviation and agricultural growth; namely production and consumption linkages. The factors that constrain agricultural economic growth and development are described in detail.

For the analysis, the study used the Limpopo Social Accounting Matrix (SAM) for 2006 developed by Conningarth Economists as a database to develop a multiplier model. Because the Limpopo SAM was unbalanced, data manipulation was performed, applying manual balancing to the existing Excel data.

Firstly, the results from the SAM multiplier analysis indicated that R1 million injected into the agricultural sector will lead to a notable change in output (R1.67 million) and value-added (R764 000). Some of the agricultural sub-sectors generated a large increment in output – the largest being subtropical fruit and forestry. The water- and electricity industry was ranked first for output (R2.02 million) and third for value-added (R900 000). The financial industry was ranked first for value added (R962 000) and sixth for output (R1.77 million).

Secondly, the analysis estimated the impact of a 5% export demand on the rest of South Africa and the rest of the world respectively. The results indicate that vegetables is the largest export demand to the rest of South Africa. On the other hand, for the rest of the world, the demand for exported citrus fruit is the largest. GDP increases by R59.48 million for a simultaneous 5% increase in export demand for output from all agricultural industries by the rest of the world. This exceeds the increase in GDP of R47.54 million for a simultaneous 5% increase in export demand for output from all agricultural industries by the rest of South Africa.

Thirdly, the analysis estimated the impact of a 5% increase in investment demand in agricultural activities. The results show that the output from the agricultural sector increases more than that of the non-agricultural sector. The largest increase in output from the agricultural sub-sectors comes from forestry. The income from Black households (R4.47

million) increases more than that of White, Coloured and Asian households (R276 000). The GDP in the economy increases with R9.30 million.

Fourthly, the forward and backward linkages for the economic sectors of Limpopo were calculated. The results show that tertiary sector industries are gaining more position on the list of leading industries in Limpopo. Moreover, the investment in the tertiary sector seems important for economic development because of its linkage to other sectors. The results of the study may be used for the development strategy of the Limpopo economy.

It was concluded that despite the fact that most of the people in the province live in rural areas and are assumed to engage in the agricultural sector as a source of livelihood, the agricultural sectors actually contribute less to economic growth than non-agricultural sectors in Limpopo, and this is contrary to the original hypothesis. It should be noted, to achieve significant development in Limpopo, more focus should be placed on the water and electricity (output), financial insurance (value-added) and community and personal services (income) sectors for their contribution to economic growth, due to large multipliers when compared to other sectors.

Key words: Agriculture, Economics, Social Accounting Matrix, Multiplier Analysis, Backward and Forward Linkages, Limpopo

Opsomming

Die landbousektor in Limpopo dra ongeveer 2.2% by tot die provinsiale BBP. Landbou kan 'n belangrike rol speel in die bydrae tot ekonomiese groei deur middel van landbouproduksie en werkskepping as gevolg van skakelings met die res van die ekonomie. Gevolglik kan dit 'n merkbare rol in die vermindering van armoede speel. Hierdie studie ondersoek die potensiële bydrae van landbou tot ekonomiese groei en ontwikkeling in Limpopo. Dit begin met 'n literatuuroorsig oor die sektorale ontwikkeling en groei van die provinsie. Die belangrikste is dat die studie twee fases van armoedeverligting en landbou -groei ondersoek, naamlik produksie- en verbruik-skakeling. Die faktore wat beperkinge op ekonomiese groei en ontwikkeling van landbou plaas, word in detail beskryf.

Vir die analise word die Limpopo Sosiale Rekeninge Matriks (SAM) vir 2006, ontwikkel deur Conningarth Economists as 'n databasis gebruik om 'n vermenigvuldiger-model te ontwikkel. Omdat die Limpopo SAM ongebalanseerd is, is data-manipulasie toegepas deur middel van handgedrewe balansering van die bestaande Excel-data.

Eerstens het die resultate van die SAM-vermenigvuldigeranalise aangedui dat 'n R1 miljoen investering in die landbousektor tot 'n noemenswaardige verandering in die produksie (R1.67 miljoen) en toegevoegde waarde (R764 000) sal lei. Sommige van die sub-landbousektors genereer 'n groot toename in uitset, waarvan subtropiese vrugte en bosbou die grootste is. Water -en elektrisiteitsvoorsiening was bo-aan die ranglys ten opsigte van produksie (R2.03 miljoen), en derde ten opsigte van die waarde-toevoeging (R900 000). Die finansiële industrie was bo-aan die lys ten opsigte van waarde-toevoeging (R962 000) en sesde ten opsigte van produksie (R1.77 miljoen).

Tweedens word die impak beraam van 'n 5% toename in vraag na uitvoere na die res van Suid-Afrika en die res van die wêreld, onderskeidelik. Die resultate toon dat die grootste vraag na uitvoere na die res van Suid Afrika vir groente is, terwyl sitrusvrugte die grootste uitvoer-vraag na die res van die wêreld is. BBP neem toe met R59.48 miljoen vir 'n gelyktydige 5% toename in vraag na die uitset van alle landbou industrieë deur die res van die wêreld. Dit oorskry die toename in BBP van R47.54 miljoen vir 'n gelyktydige 5% toename in vraag na die uitset van alle landbou industrieë deur die res van Suid Afrika.

Derdens het die ontleding die impak van 'n 5% toename in vraag na investering in landbou-aktiwiteite beraam. Die resultate toon dat die uitset van die landbou-sektor groter groei toon as dié van nie-landbou sektore. Die grootste toename in uitset vanuit die landbou subsektore

kom vanaf bosbou. Die inkomste van swart huishoudings (R4.48 miljoen) groei meer as dié van wit, gekleurde en Asiatiese huishoudings (R276 000). Die totale toename in BBP in die ekonomie beloop R9.30 miljoen.

In die vierde plek is die voorwaartse en rugwaartse skakels vir die Limpopo ekonomie se sektore bereken. Die resultate toon dat die tersiêre sektor se nywerhede besig is om toenemend meer posisies op die lys van voorste nywerhede in Limpopo te beklee. Van nog groter belang is die belegging in hierdie sektor vir groter ekonomiese ontwikkeling as gevolg van die skakeling met ander sektore. Hierdie resultate van die studie kan dus aangewend word vir 'n ontwikkelingstrategie vir die Limpopo ekonomie.

Dit is die gevolgtrekking dat, ten spyte van die feit dat die meerderheid van die mense in die provinsie in landelike areas bly, of daar aanvaar word dat hulle in landbou betrokke is, dra die landbou-sektor in der waarheid minder by tot die ekonomie as die nie-landbou sektore, wat nie volgens die oorspronklike hipotese is nie. Ten einde beduidende ekonomiese ontwikkeling in Limpopo teweeg te bring moet daarop gelet word dat groter fokus op water, elektrisiteit, finansiële sekerheid asook die gemeenskap- en persoonlike dienssektore geplaas moet word vir hulle bydrae tot ekonomiese groei, as gevolg van groot vermenigvuldigers in vergelyking met ander sektore.

Sleutelwoorde: Landbou, Ekonomie, Sosiale Rekeninge Matriks, Vermenigvuldiger-ontleding, Rugwaartse en Voorwaartse Skakelings, Limpopo

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List of Abbreviations

C-by-C	Commodity-by-Commodity
CGIS	Communication Government Information System
I-by-I	Industry-by-Industry
I-by-C	Industry-by-Commodity
DAFF	Department of Agriculture, Forestry and Fisheries
GDP	Gross Domestic Product
I/O	Input-Output
LDA	Limpopo Department of Agriculture
MAFISA	Micro-Agricultural Financial Institution of South Africa
NDP	National Development Plan
NPC	National Planning Commission
PGDS	Provincial Growth and Development Strategy
ROS	Rest of South Africa
ROW	Rest of the World
SAM	Social Accounting Matrix
S/I	Savings and Investment
StatsSA	Statistics South Africa

1. CHAPTER 1: INTRODUCTION

1.1. Problem statement

The long-term objectives of the Limpopo Department of Agriculture is to "provide technical solutions and information in support of improved sustainable agricultural production'' (LDA, 2015: 23). Further, their vision is a "United, prosperous and productive agricultural sector for sustainable rural communities." (LDA, 2015: 10). LDA (2015) stated that their vision and mission statements are to ensure that agricultural development in the province should focus heavily on sustainable management of natural resources towards growth of the economy and the alleviation of poverty. To reach the efforts of development for the province and to aid the Department of Agriculture in achieving these certain objectives, scientific research aimed at sustainable growth and development is needed.

The provincial policy implementation for agriculture has been lacking because government support to smallholder farmers does not reach all the farmers. Support to farmers is based on the subsidization of farm inputs (Anderson, 2010). In most nations, the majority of agricultural exports are derived from the commercial farms. Many of the farmers are smallholders that owns two hectares. These farms are situated in the marginal land, which indicate that they have a small chance to participate in the market activities (Oni *et al.*, 2010). The reason for the marginal land in agricultural production includes factors such as lack of agricultural finance, production limitations, lack of rural infrastructure, insufficient investment in agricultural research, shortage of skills and market distortions.

Christiaensen and Demery (2007) debated on agricultural development contribution in eradicating poverty. They indicated that faster economic growth leads to quicker eradication of poverty. Moreover, the argument was based on the fact that it is mostly agricultural income that benefits poor people as they live in underdeveloped regions and earn most of their incomes from agricultural activities, rather than from increase in non-agriculture incomes. Another viewpoint is that the non-agricultural sector strategy benefited the poor by removing them out of poverty through stimulating economic growth in the rural areas (Christiaensen & Demery, 2007). As a result, the majority of small farmers' techniques are outdated due to limited agricultural services from government – only few private agencies have taken the responsibility of providing services that were previously provided by the government. It has been difficult for smallholders to farm profitably on the marginal land.

The National Planning Commission strategy is to reduce unemployment by 11 million in 2030 (NPC, 2012). In his 2014 State of the Nation Address, President Zuma stated that "Government will provide comprehensive smallholder farmers by speeding up land reform and providing technical infrastructural and financial support. Support will be provided to communities as well to engage in food production and subsistence farming to promote food security, in line with the Fetsa Tlala food production programme" LDA (2015: 2). Hence, the government of Limpopo launched the so-called Provincial Growth and Development Strategy to assist in eradicating poverty and achieve food security in rural areas. The province of Limpopo targeted agricultural development as the cornerstone of poverty eradication (LDA, 2015). Previously, the Limpopo government tried to come up with different strategies and policies to eradicate poverty in the province (Ndwakhulu, 2007). Despite the initiative of this planning, lack of development in agriculture is still high with the majority of the people in the province still dependant on agriculture for their daily survival.

This is an indication that not all strategies that the government tried to implement in the past have translated to livelihood and agricultural productivity. The study tries to fill the gap by revealing the strength of agricultural contribution to economic growth and development in rural Limpopo.

1.2. Research objectives

❖ The main research objective

The main research objective of this study is to assess the role of agriculture in economic growth and development in rural Limpopo.

❖ The specific objectives:
  ➢ To inspect the overall structure of production of the primary, secondary and tertiary sectors in Limpopo
  ➢ To estimate the Social Accounting Matrix (SAM) multipliers:
    • Output
    • Income
    • Value added/GDP
  ➢ To simulate the impact of an increase in export demand of selected agricultural commodities
  ➢ To simulate the impact of an increase in investment subsidies on agricultural activities

> ➢ To measure the forward and backward linkages for Limpopo
>
> ➢ To pinpoint the main industries in Limpopo

The results obtained from this study will impart details that will assist in establishing effective strategies for simulating potential growth of various sectors within the economy and will therefore also be useful in resolving the challenge of poverty facing the province.

1.3. Hypothesis

The agricultural sector in Limpopo is a key sector to stimulate economic growth in Limpopo.

1.4. Research method

In order to reach the specified objectives, the study encompasses specific tasks:

Task 1: A literature review of the macroeconomic methodological framework (Input-Output tables, Social Accounting Matrices (SAM), multiplier analysis, impact analysis and linkages) was conducted to present the context of the study.

Task 2: The data used for the model is a SAM for Limpopo developed by Conningarth Economists with 2006 as a base year. Because the SAM was unbalanced, data manipulation was performed manually, to rectify the imbalance. The Limpopo SAM includes agricultural accounts because agricultural industries are particularly important to estimate the agricultural contribution to economic growth.

Task 3: The model is a SAM-based multiplier model. The model is used to assess the contribution of the agricultural sector to economic growth in Limpopo. The Leontief inverse matrix was used to estimate the SAM output, income and value added/GDP multiplier.

Task 4: Scenarios were analysed, in particular, the scenario related to increased demand for agricultural commodities by the rest of South Africa (ROS) and by the rest of the world (ROW), as well as the scenario to increase investment subsidies in Limpopo.

Task 5: The column sums of the Leontief inverse were used to estimate backward linkages and the row sums of the Ghosh inverse to estimate forward linkages. The normalized form was used to calculate the power and sensitivity of dispersion indices.

1.5. Delineation of the study

The rest of the chapters are as follows: Chapter Two focuses on the sectoral development and growth with regard to the role of investment in agricultural development, constraints of

agricultural growth and development in Limpopo. The study also discusses the theory of the macroeconomic methodological framework. Chapter Three focuses on background information of Limpopo. Chapter Four discusses the method and model used for the study. Chapter Five provides an analysis and interpretation of the results. Chapter Six provides conclusions of the findings, as well as recommendations for further studies.

2. CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

The literature review on the research topic is presented in this chapter. Different theories pertaining to sectoral development and growth are discussed. Further, the chapter discusses the macroeconomic theory of the methodological framework (I/O tables, SAMs, impact analysis, multiplier analysis and linkages). In short, the main aim of this chapter is to gain an understanding of the agricultural contribution to economic growth and development in rural Limpopo.

2.2. Sectoral development and growth

Lewis' (1954) theory regarded a model of the economy with unlimited supplies of labour. It was assumed that the economy consists of a subsistence or traditional agricultural sector and a modern or capitalist sector. Within the context of an unlimited supply of labour, wages in the capitalist sector will stay at a level just above subsistence, even if productivity increases. The reinvestment of the profits gained by the capitalist sector would increase productive capacity, thereby requiring more labour. This process will continue until the surplus labour is fully absorbed in productive employment. Henceforth wages will increase in the capitalist sector and productivity in the traditional sector will increase accordingly.

Johnston and Mellor (1961) supported the fundamental view of the importance of agriculture's contribution to the economy – especially in the early stages of growth. Hence, it was repeatedly said that agriculture does not simply supply food and labour, but its purpose is further established through production and consumption linkages. As agricultural productivity grows, incomes to the rural households create demand for domestically produced industrial products. Greyling (2012) debated on Lewis' theory since the majority of rural poor people are food-insecure: the income they have are not enough to cover their dietary requirements. Greyling (2012) stated the problem of a decrease in rural production that leads to a decrease in rural income, which in turn reduces industrialisation because of a decrease in the demand for manufactured goods. Hence the problem of low agricultural productivity will result in an insufficient market for agricultural goods (D'Haese *et al*., 2003).

Mellor (1999) stated that, since many poor people live in underdeveloped areas and agriculture is their source of employment, the growth of agriculture is more important than the growth of service and industry. Suryahadi *et al*. (2006) argued that the contribution of

agricultural growth through poverty alleviation was seen in the countries whose labour force engaged in agriculture. Two chains of reaction were considered as the key elements to eradicate poverty and achieve agricultural growth. Production linkages were considered the first chain of reaction to stimulate growth and alleviate poverty through agriculture and industry. The agricultural sector distributes inputs to another sector that uses these as outputs. In these chains of reaction, it was discovered that it will create jobs and raise the income of the agricultural sector and non-agricultural sector. The consumption linkage was considered the second chain of reaction to raise the income level of agricultural households and as a result to stimulate the demand for the products from the non-agricultural sector (Suryahadi *et al*., 2006).

Todaro and Smith (2015) stated that the reason most of the labour is moving from the rural traditional agricultural sector to the urban modern industrial sector is the additional income of workers. The traditional agricultural sector provides low productivity, low savings, and low income (Todaro & Smith, 2015). The modern industrial sector is technologically advanced with good investment. The lack of development in the rural areas is caused by the lack of investment and savings. The Harrod-Domar theory stated that the aim of development is to raise investment and savings (Todaro & Smith, 2015). Moreover, the Harrod-Domar theory problem was more focused on savings and investment, but neglected that the majority of people in rural areas are poor with no income. For them, in order to save, they need capital. For the economy to stimulate growth according to the Harrod-Domar theory, some of the Gross National Income (GNI) needs to be saved and invested in the gross national product (GNP) (Todaro & Smith, 2015).

One of the disadvantages of the Lewis-theory, is that the usefulness of the agriculture sector was not proved for the eradication of poverty and the contribution to economic growth (Todaro & Smith, 2015).

2.3. The role of investment in agricultural development

Mohr *et al.* (2008) defines investment as the spending on capital goods that could be used to increase the productive capacity of the economy. There is a particular need for investment in order to assist the underdeveloped areas in improving agriculture (Mohr *et al*., 2008). Moreover, investment should be directed towards research, infrastructure and human capital.

2.3.1. Investment in agricultural research

Nyamekye and Ntoni (2016) stated that most farmers in the underdeveloped areas often lack tools, money, knowledge and skills to respond to agriculture's development challenges. Most of these challenges are pest and diseases destroying crops and livestock, while climatic factors also play a role in reduced production. Konoma (2016) stated that the investment in agricultural research should focus on the young generation through educating them on climatic factors, value chain approach and bio-technology. The approach of this education is very important as it opens opportunities in producing quality young scientists and agricultural research specialists who will lead the future and reduce food insecurity by holding a key role in achieving sustainable development (Konoma, 2016). Investing in research improves the quality and productivity of farmers through development, thereby increasing employment and income (Pray & Fuglie, 2001).

As stated by DFID (2004), investment in agricultural research has benefited India by their investment in new technology. The introduction of new technology has raised agricultural production, it has stimulated economic growth and has reduced poverty in the country. Therefore, increases in agricultural production reduces food prices and raises income. For example, a 1% increase in investment in agriculture research and development would make it possible for the country to raise productivity growth by 6.98% and alleviate the incidence of rural poverty by 0.48%.

The investment in education will play a key role in advancing productivity by supporting agricultural research in order to reduce production constraints, which will increase yield potential for major crops, and biotechnology (DFID, 2004). The increase in agricultural research will raise the competitiveness and profitability of farmers and stimulate economic growth (Mozumbar, 2012).

2.3.2. Investment in rural agricultural infrastructure

Cloete (2013) stated that poor infrastructure continues to hinder agricultural production in underdeveloped areas. Inadequate infrastructure and lack of investment in agricultural infrastructure have constrained growth. The willingness of farmers to use modern technology to improve agricultural productivity depends significantly on the quality of the infrastructure provided. Quality rural infrastructure provided by the government to farmers will reduce poverty through improved agricultural productivity, non-farm employment and wages. Better communication between the government and the community is a key requirement to

minimize transportation cost, enlarge competition and minimize the marketing margin through improved farm income and private investment opportunities (Chitiga *et al*., 2016).

Major requirements to stimulate agricultural investment and growth are electricity, water, telecommunication, storage facilities and other infrastructural services which are limited in the rural areas (Cloete, 2013). Previous investment in infrastructure was insufficient as a result of improper design and maintenance. Insufficient agricultural infrastructure is one of the major bottlenecks for successful utilization of agricultural research and technology because it reduces farmers' options and agricultural output. This poor infrastructure has resulted in high transport costs in getting agricultural products to markets, including farm inputs costs, and it has also worsened farmers' competitiveness (Garvin, 2005).

The importance of infrastructure has many benefits for the economy: investment in infrastructure lowers the cost of production and consumption and makes it possible for the participants in the economy to enter into transaction. Ngandu *et al*. (2010) stated that the poor quality of infrastructure makes it difficult for producers and consumers to decide whether to produce and what to produce and where to work and live. These problems affect the productivity of farmers and the ability of the economy to function and adapt to external shocks.

2.3.3. Investment in human capital

Schultz (1961) defines human capital as the natural abilities, knowledge and skills attained through education and training to determine the level of productivity. Human capital is one of the factors of production where additional investment yields additional output (Djomo & Sikod, 2012). Nyamekye and Ntoni (2016) stated that the increase in the potential of labour productivity in agriculture is linked to effective growth in knowledge, which implies that more years of farming will affect productivity as farmers can benefit from experience. For the underdeveloped areas to benefit from the agricultural sector, the government must commit to human capital before considering other services, because investment in human capital has long-term benefits in the form of productivity, efficient production processes and in terms of income level. Cloete (2013) argues that, in order to achieve economic development in rural areas, investment in human capital should be considered as a key element to help develop farmers. The reason many farmers in developing areas are not doing well in their production, is because farmers are illiterate, lack skills and there is limited or no support from extension

services. The farmers that are able to raise productivity are highly educated and have the necessary income to afford the use of modern technology (D'Haese *et al*., 2013).

2.4.   Constraints to agricultural economic growth and development

The province of Limpopo continues to face huge obstacles that constrain it from economic growth and development. The number of constraints that affect the farmers must be addressed.

2.4.1. Lack of access to agricultural credit

Unemployment and poverty continue to be a critical issue in Limpopo and furthermore, access to agricultural credit for smallholder farmers has been deteriorating. The main reason is that farmers are not increasing production due to a lack of finance from the commercial banks or other financial institutions. Motsoari *et al*. (2015) stated that commercial banks demand collateral and high deposit accounts to access loans to rural farmers. The smallholder collateral they have is unsatisfactory and they do not have deposit accounts for commercial lending. Cloete (2013) stated that farming without capital is pointless for any farming operation. However, the majority of smallholder farmers lack access to credit due to the absence of collateral. Lending institutions, such as Land Bank, commercial banks and other money lenders, also consider smallholder farmers as high-risk borrowers (Machete, 2004).

Motsoari *et al*. (2015) argue that the reason for limited production in Limpopo is because of lack of capital. Furthermore, said capital is the root of growth for productivity in agriculture. Many of the obstacles that constrain farmers in their quest for productivity, is ultimately the lack of capital to purchase input necessities such as seed and fertilizer (Clover *et al*., 2005). The growth of production greatly depends on the quality of inputs. DAFF (2015) indicated that the reason Limpopo still experiences food insecurity is because most of the smallholder farmers could not afford to buy high input costs as they lack access to agriculture credit. Hence farmers are faced with using low quality inputs, which results in low productivity and yields (D'Haese *et al*., 2013).

These are key factors that cause most of the investors to view the small-scale farmers less favourably. The target of the investor is to generate a profit margin in return, but due to lack of potential of the small-scale farmers, it becomes difficult to provide capital (Motsoari *et al*., 2015).

The interest rate regulated by MAFISA is 8% on credit to small-scale farmers (GCIS, 2015). However, MAFISA is very strict in terms of extending credit to small-scale farmers because of the required collateral. Lower interest rates (low transaction cost) result in less risk to lenders. Lowering the interest rate is beneficial to small-scale farming and lenders, as lowering the interest rate results in affordable credit for borrowers and less risk to lenders. Small-scale farmers have low income, so it is beneficial to them when interest rates are low. Motsoari *et al*. (2015) stated that it has been shown that credit accessibility could assist poverty alleviation and achieve food security by expanding income through raising agricultural production.

Hence it is imperative to note that any strategy to improve economic development should cater for credit accessibility to farmers as faster growth cannot be achieved without capital.

2.4.2. Production limitations

The importance of agribusiness to the development and growth of Limpopo should not be underestimated. Unsuccessful development is caused by the level of risk, high transaction cost and improper information. Sexton and Iskom (1998) stated that the aim of the agribusinesses or cooperatives is to reduce transaction costs for the marketing channel and to improve the level of production for the farmers by supplying inputs and proper information. In order for the development to be successful, agribusiness has to improve on the institutional environment of farmers (Clover *et al*., 2005).

The prices of inputs such as seeds, fertilizer, pesticide and herbicide are expensive for farmers. The shortage of these inputs has resulted in soil organic matter, unbalanced soil nutrition and reduced fertility (Tilman and Clark, 2015). The improper usage of these inputs is one of the reasons behind limited production. It is important for the government to take effective measures to improve efficiency through standardised pesticides and by training small-holder farmers to use the relevant technology correctly, improve on outdated production technique and utilize newly developed fertilizers and safe pesticides (Tilman and Clark, 2015).

2.4.3. Lack of market access

One of the biggest challenges faced by the small-scale farmers in Limpopo province is market access and transport of their product. When high transportation costs are involved, farmers find it difficult to get their fresh produce to the market, which reduces their profit

margins. These problems of transport are experienced in rural areas; because the major markets for fresh produce are mostly situated in Johannesburg and Pretoria (Gauteng), while smaller markets in Limpopo exist only in towns (Cloete, 2010). Markets must be identified before production begins. This means that production must be guided based on market demand. To achieve this, relevant and accurate information become important.

Ortmann and Machete (2003) argued that support to small-scale farmers will improve productivity as many struggle to get their fresh produce to the market due to high transport costs. The support from extension officers in terms of market information will be a turning point for many small-scale farmers as it will motivate them to be market-orientated in their production. Higher transaction cost is another challenge that small-scale farmers face. The studies done by Baloyi (2010) mention that 76% of small-scale farmers in Limpopo experience the problem of access to market information (Masuku *et al*., 2010).

