

**EFFECTS OF PARTICIPATION IN LIMID PROGRAMME ON HOUSEHOLD  
WELFARE OF SMALL STOCK PRODUCERS IN BOTETI SUB-DISTRICT,  
BOTSWANA**

**AGNES BINGE**

**A Thesis Submitted to the Graduate School in partial fulfillment for the requirements  
of Master of Science Degree in Agricultural and Applied Economics of Egerton  
University**

**EGERTON UNIVERSITY**

**MARCH, 2019**

## DECLARATION AND RECOMMENDATION

### Declaration

This thesis is my original work and has not been presented in any university or institution of higher learning for any award.

Signature .....

Date

.....

Agnes Binge

KM17/11741/16

### Recommendation

This thesis has been submitted with our approval as the university supervisors.

Signature .....

Date .....

Prof Patience Mshenga, PhD

Department of Agricultural Economics and Agri-Business Management, Egerton University

Signature



Date .....

Dr. Keneilwe Kgosikoma, PhD

Department of Agricultural Economics, Education and Extension, Botswana University of Agriculture and Natural Resources (BUAN)

## **COPYRIGHT**

©2019, Agnes Binge

All right reserved. This thesis or any part of it may not be reproduced, stored in a retrieval system or transmitted in any form or means such as electronic, recording, mechanical, photocopying or otherwise without prior written permission of the author or Egerton University on her behalf.

## **DEDICATION**

This thesis is dedicated to my beloved family.

## **ACKNOWLEDGEMENT**

Firstly I want to thank God Almighty for his love and mercy, indeed Jesus is Lord. I also like to acknowledge Egerton University for offering me a place to study in this reputable university. I also extend my appreciation to my two wonderful supervisors Prof Patience Mshenga and Dr. Keneilwe Kgosikoma for their huge contribution to this work. My special gratitude goes to my sponsor African Economic Research Consortium (AERC) who made it possible for me to be in Egerton University. I also thank Mr Joseph Mwangi for his tireless guidance and support. Appreciate also goes to LIMID staff members and all the respondents and enumerators. I owe more than I can say to my family and friends

## ABSTRACT

The study was generally intended to estimate the effectiveness of Livestock Management and Infrastructure Development (LIMID) programme in improving the welfare of the rural poor in Boteti Sub-District Botswana. Specifically, the study was carried to determine the main challenges encountered by small stock producers during and after application for LIMID programme, and further determine the factors influencing the decision of rural farmers to participate in the LIMID programme and finally to estimate the effect of LIMID programme on the household welfare of the small stock producers. Primary data was collected from 150 respondents who were selected using multistage sampling techniques and data was collected using a semi-structured questionnaire. Descriptive statistics, factor analysis, probit regression, Ordinary Least Squares (OLS) and Propensity Score Matching (PSM) analytical techniques were used in analysing the collected data. Factors that significantly influenced the decision of effective participation of small stock producers in the programme are gender of the farmer, household income, age of the farmer, positive perception about the programme, the use of supplementary feeds, education level and the distance to LIMID office. Meanwhile, factors that were found to significantly affect the household expenditure are household income, gender of the household head, age of the household head, education level, type of labour used, distance to nearby cattle post and the distance to inputs. The average age for the small stock farmers was found to be 45 years with majority of farmers being women at 57.3% while men were 43.7%. The LIMID programme has positively impacted and empowered the resource poor households, as revealed by PSM results. Beneficiaries spent an annual average of P12313.80 (1152.05 US\$), and it was higher than that of the non-beneficiaries which was P11237.86 (US\$ 1082.86). Average Treatment on the Treated (ATT) was P1074.94 (100.67) US\$. Therefore participating in LIMID programme has increased the average household consumption expenditure of the beneficiaries. Beneficiaries need to be encouraged to take care of their mall stock as participating in LIMID programme significantly improved their household's welfare.

## TABLE OF CONTENTS

<b>DECLARATION AND RECOMMENDATION .....</b>	<b>ii</b>
<b>COPYRIGHT .....</b>	<b>iii</b>
<b>DEDICATION.....</b>	<b>iv</b>
<b>ACKNOWLEDGEMENT.....</b>	<b>v</b>
<b>ABSTRACT.....</b>	<b>vi</b>
<b>TABLE OF CONTENTS .....</b>	<b>vii</b>
<b>LIST OF TABLES .....</b>	<b>x</b>
<b>LIST OF FIGURES .....</b>	<b>xi</b>
<b>LIST OF ABBREVIATIONS AND ACRONYMS .....</b>	<b>xii</b>
<b>CHAPTER ONE .....</b>	<b>1</b>
<b>INTRODUCTION.....</b>	<b>1</b>
1.1 Background of the study .....	1
1.2 Small stock production in Botswana.....	2
1.2.1 Sheep and goats production trends in Botswana.....	3
1.3 Statement of the problem .....	6
1.4 Objectives .....	6
1.4.1 General objective .....	6
1.4.2 Specific objectives .....	6
1.5 Research questions.....	6
1.6 Justification of the study .....	7
1.7 Scope of the study .....	7
1.8 Limitations of the study .....	7
1.9 Assumptions of the study .....	8
2.0 Operational definition of terms .....	8
<b>CHAPTER TWO .....</b>	<b>9</b>
<b>LITERATURE REVIEW .....</b>	<b>9</b>
2.1 Introduction.....	9
2.2 Economic importance of Agriculture.....	9
2.3 Challenges of small stock production in Botswana .....	10
2.4 The concept of household welfare .....	11
2.5 Contribution of small stock production to household incomes.....	12
2.6 Empirical review of the impact of Government agricultural interventions on household welfare .....	13
2.7 Study gap .....	16

2.8 Theoretical framework.....	17
2.8.1 Random Utility Theory .....	17
2.8.2 Theory of the farm household.....	18
2.8.3 Conceptual framework.....	21
<b>CHAPTER THREE .....</b>	<b>23</b>
<b>METHODOLOGY .....</b>	<b>23</b>
3.1 Introduction.....	23
3.2 Study area.....	23
3.3 Research design .....	24
3.4 Population of the study and respondents.....	24
3.5 Sampling procedure and sample size .....	25
3.6 Data collection instruments.....	26
3.6 Data management.....	26
3.7 Analytical Framework.....	26
<b>CHAPTER 4.....</b>	<b>36</b>
<b>RESULTS AND DISCUSSION .....</b>	<b>36</b>
4.1 Introduction.....	36
4.2 Socio-economic dimensions of beneficiaries and non-beneficiaries of LIMD programme .....	36
4.2.1 Gender of the farmers .....	36
4.2.2 Main occupation of the beneficiaries and non-beneficiaries of LIMID programme.....	36
4.2.3 Main source of income for beneficiaries and non-beneficiaries of LIMID programme .....	37
4.2.4 Age, farming experience and household size of the beneficiaries and non-beneficiaries....	38
4.2.5: Education level of the farmers .....	39
4.2.6 Marital status of the beneficiaries and non-beneficiaries of LIMID programme.....	39
4.1.7 Assets owned by small stock farmers .....	40
4.2.8 Reasons for beneficiaries’ participation in LIMID programme.....	42
4.3 Main challenges encountered by small stock producers during and after application for LIMID programme funding.....	43
4.3.1 Challenges faced by beneficiaries during application.....	43
4.3.2 Challenges faced by applicants after approval.....	44
4.3.3 Production and marketing constraints faced by small stock farmers .....	45
4.4 Preliminary test for multicollinearity and heteroskedasticity .....	48
4.5 Factors influencing decision of rural farmers to participate in LIMID programme in Boteti sub-district, Botswana.....	49
4.5.1 Perceptions of farmers regarding LIMID programme .....	49



4.6 Impact of LIMID programme and factors that affect household consumption expenditure .....	57
4.6.1 Factors affecting household consumption expenditure .....	57
4.6.2: Impact of the programme on household consumption expenditure .....	59
4.6.3: Average Treatment Effects on household consumption expenditure of the farmers .....	60
4.6.4 Testing for balancing of propensity scores and covariates .....	61
<b>CHAPTER FIVE .....</b>	<b>63</b>
<b>CONCLUSION AND RECOMMENDATION .....</b>	<b>63</b>
5.1 Introduction .....	63
5.2 Summary .....	63
5.3 Conclusion .....	64
5.4 Recommendations .....	65
5.5 Further research .....	66
<b>REFERENCES.....</b>	<b>67</b>
<b>APPENDICES .....</b>	<b>79</b>
<b>APPENDIX 1: HOUSEHOLD QUESTIONNAIRE .....</b>	<b>79</b>
<b>APPENDIX 2: LIMID SMALL STOCK COMPONENT .....</b>	<b>89</b>
<b>APPENDIX 3: PRELIMINARY TESTS OUTPUT.....</b>	<b>92</b>
<b>APPENDIX 4: KERNEL DENSITY ESTIMATE GRAPH.....</b>	<b>94</b>

## LIST OF TABLES

Table 1: Village sample size .....	26
Table 2: Variables used in the probit model and their measurement.....	29
Table 3: Variables used in OLS model and their measurements.....	31
Table 4: Covariates for propensity matching and their measurement .....	35
Table 5 : Gender of the beneficiaries and non-beneficiaries of LIMID programme.....	36
Table 6: Main occupation of beneficiaries and non-beneficiaries of LIMID programme.....	37
Table 7: Main source of income for farmers .....	38
Table 8: Demographic characteristics of beneficiaries and non-beneficiaries of LIMID .....	39
Table 9: Education level of the farmers .....	39
Table 10: Reasons for beneficiaries’ participation in LIMID programme .....	42
Table 11: Challenges faced by beneficiaries during application for LIMID funding.....	44
Table 12: Challenges faced by applicants after approval .....	44
Table 13: Production constraints faced by small stock farmers .....	47
Table 14: Marketing constraints faced by small stock farmers .....	48
Table 15: Perceptions of the farmers about the LIMID programme .....	50
Table 16: Factors influencing decision of rural farmers to participate in LIMID programme.....	54
Table 17: OLS output on factors affecting the farmers’ household consumption expenditure....	57
Table 18: Region of common support .....	60
Table 19: Average treatment effects on household expenditure of the farmers. ....	61
Table 20: Ps-test output for covariates balance based on kernel matching method .....	62

## LIST OF FIGURES

Figure 1: Different sources of income and their percentage contribution to poverty reduction in Botswana between 2002-2003 and 2009-2010 .....	2
Figure 2: Goats population trend (000) from 2004 to 2014.....	4
Figure 3: Sheep population trend (000) from 2004 to 2014 .....	4
Figure 4: Factors that influence the decision of the farmer to participate in LIMID programme	22
Figure 5: Map of Boteti sub District, Botswana .....	24
Figure 6: Marital status of the small stock farmers.....	40
Figure 7: Household assets .....	41

## **LIST OF ABBREVIATIONS AND ACRONYMS**

AVE	Average Variance Extracted
CEDA	Citizen Entrepreneurship Development Agency
CR	Coefficient Reliability
ERSM	Endogenous Switching Regression Model
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
ISPAAD	Integrated Support Programme for Arable Agricultural Development
KMO	Kaiser Meyer-Olkin
LIMID	Livestock Management and Infrastructure Development
LWDP	Livestock Water Development Programme
OLS	Ordinary Least Squares
PEI	Poverty Eradication Initiatives
PSM	Propensity Score Matching
RADP	Remote Area Development Programme
SLOCA	Services to Livestock Owners in Communal Areas
SPP	Social Protection Programme
SPSS	Statistical Package for Social Sciences
TLU	Tropical Livestock Unit
VIF	Variance Inflation Factor
YDF	Youth Development Fund
YES	Youth Empowerment Scheme

# CHAPTER ONE

## INTRODUCTION

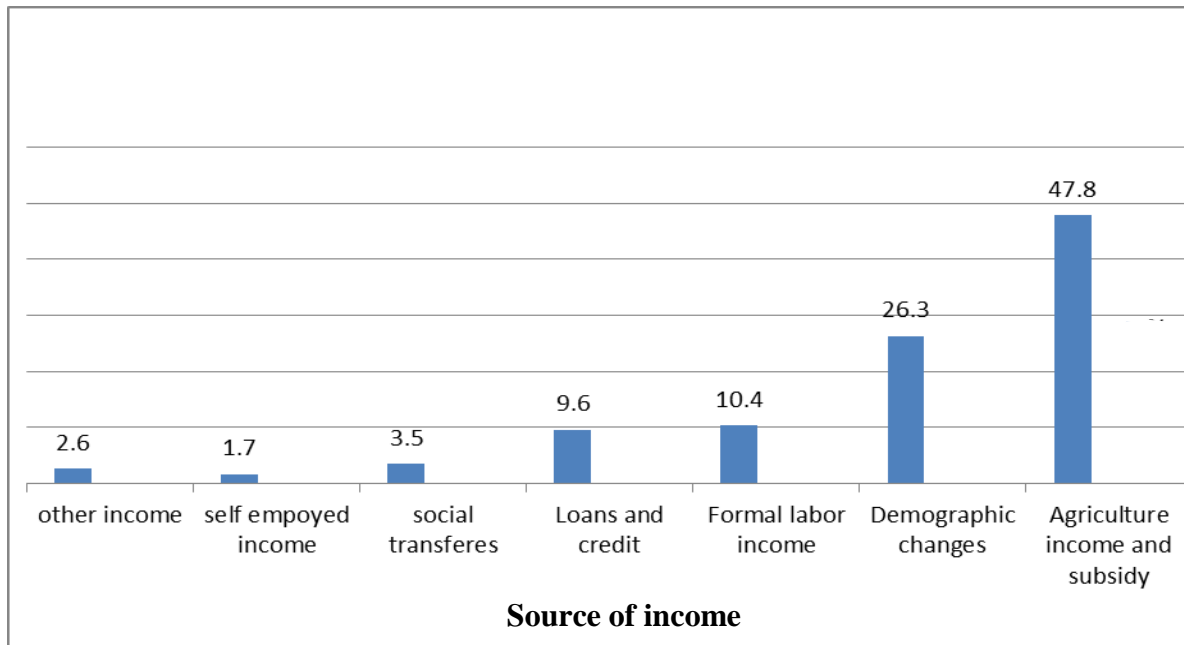
### 1.1 Background of the study

Botswana is a small country with a population of 2.3 million (United Nations, 2017). At independence, the level of physical and social development was very low and most people were living in abject poverty, without adequate access to basic needs like food, shelter and education (Jefferis and Nemaorani, 2013). Moreover, the country was characterised by high unemployment rates, over reliance on agriculture, low human capital development, as well as poor infrastructure (Siphambe, 2007). After independence, the government made these problems a foremost priority with the ambition to improve the economy and uplift the lives of the Batswana. In contrast to the situation at independence, the country has been rated as one of the fastest growing economies in the world and has attained the status of a middle income country (World Bank, 2015).

Since independence the country has made huge strides in the areas of poverty reduction and employment creation, as well as economic diversification. With the aid of various government interventions, poverty has declined from 30.6% in 2003 to 16.3% in 2016. Meanwhile, extreme poverty is now below 14 % in the whole country. Likewise, unemployment is reported to have declined from 26.6% in 2008 to 17.7 percent in 2016 (Ministry of Finance and Economic Development, 2018). To a large extent, reduction in poverty and unemployment levels has been attributed to job creation, human resource development and economic empowerment effects of various government programmes. Such programmes include Youth Empowerment Scheme (YES), Remote Area Development Programme (RADP), Social Welfare Programme, Citizen Entrepreneurship Development Agency (CEDA), Youth Development Fund (YDF), Ipelegeng Programme, Integrated Support Programme for Arable Agricultural Development (ISPAAD) and Livestock Management and Infrastructure Development (LIMID). Given the important role of agriculture in Botswana's economy and with 80% of rural communities depending on agriculture the programmes and schemes have gone a long way in driving the agricultural development agenda (World Bank, 2015).

Agricultural interventions, especially in the livestock sector are the main contributors to the achievements made in changing Botswana's economy. Rural economies mainly depend on livestock production (Bahta and Baker, 2015). The sector has been vital in the improvement

of households, since it provides employment to majority of rural dwellers (UNESCO, 2012). According to Dethier and Effenberger (2012), agriculture has the highest potential to reduce poverty especially in poor countries. In Botswana, poverty reduction has been attributed predominantly to an increase in agricultural incomes and agricultural subsidies provided by the government with the aim of improving livelihoods of its people. Figure 1 shows that incomes from agriculture led to 47.8 per cent reduction in poverty, which is more as compared to other sources of incomes (World Bank, 2015).



**Figure 1:** Different sources of income and their percentage contribution to poverty reduction in Botswana between 2002-2003 and 2009-2010

Source: World Bank (2015)

## 1.2 Small stock production in Botswana

In Botswana, the agricultural sector contributes 2.4% of the country's Gross Domestic Product (GDP). However, livestock production contributes 80% to agricultural GDP (USDA, 2017). Majority of Botswana depend on livestock as a source of livelihood mainly because of the climatic conditions in the country which favours livestock production as compared to crop production. As such, livestock is a central economic activity in rural areas providing sustainable employment to many people. About 49% of poor households depend on livestock as a major source of income with 14.6% coming from small stock only (UNESCO, 2012).

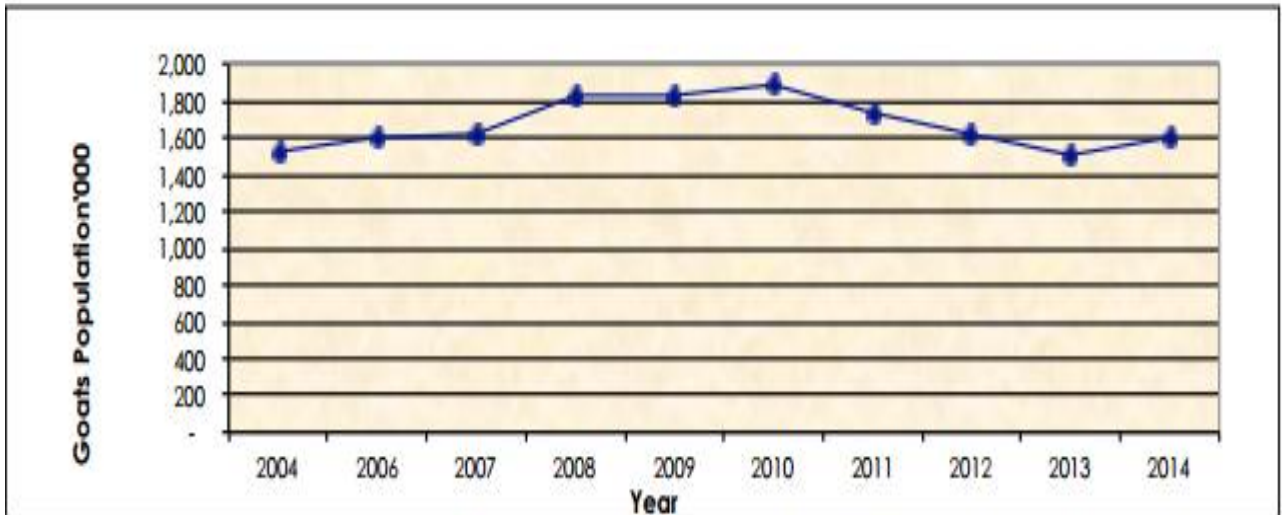
Small stock especially sheep and goat production is very important to Botswana particularly those residing in rural areas. The country goats are mainly found in rural areas especially the

communal or traditional areas called cattle posts (Statistics Botswana, 2016). Sheep and goats are kept for domestic consumption, hides, milk and use in traditional and spiritual ceremonies (Aganga and Aganga, 2015). Sheep and goats are normally preferred because their production cycle is shorter than other domesticated animals, with gestation period of only 5 months (Hale *et al.*, 2011).

In the country, sheep and goat production is commonly practiced in the Central district where most of the cattle posts are found. The number of sheep in the district is 73,958 while goats are 521,520 (Statistics Botswana, 2016). However, most farmers in the country have a preference towards goat farming as compared to sheep farming with a few farmers keeping both (Berthelsson, 2017). As opposed to sheep, goats normally survive harsh conditions and most rangelands are suitable for goats as they are mainly browsers feeding on twigs, leaves, shrubs and pods while sheep are primarily grazers (Mphinyane *et al.*, 2015). According to Arvidsson (2017), most farms in Botswana are dominated by the Tswana and Boer goat breeds. Most farmers prefer the Tswana breed as it is well suited for the climatic conditions of the country. Goats do well where there are shrubs which are a good source of feed for goats especially during the dry seasons. Sheep perform very well in Central district and Kgalagadi districts of Botswana because of high organic contents from the grass in the districts as most of the farmers in the country rely on natural pastures than getting supplements. The more the availability of pastures the better the growth of livestock (Kgosikoma *et al.*, 2016).

### **1.2.1 Sheep and goats production trends in Botswana**

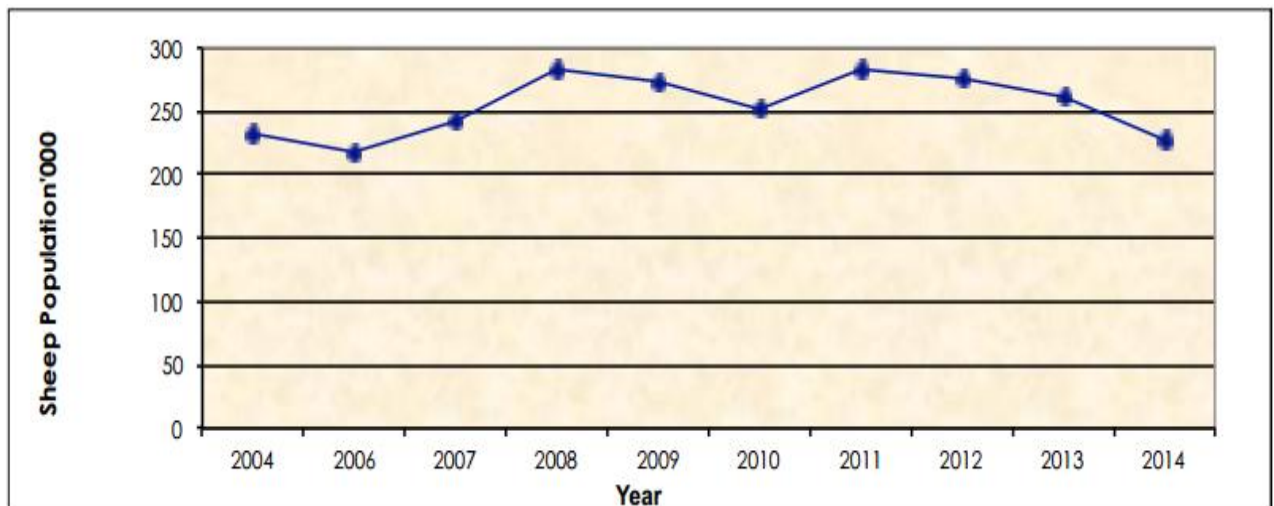
The production trends of goats in Figure 2 showed an increase from 1.5 million in 2004 to 1.9 million in 2010. There was a decline in the population of goats in 2013 to 1.5 million. However in 2014 the population of goats increased to 1.6 million in the whole country (Statistics Botswana, 2016).



