



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

**ANALYSIS OF HOUSEHOLD CHOICE AND DETERMINANTS OF LIVELIHOOD
DIVERSIFICATION ACTIVITIES IN CHOBE DISTRICT, BOTSWANA**

LESEGO MACKENZIE

A56/71120/2014

**A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN AGRICULTURAL
AND APPLIED ECONOMICS, UNIVERSITY OF NAIROBI**

February 2017

DECLARATION

This thesis is my original work and has not been presented to any University for the reward of a degree.

Signature _____ Date _____

Lesego Mackenzie

This thesis has been submitted with our approval as University supervisors:

Signature _____ Date _____

Dr. John Mburu

Signature _____ Date _____

Dr. Patrick Irungu

DEDICATION

This thesis is dedicated to my father, mother, my brothers, sister and my fiancé for their support and sacrifice they made for my studies. May they be blessed for their unconditional love and undivided support.

ACKNOWLEDGEMENTS

All the glory and honour be to God the Almighty Jehovah Jireh for giving me the opportunity to pursue my master studies and be able to do this thesis.

I sincerely express my gratefulness to my supervisors Dr John Mburu and Dr Patrick Irungu, for their direction from the conception of the study to finishing of the thesis. I am thankful for all the times they availed themselves to help me, the constructive comments, and for the friendly supervision you offered me throughout my studies. I am also grateful to the African Economic Research Consortium (AERC) for funding both my coursework and fieldwork. I also appreciate Prof Rose Nyikal for being my mediator with AERC.

My gratitude also goes to all the Chiefs of the three villages; Mabele, Kavimba and Kachikau for allowing me to carry out the fieldwork in their area. I thank the community for their cooperation and provision of data and information that I needed. I also thank the enumerators who assisted me with data collection. I am also grateful to the administration of The Botswana University of Agriculture and Natural Resource (BUAN) who allowed me to use their facilities during data collection and analysis.

My sincere gratitude goes to Dr Nelson Tselaesele for his support and contribution to my work. I am also thankful to Dr Yazan Elhadi for his support and constructive contributions that led to improvement of the study. I thank Mr Nthoiwa, a statistician at BUAN, for helping me with data analysis. And all my family members, friends and colleagues at the University of Nairobi who helped me with educational and moral support, I am very grateful. May God richly bless you all.

Table of Contents

DECLARATION	i
DEDICATION	ii
ACKNOWLEDGEMENTS	iii
LIST OF FIGURES	vii
ABBREVIATIONS AND ACCRONYMS	viii
ABSTRACT	x
CHAPTER 1	1
INTRODUCTION	1
1.1 Background	1
1.2 Statement of the Problem	4
1.3 Objectives of the Study	5
1.4 Research Question.....	5
1.5 Study Hypothesis.....	6
1.6 Justification	6
1.7 Organization of the Thesis	6
CHAPTER 2	8
LITERATURE REVIEW	8
2.1 Understanding Livelihood Diversification	8
2.2 Theories Underpinning Household Choice of Livelihood Diversification Activities	9
2.3 Review of Empirical Studies to Assess Household Choice of Livelihood Diversification Activities	10
CHAPTER 3	14
METHODOLOGY	14
3.1 Conceptual framework	14
3.2 Theoretical framework	15
3.3 Empirical framework.....	17

3.3.1	Empirical model	17
3.3.2	Justification of independent variables in the empirical model	19
3.3.3	Diagnostic tests.....	24
3.4	Gross Margin.....	26
3.5	Study area.....	27
3.5	Research design.....	29
3.5.1	Data sources and sampling	29
3.5.2	Data collection.....	30
3.5.3	Data analysis.....	30
CHAPTER 4		31
RESULTS AND DISCUSSION.....		31
4.1	Diagnostic tests.....	31
4.2	Characteristics of Livelihood Diversification Addressing Objective One	32
4.2.1	Socio-economic and Demographic Characteristics	32
4.2.2	Diversification Characterized by Land.....	34
4.2.3	Diversification Activities Characterized from the Percentage of Employment Status..	35
4.2.4	Livelihood Diversification Activities Characterized by Gross Margins	37
4.2.5	Major Characteristics of Livelihood Diversification.....	39
4.3	Determinants of Household Choice of Livelihood Diversification Activities	40
CHAPTER 5		46
CONCLUSIONS AND RECOMMENDATIONS.....		46
5.1	Conclusions	46
5.2	Policy recommendations	47
APPENDICES		58
Appendix I: Questionnaire		58
Appendix II: Multicollinearity tests		104
Appendix III: Heteroskedasticity test.....		107
Appendix IV: Goodness of Fit		108
Appendix V: Independence of Irrelevant Alternatives.....		109

LIST OF TABLES

Table 3. 1. Definition of variables in the empirical model and their hypothesized signs	19
Table 4. 1. Descriptive statistics of variables across diversification activities (percent)	32
Table 4. 2. Means of attributes of different diversification activities	33
Table 4. 3. Land ownership and farm sizes for the households (Percentage of households choosing)	35
Table 4. 4. Characterizing diversification activities using employment status (percent)	36
Table 4. 5. Gross margins for the livelihood diversification activities	38
Table 4. 6. Determinants of household choice of livelihood diversification activities in Chobe District (MNL results)	41
Table 4. 7. Marginal effects of determinants of household choice of livelihood diversification activities in Chobe District	42

LIST OF FIGURES

Figure 1. 1. Total number of workers employed in the agricultural sector (2011-2015)..**Error!**

Bookmark not defined.

Figure 3. 1. Conceptual framework for choice of livelihood diversification activities**Error!**

Bookmark not defined.

Figure 3. 2. Map of Botswana showing the Chobe District29

ABBREVIATIONS AND ACCRONYMS

ADB	African Development Bank
AEO	Annual Energy Outlook
AHM	Agricultural Household Model
AU	African Union
BAMB	Botswana Agricultural Marketing Board
BCT	Botswana Cooperative Transformation
BLUE	Best Linear Unbiased Estimates
BMC	Botswana Meat Commission
BNE	Botswana National Export
BUAN	Botswana University of Agriculture and Natural Resource
CBNRM	Community-Based Natural Resource Management
CBO	Community-Based Organisation
CEEP	Citizen Economic Empowerment Policy
CSO	Central Statistics Organization
DWNP	Department of Wildlife and National Parks
EDD	Economic Diversification Drive
FAO	Food and Agricultural Organization
FGD	Focused Group Discussion
GBPEG	Government of Botswana Poverty Eradication Guidelines
GDP	Gross Domestic Product
GoB	Government of Botswana

HM	Hausman test
HWC	Human Wildlife Conflict
IDP	Industrial Development Policy
IFAD	International Fund for Agricultural Development
IIA	Independence from Irrelevant Alternatives
IS	Investment Strategy
MNL	Multinomial Logit
MOA	Ministry of Agriculture
NEPAD	New Partnership for Africa's Development
NDP	National Development Plan
OECD	Organisation for Economic Co-operation and Development
RRA	Rapid Rural Appraisal
RUM	Random Utility Model
SACU	Southern African Customs Union
SEZP	Special Economic Zones Policy
SID	Simpson Index of Diversity
TBA	Tourism-Based Activities
UN	United Nations
UNDP	United Nations Development Programme
VIF	Variance Inflation Factor

ABSTRACT

In order to spread the proceeds of the mining sector, the government is aiming at diversifying into agriculture, industry, manufacturing, services and tourism. In its rural poverty reduction strategies the government of Botswana (GoB) has identified the off-farm and non-farm as the leading activities in the rural economy. However, even with the policies and strategies the determinants of livelihood diversification activities have not been studied. There is therefore a gap in knowledge of the determinants of household choice of livelihood diversification activities in Chobe District. Thus, analysing the determinants of household choice of livelihood diversification activities in Chobe District was the purpose of this study. Primary data was collected using a semi-structured questionnaire. A sample of 195 households was collected from three villages (Mabele, Kavimba and Kachikau) in Chobe District. The three villages chosen were adjacent to Chobe National park. The data was analysed using multinomial logit model (MNL).

The results on marginal effects showed that seven out of eleven variables are significant determinants of diversification activities for households, these are gender, age, asset category, distance to market, land ownership, farm size and extension services. Distance to markets had a positive influence to households diversifying to Tourism-based activities (TBA), crop and livestock. This implied that availability of markets encourages households to diversify to TBA, crop and livestock farming. As for crop farming distance to markets had a negative relation to households diversifying to crop farming. Farm size had positive influence on diversification to crop and livestock farming.

Access to extension services influenced household diversification to crop and livestock farming positively at 10 percent level at different marginal effects but negative to TBA, crop and

livestock farming at 5 percent. The diversity of rural livelihood is important in reducing rural poverty. Based on the findings, emphasis should be made on the determinants of diversification. Interventions aimed at improving the livelihood diversification of rural households must consider improving market availability and supervision of land ownership. Government should intervene and even the rural inhabitants should help educate and train younger members of the communities for profitable diversification to TBA, crop and livestock farming.

CHAPTER 1

INTRODUCTION

1.1 Background

Botswana, a southern African country of 2.2 million people, is among the fastest growing economies in the developing world with a real growth of the gross domestic product (GDP) of 5.2 percent in 2014 (Honde and Abraha, 2015). However, this growth has mainly been driven by mining of diamonds, which accounted for 24 percent of GDP in which 6.5 percent of the labour force was employed in 2015 (Statistics Botswana, 2016). Although mining contributes substantially to the GDP, it has the lowest share of employment compared to other sectors. Nevertheless, the Ministry of Minerals, Energy and Water Resources accounts for the second largest share of Botswana's budget (Statistics Botswana, 2016).

In its ninth National Development Plan (NDP), the government of Botswana (GoB) aims to diversify the economy in an effort to guard against the "Dutch disease"¹ (Sekwati, 2010). The need for livelihood diversification has become even more critical in view of the worldwide financial and economic crisis and the decline in revenue generated from diamond and Southern African Customs Union (SACU) (Schwab & Sala-i-Martin, 2015).

The agricultural sector has been identified as the sector of choice in this regard, particularly considering its huge potential in rural poverty alleviation as well as in reducing Botswana's reliance on food imports (Cervantes-Godoy & Dewbre, 2010). Currently, about 70 percent of rural households derive their livelihood from agriculture through subsistence farming (Statistics Botswana, 2016). Agriculture, manufacturing and construction contribute 2.2,

¹This term refers to a state where the country is adversely affected by heavy dependence on a single export especially of natural resources (Brahmbhatt *et al.*, 2010).

5.7 and 6.9 percent of the GDP, respectively, and employ 4.6, 25.7 and 20.5 percent of the labour forces respectively (Honde & Abraha, 2015; Statistics Botswana, 2016).

The arrangement of activities that households choose to embark on to attain sustainable livelihoods is inspired by livelihood strategies (Ellis & Allison, 2004). The activities are differentiated on the basis of the situation of the activities: on-farm, non-farm or off-farm (OECD, 2011). In each location, diversification activities are differentiated according to the type of output, whether: agricultural produce (growing crops or raising livestock); continuance (processing of food or providing contracting services to other farmers); or involvement in other sectors by the household to acquire proceeds (OECD, 2011).

There are different methods of identifying livelihood activities. However, the most commonly used is share of income earned from different sectors of the economy (Brown *et al.*, 2006). In this study, on-farm activities involved crop and livestock farming while non-farm activities were those undertaken outside the agriculture sector. Off-farm activities in this study refer to agricultural activities which take place outside the farmer's own farm as defined in (Yizengaw *et al.*, 2015).