Van der Heijdem (2010) also argues that one of the main challenges that small-scale farmers experience is access to output markets; this is one of the main obstacles in generating higher income. Further, because many small-scale farmers have financial constraints and cannot afford proper transport and cooling facilities, perishable products are damaged because of the distance between farmer and market-place (Baloyi, 2010).

2.5.   Theory of methodological framework

It is important to note that macro-economic modelling, such as the SAM multiplier, is complicated due to the nature of the study field. There are some important elements that need to be considered for the success of modelling: the model should be relevant to the questions and data should be as recent as possible. Therefore, various structures for capturing economic data and various methods of analysis have evolved overtime. The methodological framework of capturing macro-economic data is discussed in the next section.

2.5.1. Input-output (I/O) tables

An I/O table is not a model. It is a data set for a particular country or region showing the structure of the economy (Saikia, 2011). For this reason, the model based on an I/O table can be created to analyse how the economy works and to estimate the impact of policy changes on the economy. Miller and Blair (2009) report the I/O model as "a system of linear equations, which reports the dissemination of an industry's product throughout the economy". As stated by Robinson (2009), this model records the flow of money in the

economy and further analyses the complete system in the economy. In 1758 Francois Quesnay, a French economist, published his economic table which was used to check how expenditure could be traced in an economy using an I/O table. Therefore, the importance of this table shows the demand and supply relationship between a range of consumers and producers in the economy. In the 1930s, the I/O analysis framework was compiled/developed by Wassily Leontief. Six years later (1936), I/O tables were published for the data obtained in 1919 for the US economy (Botha, 2013). He then further transformed his I/O tables into a non-theoretical tool for economic analysis. His work was recognized in 1973 and earned him the Nobel Prize for Economics (Miller & Blair, 2009).

In 1960 Sir Richard Stone played a substantive role in enhancing the I/O technique and framework to encompass a standardized system of national economic accounts (Botha, 2013). He then earned the Nobel Prize in 1984 for his contributions to the development of the systems of national accounts.

McLennan (2006, cited by Botha, 2013) mentioned five basic assumptions of underlying input-output models. The first assumption, is that there are no supply constraints. Therefore, the supply factors of production are assumed to be abundant. The output is only limited to demand, and not supply. The second assumption is that there is constant returns to scale, implying an increase in inputs will result in an increase in outputs. The production function is assumed to be linear. The third assumption is that the industry uses similar technology to produce all its products. It is assumed that primary products are produced by the industry using certain technologies. The fourth assumption is that there is homogeneity on the industry output. The fifth assumption is that the product input structure is fixed; it is assumed that any change in the economy will be reflected in the level of output, not in the composition of inputs.

As mentioned by Miller and Blair (2009), the I/O table contains the limitation of excluding information about the distribution of income. Therefore, it focuses on the production and consumption without reporting the feedback links between institutions and factors of production. The accuracy of sub-sectors' level cannot be disclosed in the I/O table and only the aggregated level can be reflected on the I/O table. It is important to consider these limitations with regard to this study; because of these limitations Sir Richard Stone and his colleagues developed the SAM to capture information from a standardised system of national accounts.

2.5.2. Social Accounting Matrix (SAM)

Round (1981) defines the SAM as a single-entry accounting system that shows the receipts (incomes receive) and payments (expenditures) in the economy. The accounting system is used to display the transactions that take place in the economy during a particular period, typically a year (Round, 2003). Provide (2003) highlighted that the SAM accounts are represented as a square matrix, where rows and columns of the matrix are indicated as incomes (receipts) and payments (expenditures) respectively. The core data are obtained from various statistics such as national income statistics, supply and use tables, and expenditure statistics from the Reserve Bank. The difference between I/O tables and SAMs is that I/O tables capture less information, whereas SAMs capture the full circular flow with much more detail incorporated in the value-added and household sub-matrix to analyse the issue related to household consumption, labour and human capital, social welfare and social institutions (Round, 2003). As stated by Round (2003), SAMs help to combine information from various sources of the economy and therefore highlights the need for information on the data. SAMs also enable the identification of errors or missing economic data.

Round (2003) stated that it is imperative to note that a SAM is not a model. It is a tool that can be used to direct or instruct policy-making (McDonald & Punt, 2005), if it is produced properly with the important information on the data obtained. It gives important information about the structure of production and dissemination of income in an economy (Miller & Blair, 2009). Sen (1996) attests that a SAM-based model is a technique that can be used to examine both distribution and growth issues in the analytical framework of the economy.

These models which use a SAM as database include various models such as models that allow for relative price changes (Computable General Equilibrium models (CGE)) and those models that assume fixed relative prices (multiplier models) (McDonald & Punt, 2005). Of these two models, CGE models are recommended as the preponderant framework, because they incorporate a set of simultaneous equations. Various equations are available to include in the models, to represent the behaviour of agents in the economy (Lofgren *et al*., 2002). CGE models are often used to determine the impact of policy changes in the economy, which are modelled by introducing exogenous shocks (McDonald & Punt, 2005). The importance of CGE models, as stated by Punt (2013), is to analyse different macro-economic issues because of the inclusion of factor markets, government accounts and macro-balances. Moreover, the advantages of a CGE model, compared to other models, lie in a solid microeconomic

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foundation and include many aspects of economic theory. These theories are cost minimization and utility maximization and portray assumptions about how the economy is assumed to operate. This study will not be appropriate for a CGE model, but a SAM multiplier model will be suitable for agricultural contribution to economic growth and development in rural Limpopo. The SAM based multiplier analysis is important to estimate the impact of shocks in the economy for disparate households income groups.

Table 1 indicates the outline of the interaction of economic agents from Lofgren *et al.* (2002, cited by Taljaard *et al.*, 2008) which explained the SAM concept and idea of the economic systems. The adapted SAM shows all the expenses and income received from various sectors of the economy. Therefore, the activities account generates income from production of commodities. Some of the income is distributed to government in the form of net indirect tax. Activities distribute some of the income to factors of production in the form of value added. The commodity account records production by industries and the value of sales taxes and tariffs paid to government. The commodity account records income from households and government in the form of consumption. The capital account records purchase of commodities in the form of investment.

The industry account indicates all the transactions made by productive industries in the economy and shows information about value added within the economy. The column sums show the total inputs into productive industries (McDonald & Punt, 2005). The industries' row account identifies products produced by each industry in the so-called make matrix, which captures domestic production. The sum of the domestic supply is imported and domestically produced goods (Provide, 2003).

Payments to factors of production constitute GDP. The payment made to the rest of South Africa (ROS) and rest of the world (ROW) is typically capital transfers. Household owns all labour services. All the payments made by factors of production are distributed to various households as labour income, and gross operating surplus, as well as to enterprises. The factor incomes are received through domestic activities or transfers from the ROS and ROW. The usefulness of disaggregation of the factor account in a detailed SAM is crucial in terms of assessing the income distribution effect of policy changes on various household categories (McDonald & Punt, 2005).

Households receive income from different sources. The main sources of income are wages and returns to capital. It shows that households are the owners of factors of production,

foreign or domestic. Other sources of income are from enterprises, government and inter-household transfers (McDonald & Punt, 2005). Households make payments to government in the form of direct taxes and household savings are captured in the capital row account. Enterprises receive income from factors of production and government, and distribute some of their incomes to households, government, savings and to the ROW.

The capital account records savings and investment. The capital account receives the portion of their incomes from various sources such as household, enterprises and government. These incomes are captured in the row of the capital account. All these incomes constitute savings. The balance of payments on the capital account comprises of the surplus/deficit, indicating that balance of payments should be considered during policy changes. The column of the capital account records the investment expenditure (McDonald & Punt, 2005).

The ROS and ROW accounts record exports in the columns and imports in the rows. The columns of the ROS and ROW accounts indicate the foreign exchange inflow and the rows of the ROS and ROW account show the foreign exchange outflow. Product export goods are captured in the column and generate income within the country. Product import goods are captured in the row and implies a transfer of income abroad.

Table 1: Transaction-Interaction of Economic Agents

Expenditures/ receipts	Products	Industries	Factors of production	Households	Enterprises	Government	Capital	ROW	Total
Products		Use matrix		Private consumption		Government consumption	Investment	Exports	Products Demand
Industries	Make matrix								Industries income
Factors of production		Value added						Factors income form Row	Factors income
Households			Factors income to households	Inter-household transfers	Transfer to household	Transfer to household		Transfer to household from Row	Household income
Enterprises			Factors income to enterprises			Transfer to enterprise		Transfer to enterprise from Row	Enterprise income
Government	Sales taxes, tariff, export taxes	Indirect taxes, factor use taxes	Factors income to government, factors taxes	Transfer to government, direct household taxes	Transfer to government, direct enterprise			Transfer government from Row	Government income
Capital				Household savings	Enterprise savings	Government savings		Balance of payment	Savings
Row	Imports		Factors income to Row		Transfer to the Row	Government transfer to Row			Foreign exchange outflow
Total	Product Supply	Industry inputs	Factor expenditure	Household expenditure	Enterprise expenditure	Government expenditure	Investment	Foreign exchange inflow	

Source: Adapted from Lofgren *et al.* (2002, cited by Taljaard *et al*., 2008)

2.5.3.   Impact analysis

Impact analysis is a way of empirically estimating the impact of exogenous change/shock on certain industries or sectors on the economy (Miller & Blair, 2009). The importance of this impact analysis is to assist the policy makers on how a particular industry will perform over time so that planning can be done in advance. Moreover, the impact analysis provides the government with the necessary information as to how much income, employment and taxes a specific industry could generate from, or lose to, the economy (Taljaard *et al*., 2008). An increase or decrease in the shock can be simulated.

It should be noted that the consistency of the impact analysis will depended on the correctness of the Leontief inverse and final demand (Miller and Blair, 2009).

Methods of impact analysis mentioned by Hussain *et al*. (2003) include estimation of multipliers and forward and backward linkages.

2.5.4. Multiplier analysis

A multiplier is a mathematical ratio of direct, indirect and induced effect (Hussain *et al*., 2003). The importance of multipliers is to determine which sectors in the economy have the greatest effect on economic activities and which sectors have the least effect. A multiplier can be used on the micro- or macro level. Multipliers at micro level focus on the regional economy, and at macro level, on the national economy (Miller and Blair, 2009). In this study the multiplier obtained for the analysis will contribute information that will assist in producing an efficacious strategy for stimulating economic growth in Limpopo and to resolve the constraints of poverty facing the province.

Several SAM multipliers are calculated for the economy of Limpopo. The output multiplier, under the assumption of constant returns to scale, is defined "as the change in gross output resulting from a unit change in final demand in a given sector." (Makallah, 2007: 2). Income multipliers "measure the total effect of a unit change in income of a particular household type on the incomes of all household in the economy" (Bahta, 2013: 53). According to Miller and Blair (2009: 256) the value added multiplier captures the additional value added by industries due to additional production as a result of a unit change in final demand in a given sector.

2.5.5. Linkages

The inter-dependence of sectoral linkages shows connectedness of the sectors of the economy. The benefits of the linkages reveal the quality that growth in one sector could

contribute to another sector as well as overall growth (Suryahadi *et al*., 2006). When a particular sector sells its output and it is used as an input by another sector, it is referred to as production linkages (Diao *et al.*, 2007). Production linkages comprises of two linkages: backward and forward. These two linkages reveal the performance of the production sectors in the economy. Backward linkages result when a certain sector used inputs supplied by other sectors. Moreover, the industry may encourage investment in early stages of the value chain. Forward linkages result when one sector provides certain inputs to other sectors. The industry may encourage investment in the later stages of the value chain (Miller & Blair, 2009). The importance of using the linkages in the unbalanced growth for the developing economic sectors was stated by Hirschman (1958).

Freytag and Fricke (2015) emphasized that the theoretical background of the inter-industrial linkages analysis is most focused on the role of backward linkages as growth stimuli. The authors then argued that the existence of forward linkages cannot be revealed in pure form since they are a product of demand originally from the existing backward linkage.

It should be noted that, linkages and multipliers use the same methods of calculation. Both use either the Leontief and Ghosh inverse matrices. From the Leontief inverse, output multipliers and backward linkage are obtained. On the other hand, the Ghosh inverse determine forward linkages. Therefore, the only difference is the interpretation of linkages, because both backward and forward linkages can be normalized to power and sensitivity of dispersion indices respectively. The sectors with index values greater than one are recommended to be strong sectors whereas the sectors with less than one are considered weak sectors in the economy. The highest backward and forward linkages can be considered as leading sectors in the economy (Hirschman, 1958). The leading sectors are considered for economic development since investment in those sectors yield larger overall economic effects (Miller & Blair, 2009). The inter-sectoral linkages of the agricultural sector is of particular interest to determine its role in the economy.

Moreover, the work of linkages was initiated by Rasmussen (1958), and Chenery and Wanabe (1958). The aforementioned authors gave a clear concept of measuring linkages for standard I/O analysis (Miller & Blair, 2009).

2.6.   Theory review on impact studies of I/O and SAM based models

Meliko and Oni (2010) analysed agriculture's contribution to the economy with reference to Limpopo I/O tables by estimating output, income and employment multipliers. Meliko and

Oni (2010) found that agriculture ranked last for the output and income multipliers and second last for the employment multipliers. Trade services were found to be ranked higher amongst other sectors for output, income and employment multiplier. Despite the fact that most of the people in the province are low income earners and depended on agriculture for daily consumption, such investment in agricultural sectors might be useful for output and income multipliers, for the case were employment was found to be much higher than for the mining sector. This is an indication that agriculture is not contributing significantly to the economic development and poverty reduction (Meliko & Oni, 2010). However, the difference between the current study and their study is that they used an input-output table with fairly aggregated sectors, while the current study will add the more natural extension of a SAM with greater disaggregation of the sectors. Agriculture will be disaggregated to different sectors to see where investment can lead to the greatest benefits. The accuracy of sub-sectors' levels of household consumption and value added are better recorded in a detailed SAM than an I/O table that uses a single household account (McDonald and Punt, 2005). Hence, a new application based on a SAM instead of an I/O table might be important in shedding light on the role of agriculture in economic growth and in resolving the constraints of poverty facing Limpopo.

Conningarth Economists (2015) studied the impact of the wine industry on the South African economy with reference to the Western Cape SAM. The study applied macro-economic modelling techniques for provincial and national SAMs for 2006, which was suitable for impact analysis. The study shows that the impact of the wine industry on economic growth plays a major role in the creation of employment to the manufacturing sector, as greater demand is placed on this sector of the wine producing sector. The manufacturing sector has a relatively high backward linkage compared to other sectors as more preparation is done in terms of packaging and the distribution of wine to the consumers. The agricultural sector in terms of the creation of employment was notable. This is attributed to more labour intensive practices in terms of the value chain components from the farm level. The results show the local consumption of red wine deteriorated and resulted in a reduction in producers' prices. The white wine performance on exports shows positivity. It was found that an additional investment in the wine industry is more effective to stimulate the economic growth and reduce unemployment in Western Cape, Gauteng, KwaZulu-Natal, Eastern Cape, and the Northern Cape. However, the impact of wine industry on South Africa did not contribute enough growth in Limpopo because wine is produced in the Western Cape and consumption

in Limpopo is meagre (Conningarth Economists, 2015). This concludes that a more effective strategy has to be implemented to find the key sector that will contribute to stimulate the economy's growth, and alleviate poverty in Limpopo.

Van der Merwe *et al*. (2014) studied the economic impact of hunting for three provinces (Limpopo, the Northern Cape and the Free State) in South Africa. The technique that was used was economic multipliers, I/O analysis and related modelling process via I/O tables and SAMs. The results revealed that hunting in the Free State does not make a useful economic impact, while in the Northern Cape and Limpopo it does contribute to economic growth. The manufacturing sector in Limpopo was found to have the highest backward linkage. The Northern Cape was found to stimulate more growth through backward linkages of agricultural sectors. The Free State stimulates more growth via the manufacturing sector through backward linkages The study shows the reason the Free State does not seem to contribute enough to hunting is because information was unavailable in terms of tourism's contribution to hunting in the province. The province could in fact, have contributed more than is reported (Van der Merwe *et al*., 2014). The economic impact in Limpopo and the Northern Cape was seen to be important to reduce unemployment and stimulate growth. The hunting industry had a noticeable impact on the economy of Limpopo and the Northern Cape. Therefore, the study discovered that the geographical location has significant influence on game farms. However, the study could not identify how other sectors could play an important role in the economy any better than wildlife in terms of economic growth.

Cloete and Rossouw (2014) studied the South African wildlife ranching sector by using the SAM Leontief multiplier analysis. The results revealed that wildlife ranching can be more beneficial to the economy in term of employment and poverty alleviation when compared to the livestock sector that shares the same natural resources. Although the contribution of wildlife to GDP is small, it possesses a relatively large potential contribution as indicated by the multiplier effect. Therefore, an additional one million Rand of investment in wildlife ranching will lead to a notable change in the economy. However, the study focuses on the comparison between wildlife ranching and livestock. The study could not identify how other sectors could play an important role in the economy any better than wildlife ranching in terms of creating employment and income distribution level.

2.7. Conclusion

This chapter focused on theories of agriculture's contribution to economic growth and development. Section 2.2 discussed the theories on sectoral development and growth. Based on Lewis' theories and the Harrod Domar model, these theories focus more on poverty alleviation as well as increasing economic growth in the agricultural sector. Their theories apply mostly to rural areas where the majority of the poor depend on agriculture for their survival. According to the Harrod-Domar model, the only way to increase economic growth is through saving. However, the main limitation of the theory is that it does not take into account the low level of capital of the poorest people in rural areas. Lewis' theories focus on the modern industrial sector as a way to increase economic growth. Section 2.3 presented the theories on the role of investment in agricultural development. In the study conducted in India, it was discovered that investment in the introduction of bio-technology increases agricultural production, reduces prices and stimulates economic growth. Investment in roads, electricity supplies, water and storage facilities were recommended to be important for farmers to become more productive. Education and skills were the big issues for small-holders to adopt new methods of farming. Section 2.4 presented factor constraints for agricultural economic growth and development. Lack of access to agricultural credit is perceived to be the biggest problem facing small-holder farmers. Therefore, the majority of farmers are illiterate and poor, causing them not to have access to finance or being unable to access finance from financial institutions, because they do not have collateral and/or high deposit accounts. Section 2.5 discusses the theory of the macroeconomic methodological framework. From the theory of the macro-economic methodological framework it is clear that the field of modelling in macro-economic is very broad and well-researched field. Moreover, considering the discussed theory there are advantages to be derived using Limpopo SAM instead of an I/O table for the purpose of macroeconomic analysis. A major advantage is that more information will be generated by the proposed multiplier analysis.

The next chapter will show the background information of Limpopo and the performance of each industry in the economy.

3. CHAPTER 3: BACKGROUND INFORMATION

3.1. Introduction

Chapter 3 reports the historical information about the economic performance in Limpopo and specifically on regional level. The researcher used the different sources to analyse the Limpopo economy. The sources that are mainly used are data from Statistic South Africa for different years. 10.4% of the national population is found in Limpopo with the surface area of 10% (125 754km^2). The province is situated furthest north of South Africa's nine provinces and was previously called the Northern Province. The province has five district municipalities: Vhembe, Mopani, Sekhukhune, Capricorn and Waterberg (Provide, 2005). The capital city of the province is Polokwane, previously called Pietersburg. The capital city is situated 300km from the main market destination of Johannesburg and Pretoria in Gauteng Province, and 200km to the Beit bridge border of Zimbabwe.

Section 3.2 focuses on the demographics. Therefore, a short report of the racial composition of Limpopo is presented, and followed by poverty indicators for the different provinces. Section 3.3 focuses on the economic sectors in Limpopo. A brief report on various industries such as primary, secondary and tertiary industries, is given. The primary industries include agricultural sectors and mining sectors. The agricultural sub-sectors such as field crops, vegetables, fruit, livestock and game are reported. The secondary industries include manufacturing sectors, water and electricity, and building and construction. The tertiary industries include trade, accommodation, and transport, storage, communication, insurance and business services. Section 3.4 focuses on policy-implementation by the government. A short discussion of a strategic plan for South African Agriculture is followed by a discussion of a provincial growth and development strategy and a discussion of the financial scheme established by the Government of South Africa. A brief summary is presented at the end of the chapter.

3.2. Demographics

Table 2 indicates the shares of population groups in Limpopo for different districts according to the 2011 Census (StatsSA, 2014a). The Black population records the highest number of people living in Limpopo for all five districts. 98.58% of the population of Sekhukhune are Black, followed by the white population being the second highest. In the Waterberg district, the white population accounts for 7.56%. The Coloured population account for approximately

0.5% of the population in both Capricorn and Waterberg. The highest population of Indians/Asians and other population groups live in Waterberg district with 0.43% and 0.27% respectively.

Table 2: Racial Composition of Limpopo

	Vhembe	Mopani	Capricorn	Waterberg	Sekhukhune
Black	98.22%	97.00%	96.07%	91.25%	98.58%
Coloured	0.15%	0.16%	0.50%	0.49%	0.11%
Indians/Asians	0.41%	0.25%	0.41%	0.43%	0.16%
White	1.13%	2.46%	2.81%	7.56%	1.02%
Other	0.10%	0.12%	0.21%	0.27%	0.12%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

Source: 2011 Census (StatsSA, 2014a)

Poverty can be expressed in relative and absolute terms. In terms of relative poverty, a line can be drawn between poor and non-poor taking into consideration relative income to overall income distribution, or average value (Todaro and Smith, 2015). Relative poverty may differ from nation to nation. A person classified as poor in England may be defined as non-poor in South Africa. On the other hand, absolute poverty is when people cannot afford a basic basket of goods for material survival. Absolute poverty can be expressed as the level of minimum income needed to satisfy the basic human needs of shelter, food and clothing in order to continue to survive. The absolute poverty approach is predominately used rather than the relative property approach. This is mainly because of the high level of inequality between the low income population and middle income population. This measure is recommended in providing important information that will be used for poverty alleviation (Todaro and Smith, 2015). The poverty line remains constant in real terms so that we can chart our progress on an absolute level over time. The poverty gap is defined as a level of income necessary to raise the income of everyone who fall below the poverty line up to the poverty line. The poverty headcount ratio is the share of the population living below the national poverty line. The poverty severity index is similar to poverty gap; it builds on poverty gap measures and squares the distance to the poverty line. This index tries to capture how deep the poverty is and how difficult it will be to get out of poverty. Moreover, the measure of the poverty severity index captures the weight of the poorest of the poor in a particular area. For example, if an area in Limpopo has a high poverty severity index, it indicates that a sizable proportion

of the population in Limpopo is very poor and taking them out poverty would demand extra efforts or strategy.

Table 3 provides poverty indicators by province in South Africa. In 2011 approximately 45.5% of the country's population are living below the food poverty line of R321 per person per month. Five provinces in South Africa experienced the worst poverty. Limpopo experiences the worst poverty headcount ratio of 63.8%, followed by the Eastern Cape (60.8%), KwaZulu-Natal (56.6%), Mpumalanga (52.2%) and North-West (50.5%). Gauteng and the Western Cape residents are in the minority with a poverty headcount ratio of 22.9% and 24.7% respectively.

Table 3: Poverty Indicators by Province in 2011

Province	2011 Food poverty line (R321)		
	Poverty headcount ratio	Poverty gap	Poverty severity index
Eastern Cape	60.8	27.2	15.3
Free State	41.2	17.5	9.3
Gauteng	22.9	8.1	4.1
Limpopo	63.8	30.0	17.3
Mpumalanga	52.1	21.7	11.5
Northern Cape	46.8	19.1	9.9
North West	50.5	16.2	12.6
KwaZulu-Natal	56.6	25.5	14.4
Western Cape	24.7	8.5	3.9
South Africa	45.5	19.6	10.8

Source: StatsSA (2014b)

3.3. Economic sectors

3.3.1. Economic performance of Limpopo

The GDP at the market prices for Limpopo was R271 522 million in 2014, making Limpopo the 6th highest contributor towards the national GDP with 7.2% (StatsSA, 2015a). In 2014, the GDP growth rate of Limpopo was 0.8%, which is lower compared to the real GDP growth rate of 2.4% in 2013.

In terms of Limpopo's GDP, as compared to South Africa's GDP, Limpopo GDP's growth rate (0.8%) remained slight lower than the South Africa GDP growth rate of 1.5% in 2014.