**Figure 2: Goats population trend (000) from 2004 to 2014**

Source: Statistic Botswana (2016)

Figure 3 reports how the population trend for sheep reduced from approximately 238, 000 in 20004 to 220,000 in 2006. In 2008 there was an increase in the sheep population to 289,000. However, in 2010 the population of sheep in the country declined to 250,000. In the year 2011 the total numbers increased to 289,000. The number of the sheep also decreased between 2013 and 2014 from 261,458 to 247,247 (Statistics, 2016)



**Figure 3: Sheep population trend (000) from 2004 to 2014**

Source: Statistic Botswana (2016)

The number of sheep and goats showed to be fluctuating over the years from 2004 to 2014. However, LIMID is one of the programmes that were introduced by the government in order to fund resource poor farmers hence encouraging them to keep small stock and increase their



production. In addition, even though Botswana is one of the few countries in Africa that have achieved a lot in terms of realizing widespread development and poverty reduction, there still exists poverty pockets in rural areas especially among the youth and women (Sebudubudu, 2010; World Bank, 2015). Therefore, LIMID does not only encourage small stock production but it is also one of the recent government programmes targeted at uplifting living standards of the rural poor and further drive the government's rural development agenda. Having been initiated in 2007, the programmes' main aim is to improve food security, eradicating abject poverty and improving livestock husbandry among the rural producers. Fundamentally, the programme helps beneficiaries to develop into independent and competitive entrepreneurs. The programme is fully operational in the whole country. From 2007 to 2018 about 30,140 LIMID projects have been implemented in the whole country (Ministry of Finance and Economic Development, 2018). However, 76,076 of specifically small stock (sheep and goats) has been supplied to 5,474 beneficiaries in the country (Ministry of Presidential Affairs and Public Administration, 2016).

LIMID helps Botswana to purchase livestock and livestock production equipment like ear tags, burdizzo and syringes. The programme has two components: the first component is the resource-poor component whereby resource poor people are funded to keep small stock and Tswana chicken. The other component is infrastructure development which includes the construction of poultry abattoirs, livestock water development, fodder processors, crushes, loading ramps, kraals, purchase of boreholes, drilling boreholes, equipping boreholes and reticulation of water. As such, LIMID is viewed as an Agricultural support scheme as it helps and encourages resource-poor Botswana to embark on agriculture as well as improve livestock husbandry. LIMID programme is designed for all the resource poor Botswana, with those interested in participating in the programme required to apply for funding. The study will be evaluating the resource poor beneficiaries who made a decision to apply for funding in Boteti sub-district. Boteti is situated in the Central district Botswana which is the largest district in the whole country. The total population of Boteti is 57,376 (Statistics Botswana, 2015). Livestock rearing has been noted to be practiced by majority of the families in the sub-district with small stock being kept as main source of livelihoods by providing meat, milk and income (Sebego *et al.*, 2017). Similarly Mulale *et al.* (2014) highlighted that Boteti residents practice a mixed herd pastoralism as a source of livelihood whereby farmers keep different livestock including sheep and goats. In addition farmers get also employment from government institutions and government welfare programmes.

### **1.3 Statement of the problem**

The government introduced the LIMID programme with the objective of improving food security and providing opportunities for employment and income generation. This was to be attained by helping beneficiaries to develop into entrepreneurs within the small stock industry. Since inception, an estimated 1,795 beneficiary's projects have been implemented in the area to venture into or upgrade production of sheep and goats. Although the programme's main objective was to uplift the livelihoods of rural producers, the results have been mixed with some funded enterprises succeeding and others failing. In spite of the programme being operational for more than 10 years, little is known about the challenges that impede farmers from applying for LIMID funding though they might be interested in being part of the programme. Likewise, the factors influencing the decision of farmers to participate in the LIMID programme is scanty. Furthermore, there is limited empirical evidence on the effects of the programme on household welfare of beneficiaries. It is for these reasons that the study intends to analyze the welfare effects of the programme among its beneficiaries.

### **1.4 Objectives**

#### **1.4.1 General objective**

The general objective of the study was to estimate the effectiveness of LIMID programme in improving the welfare of the rural poor in Botswana.

#### **1.4.2 Specific objectives**

- i. To determine the main challenges encountered by small stock producers during and after application for LIMID programme funding in Boteti sub-district, Botswana.
- ii. To determine the factors influencing the decision of small stock producers to participate in the LIMID programme in Boteti sub-district, Botswana.
- iii. To estimate the effect of LIMID programme on the household welfare of the small stock producers in Boteti sub-district, Botswana.

### **1.5 Research questions**

- i. What are the main challenges encountered by small stock producers during and after application for LIMID programme funding in Boteti sub-district, Botswana?
- ii. What are the factors influencing decision of small stock producers to participate in the LIMID programme in Boteti sub-district, Botswana?
- iii. What are the effects of LIMID programme on socio-economic welfare of the small stock producers in Boteti sub district, Botswana?

### **1.6 Justification of the study**

The government of Botswana has made Botswana in rural areas a priority by providing income generating businesses and entrepreneurial skills. Millions are spent on funding them through the LIMID programme. Therefore with all the effort that the government is making to support Botswana and to increase economic opportunities for them there is need to look at how the programme directly impacts livelihoods of the beneficiaries. The study helps in understanding the programme's socio-economic contribution in general. The study also forms a basis for policy formulation that will inform the government on whether to continue with the programme or divest its funds to a different initiative. In addition having a better understanding of the challenges regarding LIMID services helps in the improvement of the programme for better delivery of the services. Furthermore, having a grasp of challenges that are encountered by beneficiaries after commencement of the project is expected to prompt appropriate assistance for better production thereby increased incomes and improved livelihoods. This study also contributes to new knowledge and it is also a vital source of information to many researchers.

### **1.7 Scope of the study**

The study focused only on the beneficiaries and non-beneficiaries of the programme who are found in rural areas. The collected data was for a period of 12 months thus from June 2017 to June 2018.

### **1.8 Limitations of the study**

The study intended to find out only the direct effects of the programme on the livelihoods of beneficiaries, even though non-beneficiaries could have indirectly benefited from the programme through spill-over effects. To try and take care of the spill-over effects problem data was collected from farmers who are far apart in each village. Cross sectional data was collected based on the opinions and perspectives of the beneficiaries, thus utilising the recall method. However an open ended questionnaire was utilised to enable clarification of questions and probing of respondents for accurate answers. LIMID has many components, however this study focused only on the small stock component. The main constraint was the time factor as the study was done in different cattle posts which are very far apart and have poor road access hence a limited number of respondents (150). To overcome the limitation the study included only the farmers who were accessible in nearby villages and cattle post.

## **1.9 Assumptions of the study**

The researcher assumed that the environment was going to be politically stable during data collection, thus no political hindrances/interferences. In addition the climatic conditions were going to be favourable like no floods to interrupt the enumerators. Finally, the respondents were willing to participate in the study by giving the right information thereby making the study successful.

## **2.0 Operational definition of terms**

**Abject poverty:** when an individual is living under extreme poverty and cannot meet his or her basic needs such as food and clothing.

**Beneficiary:** Any Motswana who has been funded by LIMID programme.

**BWP:** Botswana currency

**Micro-enterprise:** An enterprise established mainly to keep sheep or goats with a maximum of 150 herds.

**Botswana:** Citizens of Botswana.

**Small stock production:** refers to the rearing of sheep and goats for home consumption and commercial reasons.

**Small stock:** sheep and goats.

**Decision to participate:** is when a farmer decides to fill the application form and submit for LIMID funding.

**Household welfare:** the standard of living of famers' households

**LIMID:** Agricultural programme that fund smallholder farmers to keep small stock

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter entailed to review the literature on the economic importance of agriculture specifically small stock production in the livelihoods of rural dwellers. Further, it gave literature review that clearly defined the contribution of small stock to household incomes and household consumption expenditure. The aspect of household welfare was explained in detail by reviewing the literature that supported why household consumption expenditure was used a proxy for household welfare. Further household consumption determinants were discussed. Challenges encountered by small stock farmers were also reviewed. In addition factors that influence individuals to participate in agricultural programmes were also outlined by looking at different studies. Finally, the theoretical and conceptual frameworks of the study were discussed.

#### **2.2 Economic importance of Agriculture**

Agricultural sector is a very important sector in most countries in the world. In developed countries it contributes 50% to the GDP while in developing countries it contributes only 33 percent (Msangi *et al.*, 2014). In nations like India the agricultural sector contributes 17% to the Gross Value Added. Majority (54.6%) of India's populace is practicing agriculture (Ministry of Agriculture and farmers' welfare, 2016). In Botswana the agricultural sector employs around 30 per cent of the overall labour force, and contributes 3.1% to the country's exports. Most Batswana practice agriculture with 45.6% of the total land in the country being used for agricultural production activities (Food and Agricultural Organisation (FAO), 2013).

Agriculture has different sub sectors like crop, plant and livestock sector. In Ghana crop production sector is vital to the economy as most of the households depend on it as source of income (Diao *et al.*, 2010). In South Africa plant production sector is regarded as the cornerstone for people's livelihoods and economic development (Ramashala, 2015). Livestock sector is also one of the important agricultural sectors. Through livestock products, activities and assets this sector adds up to 40 percent to the total value of agriculture in the world. Livestock production employs 1.2 billion people in the world making it a leading employer in the world (Msangi *et al.*, 2014). Furthermore, livestock is important for socio-cultural purposes such as slaughtering during traditional and spiritual ceremonies, and it is also the only investment for small scale farmers, and a form of insurance as it can be sold in

time of needs to provide cash. It is also used for social security and prestige as in rural areas the more the number of livestock one owns the more they are respected in the community (UNESCO, 2012).

Agriculture being very important several non-government and government organizations both locally and internationally help in promotion of the sector in order to deal with the eradication of extreme poverty and improving food security in the world. Such international development bodies include the World Bank and United Nations. The World Bank helps many countries especially African countries to increase productivity in agriculture with the main reason of increasing employment in rural areas, food security and promoting environmental friendly agriculture. Countries like Ethiopia have benefited from the World Bank assistance through priority projects of developing pastoralism, Senegal in promotion of agribusiness, Central African Republic benefited in improving food security (World Bank, 2014).

### **2.3 Challenges of small stock production in Botswana**

Botswana has semi-arid climatic conditions characterized by unreliable rainfall and high temperatures that greatly limit agricultural production. In the last 25 years the country experienced 5 major droughts which mainly disadvantaged the vulnerable groups who depend on climate sensitive activities like small stock production (Ministry of Presidential Affairs and Public Administration, 2016). These led to declines in agricultural production, which eventually affected rural households living them vulnerable to poverty conditions. In the year 2016 the whole country was declared drought stricken and the government had to subsidise supplementary feeds (Ministry of Presidential Affairs and Public Administration, 2016). In addition, there are also some risks related to weather like drought or flooding which also have major effects through losing livestock. Other constraints in agricultural production are human activities as growing populations make it difficult to access water sources and inadequacy of natural resources especially rangelands. Competition with wildlife is also a major concern, as sheep and goats are eaten by wild animals (Temoso *et al.*, 2015). Predators like jackal are a threat as they feed on small stock (Aganga and Aganga, 2015).

Some cattle post are also far from roads, markets, electricity hence making it difficult to access proper services (Ministry of Agricultural Development and food Security, 2008). There are also problems of overstocking which happen in some parts of the country in turn affecting small scale farmers who depend on communal grazing. Overstocking also leads to

soil erosion, land degradation and loss of biodiversity and scarcity of grazing pastures (Monametsi *et al.*, 2012). This causes losses in incomes, savings and livestock products leading to poverty intensification in rural areas.

In addition, the government of Botswana is more biased to cattle production specifically the beef industry which is more prioritized thereby leading to less investment in promoting small stock production (Arvidsson, 2017). The occurrence of diseases and pests infestation is also one of the challenges (Berihu *et al.*, 2016), this problem can hinder farmers to trade goats to lucrative markets. Furthermore most small scale farmers invest a little in their small stock production especially in buying supplements, controlling diseases, pests and parasites and impede the small stock sub sector to grow (Kgosikoma *et al.*, 2016). Finally insufficient training and lack of proper support from extension workers is also a major obstacle to small stock production (UNESCO, 2012).

#### **2.4 The concept of household welfare**

Household welfare is a proxy for measuring the standard of living for households and is proxied by measures of consumption expenditure, income and assets accumulation (Brewer and O'Dea, 2012; Moratti and Natali, 2012). Evaluating household welfare helps in investigating the standards of living across populations over a period of time. In addition measuring household welfare is very vital in analysing policies (Slesnick, 1998). There are many debates surrounding the strength and weaknesses of the indicators of household welfare. However consumption expenditure is highly favoured by many researchers and it is considered to be a better measure for household welfare as compared to income and assets accumulation (Moratti and Natali, 2012).

Consumption expenditure is preferred over income because it is not closely related to short term fluctuations in income and it is less variable and smoother than income. Consumption is also easy or clearer than the issue of income (Deaton and Zaidi, 2002). Another disadvantage of using household income is that the incomes are normally under recorded as most household they do not keep records. Moreover, income is normally a sensitive issue to many than the issue of consumption. The main disadvantage of household expenditure is that it is time consuming and most times it depends on recall method and the respondents tend to forget their expenditure. Consumption expenditure includes food and non-food items, housing, education and health expenses. The reference period for collection of consumption information is 3 days to 1 year (Moratti and Natali, 2012).

Assets accumulation is an alternative measure of the household welfare that has become prominent over the years. This method looks at both the financial and physical assets. The advantage of this approach is that it is time saving and easy for people to remember their physical assets as compared to income. In addition, it reflects the economic status better as it is less volatile when compared to consumption and income. It is also not data intensive hence easy to calculate. However there are some studies which critique the use of assets accumulation. According to Filmer and Pritchett (2001) assets accumulation is a poor proxy for current household welfare but a better proxy for long term income. There is a relationship between household consumption, assets accumulation and income. Brewer and O’Dea (2012) highlighted that increases in income significantly contribute to better life for the reason that increase in household income means better clothing, food, education health improved nutrition and acquisition of assets. Moreover, the determination of individual’s ability to purchase food and acquisition of assets, income is a primary factor.

## **2.5 Contribution of small stock production to household incomes**

Livestock including sheep and goat is a central economic activity in rural areas. Many people have based their livelihoods in livestock production. It is the main source of income for rural people under pastoral and traditional farming system. Sheep and goats improves livelihoods of the urban, peri-urban and rural households through the provision of income (Pollott and Wilson, 2009). In countries like Ethiopia especially the semi-arid locations almost 100% of households get income from livestock (UNESCO, 2012). Similarly, Aganga and Aganga (2015); Lysholm (2016) reported that one of the reasons why people embark on goat production is because it is a way of generating income. This is supported by Orskov (2011) who reported that the supreme significant purpose for keeping goats is to serve as a current account as they can sell anytime to cater for other needs.

In Sudan specifically White Nile state, livestock is a very important agricultural component, an indispensable income source with sheep and goats being the utmost of the livestock at 59% (Ibrahim *et al.*, 2013). In Egypt sheep and goats provide income for the landless and those who possess a small piece of land (Alary *et al.*, 2016). Metawi (2015) studied the contribution of small stock to household income in the agro ecological northwestern coastal zone of Egypt. He concluded that the contribution of sheep and goats to household income is high at 71.6% in agro ecological subzones specifically the dry areas.



## **2.6 Empirical review of the impact of Government agricultural interventions on household welfare**

Several studies have been conducted on government programmes with the intention of finding out their impacts on the livelihoods of the participants. Sinyolo *et al.* (2014) conducted a study in South Africa about the impact of smallholder irrigation scheme on household welfare. The study was aimed at providing empirical evidence of the programme impacts on household welfare. Measures of household welfare such as type of house, income, agricultural production, assets and livestock were taken into consideration. Propensity Score Matching (PSM) was used to compare the participants and non-participants. Factors influencing consumption were found to be family size, off-farm income, household dwelling, and education level and land size.

Attanasio and Mesnard (2006) evaluated the impact of cash transfer programme on consumption of poor households in Colombia. The two groups were compared by looking at the expenditures of households in areas where the programme was implemented (treated) and where the programme was not implemented (control). To control for programme consumption differences Difference in Difference method (DID) was used. This method allows the researcher to control for pre-programme difference between the treated and control group. The data on the households was collected a year before the programme begun as this method requires baseline data. The results revealed that the programme increased total consumption especially the food consumptions expenditure which is the largest component of household consumption in rural households.

Moreki *et al.* (2010) conducted a study in Botswana and the main objective was to evaluate the performance of LIMID programme in order to determine if it has met its objectives in the seven districts of Botswana. The data was collected using a structured questionnaire administered to 412 sampled beneficiaries in Kgalagadi, Kweneng, Central, Kgatleng, Southern, North West, and South East districts. The collected data included socio-economic characteristics, demographic characteristics, perception on the programme program performance, design and its future. In analysis of the data descriptive statistics was employed.

Läpple *et al.* (2013) in Ireland when examining the effectiveness of government funded extension programme on dairy farm production, Endogenous Switching Regression Model (ESRM) used because it takes care of the selection bias due to unobservable characteristics of a farmer such as his or her ability. Asfaw *et al.* (2012) in Tanzania conducted a study about

the adoption of improved technology on household welfare. ESRM was employed to evaluate the impacts between the adopters and non-adopters. The effects of adoption were measured based on household expenditure.

Glewwe (1991) carried a study in Cote d'Ivoire with the aim of predicting the impact of different government policies on household economic welfare. The household expenditure was used as an indicator of household welfare and the following factors were taken into consideration thus; food and non-food expenditure, characteristics of household members, physical assets, education, work experience of household members, agricultural production, food produced and consumed by household. In addition Tambo *et al.* (2015) carried a research in Ghana to evaluate the effect of farmer innovation on household welfare. The results depicted that there was a significant improvement on household income and expenditure of innovators. PSM and ESRM were used to analyse the data.

In a study conducted in Swaziland on the impact of Micro-Projects on rural household's income, the researchers used PSM in comparing the beneficiaries and non-beneficiaries. Logit model was used to identify the factors that influence participation in the programme. The factors affecting participation of the respondents on the programme were reported to be marital status, amount contributed by the beneficiaries to the programme, farm size, education, occupation, age, and gender. Nearest Neighbour Matching (NNM) technique was used in matching the participants and non-participants with the closest propensity scores. The result showed that the programme had positive impacts on the household income (Sigh *et al.*, 2015). PSM has been used in many impact studies like (Kassie *et al.*, (2011); Ndungu *et al.*, (2013). Propensity Score Matching is commonly used because it takes care of selection bias and it reduces the dimensionality of matching to single dimension (Tilahun and Chala, 2014).

Omonijo *et al.* (2014) evaluated the impact of Elati Agricultural Development Programme on the rural dwellers in Nigeria. One of the objectives was to investigate if the programme can bring an increase on income level of farmers and in food security. The data was collected using a structured questionnaire. A multi linear regression model and descriptive statistics were used in analysing the data. The study revealed that agriculture was one of the major activities in the land and it provides employment and income to 75% of the population.

A study by Ayele *et al.* (2013) in Ethiopia evaluated the impact of an Irrigation Scheme on household incomes and poverty alleviation at Lake Tana basin. The study was based on Agricultural economic household models. According to Rola-Rubzen and Hardaker (1999),

Agricultural household models are also known as integrated farm household model, integrated production-consumption model or simply Farm household model. However in this study the theory was only referred to as farm household model. Farm household model is vital because it helps in predicting the responses of the farm household to changes like family structure, wage rates, output prices, and technology and output prices. The model also incorporates the aspect of decisions made by households on what part of the output to sell and what part to consume. Censored regression model was used to estimate the impacts of an irrigation programme on household income.

The results of the study showed that Irrigation Scheme at Lake Tana basin, Ethiopia increased the annual household income by 27% as compared to those who did not participate on the scheme. The agricultural income was calculated by multiplying the total amount of every single agricultural product sold or consumed by prices. Income does not refer to cash sales only but also the total value of the production on monetary terms. However, there are critiques about the Household Farm models because they assume that the household incomes are shared by all household members yet in reality the members diverge their incomes as per their interest. In addition the household farm models focuses on factors influencing consumption and production on directly affected households yet these factors lead to linkage effects on other households and several aspects of farm behavior which are not taken into consideration when using household farm models (Taylor and Edelman, 2002).

Botlhoko and Oladele (2013) employed probit regression model to determine factors affecting the participation of farmers in agricultural project in North West Province of South Africa. The results showed that the factors that influenced participation in agricultural programmes are effectiveness of rural development programme, education level, information source, off farm income, farming experience, household headship, number of dependents and farm size. Similarly, other studies identified several factors to be influencing participation in agricultural programmes, such factors amongst other include age, farming experience, source of information, attitude, livestock enterprise, market, constraint, livestock ownership, membership in cooperatives studies (Nxumalo and Oladele, 2013; Nwaobiala, 2014; Raufu *et al.*, 2016; Nahayo *et al.*, 2017)

Shapi (2017) conducted a study on the challenges facing participants of Green Scheme Projects in Namibia. The programme aimed at improving food production through an irrigation scheme. The study revealed that participants in the agricultural development

scheme face several challenges like lack of land ownership, lack of labour, higher inputs cost, long distance from input market, pests and disease, poor access to credit and market challenges like low output prices. Ajani *et al.* (2015) stated the problems associated with development project to be corruption of government officials, finances, markets for output, poor implementation, programme inconsistency, lack of adequate funding, natural hazards like floods, execution of sub-standard projects and difficulty in accessing resources such as land.

Another study was conducted by Mgbeka *et al.* (2015) on farmer's perception on Agricultural Development Activities of Local Government Council in South East Nigeria. Multistage sampling and random sampling were used to select 240 farmers. The required data was collected using a structured questionnaire. Descriptive statistics such as mean score, frequency and standard deviation were used to analyse the data. The challenges associated with agricultural development projects were found to be high costs of production, inadequate cash returns from the project, poor extension service, inadequate budget allocation in agriculture and corruption from staff and management

## **2.7 Study gap**

Little has been done on evaluating the impact of LIMID programme on household consumption expenditure. The government has introduced the programme but has not gone into the level of evaluating the programme. Only one study is available about LIMID programme which was done by Moreki *et al.* (2010) who was evaluating the LIMID programme in the seven districts of Botswana. The study employed only descriptive statistics with the objective of looking at the socio-economic characteristics of LIMID beneficiaries, programme performance whereby the number of small stock, guinea fowls, tswana chicken was recorded and the perceptions of the beneficiaries were captured on a bar chart. The study was not sufficient and it did not highlight the production and marketing challenges faced by the farmers.

Factors influencing participation and the impact of the programme on the livelihoods of beneficiaries were also not captured. It is in that regard that this study will differ from other studies as it estimates the effect of the programme on the household welfare of beneficiaries by looking at the household consumption expenditure using PSM analytical technique. This will give results that will help in policy formulation and necessary adjacent in LIMID programme. PSM was used because of its advantage to deal with cross sectional data. To

analyse perceptions of the farmers, factor analysis was used because of its ability to reduced data dimensionality (Yong and Pearce, 2013).

Factors that influence one to participate in agricultural programmes has been captured in different studies and they vary in studies, in some studies participation determinants are significant (negative/positive) while in others are insignificant (Botlhoko and Oladele, 2013; Singh *et al.*, 2015). Therefore this study confirms what was done by other researchers as well as filling in the gaps of the factors specifically influencing the decision of the farmer to apply for LIMID funding. This study will also add new variables like perceptions of the farmers regarding LIMID, distance to LIMID office, and distance to nearby cattle post to the pool of existing variables that are commonly used in studies like age, gender, household size. The uniqueness of this study is also capturing the challenges precisely faced by small stock farmers in Boteti sub-district. Production and marketing constraints were recorded to know what challenges farmers are facing even though their projects are running.