According to Maundeni and Mookodi (2004), majority of households in the rural areas of Botswana remain poor due to the constraint of an undiversified economy that is highly dependent on diamonds. As a result, the GoB, in its rural poverty reduction strategies has identified the off-farm and non-farm sector as the leading activities in the rural economy (Tlhalefang *et al.*, 2014). The GoB also reviewed its national policy for rural development in 2002 to entrench rural income generating activities (Tlhalefang *et al.*, 2014). This policy shift has also been emphasised in the 2016 National Vision, annual budget speeches and rural development policies. The GoB has developed several other policies aimed at motivating Batswana to diversify their livelihoods. These include the Industrial

Development Policy (IDP) (2014), Special Economic Zones Policy (SEZP) (2011), Trade Policy for Botswana (2009), and Citizen Economic Empowerment Policy (CEEP) (Sentsho, 2014).

The IDP aims at developing well-diversified, ecological and globally economical industries that will place Botswana amongst the technologically advanced countries of the 21st century. The economic strategies that have been developed to operationalize the aforementioned policies include the strategy for Selebi-Phikwe Regional Economic Diversification (SPEDU) (2013), Botswana Cooperative Transformation (BCT) (2012), Economic Diversification Drive (EDD) (2010), Botswana National Export (BNE) (2010) and Investment Strategy (IS) (2010) (Senthso, 2014). These strategies are based on the use of Government interventions, which include; local procurement, the use of preference margins and citizen economic empowerment strategies to promote local production and consumption (Ministry of Trade and Industry, 2011). Therefore, the major aim of the GoB is to diversify the economy through sectors that will be sustainable long after minerals have been exhausted.

A well-diversified livelihood ensures the survival and advancement of standards of living of household members (Ellis, 1998). According to Sisay (2010), households diversify because of the need to enhance their capabilities and assets, realization of economies of scope, liquidity constraints, and to stabilize income flows and consumption risk. Households seek to diversify their livelihood to help reduce risks, particularly those associated with seasonality of rain-fed agriculture and termination of mineral extraction (OECD, 2011). Livelihood diversification can also help the rural inhabitants avoid environmental and economic trends and seasonality shocks, and hence make them less vulnerable (UN and NEPAD-OECD, 2011). They also use it as a strategy to combine activities that add to the accumulation of wealth in the household (Khatun & Roy, 2012).

Therefore, the economic wellbeing of a household is inextricably dependent upon the set of livelihood diversification activities that it adopts.

Livelihood diversification of activities in agriculture in Chobe District faces the potential threat of human-wildlife conflict (HWC) (DeMotts & Hoon, 2012). Indeed, Chobe District has been labelled “red zone” because of HWC. This means that the district is disqualified to sell its livestock, the major economic activity, to Botswana Meat Commission (BMC) (Bowie, 2009). Actually, the area has been under quarantine since 1996 (UNDP, 2013) such that its livestock are not sold in the lucrative European Markets that BMC enjoys.

In Chobe the community-based livelihood diversification strategies include compensation for wildlife damage, community-based natural resource management (CBNRM) and community-based organization (CBO), agricultural insurance, and chilli pepper project for wading off marauding elephants (Gupta, 2013; Moepeng, 2013). However, implementing these programs has been faced with challenges because the inhabitants of Chobe District have no knowledge on their implementation (Mbaiwa, 2008). Nevertheless, Chobe District offers a unique case study on household choice of livelihood diversification activities. Evidence shows that livelihood diversification is an important contributor to total household income. An increase in household income improves well-being, food security, reduced vulnerability and social equity. It is therefore essential for policy makers to be informed about the determinants of livelihood diversification activities practiced by inhabitants of Chobe District in their pursuit of rural development in Botswana.

1.2 Statement of the Problem

Diversification of livelihoods has been Botswana’s aim since 2000 as a way to encourage rural communities to utilize the available stock of natural resources to reduce their dependence on mining. Diversification initiatives were expected to improve the welfare of

households as well-diversified livelihoods ensure the survival and advancement of standards of living (Ellis, 1998).

The GoB has developed several policies aimed at motivating Batswana to diversify their livelihoods. However, in Chobe District the choice of livelihood diversification activities that households employ in their exploitation of available natural resources are unknown. Further the choice and determinants of livelihood diversification activities have to be targeted to help households in coming up with lucrative rural development programs for policies and activities. There is therefore a gap in knowledge on the choice and determinants of household livelihood diversification activities in Chobe District. The study aimed at filling this gap in knowledge.

1.3 Objectives of the Study

The purpose of this study was to assess the household choice and determinants of livelihood diversification activities in Chobe District of Botswana.

The specific objectives were:

1. To characterize the livelihood diversification activities in Chobe District, Botswana.
2. To evaluate the determinants of household choice of livelihood diversification activities in Chobe District, Botswana.

1.4 Research Question

What are the characteristics of livelihood diversification activities in Chobe District, Botswana?

1.5 Study Hypothesis

Household size, gender, age, education, income, land tenure, farm size, distance to market, compensation and extension services taken singly have no effect on household choice of livelihood diversification activities in Chobe District, Botswana.

1.6 Justification

GoB has put in place different policies to increase economic growth. These policies include the IDP, SEZP, Trade Policy for Botswana and CEEP. This study is important for GoB as it gives guidance on how to plan for livelihood diversification of activities based on the choices made by households. This affects government spending in line with its policy to encourage diversification. The information generated by this study will empower rural households in their choice of how best to plan the diversification of their livelihoods. Furthermore, relevant organizations such as SPEDU, BCT, EDD, BNE and IS could draw appropriate strategies and design programs geared towards expanding livelihood diversification in the rural areas of Botswana. The information will be reported as a journal article to reach different entities.

This study provides empirical evidence of the determinants of household choice of livelihood diversification activities in Chobe District. The study also provides extension workers and NGOs with information on the choice and determinants diversification to target when assisting households in the area to engage in diversified livelihoods that can benefit them. The study is expected to provide scientists with literature on choice and determinants of household livelihood diversification activities.

1.7 Organization of the Thesis

This thesis is organized into five chapters. The first chapter presents the introduction, which comprises the background, problem statement, objectives, research question,

hypothesis tested and justification. Chapter two reviews the relevant theoretical and empirical literature, and chapter three presents the methodology. Chapter four reports and discusses the results of both descriptive and econometric analyses. The final chapter summarizes the major findings, conclusions and policy recommendations.

CHAPTER 2

LITERATURE REVIEW

2.1 Understanding Livelihood Diversification

The term “livelihood” refers to a way of living to sustain one’s life and provide basic needs (Khatun & Roy, 2012). Diversified livelihood occurs when household members have a portfolio of activities and communal proficiencies to exist and to develop their well-being (Ellis, 1998). Hussein and Nelson (1999) defined livelihood diversification as attempts by individuals to raise income and lessen environmental threats.

This study adopts the definition by Iiyama (2006) that livelihood diversification is grouping of on-farm, off-farm and non-farm activities to earn a living. This definition was followed because it described the specific types of activities households can diversify to. Households that adapt diversified livelihoods can cope with shocks, use the natural resources sustainably and also provide opportunities for future generations (Schwarze & Zeller, 2005).

The motivation for households to diversify their livelihoods is attributable to pull and push factors (Shen, 2004; Davis, 2006). The pull factors include the reasons behind households desiring to accumulate capital (Shen, 2004). These factors include income, education level and market access. They enable households to seize opportunities that they did not have access to. Push factors, on the other hand, are driven by circumstances or necessities (Davis, 2006). The factors consist of poverty, rural areas, unemployment, unpredictable weather, household size and fluctuating food prices. Push factors result in households adopting to cheap labour because there would be more labour than needed, thus households would be driven by pressure and not the desire diversify.

2.2 Theories Underpinning Household Choice of Livelihood Diversification Activities

Several theories underpin the concept of household choice of livelihood diversification activities. These include the Agricultural Household Model (AHM), Boserupian model and random utility model (RUM). These theories include the elements of the choice process which are; households first determines the available alternatives, it then assesses the attributes of each choice, and finally uses a decision rule of maximizing utility to select a livelihood activity from the available activities (Ben-Akiva & Lerman, 1985). Some households may first-rate a specific activity minus going through the process but by peer review/ choice and sometimes out of habit (Koppelman & Bhat, 2006).

According to Boserup (1965), increase in human population would lead to the adoption of intensive systems of agriculture, increase of total agricultural output through innovations such as use of fertilizers and mechanization. Continued population pressure on natural resources, increases competition for natural resources hence livelihood diversification activities become a strategy to ensure survival. Household well-being and rural non-farm diversification choices are generally motivated by household resources such as health, education and composition of household age (Boserup, 1965). The shortcomings of Boserup theory are that it does not take migration of households and depending on remittances as a livelihood. It also does not work in many situations because increased agricultural intensification does not necessarily require more work and really works where labour is necessary and insufficient.

AHM describes households as being both consumers and producers of the outputs in subsistence economies (Singh *et al.*, 1986). The households therefore, allocate their labour between diversified livelihood activities comprising of on-farm and non-farm activities. The decisions as to the amount of labour to allocate to each of these activities are made

jointly within the family. In its basic form, households participate in on and off-farm labour markets because they want to maximize their utilities. This model views household decision to diversify livelihoods as a function of the incentives and capacity variables (Singh *et al.*, 1986). Coral and Reardon (2001), define the incentives of livelihood diversification as the return that would either “pull” or “push” the households into the activity. One of the incentive includes higher profits the chooser derives from the activity. The capacity variables are expressed as the vector of household’s characteristics that enable them to respond to the incentives (Reardon, 2001). They influence the gap between household head’s competence in decoding relationships between behaviour and the environmental difficulty of the decision problem to be solved (Heiner, 1983).

In RUM households are assumed to maximize utility by selecting an alternative from a set of obtainable alternatives that capitalize on individual utility (Kennedy, 2003). This rule implies an underlying utility function that contains the attribute of alternatives and individual characteristics that describes an individual’s utility valuation for each alternative (Pryanishnikov & Zigova, 2003). The utility function states that an Individual chooses an alternative which has a utility greater than all utilities in the individual’s choice set (Pryanishnikov & Zigova, 2003). In the current study, this theory was chosen as household choice of livelihood diversification activities was assumed to be driven by utility maximization depending on the choice attributes that appeal to each household.

2.3 Review of Empirical Studies to Assess Household Choice of Livelihood Diversification Activities

According to numerous literatures MNL is an extensively used technique in applications that analyse more than two response groups in diverse parts of economic and social studies. Wassie *et al.* (2008) indicated that to study the determinants of

household livelihood diversification of activities it is important to use MNL for choice. A coherent household head is assumed to choose among the mutually exclusive livelihood activities that could give the maximum utility at the disposal of available asset.

Literature on diversification has identified a wide range of explanatory determinants for involvement in diversified livelihoods (Ellis, 1998; Khatun & Roy, 2012). Collectively determinants such as income, household size, education level, market access, land size, credit access and gender adversely define the household's involvement in diversified livelihoods. Correspondingly, Adepoju and Oyewole (2014) found that household size, total household income and primary education were the dominant determinants influencing the choice of livelihood activities implemented. The studies under review examined the human, financial and social determinants of a household's choice of activities. They therefore shed light on the factors that influence a household to choose a given livelihood activities but fails to explain the natural factors that influence a household to adopt a given number of livelihood activities which the current study added.

Similarly (Yizengaw *et al.* 2015) found that at 10 percent probability levels variables including land size, livestock holding size, gender, distance to market and income and urban connection were significant determinants of livelihood activities. The current study will show the significant determinants of household's decision among the alternative livelihood activities. Additionally, Ibekwe *et al.* (2010) established that in Nigeria, non-farm income diversification among households was determined by variables such as occupation, education level, household size, land size and farm output, conversely age of the household head was found not to have any impact.