Figure 1: Real GDP Growth Rate of Limpopo (2005 – 2014)
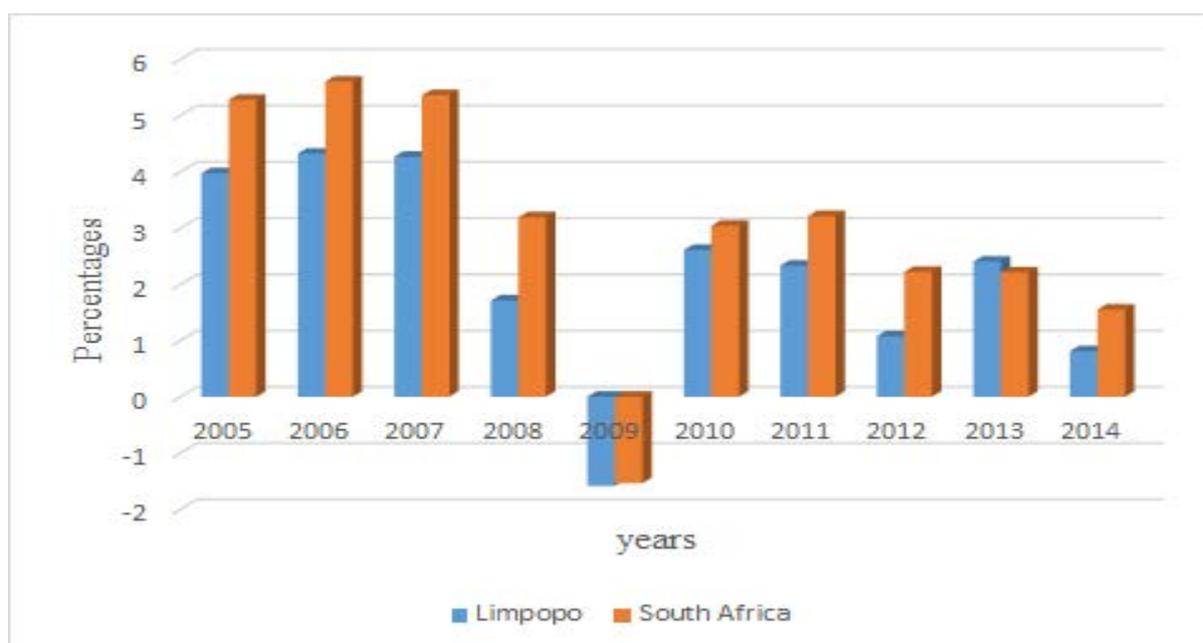
Source: StatsSA (2015a)

3.3.2. Industries' contribution to GDP in Limpopo

The contribution of the different economic industries to total GDP in Limpopo for the period 2005 till 2014 is indicated in Figure 2. The primary industries' contribution to the economy has been doing well from a minimum of 25% in 2005 to a maximum of 31% in 2008. Primary industries contributed significantly for four consecutive years from 2005 to 2008. However, the growth of the primary industries declined between years 2011 to 2014 (30% to 27%). The secondary industries started to show positive growth for three consecutive years from 2011 to 2013 (8 % to 9%). However, much is still needed to be done as the secondary industries contributed less compared to the primary industries. The tertiary industries are the biggest contributors to the provincial economy, with a maximum of 57% contributed in 2005 as compared to 52% in 2014.

Figure 2: Limpopo Sectoral Contribution to GDP (2005-2015)
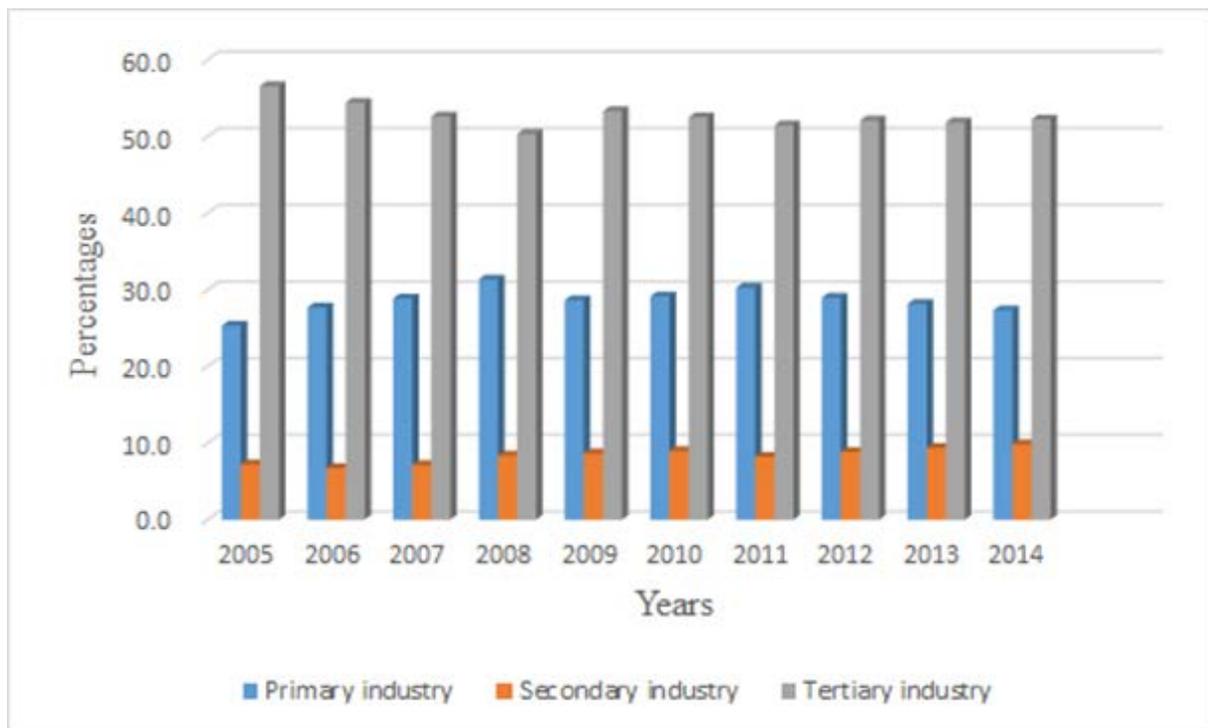
Source: StatsSA (2015a)

3.3.3. Primary industries

3.3.3.1.   *Agriculture and mining contribution to GDP*

Figure 3 indicates that primary sectors within the mining industry are making a significantly higher contribution compared to agriculture. The highest contributions for mining between 2005 and 2014 were in 2008 (28.1%) and 2011 (27.9%), while there was a decline in the economic contribution of mining from 2011 to 2014 (27.9% to 25.1%). Mining remains the biggest contributing sector in the provincial economy. A lot of effort is needed to benefit minerals and obtain maximum output.

The agricultural sector's contribution to provincial GDP declined from 2008 to 2014 (3.2% to 2.2%). According to StatsSA (2015b), agricultural industries in the 3rd quarter of 2014 in Limpopo employed 111 000, compared to 145 000 in the 3rd quarter of 2015. In terms of mining in Limpopo, employment rose from 70 000 in the 3rd quarter of 2014 to 78 000 in the 3rd quarter of 2015. However, there was an increase in employment from the 2nd quarter of 2014 (69 000) to 2nd quarter of 2015 (81 000).

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Figure 3: Agriculture and Mining Contribution to GDP in Limpopo (2005-2014)
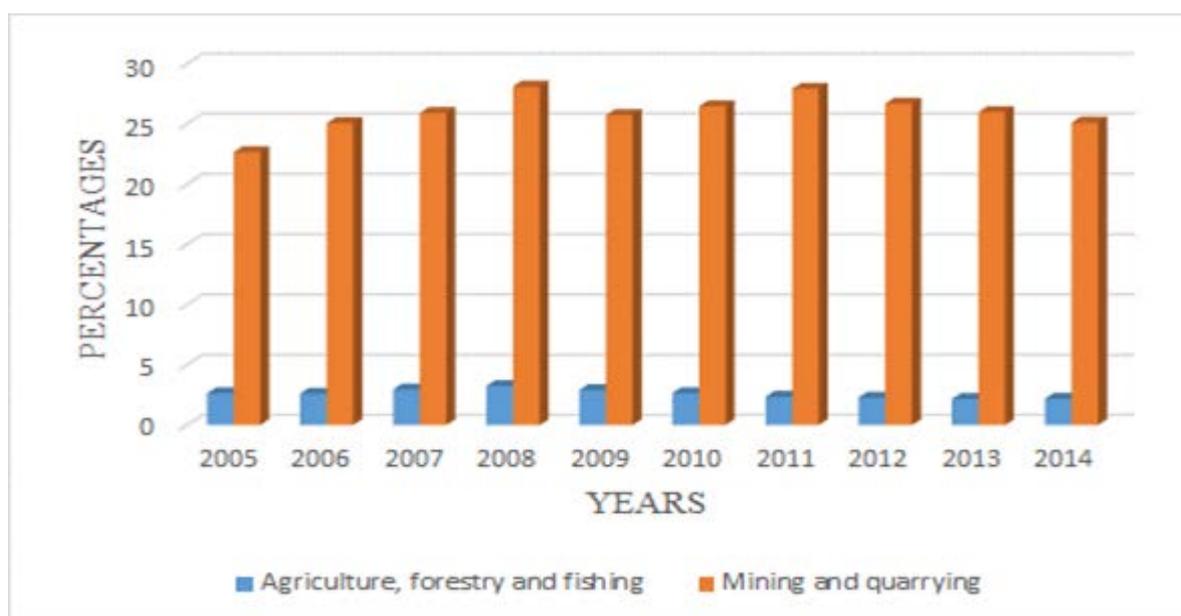
Source: StatsSA (2015a)

3.3.3.2. *Farm units and gross farm income per region*

Figure 4 shows the farm units and gross farm income for the province in 2002 and 2007. There were more farming units in Limpopo in 2007 than in 2002. The number of farm units rose from 2915 in 2002 to 2934 in 2007, whereas R5.7 billion was generated for nominal gross farm income in 2007 compared to R4.5 billion in 2002. After applying a PPI deflator, it was found that there was no notable increase in real gross farm income during this period.

Figure 4: Farming Units and Gross Farm Income for Limpopo (2002 and 2007)
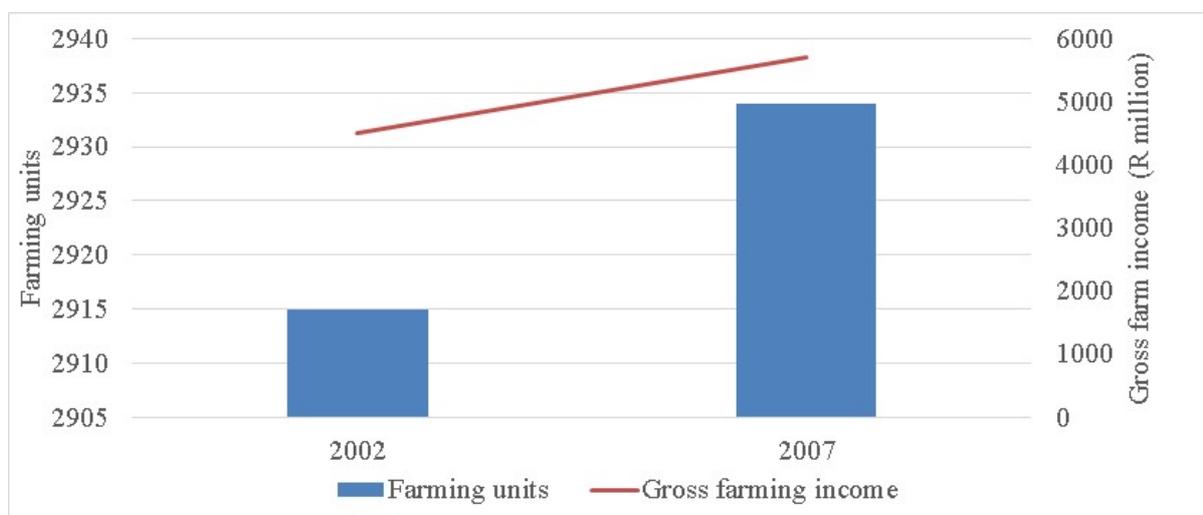
Source: 2002 and 2007 Census of Commercial Agriculture (StatsSA, 2006; StatsSA, 2011)

3.3.3.3.   Gross farm income by main division in Limpopo

Figure 5 indicates the gross farm income by main division in different districts. Waterberg generated the highest gross farm income for livestock (R715.1 million), field crops (R293.6 million) and game (R101.6 million). The second leading district for livestock (R404 041), field crops (R22.4 million) and game (R17.7 million) was Capricorn district. Mopani district recorded the highest income generation for vegetables (R535.6 million) and fruit (R509.8 million).

Figure 5: Gross Farm Income by Main Division in Limpopo (2007)
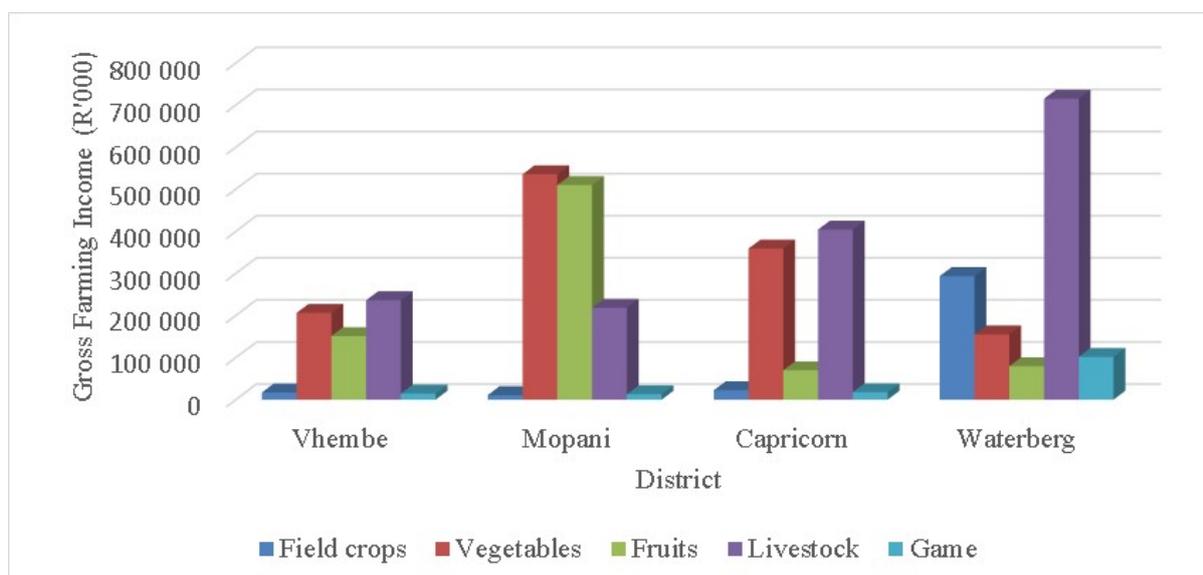
Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

3.3.3.4.   Field crops production and gross farm income in Limpopo

Figure 6 indicates the selected field crops in the regional district of Limpopo. Waterberg district produces the most arable crops of which maize contributes the highest physical output (metric tonnes) followed by wheat and sunflower. Other districts where maize and wheat contribute a major part are Capricorn followed by Mopani and Vhembe with the least.

Figure 6: Regional Production of Selected Field Crop Products
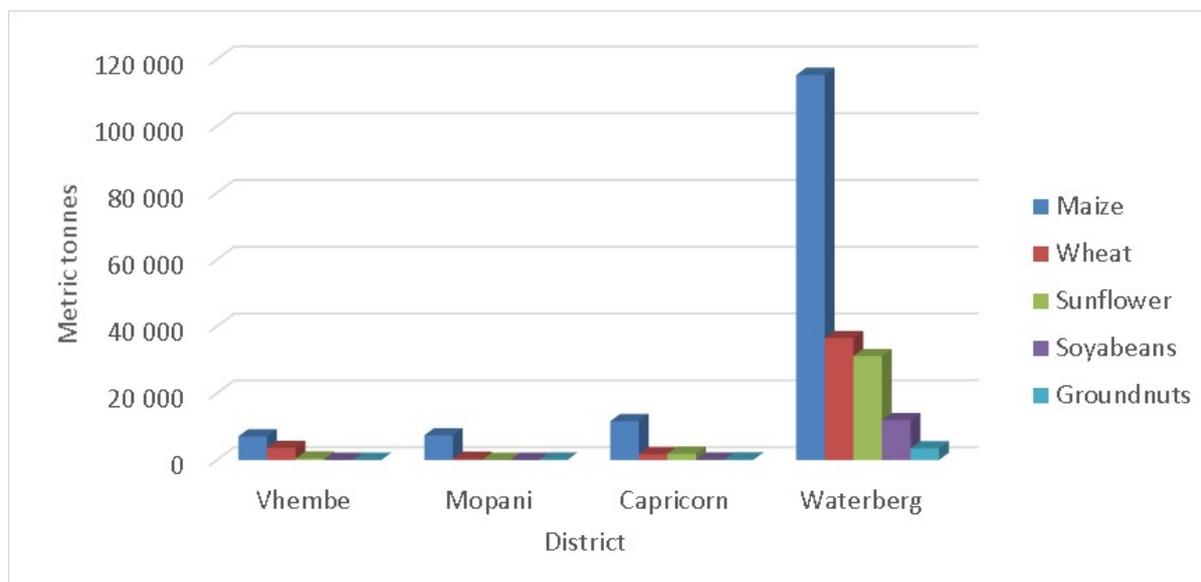
Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

Figure 7 reports the gross farming income for the selected field crops in Limpopo. Waterberg generated the highest gross farm income for maize (R134.7 million) followed by sunflower (R69.7 million) and wheat (R57.1 million).

Figure 7: Regional Gross Farming Income for Field Crops
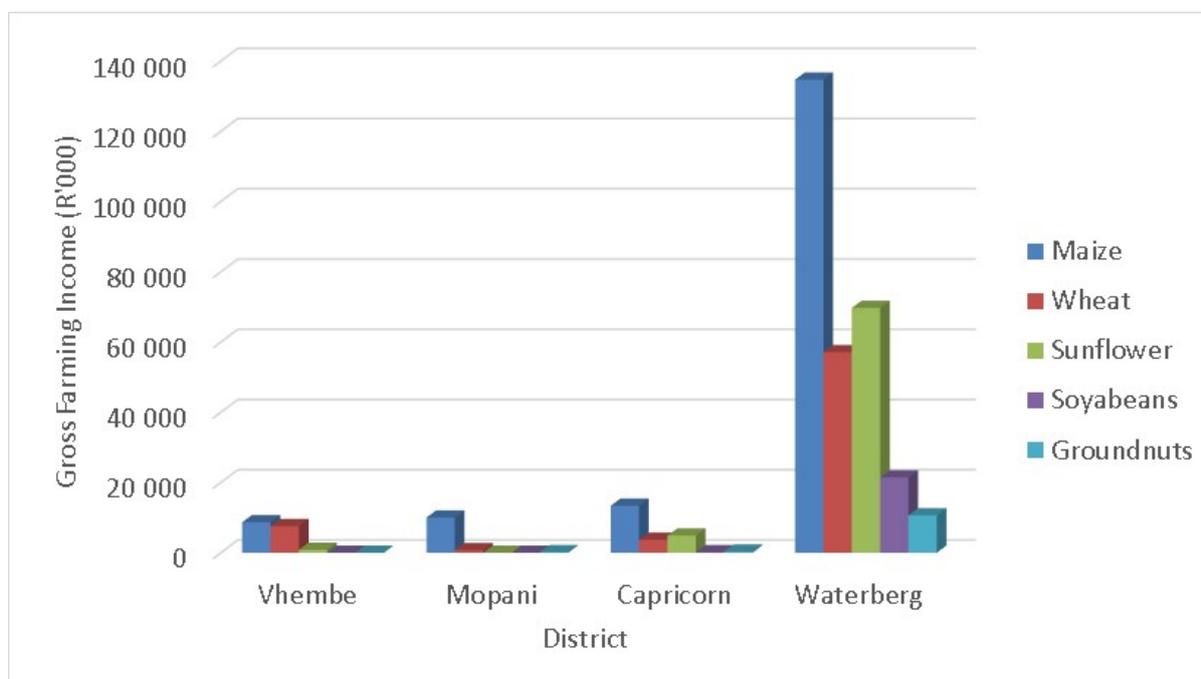
Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

3.3.3.5.   Vegetables production and gross farming income

Figure 8 indicates that tomatoes are mainly produced in Mopani (193 592 tonnes), while Capricorn district is the main producer of potatoes (157 195 tonnes), onions (18 478 tonnes) and pumpkins (16 646 tonnes). Other districts such as Vhembe mainly produce potatoes followed by tomatoes, onions and pumpkins being the least. In terms of physical output (metric tonnes) the Waterberg district mainly produced potatoes followed pumpkins, onions and tomatoes.

Figure 8: Regional Production of Selected Vegetable Products
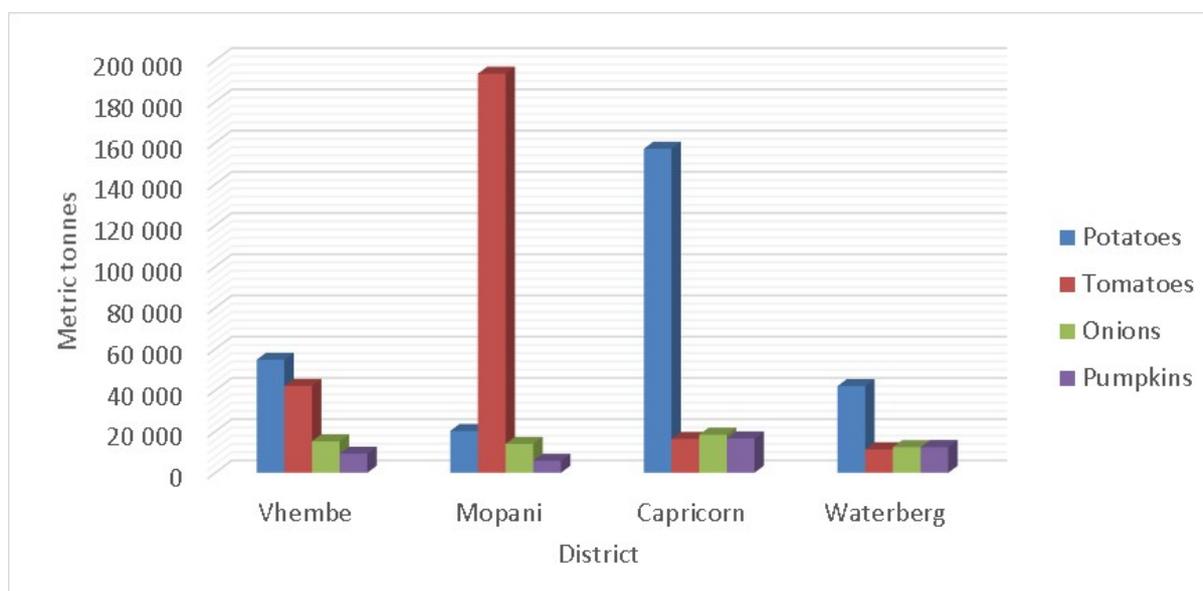
 Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

Figure 9 indicates that tomatoes generated the largest gross farming income of R479.4 million in Mopani district, followed by potatoes (R33.5 million), onions (R15.3 million) and pumpkins (R7.4 million). R270.8 million worth of potatoes was generated in Capricorn district, followed by tomatoes (R43.5 million), onions (R25.4 million) and pumpkin (R19.4 million). Other regions such as Vhembe mainly generated income from potatoes (R105.2 million), followed by tomatoes (R69.9 million).

Figure 9: Regional Gross Faming Income for Vegetables
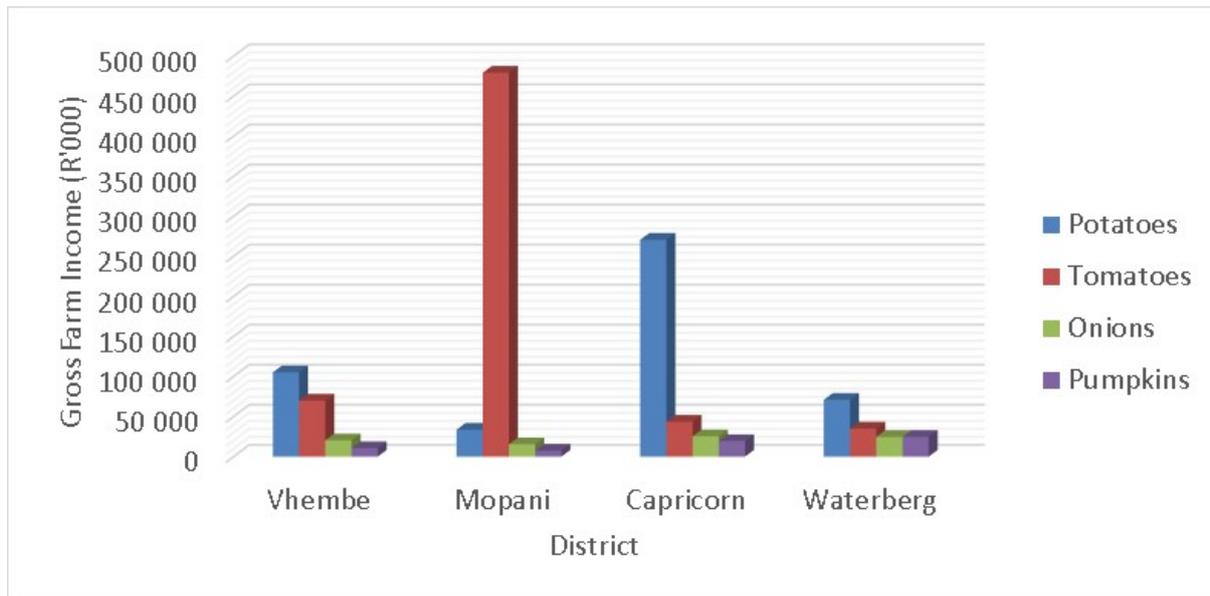
Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

3.3.3.6.   *Fruit production and gross farming income*

Figure 10 indicates that in terms of physical output (metric tonnes) oranges and bananas are mainly produced in the Mopani district (280 818 tonnes, 26 074 tonnes respectively), followed by Vhembe district (110 073 tonnes, 11 453 tonnes), Waterberg district (45 231 tonnes of oranges) and Capricorn district (30 542 tonnes, 1 965 tonnes).