## **2.8 Theoretical framework**

### **2.8.1 Random Utility Theory**

Random utility theory (RUT) is based on the idea that every person makes rational decisions in order to maximize their utility relative to the choice they have made (Cascetta, 2009). In the study small stock farmers both the LIMID beneficiaries and non-beneficiaries are faced with several choices to make regarding small stock production with the aim of maximizing their utility from a particular choice they make. Several factors were considered before they made a choice of settling for small stock production like which small stock to keep (sheep or goats or both), where to keep small stock, production constraints, marketing constraints, gestation period, pasture availability and climatic conditions of the area. In addition, choice of the inputs to use in production such as use of hired or family labour, time factors, technology to adopt is based on the alternative which yield more utility. A farmer will chose a bundle of inputs which will yield more profits or returns based on the investments made for both in the short and long run.

According to Lancsar et al. (2004) RUT can be presented as stochastic and an explainable component which can be shown as:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \dots\dots\dots(1)$$

Where:

$U_{ij}$  is the utility derived from taking choice  $j$  by an individual  $i$  from the available choices. The underlying assumption is that individual  $i$  will choose alternative  $j$  if the utility derived from  $j$  is greater than any other alternative in the set  $J$ .

$V_{ij}$  is the attributes of the choice as viewed by individual  $i$ , these include attributes of choosing either to keep sheep or goats, returns to be yielded, place of rearing, to use hired or family labour. Therefore, the probability of farmer taking choice  $j$  than alternative  $m$  will be:

$$\Pr(U_{ij} > U_{im}) \dots\dots\dots (2)$$

$$= \Pr(V_{ij} + \varepsilon_{ij} > V_{im} + \varepsilon_{im}) \dots\dots\dots (3)$$

### 2.8.2 Theory of the farm household

The study is also based on the theory of farm household. This theory gives a better understanding on which factors influences farm production and what are the necessary responses to maximize utility. The model presented is of a semi-commercial farm as the household makes decisions on what to consume and what to sell to the market. Farming household also provide inputs from their own resources like family labour (Singh *et al.*, 1986).

According to Barnum and Squire (1978), agricultural household as a competitive enterprise makes decision on the output to produce given available resources with the objective of maximizing profit. The household may decide to supply more of the family labour and less or no hired labour hence more cash profits which will allow household to buy more of consumption goods. The farm makes production decision first as consumption is influenced by the profits made in the farm. Mendola (2005) added that farm households are production and consumption units who consumes and sell part of the produce to meet cash requirements thereby catering for other obligations. He further stated that household farm behavior include utility maximization and profit maximization and risk aversion theory. In order to understand such behavior agricultural models must be used.

Even when it comes to small stock production farm households are both production and consumption entities that make decisions pertaining to consumption and what to leave for the market. Farm households often face several changes like: changes in policies of the country, changes in the prices of inputs, labour, markets and institutions. They also face several challenges in their production units, therefore they respond differently to control the situation

at hand. They make decisions with the intentions of maximizing their utility and profits in order to improve their welfare and household incomes. In addition, they decide on what inputs to use, quantity of products to sell at the given market price, where to sell their products and how much will be used for household consumption. With the funds they are given they purchase inputs like breeding stock, burdizzo, ear tags and any other necessary equipment.

Having adopted a model by Barnum and Squire (1978) the production and consumption components of rural household can be presented in the theoretical models as follows:

**Utility maximization**

Utility             $U = f(E, L, Z, a_j) \dots\dots\dots (4)$

Output             $N = f(D, d_j, M, A) \dots\dots\dots (5)$

Time constraint     $T = D + H + L \dots\dots\dots (6)$

Income constraint     $I = qE + pZ = wH + R + pF - \sum r_j d_j \dots\dots\dots (7)$

Whereas:

$U$  = utility,  $N$ = total output,  $E$  = a vector for consumption of purchased goods ( $q_1, \dots, q_n$ ),  $L$  = leisure in (hours),  $Z$  = own consumption of agricultural output,  $a_i$  = household characteristics for example household size,  $T$  = the total household time available for labour,  $F$  = total output of  $Z$ ,  $H$  = net quantity of labour time sold or purchased (hours),  $D$  =total labour input used in production (hired and family labour),  $A$ = area of land used in production,  $d_j$ = other variable input used in production,  $q$ = price of  $E$ ,  $p$ = price of good  $Z$ ,  $r_j$  = price of other variable farm factors,  $R$  = off-farm income,  $w$  = wage rate and  $M$  = fixed input

Equation (4) is the utility equation, equation (5) is the output function, and equation (6) is time constraint while equation (7) is the budget constraint. The assumption in this model is that the model is based on one agricultural production season and the household uses family labour.

Maximizing equation 4 subject to equation (5) through (7) and eliminating langrangian multipliers the first order conditions will be:

$$\frac{U_Z}{U_E} = \frac{p}{q} \dots\dots\dots (8)$$

$$\frac{U_L}{U_E} = \frac{w}{q} \dots\dots\dots (9)$$

$$pF_d = w \dots\dots\dots (10)$$

$$pF_d = r_j, j = 1 \dots\dots\dots (11)$$

$$qE + pZ + wL = \pi + R + wT \dots\dots\dots (12)$$

Whereas:

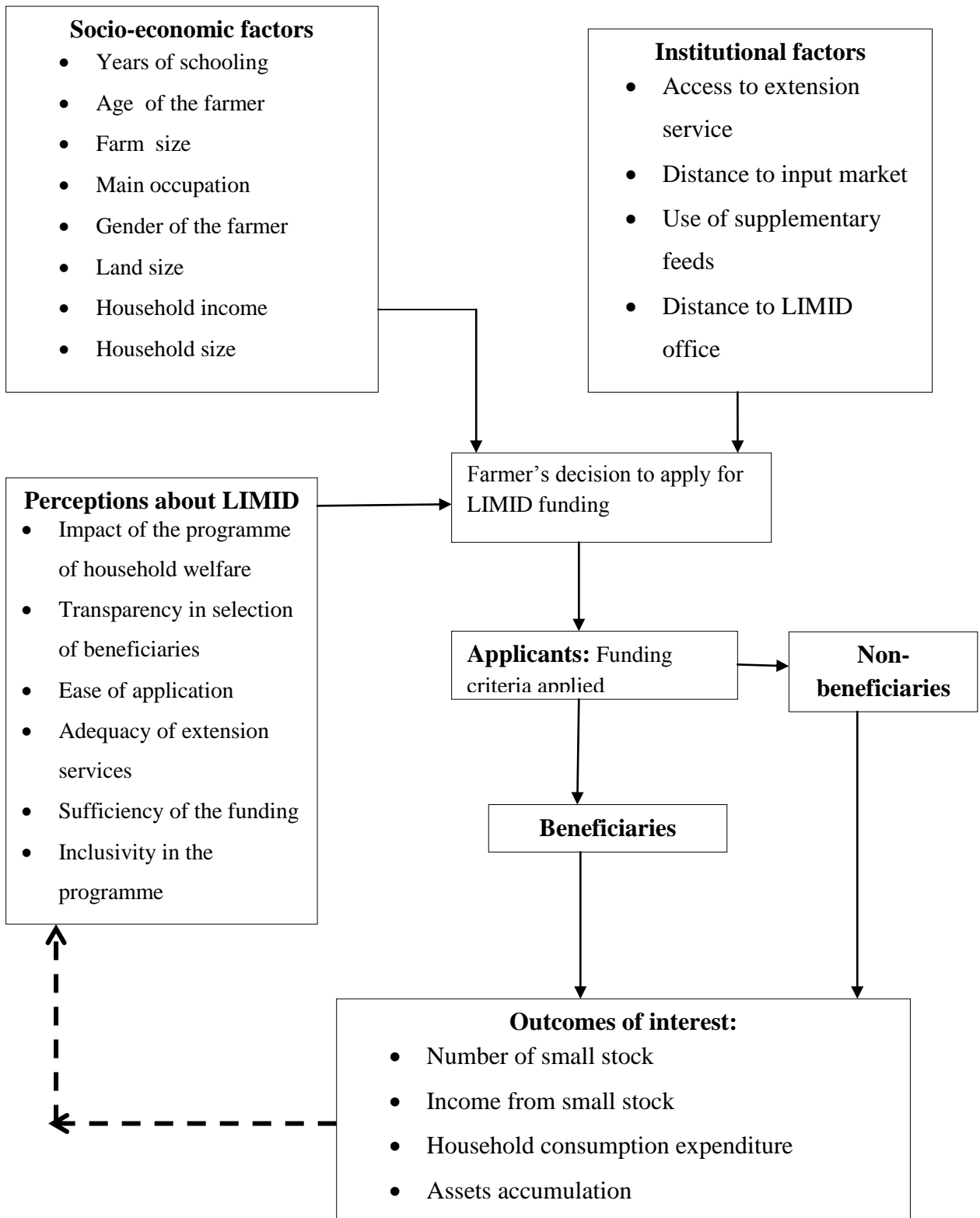
$$\pi = pF(D) - wD - \sum r_j d_j \dots\dots\dots (13)$$

Equations (5) and (6) express the first order condition of welfare economics whereby the marginal rate of substitution (MRS) must be equal to marginal rate of transformation (MRT) in production. Equations (7) and (8) are profit maximizing conditions for the allocation of labour and other variable factors. Equation (9) combines the time, income and technology constraint described by the production function. The left side of equation (9) includes the expenditure and the right side includes full household income including the net profit from household production.



### **2.8.3 Conceptual framework**

The conceptual framework of this study is based on the relation between LIMID funded sheep and goats production and an improvement in household welfare. There are inter-relationships among factors as shown on the Figure 4 below. In this study internal and external factors like socio-economic and institutional variables are expected to play an important role in influencing a farmer to apply for the programme. Perceptions of the farmers about the LIMID programme like transparency in selection of beneficiaries are also regarded to be some of the factors influencing Batswana if to participate in the LIMID programme or not. When an individual participates in the programme there are expected changes in the household like improvement in incomes and ownership of assets. However even those who are not funded they are also into small stock production hence positive changes are anticipated in their household welfare though they are less as compared to the beneficiaries. This will make farmers to make production decision that will maximize their utility given the available resources. The changes that are experienced are expected to improve the livelihoods of people thereby reducing abject poverty. The outcomes of the programme can in turn influence other farmers to decide to apply for funding as shown by the dark dotted line joining the outcome of interest and perceptions about the programme. This is actually the feedback into the cycle of making the decision to participate in LIMID programme.



**Figure 4: Factors that influence the decision of the farmer to participate in LIMID programme**

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 Introduction**

This chapter discusses where the study was carried out and gives a brief description of the study area. Further, the research design is discussed, and a clear indication of how the sample size was required is given. In addition, methods of data collection are also highlighted. Finally, the data management tools and the model used in analysing the collected data are also discussed.

#### **3.2 Study area**

The study was conducted in the Central District of Botswana, specifically the Boteti Sub-district. The Central District runs along the major part of the Eastern area of the country. It is the largest district in Botswana in terms of area and population. It covers an area of 146,531 km<sup>2</sup> which constitutes one third of the country. According to the last national census, the population of the Central District is 585,595 (Central Statistics office, 2011). Central District being enormous in size, Boteti sub-district was chosen.

Boteti Sub-district is 34,956 km<sup>2</sup> and it is located between 24°-25° east and 20°30'-21°15' south. The climate is semi-arid with rainfall occurring between October and April with an average of 350 mm per year. Temperatures range between 25-30 degrees Celsius and can go up to 40 degrees Celsius on hot summer days. During winter, temperatures range between 15 and 20 or even below (Athlopheng *et al.*, 2009). Livestock production is their main source of living as compared to crop production. Cattle, goats, sheep, horses, donkeys and chickens are normally kept at cattle posts away from villages. With Makgadikgadi National Park and part of the Central Kalahari Game Reserve found in the area, Boteti is endowed with wildlife. There are also natural resources like the Boteti river which flows perennially through the sub-district. The vegetation of the area comprises of tree savannah with different tree species ranging from, *Griwea flava*, *Acacia erioloba*, *acacia milfera*, *Combretum hereroins*, and *Colophospermum mopane*. Grasses like *cynodon dactylon*, and *Anthepora pubescence* are found in the area (Markus, 2011).

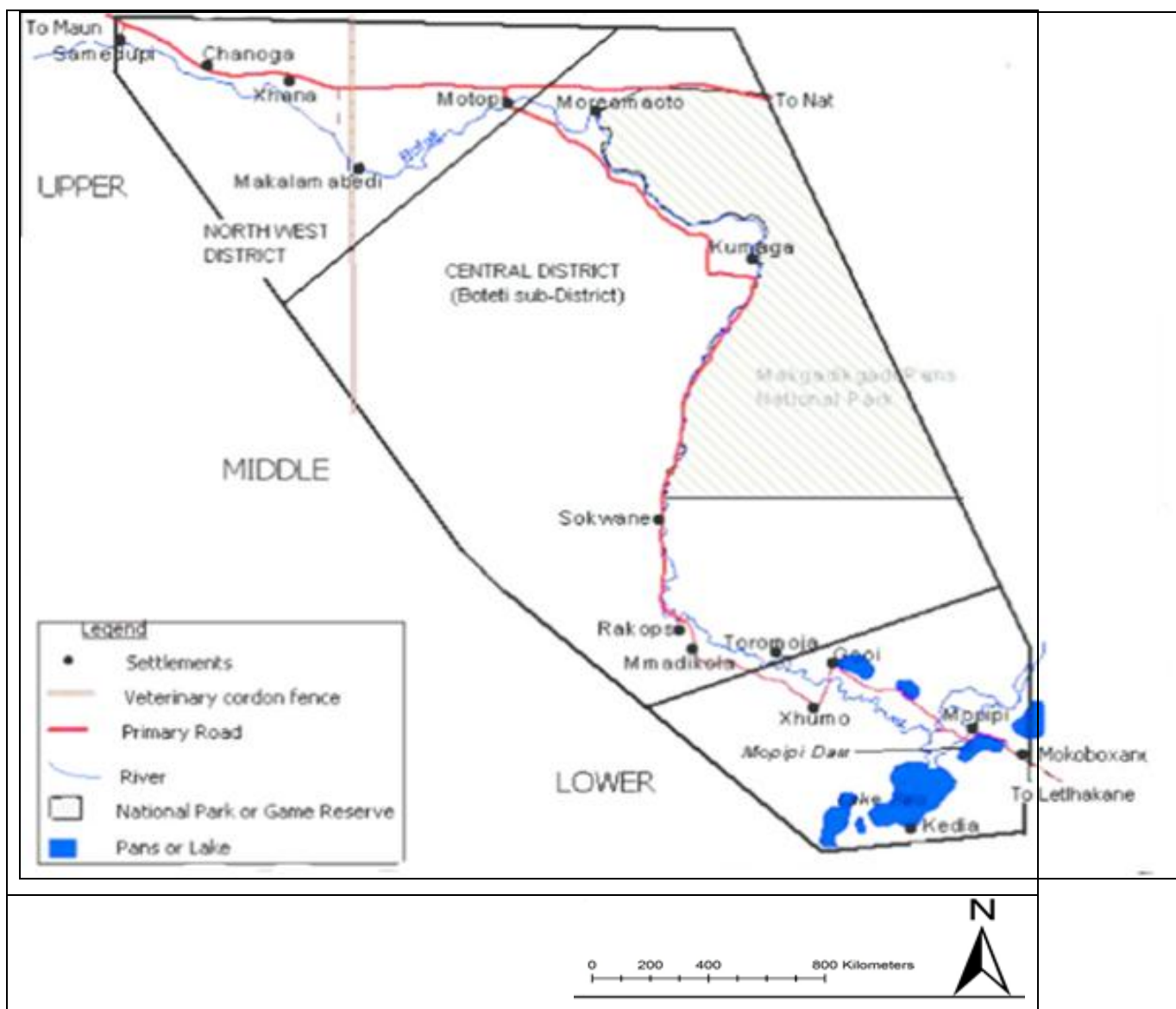


Figure 5: Map of Boteti sub District, Botswana

Source: **Swatuk *et al.* (2011)**

### 3.3 Research design

The study used a cross-sectional household survey to get data for the study. This allowed the collection of primary data.

### 3.4 Population of the study and respondents

The targeted population for the study was the small stock farmers in Boteti Sub-district, both LIMID applicants and non-applicants. The applicants who were funded for small stock production (beneficiaries) were used as the treatment group. The non-applicants (non-

beneficiaries) were used as the control group, thus allowing the establishment of a proper counterfactual.

### 3.5 Sampling procedure and sample size

Multistage sampling was used to select the respondents. In the first stage, purposive sampling of Central District was done because it is the largest in the country in terms of population and land area. In addition central district has the largest number of sheep and goats in the whole country thereby giving the researcher an advantage of attaining the required sample. In the second stage Boteti sub-district was chosen purposively. The choice of Boteti Sub-district was justified by the high levels of abject poverty in the area as well as low levels of development, making it a typical rural area. In addition the agro-ecology of Boteti gives it an advantage of having more small stock producers. In the third stage, 3 villages with the highest population were purposively selected from the list of 12 villages within the sub-district. In the last stage, simple random sampling was used to select the sub-samples of beneficiaries and non-beneficiaries from their respective lists. The respondents were picked proportionate to the size of the villages.

The list of the beneficiaries was obtained from LIMID officer in the Department of Animal Production at Boteti Sub-district agricultural office while the non-beneficiaries were obtained from the extension officers in each village. The population of the beneficiaries and non-beneficiaries is not known therefore, to determine the sample size the formula by Cochran, (1963) was used as;

$$n = \frac{pqZ^2}{E^2} \dots\dots\dots(14)$$

Where n= the sample size, p= proportion of the population containing major interest, q= is the weighted variable,  $q = 1 - p$  E=allowable error at 0.08,  $p = 0.5$  since  $q = 1 - 0.5 = 0.5$  Z= standard deviate at 95% confidence interval  $Z = 1.96$ . According to Bartlett *et al.* (2001) the researcher can increase the value of the margin of error or decrease it when high level of precision is required. Therefore in this study an allowable error of 8% was chosen because the whole study was based on primary data which largely rely on recall method and also prone to errors. Further, this research is evaluating a programme which was established a while back and that posed challenges on getting accurate information.

$$n = \frac{0.5 \times 0.5 \times 1.96^2}{0.08^2} = 150 \dots \dots \dots (15)$$

Proportionate sampling was done to calculate the number of the respondents per village. The population of the villages was of the 2011 national census (Central Statistics Office, 2011). Number of respondents per village was the village population (VP) multiplied by Sample size (SZ) and then divided by the total population (TP) of all villages.

**Table 1: Village sample size**

Village	Village population	Sampled Respondents
Rakops	6396	81
Mopipi	3912	49
Xhumo	1594	20
<b>Total</b>	<b>11902</b>	<b>150</b>

**3.6 Data collection instruments**

Data for the study was collected using a semi structured questionnaire administered face to face to randomly selected individuals. Open and closed ended questions were used in the questionnaire with the aim of getting relevant information and to avoid restricting the respondents in responding. After training, a pre-test of the questionnaire was first done to determine validity and suitability for the study to be conducted. Data on socio-economic characteristics of respondents, challenges faced by beneficiaries, factors influencing the willingness of respondent’s participation in the programme, and household consumption expenditure, income and assets accumulation was collected.

**3.6 Data management**

Quantitative and qualitative data was managed using Statistical Package for Social Scientists (SPSS 22) and STATA 14 data management tools. Qualitative and quantitative analysis was employed in the study.

**3.7 Analytical Framework**

**Objective 1: To identify the main challenges encountered by small stock producers during and after application for LIMID programme funding in Boteti Sub-district, Botswana.**

Percentages, frequency distribution and mean were used to analyse the data on challenges encountered by participants of the programme. The data was presented on graphs bar charts,

pie charts and tables. The descriptive statistics were generated by the use of SPSS and STATA. Many studies have used descriptive statistics in analysing such an objective (Ajani *et al.*, 2015; Mgbenka *et al.*, 2015; Shapi, 2017).

**Objective 2: To identify factors influencing decision of small stock producers to participate in the LIMID programme in Boteti Sub-district, Botswana.**

The probit model was used to analyse factors influencing the decision of rural farmers to participate in the LIMID programme. Participation in LIMID programme is dichotomous in nature. According to Čepar and Bojnec (2012) binary dependent variables takes on the values of zero and one. The probit model is used to estimate the result of participation because it is very effective in determining dependent variables given the explanatory variables (Yihdego, 2016). Logistic regression is another method which can be used when dealing with dichotomous variables. However logit regression model tend to produce inaccurate estimates when so many variables are used (Concato *et al.*, 1995). The choice of variables was based on various variables used on other studies used like (Botlhoko and Oladele, 2013; Nwabiola, 2014; Sigh *et al.*, 2015; Akpan and Udoh, 2016; Nahayo *et al.*, 2017). The variables that were hypothesised to be used in the model are shown in Table 2. Probit modelling was adopted from studies by (Verbeke *et al.*, 2000; Kimberly *et al.*, 2004)

$$Y_i^* = \beta_0 + \sum_{k=1}^K \beta_k \chi_{ki} + \mu_i \dots\dots\dots (16)$$

Where, *i* denote the respondent and:

$Y_i^*$ : shows the participation decision ( $Y_i^* = 1$ , if one participates on LIMID programme

$Y_i^* = 0$  if one does not participate on LIMID programme),

$\chi_i$ : is the is the vector of explanatory variables that is determining the probability of participation in LIMID programme

$\chi_{ki}$ : k=1 through K independent variables that are explaining the phenomenon for respondent

$\beta_k$ : is the parameter that indicates the effect of explanatory variable on the dependent variable

$\mu_i$  : is the error term with zero mean and constant variance.