A survey by Beyene (2008) on the contributing factor of non-farm involvement decision in Ethiopia also point out that age, health status of the male members, training in handcraft skills by male, gender and presence of children had a substantial influence on households non-farm participation decisions. The author argued that at an earlier age, the likelihood of working non-farm activities increased and that households who were trained in non-farm activities were more likely to engage in either salary employment such as woodworking or self-employment activities such as weaving and pottery. The study under review examined the determinants of a household's choice of non-farm activities. It therefore sheds light on the factors that influence a household to choose a given livelihood activity but fails to explain the factors that influence a household to adopt a given number of livelihood activities which the current study focused on.

Moreover, results on the determinants of off-farm diversification according to Awudu and Anna (2001) point out that landholding as a degree of wealth had a great positive impact on participation in livestock-rearing and non-farm strategies. Preceding studies in Ethiopia suggest that the determinants of diversification differ according to household wealth and geography. For instance, Demisse and Workineh (2004) specified that ownership of assets, especially livestock, played a major role in inducing the decision of the household to diversity into off-farm activities. Furthermore, the authors also disclosed that quality and quantity of labour determined the choice of diversification by enabling the barriers to involvement in non-farm activities. However, land size, cash crop production and extension services did not seem to inspire diversification in Ethiopia (Damite & Negatu, 2004). The studies under review focused on off-farm income activities to determine the factors influencing livelihood diversification. The current study focused on the set of various livelihood diversification activities adopted by a household.

Asfaw *et al.* (2015) studied livelihood diversification and vulnerability to poverty in rural Malawi using both the pull and push factors that influence households. The study addressed the comprehensive diversification as a linear function. This means that an assumption was made that no matter the diversification activities households were involved in, they would have been affected the same way. In the current study the assumption of linearity on livelihood diversification activities was dishonoured therefore MNL was used.

CHAPTER 3

METHODOLOGY

3.1 Conceptual framework

Figure 3.1 shows how the household choice of livelihood diversification is linked from the resources they are endowed with to the varying outcomes possible from the resources.

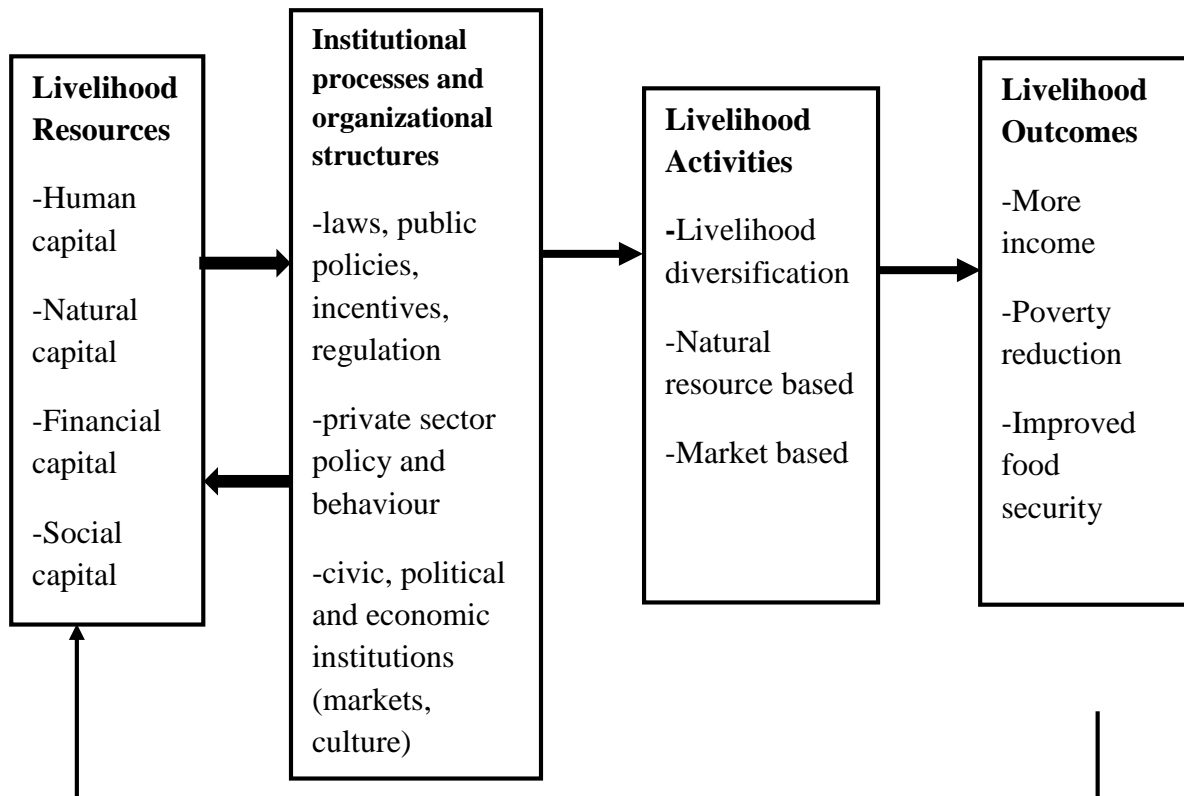


Figure 3. 1 Rural Livelihood Framework

Source: Scoones (1998)

The framework can be applied at a range of different scales, individual, household, household cluster, extended kin grouping, village, region or even nation, with sustainable livelihood outcomes assessed at different levels (Scoones, 1998). The household diversification of livelihoods has four livelihood resources human capital, natural capital, financial capital and social capital as depicted in Figure 3.1. The framework shows how people operate within a vulnerability context and trends that is shaped by different factors,

macro-economic conditions, climate, trade terms and demography (Scoones, 1998). With this conditions they still draw on different types of livelihood resources they develop a range of livelihood activities while influenced by institutions and organizational structures to achieve desired livelihood outcomes. The livelihood outcomes continue to influence the livelihood resources that households are embedded with. Livelihood outcomes include benefits of being involved in one of the diversification activities was expected to be increased income, food security in the area and improvement of well-being.

3.2 Theoretical framework

This study is based on random utility model (RUM). RUM states that given a choice, a household will always go for the alternative that yields the highest utility (Kennedy, 2003). In this context, the household is assumed to derive a definite level of utility from each livelihood activity. Because utility is not observed, what is observed is characteristics of the household and attributes of the alternatives as faced by the decision-maker. Representing the utility derived from each livelihood activity, j , by the i th household as U_{ij} , one can decompose this utility into a deterministic component, V_{ij} and a random component, ε_{ij} , as follows:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \quad (3.1)$$

The deterministic component V_{ij} shows the observable components of the utility which include the characteristics of households and attributes of the alternatives. The random component ε_{ij} captures unobservable components of the utility including measurement errors.

Suppose a household i has a choice set C of m alternative activities to choose from. Based on RUM, the household will choose the activity from the choice set which maximizes his

utility. For each activity choice j , the utility U_{ij} is the sum of a systematic component V_{ij} and a random component ε_{ij} .

The probability that the household i chooses alternative j from choice set C_m is therefore:

$$\begin{aligned} P(j|C_m) &= P(U_{ij} > (U_{ik}) \quad \forall j \neq k \\ &= P(V_{ij} + \varepsilon_{ij} > (V_{ik} + \varepsilon_{ik})) \quad \forall j \neq k \end{aligned} \quad (3.2)$$

where $j= 1..,k...m$ & $i= 1...n$

Equation (3.2) shows how the household chooses between alternatives j and k . It shows that if utility of alternative j is greater than that of alternative k , the household will choose the j alternative.

When C_m is large, MNL is more popular. MNL assumes errors in the different equations are uncorrelated with one another and it is easier to estimate. We combine the characteristics of the chooser & the choice. The probability of individual i with characteristics vector y_i choosing activity j with an attribute vector x_{ij} is given by;

$$P(j|C_m) = \frac{\exp(\beta'x_{ij} + \alpha'_j y_i)}{\sum_{k=1}^m \exp(\beta'x_{ik} + \alpha'_k y_i)} \quad (3.3)$$

where x_{ij} is the vector of the characteristics of activity j e.g. as perceived by the household i while m is the number of activities in the choice set, C_m . β_{j1} is the coefficient on first explanatory variable in this regression.

In MNL an assumption is made that the log-odds of the each household response follow a linear model (Greene, 2003). That is,

$$P_{ij} = \log \frac{\pi_{ij}}{\pi_{ik}} = \alpha_j + X_j \beta_j + \varepsilon_{ij} \quad (3.4)$$

where P_{ij} is the probability of choice, α_j is a constant and β_j is a vector of regression coefficients, X_j is a vector of covariates and ε_{ij} is the random error term for $j = 1, 2, \dots, J-1$ alternatives.

As in other models, the regressors in the MNL do not vary with the choice made; thus, for a unit change in x_{ij} , the coefficient, β_j , will display the variation in the log-odds of choosing alternative j against k , the benchmark (Greene, 2003). Subsequently, the marginal effects (MFX) of the regressors have been computed to gauge changes in probability with a unit change in the regressors. The MFX were computed at the mean of the regressors (Greene, 2003).

One of the shortcomings of MNL is the problem of independence from irrelevant alternatives (IIA). IIA implies that, when all else being equal, a household's choice between two alternative is unaffected by what other choices are available (McFadden, 1974). The IIA Property requires that the relative probabilities of two alternatives being selected are unaffected by the introduction or removal of other alternatives.

3.3 Empirical framework

3.3.1 Empirical model

In order to test the second hypothesis that household socio-economic characteristics as well as institutional factors taken singly have no effect on household choice of livelihood diversification activities in Chobe District of Botswana, the following MNL was fitted into the data:

$$\text{CHOICE} = \beta_0 + \beta_1\text{HHZ} + \beta_2\text{GND} + \beta_3\text{AG} + \beta_4\text{EDU} + \beta_5\text{INC} + \beta_6\text{ASSTCAT} + \beta_7\text{DISMRKT} + \beta_8\text{LNDOWN} + \beta_9\text{FMSZ} + \beta_{10}\text{CMP} + \beta_{11}\text{EXTNs} + \varepsilon_i \quad (3.5)$$

As indicated above, the dependent variable, CHOICE, had four possible values: crop farming= 1, livestock farming=2, crop and livestock farming= 3 and TBA, crop and livestock farming= 4.

Table 3.1 shows the expected signs for all the explanatory variables. This is guided by existing literature on livelihood diversification activities.

Table 3. 1. Definition of variables in the empirical model and their hypothesized signs

Variables	Definition	Measurement	Expected sign
HHSZ	Size of household	Number of members	+
GND	Gender of household head	Dummy variable 1= Male and 0= Female	+
AG	Age of household head	Years of head	-
EDU	Highest level of schooling in years	Number of years of schooling	+
INC	Total income earned	Pula(P)	+
ASSTCAT	Asset category	Ownership of assets	+
DISMKT	Distance to the nearest market	Kilometres	-
LNDOWN	Do you own land?	1=yes and 0=no	+
FMSZ	Size of land owned	Size in Hectares	+
CMP	Compensation in last 12 months	1=yes and 0=no	+
EXTNs	Access to extension services	1=yes and 0=no	+

Source: Author (2016)

3.3.2 Justification of independent variables in the empirical model

Household size (HHSZ): This variable was measured as a continuous variable. This variable was anticipated to positively be associated with the household choice of livelihood diversification activity. Khatun and Roy (2012) established that household size impacts the ability of a household to supply labour. In a large household some members could stay engaged in traditional farming while others could choose non-farm/off-farm activities.

Similarly Tizale (2007) found that larger households divert their labour to different activities to generate more income and provide for their households. Therefore, the chance of a household choosing a particular livelihood diversification activity would increase with the size of the household, *ceteris paribus*. Therefore, a positive relationship was expected between livelihood diversification activities and household size.