Figure 10: Regional Production of Selected Fruit Products
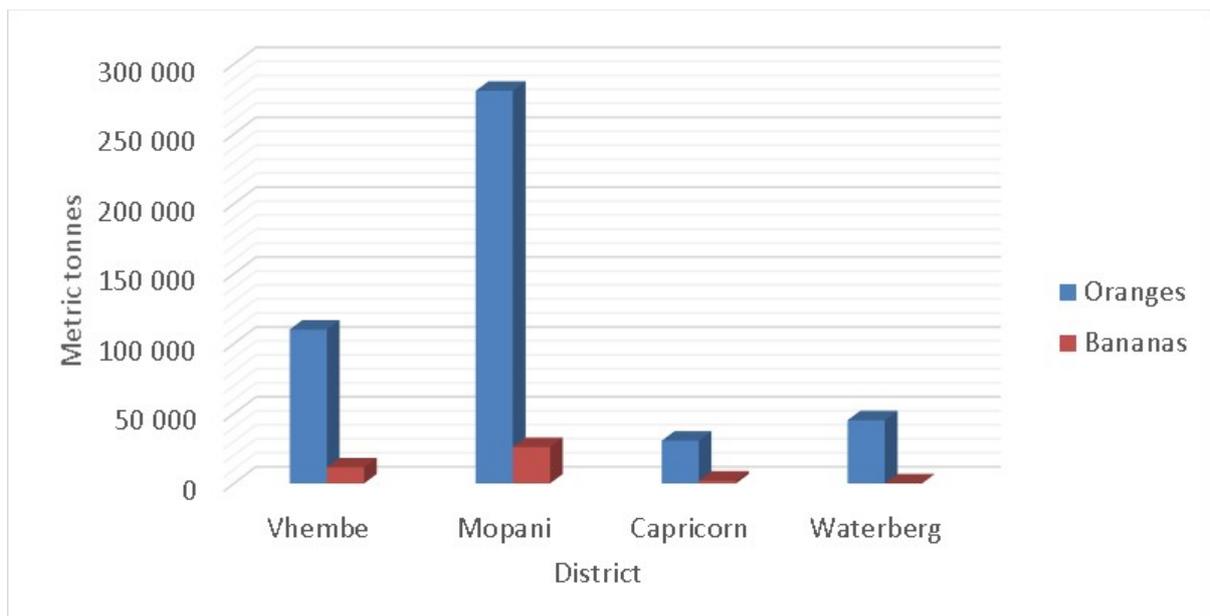
Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

Figure 11 indicates oranges and bananas generated the largest gross farming income of R448.9 million and R60.98 million respectively in Mopani district, followed by Vhembe district (R125.6 million and R25.5 million), Waterberg district (R79.4 million for oranges) and Capricorn district (R59.3 million and R10.6 million).

Figure 11: Regional Gross Farming Income for Fruit
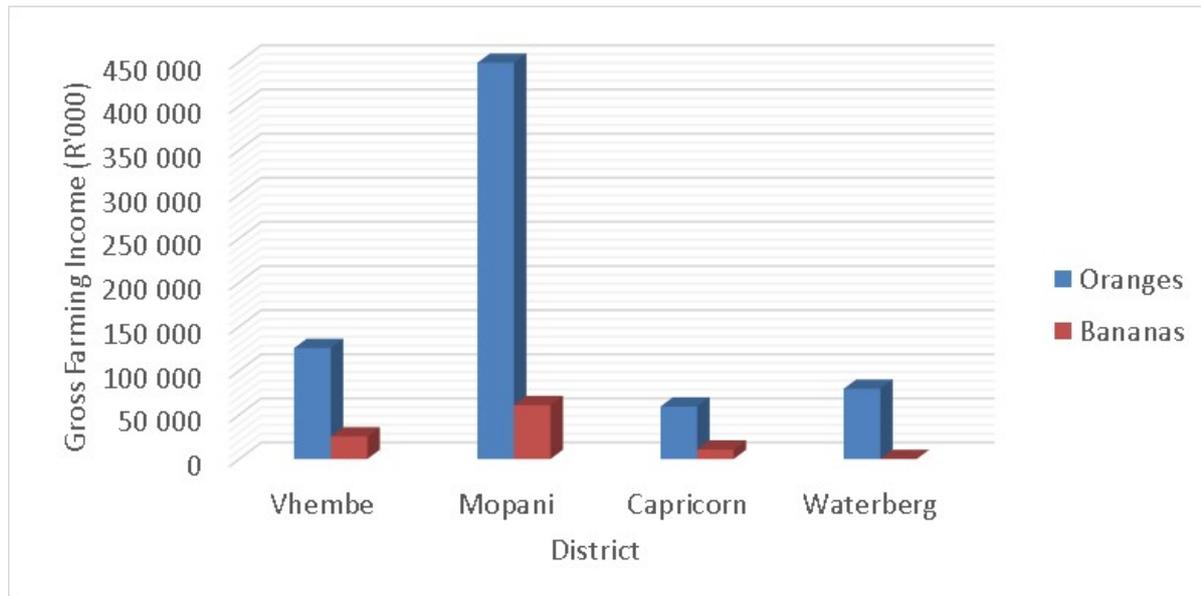
Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

3.3.3.7.   *Number of livestock products and gross farming income*

Figures 12 indicates that chickens are mainly produced in Waterberg district (47.63 million head) followed by Mopani district (4.05 million head)[1], Capricorn (607 849 head) and Vhembe (175 721 head). Pigs are mainly produced in Waterberg district (114 182 head) and Capricorn district (103 863 head). Cattle are mainly produced in Waterberg (99 302 head), Capricorn (48 436 head) and Vhembe (43 548 head).

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[1] Note that for improved visibility of the smaller categories, the maximum value of the vertical axis was set to 1 000 000 units, hence it does not capture the full length of the bars for chicken in Waterberg and Mopani.

Figure 12: Number of Livestock in the Districts
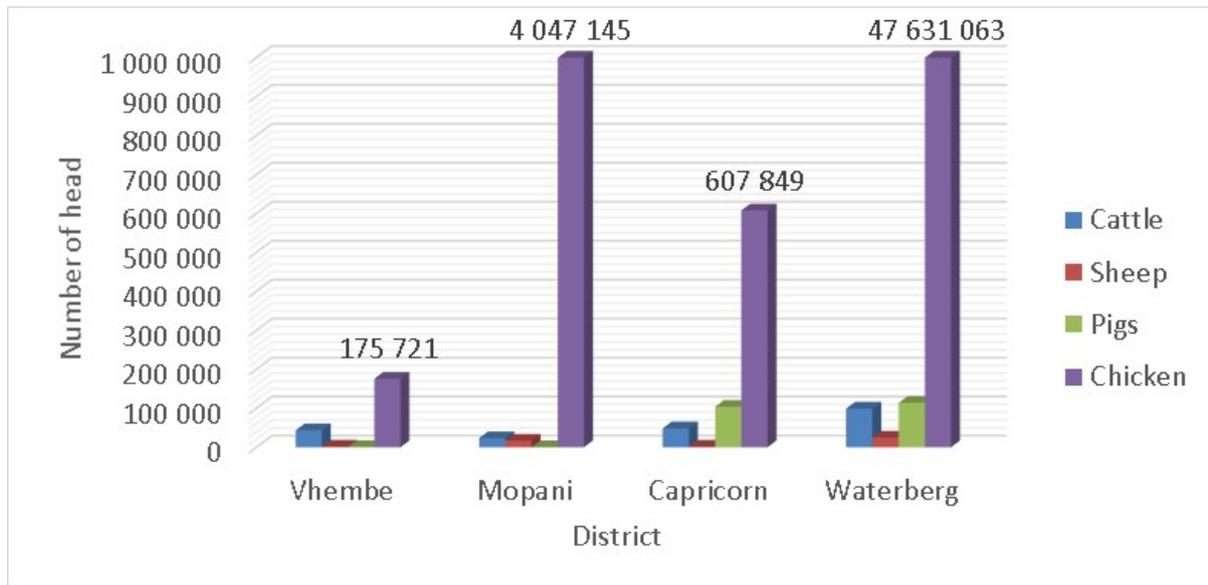
Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

Figure 13 indicates cattle and chickens generated the largest gross farming income of R404.1 million and R218.5 million respectively in the Waterberg district. Vhembe's largest income came from cattle (R232.4 million), whereas Capricorn district generated gross farming income mainly from cattle (R232.1 million) and chickens (R125.1 million) and Mopani mainly from chickens (R109.7 million) and cattle (R99.98 million).

Figure 13: Gross Farming Income of Livestock Products
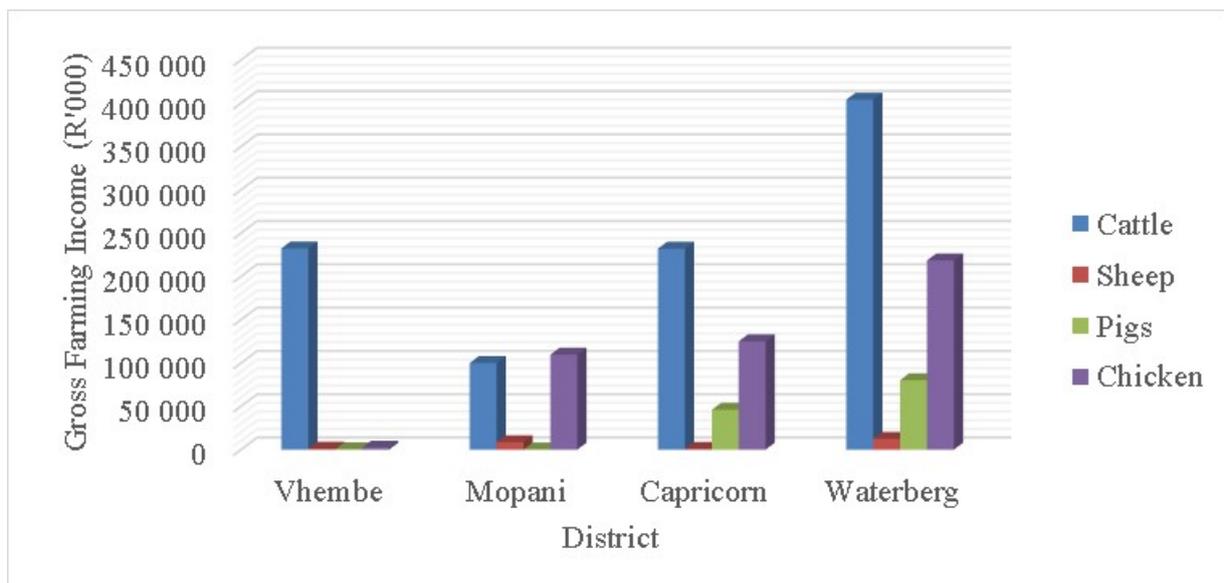
Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

3.3.3.8.   Game farm and gross farming income in Limpopo

Game farming is defined as suitable-fenced land with a variety of game species that can be used for meat production, hunting, or serve as an educational environment and which provide infrastructure for eco-tourism (Sebola, 2014). In South Africa game ranching started in the early and late 1960s with the separation of wild animals and domestic livestock. This was proposed because of the transmittable wildlife diseases that threaten the health of livestock and because of the fact that wildlife and domestic livestock also compete for grazing. It was proposed that for the modern agricultural production to achieve the desire results, game should be replaced with livestock (Rossouw & Cloete, 2014). In South Africa the game industry is important for rural tourism and serves as one of the main contributors for accommodation and hunting provision. Limpopo and the Northern Cape are the fastest growing economic sectors in South Africa. The industry rests on three pillars: hunting, eco-tourism and game trade. These pillars are predominantly driven by biltong and trophy hunting (Kamuti, 2014). There are about 9000 registered private game farms in South Africa and 6000 unregistered or in the process of being registered. The contribution of game farms is increasing whereas agricultural farming is deteriorating (Cloete *et al*., 2007). The game industry holds many economic and ecological advantages. These advantages have increased wildlife ranches in the country. The disadvantage for converting livestock production to game production is that it requires more financial assistance and quality infrastructure. Moreover, extensive knowledge and skills are needed to contain the possible threat of dangerous- and wild animals. The required knowledge and training will contribute to alleviate poverty and reduce unemployment.

Game in the districts of Limpopo is shown in Figure 14 which indicates that game is mainly owned in Waterberg district (31 379 head), followed by Vhembe (16 218 head), Capricorn (7 121 head) and Mopani (6 107 head).

Figure 14: Regional Game Farming
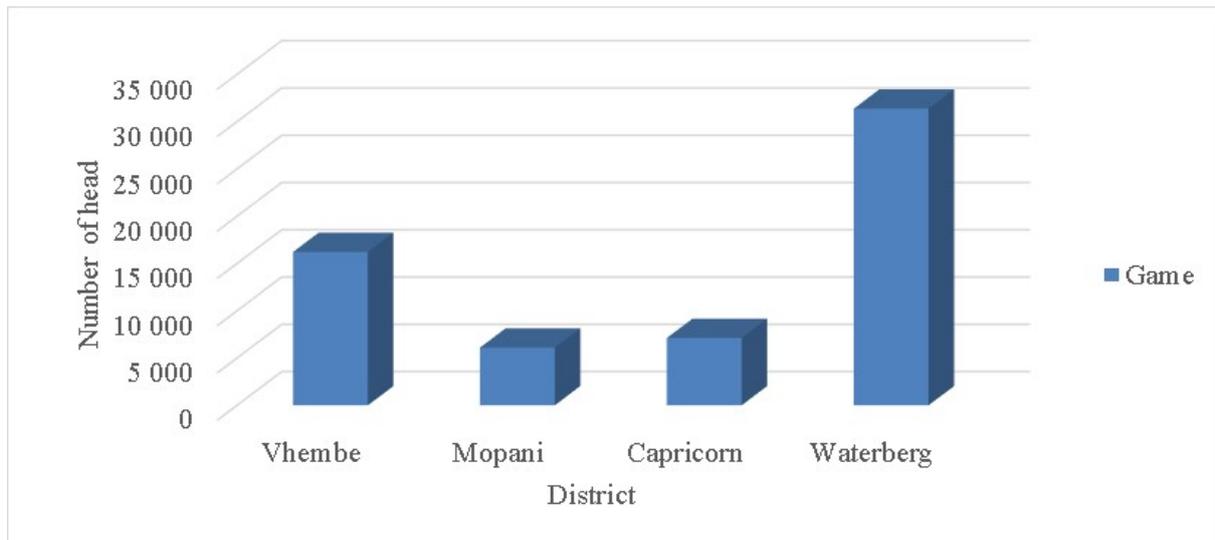
Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

Figure 15 indicates that Waterberg district generated the largest gross farming income of R101.6 million, followed by Capricorn (R17.69 million), Vhembe (R14.4 million) and Mopani (R12.9 million).

Figure 15: Gross Farming Income for Game Farming
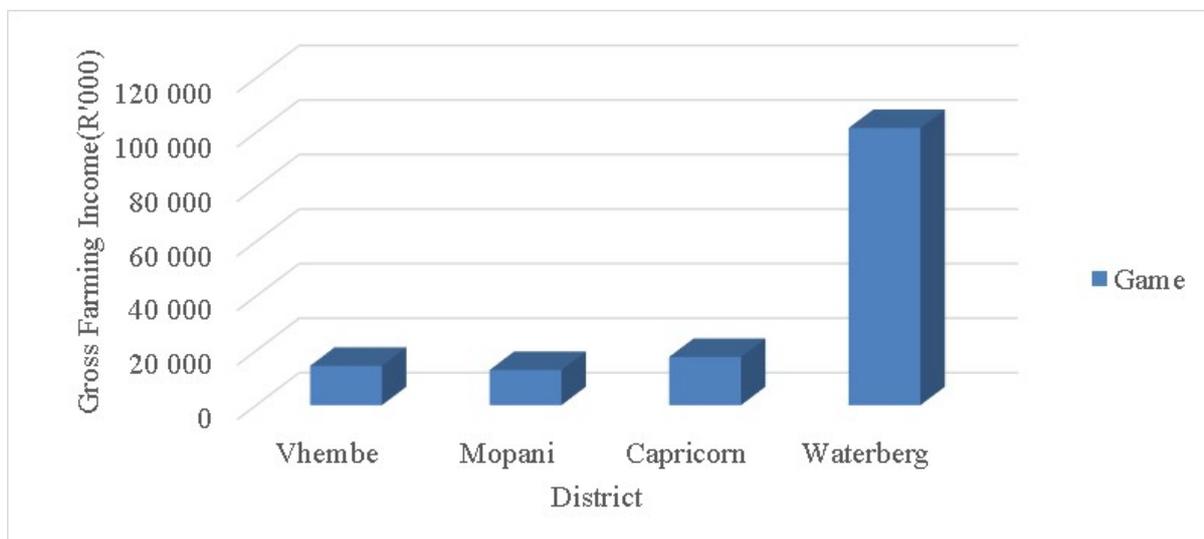
Source: 2007 Census of Commercial of Agriculture (StatsSA, 2011)

3.3.3.9. *The usefulness of skilled labour in agriculture growth*

The importance of labour in agricultural production should not be underestimated, because agricultural commodities cannot be produced without it (Mohr *et al*., 2008). The labour used

in the production of goods and services is in the form of physical and human effort. Human effort is rewarded in the form of money, for farm workers in the form of wages. The table below shows the sources of income for households in the study done on 138 irrigation smallholdings in Limpopo by Machete *et al.* (2004).

Table 4 states that 41% of the income of smallholder farmer households is generated through farming in the province. The wages and pension contribute around 45% of household income. Most of the income received by pensioners comes from the government. 59% of the total income is from non-farming sources.

Table 4: Various sources of income for households in Limpopo (2004)

Sources of income	Average monthly income	Share of total household income (%)
Farming	R545	41.0
Pension	R329	24.8
Wages	R258	19.4
Remittances	R165	12.4
Family business	R19	1.4
Other non-farm income	R13	1.0
Total	R1 329	100

Source: Machete *et al*. (2004)

3.3.4. Secondary industries

3.3.4.1. Manufacturing, electricity, gas & water and construction contribution

Figure 16 indicates that electricity, gas and water record a high contribution of 4.1% to provincial GDP in 2014 and, at its lowest, 1.9% in 2008. The manufacturing industry made the highest contribution of 3.3% in 2005 and the lowest contribution of 2.3% in 2013. The manufacturing industry's contribution has been diminishing since 2005, and this has become a serious concern to the industry as most of the strategies are focused on this industry to stimulate growth in the economy and create employment. The government still relies heavily on this industry for development and growth in the economy. In 2014, the construction industry contributed 2.9% compared to the highest contribution of 3.6% in 2009. This sector's contribution has shown some improvement from 2011 to 2014.

Figure 16: Manufacturing, Electricity, Gas & Water and Construction Contribution in Limpopo
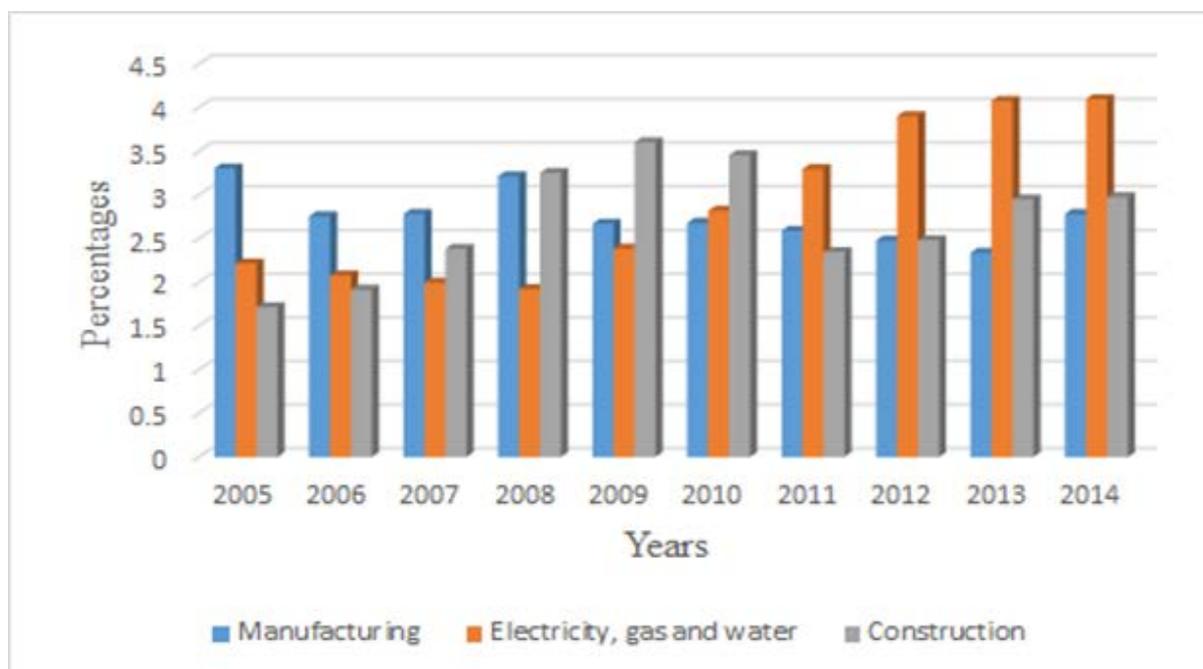
Source: StatsSA (2015a)

Limpopo province employed the highest number of people in the manufacturing and processing sector, i.e. 89 000 in the 2nd quarter of 2014, but it diminished to 73 000 in the 2nd quarter of 2015 (StatsSA, 2015b). In terms of utilities in Limpopo Province, employment rose from 7 000 in the 3rd quarter of 2014 to 15 000 in the 3rd quarter of 2015 (StatsSA, 2015b). Mostly this sector (utilities) focuses on gas and hot water, and supplying (collection, distribution and production) electricity. Construction employment rose from 107 000 in the 1st quarter of 2014 to 139 000 in the 1st quarter of 2015 (StatsSA, 2015b). Construction comprises of civil engineering, preparation of site building and installation.

3.3.5. Tertiary industries

3.3.5.1 Trade & accommodation and transport & communication

Figure 17 shows that the wholesale, retail and motor trade and accommodation industry has experienced the highest contribution of 14.2% in 2009 and, at the lowest, 11.1% in 2008. It remains a crucial sector of the provincial economy. There is a decline from 9.1% in 2005 to 4.7% in 2014 for the transport, storage and communication industry.

Figure 17: Trade & Accommodation and Transport & Communication
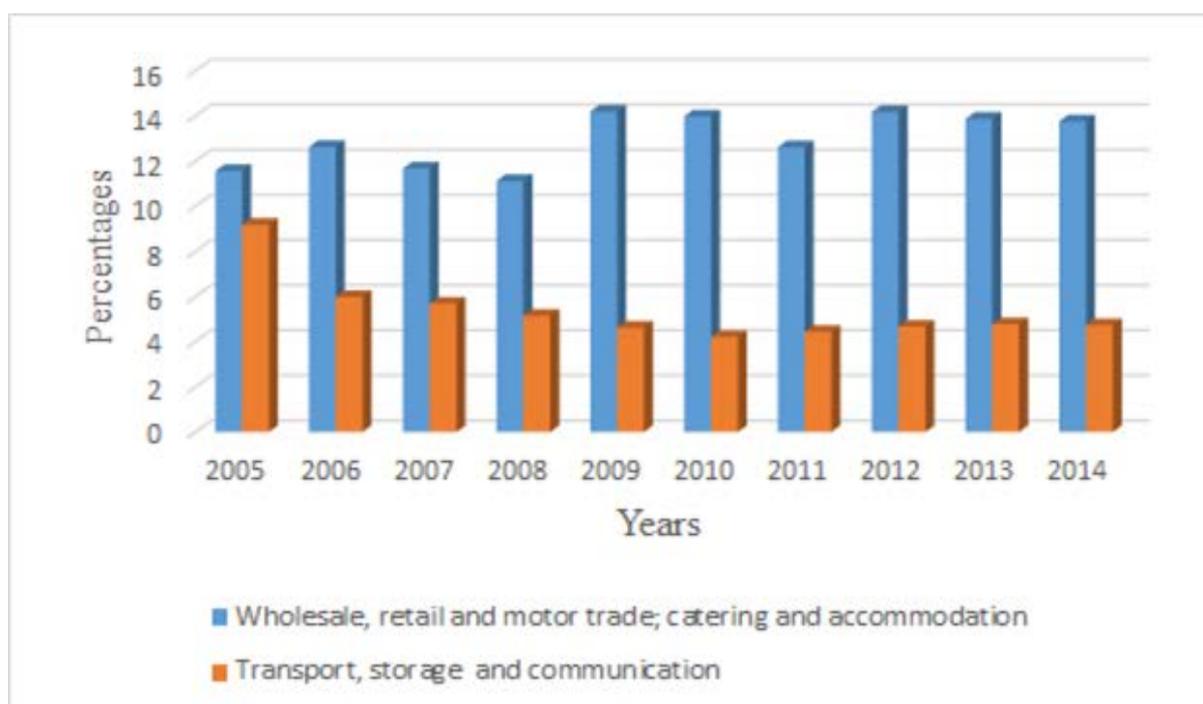
Source: StatsSA (2015a)

According to StatsSA (2015b), trade industries in the 3rd quarter of 2015 in Limpopo employed 296 000, which is a decline from 313 000 in the 3rd quarter of 2014. Transport and communication employed 60 000 of the workers in this sector for the 3rd quarter in 2015 as compared to 45 000 for the 3rd quarter in 2014. This sector comprises of water, land, railway and pipeline, and air transport services.