$K$  : is the number of variables

Therefore probability of participating in LIMID will be modeled as:

$$\begin{aligned} \text{Participation in LIMID} = & \beta_k + \beta_1 \text{Gender} + \beta_2 \text{ExtSer} + \beta_3 \text{OfficeD} + \beta_4 \text{Age} + \beta_5 \text{WaterD} \\ & + \beta_6 \text{Fsize} + \beta_7 \text{Skul} + \beta_8 \text{MarktD} + \beta_9 \text{MainO} + \beta_{10} \text{HhInc} + \beta_{11} \text{Herd} + \beta_{12} \text{CattleD} + \beta_{13} \\ \text{MainL} & + \beta_{14} \text{Perceptions} + \\ & \mu_i \dots\dots\dots (17) \end{aligned}$$

After running the probit regression, the command *mfx* was used to estimate marginal effects. This was mainly done for ease of interpretation of the results. The marginal effects are functions of the probability and are used to measure the expected change in the probability of a particular choice which was made with respect to one unit change in an independent variable (Makana and Thebulo, 2018)



**Table 2: Variables used in the probit model and their measurement**

<b>Variable</b>	<b>Variable code</b>	<b>Variable measurement</b>	<b>Expected sign</b>
Gender of the farmer	Gender	1= male 0=female	+/-
Access to extension service	ExtSer	Number of contacts	+
Distance to LIMID office	OfficeD	In km	+/-
Age of the farmer	Age	In years	+/-
Distance to water source	WaterD	In km	+/-
Farm size	Fsize	In hectares	+/-
Years of schooling	Skul	In years	-
Distance to input market	MarktD	In km	+/-
Farming as main occupation		1=full time	
	MainO	0=parttime	+
Household income(000)	HhInc	In BWP	+/-
Herd size	Herd	In numbers	+/-
Distance to nearby cattle post	CattleD	In km	
Main labour (family)	MainL	1=family 0=hired	+/-
Perception 1: Impact on household welfare		1= agree 2=Neutral 3=Disagree	+
Perception 2: Inclusivity in the programme	Percep1		
	Percep2	1= agree 2=Neutral 3=Disagree	+
Perception 3: Transparency in selection	Percep3	1= agree 2=Neutral 3=Disagree	+
Perception 4: Sufficiency of the funding	Percep4	1= agree 2=Neutral 3=Disagree	+
Perception 5: Adequacy of extension services	Percep5	1= agree 2=Neutral 3=Disagree	+
Perception 6: Ease of application for funding	Percep6	1= agree 2=Neutral 3=Disagree	+

**Objective 3: To estimate the effect of LIMID on the household welfare of the small stock producers in Boteti Sub-district, Botswana.**

The main purpose of this objective was to find the impact of the programme on household consumption expenditure of the beneficiaries. However, before estimating the effects of the programme factors that influence household consumption expenditure were determined using Ordinary Least Square (OLS). Household consumption expenditure is a continuous variable with a single response therefore OLS was appropriate. OLS is a linear modeling technique that is used in the prediction of a single response dependent variable and can be used when dealing with a single or multiple independent variables (Sharma, 2014). Similarly, Kuwornu and Owusu (2011) posited that a linear regression model can be used to analyse the relationship between the household consumption expenditure given various variables on individual, farm, household, community and village variables. The advantage of OLS is that the results are normally easy to interpret and it shows a relationship between a single outcome variable and one or more explanatory variables (Leeper, 2018). Further, OLS is a consistent estimator which is also unbiased and data analysis using OLS is often sufficient (McDonald, 2008)

Household head's socio-economic characteristics have been used because the household head is the one who makes a lot of decisions pertaining household consumption expenditure. Beneficiaries and non-beneficiaries are part of this household but it not necessary that they are household heads. Therefore the head of the household is the one who has more influence. According to Mignouna *et al.* (2015) socio-economic characteristics of household heads are vital as the head of the household has a primary role in purchasing of goods and services. OLS have been employed in various studies to determine factors that influence household consumption expenditure. The selection of the various factors that are likely to influence the household consumption expenditure relies on previous studies by (Sekhampu and Niyimbanira, 2013; Mignouna *et al.*, 2015; Bakri *et al.*, 2017; Piekut *et al.*, 2017). It is in this regard that several explanatory variables were hypothesized to be used (Table 3).

**Table 3:** Variables used in OLS model and their measurements.

<b>Variable</b>	<b>Variable code</b>	<b>Variable measurement</b>	<b>Expected sign</b>
Gender of the household head	Gender	1= male 0=female	+/-
Distance to output market	OutD	In km	+/-
Age of the household head	Age	In years	+/-
Distance to grazing	GrazingD	In km	+/-
Years of schooling	Skul	In years	-
Distance to input market	MarktD	In km	+/-
Predators as a main constraint	Ranked1	1=yes 0=no	-
Household income(000)	HhInc	In BWP	+/-
Herd size	Herd	In numbers	+/-
Distance to nearby cattle post	CattleD	In km	+
Main labour (family)	MainL	1=family 0=hired	+/-

PSM was used in determining the effect of LIMID on household welfare. This method was used to compare the beneficiaries and non-beneficiaries. In this study the LIMID beneficiaries were used as the treatment group while the non-beneficiaries were used as the control group. The intention was to compare the household consumption expenditure for those who were funded to keep small stock and those who were not. The expectation was that the participants had less consumption expenditure and less accumulated assets in the absence of the LIMID project. Upon participating in the programme then their incomes are expected to increase. When incomes of household are increased even their household welfare will become better in that their consumption expenditure will increase, they will be able to acquire assets, improve their livestock production by buying better breeds and taking care of other needs. This will in turn reduce poverty problems and improve household welfare.

PSM technique was used to estimate the average change in the outcome variable. PSM approach is popular in estimating causal effect on the treated farmer and it has been applied in many study fields. It can be used in all situations where there is a treatment and control group (Caliedo and Kopeining, 2005). In impact analysis when dimensions of covariates are many it is not easy to do individual matching therefore using propensity scores provide better results (Rosenbaum and Rubin, 1983). PSM is a balancing score which allows the control and the treated to subjects to have similar distribution of covariates (Austin and Stuart, 2015). PSM also aligns the dissimilarities between the two groups and allows the comparable to be compared. PSM was also preferred over other models as it has an advantage of not limiting the number of variables to be included in the model and this makes the researchers to include any variable they think it could be related to the outcome (Thavaneswaran and Lix, 2008). Further, PSM was chosen over other models which can be used in approximating causal effects like Difference in Difference because it does not require panel data. Difference in difference method is one of the methods that could be employed but it does not work in cross-sectional studies because it requires the pre-treatment data (Lechner, 2010). According to Thavaneswaran and Lix (2008) when using DID outcomes for two groups are observed in two time periods with the intervention occurring in one group and not in the other. Therefore PSM was considered the best approach to be employed on the study as cross sectional data was used in the study.

There is a wide range of covariates that are used to compare the treatment and control groups. Such covariates include gender of the farmer, household size, household income, farmer's education level, age, market distance, input and output price, extension service, farming experience, land size and herd size (Botlhoko and Oladele, 2013). Therefore, variables used in the study in the study were adopted from previous studies by different authors.

There are two assumptions on which effectiveness of PSM depends (Heinrich *et al.*, 2010; Baum, 2013). Conditional Independence Assumption (CIA): This assumption implies that the value of the outcome variable is independent of the treatment state. The selection into the participating group is based only on observable characteristics. Common Support Assumption: This assumption states that the treatment effect occurs only on the region of common support. There is normally a unit interval with which each possible value of vector X ranges. This assumption helps in making sure that there are adequate matches for both the treated and untreated.

### Estimating a model of programme participation

$$P(X_i) = \Pr(D = 1 / X_i) \dots\dots\dots(18)$$

P (X<sub>i</sub>) is the probability of participation in the LIMID programme. For participants D=1 while non-participants D=0, X<sub>i</sub> is all the variables that determine participation.

### Average treatment Effect

Average Treatment Effect (ATE): The average outcome of the participants is compared with the average outcome of the control group. The impact of individual *i* is denoted by δ<sub>*i*</sub> as the difference in outcomes of treated and the control.

$$\delta_i = Y_{1i} - Y_{0i} \dots\dots\dots (19)$$

$$ATE = E(\delta) = E(Y_1 - Y_0) \dots\dots\dots (20)$$

Y<sub>1</sub> is the treated group outcome while Y<sub>0</sub> is the control group outcome. E is the expected value and Y<sub>1</sub> - Y<sub>0</sub> is the treatment effect.

### Average Treatment effect on the Treated (ATT)

This helps in comparing the eligible non participants in the control group with the participants (effects on whom the programme is intended). D below denotes the treatment.

$$ATT = E(Y_1 | D = 1) - E(Y_0 | D = 0) \dots\dots\dots (21)$$

### Defining the region for common support and balance

The common support region is the area which includes all the minimum and maximum propensity scores for both the control and treatment group. The minimum and maximum scores are compared. Propensity scores which are less than the minimum score or more than the maximum score for both the treated and control groups are discarded from the analysis (Caliedo and Kopeining, 2008).

### **Matching participants to non-participants methods**

The estimated propensity scores are adjusted using one of the four matching methods or a combination of them (Thavaneswaran and Lix, 2008). The methods are Nearest Neighbour (NN) Matching, Stratification Matching, Radius Matching, Kernel Matching, and Mahalanobis Metric Matching. No method has been seen to be the most effective or appropriate as each method is effective in particular circumstances (Rosenbaum and Rubin, 1983).

#### **Nearest Neighbour Matching**

This method is considered to be the straightforward procedure in which respondents are matched without replacement. Estimated propensity scores are used to match the treated group individuals with the control group individuals who have similar or closest propensity scores (Heinrich et al., 2010). The unmatched subjects will then be eliminated from the analysis. This method is well suited when the number of the treated group is less than the control group. The main limitation of this method is that the respondents can have more than one pair sets (Thavaneswaran and Lix, 2008).

#### **Stratification Matching**

Propensity scores are used to group the subjects into homogenous sub classes. The subjects are divided into five equal groups using the quintiles of the estimated propensity scores. The impact in each interval is calculated by taking mean difference in outcomes of the treated and untreated groups. Five strata are used because they eliminate up to 90% - 95% of covariate biasness (Thavaneswaran and Lix, 2008; Caliedo and Kopeining, 2005).

#### **Radius Matching**

The treated and the control are matched basing on the propensity scores which are in the same radius. The comparators of the participants and non-participants which fall within the same propensity score radius are matched. Those which fall outside the radius will not be matched with any comparators (Bryson *et al.*, 2002).

#### **Kernel matching**

The weighted average is used to compare the beneficiaries and the non-beneficiaries. Weights are normally inversely proportional to the distance between the propensity scores of the treated and the control group. Advantage of this method is that there is lower variance due to more information which is used (Heinrich et al., 2010; Caliedo and Kopeining, 2005).

**Table 4:** Covariates for propensity matching and their measurement

<b>Variable</b>	<b>Variable code</b>	<b>Variable measurement</b>	<b>Expected sign</b>
Gender of the farmer	Gender	1= male 0=female	+/-
Access to extension service	ExtSer	Number of contacts	+
Distance to LIMID office	OfficeD	In km	+/-
Age of the farmer	Age	In years	+/-
Distance to water source	WaterD	In km	+/-
Farm size	Fsize	In hectares	+/-
Years of schooling	Skul	In years	-
Distance to input market	MarktD	In km	+/-
Farming as main occupation	MainO	1=full time 0=parttime	+
Household income(000)	HhInc	In BWP	+/-
Herd size	Herd	In numbers	+/-
Distance to nearby cattle post	CattleD	In km	
Main labour (family)	MainL	1=family 0=hired	+/-

## CHAPTER 4

### RESULTS AND DISCUSSION

#### 4.1 Introduction

The chapter is divided into 4 sections. Section 1 reports the descriptive statistics on the beneficiaries and non-beneficiaries. The second section presents the challenges encountered by respondents when they were applying into the programme. This section also includes the descriptive statistics of the major production and marketing constraints faced by respondents in Boteti Sub-district. Probit results on factors influencing the decision of an individual to participate in the programme are reported in section 3. Section 3 also includes factor analysis results on the perceptions that influenced participation in the programme. The last section discusses the factors that affect household consumption expenditure. PSM results on effect of the programme on the household consumption expenditure are also reported in the last section. The analyzed results are for 100 beneficiaries and 50 non-beneficiaries.

#### 4.2 Socio-economic dimensions of beneficiaries and non-beneficiaries of LIMD programme

##### 4.2.1 Gender of the farmers

Results on the gender of the farmers presented in Table 5 shows that 57.3% of all the farmers are female while 43.7% are male. However, when separating the two groups, for beneficiaries females were 57% and male were 43% while for the non-beneficiaries male respondents were 52% while female respondents were 48%. The results on the gender indicate that small stock production is not male dominated. The reason could be that female farmers prefer small stock because it is easy and cheap to manage. Moreki *et al.* (2010) reported that women own more goats than men who normally own a lot of resources thereby being in better position to purchase bigger livestock like cattle.

**Table 5** : Gender of the beneficiaries and non-beneficiaries of LIMID programme

Gender	Overall household (%)	Segregated households (%)	
Female	57.3	Beneficiaries	57
		Non-beneficiaries	48
Male	43.7	Beneficiaries	43
		Non-beneficiaries	52

##### 4.2.2 Main occupation of the beneficiaries and non-beneficiaries of LIMID programme

From the overall results on occupation given in Table 6, majority of the beneficiaries (85%) are full time farmers while only 15% are part time farmers. For non-beneficiaries 84% are



full time farmers while 16% are part time farmers. Many rural dwellers are specifically livestock farmers because they depend on livestock as a source of food, wealth, prestige, and for social-economic role like slaughtering during initiation ceremonies. The findings are similar to Omonijo *et al.* (2014) reported that the main occupation was farming (67.4%) amongst rural dwellers.

**Table 6:** Main occupation of beneficiaries and non-beneficiaries of LIMID programme

<b>Main occupation</b>	<b>Overall household (%)</b>	<b>Segregated households (%)</b>	
Full time farmer	85	Beneficiaries	85
		Non-beneficiaries	84
Part time farmer	15	Beneficiaries	15
		Non-beneficiaries	16

#### **4.2.3 Main source of income for beneficiaries and non-beneficiaries of LIMID programme**

Result in Table 7 showed that that 48% of the beneficiaries get their income from small stock while for non-beneficiaries is 30%. Rural residents make their living from livestock (Magole, 2009). Government schemes are a source of income for 23% of beneficiaries and 20% non-beneficiaries. Rural household depend mainly on external support in the form of government and private transfers and also from wage earned from employment generated by government expenditures extended to the rural economies (Moepeng and Tisdell, 2008). However, 4% of beneficiaries and 10% of non-beneficiaries own businesses or are self-employed. The possible explanation of this could be that some farmers have enough income to purchase inputs to start their own businesses like tuck shops. These results are supported by Zuwarimwe and Mbaai (2015) who reported that integration of farmers into agriculture empowers them to diversify their livelihood into no-farm enterprises.

**Table 7:** Main source of income for farmers

Main source of income	Beneficiaries (%)	Non-beneficiaries (%)
Small stock	48	30
Other on-farm	1	14
Off- farm employment	24	26
Government Schemes	23	20
Own business	4	10
<b>Total</b>	<b>100</b>	<b>100</b>

#### 4.2.4 Age, farming experience and household size of the beneficiaries and non-beneficiaries

Regarding the results about age in Table 8, the average age for respondents is approximately 45 years. This indicates that most of the farmers in the area are middle-aged. The possible explanation could be that LIMID target the vulnerable group like the youth that is why most of the farmers are youths or middle aged. When the two groups of beneficiaries and non-beneficiaries are separated the mean age for a beneficiary is about 45 years while for non-beneficiaries is about 44 years. The middle aged participated in the programme because they are still active as compared to old people therefore age makes farming easy for them.

Further, the results showed there is no significant ( $p>0.1$ ) difference between the beneficiaries and Non-beneficiaries based on age, farming experience and the size of the household size. This shows that the two groups had similar characteristics and this is good when using PSM as the treated and control group need to have similar/close characteristics for better comparison. The overall farming experience is 16 years, however the mean for farming experience of beneficiaries and non-beneficiaries is 16 years and 15 years respectively. Regarding the household size, the mean size for both the beneficiaries' and non-beneficiaries' households is 8 but when dividing the respondents for beneficiaries is 8 while for non-beneficiaries is 7. The possible explanation could be that average household is big mainly because most farmers live in extended families. A large household shows that there is availability of extra labour which can be used to take care of small stock. Large households provide adequate household labour that can be used on operating farm activities (Kelebe *et al.*, 2017)

**Table 8:** Demographic characteristics of beneficiaries and non-beneficiaries of LIMID

Variables	Beneficiaries		No-beneficiaries		Total		t test	p-value
	Mean	SD	Mean	SD	Mean	SD		
Age	44.56	13.99	44.40	13.71	44.56	13.83	-0.869	0.3860
Farming experience	15.57	12.73	15.28	9.80	15.57	11.80	-0.075	0.941
Household size	7.82	3.614	7.08	2.769	7.57	3.37	-0.145	0.885

**Note:** SD=standard deviation

#### 4.2.5: Education level of the farmers

Results on the education level of the respondents in Table 9 showed that most (36.7%) of the small stock producers attended junior school. However beneficiaries who have no formal education are depicted by 26% while only 22% of non-beneficiaries did not attend school. Most of the beneficiaries (40%) attained junior certificate as compared to non-beneficiaries (30%). Meanwhile, most non-beneficiaries (36%) attended primary school while only 19% of the beneficiaries attained primary education. Only 3% of beneficiaries attained tertiary education while 4% of non-beneficiaries went up to tertiary level. In general the result on the education, show that most of the respondents are not highly educated though they are not illiterate. This is supported by Moepeng and Tisdell, (2008) who reported the urban sector to be attracting the more educated rural out-migrants than those who have low education level such as primary school leavers. This means that the educated leave the households and migrate to cities leaving the less educated in the villages as shown by the results on education.

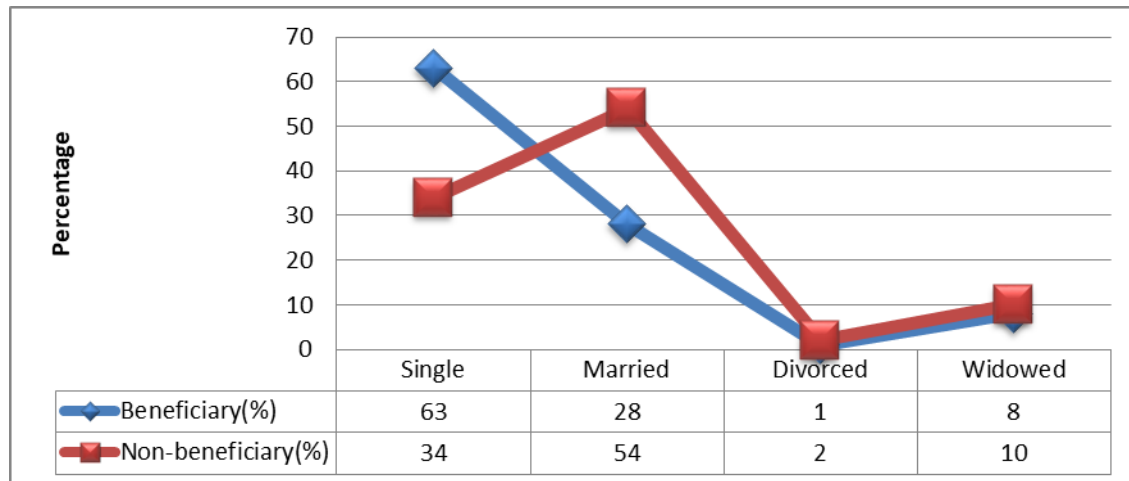
**Table 9:** Education level of the farmers

Education level	Overall respondents (%)	Beneficiaries (%)	Non-beneficiaries
No formal education	24.7	26	22
Primary school	24.7	19	36
Junior school	36.7	40	30
High school	10.6	12	8
Tertiary institution	3.3	3	4
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

#### 4.2.6 Marital status of the beneficiaries and non-beneficiaries of LIMID programme

Marital status of beneficiaries and non-beneficiaries is presented in Figure 5. Most (63%) of the beneficiaries are single while 28% are married. Moreki *et al.* (2010) found that majority (65.78%) of the resource poor in Botswana are single. Meanwhile, majorities (54%) of non-

beneficiaries are married and 10% are widowed. This result agrees with the findings of Chima and Bowell (2016) who found that majority (68%) of the small ruminant owners were married.



**Figure 6:** Marital status of the small stock farmers

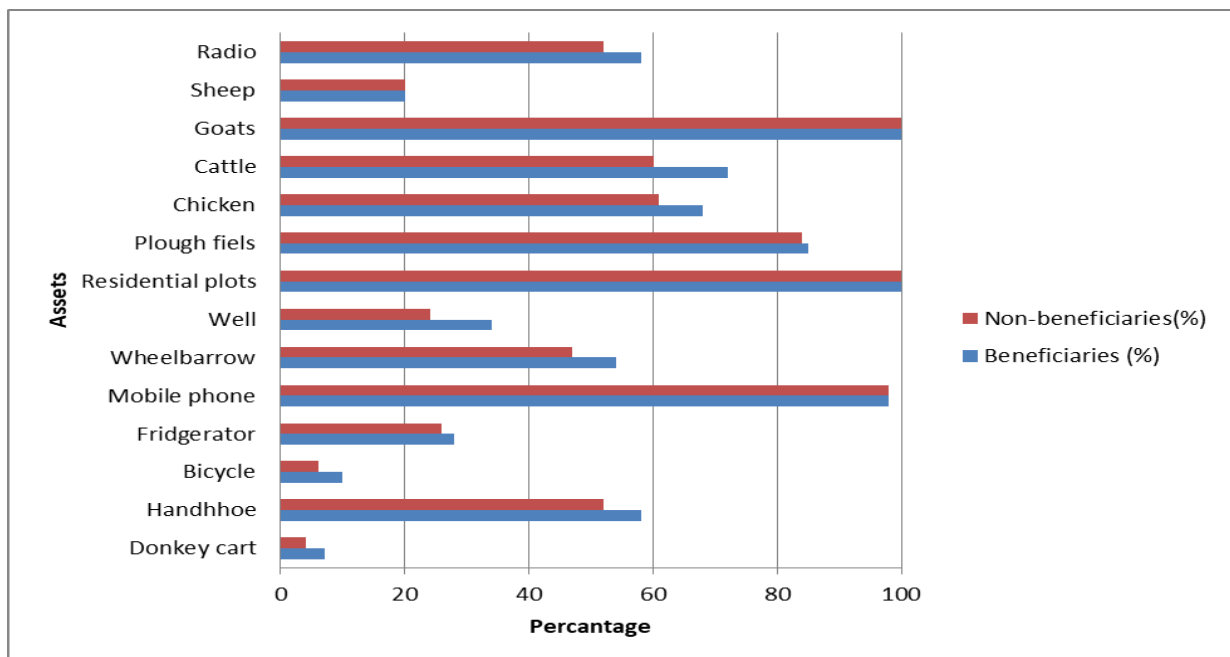
#### 4.1.7 Assets owned by small stock farmers

Assets ownership is an indicator of the standard of living of people and is used as a welfare proxy (Brewer and O’Dea, 2012; Moratti and Natali, 2012). The results on the assets owned by small stock farmers are presented in Figure 7. Both the beneficiaries and non-beneficiaries’ households own residential plots. All the members of the community enjoy the right to arable and residential plots (Magole, 2009). The results also showed that 54% of the beneficiaries own wheelbarrows while 47% of the non-beneficiaries own wheelbarrows. Wheelbarrows are vital for rural dwellers as they are used for daily households work like to fetch water from the river and to carry food items from shops.

Comparing the beneficiaries and non-beneficiaries with regard to ownership of mobile phones, 99% of both the beneficiaries and non-beneficiaries’ households own mobile phones. Most farmers own cell phones as it the quickest, fastest and cheapest mode of communication they normally use to communicate when they have access to network in order to get relevant information like prices of farm inputs. Cell phones are important as they link farmers with buyers and input providers (Kebebe *et al.*, 2017). The results also showed that 58% and 52% of the beneficiaries and non-beneficiaries households owns radios respectively. Farmers use radios to listen to national agricultural programs as well as to get information about the input and output markets, extension services and outbreak of diseases.

Only a few (20%) households for both beneficiaries and non-beneficiaries own sheep while majority (80%) do not keep sheep. On the other hand all households own goats. Regarding the ownership of goats, when comparing the two groups the results indicated that only 20% of both beneficiaries and non-beneficiaries owned sheep whereas 100% of the same household owned goats. This might be because sheep are easily attacked by dogs and they are neither drought nor disease tolerant as compared to goats. Most farmers in the country have a preference towards goat farming as compared to sheep farming with a few farmers keeping both (Berthelsson, 2017).