GENDER (GND): This variable was coded as a dummy variable with one if male and zero if female. Various studies have shown that gender is an important factor in influencing the choice of physically challenging work and therefore the household livelihood diversification activities (Dirribsa & Tassew, 2015). In this study, male headed households were expected to be positively related to diversification compared to their counterparts, this is because females are often restricted by time given their greater envelopment in household chores (Akaakohol & Aye, 2014). Furthermore, male-headed households have more access to opportunities than female-headed households, the probability of diversifying is expected to be positive for the former (Beyene, 2008). Therefore, the choice of households to livelihood diversification activities was expected to be positively associated with the gender of the household head.

AGE (AG): This variable was measured continuous according to the years of the household head. This variable was hypothesized to have a negative influence on household choice of livelihood diversification activities in Chobe District. This is because the older the household heads get, the more reluctant they become to diversify. This is in line with what Khatun and Roy (2012) found that household with a younger head will have more desire and access to non-farm activities therefore have diversified livelihoods. According to Mariotti *et al.*, (2014) as age increases and the household heads cross the turning point

of approximately 60 years, it is less likely that the households would choose to have diversified livelihoods.

Education (EDU): This was measured as a continuous variable representing the number of formal education years of the household head. This variable was expected to be positively associated with household choice of livelihood diversification activities. This is expected because the more educated household heads are, the more diversified activities they would have (Yizengaw *et al.*, 2015). Formal education increases the knowledge that one needs to become competent to choose activities that generates more income and up to date with all the modern technologies that make entrepreneurship much easier (Asfaw *et al.*, 2016). Therefore, enhancement in the educational level will escalate the probability engagement in livelihood diversification (Khatun & Roy, 2012).

Income (INC): This was a continuous variable and measured in terms of total amount of income for the household from activities and other income source not related to the diversified activities like formal employment and remittances. According to Ito and Kurosaki (2009), farmers find off-farm employment as an activity to deal with the risks of farming. In this study, income was hypothesized to be positively associated with household choice of alternative livelihood diversification activities. Babatunde and Qaim (2009) support that high income earners can easily mobilize productive resources and are more diversified than low income earners.

Asset category (ASSTCAT): Asset was measured as a continuous variable, taking the value of one if the household is rich, two for the middle poor and three for the poor. According to Barrett *et al.* (2001) assets may be categorized as direct or indirect productive factors that produce a stream of cash or in-kind returns. In this study assets such as farm size, livestock, machinery, houses and transport were used. This variable was expected to

positively impact choice of livelihood diversification of activities by households. Mariotti *et al.* (2014) found that assets owned have a positive impact on whether households diversified their livelihoods to earn more income.

Distance to market (DISMKT): This was measured as a continuous variable in kilometres. Markets are an indicator of whether there is systematized trade and proximity to economic resources. Distance to market was expected to be negatively related to household choice of livelihood diversification activities. This is because, the further to the markets the households are the more reluctant they would be to adopt the particular livelihood activity. Akaakohol and Aye (2014) in their study of diversification and farm household welfare in Nigeria found that distance to market was significant at the 5% level and negatively related to diversification. There is robust empirical evidence that suggests proximity and good infrastructure that favour the distance to market and facilitate the diversification process (Babatunde and Qaim 2009). Therefore, a lengthy distance to the nearest market decreases the probability of households diversifying their livelihoods.

Land ownership (LNDOWN): This was coded as a dummy variable taking a value of one if the household owned land and zero otherwise. This variable was expected to positively influence household's decision to diversify. Land ownership motivates the user of the land to invest labour and other resources in the land so as to diversify, sustain productivity and to maintain the value of that land (Julian, 2006).

Farm size (FMSZ): This was measured in hectares as a continuous variable indicating the total land size households owned. An increase in farm size explained by the assurance of households to invest in varying source of income and develop the land. Culas and Mahendrarajah (2005) found that in Norwegian farm size has a positive effect on household diversification. In addition Andersson (2012) found out that bigger land sizes

have largely been associated to increased involvement in agricultural activities. Therefore, farm size was expected to be positively associated with household choice of livelihood diversification activities.

Compensation (CMP): This was coded as a dummy variable one if the household were compensated and zero if not. Compensation referred to reimbursement made to the household (Kgathi *et al.*, 2012) for crop and livestock losses associated with wildlife damage. Livestock compensation amount (BWP) differed among the species this includes, bull, ox, cow/heifer, mule, calf or foal, goat/sheep, horse and donkey paid at 1925, 1050, 1050, 350, 157.50, 1400 and 120 respectively (Statistics Botswana, 2016). According to GoB guidelines for households to qualify for compensation payments depended upon the species of predators (lion, leopard, wild dog and cheetah) and also on livestock management by households Department of Wildlife and National Parks (DWNP, 2009). Compensation amount (BWP) for crop damages per hectare which are mostly done by elephants vary with the type of crop, maize, sorghum, bean and sweet reed at 500, 400, 320 and 200 respectively (Statistics Botswana, 2016). Several studies have shown that compensation would have a positive effect on households diversifying to livelihood diversification activities that are compensated, as this reduces their risks of losses (Mmopelwa & Mpolokeng, 2008; Kgathi *et al.*, 2012).

Extension services (EXTNs): This was coded as categorical dummy variable one if the household had access to extension services and zero if not. Access to extension services was expected have a positive impact on choice of livelihood diversification of activities, this is because extension services provide information and acts as a pull factor enabling households to take advantage of diversification opportunities (Asfaw *et al.*, 2015).

3.3.3 Diagnostic tests

3.3.3.1 Independence from irrelevant alternatives IIA

The Hausman test was undertaken to check for the existence of IIA in equation (3.5). Hausman and McFadden (1984) proposed a Hausman (HM) type test of the IIA property. The HM test compares the estimations from the full model (β^{*f}) with the ones from the restricted model (β^{*r}). The estimates from the full model are consistent and efficient when compared to the consistent but inefficient restricted estimates. The HM equation below shows the difference between the coefficient of the omitted model and the no-omitted model:

$$HM = (\beta^{*r} - \beta^{*f})' [\text{var}^*(\beta^{*r}) - \text{var}^*(\beta^{*f})]^{-1} (\beta^{*r} - \beta^{*f}), \quad (3.6)$$

Where $\text{var}^*(\beta^{*r})$ and $\text{var}^*(\beta^{*f})$ are the estimated covariance matrices. If the IIA holds, HM is asymptotically distributed as chi-square with degree of freedom equal to the rows in β^{*r} (Hausman & McFadden, 1984). Significant values of HM show that the IIA assumption has been violated. Hausman and McFadden (1984) note that HM can be negative if $\text{var}^*(\beta^{*r}) - \text{var}^*(\beta^{*f})$ is not positive semi-definite, but they conclude that this is evidence that IIA holds. The IIA holds when the estimated coefficients of the general specification are statistically similar to those of the restricted. If the test value is significant, the assumption of IIA is overruled and the conclusion that MNL is inappropriate is made.

3.3.3.2 Testing for multicollinearity

Multicollinearity occurs when the explanatory variables have a linear relationship with each other, such that the correlation coefficients are very close to ± 1 (Asteriou & Hall, 2007). The problem of multicollinearity is that the variance of the model and coefficients are inflated, thus the inferences are unreliable and the confidence interval becomes wide

(Littell & Freund, 2000). To test for multicollinearity, two tests were used (a) Pearson correlation matrix, and (b) variance inflation factor (VIF).

Pearson's correlation is a measure of the intensity of the linear association between variables introduced by Pearson, (1920). It ranges from -1 to +1, if variables are highly correlated then there will be a need to investigate their association further to determine if there is a causal mechanism operating (Hauke & Kossowski, 2011).

VIF demonstrates the impact of multicollinearity on the instability of the coefficient estimates (Littell & Freund, 2000). According to Gujarati (2004), VIF is calculated as follows:

$$\text{VIF} = 1 / (1 - R_j^2), \quad \text{for } j = 1, 2, \dots, p-1 \quad (3.7)$$

Where R_j^2 denotes the coefficient of determination between the explanatory variables
VIF= 1 when $R_j^2 = 0$ showing that the variables are not linearly related. The increase in R_j^2 shows the increase in the VIF which means colinearity at $R_j^2 = 1$ the variables are linearly related.

VIF values that exceed 5 for each variable are generally viewed as evidence of existence of multicollinearity (Gujarati, 2004). Asteriou and hall (2007), suggested several ways that can solve the multicollinearity problem, one is to drop the linearly related variables. Secondly, to transform the highly correlated variables into ratios and to increase the sample size.

3.3.3.3 Testing for heteroskedasticity

Heteroskedasticity occurs when the error term does not have a constant variance; thus, the conditional variance of the Y population varies with increases in X (Gujarati, 2004). The existence of heteroskedasticity implies that the least square estimator is still linear and unbiased, thus it is not best since there is another estimator with a smaller variance

(Williams, 2012). It also implies that the standard errors computed for the estimators are biased and incorrect, and therefore, confidence and hypothesis that use those standard errors may be misleading (Gujarati, 2004; Williams, 2012).

The Breusch-Pagan tests the null hypothesis that the error variances are all equal versus the alternative that the error variances are a multiplicative function of one or more variables. This test was done in Stata with the command *hettest* (Baum *et al.*, 2003). A significant chi-square indicates the presence of heteroskedasticity. Heteroskedasticity can be solved by re-specification of the model or transformation of the variables, using robust standard errors and using weighted least squares (Gujarati, 2004; Williams, 2012). Breusch-Pagan test was employed in this study following (Williams 2012).

3.3.3.4 Goodness-of-fit

In MNL, goodness-of-fit is assessed from the pseudo R^2 (Hu *et al.*, 2006). Pseudo R^2 is defined as the proportion of the variance of the latent variable that is explained by the covariate. McFadden (1973) indifferently suggested an alternative known as the likelihood ratio index. This compares the model without some predictor to a model including all predictors. Maddala (1977) developed an improved pseudo R^2 that can be used in any model estimated with maximum likelihood method. Pseudo R^2 that shows goodness-of-fit ranges from 0.2-0.4 for a case of excellent fit (McFadden, 1977; Gujarati, 2004).

3.4 Gross Margin

The gross margin is a tool that is used to assess the financial cost-effectiveness of an enterprise. It is calculated as the difference between the gross income accrued and the variable costs incurred by an enterprise (Makeham *et al.*, 1986). Gross margin is calculated using the following formula:

$$GM = TR - VC \quad (3.8)$$

where *GM* is the gross margin, *TR* is the total revenue from the sales and *VC* is the variable costs incurred. Gross margin analysis was used to identify which livelihood activity accrues more returns and whether they pursue their economic activities sustainably. A high gross margin indicates a good performance while a low gross margin indicates a poor livelihood performance.

The gross margins were calculated from each activity. In crop farming the revenue included the income from sales while the costs included costs of (seeds, fertilizer, land maintains, plough, marketing, harvest, transport, labor, irrigation and storage). The gross margins in livestock farming included returns from sales of (whole cow and by-products) the costs included of (vaccine, labor, feeds, ear tag, market, license, transport and water). Weather and market conditions are uncertainties that household farmers deal with resulting in variable returns. Varying returns is the major factor that would lead to households diversifying (Mishra *et al.*, 2004). The more the returns the more the strategy would be preferred over the less earning. Though more returns generating strategies are cumbersome, households would prefer to earn more from working hard, rather than work less and not be able to provide for basic needs.