3.3.5.2. Financial, Personal and Government Services

Figure 18 shows that general government services are the biggest contributor to the tertiary sector. The sector contributed 17.8% in 2014 compared to the contribution made by financial and personal services of 12.0% and 3.9% respectively. The fact that government service is one of the greatest contributors to the provincial economy is unhealthy because an economy underpinned by consumption compared to an economy underpinned by production is not advisable.

Figure 18: Finance, Personal and Government Services
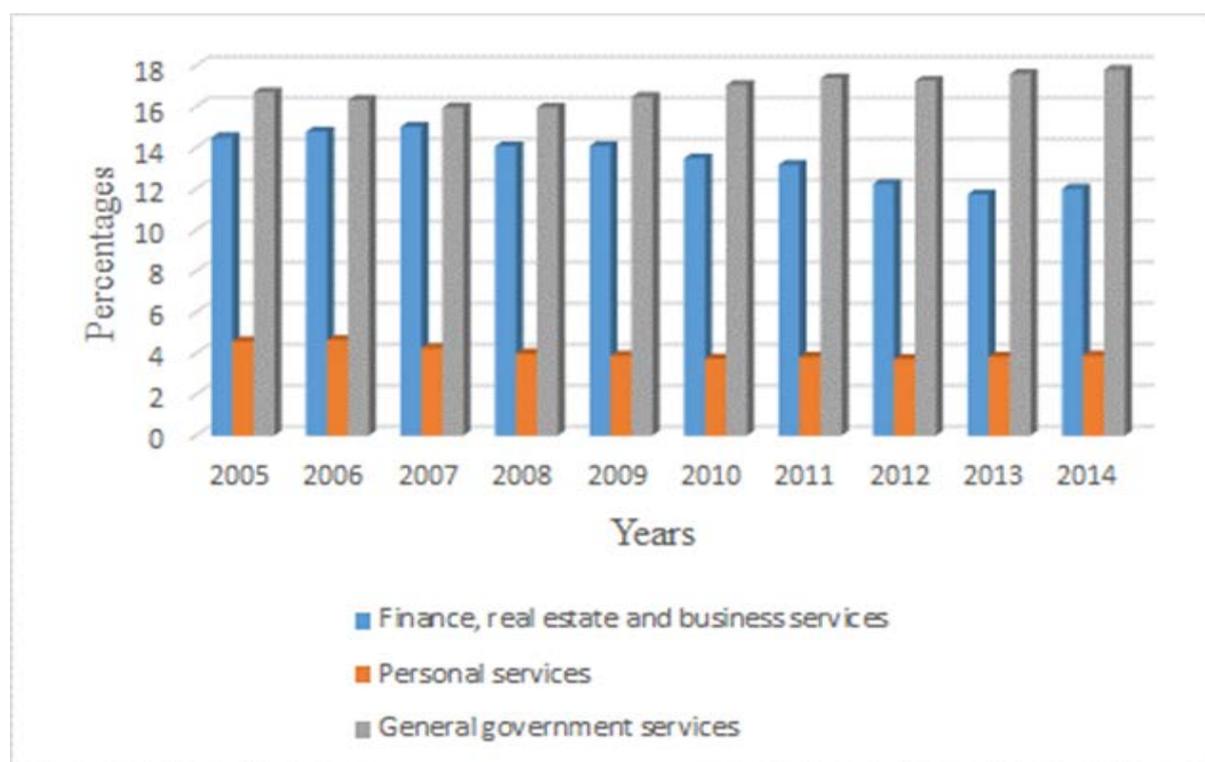
Source: StatsSA (2015a)

StatsSA (2015b) indicated that finance, real estate and business services' employment for this sector rose from 66 000 in the 1ˢᵗ quarter of 2014 to 94 000 in the 1ˢᵗ quarter of 2015. Mostly these sectors focus on services such as pension funds, computers, development and research, accounting, insurance, engineering, bookkeeping and auditing. In terms of community, social and other personal services, employment declined from 296 000 in the 1ˢᵗ quarter of 2014, to 276 000 in the 1ˢᵗ quarter of 2015. Mostly this sector focused on education, social work, general government activities, health, and public and private defence.

3.4. Policy implementation by the government and priorities

3.4.1. The Strategic Plan for South African Agriculture

The strategic plan for SA agriculture is aimed at building a united and prosperous agricultural sector that will raise the contribution of this sector towards economic growth and development. Further, the strategy recognised the importance of building global competitiveness and maintaining profitability in the agriculture sector through supply inputs (GCIS, 2015). Therefore, this strategic plan focuses on the positivity of SA agricultural sector to meet the challenge for increased competitiveness. It also ensures that the agricultural sub-

sectors are competitive, locally and internationally. The sub-sectors that are uncompetitive cause challenges of high input cost together with low productivity and unsuccessful business strategies. Ineffective international competitiveness also results in low productivity and low returns in the sector, which then respond to low investment in other industries (GCIS, 2015).

Another strategic plan is to improve support to small-scale producers and in doing so, increase the number of small-scale producers. The plan can be achieved through extension, cooperation development, mechanisation, marketing and financial services (DAFF, 2012). This strategic plan seeks to identify innovative ways in which the environment can be important to small-scale development. The strategy is to achieve zero hunger through addressing the challenges that small-scale producers face (DAFF, 2012).

The strategy also focuses on the agro-processing as one the sectors capable of creating jobs on a large scale. This strategy plan is necessary because agro-processing and particularly food processing is one of the sectors with the highest employment multipliers in the economy (DAFF, 2012).

3.4.2. Provincial Growth and Development Strategy

The Limpopo growth and development strategy focuses on the creation of employment and the development of the economy. Furthermore, the strategy focuses on how to attract investors to the province. One of the driving mechanisms that will contribute towards achieving objectives, is development. Certain sectors such as mining, agriculture, trade and manufacture contribute significantly to the economy and are considered to be the core of development in the province (LDA, 2015). The province recognised the importance of the agricultural sectors by linking small-scale farmers to commerce through providing services of extension officers, market access and infrastructure development. The mission of the Provincial Growth and Development Strategy is to achieve food security and entrepreneurial development with the goal to promote economic growth. Vhembe and Mopani are also big targets for the action plan for fruit- and vegetable- cultivation (horticulture) in the districts. In Capricorn district the focus will be on logistics to enhance development and economic growth, whereas red and white meat will be focused upon in all districts (LDA, 2015).

The Provincial Growth and Development Strategy is to eliminate the shortage of water resources in the district of Limpopo. The shortage of water is caused by the arid climate, unfavourable topography, limited potential to increase the ground water abstraction, and sand rivers. Most of the industries supply water from ground water, however, due to over-

utilization, it may not guarantee long-term sustainability (LDA, 2015). The problem regarding water resources is also caused by a lack of technical capacity, decaying infrastructure, lack of maintenance capacities and proper operation, and lack of dams. The development strategies should focus on the improvement of Olifants River resource development project (greater Sekhukhune, Capricorn and Waterberg), Nwamitwa Dam (Great Letaba water scheme), Nadoni Dam (Vhembe) and Mokolo and Crocodile River water augmentation project in Lephalale. Failure to achieve these development goals will result in continued agricultural production problems, and that will result in low productivity.

3.4.3. MAFISA and Land Bank

MAFISA is a financial scheme established by the government of South Africa aimed at assisting the poor or small-scale farmers with the capital to start agricultural production activities (GCIS, 2015). The establishment of this program could open the door to a successful development rate for the poor households of Limpopo. MAFISA offers loans at an interest rate of 8% with the production loans of up to R500 000, each with a repayment term according to the enterprise income period. GCIS (2015) stated that loans up to R25 000 could be offered without security. A R25 000 loan offer without security to smallholder farmers is, however, too small for agricultural activities considering the cost involved.

The Land Bank offers loans at an interest rate of 4% to support the smallholder farmer towards increasing production. Previously, Land Bank managed to offer farmers loans at the lowest interest rate. More than R2 billion loans, assisting more than 15 000 black farmers, were given by the Land Bank; 130 000 micro-enterprise entrepreneurs received loans from the Land Bank. GCIS (2015) stated that more than R48.2 billion on the GDP was generated from the Land Bank while 23 000 jobs were created, and more than 37 000 people maintained jobs.

The improvement of access to agricultural credit to smallholder farmers has to focus on the credit needs of smallholder farmers while MAFISA and Land Bank concentrate on lending to established commercial farmers instead. The major challenge is to find an alternative way to provide agricultural credit to smallholders who do not have security.

Hence it is imperative to note that any strategy to improve economic development should cater for credit accessibility to farmers as faster growth cannot be achieved without capital.

3.5. Conclusion

Chapter 3 reported on the historical information of the Limpopo economy. The report revealed that the majority of the population living in Limpopo find themselves in economic hardship. The deterioration of the GDP in 2014 also had negative effects. The province occupies 10% of the national population covering 10% of the area in South African and contributes 0.8% of the national GDP to the economy. Despite the decline of the agricultural sector, it contributes approximately 2.2% to the provincial GDP. The agricultural sub-sectors are field crops (maize, wheat, soybeans and sunflower), vegetables (tomatoes, potatoes, onion and pumpkins), fruit (oranges and bananas), livestock (cattle, sheep, pigs and chickens) and game. The study used four regional district levels namely Vhembe, Mopani, Capricorn and Waterberg to report on production and gross farming income for agricultural sub-sectors. The report revealed that the Waterberg district produces most of the arable crops of which maize contributes the most output (in tonnes). In terms of gross farming income Waterberg generates the largest farming income for maize. In the case of vegetables, tomatoes are mainly produced in the Mopani district and Mopani's gross farming income is mainly generated from potatoes, oranges and bananas. In the case of livestock, chickens are mainly owned in the Waterberg district where the main income is generated from cattle. Game is mainly found in the Waterberg district.

The aim of the Provincial Growth and Development Strategy is to focus on attracting investors to the province, focusing on the mining-, agriculture-, trade- and manufacturing sectors. Vhembe and Mopani districts were considered the biggest targets for fruit and vegetables to achieve food security and entrepreneurial development with the goal to promote economic growth.

The next chapter will reveal the method used to simulate the potential growth of change in demand and/or supply of various sectors of the economy in Limpopo.

4. CHAPTER 4: MODELLING FRAMEWORK

4.1. Introduction

As stated in Chapter 2, a macroeconomic methodological framework is used for this study. The data applied for the model is a Social Accounting Matrix (SAM) of Limpopo developed/compiled by Conningarth Economists with 2006 as a base year. Because the SAM was unbalanced, data manipulation was performed manually in order to balance the SAM. The Limpopo SAM includes various agricultural accounts because it is important to have different agricultural sectors represented when estimating the agricultural contribution to economic growth.

The model is a SAM multiplier model. The model is used to assess the contribution of agriculture to economic growth in Limpopo. The Leontief inverse matrix was used to estimate the SAM output, income and value added/GDP multipliers. Scenarios were analysed, in particular the scenario related to increase in demand for agricultural commodities domestically and abroad, as well as the scenario related to an increase in investment subsidies in Limpopo. The Leontief inverse was used in the calculation of the backward linkages and the Ghosh inverse for forward linkages. The backward and forward linkages were normalized to derive the power and sensitivity of dispersion indices.

Section 4.2 focuses on the preparation of the 2006 SAM data for Limpopo. Furthermore, a brief discussion of the balancing process that was applied to estimate the missing information in order to arrive at a balanced SAM, follows. Section 4.3 focuses on the Limpopo economy as portrayed by the SAM. Section 4.4 discusses the model selection, therefore, a short discussion of the Input-Output (I/O) theory based on the Input-Output (I/O) tables is followed by a discussion of the extension of I/O theory to allow for secondary production (make and use SAM matrices). The section proceeds with a discussion of I/O and SAM multipliers and linkages. A brief summary is presented at the end of the chapter.

4.2. Preparing the 2006 Limpopo SAM data for the model

The 2006 macroeconomic SAM for Limpopo is shown in Table 5. The SAM was compiled and published by Conningarth Economists under the auspices of the Development Bank of Southern Africa (DBSA). The original macro SAM has 14 accounts: production accounts (activities and commodities), factors of production (labour and capital), institutional accounts (national, provincial and local government, enterprises and households), savings-investment,

rest of South Africa (ROS) account and rest of the world (ROW) account and an international capital transfer account. The original SAM also contains an account with discrepancies between row and column account totals because the original SAM is unbalanced.

Because the SAM was unbalanced, manual balancing in Excel was used to estimate incomplete data. The original SAM was not a square matrix because it did not contain the same accounts in the rows and columns. As part of using manual balancing, the starting point was to aggregate across certain rows to get single national government, ROS and ROW accounts. The second part was to aggregate the columns to get single national government, ROS and ROW accounts. Some of the original accounts such as government and capital remained unbalanced in terms of row and column totals. The third part was to get rid of small values (less than 0.00001) and discrepancies row and column and then to proceed with changes to get rid of imbalances in factor capital and commodity accounts in the square SAM. Finally, total income and total expenditure in the SAM balanced exactly so all flows are accounted for as shown in table 6. The detailed SAM was balanced and used as base to derive the macro SAM in table 6.

Table 5: A 2006 unbalanced macro SAM for Limpopo (R million)

	Activities	Commodities	Labour	Capital	Enterprises	Households	National	Provincial	Local	S-I	ROS	ROW	Capital	Discrepancies	Total
Activities		200 872													20 0872
Commodities	108 527					79 685	1 397	2 738	887	26 395	30 471	64 406		936	315 443
Labour	36 196						9 330	5 311	592		22 458	320			74 206
Capital	54 143										14 082	2 425			70 650
Enterprises				38 665			201	0	41						38 907
Households			42 864		33 002	765	9 716	820			332	44			87 542
National	594	13 310		877	4 690	7 122	760								27 354
Provincial	314			30	120		23 730								24 194
Local	1 098				177	28	2 544	66							3 912
S-I				8 922	881	-195	-20 325	15 259	2 393						6 935
ROS		72 134	30 854			116							-52 286		50 818
ROW		29 128	488		37	21							32 825		62 499
Capital										-19 460					-19 460
Discrepancies				936											936
Total	20 0872	315 443	74 206	49 430	38 907	87 542	27 354	24 194	3 912	6 935	67 343	67 195	-19 460	936	

Source: Aggregation of the original unbalanced SAM for Limpopo

Table 6: A 2006 balanced macro SAM for Limpopo (R million)

	Activities	Commodities	Labour	Capital	Enterprises	Households	National	Provincial	Local	S-I	ROS	ROW	Total
Activities		20 0872											200 872
Commodities	10 8527	62 613				79 685	1 397	2 738	887	26 605	30 018	66 924	379 394
Labour	36 196						9 330	5 311	592		22 458	320	74 206
Capital	54 143										13 153	2 425	69 721
Enterprises				38 665			201	0	41				38 907
Households			42 864		33 002	765	9 716	820			332	44	87 542
National	594	13 310		877	4 690	7 122	760						27 354
Provincial	314			30	120		23 730						24 194
Local	10 98				177	28	2 544	66					3 912
S-I				8 922	881	-195	-20 325	15 259	2 393		53 668	-33 998	26 605
ROS		72 134	30 854	16 525		116							119 628
ROW		30 466	488	4 703	37	21							35 715
Total	20 0872	379 394	74 206	69 721	38 907	87 542	27 354	24 194	3 912	26 605	119 628	35 715	

Source: Aggregation of the balanced detailed SAM for Limpopo

4.3. The Limpopo economy as portrayed by the SAM

The SAM micro-economic data records all information about economic agents in detail. For example, data on production records the amount spent by each agent on each type of goods. A SAM database reports some of the macroeconomic indicators in the total row and column place. For example, the column total of the rest of South Africa and rest of the world report the total export of goods and services locally (to the rest of South Africa) and abroad.

Table 7 summarises the sectoral contribution to value added and production from the 2006 Limpopo SAM. The production value in Table 7 represents the distribution of the value of intermediate inputs used by each sector in the economy. The mining sector holds the highest position both in terms of value added and production value. Mining contributes 30% (R26.8 billion) of GDP at factor cost and uses 27% (R55.1 billion) of the total value of intermediate inputs. Agriculture contributes 3.8% of production value and 3.7% of value added. Building and construction, manufacturing and water & electricity also contribute less than 5% of both production value and value added.

The labour column of Table 7 represents the estimates of labour payments in value terms for each sector in the economy. The mining sector made 26.8% of labour payments in the economy. Within the context of Table 7, the financial sector contributes only 20.18% of total labour value-added, followed by trade and accommodation (17.52%), transport and communication (11.19%) and community and personal services (10.07%). The agricultural sector contributes the least of total labour value-added (2.63%) in the economy.

Table 7 represents the dissemination of the capital stock for each sector in Limpopo. Mining and financial services dominate with 32% and 24% of capital stock, followed by trade with 11.9% (R6.6 billion) and 12.32% for transport service (R6.3 billion). On the other side, agriculture (4.42%), manufacturing (3.94%), water & electricity (3.96%) and building & construction (1.52%) contribute the least.

Table 7: Sectoral production, value added, labour and capital patterns (R million and %)

	Production		Value added		Labour		Capital	
	R m	%	R m	%	R m	%	R m	%
Agriculture	7 588	3.78	3 347	3.70	951	2.63	2 395	4.42
Mining	55 144	27.45	26 806	29.67	9 716	26.84	17 090	31.56
Manufacturing	16 706	8.32	3 946	4.37	1 813	5.01	2 133	3.94
Water and electricity	7 486	3.73	3 366	3.73	1 220	3.37	2 146	3.96
Building and construction	8 985	4.47	1 976	2.19	1 154	3.19	822	1.52
Trade and accommodation	25 513	12.70	13 011	14.40	6 343	17.52	6 668	12.32
Transport, storage and communication	26 451	13.17	10 432	11.55	4 050	11.19	6 382	11.79
Financial insurance, real estate, business services	41 477	20.67	20 504	22.70	7 303	20.18	13 200	24.38
Community, social, personal services	11 477	5.71	6 950	7.69	3 645	10.07	3 305	6.10
TOTAL	200 872	100.0	99 339	100.0	36 196	100.0	54 143	100.0

Source: Derived from the Limpopo SAM for 2006

Table 8 classified the government income pattern derived from the Limpopo SAM. Based on the income shares, 48.66% of national government income is received in the form of net indirect sales taxes and subsidies levied on commodities, followed by tax revenue obtained from households in the form of direct income tax (26.04%). Depreciation and industry taxes contribute only 2.17% and 3.21% respectively in the form of property income.

Table 8: Government income pattern (R million and %)

| | Government income (R million and %) | | | | | |
| | National | | Provincial | | Local | |
	R m	%	R m	%	R m	%
Activities	594	2.17	313	1.30	1 097	28.06
Commodities	13 310	48.66	0	0.00	0	0.00
Capital	877	3.21	29	0.12	0	0.00
Enterprises	4 690	17.15	120	0.50	176	4.51
Households	7 122	26.04	0	0.00	27	0.71
Government	759	2.78	23 730	98.08	2 610	66.72
TOTAL	27 353	100.0	24 194	100.0	3 911	100.0

Source: Derived from the Limpopo SAM for 2006

Table 9 classified the household expenditure pattern derived from the Limpopo SAM. Based on the expenditure share, 88.51%, 95.67% and 99.39% of total income of Black households (high, medium and low incomes respectively) is spent on consumption. Transfers to other households are 1.08%, 0.50% and 0.07% respectively of total household expenditure for Black households (high, medium and low income), with direct taxes at 10.55%, 3.79% and 0.49% and savings being negative (-0.27%, -0.13% and -0.02%).

Table 9: Household expenditure patterns (%)

| | Black (%) | | | White, Coloured and Asian (%) | | |
Income Group	High	Medium	Low	High	Medium	Low
Consumption	88.51	95.67	99.39	67.22	91.58	97.84
Household	1.08	0.50	0.07	3.20	0.60	0.20
Government	10.55	3.79	0.49	29.85	7.41	1.69
Saving	-0.27	-0.13	-0.02	-0.82	-0.15	-0.05
ROS	0.12	0.15	0.05	0.47	0.48	0.29
ROW	0.02	0.03	0.01	0.09	0.09	0.05
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00

Source: Derived from the Limpopo SAM for 2006

Table 10 classified the household income pattern derived from the Limpopo SAM. Based on the income shares, as captured in the Limpopo SAM, incomes from labour services provided

55.73%, 37.4% and 33.64% of Black household incomes, inter-households transfer (2.18%, 35.52% and 17.42%), payments from enterprise (41.66%, 43.69% and 27.75%) and transfers from government (2.25%, 16.01% and 37.28%).

Table 10: Household income patterns (%)

Income Group	Black (%)			White, Coloured and Asian (%)		
	High	Medium	Low	High	Medium	Low
Labour	55.73	37.40	33.64	86.13	28.11	25.91
Enterprises	41.66	43.69	27.75	11.52	35.85	55.83
Households	0.01	2.43	0.62	2.18	35.52	17.42
Government	2.25	16.01	37.28	0.11	0.52	0.83
ROS	0.31	0.41	0.62	0.05	0.01	0.00
ROW	0.04	0.05	0.08	0.01	0.00	0.00
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00

Source: Derived from the Limpopo SAM for 2006

Table 11 reveals the share of commodities exported and imported between the rest of South Africa and rest of the world. Mining dominated the domestic and foreign exports of Limpopo with 36.35% and 62.10% respectively, followed by trade and accommodation with 27.91% domestic and 11.35% foreign exports. Agricultural products contributed 6.15% domestically and 2.77% abroad. On the other hand, 38.69% and 80.21% of imports domestically and abroad are dominated by manufacturing products, while agricultural products are 2.78% of domestic imports and 2.50% of international imports. Therefore, other imports of products come from community, social and personal services with 10.02% domestically and 0.86% abroad. From the values in the macro SAM in table 5, it can be seen that the structure of the economy is imbalanced in trade; domestic imports exceed domestic exports. On the other side, foreign exports exceed foreign imports.

Table 11 Export and import patterns (%)

	Exports (%)		Imports (%)	
	Domestic	Abroad	Domestic	Abroad
Agriculture sector	6.15	2.77	2.78	2.50
Mining sector	36.35	62.10	10.61	1.99
Manufacture sector	3.64	7.34	38.69	80.21
Water & electricity	2.41	0.00	0.80	0.46
Building and construction	2.27	0.00	2.20	0.10
Trade and accommodation	27.91	11.35	27.89	0.24
Transport, storage and communication	6.15	13.75	0.80	9.76
Financial insurance, real estate and business service	12.81	1.23	6.21	3.90
Community, social and personal Services	2.31	1.45	10.02	0.86
Total	100.00	100.00	100.00	100.00

Source: Derived from the Limpopo SAM for 2006

Table 12 indicates the share of the demand for commodity groups included in the SAM. 92.62 % of citrus fruit, which include oranges, lemons and grape fruit and other, is exported to other countries and 2.30% to other provinces, whereas 3.14% is used for intermediate demand and the remainder is consumed locally (1.54%). Subtropical fruit such as avocadoes, bananas and mangoes are predominately consumed locally (36.60%), followed by 30.84% of products exported to other countries and 18.22 % is used as intermediate products. In terms of vegetables such as potatoes, tomatoes and onions, the largest share is exported to other provinces and consumed locally by households (47.66% and 31.31% respectively). 57.70% of livestock such as cattle, sheep, pigs and other, is consumed locally and used as intermediate products (21.48%). Almost 93.08% of game is intermediate demand and the remainder is exported (domestically 1.38% and abroad 5.26%). Forestry is mostly used as intermediate product (76.89%), while 15.09% of forestry is investment demand and the remainder is exported domestically (8.02%). Other agriculture such as grains are used as intermediate demand (89.94%), whereas some is directly consumed by households (4.34%).

Table 12: Components of final demand by commodities (row shares)

	Interme-diate demand (%)	Household consump-tion (%)	Government consump-tion (%)	Invest-ment (%)	Exports (ROS) (%)	Exports ROW) (%)
Citrus fruit	3.14	1.54	0.00	0.35	2.30	92.67
Subtropical fruit	18.22	36.60	0.00	2.29	12.06	30.84
Vegetables	10.76	31.31	0.00	0.55	47.66	9.71
Livestock	21.48	57.70	0.00	1.59	15.36	3.86
Game	93.08	0.00	0.00	0.27	1.38	5.26
Forestry	76.89	0.00	0.00	15.09	8.02	0.00
Other agriculture	89.94	4.34	0.66	0.73	1.39	2.94

Source: Derived from the Limpopo SAM 2006

Table 13 indicates the components of agricultural commodity exports to the rest of South Africa and to the rest of the world.