The results on cattle ownership has shown that 72% of the beneficiaries own cattle while 60% of the non-beneficiaries own cattle. Ownership of bicycles is low amongst the respondents. Only 10% of beneficiaries own bicycles with this percentage being lower among the beneficiaries whereby only 5% own bicycles. This is because most of the farmers do not use bicycles due to cattle post which are located far from villages and also to avoid the risk of animal attacks. Farmers normally use cars or ride on horses as they are fast. In addition, beneficiaries (38%) and non-beneficiaries (26%) own fridges. The explanation is that most of them do not have access to electricity as there is a shortage of electricity in the country or they cannot afford it. Electricity is expensive and rural household may not afford to pay for such a service due to limited disposable income (Feleke *et al.*, 2016).



**Figure 7:** Household assets

#### 4.2.8 Reasons for beneficiaries' participation in LIMID programme

Beneficiaries ranked different reasons for applying into the programme according to their importance as shown in Table 10. The main reason the smallholder farmers decided to join the LIMID programme is that they wanted to keep small stock as source of income. This was ranked as the most important reason by 98% of the beneficiaries who revealed that their low levels of income prompted them to apply for LIMID funding. Beneficiaries participated in the programme to earn money to take care of the households needs. The acquired money is used to cater for needs like food, clothes even to pay for children's school fees. One of the factors why farmers decide to keep goats is for socio-economic reasons like cash and assets accumulation (Berhanu *et al*, 2012). The results were also supported by Ahmed and Egwu (2014) who indicated that farmers keep small stock for income in order to meet family needs.

Furthermore, 75% of the beneficiaries said they chose to keep sheep and goats mainly because of lack of employment in the country. Unemployment rate was reported to be 17.7% in 2016 (Ministry of Finance and Economic Development, 2018). However 63% of beneficiaries revealed that they applied because they were given goats for free. Similarly 63% of the beneficiaries said they chose to keep small stock as it easy to manage. Meanwhile 52% revealed that they embarked in sheep and goat's production because they had farming experience so they knew that managing small stock was going to be easy for them. In relation to farming experience, farmer who have many years in farming have high chances of participating in the programme because for an experienced farmer it is easy to manage livestock than a new farmer. These results concur with Akpan and Udoh (2016) who indicated that farmers who have experience are likely to participate in the government agricultural programmes than those who do not.

**Table 10:** Reasons for beneficiaries' participation in LIMID programme

Reasons	Percentage of Cases
Low level of income	98
Source of employment	75
Small stock easy to manage	63
Small stock is given for free	63
Farming experience	52

### **4.3 Main challenges encountered by small stock producers during and after application for LIMID programme funding.**

#### **4.3.1 Challenges faced by beneficiaries during application**

There are several challenges that the beneficiaries went through before they were given the fund. The results on the challenges faced by beneficiaries during application are presented in Table 11. Majority of the applicants (98%) ranked administrative procedures to be the most important challenge they faced when they were applying for the programme. For example, they were told to bring many quotations which they were collecting from a village which is 165 km away. In addition, they highlighted that it takes a long time for them to be assessed and given feedback if they qualify or not. Some applicants who had submitted the quotations were told to bring new ones again. Kathiresan (2011) reported operational and administrative challenges to be an impediment to service delivery which delay delivery of services like inputs to farmers. This problem makes some farmers not to apply because they lack self-assurance in the service provided by the extension workers. Lack of confidence in the extension service agents was reported to be a problem in agricultural training programmes (Lioutas, *et al.*, 2010).

The other challenge was insufficient information which was ranked the second most important challenge by 45% of the applicants. Most people do not apply because they do not have sufficient nor accurate information about the programme because they rarely have access to extension workers who have the right information. Nahayo *et al.* (2017) indicated that participants of Crop intensification programme in Rwanda rarely have access to extension agents for advice and training. Difficulty to access the forms and unfriendly personnel were both ranked as the third important challenge by only 34% of the respondents. Some of the staff members were reported to be rude and untrustworthy because they had a tendency of discriminating people and even giving unreliable information. Chima and Howell, (2016) reported lack of trust on the extension agents as one of the factors discouraging farmers' participation in agricultural programmes. Meanwhile only 31% complained about the long distance to the office.

**Table 11:** Challenges faced by beneficiaries during application for LIMID funding

<b>Constraints</b>	<b>Percentage of cases</b>
Administrative procedure	98
Insufficient information	45
Not easy to access application forms	34
Unfriendly personnel	34
Long distance to LIMID office	31

#### **4.3.2 Challenges faced by applicants after approval**

Even after being approved the beneficiaries went through several challenges before the inception of the projects. Table 12 presents challenges faced by applicants after being approved. Untimely disbursement of inputs was ranked as the most important challenge that the beneficiaries faced by 87%. This is in accordance with Nahayo *et al.* (2017) who found late delivery of inputs as a main constraint in the programme, which hinders farmers from participating in the programme. The second most important challenge was that most of the respondents did not receive all the inputs they applied for. For instance some of the inputs like the supplementary feeds, drugs, even their goats were missing, and this was ranked as important by 83% of the respondents. This result is supported by Nahayo *et al.* (2017) who posited that there are challenges regarding the availability and accessibility of the inputs for agricultural programmes. Many (80%) of the respondents complained about administrative procedure that the officers are very slow and more often there are never organized. For instance some people who are supposed to be given goats at the same time you will find that some are in the list while some are not yet they were approved at the same period. Only 27% showed a concern of long distances to LIMID office because they stay far at the cattle post so it difficult to make follow ups on their missing inputs or even to access extension services.

**Table 12:** Challenges faced by applicants after approval

<b>Challenges</b>	<b>Percentage of cases</b>
Untimely disbursement of inputs	87
Inputs was less than what was applied for	83
Administrative procedure very long	80
Distance to the institution	27



### **4.3.3 Production and marketing constraints faced by small stock farmers**

#### **4.3.3.1 Production constraints on small stock production**

There are several challenges that producers are facing including production and marketing challenges. Table 13 reports the production constraints faced by small stock farmers in Boteti Sub-district. All the sampled farmers (150) indicated that they face various production challenges. In Namibia 96% of the small holder farmers were found to be having production constraints on a study that was done about the small scale farmers in Green Scheme projects (Shapi, 2017). The first major production challenge is the predators like jackals, fox, lions and dogs. The challenge is common amongst all the villages, with 90.7% of the farmers having ranked predators to be the first major constraint they face. In Botswana the conflict between wildlife and humans has been on a rise, with small holder farmers losing a lot of livestock to wild animal because they keep their animals in communal areas which are not fenced. This result is similar to the findings of Mosalagae and Mogotsi (2013) who reported that pastoral farmers in the Ghanzi region of Botswana indicated that the loss of livestock was due to predation.

Many farmers do not herd their livestock at grazing areas and that is where most of the attacks occur. In addition small holder farmers do not have good housing structures for the goats so the kids are fed on by predators while straying outside the kraals, even though some predators attack livestock while in the kraal (Aganga and Aganga, 2015). Theft was ranked the second important constraint by 82.7% of the farmers. Theft has become common in recent years in the country especially by the youth due to high levels of unemployment and other social challenges in the nation. In Kgalagadi south, Botswana, 19% of the pastoral households reported to be having the problem of theft (Mosalagae and Mogotsi, 2013). Theft is also a contributor to livestock loss in Malawi (Assa *et al.*, 2014)

Diseases were ranked the third important constraint by 78% of small holder farmers. Most of the farmers during the interview indicated that diseases like phosphorosis and coccidiosis which were contributing to high mortality rates hence low productivity. Small stock is managed communally in the rural Botswana where farmers invest little in disease control, labour and supplementary feeds (Kgosikoma *et al.*, 2016). In Malawi, pest and diseases were identified to be amongst the major agricultural productivity challenges (Phiri *et al.*, 2012).

Access to financial markets or insufficient financial support service was identified as one of the major production constraints by 71.3% of the small holder farmers in Boteti-Sub district. In Sub Saharan African countries, farmers face several challenges including lack of credit (Druilhe and Barreiro-Hurle, 2012). Due to lack of finances, farmers are not able to improve their livestock variety because they cannot afford to buy other breeds like karakul sheep and Boer goats. All the farmers in the study only keep Tswana breeds of sheep and goats. Farmers revealed that they cannot afford to buy other breeds. Furthermore, feed unavailability is one of the limiting factors in small stock production with 45.3% of the farmers having ranked pasture scarcity to be the sixth major constraint they face in production. Botswana being a semi-arid region of Africa, drought is a recurrent feature. The exposure to drought hazard eventually disrupts production systems. Low pasture quantity and quality is one of the adverse effects of climate (Mogotsi *et al*, 2013).

Tadesse *et al.* (2013) also found out that feed shortage was among the most important constraints of sheep and goat production in Ethiopia. Goats feeding on low quantity and quality feeds make them to be unable to resist pest and diseases hence low survival rates of kids (Aganga and Aganga, 2015). However, 50.7% of the farmers use supplementary feeds which they either buy or get from the crop remains in their fields in response to adverse drought conditions in the area. The feeds they use include molasses, bran, crop remains, block, salt, drought pellets, pods, lablab and milk (for kids). Only 49.3% of the farmers don't use supplementary feeds. Inadequate extension services were ranked by 23.3% of the respondents as one of the production constraints. Ahmed and Egwu (2014) found inadequate extension service to be one of major constraints for sheep farming. Another challenge that was ranked by 20% of the respondents was that of natural disaster. Some small stock farmers lose their animals to natural disaster like floods and sometimes animals being struck by lightning. Ajani *et al.* (2015) reported natural disasters as one challenge associated with agricultural development programmes. Water scarcity was ranked by 18% while transport was ranked by 16% of the farmers.

**Table 13:** Production constraints faced by small stock farmers

<b>Challenges</b>	<b>Percentage of cases</b>
Predators	90.7
Theft	82.7
Diseases	78.0
Access to markets	74.7
Insufficient financial support	71.3
Pasture scarcity	45.3
Inadequate extension service	23.3
Natural disaster	20.0
Water scarcity	18.0
Transport	16.0

#### **4.3.3.2 Marketing constraints faced by small stock farmers**

In marketing the small stock, farmers indicated that they normally face a problem of identifying a proper market as only the government has become a major buyer. Marketing constraints are presented in Table 14. Lack of market was ranked as the first most important marketing constraint by 88% of the farmers. In Namibia, Shapi (2017) reported that lack of access to effective and efficient markets is one of the factors that impede the sale of the small scales farmers produce. Majority of the farmers (87%) considered low prices to be the second important constraint in selling their produce. Farmers sell their sheep and goats to the government. However, there are challenges with selling to the government because there are always delays of the payment as indicated by 43% of the farmers in Table 12, thereby leaving the farmers in the hands of traders, butcheries, and other buyers who take their livestock at very low prices. The results are substantiated by the Bahta *et al.* (2013) who found that in Botswana traders buy livestock at village level and farmers more often complain about low prices they receive. Even though farmers can also sell to individual customers and other farmers, the government has become a major buyer of small stock with the main reason of supplying those who are beneficiaries of public programmes.

The third important constraint was found to be lack of transport as shown by 63% of the farmers. The possible explanation is that most of the cattle posts are situated far from tarred roads and farmers lack transport to take their small stock to better markets. This results in farmers selling their small stock at very low prices. This result is supported by Zuwarimwe and Mbaai (2015) who reported that small holder livestock farmers in Namibia indicated to be having the same problem of transport to markets.

Meanwhile, poor roads were ranked the fifth market constraint by 30.7% of the small stock farmers. The least important constraint was reported to be lack of information and it was ranked by 28% of the farmers as shown in Table 12. Access to market information is very vital to small holder farmers as they get to know available markets and the prices. More often than not, small holder farmers do not have access to information because farmers are far from villages. Therefore, despite majority of the farmers owning cellphones because of poor networks it is not easy to communicate with their loved ones. This problem makes it difficult for farmers to be accessible to potential buyers who are willing to reach them at cattle posts to buy small stock from them. Masole *et al.* (2015) reported inconsistency in market information to be a problem among poultry farmers in Botswana. Ajani *et al.* (2015) identified lack of access to market information as one of the problems associated with agricultural development programmes. In addition, families who stay in remote areas are disadvantaged as they cannot get access to information like on markets and inputs such as technology (Kelebe *et al.*, 2017). Poor roads and lack of information were also identified to be some of the challenges that are faced by farmers in Namibia (Hangari *et al.*, 2011).

**Table 14:** Marketing constraints faced by small stock farmers

<b>Constraints</b>	<b>Percentage of cases</b>
Lack of market	88.7
Low prices	87.3
Lack of transport	66.0
Delayed payments from the government	43.3
Poor roads	30.7
Lack of information	28.0

#### **4.4 Preliminary test for multicollinearity and heteroskedasticity**

Several tests were conducted to check if the data was fit for analysis before running any model. Variable Inflation Factor (VIF) was conducted for continuous variables in order to see if there is multicollinearity amongst the continuous variables. Multicollinearity is a situation whereby two or more independent variables are related with each other and even with the dependent variable. Multicollinearity normally leads to inflated standard errors, thereby making some variables to be statistically insignificant when they were supposed to be significant (Akinwande *et al.*, 2015). The results are presented in Appendix 3. The VIF of each individual variable was less than 5 with the mean of 2.14. VIF mean of less than 5

confirms the absence of multicollinearity among the continuous explanatory variables of the estimated model (Mignouna, 2015). This test endorsed the use of this data in the study.

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity was also conducted using the command *.estat hettest* to see if the residuals are randomly dispersed throughout the range of the independent variable (Appendix 3). A *p* value of 0.253 showed the absence of heteroskedasticity and proved that the data is fit to be used for analysis in the study. When *p* value > 0.1 is insignificant, revealing that there errors are homoscedastic hence the absence of heteroskedasticity (Masole *et al.*, 2018). Pairwise correlation test was also done to check if there was any correlation among the categorical variables (Appendix 3).

#### **4.5 Factors influencing decision of rural farmers to participate in LIMID programme in Boteti sub-district, Botswana**

##### **4.5.1 Perceptions of farmers regarding LIMID programme**

The analysis of perceptions was done in different stages using several statistical techniques. Factor Analysis was used with the main aim of summarizing data and also to reduce dimensionality for better interpretation. Perceptions are unobservable characteristics which cannot be measured directly but rather used as hypothetical constructs, therefore there is need to use factor analysis in reducing the number of variables into few clusters for better interpretation (Yong and Pearce, 2013). Factor analysis can also be used as a tool to explore the associations between the traits that are being studied (Freitas *et al.*, 2017). Factor analysis and orthogonal varimax (Kaiser off) were used in the analysis of the 22 latent variables which were grouped into six primary components. Varimax method has an advantage of minimizing the number of variables on each factor and makes interpretation of factors simple (Boohene *et al.*, 2012).

Furthermore rotating variables ensures that each component loads a few variables at the same time maintaining high loadings for each component to reduce ambiguity and ease of interpretation (Yon and Pearce, 2013). Kaiser Meyer-Olkin (KMO) was also performed to measure the adequacy of the sample and the factor loadings. Cronbach's alpha ( $\alpha$ ) for all the factors was estimated in evaluation of the internal consistency reliability of the factors (Yang and Wu, 2016). In addition  $\alpha$  coefficient can be used to measure the reliability of the scale (Teo and Fan, 2013). Yang and Green (2011) stated that coefficient alpha is used in deciding which items to be include and which ones to be excluded from the scale. The results for analysing of the perceptions of the small stock farmers about the LIMID programme are presented in Table 15.

**Table 15:** Perceptions of the farmers about the LIMID programme

<b>Constructs</b>	<b>Items</b>	<b>Factor loadings</b>	<b>CR</b>	<b>AVE</b>	<b>KMO</b>
Impact of the programme on household welfare	LIMID programme increase household income	0.812	0.753	0.670	0.692
	LIMID programme increase household wealth/assets	0.833			
	LIMID programme is a source of employment to beneficiaries	0.811			
Inclusivity in the programme	LIMID should be discontinued it does not impact livelihoods	-0.71	0.437	0.471	0.558
	LIMID encourages youth participation in agriculture	0.710			
	The programme increase economic opportunity for women	0.268			
Transparency in selection of beneficiaries	Applicants with connections are funded	0.684	0.739	0.437	0.745
	Wealthier people are turned away from the project	0.732			
	The selection process is unfair	0.691			
	Only the very needy are funded	0.603			
	Only people with certain ethnic groups are selected/funded	0.583			
Sufficiency of the funding	Poorer people are given more fund	0.661	0.664	0.749	0.500
	The amount given for funding is sufficient	-0.865			
	The amount should be increased	0.865			
Provision of adequate extension service	Training of the farmers is undertaken after the funding	0.805	0.804	0.719	0.687
	Funded farmers re linked to markets for small stocks	0.886			
	Farmers are provide with sufficient support service	0.853			

Table 15: Perceptions of the farmers about the LIMID programme (continued)

Ease of application for funding	It is easy to access the application forms	-0.628			
	There is shortage of application forms	0.711			
	The LIMID offices are located far from where you stay	0.545	0.693	0.455	0.707
	Application procedure is complicated	0.774			
	After application the selection criteria takes long time to be effected	0.692			

**Note:** CR: coefficient of reliability; AVE: Average variance extracted; KMO: Kaiser Meyer-Olkin,  $p < 0.0001$

### Scale 1: Impact of the programme on household welfare

This perception is based on the assumption that positive perceptions of the individuals about the impacts brought about by the programme increases the likelihood of people participating in the programme. This means that farmers participate in programmes looking at the perceived benefits. Nxumalo and Oladele (2013) in a study evaluating the attitudes of the participants of agricultural programme found out that the participants had a positive perception about the impact of the programme. Participants agreed that participating in the programme enhances household food security and job creation. When evaluating the perception of the youth on the government agricultural programmes in Nigeria Ayinde *et al.* (2016) revealed that one of the significant perceptions about the programmes was that the programme could reduce unemployment in the state. In analysing this component, the AVE of this scale is 0.670 and this shows that the items are related and explains well the construct (Ozkaya *et al.*, 2015). The KMO for this component is 0.692 which is considered to be an average indicator of sample adequacy. According to Kweyu and Ngare (2012) KMO values between 0.5 and 0.7 are taken to be average, between 0.7 and 0.8 are considered to be good while any values above 0.9 are excellent. Meanwhile the CR is 0.753 which is categorized as good according to Boohene *et al.* (2012). This results shows the validity and reliability of the construct, therefore all the items were maintained for further analysis in the study.

### **Scale 2: Inclusivity in the programme**

Inclusivity perception is based on the idea that LIMID programme targets certain individuals in the community specifically the resource poor people. Therefore if people have positively perceived that they will be funded then they tend to participate. Sirivongs and Tsuchiya (2012) also reported a positive relationship between attitudes, positive perception and participation. The KMO for this scale is more than 0.5 and also the factors had an eigenvalue of more than 1. The maintained factors were based on the Kaiser's criterion which suggests that all factor loadings with more than eigenvalue of 1 should be retained as adopted in a study by Kweyu and Ngare (2013).

### **Scale 3: Transparency in selection of beneficiaries.**

This construct is mainly focused on how fair the selection process is after applying for funding. If there is any perceived biasness in assessing the applicants based on ethnicity, social status or even if there is no transparency in the selection of beneficiaries then people will not apply. Moepeng and Tisdell, (2008) noted that the low presentation of the poor amongst the people who receive government assistance shows that there is a problem of target insufficiency in the redistribution of government provided welfare. The component had a KMO of more than 0.7450. Boohene *et al.* (2012) stated the KMO value ranges between 0 and 1 so the closer the value is to 1 then there is a significant correlation between the variables. Therefore having a KMO range of 0.745 in this study reveals that there is a significant correlation between the items and that the sample is adequate.

### **Scale 4: Sufficiency of the funding**

When people perceive that the funding is enough then many will be willing to participate. In analysing this perception Prob>chi2 value was 0.000 showing that this construct is significant to be retained and used for further analysis in the study. Olsen *et al.* (2017) stated that when  $p < 0.001$  depict that all the factor loadings are highly significant. Therefore this component was maintained to be used in further analysis. Increase of the fund was one of the positively perceived factors about LIMID programme on a study by Moreki *et al.* (2010). This entails that people applied because of the positive perception about the funding.



### **Scale 5: Provision of adequate extension service**

Regarding extension service farmers will decide to participate or not based on the perception of how much they will access the extension service. Increased number of contacts with extension workers increases the likelihood of one applying for LIMID programme because they know that they will get advice and information about diseases and markets. Availability of extension service raises the chances of an individual to participate on government agricultural programmes (Akpan and Udoh, 2016). In addition, Mgbenka and Ignokwe (2015) while studying the perceptions of farmers about the government agricultural activities reported that poor extension coverage was perceived to be one of the factors affecting the effective performance of the government in development activities. In analysing this component, the reliability coefficient (Cronbach alpha) for this factor was tested and it is 0.804 which shows that the variables are reliable to be used on the study. According to Field (2009) a value of more than 0.7 is an acceptable alpha value. Such results show that factor analysis technique is suitable for the analysis of the data.

### **Scale 6: Ease of application for funding**

The perception on ease of application was assumed to be one of the main perceptions that will influence the participation. When farmers have positive perception on being able to easily access the forms they will be willing to apply. In analysing this construct the Coefficient alpha is 0.6926 depicting that there is internal consistency among the items (Boohene *et al.*, 2012). Prob>chi2 for this construct was significant at 1% thereby allowing the use of this variable for further analysis. The conclusion was that factor analysis proved to be reliable and appropriate to be used for analysis on the study. The sample size also proved to be adequate. The six grouped components (perceptions) were all found to be significant ( $p < 0.01$ ) showing that the data fit factor analysis. Therefore all constructs were retained for further analysis in the study none were discarded.

Factors influencing an individual to participate in the programme were identified using probit model (Table 16). The  $p$  value is less than 0.01 ( $p < 0.01$ ) depicting that the independent variables used in the model are suitable to be used in explaining the decision of the rural farmers' participation on the programme. In addition this shows goodness of fit of the model used for analysis.

**Table 16:** Factors influencing decision of rural farmers to participate in LIMID programme

<b>Variable</b>	<b>Marginal effects</b>	<b>Std. Err.</b>	<b>z</b>	<b>P&gt;z</b>
Gender	-0.388	0.0923	-4.18	0.000
Access to extension service	0.063	0.106	0.60	0.549
Distance to LIMID office	-0.005	0.003	-1.83	0.068
Age	-0.008	0.004	-2.11	0.035
Distance to water source	0.057	0.041	1.39	0.163
Farm size	0.006	0.009	0.66	0.507
Education level	-0.020	0.011	-1.75	0.080
Distance to input market	0.001	0.001	-1.35	0.176
Main occupation	0.032	0.054	0.60	0.546
Household income(000)	0.033	0.020	2.16	0.030
Herd size	0.002	0.002	1.03	0.304
Distance to nearby cattle post	0.069	0.041	1.68	0.094
Use of supplementary feeds	-0.137	0.089	-1.54	0.124
Type of labour	-0.226	0.109	-2.08	0.037
Perception 1: Impact on household welfare	-0.039	0.052	-0.74	0.461
Perception 2: Inclusivity	0.092	0.047	1.93	0.054
Perception 3: Transparency in selection	0.095	0.112	-0.84	0.399
Perception 4: Sufficiency of the funding	0.059	0.123	0.48	0.630
Perception 5: Adequacy of extension services	-0.057	0.058	-0.96	0.336
Perception 6: Ease of application	0.071	0.065	-1.09	0.274
<b>Number of obs</b>	150			
<b>LR chi2(15)</b>	42.74			
<b>Prob&gt;chi2</b>	0.0022			
<b>Log likelihood</b>	-70.614035			
<b>Pseudo R2</b>	0.2604			

An increase in the age of the farmer by one year decreases the probability of participating in the programme by 0.8%. As someone ages they are less likely to apply in the programme knowing that they cannot be able to manage the small stock due to old age. On the contrary young people will opt to keep small stock knowing that they are capable of staying at cattle

post and herd their sheep or goats. This result agrees with the result of Assa *et al.* (2014) who found an increase in age to be decreasing the probability of keeping small stock, they deposited that older farmers find it difficult to herd their livestock and that small stock is preferred by people who are young and energetic. Increase in age makes farmers to age out of active farming and young people need to be encouraged to go into the farming business (Akpan and Udoh, 2016).