3.5 Study area

This study was undertaken in Chobe, one of 16 districts in Botswana (CSO, 2011). The district lies to the north-west part of Botswana (Figure 3.2). Chobe has the third largest national park endowed with various species of wild animals (Hachileka, 2003). The District is one of the areas where livelihood diversification activities has a high potential especially in the sector of agriculture as the area is endowed with high rainfall, natural resources and abundant water from the Zambezi River (Wingqvist & Dahlberg, 2008).

However, livelihood diversification activities in Chobe District faces potential threat of human wild conflict (HWC) (DeMotts & Hoon, 2012). The major economic activities in this area include keeping livestock, arable farming, tourism, handicrafts and to a lesser extent, fishery and forestry (Mbaiwa, 2008). However, poverty, limited employment and inadequate infrastructure are still a challenge in the District. In line for resource endowment unemployment stood at 10.6 percent compared to 17.9 percent nationally (Statistics Botswana, 2016). The unemployment rate in this area shows that understanding the determinants of household’s choice of livelihood diversification activities can help the District inhabitants and policy makers alleviate poverty in the area.

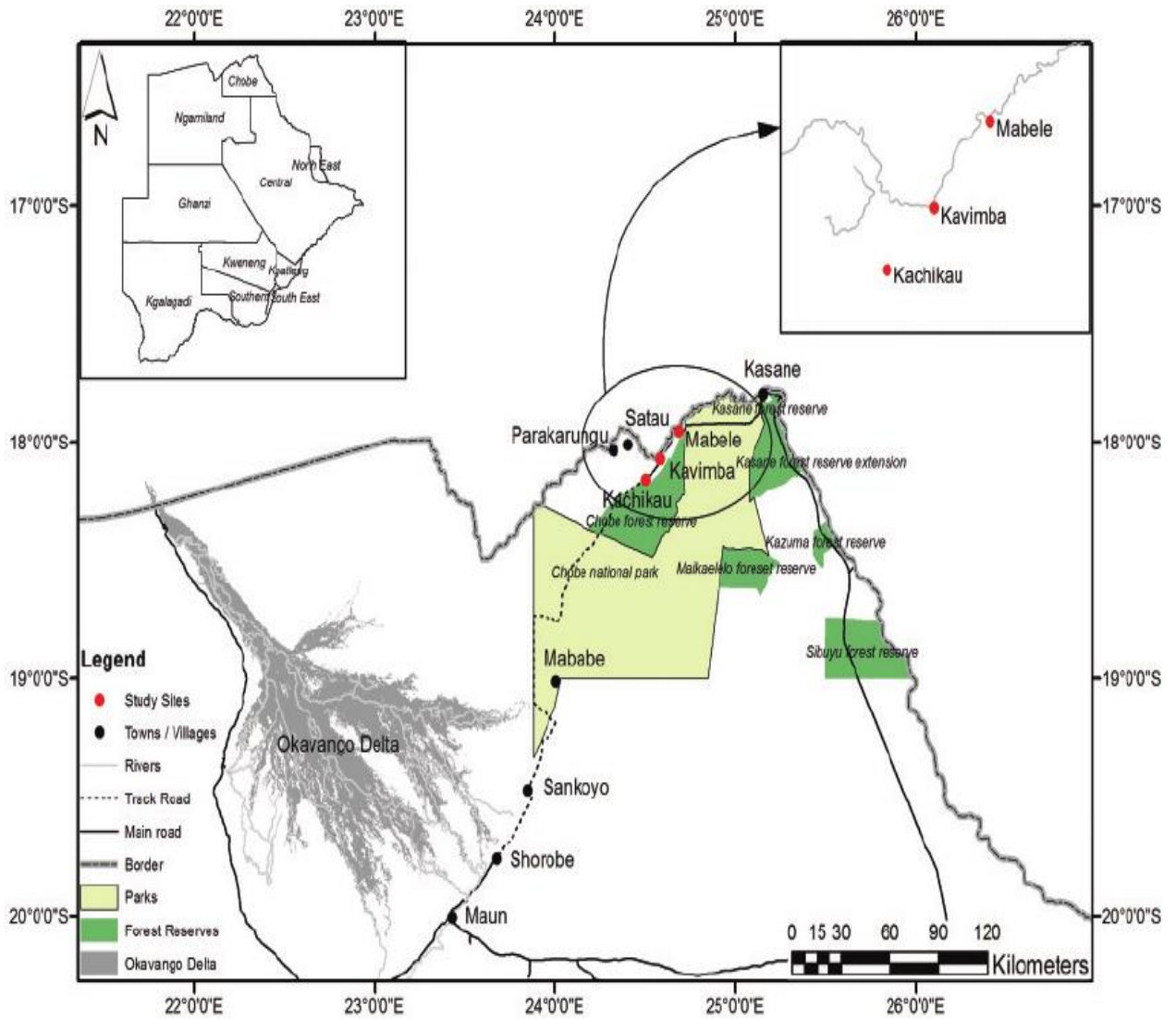


Figure 3. 2. Map of Botswana showing the Chobe District

Source: Government of Botswana (2001)

3.5 Research design

3.5.1 Data sources and sampling

The population of interest was a local community located near Chobe national park. A systematic random sampling technique was used to select households from a sampling frame constructed with the help of extension officers and village chiefs. The first household was randomly selected to start the interview. Then every fourth household in the sampling frame was selected until the required sample size was obtained. There were 1261 households in the sampling frame in total. This population size determined how many households to skip between two consecutive selections to obtain the target sample size. The study employed selection without replacement.

The sample size was determined using Yamane (1967) equation. The equation helps to determine the sample size when the population is known. The equation is given by:

$$n_0 = \frac{N}{1 + Ne^2} \quad (3.9)$$

where n_0 is the sample size, N is the population of the households and e is the sampling error which is the standard deviation of the sampling distribution of the estimator. Three villages, Mabele, Kachikau and Kavimba in Chobe District were purposively chosen for the study on the basis of their proximity to the Chobe national park. The three villages had 773, 323 and 165 households respectively. Accordingly, the sample sizes were 88, 76 and 62 respectively using equation (3.8).

3.5.2 Data collection

Five enumerators with undergraduate qualifications were hired by the researcher to assist with data collection. They were trained on the contents of the questionnaire two days prior to the household survey. Both the researcher and the enumerators pre-tested the questionnaire during the training with 45 households thus 9 households per enumerator. The enumerators did the face-to-face interviews with household heads. On average, a single schedule took 30 minutes to complete. To ensure quality of data capture, the researcher checked the filled up questionnaires from every enumerator every evening.

3.5.3 Data analysis

The questionnaire data were input in Statistical Package for Social Science (SPSS). The first objective used descriptive statistics involving the computation of percentages, frequencies, mean, mode and standard deviations to characterize the livelihood diversification activities in Chobe District. The second objective used Stata to fit MNL in equation 3.5 of the data collected to assess the determinants of household choice of alternative livelihood diversification activities in Chobe District, Botswana.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Diagnostic tests

The HM test showed that there was no violation of the IIA. This means that the difference between the coefficients were negligible, this was also shown by insignificant probabilities for each livelihood activities as compared to the full model. The chi-square (χ^2) which are not significant and $\text{prob} > \chi^2$ for crop farming, livestock farming and TBA, crop and livestock farming were having χ^2 0.21 and $\text{prob} > \chi^2$ of 1.000, χ^2 1.95 and $\text{prob} > \chi^2$ of 0.9995 and χ^2 20.09 and $\text{prob} > \chi^2$ of 0.6918 respectively (see Appendix V).

The results from the test done on stata have shown that the variables are not highly correlated to each other, they had Pearson's correlations not close to ± 1 and the p-values showed significance at 0.05 and 0.01 levels (see Appendix II). The mean VIF for this study was 1.17 and for each explanatory variable, the VIF ranged between 1.05 and 1.60 (see Appendix II). The VIF was less than 5 for all the explanatory variables, there was insignificant linear relationship among the variables therefore justifying their inclusion in MNL.

The Breusch-Pagan test for this study was insignificant with $\text{prob} > \chi^2$ of 0.372. This indicates that there is no heteroskedasticity in the model ran (see Appendix II). The pseudo R^2 showed a goodness-of-fit of 0.2017, this showed that the predictors were good for the model.

4.2 Characteristics of Livelihood Diversification Addressing Objective One

4.2.1 Socio-economic and Demographic Characteristics

Socio-economic and demographic characteristics are presented in Table 4.1. Among the interviewed households, 33.8 percent were male-headed while 66.2 percent were female-headed. The results have revealed that only education and extension services were significantly different among the livelihood diversification activities in Chobe District.

Table 4. 1. Descriptive Statistics of Variables across Diversification Activities (percent)

Variable	Category	Sample (%)	Crop farming (%)	Livestock farming (%)	Crop and livestock farming (%)	TBA, crop and livestock farming (%)	Chi-square
GND	Male	33.8	15.2	19.7	54.5	10.6	4.93
	Female	66.2	18.6	20.2	40.3	20.9	
AG	29-59	71.3	15.1	18.7	42.5	23.7	16.3
	>60	28.7	23.2	23.2	51.8	1.8	
EDU	0	12.8	36	12	48	4	9.61**
	1-16	87.2	14.7	21.2	44.7	19.4	
EXTNs	Yes	68.7	21	27	57	29	6.35*
	No	31.3	13	12	31	5	

Source: Author's survey data (2016). The asterisks ***, ** indicate a 1% and 5% significance levels, respectively.

Education years were significantly different among livelihood diversification activities ($\chi^2=9.61$). Majority of the households were the educated households, with the highest of 44.67percent who diversified to crop and livestock farming, 21.2 percent to livestock farming, 19.4 percent in TBA, crop and livestock farming and lastly 14.7 percent in crop farming. Extension services availability was significantly different among livelihood

diversification activities ($\chi^2=6.35$). This can be explained by the fact that most of the households farms were nearer to the services provided by extension workers like information. Hence, many of them did not have to wait days or travel long distances to be assisted.

Table 4.2 presents the means of various socio-economic characteristics of household heads in Chobe District, Botswana. The average number of household members showed a significant difference (1.45) among the livelihood activities. The results show that, on average, the households who diversified to livestock farming, crop and livestock farming and TBA, crop and livestock farming had the same household size. Crop farming had the least household members among the livelihood diversification activities with a mean difference of one member.

Table 4. 2. Means of Attributes of Different Diversification Activities

Variable	Crop farming	Livestock farming	Crop and livestock farming	TBA, crop and livestock farming	t-value
AG	59.0	56.2	57.9	53.1	0.37
HHSZ	2	3	3	3	-1.45*
EDU	6	7	7	7	-1.21*
FMSZ	2.2	2.0	2.4	2.1	-2.23**
INC	29032.13	19142.1	24776.1	20376.7	-0.33

Source: Author's survey data (2016). The asterisks *, ** indicate 10% and 5% significance levels, respectively.

Number of formal education years was significantly different among livelihood activities (1.21), with livestock farming, crop and livestock farming and TBA, crop and livestock farming having the highest number of years of schooling. The mean number of years of schooling among household heads in the current study shows that every one of them has attained at least primary education. This might be the case because, education system in Botswana has been structured such that all can attend the basic ten years of education

(Nthomang, 2007). GoB has recognized that investment in human development is a critical step to reduction of absolute poverty. Thus, provides free education till the level of secondary (Nthomang, 2007). Additionally, Diawara (2012) found that there is a direct relationship between low education and poverty in different countries. However, contrary to the recognition of the importance of education, majority of people in the rural areas still do not attend school and they do not understand the importance of getting educated.

On average, the farm size of household heads had a significant difference at the 5 percent (2.23) level among the livelihood activities. Crop and livestock farming had the highest average of 2.4ha followed by crop farming with 2.2ha, then TBA, crop and livestock farming with 2.1ha and lastly livestock farming with 2.0ha. This result is consistent with what Legesse *et al.* (2012), who found that farm size is statistically and significantly different among households.