Table 13: Components of exports in agricultural commodities (R million)

	Exports (ROS) R million	Exports (ROW) R million
Citrus fruit	30	1 206
Subtropical fruit	76	195
Vegetables	1 335	272
Livestock	286	72
Game	2	7
Forestry	70	0
Other agriculture	49	103

Source: Derived from the Limpopo SAM 2006

Table 13 shows that vegetables are the largest export demand to the rest of South Africa with R1.3 billion, followed by livestock (R286 million), subtropical fruit (R76 million), forestry (R70 million), other (R49 million), citrus fruit (R30 million) and game (R2 million).

Citrus fruit is the largest agricultural export category to the rest of the world with R1.2 billion, followed by vegetables (R272 million), subtropical fruit (R195 million), other (R103 million), livestock (R72 million) and game (R7 million).

4.4. Model selection

4.4.1. Input-Output (I/O) theory based on Input-Output (I/O) tables

The main purpose of the I/O analysis is to quantify the relationship between production industries and commodity demand. Therefore, I/O tables are derived mainly from the information contained in use tables. The I/O table reports information for either industries or commodities, not both. On the other side, use tables report information for both industries and commodities (Miller & Blair, 2009). For this reason, the I/O table should have the same accounts for either industries or commodities for rows and columns. Therefore, the production matrix is known as being symmetric because the production matrix is square.

4.4.2. Multiplier models and multipliers based on I/O tables

Following Miller and Blair (2009), the basic I/O model, based on an I/O table, can be derived as:

$$x_i = z_{i1} + \cdots + z_{ij} + \cdots + z_{in} + f_i = \sum_{j=1}^{n} z_{ij} + f_i \qquad\qquad 1$$

And in matrix format:

$$x = Zi + f \qquad\qquad 2$$

Where **Zi** denotes a column vector of the sum of the values of purchases of output from industry *i* by industry *j*. Total output of industry *i* is denoted by **x**. Final demand of output by industry *i* is indicated by **f**.

The direct requirements matrix, or technical (input) coefficients matrix **A**, is determined as intermediate inputs (**Z**) used by industry *j* as shares of **x**, which is output of industry *j*:

$$A = Z\hat{x}^{-1} \qquad\qquad 3$$

Substituting equation 3 into equation 2 gives:

$$x = Ax + f \qquad\qquad 4$$

Equation 4 can be rewritten in terms of output and represents the I/O multiplier model:

$$x = (I - A)^{-1}f = Lf \qquad\qquad 5$$

Where $L = (I - A)^{-1}$ is the total requirements matrix, also commonly known as the Leontief inverse matrix. The Leontief inverse in the I/O model plays the important role of connecting final demand **f** to industry output **x**.

Equation 5 represents the ordinary I/O model and output multipliers are derived from the column sums of the Leontief inverse matrix ($\sum_i L_{ij}$). Income and value-added/GDP multipliers are simply base year income and value added shares of a unit of output. These multipliers are then multiplied with the additional output in the economy due to a shock, as estimated using the output multipliers, to obtain the additional income and value added generated as a result of the shock.

The extension of the ordinary I/O multipliers model and multipliers to be applicable for use with a SAM that contains both industry and commodity accounts, such as the one used in the current study, is explored in the next two sections.

4.4.3. Extension of Input-Output (I/O) tables to commodity-by-industry I/O tables

Secondary production means that there are multiple commodities that can be produced by a single industry. It is therefore also possible that more than one industry can produce similar commodities (Punt, 2013). I/O tables that contain only one production sub-matrix do not explicitly record secondary production. In order to explicitly capture secondary production both commodity and industry accounts should be included in the dataset to allow for two sub-matrices: a make matrix and a use matrix. The make matrix records the values of commodities that are produced by the industries in the economy. The use matrix records values of all commodities that are purchased by the industries as intermediate inputs. Most of the more recent SAMs, including the SAM for Lesotho, include make and use matrices.

Table 14 shows the commodity-by-industry sub-matrices for an I/O table, for the basis of the model discussion. The same principles will apply for commodity-by-industry SAM, such as the one used for the current study. The framework shows the use matrix (**U**) (commodities-by-industries) and the make matrix (**V**) (industries-by-commodities) and **e** indicates final demand by commodity and **v′** represents value added by industry. The output per industry (**x**) is derived from the Make matrix (**V**), as the sum of the value of all commodities that are produced by each industry. The output per commodity (**q**) is derived as the row sums of the commodity accounts, and it is the sum of intermediate input use (from **U**) and final demand

(**e**). The column totals of the Use matrix (**U**), sums all the value of all commodities that are purchased by each industry and used as intermediate inputs.

Table 14: Commodity-by-industry I/O table

		Commodities		Industries		Final Demand	Total Output
		Agric	Other	Agric	Other		
Commodities	Agric			Use (U)		e	q
	Other						
Industries	Agric	Make (V)					x
	Other						
Value-Added				v′			
Total Input		q′		x′			

Source: Adjusted from Miller and Blair (2009)

Multiplier model theory changed when the underlying data changed. Therefore, with the extension of I/O tables to the SAM that contains both a make and a use sub-matrix, certain assumptions were made as to the production of secondary products. Commodity demand-driven models or industry demand-driven models can be derived from the commodity-by-industry SAM. Each of these types of models can further be separated into assuming either industry technology or commodity technology.

If you calculate a total requirements matrix, similar to the Leontief inverse matrix, on the entire production block of the SAM (i.e. across all commodity and industry accounts), which includes the make matrix as well as the use matrix, then the inverse matrix contains four submatrices, the commodity-by-commodity, industry-by-commodity, industry-by-industry and commodity-by-industry sub-matrices. It can be shown that only three of these four matrices contain values that are consistent with those calculated for each individual sub-matrix following the literature by Miller and Blair (2009, chapters 5 and 6) for commodity-by-industry data (i.e. SAMs with make and use matrices). It is only the commodity-by-industry submatrices that do not give consistent results, and which therefore should not be used in the interpretation of results.

Although there is no secondary production recorded in the SAM of Limpopo, the SAM still makes provision for it in its layout, because it contains explicit make and use sub-matrices.

Therefore, the extended theory was consulted rather than transforming the make and use SAM into a reduced form SAM that contains only one production matrix similar to that of an I/O table.

According to Miller and Blair (2009) each of these four submatrices represents different technology assumptions. The industry-by-commodity and the commodity-by-commodity submatrices represent industry technology for the commodity demand driven model. The industry-by-industry matrix represents industry technology for the industry demand driven model. The results from the industry-by-industry sub-matrix of the total requirements matrix were used in this study for the results on multipliers and linkages. The industry-by-commodity sub-matrix of the total requirements matrix was used for the scenarios in order to relate the change in commodity demand to the impact on industry output.

4.4.4. Extending Input-Output multiplier model theory to use with commodity by industry SAMs

Similar to the case of the simple I/O model, the calculation of a multiplier model based on a commodity-by-industry SAM also proceeds with the calculation of the direct requirements matrix, or technical coefficient matrix. Following Miller and Blair (2009), the commodity-by-industry submatrix of technical coefficients is specified as follows:

$$B = U\hat{x}^{-1} \qquad \text{(thus } U = B\hat{x}) \qquad\qquad 6$$

Where matrix **B** is the direct technical (input) coefficients derived from the use matrix **U**, with commodity-by-industry dimensions; and **x** is the industry output. $\hat{\boldsymbol{x}}^{-1}$ is the inverse matrix of the diagonal matrix of **x**. Matrix **B** therefore captures the commodity shares required to produce one-unit of industry output.

The data provided in the make matrix **V** shows all the commodities produced by each of the industries. The total output per industry **x** is found by the row sums of V (or the column sum of the transposed make matrix **V′**) in equation 7, where **i** is a column vector of ones and **i'** is a row vector of ones.

$$x = Vi \qquad \text{(or } x' = i'V') \qquad\qquad 7$$

The total output per commodity **q**, regardless which industry produces it, can be calculated as the column sums of the make matrix **V** (or the row sums of **V′**):

$$q = (V')i \qquad \text{(or } q' = i'V) \qquad\qquad 8$$

Since commodity demand and supply must equate, the total output per commodity q can also be obtained from a demand perspective by summing intermediate input use of each commodity by all industries (row sums of use matrix U), as well as final demand e per commodity:

$$q = Ui + e \qquad\qquad 9$$

By using equation 6 ($U = B\hat{x}$), and substituting into equation 9, an accounting identity can be derived that equates total output per commodity q to intermediate use Bx and final demand e:

$$q = Bx + e \qquad\qquad 10$$

Equation 10 is similar to equation 4 ($x = Ax + f$) from the simple I/O model. The problem is that it is impossible to use equation 10 to generate a total requirements matrix, as in equation 5 ($x = (I - A)^{-1}f$), because equation 10 contains industry output x on the right and commodity output q on the left. The solution to this problem is to transform the commodity dimension into an industry dimension or *vice versa*. The data required for transformation can be obtained from the make matrix V, which is an industry-by-commodity matrix. The commodity output proportions matrix D indicates the fraction of total commodity output q that was produced by each industry (i.e. column shares of the make matrix V):

$$D = V\hat{q}^{-1} \qquad\qquad \text{thus } (D\hat{q} = V) \text{ or } (Dq = Vi) \qquad\qquad 11$$

Therefore matrix D shows the industry sources of commodity outputs and is also known as the market share matrix. It is used in the industry technology models[2] such as the one used in the current study. By substituting equation 7 ($x = Vi$) into equation 11 and rearranging, the following is obtained:

$$Dq = x \qquad\qquad \text{thus } (q = D^{-1}x) \qquad\qquad 12$$

In order to provide a linear transformation from industry output x to commodity output q, x is substituted for Dq (based on equation 12) in equation 10. Equation 13 presents and an accounting identity similar to equation 10.

$$q = B(Dq) + e \qquad\qquad 13$$

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[2] Commodity technology models make use of the product mix matrix C, which indicates the row shares of the make matrix V, i.e. the share of each industry in each commodity, calculated as: $C = V'\hat{x}^{-1}$

All the terms in equation 13 have a commodity dimension, therefore it can be used as base for deriving a total requirements matrix similar to the Leontief matrix for the I/O model in equation 5. So through rearrangement of equation 13, equation 14 can be derived.

$$e = q - (BD)q$$

$$e = q(I - BD)$$

$$q = (I - BD)^{-1}e \qquad\qquad 14$$

Where $(I - BD)^{-1}$ in equation 14 is the *commodity-by-commodity total requirements matrix* for the SAM model. Equation 14 translates commodity demand **e** to commodity output **q** through the C-by-C total requirements matrix $(I - BD)^{-1}$.

Equation 14 can be transformed from a commodity output **q** equation to an industry output **x** equation by substituting **q** for $\mathbf{D^{-1}x}$ (from equation 12) into equation 14 and rearranging to obtain equation 15:

$$D^{-1}x = (I - BD)^{-1}e$$

$$x = D(1 - BD)^{-1}e \qquad\qquad 15$$

Where $D(I - BD)^{-1}$ is the *industry-by-commodity total requirements matrix* for the SAM model. Equation 15 translates commodity demand **e** into industry output **x** through the I-by-C total requirements matrix $D(1 - BD)^{-1}$.

According to Miller and Blair (2009) the models in equations 14 and 15 are both referred to as commodity demand driven models. An alternative is an industry demand driven model. These models assume that the demand for industry output (as opposed to commodity output) increases as an initial shock.

The aim is therefore to transform the accounting identity with a commodity dimension into an accounting identity with an industry dimension. Starting again from the accounting identity in equation 10, and pre-multiplying both sides by D and rearranging gives:

$$Dq = D(Bx + e)$$

$$Dq = DBx + De$$

Since Dq = x, then substitute **Dq** for **x** and rearrange to obtain equation 16, where equation 16 is an accounting identity with industry dimensions in all the terms, i.e. equating total industry output **x** to intermediate input use per industry **DBx** and final output demand **De**:

$$x = DBx + De \qquad\qquad 16$$

DB indicates required inputs from industries per unit of industry output **x**. Its dimensions are industry-by-industry (I-by-I). All the terms in equation 16 therefore have an industry dimension, hence the equation can be used as base for deriving a total requirements matrix similar to the Leontief matrix for the I/O model in equation 5. So through rearrangement of equation 16, equation 17 can be derived.

$$De = x - DBx$$

$$De = x(1 - DB)$$

$$x = (1 - DB)^{-1}De \qquad\qquad 17$$

Where $(I - DB)^{-1}$ is an *industry-by-industry total requirements matrix* for the SAM model. Equation 17 translates industry final demand **De** into industry output **x** through the I-by-I total requirements matrix $(1 - DB)^{-1}$.

From the discussion it can be seen that the ordinary I/O model has only one total requirements matrix, i.e. the Leontief inverse matrix $(I-A)^{-1}$, but that several total requirements matrices can be derived from a commodity-by-industry SAM. Only three such matrices were shown here, which were deemed the most relevant of the eight different matrices discussed in Miller and Blair (2009).

The SAM multiplier models provide a tool for economic analysis to determine the impacts of exogenous change of macroeconomic policies on the economy. For example, scenarios that were analysed relate to increases in demand for agricultural commodities exported to the Rest of South Africa and abroad, as well as the impact of investment subsidies in Limpopo.

In the current study the industry-by-commodity (I-by-C) total requirements matrix was used for the export demand and investment scenarios, whereas the industry-by-industry (I-by-I) total requirements matrix was used for the multipliers and linkages.

4.4.5. Open *vs.* closed models

It is important to distinguish the difference between multipliers obtained from open models and closed models[3]. In open models only the production accounts are used in the calculation of the total requirements matrix, whereas in closed models, some of the institutional accounts are also included in the calculation of the total requirements matrix. The accounts that are included in the calculation of the total requirements matrix are referred to as endogenous accounts, whereas the remaining accounts are referred to as exogenous accounts (Miller and Blair, 2009).

Multipliers derived from an open model record only the inter-industry transaction direct and indirect effects. On the other hand, the multipliers derived from a closed model captures the total effect, which includes the direct, indirect and induced effects (consumption linkages). If the endogenous accounts also include consumption transactions from households and enterprises they provide some important information about household income, consumption as well as income distribution. Government, investment and domestic and foreign exports are typically specified as exogenous accounts (also in the current study). Multipliers derived from open models are smaller than those derived from closed models because of the additional induced effects captured in closed models (Miller and Blair, 2009).

The closed model was used in the current study. In terms of the model discussed in the previous section, the implication is that the technical coefficients matrix **B** based on the use matrix **U** is extended to incorporate the additional non-production endogenous accounts (factors, enterprises and households). These accounts are also transformed to either commodity or industry dimensions as needed, using the make matrix shares **D** (Miller and Blair, 2009).

Compared to the I/O multipliers discussed at the end of section 4.4.2, in the case of the commodity-by-industry SAM for Lesotho output multipliers are also calculated as the columns sums of the relevant total requirements matrices. Income and value-added/GDP multipliers are however now calculated as part of the total requirements matrix because factor and household accounts are endogenous and therefore part of the total requirements matrices.

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[3] Multipliers from open models are often referred to as I/O multiplier, but they could also be calculated with a SAM, because it depends on the selection of accounts, not the underlying database. Similarly multipliers from closed models are often referred to as SAM multipliers, but they could also be calculated using an IO table.

4.4.6. Linkages

Backward and forward linkages are based on the Leontief and Ghosh inverses respectively. The theory of the Ghosh inverse, differs from that used for the Leontief inverse, because there are different assumptions. The Leontief inverse links total output of sectors to changes in final demand. On the other hand, the Ghosh inverse links total production of sectors to changes in primary inputs (i.e. value added) (Miller and Blair, 2009).

The Leontief inverse are input (column) shares of the production matrix, whereas the Ghosh inverse represents output (row) shares of the production matrix (Miller and Blair, 2009).

4.4.6.1   Backward linkages

Miller and Blair (2009) define backward linkages through a simple process. Assume that sector j increases its output, this means that there is a demand from sector j to sector i whose goods are used as input in the production process of sector j. The higher the industry's backward linkage ranking, the higher the dependence on other industries' production to stimulate the effect to the rest of the economy (Fricke & Dettmer, 2014).

The direct backward linkage **BL(d)** is calculated as follows (Miller and Blair, 2009):

$$BL(d)_j = \sum_{i=1}^{n} a_{ij} \hspace{4cm} 18$$

Where $\boldsymbol{a_{ij}}$ denotes the direct technical coefficients. Equation 18 shows that the ordinary direct backward linkage captures the column sums of the direct requirement matrix **A**, whereas equation 19 shows that calculation of the normalised direct backward linkage $\overline{\textbf{BL}}(\textbf{d})$. This method was originally proposed by Chenery and Watanabe (1958, as cited by Miller and Blair, 2009).

$$\overline{BL}(d)_j = \frac{BL(d)_j}{(\frac{1}{n})\sum_{j=1}^{n} BL\,(d)_j} = \frac{\sum_{i=1}^{n} a_{ij}}{(\frac{1}{n})\sum_{i=1}^{n} a_{ij}\,\sum_{j=1}^{n} a_{ij}} \hspace{2cm} 19$$

The direct backward linkages can be normalized based on the direct requirements matrix. So the direct backward linkage for a particular industry is divided by the average of all direct backward linkages (Equation 19).

Rasmussen (1956, cited in Miller and Blair, 2009) suggested that in order to determine the total (direct and indirect) linkages in the economy **BL(t)**, the column totals of the total requirements matrix **L** should be used as a measure of total backward linkages. It is the same as the output multiplier.

$$BL(t)_j = \sum_{i=1}^{n} l_{ij} \qquad\qquad 20$$

The total backward linkages can be normalized $(\overline{\mathbf{BL}}(\mathbf{t}))$ based on the total requirements matrix L. So the total backward linkage for a particular sector is divided by the average of all total backward linkages as shown in Equation 21.

$$\overline{BL}(t)_j = \frac{BL(t)_j}{(\frac{1}{n})\sum_{j=1}^{n} BL\,(t)_j} = \frac{\sum_{i=1}^{n} l_{ij}}{(\frac{1}{n})\sum_{i=1}^{n} l_{ij}\,\sum_{j=1}^{n} l_{ij}} \qquad\qquad 21$$

The normalized total backward linkages are also known as the power of dispersion index.

4.4.6.2   *Forward linkages*

Miller and Blair (2009) defines forward linkages as the inter-relationship between a particular industry and the industries that are using its products. The higher the value of the forward linkage of an industry, the greater the probability that an industry will increase production of other industries (Fricke & Dettmer, 2014). The dissatisfaction with Rasmussen's (1957) measure of forward linkage resulted in the suggestion that the Ghosh inverse $G = (I - B)^{-1}$, is the suitable measure for the strength of total forward linkage. The Ghosh-method was suggested to be a better estimate of forward linkage by Beyers (1976) and Jones (1976).

The direct forward linkage **FL(d)** is calculated as follows (Miller and Blair, 2009):

$$FL\,(d)_i = \sum_{j=1}^{n} b_{ij} \qquad\qquad 22$$

Where $\mathbf{b_{ij}}$ denotes the output shares of an industry, i.e. the share of output used by each industry *j* per unit output of industry *i*.

The direct forward linkages can be normalized based on the direct requirements matrix **B**. Therefore, the direct forward linkages for a particular industry is divided by the average of all the industries' forward linkages (equation 23).

$$\overline{FL}(d)_i = \frac{FL(d)_i}{(\frac{1}{n})\sum_{i=1}^{n} FL\,(d)_i} = \frac{\sum_{j=1}^{n} b_{ij}}{(\frac{1}{n})\sum_{j=1}^{n} b_{ij}\,\sum_{i=1}^{n} b_{ij}} \qquad\qquad 23$$

The total forward linkages is therefore derived from the row sums of the Ghosh inverse **G,** which is the total requirements matrix.

$$FL\,(t)_i = \sum_{j=1}^{n} g_{ij} \qquad\qquad 24$$

The forward linkages can be normalized when the total forward linkage of a sector is divided by the average of all total forward linkages. The normalized total forward linkages are also called the sensitivity of dispersion index (Miller and Blair, 2009).

$$\overline{FL}(t)_i = \frac{FL(t)_i}{(\frac{1}{n})\sum_{i=1}^{n} FL(t)_i} = \frac{\sum_{j=1}^{n} g_{ij}}{(\frac{1}{n})\sum_{j=1}^{n} g_{ij}\ \sum_{i=1}^{n} g_{ij}} \qquad\qquad 25$$

Both linkages determine the magnitude of transaction between industries. The figures could be interpreted in non-normalized form, for example, if one of these linkages (backward or forward) is larger for industry A than for industry B, it could attest that a monetary unit value expansion of industry A would be more beneficial to the economy than the equal expansion of industry B. Therefore, in the normalized form of both linkages (backward or forward) sectors that have an index value of greater than one are deemed to have an above average (backward or forward) linkage.

The study reports the estimated normalised backward and forward linkages in Chapter 5, using equations 21 and 25 respectively, and the industry-by-industry total requirements matrix.

4.5. Conclusion

In Chapter 4 the preparation of the Limpopo SAM for 2006 as compiled/developed by Conningarth Economists, was discussed. The Limpopo SAM was unbalanced, data manipulation was performed, applying manual balancing on the existing Excel data. The method used to balance the SAM was manual balancing, which reduces the missing information in order to achieve the balance.

The study briefly discussed the extension of the I/O tables to SAMs that contain both make and use matrix. Although there is no secondary production recorded in the Limpopo SAM, it structure makes provision for it because the SAM includes both commodity and industry accounts. According to the theory for multiplier models based on commodity-by-industry SAMs, which is an extension of the ordinary I/O multiplier models, there are three total requirements matrices that can be used following industry technology, namely the industry-by-industry, industry-by-commodity and commodity-by-commodity matrices. The results of the industry-by-industry submatrix were used in this study for the multiplier and linkage results, whereas the industry by commodity total requirements matrix was used for the scenarios.

The study found that the column of Leontief inverse is suitable to calculate backward linkage and the row of Ghosh inverse is suitable for forward linkages. In terms of normalization form, a sector with a linkage of less than one or greater than one would be considered weakly or strongly interdependent respectively.

Chapter 5 presents the main findings of this study.

5. CHAPTER 5: RESULTS FROM THE MODEL

5.1. Introduction

As stated in Chapter 4, a SAM multiplier analysis will be used for this study, in order to analyse the agricultural contribution to economic growth and development in Limpopo. Therefore, the SAM multiplier analysis is used to estimate the output, income and value added multipliers for the economy of Limpopo. The output multiplier is used to analyse the increase in total production value resulting from a change in final demand of a particular sector in the economy. The income multiplier is used to analyse the income generated by households from various sectors of the economy. For this reason, various racial (Black, Coloured, Asian & Indians and White) and income (low, medium and high income) household classification groups of Limpopo will shed some light on the existing imbalance. The value added multiplier is used to analyse the increase in factor income received when demand for output from various sectors within the economy increases.

The SAM multiplier model is also used to analyse various scenarios of change in demand for agricultural sectors in Limpopo. Moreover, the study will determine the structure of sub-sectors for primary, secondary and tertiary sectors in the Limpopo economy. Therefore, the measure of backward linkages (power of dispersion index) and forward linkages (sensitivity of dispersion index) will be used. The two measures are calculated using the Leontief and Ghosh inverse matrices respectively based on the industry-by-industry total requirements matrix of the Limpopo SAM.

Section 5.2 presents the results of the multiplier analysis. Section 5.3 presents the impact analysis of the proposed scenarios on the increase in agricultural commodities due to an increase in exports to the rest of South Africa and abroad, as well as a scenario on investment subsidies on agricultural production. Section 5.4 presents the backward and forward linkages of industries in the economy of Limpopo. A brief summary is presented at the end of the chapter.

5.2. Multiplier analysis

The multiplier analysis shows details of the impact of changes in final demand on production, income and value added to the entire economy. For this reason, they are considered important indicators for analysing the specific sectors and the interdependence of the industrial structure.

The output, income, and value added/GDP multipliers are all estimated using the SAM Leontief multipliers based on the industry-by-industry total requirement matrix.

5.2.1. Output multipliers

Table 15 summarises the output multipliers for the economy of Limpopo. This shows the increase in output as a result of a R1 million increase in final demand of each sector in the economy respectively.

Table 15: Output multipliers

Industries	Output multiplier	Rank[4]
All agriculture	1.671	8
Citrus fruit	1.593	VII
Subtropical fruit	1.660	V
Vegetables	1.622	VI
Livestock	1.712	II
Game	1.716	I
Forestry	1.695	IV
Other agriculture	1.700	III
Mining	1.811	4
Manufacturing	1.601	9
Water and electricity	2.027	1
Building and construction	1.876	2
Trade and accommodation	1.853	3
Transport, storage and communication	1.807	5
Financial insurance, real estate and business services	1.773	6
Community, social and personal services	1.668	7

Source: Researcher calculations

For example from Table 15, for a R1 million increase in demand for agricultural industries' output, the industry output in the economy increases by R1 671 000. R1 million increase in demand for water and electricity industry output, will result in an increase of R2 027 000 industry output in the economy. The output multiplier effects are largest for water and electricity, followed by building and construction, trade and accommodation, mining,

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[4] Agricultural sub-sectors were ranked using roman numerals numbers.

transport and communication, and financial insurance. Some of the agricultural sub-sectors generate large increments in output, the highest being game farming, followed by livestock, other agriculture, forestry, subtropical fruit, vegetables and citrus fruit having the lowest output multiplier. The R1 million injections in water and electricity, mining, agriculture and manufacturing industries output respectively, lead to increases of R2 027 000, R1 811 000, R1 671 000 and R1 601 000 to the output of all industries in the economy. This is because there are linkages between water and electricity, mining, agriculture and manufacturing sectors. Hence, an increase in electricity and water industry will lead to increased economic activity in other all industries. The output multipliers capture the total effect (direct, indirect and induced).