Results on education level indicate that an increase in the education level of a farmer decreases the probability of them participating in the programme by 2% (Table 16). The possible explanation is that as people get educated they get better jobs and they are not vulnerable to poverty like the uneducated. This makes them not to qualify for the programme, for instance only 3% of the participants attained tertiary education. The other possible explanation is that educated people migrate to urban areas to look for white collar jobs so they do not care about farming. During the interview farmers indicated that the reason they decided to apply into the programme is because they are unemployed. This research proved that majority of the participants (97%) never attained tertiary education. The relationship between participating in LIMID and gender is negative, depicting that being a male decreases the probability of keeping small stock by 38.8%. Men normally have resources like money which help them to acquire other expensive animals like cows and horses. This is true because in this study the majority of the participants (57%) are female. The finding agrees with Assa *et.al* (2012) who reported more women to be participating in small ruminant production as compared to men.

The perception about the inclusivity in the programme is statistically significant in influencing participation in the programme. A positive perception will increase the chances of participating in the programme by 4.7%. The positive perception about inclusivity in the programme positively influenced the resource poor to apply into the programme knowing that they will be included in the programme. LIMID programme specifically target the vulnerable group like woman and the youth. Women and the youth knowing that they are a priority to the government they will apply for LIMID funding anticipating that they will be approved for funding. This is true because in this study women are more than men as much as the young people are more than the old people who are more than 40 years. This result means that perception is an important determinant of the decision of farmers to participate in government

programme. This result is corroborated by Charatsari *et al.* (2013) who showed that females are willing to take part in the agricultural programme.

Regarding the result on distance to nearby cattle post, an increase in the distance to a nearby cattle post by 1km increases the probability of participating on LIMID programme by 6.9%. The possible explanation could be that farmers would want to stay far from other cattle post away to avoid pest and diseases from spreading to their farms. Muroga *et al.* (2013) Farmers will prefer their cattle post to be far apart to avoid spread of diseases. Farms which are far apart reduce the chances of diseases being spread. When there are limited diseases in the farms then people can sell their livestock hence an improvement in their livelihoods.

Results on household income depicted that household income and participation are positively related indicating that an increase in household income by P1 will increase the probability of participating in the programme by 3.3%. Farmers with higher income are able to sustain their projects as they can be able to buy inputs like supplementary feeds and drugs when the ones they are given by the government are finished. This is in accordance with Nxumalo and Oladele (2013) who reported a positive relationship between income and participating in agricultural activities. In addition Nahayo *et al.* (2017) found that off-farm income increases the decision of a farmer to participate on the programme as off-farm income eases the finances for programme activities.

Furthermore, the results on the type of labour used for herding small stock and participation in LIMID programme has a negative relationship. An increase in the use of hired labour will decrease the probability of someone applying for LIMID funding by 22.6%. Farmers normally use hired labour or family labour, which means an increase in the use of hired labour will decrease the likelihood of someone to apply because they cannot afford the wage rate of their employees.

Finally, an increase in the distance to LIMID office decreases the probability of people participating in the programme by 0.5%. The possible explanation could be that the people who are far from the office are reluctant to visit the office and apply because of the long distance. Moreover in rural Botswana farmers stay at the cattle posts far away from the villages where they get several services including extension service. People who are near the office are more likely to be included in the programme (Tolemariam, 2010)

## 4.6 Impact of LIMID programme and factors that affect household consumption expenditure

### 4.6.1 Factors affecting household consumption expenditure

The OLS results of the factors affecting household consumption expenditure are presented in Table 17 below. The dependent variable was household consumption expenditure. According to Varlamovaa and Larionovaa (2015) household expenditures indicate the individual as well as social welfare. Therefore, estimating it will help in depicting the impact of the programme on household welfare.

**Table 17:** OLS output on factors affecting the farmers' household consumption expenditure

Variable	Marginal effects	Std. Err.	z	P>z
Household size	132.15	49.33	2.68	0.007
Age of the household head	-32.87	12.68	-2.59	0.010
Gender of the household head	-665.95	314.72	-2.12	0.034
Education level of the household head	-47.33	34.59	-1.37	0.171
Household income	0.320	0.05	5.61	0.000
Predators as a major challenge	65.836	53.32	1.23	0.217
Distance to input market	2.329	2.83	0.82	0.411
Distance to grazing	-36.55	46.21	-0.79	0.429
Farming experience household head	-29.34	17.63	-1.66	0.096
Distance to a nearby cattle post	179.18	99.85	1.79	0.073
Type of labour	279.41	351.34	0.80	0.426
Herd size	3.21	4.66	0.69	0.491
<b>Number of obs</b>	150			
<b>Prob&gt;F</b>	0.0000			
<b>R-squared</b>	0.3617			

Gender of the household head negatively influences the household consumption expenditure, being male has the probability of decreasing the household expenditure by P665.95 (62.29USD). The reason could be that men are not spenders like their counterparts woman. Piekut and Kludacz-Alessandri (2017) reported that the households which were headed by

female had more expenditure than household headed by male. On the other hand Çağlayan and Astar (2012) posited that the consumption expenditure of men is lower than that of women.

The result on age of the household head shows that a year increase in age has the probability of decreasing household consumption expenditure by P32.87 (3.07USD). The possible explanation could be that as one is ageing they are no longer working and they do not have income opportunities like they used before. In addition, as age increases spending decreases as compared to young people, for instance old people do not eat a variety of food items like junk food nor do they spend a lot of money on clothes. This result is supported by İpek and Sekmen (2018) who reported the variable of age to be having a negative and statistically significant effect on household consumption expenditure. According to Çağlayan and Astar (2012) who were analysing the determinants of household expenditure in urban and rural areas in Turkey concluded that an increase in age actually decreases the household consumption expenditures in rural household.

Household size had a positive effect on household expenditure at 1% significance level. An additional member to the household has the probability to increase household consumption expenditure by P132.15 (12.36 USD). The logic behind this is the more there are many mouths to feed the more the expenses. On the other hand many people have different means of income and they will bring income to the household hence increased expenditure. The results are similar to Zin and Nabilah (2015) who reported an increase in household size to be influencing expenditure in a positive direction. Sekhampu and Niyimbanira (2013) added that large households are associated with an increase in expenditure. Meanwhile, Ntshangase *et al.* (2018) stated that large household shows high levels of economic burden to households.

Distance to a nearby cattle post is used to assess the pasture availability. An increase in the distance to a nearby cattle post by 1km has the probability to increase household expenditure by P179.18 (16.76USD). In rural Botswana farmers live and herd their animals in communal areas where they are often experiencing overstocking and overgrazing. If the cattle post are far apart the better. Farmers in communal areas are many yet the piece of land they use for livestock keeping is small. If there is pasture scarcity then farmers will not be able to sell hence a reduction in income thereby negatively affecting the rural household expenditure. According to Magole (2009), livestock commercialization (big farms) and wildlife management areas and other uses have reduced the communal land and deny access by rural

dwellers. In relation to farming experience one year increase in the experience of the household head has the probability to decrease the household expenditure by P29.34 (2.74USD). The possible explanation could be that experienced farmers tend to stick to traditional farming practices. Therefore they will not adopt new farming methods like use of fertilisers and technology. This will lead to decreased production output and less sales hence low household consumption expenditure. The results are substantiated by Nahayo *et al.* (2017) who claimed that experienced farmers are reluctant in shifting to new farming practices.

The results on household income showed that an increase in household income by P1 has the probability to increase the household expenditure by P0.32. As income increases people have the liberty to spend on items they want to purchase as household income widens the consumption options. The result is substantiated by Kiran and Sethia (2013) who found an increase in income to be increasing household consumption expenditure. In addition, Sekhampu and Niyimbanira (2013) posited that household income is important as it determines how much can be spent on household needs. The quality and quantity of household consumption are in correlation with the purchasing power. Several literatures (Astar and Çağlayan, 2012; Bakri *et al.*, 2017; İpek and Sekmen, 2018) also reported income to be significantly increasing household consumption expenditure.

#### **4.6.2: Impact of the programme on household consumption expenditure**

##### **The region of common support**

The balancing property was satisfied and the region of common support was selected, the estimated propensity scores lie between at 0.148 and 0.997. Observations for beneficiaries and non-beneficiaries who were within the region of common support were compared. The matching only takes place in the common support region (Raufu *et.al*, 2016). However, the observations showing propensity scores below 0.148 and above 0.997 were discarded from the comparison. Table 18 reports the overall region of common support and the number of discarded observations. As much as the balancing property was satisfied, some observations were discarded. From the 150 respondents, 18 of them were dropped from the analysis because they were not in the region of common support. Propensity scores which are less than the minimum score or more than the maximum score for both the treated and control groups are discarded from the analysis (Caliedo and Kopeining, 2008). The distribution of households based on their propensity score is shown in (Appendix 3). Most of the treatment

households are found on the right side of the graph while the control is mainly in the center. This distribution is the same as of Tolemariam, (2010).

**Table 18:** Region of common support

Treatment assignment	Region of common support [0.148, 0.997]		Total
	Off-support	On-support	
Non-beneficiaries	0	50	50
Beneficiaries	18	82	100
<b>Total</b>	<b>18</b>	<b>132</b>	<b>150</b>

#### 4.6.3: Average Treatment Effects on household consumption expenditure of the farmers

To determine the impact of the programme on household welfare of the participants the average annual household consumption expenditure for beneficiaries and non-beneficiaries was compared. The household expenditure was calculated based on the food items, toiletry, school fees, clothing, household utensils, farms expenses and medical expenses. Table 18 shows that there was significant difference ( $t > 1.66$ ) in the household expenditures of beneficiaries and non-beneficiaries at 5% significance level. Beneficiaries spend an average of P12313.80 annually which is an equivalent of 1152.05 US\$, and it was higher than that of the non-beneficiaries which was P11237.86 (US\$ 1082.86). This result entails that the LIMID programme has positively impacted the household welfare of beneficiaries and it has increased the average household consumption expenditure by P1075.94 an equivalent of 100.67 US\$. Thus, beneficiaries spend 8.7% more than the non-beneficiaries. Indeed the programme has achieved its main agenda of impacting the resource poor people. Goat farming generates income and provides food security for household (Ogola *et al.*, 2010). The presented results below are for the kernel matching algorithm which showed the significant results amongst the three tests which were performed. Kernel matching algorithm uses more information or takes into consideration many aspects when matching hence low variance between the compared respondents. Therefore this gives this method an advantage over other methods (Heckman *et al.*, 1998).



**Table 19:** Average treatment effects on household expenditure of the farmers.

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
Household expenditure	Unmatched	12320.32	10682.88	1637.44	342.7854	4.78
	ATT	12313.8	11237.86	1075.94	476.7369	2.26

#### 4.6.4 Testing for balancing of propensity scores and covariates

There are differences that exist on observed covariates of the matched groups, therefore propensity score is used to reduce the bias and balance the covariates of the treated and control group (D'agostino, 1998). It is vital to assess the balance of the measured covariates between the treatment and comparison groups whereby balance means the similarity in the distribution of covariate (Harder *et al.*, 2010). Hence, the success of the matching after estimating the impact of LIMID programme on household expenditure was checked by testing for covariate balance. Covariate imbalance was checked to see if all the observations had the same distribution of the estimated propensity scores. Table 19 below reports the estimated counterfactuals which were used to match the beneficiaries and non-beneficiaries. The outcome variable is the consumption expenditure of the household. The factors used were gender, age, education level, impact perception, distance to input market, household size, herd size, household income, distance to water, nearby cattle post, farming experience, use of supplementary feeds and the type of labour used.

This study used the decision criterion that was adopted by Harder *et al.* (2010) suggesting that to assess the statistical significance of the imbalance of the measured covariates is by using *t*-test. Looking at the results in Table 19 depict 6 variables were significant before the matching while none of the covariates showed statistical significance of the covariates imbalance after matching as the *p*-value ( $p > 0.1$ ). This shows that all the covariates were balanced after the matching. The conclusion is that covariates were balanced and well distributed in matching beneficiaries and non-beneficiaries.

**Table 20: Ps-test output for covariates balance based on kernel matching method**

Variable	Unmatched Matched	Mean		%bias	% reduction bias	t-test	
		Treated	Control			t	p>t
Gender	U	0.54	0.70	-33.2		-1.89	0.061
	M	0.60	0.58	3.8	88.5	0.23	0.819
Age	U	44.40	44.64	-12.1		-0.69	0.492
	M	44.96	44.98	-5.6	-124.4	-0.37	0.711
Education level	U	5.05	5.54	-9.5		-0.56	0.578
	M	5.40	4.52	17.3	-81	1.11	0.270
Impact perception	U	2.68	2.78	-15.2		-0.88	0.379
	M	2.70	2.76	-8.8	42	-0.50	0.618
Distance to input market	U	34.32	51.38	-42.9		-2.56	0.011
	M	35.24	35.79	-1.4	96.8	-0.09	0.927
Household size	U	7.82	7.16	19.8		1.11	0.512
	M	7.81	7.49	9.6	51.8	0.66	0.329
Herd size	U	38.05	31.24	23.8		1.29	0.200
	M	33.39	31.26	7.5	68.7	0.43	0.671
Household income	U	15229	13776	23.5		1.32	0.189
	M	15026	15141	-3.9	90.4	-0.21	0.837
Distance to water	U	1.50	1.12	32.3		1.78	0.077
	M	1.40	1.60	-17.7	45.1	-1.01	0.313
Nearby cattle post	U	1.49	0.984	37.8		2.10	0.037
	M	1.30	1.28	1.4	96.4	0.08	0.933
Farming experience	U	15.58	15.28	2.6		0.15	0.885
	M	14.30	17.06	-24.2	-82.2	-1.47	0.144
Labour source	U	0.91	0.76	-45.5		-2.83	0.012
	M	0.90	0.94	15.3	60.8	-1.56	0.120

## **CHAPTER FIVE**

### **CONCLUSION AND RECOMMENDATION**

#### **5.1 Introduction**

This section gives a brief summary of the whole study by giving the findings for each objective. The conclusion and recommendations pertaining to the carried study are also outlined. Finally the area of further study is also pointed out.

#### **5.2 Summary**

The general objective of the study was to estimate the effectiveness of LIMID programme in improving the welfare of the rural poor in Botswana. Primary data was collected from 150 respondents who were selected randomly from the villages of Rakops, Xhumo and Mopipi. Amongst the respondents, 100 were beneficiaries while 50 were non-beneficiaries. Majority of the farmers are female at 57.3% while male are 43.7%. Further, farmers are middle aged with a mean age of 45 years.

In analysing the results, descriptive statistics was used to analyse the main challenges encountered by small stock producers during and after application as well as the major production and marketing challenges faced by small stock farmers. Probit model was used to identify factors that influenced the decision of a farmer to participate in the LIMID programme. In order to estimate the impact of the programme on the livelihoods of farmers the household consumption expenditure was used as proxy for household welfare. Factors affecting the household expenditure were identified using OLS (Ordinary Least Squares). The effect of LIMID programme on socio-economic welfare of the small stock producers in Boteti sub-district was indicated Average Treatment Effect on the treated (ATT). ATT was calculated by using Propensity Score Matching (PSM) analytical technique.

The challenges were ranked by the farmers and reported in percentage of cases. Challenges faced by farmers during application were Administrative procedure (98%), insufficient information (45%), not easy to access application forms (34%), unfriendly personnel (34%) and long distance to LIMID office (31%). Even after being approved for funding, farmers still faced numerous challenges before inception of their projects. Such challenges are, untimely disbursement of inputs (87%), inputs was less than what was applied for (83%), administrative procedure very long (80%), and long distance to LIMID office (27%). Major production challenges were reported to be predators (90.7%), Theft (82.7%) pest and diseases (78.0%), Insufficient financial support (71.3%), pasture scarcity (45.3%), inadequate

extension service (23.3%), Natural disaster (20.0%), water scarcity (18.0%) and transport (16%). Meanwhile marketing constraints were found to be Lack of market (88.7%), low prices (87.3%), lack of transport (66.0%), delayed payments from the government (43.3%), poor roads (30.7%), and lack of information (28.0%).

Factors that significantly influenced the decision of a farmer to participate in LIMID programme were gender of the farmer, household income, age of the farmer, positive perception about the programme, the use of supplementary feeds, education level and the distance to LIMID office. Household size, distance to nearby cattle post and household income positively influenced household expenditure while age, gender, farm experience of the household head negatively influenced household expenditure. Beneficiaries spent an average of P12313.80 (1152.05 US\$) annually, and it was higher than that of the non-beneficiaries which was P11237.86 (US\$ 1082.86). Participating in LIMID programme has increased the average household consumption expenditure by P1075.94 (100.67) US\$.

### **5.3 Conclusion**

During the application process and even after funding farmers went through numerous challenges. Major challenges faced during application were long administrative procedure, insufficient information, not easy to access application forms, unfriendly personnel and long distance to LIMID office. This showed that applying for LIMID is a very long and hectic process which consumes a lot of time. On the other hand challenges faced by farmers after being approved for funding were untimely disbursement of inputs, inputs was less than what was applied for, very long administrative procedures, and long distance to LIMID office. This showed that it is not easy for beneficiaries to be given the small stock and implement their projects even after being approved for funding. Small stock farmers also faced several marketing and production challenges. Major production constraints were predators, theft, pest and diseases, insufficient financial support, pasture scarcity, inadequate extension service, natural disaster, water scarcity and lack of transport. Major marketing constraints were, lack of market, low prices, lack of transport, delayed payments from the government, poor roads, and lack of information. Beneficiaries and non-beneficiaries they encounter the same challenges. One would have expected that the beneficiaries would not be faced with challenges as they are funded by the government who is believed to shield them from such challenges. The conclusion is that both beneficiaries and non-beneficiaries face the same challenges.

Socio-economic characteristics, institutional factors and perception of farmers about the LIMID programme play a role in influencing the decision of a farmer to participate in LIMID. Factors that positively influenced participation were the perception about inclusivity in the programme, distance to nearby cattle post and household income. Meanwhile, factors that negatively influenced participation in LIMID programme were education level of the farmer, gender of the farmer, age of the farmer, distance to LIMID office, and type of labour used.

LIMID programme has shown to have positively impacted and improved the livelihoods of the resource poor beneficiaries. It can be concluded that LIMID increase the household income as it was shown by an increase in household consumption expenditure of the beneficiaries as compared to non-beneficiaries. Therefore, LIMID participants had better household welfare than those who did not participate in the programme. Owing to the fact that LIMID effectively and significantly contribute to household welfare, this programme is essential in eradicating extreme poverty on the rural dwellers which has been the core agenda of the government.

#### **5.4 Recommendations**

LIMID is very impactful and members of the community need to be encouraged to be applying in the programme hence an improvement in their welfare. Community (kgotla) meetings, workshops and seminars could be a vital tool in highlighting the importance of LIMID on household welfare. LIMID proved to be crucial in improving livelihoods of the rural population. Therefore, this policy has to be re-designed and include training of the beneficiaries before they are given the small stock. Farmers must be trained in keeping small stock and be taught proper management and the importance of using drugs to protect their animals against diseases. This would help in the improvement of production capacity hence better profits.

Further, for the programme to benefit and even impact more livelihoods the marketing constraints, especially the low prices which are a concern to many small holder farmers should be addressed by the government. The problem can be addressed by protecting farmers from profit motivated private entrepreneurs who take advantage of the fact that rural people are in need of money, thereby buying their livestock at very low prices. There should be a law that is imposed to set minimum price for buying and selling of small stock to that both the buyer and seller can benefit.

Finally long distance to LIMID office was a serious concern due to cattle posts which are situated far from villages. Farmers need to be visited by extension workers and monitor their projects and by so doing they can get vital information on challenges that the farmers face. As projects are intensively monitored farmers will be encouraged to take their projects serious. Also LIMID in general needs to be continuously assessed on its progress to identify areas that need improvement. In addition people who steal other people's livestock should be punished severely.

### **5.5 Further research**

This study only looked at the effect of the programme on household expenditure in Boteti sub-district using cross sectional data of the year 2017/2018. Owing to the fact that variables keep on changing there is need to conduct a study based on time series data. In addition, the cross sectional data was collected based on the opinions and perspectives of the beneficiaries; therefore if another study is conducted it will help in filling such gaps. In addition the study was only conducted amongst 150 respondents in only three villages therefore the study need to be expanded to other places and increase sample size to determine real programme impacts and to avoid biasness.

The main emphasis of the study was on the beneficiaries who received 100% grant from the government. An interesting research needs to be carried in comparing the 100% beneficiaries and 90% beneficiaries of LIMID programme. Further research can be conducted to see the direct effect of the programme on household incomes. Another issue to be looked at is to compare the youth beneficiaries and the other beneficiaries to see how their projects vary. The reason is that one of the major concerns in the country is that the youth do not take their agricultural projects serious and they are not interested in agriculture.