4.2.2 Diversification Characterized by Land

Majority of households (92.8 percent) owned farms while 7.2 percent had leased the land. The difference was statistically significant at the 0.01 alpha level ($\chi^2=13.3$). The farm sizes were also significantly different at ($\chi^2=41.8$). Among the livelihood activities majority of the households (91.5 %) had 1-6ha farms. Households with 7-13ha were few, constituting only 8.5 percent.

Table 4. 3. Land Ownership and Farm Sizes for the Households (Percentage of households choosing)

Item	Sample (%)	Crop farming (%)	Livestock farming (%)	Crop and livestock farming (%)	TBA, crop and livestock farming (%)	Chi-square
<i>LNDOWN</i>						
Yes	92.8	18.2	17.1	47	17.7	
Leased	7.2	16.7	16.7	50	16.7	13.3***
<i>FMSZ</i>						
1-6	91.5	18.9	17.7	44.5	18.9	
7-13	8.5	7.69	7.69	76.9	7.69	41.8***

Source: Author's survey data (2016). The asterisks ***, indicate a 1% significance level

According to Karugia *et al.*, (2006), larger land holdings played an important role in poverty reduction and income diversification. In Botswana land is sufficient for the residents, and because of this land is given out for free (Petrie & Taylor, 2007). In spite of this, some households still have no land as their own property.

4.2.3 Diversification Activities Characterized from the Percentage of Employment Status

Table 4.4 presents employment status of the households. It shows that in total, 44.6 percent of the households were involved in farming (including crop and livestock farming), and had not diversified their livelihood to other off-farm activities. However, they had diversified within farming. Crop farming and livestock farming constituted 23 percent each of the households involved in farming.

Table 4. 4. Characterizing diversification activities using employment status**(percent)**

Employment status*	Sample (%)	Crop farming (%)	Livestock Farming (%)	Crop and livestock farming (%)	TBA, crop and livestock farming (%)
Farming	44.6	23	23	54	0
Government	21	12.2	22	56.1	9.7
Private	3.6	42.9	14.2	42.9	0
Self-employment	30.8	10	15	25	50
Total	195				

Source: Author's survey data (2016)

A high percentage of households engaged in farming were involved in crop and livestock farming. They constituted 54 percent. This was followed by households who were involved in crop farming and livestock farming at 23 percent. Around 21 percent of the households were employed with the government organisations but also performed all the other livelihood activities. The results show that 12.2 percent of the households employed by government had diversified their livelihood to crop farming. This means that they do crop farming as a part time activity in order to earn extra income for their households. There were 22 percent of households in livestock farming, 56.1 percent in crop and livestock farming and 9.7 percent in TBA, crop and livestock farming who were at the same time working for the government.

Only a few households (3.6) earned extra income through the private sector. In other words, the private sector is the lowest source of income among all the employment types. Among households engaged in the private sector, 42.9 percent were involved in crop

farming and crop and livestock farming. These were followed by only 14.2 percent in livestock farming and none in TBA, crop and livestock farming. It is not surprising that there are more households into government sector than in the private sector because private sector has lower wages in comparison to the government sector (Lammam *et al.*, 2015).

The results for self-employed households were more interesting as it had the highest percentage (50 percent) who had diversified their incomes to TBA, crop and livestock farming. The results show that 10 percent of the self-employed households had diversified their incomes to crop farming, 15 percent had diversified to livestock farming and 25 percent had diversified their income sources to both crop and livestock farming. A self-employed individual is best described as an entrepreneur. This would mean an entrepreneur can turn ideas into action, thus is innovative and risk loving (European Union, 2012). Since entrepreneurship shows more level of diversification it would be the centre of economic growth of any nation.

4.2.4 Livelihood Diversification Activities Characterized by Gross Margins

Livelihood diversification activities are assumed to be the key for reducing risks (Kahan, 2013). Gross margins were used in this study to determine whether the livelihood diversification activity chosen by households is cost-effective. According to Barghouti *et al.*, (2004) livelihood diversification activities reduce vulnerability to shocks from climatic variability, ecological risks and economic risks such as instability of commodity prices. Therefore, it was expected that more diversified households would have positive gross margins because of variation of sources of income, as compared to undiversified households. A strong negative correlation between the diversified activities is most desirable (Barghouti *et al.*, 2004 & Andrews-Speed *et al.*, 2014), because this would mean that if one activity experiences losses it will not have a spill over effect to other activities.

Table 4. 5. Gross Margins for Livelihood Diversification Activities

Livelihood activities	Sample Size	Average GM (P)	Minimum GM (P)	Maximum GM (P)
Crop farming	34	-1548.21	-13840	3368
Livestock farming	39	2946.28	-7036	15860
Crop and livestock	88	-2823.35	-14998	8800
TBA, crop and livestock farming	34	2957	-5270	21546
Total	195			

Source: Author's survey data (2016)

From the results in table 4.5, it is evident that all households have experienced deficit returns. Crop and livestock farming had the lowest negative average GM of P2823.35. This was followed by crop farming, which had a negative average GM of P1548.21 and the lowest maximum amount of GM of P3368. This shows that crop and livestock farming and crop farming are not cost-effective, which may be because of losses caused by wildlife. Overall, crop and livestock farming accounted the highest number of households. Household choice of crop and livestock farming may be influenced by their lack of skills to diversify to other livelihood diversification activities. Livestock farming had an average of P2946.28, a minimum negative of P7036 and a maximum of P15860. TBA, crop and livestock farming had the lowest negative gross margin of P5270. On average, this livelihood activity performed better than all the other activities as it had the highest average GM of P2957. The average GM of TBA, crop and livestock farming may be accounted for by the fact that TBA does not face wildlife menace and disease spread that other activities

are faced with. Therefore, looking at GM, it would be an efficient benefit to invest in encouraging households to diversify to TBA, crop and livestock farming.

4.2.5 Major Characteristics of Livelihood Diversification

It is important to examine the major constraints that households face in the diverse livelihood activities they are involved in, as these may have an impact on the livelihood diversification activity they do and whether they can diversify or not. The major challenge that applies to all households is markets. The market opportunities influence the decision of an individual or households to diversify. As an efficient entrepreneur, first objective is to know the market. Without a market there is no one who can really diversify.

Crop farming households were faced by constraints of crop destruction by wild animals, inadequate extension services, pests, drought, market access and destruction of crops by domesticated animals. These findings are consistent with Mbaiwa (2008) who showed that there is significant destruction by wild animals in the area due to the unfenced park. Constraints encountered by livestock farming households were wildlife destruction, inadequate extension services, pests and diseases, drought and market access. Lack of material, skills and government intervention interfered with household choice of diversification in TBA, crop and livestock farming.

In general, market access afflicted the highest percentage of households (32.7 percent) among the constraints that the households encountered in the study area. The results found in this study are significantly correct because markets like BMC and Botswana Agricultural Marketing Board (BAMB) are not found in Chobe District (Gupta, 2013). Lack of skills to be involved in other activities is another constraint that rural households in Chobe District are faced with. This separates between a learned and trained individual and the one who is just doing for survival. According to Zerai and Gebreegziabher (2011),

special skills are found to be key drivers to whether individuals are involved in non-farm activities. Another constraint to diversification is lack of start-up capital. Only 6.15 percent of the households had access to credit for their activities.

4.3 Determinants of Household Choice of Livelihood Diversification Activities

Table 4.6 presents the results of MNL obtained after fitting Equation 3.5 to the data. Six of the variables were significant at 1, 5 and 10 percent significance levels. These are age, assets category, distance to market, land ownership and farm size. Education and compensation were expected to have positive significant influence on livelihood diversification activities from table 3.1. However, the variables were unexpectedly negative and insignificant influence.

Table 4. 6. Determinants of Household Choice of Livelihood Diversification Activities in Chobe District (MNL Results)

Variable	Crop farming		Crop and livestock farming		TBA, crop and livestock farming	
	Coefficient	P> t	Coefficient	P> t	Coefficient	P> t
HHSZ	-0.121	0.605	0.133	0.484	0.207	0.398
GND	-0.022	0.122	-0.659	0.162	0.308	0.628
AG	1.32	0.497	0.784	0.279	3.35	0.001***
EDU	-0.446	0.273	-0.127	0.717	-0.0649	0.888
INC	3.99e-06	0.658	2.49e-06	0.770	4.14e-06	0.699
ASSTCAT	-0.172	0.552	0.0628	0.793	0.631	0.053*
DISMRKT	-0.051	0.024**	-0.004	0.537	0.011	0.085*
LNDOWN	2.10	0.071*	1.83	0.030**	1.95	0.052*
FMSZ	0.275	0.586	1.04	0.009***	0.0542	0.931
CMP	-0.079	0.928	-0.802	0.259	-0.340	0.704
EXTNs	0.516	0.367	0.422	0.375	-1.02	0.132
Constant	-3.22	0.373	-3.93	0.196	-7.02	0.070*

Source: Author's survey data (2016). The asterisks ***, ** & * indicate 1%, 5% and 10% significant levels, respectively, n=195; Pseudo R²= 0.2017; LR chi²= 101.49; Prob > chi²= 0.0000. The reference activity is livestock farming.

Table 4.7 presents the marginal effects of determinants of household choice of livelihood diversification activities in Chobe District. The marginal effects permit analysis of the impact of individual variable on household's decision on livelihood diversification activities assuming that the other variables are held constant. The discussion was made only for the marginal effects because the literature has shown that it is better to discuss the marginal difference made by each significant variable to make informative policy recommendations for each livelihood activity.

Table 4. 7. Determinants of Household Choice of Livelihood Diversification**Activities in Chobe District (MFX)**

Variable	Crop farming		Crop and livestock farming		TBA, crop and livestock	
	dy/dx	P> t	dy/dx	P> t	dy/dx	P> t
Probability to engage%	0.101		0.576		0.106	
HHSZ	-0.021	0.406	0.027	0.444	0.013	0.496
GND	0.033	0.406	-0.179	0.029**	0.101	0.051*
AG	0.038	0.542	-0.091	0.497	0.257	0.001***
EDU	-0.0325	0.254	-0.0009	0.989	0.0064	0.864
INC	1.74e-07	0.798	1.20e-07	0.939	1.98e-07	0.812
ASSTCAT	-0.026	0.248	-0.013	0.771	0.058	0.032**
DISMRKT	-0.0046	0.000***	0.0014	0.279	0.002	0.003***
LNDOWN	0.063	0.240	0.312	0.061*	0.059	0.236
FMSZ	-0.036	0.336	0.235	0.001***	-0.062	0.222
CMP	0.043	0.477	-0.170	0.164	0.018	0.788
EXTNs	0.033	0.441	0.158	0.083*	-0.129	0.020**

Source: Author's survey data (2016). The asterisks ***, ** & * indicate 1%, 5% and 10% significant levels respectively; dy/dx is for discrete change of dummy variable from 0 to 1

Being male unexpectedly negatively influenced the decision of household heads to diversify to crop and livestock farming by 17.9% relative to their female counterparts. This finding is inconsistent with various studies that have shown that male headed households are positively related to diversification due to their physical capability (Dirribsa & Tassew, 2015). The results of this study may be explained by the high number migration of men to mining areas in search of employment.

On the other hand, as was expected, being male positively and significantly impacted the household heads decision to diversify to TBA, crop and livestock farming at a 10 percent

marginal effect. This findings are consistent with what Beyene, (2008) and Akaakohol and Aye, (2014) found in their studies showing that due to their accessibilities to opportunities, male-headed households are positively related to livelihood diversification activities. This results may have been because of the majority of the TBA activities that households were involved in were perceived to be male associated like crafting and traditional performances.