5.2.2. Income multipliers

Table 16 shows the sectors with the largest income multipliers. For example, if there is a R1 million increase in demand for products from the citrus fruit industry, incomes of Black households (high, medium and low income) in the economy increase by R192 100, R96 100 and R54 900 respectively. A R1 million increase in demand for products from the subtropical fruit industry, causes incomes of Black households (high, medium and low income) to increase by R244 300, R124 300 and R70 800 respectively.

A R1 million increase in demand for products from the subtropical fruit industry, will result in incomes of White, Coloured and Asian high income households to increase by R21 800, but with negligible effects for medium and low income households. For a R1 million increase in demand for products from the forestry industry, incomes of White, Coloured and Asians high income households increase by R20 900 and for demand from other agriculture, by R32 400.

On average, for a R1 million increase in demand for products from the agricultural industry, incomes of Black households (high, medium and low income) in the economy increase by R210 200, R99 000 and R56 900 respectively. A R1 million increase in demand for water and electricity, incomes of Black households (high, medium and low income) in the economy increase by R268 400, R115 000 and R68 300 respectively. A R1 million increase in demand for community and personal services, incomes of Black households (high, medium and low income) increase by R315 000, R105 600 and R62 800 respectively.

The largest increase in the income of high income Black households is for community and personal services industry. These are followed by water and electricity, wholesales industry,

financial insurance industry, mining industry, transport industry, agriculture industry, manufacturing industry and construction industry.

Table 16: Income multiplier s

Industries	Black			White, Coloured and Asian		
	High income	Medium income	Low income	High income	Medium income	Low income
All agriculture	0.2102	0.0990	0.0569	0.0212	0.0021	0.0005
Citrus fruit	0.1921	0.0961	0.0549	0.0173	0.0005	0.0001
Subtropical fruit	0.2443	0.1243	0.0708	0.0218	0.0006	0.0001
Vegetables	0.2092	0.1054	0.0602	0.0188	0.0005	0.0001
Livestock	0.1967	0.0964	0.0552	0.0183	0.0008	0.0001
Game	0.2007	0.0985	0.0564	0.0187	0.0008	0.0001
Forestry	0.2317	0.1170	0.0667	0.0209	0.0007	0.0001
Other agriculture	0.1968	0.0551	0.0337	0.0324	0.0111	0.0029
Mining	0.2616	0.1112	0.0658	0.0265	0.0007	0.0001
Manufacture	0.1837	0.0834	0.0489	0.0221	0.0008	0.0001
Water and electricity	0.2684	0.1150	0.0683	0.0230	0.0007	0.0001
Building and construction	0.1776	0.0743	0.0453	0.0177	0.0004	0.0001
Trade and accommodation	0.2633	0.1190	0.0699	0.0235	0.0006	0.0001
Transport, storage and communication	0.2176	0.0950	0.0561	0.0191	0.0006	0.0001
Financial insurance, real estate and business services	0.2629	0.1230	0.0689	0.0364	0.0008	0.0001
Community, social and personal services	0.3150	0.1056	0.0628	0.0314	0.0008	0.0001

Source: Researcher calculation

5.2.3. Value added/GDP multipliers

Table 17 summarises the value added/GDP multiplier for the economy of Limpopo. For example, for a R1 million increase in demand for output from the vegetable industry, the value added in the economy increases by R773 000. For a R1 million increase in demand for livestock industry output, the value added in the economy increases by R718 000. A R1 million increase in demand for agricultural industry output on aggregate, leads to an increase in value added in the economy of R764 000. Some of the sub-sectors of agriculture generate

substantial increments of value added, the highest being subtropical fruit, followed by forestry, vegetables, game, livestock, citrus fruit and other agriculture.

The highest value added multiplier is for the financial insurance and business service industry, which leads to an increase in value added of R962 000. The community and personal services industry has the second highest impact on value added with R921 000. The water and electricity industry the third highest with R902 000, followed by the wholesale industry with R900 000.

Table 17: Value-added multipliers

Industries	Value added	Rank[5]
All agriculture	0.764	7
Citrus fruit	0.707	VI
Subtropical fruit	0.908	I
Vegetables	0.773	III
Livestock	0.718	V
Game	0.734	IV
Forestry	0.858	II
Other agriculture	0.650	VII
Mining	0.885	5
Manufacturing	0.651	8
Water and electricity	0.902	3
Building and construction	0.584	9
Trade and accommodation	0.900	4
Transport, storage and communication	0.738	6
Financial insurance, real estate and business services	0.962	1
Community, social and personal services	0.921	2

Source: Researcher calculations

5.3. Impact analysis

Miller and Blair (2009) stated that the usefulness of the impact analysis is to estimate the change or shock of the sector on the economy. The authors indicated that the usefulness of this impact analysis will depend on the correctness of the Leontief inverse and estimated

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[5] Agricultural sub-sectors were ranked using roman numerals numbers.

changes in final demand. Moreover, this final demand vector project one or more behaviours of the exogenous elements, and correctness of these elements is important to generate a precise result (Miller & Blair, 2009). Scenarios were analysed, in particular the scenarios related to an increase of a 5% in export demand of agricultural commodities to the rest of South Africa and to the rest of the world respectively, as well as a 5% increase in investment subsidies in Limpopo.

5.3.1. Impact of a 5% increase in exports of selected agricultural commodities to the rest of South Africa

Table 18 indicates the components of agricultural commodity exports to the rest of South Africa. The base values of exports to the rest of South Africa in the SAM are shown in Table 18 and are used to estimate the 5% increase in exports demand of selected agricultural commodities to the rest of South Africa. For example, a 5% increase of the exports demand of citrus fruit amounts to an increase of R1.5 million.

Table 18: Components of agricultural export demand to the rest of South Africa

Product	Base SAM values (R million)	5% Increase in export demand (R million)
Citrus fruit	29.91	1.50
Subtropical fruit	76.18	3.81
Vegetables	1 334.62	66.73
Livestock	285.77	14.29
Game	1.77	0.09
Forestry	70.25	3.51
Other agriculture	48.55	2.43

Source: Researcher calculations

Table 19 shows that a 5% increase in export demand for citrus fruit, will lead to an increase in citrus fruit output of R1.53 million and R1.60 million in aggregate agricultural output. Non-agricultural output will increase by R1.65 million in the economy, when the export demand for citrus fruit increase by 5%. It will further lead to an increase in incomes of Black households of R484 300. White, Coloured and Asian incomes will increase by R25 200 and GDP by R997 400. Similar interpretations apply for a 5% increase in export demand for each of the other respective products.

Table 19: Impact of 5% increase in exports of selected agricultural commodities to the rest of South Africa (R million)

	Citrus fruit	Subtropical fruit	Vegetables	Livestock	Game	Forestry	Other agriculture	All
Agriculture	**1.6007**	**4.3555**	**72.8953**	**15.1890**	**0.0899**	**3.9359**	**2.5474**	**100.6137**
Citrus fruit	1.5349	0.0005	0.0050	0.0012	0.0000	0.0002	0.0002	1.5420
Subtropical fruit	0.0017	4.1254	0.0564	0.0196	0.0000	0.0031	0.0025	4.2088
Vegetables	0.0057	0.0185	70.0591	0.0495	0.0001	0.0096	0.0069	70.1493
Livestock	0.0078	0.0251	0.2562	14.5596	0.0001	0.0134	0.0106	14.8727
Game	0.0005	0.0015	0.0157	0.0072	0.0888	0.0010	0.0010	0.1157
Forestry	0.0363	0.1400	2.0424	0.0524	0.0001	3.8675	0.0199	6.1586
Other agriculture	0.0138	0.0445	0.4605	0.4995	0.0008	0.0411	2.5064	3.5666
Non-agriculture	**1.6529**	**3.7920**	**46.7886**	**14.2414**	**0.0232**	**2.0301**	**2.2640**	**70.7922**
Black low income	0.0775	0.2515	2.5545	0.5968	0.0010	0.1254	0.0592	3.6658
Black medium income	0.1355	0.4413	4.4737	1.0395	0.0017	0.2196	0.0971	6.4083
Black high income	0.2713	0.8683	8.8904	2.1351	0.0035	0.4364	0.3322	12.9372
Subtotal Black income	**0.4843**	**1.5611**	**15.9186**	**3.7714**	**0.0062**	**0.7813**	**0.4885**	**23.0114**
White, Coloured and Asian low income	0.0001	0.0002	0.0025	0.0013	0.0000	0.0002	0.0046	0.0089
White, Coloured and Asian Medium income	0.0007	0.0022	0.0228	0.0081	0.0000	0.0012	0.0174	0.0525
White, Coloured and Asian high income	0.0244	0.0776	0.7988	0.1978	0.0003	0.0393	0.0528	1.1910
Subtotal White, Coloured and Asian income	**0.0252**	**0.0801**	**0.8241**	**0.2071**	**0.0003**	**0.0407**	**0.0748**	**1.2523**
Overall income	**0.5095**	**1.6411**	**16.7427**	**3.9786**	**0.0065**	**0.8220**	**0.5633**	**24.2636**
GDP	**0.9974**	**3.2253**	**32.8329**	**7.7560**	**0.0127**	**1.6123**	**1.0999**	**47.5366**
Labour	0.3250	1.0220	10.5900	2.6387	0.0043	0.5209	0.3789	15.4799
Capital	0.6724	2.2033	22.2429	5.1173	0.0084	1.0914	0.7210	32.0567
All	**4.7605**	**13.0139**	**169.2595**	**41.1650**	**0.1302**	**8.4004**	**6.4746**	**243.2061**

Source: Researcher calculations

Table 19 shows that the highest increase in aggregate agricultural output is when there is a 5% increase in export demand for vegetables, with R72.90 million. Demand for livestock leads to the second highest output in agricultural output of R15.19 million, followed with subtropical fruit (R4.35 million), Forestry (R3.93 million), other agriculture (R2.54 million), citrus fruit (R1.60 million) and game (R89 900). Each column shows the results if exports demand for just one commodity increases, but the final column shows the simultaneous effect. For example, a 5% increase in exports demand on all the selected agricultural commodities simultaneously, will increase agricultural output by R100.61 million, compared to an increase output of R70.79 million for non-agriculture. The total Black income increases with R23.01 million, compared to R1.25 million of the total income for Whites, Coloureds and Asians. The total GDP in the economy increases with R47.53 million. The overall impact on the economy is R243.20 million.

5.3.2. Impact of a 5% increase in exports of selected agricultural commodities to the rest of the world

Table 20 indicates the components of agricultural commodity exports to the rest of the world. The base values from the SAM are shown in Table 20 and are used to estimate the 5% increase in export demand of selected agricultural commodities to the rest of the world. For example, a 5% increase in the exports demand of citrus fruit amounts to (R60.29 million).

Table 20: Components of agricultural export demand to the rest of the world

	Base SAM values (R million)	5% Increase in export demand (R million)
Citrus fruit	1 205.71	60.29
Subtropical fruit	194.86	9.74
Vegetables	272.02	13.60
Livestock	71.83	3.59
Game	6.75	0.34
Forestry	0.00	0.00
Other agriculture	102.85	5.14

Source: Researcher calculations

Table 21 shows that a 5% increase in export demand for citrus fruit, will lead to an increase in citrus fruit output of R61.87 million and R64.52 million for aggregate agricultural output.

Non-agricultural output will increase by R66.63 million, when the export demand in citrus fruit increase by 5% and it will also lead to an increase in income of Black households of R19.52 million and R1.01 million for White, Coloured and Asian households. GDP increases by R40.20 million.

Table 21: Impact of 5% increase in exports of selected agricultural commodities to the rest of the world (R million)

	Citrus fruit	Subtropical fruit	Vegetables	Livestock	Game	Forestry	Other agriculture	All
Agriculture	**64.524**	**11.140**	**14.857**	**3.818**	**0.342**	**0.000**	**5.397**	**100.079**
Citrus fruit	61.872	0.001	0.001	0.000	0.000	0.000	0.000	61.875
Subtropical fruit	0.069	10.552	0.012	0.005	0.000	0.000	0.005	10.643
Vegetables	0.232	0.047	14.279	0.012	0.000	0.000	0.015	14.585
Livestock	0.314	0.064	0.052	3.660	0.000	0.000	0.022	4.113
Game	0.019	0.004	0.003	0.002	0.338	0.000	0.002	0.368
Forestry	1.462	0.358	0.416	0.013	0.000	0.000	0.042	2.292
Other agriculture	0.557	0.114	0.094	0.126	0.003	0.000	5.310	6.204
Non-agriculture	**66.631**	**9.699**	**9.536**	**3.580**	**0.088**	**0.000**	**4.796**	**94.331**
Black low income	3.124	0.643	0.521	0.150	0.004	0.000	0.125	4.567
Black medium income	5.461	1.129	0.912	0.261	0.006	0.000	0.206	7.975
Black high income	10.938	2.221	1.812	0.537	0.013	0.000	0.704	16.225
Subtotal Black income	**19.523**	**3.993**	**3.244**	**0.948**	**0.024**	**0.000**	**1.035**	**28.767**
White, Coloured and Asian low income	0.003	0.001	0.001	0.000	0.000	0.000	0.010	0.014
White, Coloured and Asian medium income	0.028	0.006	0.005	0.002	0.000	0.000	0.037	0.077
White, Coloured and Asian high income	0.983	0.198	0.163	0.050	0.001	0.000	0.112	1.507
Subtotal White, Coloured and Asian income	**1.014**	**0.205**	**0.168**	**0.052**	**0.001**	**0.000**	**0.158**	**1.599**
All income	**20.537**	**4.198**	**3.412**	**1.000**	**0.025**	**0.000**	**1.193**	**30.366**
GDP	**40.207**	**8.250**	**6.692**	**1.950**	**0.048**	**0.000**	**2.330**	**59.477**
Labour	13.103	2.614	2.158	0.663	0.016	0.000	0.803	19.358
Capital	27.104	5.636	4.533	1.286	0.032	0.000	1.528	40.119
All	**191.900**	**33.287**	**34.498**	**10.347**	**0.504**	**0.000**	**13.717**	**284.252**

Source: Researcher calculations

Table 21 further shows that the highest aggregate agricultural output of R64.52 million is obtained when the export demand for citrus increases by 5%. Vegetables leads to the second highest output of R14.85 million, followed by subtropical fruit (R11.14 million), other agriculture (R5.39 million), livestock (R3.81 million) and game (R342 000). Each column shows the results if export demand for just one commodity increases, but the final column shows the effect of a simultaneous increase of 5% in export demand for all the selected agricultural commodities. In this instance aggregate agricultural output increases by R100.08 million, compared an increase in output of R94.33 million for non-agriculture. Total incomes of Black households increase with R28.76 million, compared to the R1.59 million for Whites, Coloureds and Asians. The GDP in the economy increases with R59.48 million and the overall impact in the economy is an increase of R284.25 million.

5.3.3. Impact of a 5% increase in investment subsidies on selected agricultural industries

Investment subsidies would allow the agricultural industries to increase the level of their physical capital goods and services, enabling the sector to expand by increasing its output. Table 22 indicates the components of investment demand in agricultural activities. The base values in Table 22 are used to calculate a change of 5% increase in investment demand of selected agricultural industries. Infrastructure is included and refers to the construction industry, because typically investment in agriculture also requires additional infrastructure. If money is spent on agricultural infrastructure, then there is an also an indirect and induced effect on demand for products from the agricultural industries.

Table 22: Components of investment demand

	Base SAM values (R million)	5% Increase in investment demand (R million)
Citrus fruit farming	4.50	0.22
Subtropical fruit farming	14.46	0.72
Vegetable farming	15.49	0.77
Livestock farming	29.59	1.48
Game farming	0.35	0.02
Forestry	132.18	6.61
Other agriculture	25.61	1.28
Infrastructure	10.615	0.531

Source: Researcher calculations

Table 23 shows the impact of a 5% increase in investment demand on selected agricultural industries. Forestry has the highest output of R7.32 million, when the investment demand increases by 5%. Livestock has the second highest output (R1.55 million), followed by other agriculture (R1.49 million), vegetables (R846 000), subtropical fruit (R799 000), citrus fruit (R232 000) and game (R18 000). Agricultural output increases by R12.25 million, compared to an increase in non-agricultural output of R7.49 million. Incomes of Black households increase with R4.48 million, compared to R275 000 for Whites, Coloureds and Asians. GDP increases by R9.30 million, with an overall impact of R33.81 million.

Table 23: Impact of 5% increase investment subsidies on agricultural activities (R million)

|	Investment subsidies on agricultural industries
Agriculture	**12.258**
Citrus fruit farming	0.232
Subtropical fruit farming	0.799
Vegetable farming	0.846
Livestock farming	1.556
Game farming	0.018
Forestry	7.328
Other agriculture	1.479
Non-agriculture sector	**7.493**
Black high income	2.554
Black medium income	1.221
Black low income	0.701
Subtotal Black income	**4.475**
White, Coloured and Asian high income	0.250
White, Coloured and Asian medium income	0.021
White, Coloured and Asian low income	0.005
Subtotal White, Coloured and Asian income	**0.276**
All income	**4.751**
GDP	**9.304**
Labour	3.052
Capital	6.252
All	**33.806**

Source: Researcher calculations

5.4. Linkages

The normalized values of backward and forward linkages of 41 industries in the economy of Limpopo were calculated in order to identify key industries in the economy. Industries which have both forward and backward linkages above average (greater than one), are classified as key industries and could play a potentially important role in the development strategy of the province (Miller and Blair, 2009). Results are based on the industry-by-industry total requirements matrix.

The backward linkages (power of dispersion index) measure the direct, indirect and induced effects of inputs needed by other industries for a one-unit increase in the industry's final product. The forward linkages (sensitivity of dispersion index) measure the total increase of output by an industry from an initial one-unit increase of product that is needed by another industry as input from their own production. The following figures compare the linkages for each of the primary, secondary and tertiary industries.

Figure 19 shows the calculated indices for the primary sector in Limpopo, which contains 12 industries. Seven industries are agricultural industries, while the remaining five are mining industries. Most of the industries from the primary sector have shown weak backward and forward linkage values. The agricultural industries with the strongest backward linkages are livestock and game farming, and for mining industries it is ferrous mineral mining, non-ferrous mineral mining and other mining and quarrying (Figure 19). High forward linkages for agricultural sub-industries such as game farming, forestry and other agriculture, mean that other sectors demand output to use it as inputs for their own production. These industries are important for the economic development in Limpopo.

Figure 19: Primary sector power and sensitivity of dispersion indices
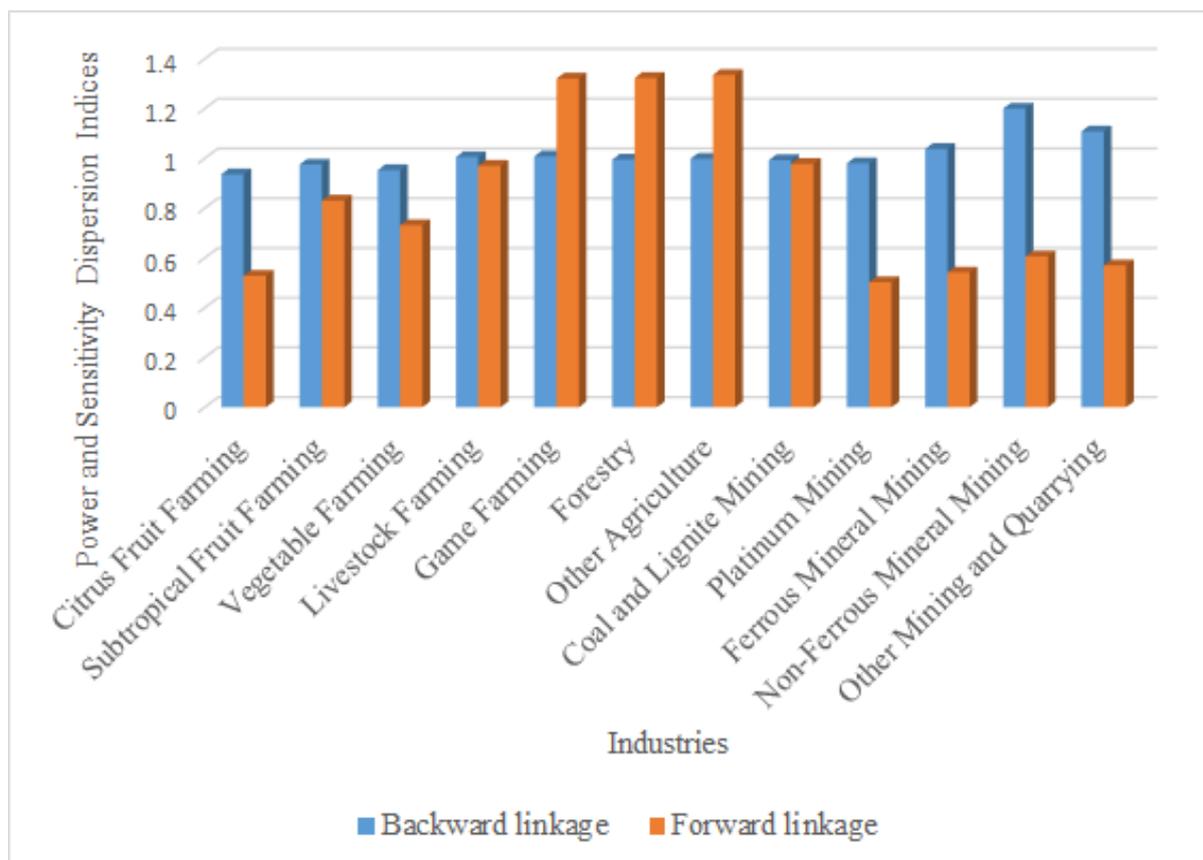
Source: Researcher calculations

Figure 20 shows that Limpopo's manufacturing sector is disaggregated into 18 industries. In the case of forward linkages 14 out of 18 industries show are above average, with the highest being publishing and printing, followed by paper and paper products. On the other hand, there are only seven industries with backward linkages that are above average (one). The industry with the highest backward linkage is water, followed by meat and fats, grain mill and animal feed, and electricity. The strong backward and forward linkage-effects for electricity and water is because sectors require or need water and electricity to operate. The weak forward linkage-effect for building and construction is because other sectors supply large amounts of raw materials such as cement, sand and steel to this sector, and therefore they are considered a demander of inputs. It should be noted that electricity and water are the key sectors in terms of linkages for the economic development in Limpopo and special attention should be placed in these sectors.

Figure 20: Secondary sector power and sensitivity of dispersion indices
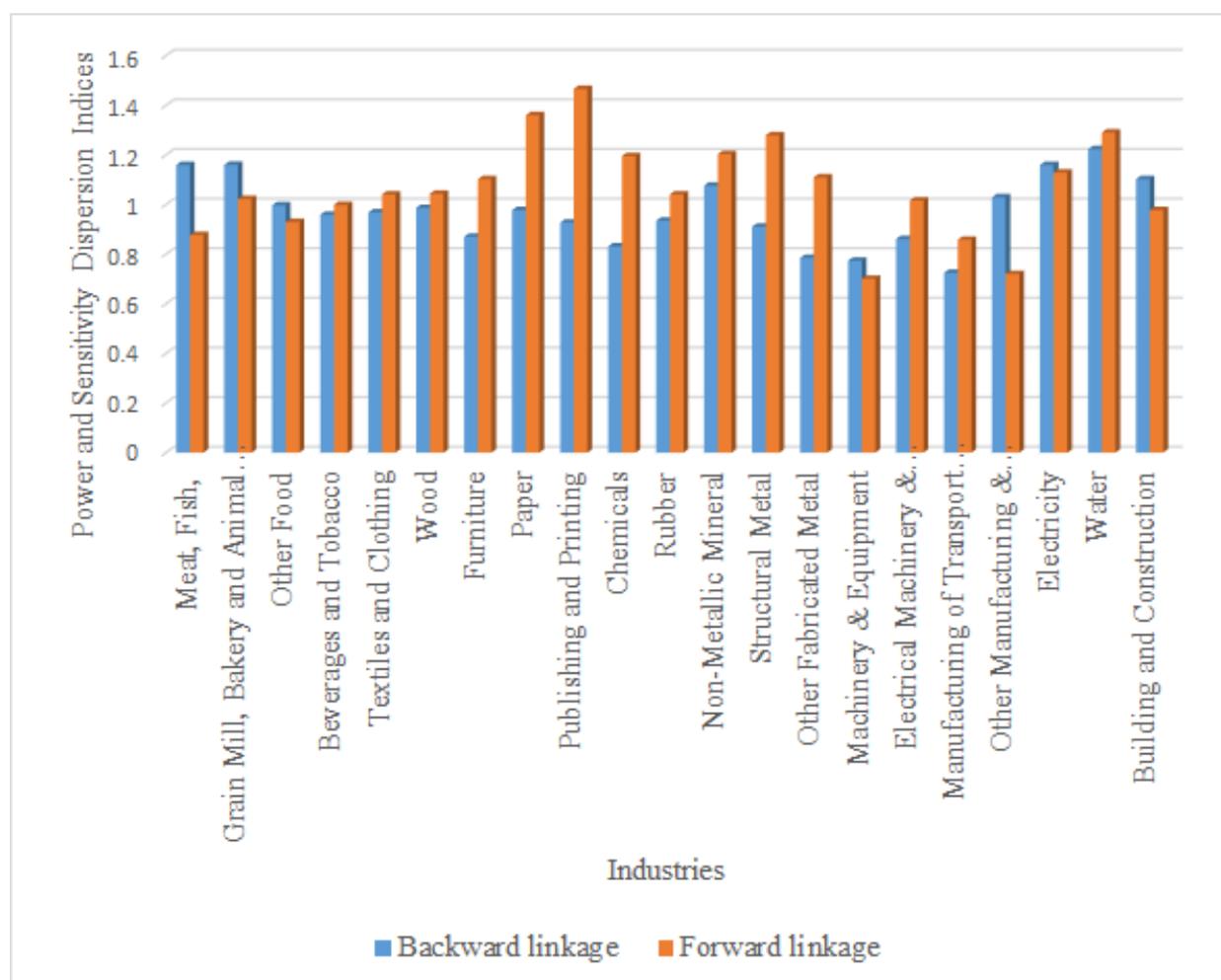
Source: Researcher calculations

The Limpopo tertiary sector contains eight industries of services (Figure 21). In the case of backward linkages, the majority of the industries are above average. Five industries have forward linkages that are above average. Real estate show the strongest backward linkage and business services the strongest forward linkage. The strong forward linkage effects of business services is because other industries require services to operate their businesses. Based on the results the tertiary sector is among the key sectors in Limpopo and therefore require special attention from the policy-makers.