## REFERENCES

- Aganga, A. O. and Aganga, A. A. (2015). Quality Assurance in Goat Meat Production for Food Safety in Botswana. *Asian Journal of Biological Sciences*, 8(2):51–56.
- Afolami, C. A., Obayelu, A. E. and Vaughan, I.I. (2015). Welfare Impact of Adoption of Improved Cassava Varieties by Rural Households in South Western Nigeria. *Agricultural and Food Economics*, 3(2):18-26.
- Ahmed, A. and Egwu, G. O. (2014). Management Practices and Constraints of Sheep Farmers in Sokoto State, Northwestern Nigeria. *International Journal of Science and Technology*, 3( 2):735 – 748
- Ajani, E., Mgbenka, R., and Onah, O. (2015). Empowerment of Youths in Rural Areas through Agricultural Development Programmes: Implications for Poverty Reduction in Nigeria. *International Journal of Research in Agriculture and Forestry*, 2(2):34–41.
- Akinwande, M.A., Dikko, H.G. and Samson, A. (2015). Variance Inflation Factor: As a Condition for the Inclusion of Suppressor Variable(s) in Regression Analysis. *Open Journal of Statistics*, 5(07):754-767
- Akpan, S. B., and Udoh, E. (2016). Farmers' Decision to Participate In Government Agricultural Programmes in a Volatile Political Environment: A Case Study of Farmers in The South-South Region Of Nigeria. *Journal of Agriculture and Socio-Economic Sciences*, 5(43):135-147.
- Alary, V., Sheifa, M. El, Abdelkrim, N., Hamdon, H., and Metawi, H. (2016). Role of small ruminants in the rural livelihood improvement – Comparative analysis Report, pp1-8. Cairo, Egypt.
- Arvidsson A. (2017). The Goats are my Friends, my Children, my Everything: A Study of Remote Farmers and Farm Workers in Botswana and their Attitudes to their Goats. Second cycle, A2E. Uppsala: SLU, Dept. of Urban and Rural Development, Sweden.
- Asfaw, S., Shiferaw, B., Simtowe, F. and Leslie, L. (2012) Impact of Modern Agricultural Technologies on Smallholder Welfare: Evidence from Tanzania and Ethiopia. *Food Policy*, 3(7):283–295.
- Assa, M. M., Maonga, B.B., Mapemba, L.D. (2014). Determinants of Keeping Small Ruminants and Non-ruminant Livestock in Malawi: A Simulated Maximum Likelihood Multivariate Probit. *Agrekon: Agricultural Economics Research, Policy and Practice in Southern Africa*, 53(4):123-135

- Atlhopheng, J.R., Chanda, R., Mphinyane, W., Sebegu, R.J. (2009). Study Site Description: Boteti, Botswana, Retrieved on 23 October 2019 from <http://www.desirehis.eu/wimba/CG%20SSD%20Boteti,%20Botswana/index.htm>
- Attanasio, O. and Mesnard, A. (2006). The Impact of a Conditional Cash Transfer Programme on Consumption in Colombia. *Fiscal Studies*, 27 (4):421–442.
- Austina, P.C. and Stuart, E.A. (2015). Moving towards best practice when using inverse probability of treatment weighting (IPTW) using the propensity score to estimate causal treatment effects in observational studies. *Statistics in Medicine* 34: 3661–3679
- Ayele, G., Nicholson, C., Collick, A., Tilahun, S. and Steinhuis, T. (2013). Impact of small-scale Irrigation Schemes on Household Income and the Likelihood of Poverty in the Lake Tana Basin of Ethiopia, in Mekuria, W. (ed.), ‘Rainwater Management for Resilient Livelihoods in Ethiopia: Proceedings of the Nile Basin Development Challenge Science Meeting’, Addis Ababa, 9–10 July, NBDC Technical Report No. 5, International Livestock Research Institute, Nairobi.
- Ayinde, J.O., Olarewaju, B.E. and Aribifo, D.L. (2016). Perception Of Youths on Government Agricultural Development Programmes in Osun State , Nigeria. *Economic Engineering in Agriculture and Rural Development*, 16 (3): 67-76.
- Bahta, S., Baker, D., Podisi, B. and Marobela, O. (2013). Competitive smallholder livestock in Botswana: Results of a livestock value chain survey in the Central district of Botswana. International Livestock Research Institute. Nairobi, Kenya.
- Bakri, S.M., Rambeli, N., Hashimc, E., Mahdinezhadd, M. and Jalile, N.A. (2017). Understanding Behavior of Consumption Expenditure of Households. *International Business Education Journal*, 10(1):43-52.
- Barnum, H. N. and Squire, L. (1979). An econometric application of the theory of the farm-household. *Journal of Development Economics*, 6(1):79–102.
- Batlett II, E. J., Kotrlik, W.J and Higgins, C.C. (2001). Organaisational Research: Determining Appropriate Sample Size in Survey Research. *Information technology, Learning, and Performance Journal*, 19(1): 43-50.
- Berhanu, T., Thiengtham, J., Tudsri, S., Abebe, G., Tera, A., and Prasanpanich, S. (2012). Purposes of Keeping Goats Breed Preferences and Selection Criteria in Pastoral and Agro-pastoral Districts of South Omo Zone. *Livestock Research for Rural Development* 24 (12). Retrieved on 23 October, 2018 from <http://www.lrrd.org/lrrd24/12/berh24213.htm>
- Berihu, M., Berhane, G. and Gebrechiristos, S. (2016). Feeding and Management Practices of



- Free Range Goat Production in Tahtay Koraro District Northern Ethiopia Department of Animal Production Studies , College of Veterinary Medicine and Agriculture ,*American Journal of Social and Management Sciences*, 6(2):40–47.
- Berthelsson, J. (2017). *Anaplasma* spp . Infection in Smallholder Goat Flocks Around Gaborone. SLU, Dept. of Urban and Rural Development, Sweden. Rreived on 12 November, 2018 from <https://stud.epsilon.slu.se/10101/>
- Boohene, R., Marfo-Yiadom, E. and Yeboah, M. A. (2012). An empirical Analysis of the Effect of Entrepreneurial Orientation on Firm Performance of Auto Artisans in the Cape Coast Metropolis. *Developing Country Studies*, 2 (9):1-8
- Bothhoko, G. J. and Oladele, O. I. (2013). Factors Affecting Farmers Participation in Agricultural Projects in Ngaka Modiri Molema District North West Province , South Africa. *Journal of Human Ecolodgy*, 41(3):201–206.
- Brewer, M. and O’Dea, C. (2012). Measuring Living Standards with Income and Consumption: Evidence from the UK. IFS Working Papers W12/12, London, Institute for Fiscal Studies.
- Bryson, A., Dorsett, R. and Purdon, S. (2002). The use of Propensity Score Matching in the Evaluation of Active Labour Market Policies. Working Paper, vol. 4. Policy Studies Institute, London.
- Caliedo, M. and Kopoeinig, S. (2008). Some Practical Guidance for the Implementation of Propensity Score Matching. *Journal Compilation Blackwell*, 22(1): 31-72.
- Caliendo, M. and Kopeinig, S. (2005). “Some Practical Guidance for the Implementation of Propensity Score Matching”. Paper 1588. Institute for the Study of Labor, IZA.
- Challa, M. and Tilahum, U. (2014). Determinants and Impacts of Modern Agricultural Technology Adoption in West Wollega: The case of Gulliso District. *Journal of Biology, Agriculture and Healthcare*, 4(2):33-48.
- Charatsari, C., Istenič, C.M. and Lioutas, E.D. (2013a). “I’d like to participate, but...”: Women Farmers’ Scepticism Towards Agricultural Extension/education Programs. *Development in Practice*, 23 (1):511–525.
- Central Statistics Office (2011). National Housing and Population Census. Gaborone, Central Statistics Office. Retrieved from <https://www.statsbots.org.bw>.
- Cepar and S. Bojnec. Probit Model of Higher Education Participation Determinants and the Role of Information and Communication Technology. *Economic Research*, 25(1):268–280
- Chima, N. E. and Bowel, O. (2016). Small ruminant management practices and ruminant

- famers' training needs in Anambra State, Nigeria. *Global Journal of Animal Science, Livestock*, 5 (4):334-342.
- Chochran, W. G. (1963). *Sampling Techniques*. 2<sup>nd</sup> Edition. John Wley and Sons, Inc. New York.
- Çağlayan, E. and Astar, M., (2012). A Micro econometric Analysis of Household Consumption Expenditure Determinants for both Rural and Urban Areas in Turkey. *American International Journal of Contemporary Research*, 2(2), 27-34.
- Deaton, A. and S. Zaidi. (2002). 'Guidelines for Constructing Consumption Aggregates for Welfare Analysis', World Bank LSMS Working Paper 135.
- Dethier, J. J. and Effenberger, A. (2012). Agriculture and development: A Brief Review of the Literature. *Economic Systems*, 36(2):175–205.
- Diao, X., Hazell, P. and Thurlow, J. (2010). The Role of Agriculture in African Development. *World Development*, 38(10):1375–1383.
- D'agostino, R. B. (1998). Tutorial In Biostatistics Propensity Score Methods For Bias Reduction In The Comparison of A Treatment To A Non-Randomized Control Group. *Statistics in Medicine*, 27:(2265–2281).
- Druilhe, Z. and Barreiro-Hurlé, J. (2012). Fertilizer Subsidies in Sub-Saharan Africa. ESA Working paper No:12, 04 July 2012. Agricultural Development Economics Division Food and Agriculture Organization of the United Nations.
- Field, A. (2009). *Discovering Statistics Using SPSS: Introducing Statistical Method* (3rd ed.). Thousand Oaks, CA: Sage Publications, London.
- Filmer, D. and Pritchett, L. H. (2001). Estimating Wealth Effect Without Expenditure Data or Tears: An Application to Educational Enrollments in States of India. *Demography*, 38 (1):15-32.
- Food and Agriculture Organization (FAO). (2013). Botswana Bioenergy and Food Security Projects. Food and Agricultural Organisation of the United Nations. Rome, Italy.
- Freitas, D. R., Souza, F. N., Fonseca, L. M., Ladeira, C.V.G., Santos, V. P. F., Diniz, S. A., Silva, M. X., Haddad, J. P. A. and Cerqueira, M. M. O. P. (2017). Factor Analysis as a Tool to Estimate Association Among Individual Proteins and other Milk Components with Casein Micelle Size and Cheese Yield. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 69 (5):1319-1325.
- Glewwe, P. (1991). Investigating the Determinants of Household Welfare in Cote d'Ivoire. *Journal of Development Economics*, 35:307-337.
- Gujarati, D. N. (1995). *Basic Econometrics*, Third Edition. McGraw Hill Inc, New York.

- Hale, B. M., Coff, L., Spencer, T., and Pressman, A. (2011). Small-Scale Livestock Production. ATTRA publications. California, United States of America.
- Hangari G. N., Teweldemedhin M. Y. and Groenewald I. B. (2011). Measuring factors that can influence cattle supply response to the market in Namibia: Case study from Omaheke communal farmers. *Journal of Agricultural Extension and Rural Development*, 3(8):141-146.
- Harder VS, Stuart EA, Anthony J. (2010). Propensity score techniques and the assessment of measured covariate balance to test causal association in psychological research. *Psychological Methods*, 15(3):234–249.
- Heckman, J., Ichimura, H., Smith, J. and Todd, P. (1998). Characterizing selection bias using experimental data. *Econometrica*, 66 (5): 1017–1098.
- Heinrich, C., Maffioli, A. and Vázquez, G. (2010). “A Primer for Applying Propensity-Score Matching”. Strategy Development Division, Technical Notes No.IDB-TN-161. Inter-American Development Bank, Washington, D.C.
- Ibrahim, A., Shiwei, X. and Wen, Y. (2013). The Impact of Social Factors of Rural Households on Livestock Production and Rural Household Income in White Nile State of Sudan. *International Journal of Agricultural and Food Research*, 2(4):1–13.
- Ipek, E. and Sekmen, O. (2017). Effect of Household Heterogeneity on Consumption Expenditure: A Simultaneous Quantile Regression Analysis. *The Empirical Economics Letters*, 16(12): 1329-1336
- Jefferis, K. and Nemaorani, T. (2013). Botswana Country Overview. Capital Resources. Gaborone, Botswana.
- Kassie, M., Shiferaw, B. and Muricho, G. (2011). Agricultural Technology, Crop Income, and Poverty Alleviation in Uganda. *World Development*, 39(10):1784–1795.
- Kathiresan, A. (2011). Strategies for sustainable crop intensification in Rwanda. In: Shifting Focus from Producing Enough to Producing Surplus. Ministry of Agriculture and Animal Resources, Kigali, Rwanda.
- Kebebe, E. G., Oosting, S. J., Baltenweck, I. and Duncan, A. J. (2017). Characterisation of Adopters and Non-adopters of Dairy Technologies in Ethiopia and Kenya. *Journal of Tropical Animal Health Production*, 49:681-690.
- Kelebe, H.E., Ayimut, K.M., Berhe, G.H., Hints, K., 2017. Determinants for adoption decision of small scale biogas technology by rural households in Tigray, Ethiopia. *Energy Economics* 66: 272–278.
- Kgosikoma, O.E., Baleseng, L., Coleman, M., Baker, D., Temoso, O., Morley, P.,

- Makgekgenene, A. and Bahta, S. (2016). Performance of goats and sheep under communal grazing in Botswana. International Livestock Research Institute, Nairobi.
- Kiran, M. and Sethia, S. (2013), “Factors that Influence Household and Individual Food Consumption: A Review of Research and Related Literature”. *Journal of Management*, 5 (2):15-17.
- Kuwornu, J. K. M., and Owusu - Nantwi, V. Macroeconomic Variables and Stock Market Returns: Full Information Maximum Likelihood Estimation. *Research Journal in Finance and Accounting*, 2 (4):49 - 63.
- Kweyu, M. and Ngare. P. (2013). Factor Analysis of Customers Perception of Mobile Banking Services in Kenya. *Journal of Emerging Trends in Economics and Management Sciences (JETEMS)*, 5(1):1-8.
- Lancsar, E. and Savage, E. (2004). Deriving welfare measures from discrete choice experiments: inconsistency between current methods and random utility and welfare theory. *Health Economics Letters*, 13:901-907.
- Läpple, D., Hennessy, T. and Newman, C. (2013). Quantifying the Economic Return to Participatory Extension Programmes in Ireland: an Endogenous Switching Regression Analysis. *Journal of Agricultural Economics*, 64(2):467–482.
- Lechner, M. (2010). The Estimation of Causal Effects by Difference-in-Difference Methods. *Econometrics*, 4(3):165–224.
- Leeper, T. J. (2017). Interpreting regression results using average marginal effects with R's margins. Retrieved on 12 January, 2019 from <https://cran.r-project.org/web/packages/margins/index.html>.
- Lioutas, E. D., Tzimitra-Kalogianni, I. and Charatsari, C. (2010). Small ruminant producers' training needs and factors discouraging participation in agricultural education/training programs. *Livestock Research for Rural Development*. 22(7). Retrieved on 25 September 2018, from <http://www.lrrd.org/lrrd22/7/liou22126.htm>
- Lysholm, S. (2016). Prevalence and risk factors for BVDV in goats and cattle in and around Gaborone, Botswana. SLU, Department of Urban and Rural Development, Sweden.
- Magole. L. (2009). The ‘shrinking commons’ in the Lake Ngami grasslands, Botswana: the impact of national rangeland policy. *Development Southern Africa*, 26(4):612-620
- Makana, P. C and Thebulo, D. C. (2018). Determinants of Grain Postharvest Storage Technology Choices in Malawi. *Journal of Economics and Sustainable Development* , 9 (16): 29-34
- Markus, M. H. (2011). The impact of overgrazing on desertification: A case study in

- Botswana Working Report.Land Degradation and Development Group.Wageningen, Netherlands
- Masole, C., Mphothwe, G. K. and Moreki, J.C. (2015). Value Chain Analysis of Botswana Poultry Industry: The Case of Gaborone, Kgatleng, Kweneng and South East Districts. *J. World's Poult. Res.* 5(3): 64-72.
- McDonald, J. (2008). Using least squares and tobit in second stage DEA efficiency analyses. *European Journal of Operational Research*, 197(2009):792–798
- Mendola, M. (2005). Farm Household Production Theories: A Review of ‘Institutional’ and “Behavioral” Responses. *Asian Development Review*, 24(1):49–68.
- Metawi, H. (2015). Contribution of small ruminants to household income in the agroecological northwestern coastal zone of Egypt. *Revue delevage et de medicine veterinaire des pay tropicaux*, 68 (3): 75-78.
- Mgbenka, R. N., Igbokwe, E. M. and Mbah, E. N. (2015). Farmers ’ Perception of Agricultural Development Activities of Local Government Councils in Southeast , Nigeria. *International Journal of Research in Agricultural Sciences (IJRSAS)*, 1(2):19–25.
- Mignouna, D. B., Abdoulaye, T., Alene, A., Manyong, V. M., Dontsop, P. N., Ainembabazi, J. H. and Asiedu, R. (2015). A Microeconometric Analysis of Household Consumption Expenditure Determinants in Yam-growing Areas of Nigeria and Ghana, *Tropicultura*, 33(3):226-237.
- Ministry of Agriculture and Farmers Welfare (2016). Agricultural Annual Report. Department of Cooperatives and Farmers Welfare.New Delhi, India.
- Ministry of Agricultural Development and food Security (2008). Gender and Agriculture. Sustainable Development Summit. Monitoring and Evaluation Unit, Agricultural Planning and Statistics.Gaborone, Botswana, 1–10 July 2008.
- Ministry of Finance and Economic Development (2018). Republic of Botswana 2018 Budget Speech. Gaborone, Botswana.
- Ministry of Presidential Affairs and Public Administration (2016). State of the nation address by His Excellency Lt. Gen. Dr. Seretse Khama Ian Khama, President of the Republic of Botswana.Gaborone, Botswana .Retrieved from <http://www.bankofbotswana.bw/assets/uploaded/stateofthenationaddress nov 04 2013.pdf>
- Mogotsi, K., Nyangito, M. M. and Nyariki, D.N. (2013). The role of drought among agro pastoral communities in a semi-arid environment: The case of Botswana. *Journal of*

*Arid Environments*, 91 (2013):38-44

- Monametsi, N. F., Makhabu, S. W. and Mogotsi, K. (2012). The effects of cattle-goat mixed grazing on steer performance and rangeland condition in semi-arid north eastern Botswana. *Botswana Journal of Agriculture and Applied Science*, 8(2):67–74.
- Moepeng, P.T (2013). Rural Development in Botswana: Experiences from Elsewhere and Emerging Issues. “Re-thinking Rural Development: Moving more towards Sustainable Livelihoods and an Indigenous Knowledge System”. Rural Development Council of Botswana’s Pitso 30 May 2013 in Kang. Working paper no:54, Social Economics, Policy and Development. Botswana Institute for Development Policy Analysis, Botswana.
- Moepeng, P. T. and Tisdell, C.A. (2008). The Pattern of Livelihoods in a Typical Rural Village Provides New Perspectives on Botswana's Development: Social Economics, Policy and Development Working Papers 52, University of Queensland, School of Economics.
- Moreki, J.C., Mokokwe, J., Keboneilwe, D. and Koloka, O. (2010). Evaluation of the livestock management and infrastructure development support scheme in seven districts of Botswana. *Livestock Research for Rural Development*, 22:(87). Retrieved on 29 July 2018 from <http://www.lrrd.org/lrrd22/5/more22087.htm>
- Moratti, M. and Natali, L. (2012), ‘Measuring Household Welfare: Short versus long consumption modules’, Working Paper 2012-04, UNICEF Office of Research, Florence.
- Mosalagae D., and Mogotsi, K. (2013). Caught in a sandstorm: an assessment of pressures on communal pastoral livelihoods in the Kalahari Desert of Botswana. *Pastoralism: Research, Policy and Practice*, 3(18):1-20
- Mphinyane, W. N., Tacheba, G. and Makore, J. (2015). Seasonal diet preference of cattle, sheep and goats grazing on the communal grazing rangeland in the Central District of Botswana. *African Journal Agricultural Research*, 10(29): 2791–2803.
- Msangi, S., Enahoro, D., Herrero, M., Magnan, N., Havlik, P., Notenbaert, A. and Nelgen, S. (2014). Integrating livestock feeds and production systems into agricultural multi-market models.. *Food Policy*, 49(2):365–377.
- Mulale, K., Chanda, R., Perkins, J.S., Magole, L., Sebego, R.J., Athlopheng, J.R., Mphinyane, W., Reed, M.S. (2014). Formal institutions and their role in promoting sustainable land management in Boteti, Botswana. *Land Degradation Development*, 25:80–91. Retrieved on 20 February, 2019 from <https://onlinelibrary.wiley.com/doi/epdf/10.1002/ldr.2274>

- Muroga, N., S. Kobayashi, T. Nishida, Y. Hayama, T. Kawano, T. Yamamoto, and T. Tsutsui, (2013). Risk factors for the trans- mission of foot-and-mouth disease during the 2010 outbreak in Japan: a case control study. *BMC Vet. Res.* 9:150
- Mutula, S.M. (2015). Factors Influencing Perceptions and Attitudes of Nurses Towards the Use of ICT in Patient Care in KwaZulu Natal Province, South Africa. *The African Journal of Information Systems*, 8(1):1-14
- Nahayo, A., Omondi, M. O., Xu-hui, Z., Lian-qing, L., Gen-xing, P. and Joseph, S. (2017). Factors influencing farmers' participation in crop intensification program in Rwanda. *Journal of Integrative Agriculture*, 16(6): 1406-1416
- Ndungu, S. K., Macharia, I., Kahuthia-Gathu, R. and Wahome, R. G. (2013). Impact of Organic Vegetable Production System in Kiambu and Kajiado Counties of Kenya. *A Journal of Environmental Science and Engineering*, 2(2):256–266.
- Ntshangase, N.L., Muroyiwa, B and Sibanda, M. (2018). Farmers' Perceptions and Factors Influencing the Adoption of No-Till Conservation Agriculture by Small-Scale Farmers in Zashuke, KwaZulu-Natal Province. *Sustainability*, 10(555): 1-16.
- Nwaobiala, C. U., (2014). Socio-Economic Factors Influencing Farmers' Participation in Community- Based Programme in Abia and Cross River States of Nigeria. *Journal of Agricultural Extension* 18(1):48-51.
- Nxumalo, K. K., and Oladele, O. I. (2013). Factors Affecting Farmers' Participation in Agricultural Programme in Zululand District, Kwazulu Natal Province, *South Africa. Journal of social Sciences*, 34(1): 83-88.
- Ogola, T.D.O., Nguyo, W.K. and Kosgey, I.S. (2010). Dairy goat production practices in Kenya: Implications for a breeding programme. *Livestock Research for Rural Development*, 22(16)
- Olsen, S. O., Tuu, H. H., and Grunert, K. G. (2017). Attribute importance segmentation of Norwegian seafood consumers: The inclusion of salient packaging attributes. *Appetite*, 117(supplement C):214–223.
- Omonijo, D., Toluwase, S. O., Oludayo, O. A. and Uche, O. O. (2014). Impacts of Agricultural Development Programme ( ADP ) on Rural Dwellers in Nigeria : A Study of Isan-Ekiti. *International Research Journal of Finance and Economics*, 1(28):17-21
- Orskov, E. R. (2011). Goat production on a global basis. *Small Ruminant Research*, 98(13):9–11
- Ozkaya, H. E., Droge, C., Hult, G. T. M., Calantone, R. and Ozkaya, E. (2015). Market orientation, knowledge competence, and innovation. *International Journal of Research*

*in Marketing*, 32(3):309-318

- Piekut, M., and Kludacz-Alessandri, K. (2017). Analysis of Health Expenditure In Polish Households of Elderly People. The 11th International Days of Statistics and Economics, September 14-16, 2017. Prague, Czech Republic.
- Phiri, M.A.R., Chilonda, P. and Manyamba, C. (2012). Challenges and Opportunities for Raising Agricultural Productivity in Malawi. *International Journal of Agriculture and Forestry*, 2(5): 210-224
- Pollott, G. E. and Wilson, R. T. (2009). Sheep and goats for diverse products and profits. Rural Infrastructure and Agro-Industries Division, Food and Agriculture Organization of the United Nations, Rome.
- Ramashala, T. (2015). Best Practices In Crop Production. 3rd Global Conference On Agriculture, Food And Nutrition Security And Climate Change. Johannesburg, South Africa.
- Raufu, M. O., Oyewo, I.O. and Abdurrasheed, M. D. (2016). Impacts of rural water schemes on maize production in the Hhohho region of Swaziland. *Scientia Agriculturae*, 14 (1):179-184
- Rola-Rubzen, M. F. and Hardaker, J. B. (1999). Intra-Household Modelling Farm- Household Systems. Conference Paper.Joint 43rd Annual AARES Conference/ 6th Annual NZARES Conference. Chistchuch, Newzealand.
- Rosenbaum, P. and Rubin, D. (1983). The Central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(9): 41-50.
- Sebego, J.R. Athlpheng, R. Chanda, K. Mulale & W. Mphinyane (2017): Land use intensification and implications on land degradation in the Boteti area: Botswana. *African Geographical Review*, Retrieved on 24 February, 2019 from <https://doi.org/10.1080/19376812.2017.1284599>
- Sebudubudu, D. (2010). The impact of good governance on development and poverty in Africa: Botswana -A relatively successful African initiative. *African Journal of Political Science and International Relations*, 4(7):249–262.
- Sekhampu, T. J. and Niyimbanira, F. (2013). Analysis of The Factors Influencing Household Expenditure in a South African Township. *International Business and Economics Research Journal*, 12 (3):279-284.
- Shapi, M. K. (2017). Contemporary Challenges Facing the Small Farmers in the Green Scheme Projects in Namibia. *Sustainable Agriculture Research*, 6(3):1–13.
- Sharma, J., C. (2014). OLS, Probit, Logit, Logistic Regression and Discriminant Analysis.