It is shown that while holding all variables constant, increasing the age of the household head increases the chances of being involved in TBA, crop and livestock farming activity by 10 percent. This results were unexpected, that as the age of the household head increased they would positively diversify to TBA, crop and livestock farming. These findings were inconsistent with what Zerai and Gebreegziabher (2011) and Moepeng (2013) found. They found that as household heads get older, their ability to generate income is considered to be ineffective. Basket weaving would be a challenge with increased age because it needs virtuous eyesight and focus which reduces with age increase. Similarly Babatunde and Qaim (2009) found that age negatively impacts diversification to non-farm activities, which is explained by physical capability required and time needed. This can be explained by the diverse TBA activities that involved all age groups like crafting and traditional performance.

Asset category was positively and significantly associated with diversification of households involved in TBA, crop and livestock farming as was expected. There was 5.8 percent marginal effect at the 5 percent significance level. This showed that as the households increased their assets, they diversified their income to TBA, crop and livestock farming. This was explained by the low costs of raw material which some were freely acquired from the forest and marketing of the products incurred by households. The results

are consistent with what Ellis (2000) found, that being asset rich positively influences livelihood diversification activities.

According to the results, as was expected, distance to markets had a negative influence to households diversifying to crop farming with a marginal effect of 0.46 percent, while holding all other variables constant. This is explained by the losses that households will incur from transaction costs and the perishability of the produce. Unvaryingly Kankwamba *et al.* (2012) found that economic areas like rural growth centres diversify as way of meeting their subsistence requirements. This shows the significance of markets. Distance to markets is therefore an indicator of whether there is systematized trade and proximity to economic resources. Contrary to the expectations, distance to the market had positive impact on households diversifying to TBA, crop and livestock farming by 0.2 percent. This may be attributed to the fact that customers may travel to buy the products, and that products from TBA are not perishable hence easy to carry even for longer distance.

Land ownership, as expected, was found to be a positive significant variable for diversifying to crop and livestock farming livelihood activity, with a marginal effect of 31.2 percent. Likewise, Julian (2006) found that land ownership positively influences the households to diversify to crop and livestock farming in order to sustain productivity and to maintain the value of that land. Furthermore the variable of farm size was considered. It showed that as the farm size increase the tendency of households to diversify to crop and livestock farming increased by 23.5 percent. This is explained by the rational behaviour of households to want varying sources of income as land size increases. These findings are similar to what Culas and Mahendrarajah (2005) found in Norway, that farm size has a positive effect on crop and livestock diversification. Invariably, bigger land sizes

have largely been associated to increased involvement in agricultural activities as found by several studies (Winters *et al.*, 2009 and Andersson, 2012).

Expectedly having access to extension services had positive effect on diversifying to crop and livestock farming with a marginal effect probability of 15.8 percent. These results are consistent with the findings by Masoud-Ali (2010), who found that in Tanzania extension services are highly significant and positively related to the likelihood of household's diversification process for both on-farm and non-farm. Contrary to expectations, access to extension services was negatively significant for TBA, crop and livestock farming at ($p > |t|$ 0.02) with a marginal effect of 12.9 percent. This may be explained by the fact that in the area the TBA activities are traditionally embedded. This is contradictory to what Asfaw *et al.* (2015) found. According to the authors, extension services provide information and acts that enable households to take advantage of diversification opportunities.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Diversification has been defined in various ways. As for this study, the profound distinction is that diversification must consider both internal and external diversification. Households are involved in diversified activities in crop farming, livestock farming, crop and livestock farming and TBA, crop and livestock farming. The activities have shown that households in Chobe District are involved in on-farm and on-farm and non-farm activities. Majority of the households had diversified to crop and livestock farming activity. However, crop and livestock farming was the least beneficial as shown by the gross margins. The major constraints to diversification that apply to all households are markets and lack of skills. The study characterized livelihood diversification activities by demographic characteristics, farm level characteristics and economic characteristics.

The descriptive statistics revealed that majority of household heads were females and crop and livestock farming livelihood had the highest number of both females and males household heads. The results also showed that, on average the youngest household head is in their early fifties and were involved in TBA, crop and livestock farming, while on average the oldest household head were in their late seventies and were mostly involved in crop farming. Households received income from a diverse employment activities which include, farming, government, private sector and self-employment. The results indicate that farming is the main source of income for many households in this area.

Furthermore, the study has shown the determinants of household livelihood diversification activities that can be modified to allure the households in Chobe District to venture into diversified livelihoods. The variables that significantly determine which diversification

activity households may venture into were gender, age, asset category, distance to market, land ownership, farm size and extension services. Gender and extension services were significant for diversifying to crop and livestock farming and TBA, crop and livestock farming. Distance to market was significant to crop farming and TBA, crop and livestock farming. Land ownership and farm size was only significantly relevant for crop and livestock farming. Lastly, age and asset category were relevant for diversifying to TBA, crop and livestock farming livelihood diversification activity only.

Distance to markets positively had an effect on diversifying to TBA, crop and livestock farming, while for crop farming it had a negative relation. Ownership of farm land positively influenced crop farming, crop and livestock farming and TBA, crop and livestock farming at differing marginal effects. The income variable only influenced diversification to crop and livestock farming with a positive marginal effect.

This implied that indeed there existed differences among households who diversified to crop farming, livestock farming, crop and livestock farming and TBA, crop and livestock farming, thereby justifying the use of MNL. The MNL and MFX results showed a significant impact of the variables. Therefore, the null hypothesis that social and economic characteristics as well as institutional factors have no influence on household livelihood diversification activities could not be sustained.

5.2 Policy recommendations

A general recommendation of this study is that policies for lucrative and sustainable livelihood diversification of activities should be implemented.

5.2.1 Recommendations for crop farming livelihood diversification activity

The distance to market needs to be improved by opening subsidized or government oriented markets. For example, the existing ones in other parts of Botswana like Botswana Agricultural Marketing Board (BAMB) and Botswana Horticultural Market (BHM). This would help the households who have diversified to crop farming reduce transaction costs due to distance to markets. In addition, government has to make the households aware of improved technologies for the households to penetrate the markets and provide protection schemes like insurance for protecting the fields from wild animals.

5.2.2 Recommendations for crop and livestock farming livelihood diversification activity

The male headed households have a negative relationship to diversification in crop and livestock farming activity. This is mainly because many have migrated to mining areas. The government has to intervene by showing them how to maximize production and profit from the resources they have readily available to encourage crop and livestock farming. Initiatives that seek to increase diversifying to crop and livestock farming must be fortified to increase opportunities for households. In addition, income availability from other sources like wages must be encouraged, strengthened to enhance skills and opportunities in crop and livestock farming.

In Botswana the citizens are allocated land freely through applications as a way of improving farm ownership and self-reliance. However, the people are not maximizing on this opportunity since after being allocated the land freely some sell while others do not use the land. Therefore farm ownership could be controlled by careful management of land allocation and transfers. Land could be leased to the households for a period of 5-10 years, so that households who have efficiently used the land can be entitled with that land. This would help avoid the land being owned by people who just want to keep it desolate or sell

it. The households must be taught the importance of expanding their businesses through farm size increment. Extension services must be improved by making it more readily available to the households. These can be done through weekly visits to the farms by extension workers.

5.2.3 Recommendations for TBA, crop and livestock farming livelihood diversification activity

Government should intervene and even the rural inhabitants should help educate and train younger household heads and the older should also be taught the relevant activities they can do at their age in TBA, crop and livestock farming for profitable diversification to exist. Households should be encouraged to invest in assets as they positively influence diversification. Assets provide a better representation of long term living standards that are accumulated over time and last longer.

Distance to markets is one of the key factors that influence households to diversify to TBA, crop and livestock farming. Therefore, intervention by both government and non-government agencies are needed to improve market accessibility. Also policies that can help boost markets in this area should be exploited. Transport facilities and infrastructures are important for market access. They need to be developed to increase access to an array of opportunities to improve the livelihood of households.

Based on the findings, emphasis should be made on extension services to improve diversification to TBA, crop and livestock. Staff of extension service centres could have a visit to the households once a week to check on how they are doing and also do some short-term courses for the household's skills enhancement and competitiveness.

REFERENCES

- Adepoju, A. O., and Oyewole, O. O. (2014). Rural livelihood diversification and income inequality in local government area Akinyele, Ibadan, Oyo state, Nigeria. *Journal of Agricultural Sciences*, 59(2):175-186.
- Akaakohol, M. A. and Aye, G. C. (2014). Diversification and farm household welfare in Makurdi. Benue State, Nigeria. *Development Studies Research*, 1(1):168-175.
- Andersson, D. A. (2012). Seasonality and farm/non-farm interactions in Western Kenya. *Journal of Modern African Studies*, 50(1): 1-23.
- Asfaw, S., McCarthy, N., Paolantonio, A., Cavatassi, R., Amare, M. and Lipper, L. (2015). Livelihood diversification and vulnerability to poverty in rural Malawi. Agricultural Development Economics Division Food and Agriculture Organization of the United Nations. ESA Working Paper No. 15-02, Rome.
- Asfaw, S., Palma, A., and Lipper, L. (2016). Diversification strategies and adaptation deficit: Evidence from rural communities in Niger. ESA Working Paper No. 16-02. Rome.
- Asteriou, D., and Hall, S. G. (2007). *Applied Econometrics: A Modern Approach*, Revised edn. Palgrave Macmillan publication, New York.
- Babatunde, R.O. and Qaim, M. (2009). Patterns of income diversification in rural Nigeria: Determinants and impacts. *Quarterly Journal of International Agriculture*, 48(4):305-320.
- Barghouti, S., Kane, S., Sorby, K., and Ali, M. (2004). *Diversification for the Poor*. The World Bank, Agriculture and Rural Development Discussion Paper 1.
- Baum, C. F., Schaffer, M. E., and Stillman, S. (2003). Instrumental variables and GMM: Estimation and testing. *Stata Journal*, 3(1):1-31.

- Beyene, A. D. (2008). Determinants of off-farm participation decision of farm households in Ethiopia. *Agrekon*, 47(1):140-161.
- Boserup, E. (1965). The condition of agricultural growth. The Economics of Agrarian Change under Population Pressure. Transaction Publishers, London.
- Bowie, H. G. (2009). Wildlife Conflict Management and Biodiversity Conservation for improved Rural Livelihoods in Botswana Project. Economic and Financial Analysis–Community Investments Study. GEF-PPG TF No.057046.
- Brahmbhatt, M., Canuto, O., and Vostroknutova, E. (2010). Dealing with Dutch disease. *World Bank-Economic Premise*, 16:1-7.
- Cervantes-Godoy, D. and Dewbre, J. (2010). Economic Importance of Agriculture for Poverty Reduction, OECD Food, Agriculture and Fisheries Papers, No. 23, OECD Publishing.
- Culas, R., and Mahendrarajah, M. (2005). Causes of diversification in agriculture over time: Evidence from Norwegian farming sector. In 11th International Congress of the European Association of Agricultural Economists, Annals Copenhagen (Denmark): EAAE.
- Damite, D., and Negatu, W. (2004). Determinants of rural livelihood diversification: evidence from southern Ethiopia. *Quarterly Journal of International Agriculture*, 43(3):267-288.
- Davis, J. (2006). Rural non-farm livelihoods in transition economies: emerging issues and policies. *Electronic Journal of Agricultural and Development Economics*, 3(2):180-224.
- DeMotts, R., and Hoon, P. (2012). Whose elephants? Conserving, compensating, and competing in Northern Botswana. *Society & Natural Resources*, 25(9):837-851.
- Diawara, B. (2012). Schooling and Assets Ownership. *Modern Economy*, 3(01), 126.