Figure 21: Tertiary sector power and sensitivity of dispersion indices
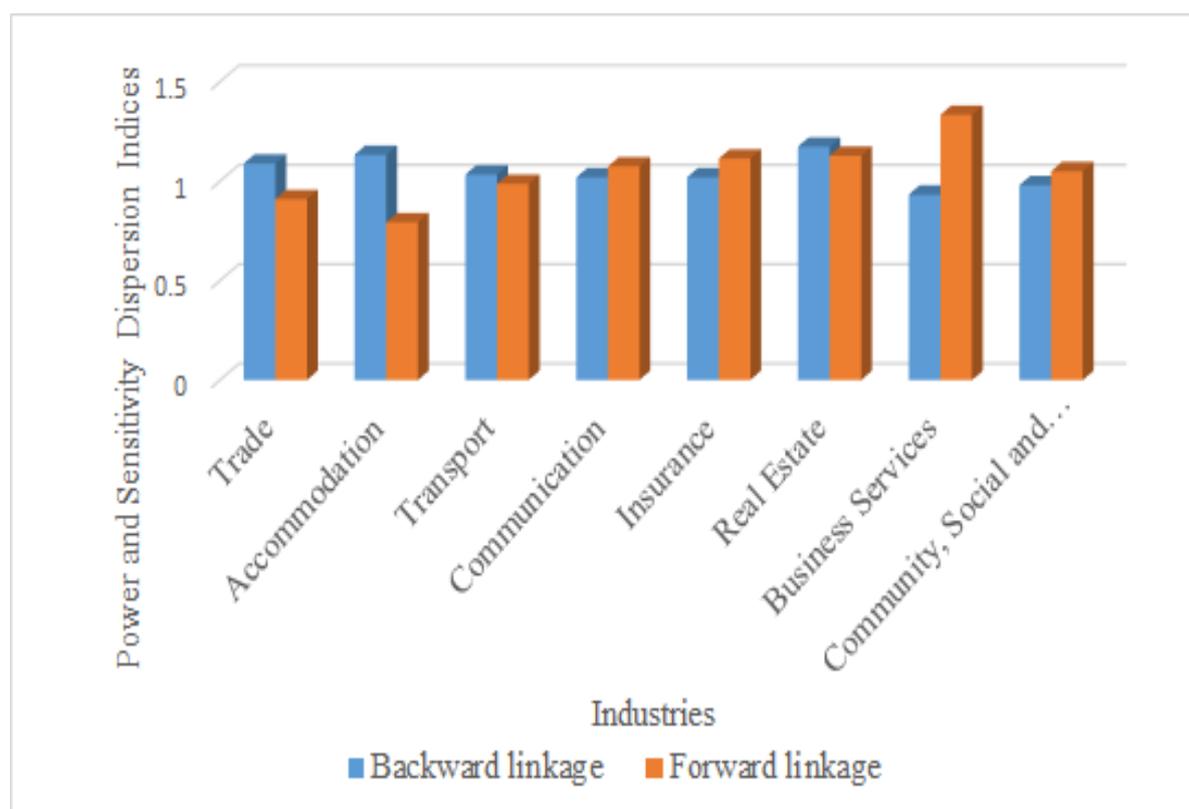
Source: Researcher calculations

Table 24 indicates the detailed index values for the power and sensitivity of dispersion. Those values that are greater than one are highlighted in bold and indicate that the industries have stronger than average linkages.

Table 24: Key sectors in Limpopo's economy based on power of dispersion index (backward linkages) and sensitivity of dispersion index (forward linkages)

	Backward	Forward		Backward	Forward
Citrus Fruit Farming	0.936	0.529	Chemicals & Chemical (incl Plastic)	0.831	**1.195**
Subtropical Fruit Farming	0.976	0.831	Rubber	0.935	**1.041**
Vegetable Farming	0.953	0.732	Non-Metallic Mineral	**1.077**	**1.203**
Livestock Farming	**1.006**	0.971	Structural Metal	0.911	**1.280**
Game Farming	**1.008**	**1.322**	Other Fabricated Metal	0.785	**1.110**
Forestry	0.996	**1.324**	Machinery & Equipment	0.774	0.701
Other Agriculture	0.999	**1.336**	Electrical Machinery & Apparatus	0.861	**1.016**

	Backward	Forward		Backward	Forward
Coal and Lignite Mining	0.993	0.979	Manufacturing of Transport Equipment	0.725	0.858
Platinum Mining	0.981	0.503	Other Manufacturing & Recycling	**1.030**	0.720
Ferrous Mineral Mining	**1.038**	0.542	Electricity	**1.160**	**1.129**
Non-Ferrous Mineral Mining	**1.201**	0.607	Water	**1.223**	**1.290**
Other Mining and Quarrying	**1.109**	0.571	Building and Construction	**1.103**	0.978
Meat, Fish, Fruit, Vegetables, Oils and Fat Products	**1.160**	0.877	Trade	**1.089**	0.910
Grain Mill, Bakery and Animal Feed Products	**1.160**	**1.023**	Accommodation	**1.133**	0.793
Other Food Products	0.997	0.930	Transport	**1.034**	0.987
Beverages and Tobacco Products	0.958	0.998	Communication	**1.019**	1.075
Textiles, Clothing, Leather Products and Footwear	0.968	**1.040**	Insurance	**1.019**	**1.114**
Wood and Wood Products	0.986	**1.044**	Real Estate	**1.174**	**1.129**
Furniture	0.871	**1.102**	Business Services	0.932	**1.335**
Paper and Paper Products	0.977	**1.361**	Community, Social and Personal Services	0.981	**1.050**
Publishing and Printing	0.928	**1.466**			

Source: Researcher calculations

5.5. Conclusion

In this chapter, the results on the SAM-based output, income and value added multipliers for the Limpopo economy were reported. From the results of the output multiplier, it is found that the water and electricity industry have large multiplier effects, and the agricultural industry was ranked 7th and 8th for output and value added multiplier respectively. Some of the agricultural sub-sectors generate large increases in output, the highest being subtropical fruit with regard to the output multiplier. The results indicated that an injection of R1 million in the agricultural sector will lead to a notable change in output (R1.67 million) and value added (R764 000). The water and electricity industry was ranked first for output (R2.03

million) and third for value added (R900 000). The finance industry was ranked first for value added (R962 000) and sixth for output (R1.77 million).

Secondly, the analysis estimated the impact of a 5% increase in export demand to the rest of South Africa and the rest of the world respectively. The results indicate that vegetables are the largest export demand to the rest of South Africa. Citrus is the largest export demand to the rest of the world. The increase in total GDP (R59.47 million) resulting from an export demand increase from the rest of the world exceeds the increase in total GDP (R47.53 million) from the increase in demand from rest of South Africa.

Thirdly, the analysis estimated the impact of a 5% increase in investment demand in agricultural activities. The results show that agricultural sectors increase more than non-agricultural sectors, as expected. For this scenario the forestry industry shows the greatest increase in output compared to other agricultural sub-sectors. The total income from Black households (R4.48 million) increased more than that of Whites, Coloureds and Asians (R276 000). The total GDP in the economy increased with R9.3 million.

Finally, the study also determined the inter-sectoral forward and backward linkages, which was used to determine the leading sectors in the Limpopo economy based on the normalized form of the linkages. The results indicated that industries from the tertiary sector are gaining higher position on the list of leading industries in Limpopo. Moreover, investment in this sector would initiate economic development due to the inter-linkage with other sectors. The result of the study may be used for the development strategy of Limpopo economy.

In the following chapter the empirical results are summarized and policy implications are noted.

6. CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1. Introduction

The main aim of this chapter is to discuss the overall findings of the thesis. The approach used in the previous chapter is based on the SAM Leontief multiplier, and has the following objectives: to estimate the SAM multiplier analysis such as output, income and value added and to simulate the scenarios for the selected agricultural commodities as well as investment subsidies in agricultural activities. A further objective is to measure industries' backward and forward linkages. The section that follows will briefly review the main findings of the chapters followed by policy recommendations. The last section of this chapter will present final conclusions and areas for further research.

6.2. Overview literature of the study

It is important to note that this theoretical framework imparted an interesting point of departure for agricultural economic growth and development. In this section, the theories of economic growth and development were examined. The majority of the theories stated that agriculture is important to alleviate poverty and improve development in rural areas.

Based on Lewis' theories and Harrod Domar's model, the main focus should be more on the alleviation of poverty as well as increasing economic growth in the agricultural sector. Their theories apply mostly to rural areas where the majority of poor people depend on agriculture for their survival. Lewis' theories recommended the industrial sector as a mechanism to improve the life of the poor in rural areas. As concluded by Harrod Domar's model, for production in the agricultural sector to increase, there must be a level of increase in savings which in turn stimulates economic growth. Therefore, the motivation to focus on investment in new methods of technology, is because of the fact that skilled labourers find it easier to adopt new methods of technology.

It is important in this study to recommend investment as a key factor for agriculture development: as it was discussed, skilled labour is likely to fuel innovation and the creation of domestic technology, which in turn can stimulate economic growth. According to the literature review of the traditional role of agriculture, agriculture can stimulate overall economic growth. Agriculture can play an important role in earning foreign exchange through exports and can benefit from capital formation and investment in agricultural research, infrastructure and human capital.

In section 2.4 the study discusses the constraints that affect small-scale farmers. Most of the famers are faced with the problem of not having access to agricultural credit because the financial institution such as Land Bank, commercial banks and other moneylenders consider them to be high-risk borrowers. Therefore, it is concluded that in order to eliminate production limitations and problems of market access, government should note that no strategy to improve development could be successful without credit accessibility to farmers since faster growth requires access to finance.

Chapter 3 reviews Limpopo's contribution to GDP. It was found that the province's contribution deteriorated from 2013 to 2014. Henceforth, the GDP growth rate in Limpopo (0.8%) remained slightly lower than the GDP growth rate of South Africa (1.5%) in 2014. The tertiary industries continued to dominate the primary and secondary industries. The manufacturing sector employed 89 000 in the 2nd quarter of 2014, compared to 73 000 in the 2nd quarter of 2015. In terms of the agricultural sectors, the contribution to Limpopo's GDP declined from 3.2% in 2008 to 2.2% in 2014. In the 3rd quarter of 2014 this sector employed 111 000, compared to 145 000 in the 3rd quarter of 2015. Employment in the mining sector, rose from 70 000 in the 3rd quarter of 2014 to 78 000 in the 3rd quarter of 2015. In terms of nominal income, there was an increase of R1.17 billion (25.8%) worth of gross farm income from 2002 to 2007, although real income remained almost constant over this period. The Waterberg district generated the highest gross farm income for livestock (R715.1 million), field crops (R293.6 million) and game (R101.6 million). Mopani recorded the highest income generation for vegetables (R535.6 million) and fruit (R509.8 million). Waterberg produced the most arable crops, of which, maize contributes the most to the physical output (metric tonnes). Tomatoes are mainly produced in Mopani (193 592 tonnes), while Capricorn is the main producer of potatoes (157 195 tonnes). Oranges (280 818 tonnes) and bananas (26 074 tonnes) are mainly produced in the Mopani. Within the context of agricultural production, game is mainly owned in Waterberg (31 379 head).

The aim of the policy implementation by the government and priorities is to build a united and prosperous agricultural sector that will raise the contribution of the national and provincial agricultural sectors towards economic growth and development. The national and provincial strategy recognized the importance of building global competitiveness and maintaining profitability in the agricultural sector through providing inputs. Moreover, the strategic plan aimed to improve support to small-scale producers and in doing so, increase the number of small-scale producers. This plan can be achieved through extension, cooperation

development, mechanisation, marketing and financial services. The empirical evidence (DAFF, 2012) however, shows that agro-processing and particularly food processing is one of the sectors with the highest employment multipliers in the economy.

In Chapter 4 the study addresses the extension of the I/O tables to SAMs that contain both make and use matrices. There is no secondary production recorded in the Limpopo SAM, but the SAM has a make and use framework. Four total requirements matrices can be derived from the four production sub-matrices, namely the industry-by-industry, industry-by-commodity, commodity-by-industry and commodity-by-commodity matrices. The results of the industry-by-industry total requirements matrix were used for the calculation of the multipliers and linkages in this study, whereas the results of the industry-by-commodity total requirements matrix were used for the scenarios. The multipliers indicate the output, income and value-added/GDP that are generated due to an additional unit of final demand.

In Chapter 5, the results indicate that a R1 million injected into the economy will lead to an increase in output of the water and electricity industry (R2.02 million). The industry does not only have relatively high backward linkages, but also above average forward linkages. The high forward linkages of water and electricity industries is because of the linkages with other industries such as manufacturing, mining, agriculture and financial services. These industries require water and electricity to operate their businesses. Despite the relatively low contribution of the aggregated agricultural industry to output growth (R1.67 million), the findings have underlined the importance of the game sub-sector as key sector due to it being highly integrated with backward and forward linkages that are above average. Livestock has an above average backward linkage, whereas forestry has above average forward linkages. The community and personal service industry generates the most income for Black households in the economy. The financial industry generates the highest value added in the economy. Moreover, the findings of the study revealed the important benefits of the financial industry as a key sector of the economy, with strong backward and forward linkage effects. In the case of the manufacturing, industries such as animal feed is of importance to enhance development and economic growth to the rest of the economy; given its above average and relatively strong backward and forward linkage effects. Manufacturing industries such as oil and fats, recycling and construction have above average backward linkages. On the other hand, industries such as textile, wood, furniture, paper, publishing and printing, and electrical machinery have above average forward linkages. Tertiary sub-sector industries such as trade,

accommodation, communication have above average backward linkages, whereas business services, and community and personal services, have relatively stronger forward linkages.

The results for the 5% increase in exports to the rest of South Africa revealed that the highest increase in agricultural output is for vegetables (R72.90 million); whereas for the 5% increase in exports to the rest of the world, it is citrus fruit (R64.52 million). As expected, a 5% increase in exports to the rest of South Africa creates a smaller increase in GDP (R243.20 million) compared to a 5% increase in exports to the rest of world (R284.25 million).

Forestry has the highest output of 7.32 million in the economy, when investment demand increases by 5%. Agricultural output (R12.25 million) contributes more than non-agricultural output (R7.49 million). Black household's income increase relatively more (R4.48 million) compared to White, Coloured and Asian households (R0.28 million). GDP in the economy rose by R9.30 million, with an overall impact of R33.81 million.

6.3. Policy Implications

It is important to suggest effective policy to stimulate economic growth in Limpopo. The first policy should stimulate the water and electricity sector; the water and electricity sector not only have strong backward linkages effect, but also strong forward linkage effects with other sectors, therefore the economy will reap the benefits of the expansion of this sector.

The second policy should target the finance sector because the sector has strong linkages with the agricultural sector. It is because any policy to improve economic development should cater for finance accessibility to agricultural production, as faster growth cannot be achieved without capital. The empirical evidence from this study reveal that agricultural sub-sectors that should be targeted include game livestock and forestry. Another policy suggestion is to increase investment in infrastructure. Investment in roads, water and food storing infrastructure will be beneficial to the economy because of the provision of food at lower prices. This will not only improve the competitiveness of agricultural (vegetables and citrus fruit) exports markets to the rest of the South Africa, but also to the rest of the world.

6.4. Conclusions

Since most of the people in Limpopo live in underdeveloped areas they are assumed to be engaged in the agricultural sector as their source of livelihood. The hypothesis states that the agricultural sector is expected to contribute more than non-agricultural sectors to economic growth in Limpopo, but this was not found to be true. It should be noted that for development

in Limpopo, more focus should be placed on water and electricity (to stimulate output), financial insurance (to stimulate value-added) and community and personal services (to stimulate income) sectors for the contribution to economic growth due to larger multipliers when compared to other sectors.

The strength of linkages is to show the probability that the action in the industry in question will positively influence other industries in the economy. The empirical findings revealed that the agricultural sector has relatively weak linkages compared to most other sectors in the economy. It is therefore concluded that the production linkages of the agricultural sector is low and not key to stimulate economic growth. However, the findings of this study have underlined the potential importance of an agricultural sub-sector such game, which although relatively small, could act as a key sector to stimulate the provincial economy. This sector is highly integrated with relatively high backward and forward linkages. The livestock sub-sector is strongly backward orientated, i.e. it has strong linkages as a demander of inputs from other sectors. Within the agricultural sector, the forestry sub-sector has relatively strong linkages as a provider of output to other sectors. The study has underlined the notable benefits of the financial insurance sector as key sector of the economy, with strong backward and forward linkage effects. Henceforth, it is recommended that any strategy to improve economic development should cater for credit accessibility to agricultural production, since access to capital is essential for accelerated growth.

In terms of export demand to the rest of South Africa and rest of the world, more focus should be place on vegetables (such as potatoes, tomatoes, onions and pumpkins) and citrus fruit (such as oranges and bananas). On the other hand, investment in the forestry sub-sector will yield a higher return compared to other agricultural sub-sectors. In the case of the manufacturing industries such as animal feed is of importance to enhance development and economic growth to the rest of the economy due to its strong backward and forward linkages. Tertiary sector industries are important for economic development because of its relatively strong linkages to other sectors. Within the tertiary sector, industries such as trade, accommodation and communication have strong linkages as a demander of inputs. On the other side, business services and personal service have strong linkages as a provider of output to other sectors.

6.5. Recommendations for further studies

This research assesses the agricultural contribution to economic growth and development in Limpopo through a SAM multiplier analysis approach. The limitation of a SAM is the substantial data requirement and hence SAMs are usually not updated regularly. The Limpopo SAM is ten years old, and even if the SAM is in 2006 values, it is of greater concern if it is suspected that the structure of the provincial economy has changed substantially over the past ten years, since the patterns of expenditure rather than absolute values drive the multiplier results. Therefore, the future researchers should update the SAM to a recent year to ensure the relevance thereof.

It is also important for future researchers to study the contribution to economic growth in Limpopo comparing small-scale and large-scale agriculture through SAM multipliers and even CGE model approaches. The disaggregation of the agricultural sector is essential to distinguish the level of income (rural and urban households) received from small-scale and large-scale farming.

The estimation of employment multipliers is also recommended in order to compare the agricultural sector's contribution to employment relative to other economic sectors of Limpopo.

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ADDENDUM

Table 25: Accounts in the Limpopo Social Accounting Matrix (SAM)

Industries	Commodities	Labour	Capital	Enterprises	Households
Citrus Fruit Farming	Citrus Fruit	Africans - Legislators, senior officials and managers	Capital (GOS) Public Enterprise	Public Enterprise	Blacks - P1
Subtropical Fruit Farming	Subtropical Fruit	Africans - Professionals	Capital (GOS) Private Business Enterprise	Private Business Enterprise	Blacks - P2
Vegetable Farming	Vegetable	Africans - Technical & associate professionals	Capital (GOS) Informal Enterprise	Informal Enterprise	Blacks - P3
Livestock Farming	Livestock	Africans - Clerks			Blacks - P4
Game Farming	Game	Africans - Service workers, shop & market sales workers			Blacks - P5
Forestry	Forestry	Africans - Skilled agric. and fishery workers			Blacks - P6
Other Agriculture	Other Agriculture	Africans - Craft and related traders workers			Blacks - P7
Coal and Lignite Mining	Coal and Lignite Mining	Africans - Plant and machine operators & assemblers			Blacks - P8
Platinum Mining	Platinum Mining	Africans - Elementary occupations			Blacks - P9
Ferrous Mineral Mining	Ferrous Mineral Mining	Africans - Domestic workers			Blacks - P10
Non-Ferrous Mineral Mining	Non-Ferrous Mineral Mining	Coloureds - Legislators, senior officials and managers			Blacks - P11
Other Mining and Quarrying	Other Mining and Quarrying	Coloureds - Professionals			Blacks - P12
Meat, Fish, Fruit, Vegetables, Oils and Fat Products	Meat, Fish, Fruit, Vegetables, Oils and Fat Products	Coloureds - Technical & associate professionals			Coloureds - P1
Grain Mill, Bakery and Animal Feed Products	Dairy products	Coloureds - Clerks			Coloureds - P2
Other Food Products	Grain Mill, Bakery and Animal Feed Products	Coloureds - Service workers, shop & market sales workers			Coloureds - P3
Beverages and Tobacco Products	Other Food Products	Coloureds - Skilled agric. and fishery workers			Coloureds - P4
Textiles, Clothing, Leather Products and Footwear	Beverages and Tobacco Products	Coloureds - Craft and related traders workers			Coloureds - P5
Wood and Wood Products	Textiles, Clothing, Leather	Coloureds - Plant and machine operators			Coloureds - P6

Industries	Commodities	Labour	Capital	Enterprises	Households
	Products and Footwear	& assemblers			
Furniture	Wood and Wood Products	Coloureds - Elementary occupations			Coloureds - P7
Paper and Paper Products	Furniture	Coloureds - Domestic workers			Coloureds - P8
Publishing and Printing	Paper and Paper Products	Asians/Indians - Legislators, senior officials and managers			Coloureds - P9
Petroleum	Publishing and Printing	Asians/Indians - Professionals			Coloureds - P10
Chemicals & Chemical Products (incl Plastic Products)	Petroleum	Asians/Indians - Technical & associate professionals			Coloureds - P11
Rubber Products	Chemicals & Chemical Products (incl Plastic Products)	Asians/Indians - Clerks			Coloureds - P12
Non-Metallic Mineral Products	Rubber Products	Asians/Indians - Service workers,			Asians/Indians - P1
Basic Metal Products	Non-Metallic Mineral Products	Asians/Indians - Skilled agric. and fishery workers			Asians/Indians - P2
Structural Metal Products	Basic Metal Products	Asians/Indians - Craft and related traders workers			Asians/Indians - P3
Other Fabricated Metal Products	Structural Metal Products	Asians/Indians - Plant and machine operators & assemblers			Asians/Indians - P4
Machinery & Equipment	Other Fabricated Metal Products	Asians/Indians - Elementary occupations			Asians/Indians - P5
Electrical Machinery & Apparatus	Machinery & Equipment	Asians/Indians - Domestic workers			Asians/Indians - P6
Communication, Medical and other Electronic Equipment	Electrical Machinery & Apparatus	Whites - Legislators, senior officials and managers			Asians/Indians - P7
Manufacturing of Transport Equipment	Communication, Medical and other Electronic Equipment	Whites - Professionals			Asians/Indians - P8
Other Manufacturing & Recycling	Manufacturing of Transport Equipment	Whites - Technical & associate professionals			Asians/Indians - P9
Electricity	Other Manufacturing & Recycling	Whites - Clerks			Asians/Indians - P10
Water	Electricity	Whites - Service workers, shop & market sales workers			Asians/Indians - P11
Building and Construction	Water	Whites - Skilled agric. and fishery workers			Asians/Indians - P12
Trade	Building and Construction	Whites - Craft and related traders workers			Whites - P1
Accommodation	Trade	Whites - Plant and machine operators & assemblers			Whites - P2
Transport	Accommodation	Whites - Elementary occupations			Whites - P3

Industries	Commodities	Labour	Capital	Enterprises	Households
Communication	Transport	Whites - Domestic workers			Whites - P4
Insurance	Communication				Whites - P5
Real Estate	Insurance				Whites - P6
Business Services	Real Estate				Whites - P7
Community, Social and Personal Services	Business Services				Whites - P8
	Community, Social and Personal Services				Whites - P9
					Whites - P10
					Whites - P11
					Whites - P12