*Gyan jyoti e-journal*, 4(4):17-18.

- Singh, A. S., Masuku, M. B. and Thwala, N. Z. (2015). Impact of Microprojects Programme on Rural Households Income in Swaziland. *International Journal of Economics, Commerce and Management*, 3(2):582-603.
- Singh, I., Squire, L. and Strauss, J. (1986). *Agricultural Households: Extensions, Applications and Policy*. Report 111179. Baltimore, The John Hopkins University Press.
- Sinyolo, S., Mudhara, M. and Wale, E. (2014). The impact of smallholder irrigation on household welfare: The case of Tugela Ferry irrigation scheme in KwaZulu-Natal, South Africa. *Water SA*, 40(1):78-83.
- Siphambe, H. (2007). *Development Strategies and Poverty Reduction In Botswana*. Geneva, United Nations Research Institute for Social Development.
- Sirivongs, K., and Tsuchiya, T. (2012). Forest Policy and Economics Relationship between local residents' perceptions, attitudes and participation towards national protected areas: A case study of Phou Khao Khouay National Protected Area, central Lao PDR. *Forest Policy and Economics*, 21: 92–100.
- Slesnick, D.T. (1998). Empirical Approaches to Measurement of Welfare Empirical Approaches to the Measurement of Welfare. *Journal of Economic Literature*, 30(6):2108–2165.
- Statistics Botswana. (2016). *Agricultural Census*. Government printers. Gaborone, Botswana.
- Swatuk, L., Motsholapheko, M. R. and Mazvimazvi, D. (2011). A Political Ecology of Development in the Boteti River Region of Botswana: locating a place for sport. *Third World Quarterly*, 32(3):453–475.
- Tadesse, D., Urge, M., Animut, G. and Mekasha, Y. (2014). Perceptions of households on purpose of keeping, trait preference, and production constraints for selected goat types in Ethiopia. *Trop Anim Health Prod*, 46:363–370
- Taylor, J. E. and Adelman, I. (2003). *Agricultural Household Models: Forthcoming in Review of Economics of the Household*. California, United States of America.
- Temoso, O., Hadley, D. and Villano, R. (2015). Technical efficiency and technological gaps for extensive beef farms in Botswana: A stochastic meta-frontier approach. Conference paper for annual AARES. Rotorua, New Zealand 10-13 February 2015.
- Teo, T. and Fan, X. (2013). Coefficient Alpha and Beyond: Issues and Alternatives for Education Research. *Asia-Pacific Education Researcher*, 22(2): 209-213.
- Thavaneswaran, A. and Lix, L. (2008). *Propensity Score Matching in Observational Studies*. Manitoba Centre for Health Policy. University of Manitoba, Canada. Retrieved from

- [http://umanitoba.ca/faculties/health\\_sciences/medicine/units/community\\_health\\_sciences/departmental\\_units/mchp/protocol/media/propensity\\_score\\_matching.pdf](http://umanitoba.ca/faculties/health_sciences/medicine/units/community_health_sciences/departmental_units/mchp/protocol/media/propensity_score_matching.pdf).
- Tolemariam, A. (2010). Impact assessment of input and output market development interventions by IPMS project: The case of Gomma Woreda, Jimma Zone. Unpublished Masters' Thesis. Haramaya University, Ethiopia
- United Nations (2017). Botswana voluntary national review on sustainable development goals. United Nations. Gaborone, Botswana.
- UNESCO (2012). Report on Livestock Value Chains in Eastern and Southern Africa .Eighth Session of the Committee on Food Security and Sustainable Development 19- 21 November. Addis Ababa, Ethiopia.
- USDA (2017). Agricultural Information Network: Botswana.Agricultural Economic Fact Sheet Report.20 August.
- Verbeke, W., Ward, R., W.,Viaene, J. (2000). Probit analysis of fresh meat consumption in Belgium: Exploring BSE and television communication impact. *Agribusiness; An international Journal* , 16(2):215–234.
- Varlamovaa, J., and Larionovaa, N. (2015). Macroeconomic and demographic determinants of household expenditures in Organisation for Economic Co-operation and Development (OECD) countries. *Procedia Economics and Finance*, 24:727 – 733
- World Bank (2015). Botswana - Poverty Assessment.(2015). Report No. 88473-BW.World Bank Group.Retrieved from <http://www.worldbank.org/Botswana-poverty-assessment>.
- World Bank (2014). The World Bank Annual Report. IBRD-IDA World Bank Group Publishers.
- Yang, T. M. and Wu, Y. J. (2016). Examining the socio-technical determinants influencing Government agencies' open data publication: a study in Taiwan. *Government Information Quarterly*, 33(3): 378-392.
- Yang, Y. and Green, S. B. (2011). Coefficient Alpha: A Reliability Coefficient for the 21st Century? *Journal of Psychoeducational Assessment*, 20(10):1-16
- Yong, A.J. and Pearce, S. (2013). A Beginner's Guide to Factor Analysis: Focusing on Exploratory Factor Analysis. *Tutorials in Quantitative Methods for Psychology*, 9(2):79-94.
- Zin, W. Z. W. and Nabilah, S. F. (2015) Malaysian Household Consumption Expenditure: Rural vs Urban, Department of Statistics, Malaysia, MyStats 2015 Conference Papers.
- Zuwarimwe, J., Mbaai., S. M. (2015). Factors influencing small holder farmers' decision to participate in markets in Namibia. *Journal of Development and Agricultural Economics*, 7(7):253-260.

## APPENDICES

### APPENDIX 1: HOUSEHOLD QUESTIONNAIRE

Dear Respondent

The questionnaire is prepared to gather data for the study about the Effects of Participation in LIMID Programme on household welfare of small stock producers in Boteti Sub-District, Botswana. The aim of the study is to collect data on the challenges faced by LIMID beneficiaries, factors that influence farmer's decision to participate in the programme and to determine the effect of LIMID programme on household welfare. The study is being conducted by a student from Egerton University- Kenya. Therefore be assured that the research is solely for academic purpose and the information you provide is strictly confidential.

<b>Name of enumerator</b>	
Village	
Questionnaire number	
Interview Date	
Respondent's name	Contacts:

### SECTION A: Farm and farmer's characteristics

#### A.1 Household head Characteristics

Characteristics	Coding	Answer
Gender of household head	1= male 0= female	
Age of household head	Write the number of years	
Marital status	1=married 2= single 3=Divorced 4= widowed 5= other(specify)_____	
Education level	Write the number of years of schooling	
Household size	Females Adults:_____ Children:_____	
	Males Adults:_____ Children_____	
Main occupation	1=Farmer 2=Government 3=unemployed 4=Private sector 5=self-employed/own business 6= other, specify_____	

Main source of income	1=small stock 2=other on-farm 3= off-farm employment 4= government schemes 5=self-employed/own business 6= other, specify_____	
Farming experience	Write the number of years of schooling	
Farm size	Write in hectares	
Type of dwelling	1=Mud hut and grass 2=Brick house and iron roof 3=.Mud hut and iron roof 4=blockhouse and grass thatch 5=Other, specify_____	

### A.2 Respondent's characteristics

Characteristic	Coding	Answer
Gender	1= male 0= female	
Age of respondent	Write in years	
Marital status	1=married 2=single 3=Divorced 4=widowed 5= other(specify)	
Education level	Write number of years	
Main occupation	1=Farmer 2=Government 3=unemployed 4=Private sector 5=self-employed/own business 6= other(specify)- _____	
Main source of income	1=small stock 2=other on-farm 3= off-farm employment 4= government schemes 5=self-employed/own business 6= other, specify_____	
Farming experience in years	Please write the number of years	

**SECTION B: Small Stock Production and Marketing**

1.1 Are you aware of the LIMID programme 1= Yes 2= NO

1.2 How did you come to know about it?

\_\_\_\_\_

1.3 Are you a LIMID beneficiary? 1= Yes 2= NO ( if no proceed to 1.9)

1.4 If Yes when did you start benefiting from the programme? -

\_\_\_\_\_

1.5 What funding did you receive from LIMID? 1= 100% 2= 90%

1.6 What was the number of the stock before the funding?

\_\_\_\_\_

1.7 What are the most important challenges you faced during application?

Challenge	Code	Challenge	Code
1.Long administrative procedure		Other, specify	
2. Not easy to access forms		6.	
3. Long distance to LIMID office		7.	
4. Insufficient information		8.	
5. Unfriendly personnel/stuff		9.	

1.8 If yes, why did you choose to participate in LIMID programme? Tick answer/s.

Reason	Tick	Reason	Tick
1. Low level of income		Others, specify	
2. Farming experience		6.	
3. Small stock is easy to manage		7.	
4. Low amount to pay back to the government		8.	
5. Source of employment		9.	

1.9 Had you applied for LIMID fund? 1= Yes 2= No

1.10 If yes, why were you denied the funding? \_\_\_\_\_

1.11 If no, why did you not apply for the funding?

\_\_\_\_\_

1.12 When did you start your own project? \_\_\_\_\_

1.13 How many small stock did you start with? \_\_\_\_\_



Breed	Reason	Reason
1= Tswana 2=Boer goat 3= karakul sheep 4=other,specify_____	1=cheap 2=Drought resistant 3= Disease tolerant Other, specify	5= Preferred by buyers 7=Cultural value/ purposes 8= Eat broad variety of plants 9.

10. What is the number of your animals and their unit price (price at which you purchased them) at the inception of the project?

Stock started with	Female		Male	
	Number	Unit price	Number	Unit price
Current stock	Female		Male	
	Number	Unit price	Number	Unit price

11. What are the most important constraints you are currently facing in small stock production?

Constraints	Code	How do you deal with the problem
1. Pasture scarcity		
2. Diseases		
3. Predators		
4. Transport		
5. Access to markets		
6. Insufficient financial support		
7. Water scarcity		
8. Inadequate extension service		
9. Theft		
10. Other, specify_____		

12. Where do you sell your small stock?

1= butchery      2= Individuals      3= Government      4= Restaurants  
5= other, specify\_\_\_\_\_

13. Have you ever given away any of your live animals? 1=yes      2= No

14. If yes how many? \_\_\_\_\_

15. Whom have you given the animals to? 1= family members 2= friends 3= Donation  
4= other, specify \_\_\_\_\_

16. For what reason? 1= gift 2= debt payment 3= Cultural purpose 4= Mafisa 5= Breeding  
6= other, specify \_\_\_\_\_

17. Does small stock production contribute to your household income? 1= Yes 2= No

18. If yes fill the table below

	Goats sold in the last 12 months	Sheep sold in the last 12 months
Number		
Prices		

19. How often do you sell your output? \_\_\_\_\_

1= 3 months 2= 6 months 3= 12 months 4 other specify, \_\_\_\_\_

20. How much do you sell each sheep or goat? \_\_\_\_\_

21. How much were your total savings before and after the project inception in BWP?

Before _____	After _____
--------------	-------------

22. What is the distance to following facility or institution from your farm in (km)?

Extension service____	Input market____	Financial institutions____	Output market__	Grazing area____	Water point____	Nearby cattle post____
-----------------------	------------------	----------------------------	-----------------	------------------	-----------------	------------------------

21. What are the most important challenges in marketing your output?

<b>Challenge</b>	<b>1. Lack of market</b>	<b>2. Poor roads</b>	<b>3. Low prices</b>	<b>4. Lack of transport</b>	<b>5. Inadequate communication</b>	<b>6. Other(specify )</b>
<b>Code</b>						
<b>How do you deal with the problem</b>						



22. Fill the table below appropriately.

Labour source	Type of labour ( for hired)	Number of employees	Number of days	Wage rate
1= Family labour 0=Hired	1= seasonal			
	2= contract			
	3=permanent			

23. What is the type of production system used? 1= Communal 0= Privately

24. Do you use supplementary feeds for your small stock 1= yes

25. If yes what type feed do you use? \_\_\_\_\_

26. How do you see the prices of the feeds?

1= cheap

2= Expensive

3= Normal

27. Please fill the table below about extension services, choose answer/s

Do you receive extension service?	If yes how often/how many times	Source of the service
1= Yes 0= No	1= Weekly 2=Monthly 3=After 2 months 4= Other (specify)	1= Government 2=Private 3= Other(specify)

28. Where do you get information about markets, prices, and disease outbreaks? (Answer/s)

1= Extension officer 2= Media 3=Other farmers 4=Other (specify)

\_\_\_\_\_

### SECTION C: services provided by LIMID programme

1. How long did it take for you to start the project after being approved?\_\_\_\_\_

2. What kind of services did you receive after starting the project? Please circle answer/s

1= supply of inputs

2= Veterinary service

3=Linkage to markets

4=other, specify \_\_\_\_\_

3. What are your perceptions regarding the LIMID programme? Use the 3 likert scale of:

1=Disagree

2=Neutral

3=Agree

Factor and statements	Rate
<p><b>1. Effect of programme on poverty and employment</b></p> <ul style="list-style-type: none"> <li>❖ LIMID increase household income</li> <li>❖ LIMID increase household wealth/assets</li> <li>❖ The programme is a source of employment to beneficiaries</li> <li>❖ The programme is a source of employment to non- beneficiaries</li> <li>❖ LIMID should be discontinued it does not impact livelihoods</li> <li>❖ LIMID encourages youth participation in agriculture</li> <li>❖ The programme increase economic opportunity for women</li> </ul>	
<p><b>2. Transparency in selection of beneficiaries</b></p> <ul style="list-style-type: none"> <li>❖ Applicants with connections are funded</li> <li>❖ Wealthier people are turned away from the project</li> <li>❖ The selection process is unfair</li> <li>❖ Only the very needy are funded</li> <li>❖ The selection process is fair</li> <li>❖ Only people with certain ethnic groups are selected/funded</li> <li>❖ Poorer people are given more fund</li> </ul>	
<p><b>3. Sufficiency of the programme</b></p> <ul style="list-style-type: none"> <li>❖ The amount is sufficient</li> <li>❖ The amount should be increased</li> <li>❖ The extension worker must come for monitoring</li> <li>❖ Training of the farmers is undertaken after the funding</li> <li>❖ Funded farmers re linked to markets for small stocks</li> <li>❖ Farmers are provide with sufficient support service</li> </ul>	
<p><b>4. Ease of application for LIMID funding</b></p> <ul style="list-style-type: none"> <li>❖ It is easy to access the application forms</li> <li>❖ There is shortage of application forms</li> <li>❖ The LIMID offices are located far from where you stay</li> <li>❖ Application procedure is complicated</li> <li>❖ After application the selection criteria takes long time to be effected</li> </ul>	

4. What do you think should be improved about the programme? Please tick answer/s.

Options	Tick		Tick
1. Administrative procedures		Other, specify	
2. Increment of the loan		5.	
3. Equality in selecting beneficiaries		6.	
4. Extension services		7.	

## SECTION D: Household Expenditure

### A. FOOD EXPENDITURE (weekly)

Food, Beverage, Tobacco	Consumption out of purchases (BWP)
Bread and cereals	
Meat, fish, eggs	
Vegetables	
Fruits	
Legumes and nuts	
Food (rice, flour etc)	
Dairy products	
Sweets, spices ,condiments	
Fats and oils	
Alcoholic drinks (beer, whisky, vodka, wine etc)	
Non-alcoholic drinks (juice, soda, mineral water etc)	
Cigarettes, snuff and other tobaccos	

### B. HOUSING, ENERGY, TRANSPORT AND COMMUNICATION EXPENDITURE (monthly)

Expenses	Consumption out of expenditure (BWP)
Rent paid for rented house	
Owned house	
Firewood	
Electricity	
Paraffin	
Charcoal	
Batteries for torch ,radio etc	
Water bill	

**C. TRANSPORT AND COMMUNICATION EXPENDITURE (monthly)**

Transport and communication	Consumption out of expenditure (BWP)
Tyre, tubes, repairs	
Petrol or diesel	
Taxi, bus,	
Airtime	

**C. EDUCATION, HEALTH, CLOTHING, ETC. EXPENDITURE (BWP) (monthly)**

<b>Expenses</b>	<b>Expenditure</b>	<b>Expenses</b>	<b>Expenditure</b>
<b>Education expenses</b>		<b>Medical expenses</b>	
School and exam fees		Drugs	
Accommodation(boarding)		Hospital bills	
Books and stationary		Traditional healing	
Uniforms			
		<b>Clothing</b>	
<b>Farming</b>		Women clothing and shoes	
Seeds		Men clothing and shoes	
Fertiliser		Children clothing and shoes	
Labour cost		Bedding material(sheets,	
Farm repair			
Medication and feed costs		<b>Personal goods</b>	
		Toiletry(soap, lotion )	
<b>Remittances and donations</b>		Cosmetics	
Gifts			
Offerings and donations(weddings, church)		<b>Household appliances</b>	
		Kitchen utensil	
<b>Others</b>		Cleaning items	
Insurance, (car, life, house)			
Burial society			
Entertainment (DSTV, Parties)			

## HOUSEHOLD ASSETS

Item	Number	Value (BWP)	ITEM	Number	Value (BWP)
1.Sheep			9. Borehole		
2.Goats			10. Plough		
3.Cattle			11.Radio		
4.Chicken			12.Television		
5.Car			13.Mobile phone		
6.Tractor			14.Urban house		
7.Truck			15.Refridgerator		
8. Plots			16. Bicycle		
17.Wheelbarrow			18. Hand hoe		
19. Computer			20. Trailer		

## SECTION D: Sources of household income.

Income	Monthly	Income	monthly
Livestock sales		Retail shop	
Crop sales		Money sent from somewhere	
Wages earned by household members		Retail shop	
Traditional healing		Pension	
Brewing/bottle store		Hawker	
Restaurants		Saloon	
Transport operator (taxi, bus, etc)		Rent	
Other, specify			

## APPENDIX 2: LIMID SMALL STOCK COMPONENT

LIMID is one of many government initiatives of economically empowering and uplifting the lives of Batswana. This agricultural scheme was established in 2007 after merging two programmes being Services to Livestock Owners in Communal Areas (SLOCA) and

Livestock water Development Programme (LWDP). The programme was meant to economically empower the poor resourced Botswana households, to enhance beneficiaries' self-esteem thereby turning them into innovative, productive and prosperous people in their communities. Some beneficiaries are given 100% grant while some is 90% grant hence requiring 10% contribution from them. Objectives of LIMID are poverty eradication, promotion of food security by improving productivity of small stock, Tswana chickens and improving management of livestock, improving the utilization and conservation of range resources and providing infrastructure in order to process poultry products in a hygienic and safe way.

### **Small stock component**

#### **i. Application requirements**

The small stock component of LIMID helps beneficiaries to buy a maximum of 13 ewe/doe and one buck/ram. The applicant is also provided with all the required veterinary requisites like drugs, ear tags, burdizzo, and dehorn. The applicant must be a citizen of Botswana aged 18 years and above and in possession of a valid National identification document. Proof of the supplier of the stock must be availed and also applicant should be having proof of availability of a water source for the animals and the animals must be from the surrounding areas where the project will be operating and must be a breeding stock of 1-3 years. One goat or sheep must cost around 100 US\$ while the buck or ewe is 200 US\$. The applicant must not source the stock from the relatives or siblings. In addition those who are supplying the stock must provide the proof of ownership as verified by the extension officer or the Chief. To qualify for the 90% grant one must have 11-20 goats, while for 100% grant one should own 0-10 sheep or goats. The applicants upon completing forms they submit them at any nearby Department of Animal Production or Veterinary Office. The LIMID officer will check if all the required documents are attached before they are submitted to the District Evaluation Committee for assessment, evaluation and selection of the applicants who are fit and eligible to be beneficiaries.

#### **ii. Terms and conditions**

The beneficiary signs a Memorandum of Agreement with the government stating the conditions of assistance. One of the conditions is that the livestock remains the government property until 5 years thus the breeding stock will not be sold until five years. However the off springs are sold immediately after weaning at 6 months. Beneficiaries are also required

that the project must be operational within six months after approval and if the funds are not disbursed they are forfeited.

**iii. Beneficiary's role**

Farmers are required to keep monthly records about their production especially on the numbers of animals reared, births, deaths and sales. It is also their responsibility to make sure that their projects grow and keep on running.

**iv. Extension service support**

Applicants undergo training on small stock management and this is organized by the Department of Animal Production. They are also visited on monthly basis and they even consult the veterinary or animal production office anytime for assistance. (Ministry of Agricultural Development and Food Security, 2008)

### APPENDIX 3: PRELIMINARY TESTS OUTPUT

#### 1. Heteroskedasticity test

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of Type Farmer

chi2(1) = 1.30

Prob >chi2 = 0.2534

#### 2. Variance Inflation Factor for continuous variables

Variable	VIF	1/VIF
Age of the household head	4.76	0.210
Farming experience of the household head	3.47	0.288
Years of schooling of the household head	3.45	0.290
Years of schooling of the respondent	3.18	0.314
Age of the respondent	2.97	0.337
Extension service perception	2.89	0.345
Transparency perception	2.28	0.439
Farming experience of the respondent	2.14	0.467
Herd size	1.88	0.532
Ease of application perception	1.82	0.550
Distance to a nearby cattle post	1.80	0.556
Sufficiency perception	1.69	0.591
Distance to input market	1.50	0.669
Impact perception	1.48	0.673
Household size	1.45	0.691
Farm size	1.40	0.716
Distance to extension office	1.32	0.756
Distance to water source	1.27	0.785
Inclusivity perception	1.25	0.797
Total household expenditure	1.23	0.811
<b>Mean VIF</b>	<b>2.14</b>	

**Note:** VIF=Variance inflation factor



### 3. Pairwise correlation test for categorical variables

```
. pwcorr MariStathhh MainOcchhh GenHhh GenResp MariResp EduLevresp EduLevhhh
MainOccresp MainssIncrresp Ranked1
```

	MariSt~h	MainOc~h	GenHhh	GenResp	MariResp	EduLev~p	EduLevhhh
MariStathhh	1.0000						
MainOcchhh	0.1086	1.0000					
GenHhh	-0.6269	-0.0606	1.0000				
GenResp	-0.3301	0.0561	0.4658	1.0000			
MariResp	-0.5539	-0.0931	0.5054	0.1358	1.0000		
EduLevresp	-0.0404	0.0820	0.0038	0.1700	-0.1527	1.0000	
EduLevhhh	-0.2799	-0.1098	0.1379	0.2070	0.0282	0.6179	1.0000
MainOccresp	0.0411	0.4900	0.0660	0.0377	0.0893	-0.0087	-0.0583
MainssIncr~p	0.1679	0.1700	-0.0629	-0.2050	0.0432	-0.3287	-0.2223
Ranked1	-0.0867	-0.0020	-0.0703	-0.0603	0.1034	-0.0083	-0.0882

	MainOc~p	Mainss~p	Ranked1
MainOccresp	1.0000		
MainssIncr~p	0.3103	1.0000	
Ranked1	-0.0132	0.0540	1.000

#### APPENDIX 4: KERNEL DENSITY ESTIMATE GRAPH