- Dirribsa, S., and Tassew, B. (2015). Analysis of Livelihood Diversification Strategy of Rural Household: A Case study of Ambo District, Oromiya Regional State, Ethiopia. Department of Cooperatives & Institute of Cooperatives & Development Studies, Ambo University, Oromiya Regional State, Ethiopia. *International Journal of Current Research and Academic Review*, 3(8):406-426.
- Ellis, F. (1998). Household strategies and rural livelihood diversification. University of East Anglia, Norwich, UK. *Journal of Development Studies*, 35 (1):1-38.
- Ellis, F. (2000). The determinants of rural livelihood diversification in developing countries. *Journal of Agricultural Economics*, 51(2):289-302.
- Ellis, F., and Allison, E. (2004). Livelihood diversification and natural resource access. University of East Anglia, Norwich, UK. Overseas Development Group. 40(4):1-30.
- Greene, W. H. (2003). *Econometric analysis*. Fifth edition. Prentice Hall, New Jersey.
- Gupta, A. C. (2013). Elephants, safety nets and agrarian culture: understanding human-wildlife conflict and rural livelihoods around Chobe National Park, Botswana. *Journal of Political Ecology*, 20:238-254.
- Gujarati, D. N. (2004). *Basic Econometrics* (4th ed.). New York: The McGraw-Hill Companies.
- Hauke, J., and Kossowski, T. (2011). Comparison of values of Pearson's and Spearman's correlation coefficients on the same sets of data. Adam Mickiewicz University, Institute of Socio-Economic Geography and Spatial Management, Poznań, Poland. *Quaestiones Geographicae*, 30(2):87-93.
- Hausman, J., and McFadden, D. (1984). Specification tests for the multinomial logit model. *Econometrica. Journal of the Econometric Society*, 1219-1240.
- Honde, G. J. and Abraha, F. G. (2015). Botswana. *African Economic Outlook*.

- Hussein, K., and Nelson, J. (1999). Sustainable Livelihoods and Diversification. IDS Working Paper 69. London: Institute of Development Studies.
- Hu, B., Shao, J. and Palta, M. (2006). Pseudo-R² in logistic regression model. University of Wisconsin-Madison. *Statistica Sinica*, 16:847-860.
- Ibekwe, U.C., Eze C.C., Ohajianya, D.O., Orebiyi, J.S., Onyemauwa, C.S., and Korie, O.C. (2010). Determinants of non-farm income among farm households in South East Nigeria. *Academia Arena*, 2(7):1-4.
- Iiyama, M. (2006). Livelihoods Diversification Patterns among Households and their Implications on Poverty and Resource Use: A Case Study from a Kerio River Basin Community. 51(5):22-23.
- Ito, T., and Kurosaki, T. (2009). Weather risk, wages in kind, and the off-farm labour supply of agricultural households in a developing country. *American Journal of Agricultural Economics*, 91(3):697-710.
- Julian, Q. (2006). Land access in the 21st century: Issues, trends, linkages and policy options. LSP Working Paper 24.
- Kahan, D. (2013). Managing risk in farming. Food and Agriculture Organization of the United Nations. FAO publication, Rome.
- Kankwamba, H., Mapila, M. A. T. J., and Pauw, K. (2012). Determinants and spatiotemporal dimensions of crop diversification in Malawi. Project Report produced under a co-financed research agreement between Irish Aid, *USAID and IFPRI, Paper*, (3).
- Karugia, J. T., Oluoch-Kosura, W., Nyikal, R., Odumbe, M., and Marenya, P. P. (2006). Access to land, income diversification and poverty reduction in rural Kenya. International Association of Agricultural Economists Conference, Gold Coast, Australia.

- Kennedy, P. (2003). *A guide to econometrics*. MIT press, United Kingdom.
- Kgathi, D. L., Mmopelwa, G., Mashabe, B., and Mosepele, K. (2012). Livestock predation, household Adaptation and compensation policy: a Case study of Shorobe village in northern Botswana. *Agricultural Economics Research, Policy and Practice in Southern Africa*, 51(12):22-37
- Khatun, D., and Roy, B. C. (2012). Rural livelihood diversification in west Bengal: determinants and constraints. *Agricultural Economics Research Review* 25(1):115-124.
- Lammam, C., Palacios, M., Ren, F., and Clemens, J. (2015). *Comparing Government and Private Sector Compensation in Quebec*. Fraser Institute, Canada.
- Lilleor, H. B. (2008). *Human Capital Diversification within the Household. Findings from Rural Tanzania* (No. 2008-04). CAM working paper.
- Littell, R. C., and Freund, R. J. (2000). *SAS system for regression*. Cary: SAS Institute Inc, North Carolina.
- Legesse, B., Ayele, Y., and Bewket, W. (2012). Smallholder Farmers' Perceptions and Adaptation to Climate variability and climate change in Doba District, West Hararghe, Ethiopia. *Asian Journal of Empirical Research* 3(3):251-265.
- Maddala, G. S. (1977), *Econometrics*. McGraw- Hill Book Company, New York.
- Mariotti, F., Mumford, K., and Pena-Boquete, Y. (2014). *Household Asset Holding Diversification in Australia*, University of Vigo. Bonn Germany. Discussion Paper No. 8302.
- Masoud-Ali, H. (2010). *Agricultural diversification determinants and contribution to small holder farmers' incomes*. Doctoral dissertation, Sokoine University of Agriculture, Tanzania.

- Maundeni, T., and G. Mookodi. (2004). Critical Social Challenges in Contemporary Botswana. *Botswana Journal of African Studies* 18(1):1-6.
- Mbaiwa, J. (2008). Tourism Development, Rural Livelihoods and Conservation in the Okavango Delta. Botswana [unpublished PhD dissertation]. [College Station (TX)]: Texas A&M University.
- McFadden, D. (1973). Conditional logit analysis of qualitative choice behaviour. University of California, Berkeley, California.
- McFadden, D. (1974). The measurement of urban travel demand. *Journal of Public Economics*, 3(4):303-328.
- McFadden, D. (1977). Quantitative methods for analysing travel behaviour of individuals: some recent developments. Institute of Transportation Studies, University of California. Cowles Foundation Discussion paper No. 474.
- McFadden, D., Tye, W. B., and Train, K. (1977). An application of diagnostic tests for the independence from irrelevant alternatives property of the multinomial logit model. Institute of Transportation Studies, University of California. Charles River Associates, Inc., California.
- Ministry of Trade and Industry, (2011). Economic diversification drive: Medium to Long-Term Strategy 2011 – 2016. Botswana Government.
- Mishra, A. K., El-Osta, H. S., and Sandretto, C. L. (2004). Factors affecting farm enterprise diversification. *Agricultural Finance Review*, 64(2):151-166.
- Mmopelwa, G. and Mpolokeng, T. 2008. Attitudes and perceptions of livestock farmers on the adequacy of government compensation scheme: human-carnivore conflict in parts of Ngamiland. *Botswana Notes and Records*, 40:147-156.
- Moepeng, P. (2013). Rural development in Botswana: Experience from elsewhere and emerging issues (No. 152685). University of Queensland, School of Economics.

- Nthomang, K. (2007). Democracy and social policy in Botswana. Democracy and Social Policy. UNRISD/Palgrave Macmillan, Basingstoke.
- OECD (2011), Economic Diversification in Africa: A Review of Selected Countries, OECD Publishing.
- Pryanishnikov, I. and Zigova, K. (2003). Multinomial Logit Models for the Austrian Labor Market. *Austrian Journal of Statistics*, 32(4):267–282.
- Schwab, K., and Sala-i-Martin, X. (2015). World Economic Forum's Global Competitiveness Report, 2014-2015. Retrieved from: <http://reports. We forum. Org/global-competitiveness-report-2014-2015/>. Switzerland: World Economic Forum.
- Schwarze, S., and Zeller, M. (2005). Income diversification of rural households in Central Sulawesi, Indonesia. *Quarterly Journal of International Agriculture*, 44(1):61-74.
- Scoones, I. (1998). 'Sustainable Rural Livelihoods: A Framework for Analysis', IDS, 72.
- Sekwati, L. (2010). Botswana: A note on economic diversification. *Botswana Journal of Economics*, 7(11):79-85.
- Shen, T. T. (2004). Beyond Agriculture: Diversification of Household Income in the Ethiopian Highlands. Doctoral dissertation, Georgetown University, Washington, DC.
- Singh, I., Squire, L., and Strauss, J. (1986). Agricultural household models: extensions, applications, and policy. Johns Hopkins University Press.
- Sisay, W. A. (2010). Participation into off-farm activities in rural Ethiopia: who earns more? Masters of Arts in Development Studies; International Institute of Social Studies, Erasmus University, Ethiopia.
- Statistics Botswana, (2016). 2015 *Formal sector employment survey*. Gaborone, Botswana.

- Statistics Botswana, (2011). Preliminary results of the Botswana core welfare indicators (Poverty) survey 2009/10. Gaborone, Botswana.
- Tizale, C.Y. (2007). “The dynamics of soil degradation and incentives for optimal management in the Central Highlands of Ethiopia”. PhD thesis, Department of Agricultural Economics, Extension and Rural Development, Faculty of Natural and Agricultural Sciences, University of Pretoria, Ethiopia.
- Tlhalefang, J. B. (2014). Stanbic Bank Quarterly Economic Review. Department of Economics, University of Botswana, Botswana.
- Williams, R. (2012). Heteroscedasticity. University of Notre Dame.
- Wingqvist, G. O., and Dahlberg, E. (2008). Botswana environmental and climate change analysis. Gothenburg: Sida Helpdesk for Environmental Economics, University of Gothenburg.
- Winters, P., B. Davis, G. Carletto, K. Covarrubias, E. J. Quinones, A. Zezza, C. Azzarri and K. Stamoulis. (2009). Assets, Activities and Rural Income Generation: Evidence from a Multicountry Analysis. *World Development*, 37(9):1435–1452.
- Yamane, T. (1967). Elementary sampling theory.
- Yizengaw, Y. S., Okoyo, E. N. and Beyene, F. (2015). Determinants of livelihood diversification strategies: The case of smallholder rural farm households in Debre Elias Woreda, East Gojjam Zone, Ethiopia. *Academic Journals*, 10(19).
- Zerai, B., and Gebreegziabher, Z. (2011). Effect of nonfarm income on household food security in eastern Tigray, Ethiopia: An entitlement approach. *Food Science and Quality Management*, 1:1-22.

APPENDICES

Appendix I: Questionnaire

A) Demographic characteristics

1. Name of enumerator:		Household number	
2. Date of interview (dd/mm/yr)		Start time:	
3. Village		End time :	
4. Name of respondent		Phone No.	
5. Respondent's position in household []	<u>Codes for relationship with household head</u> 1= head 2=spouse 3=own child 4=step child 5=parent 6= brother/ sister 7=nephew/niece 8=son/daughter in law 9= grandchild 10=other relative (specify)		
6. Age of respondent in years	[]		
7. Sex of respondent	Male [] Female[]		
8. Marital status []	<u>Codes for marital status</u> 1= Single 2=Married 3=Divorced 4=Widowed 5 =other relative (specify)		
9. Years of schooling	[]		
10. Employment status []	<u>Codes for employment status</u> 1= Farming 2=Government 3=Private sector 4=Self-employment (Specify) 5 =other (specify)		

11. How many people are living in the compound for the past 12 months? _____

12. Among the three livelihood options listed below which have you been involved in the last 12 months?

Farming	Tourism based activities (TBA)	Both farming and TBA

13. Why did you choose to do the option above instead of others?

14. Do the members of the household help in the enterprise? _____ Yes/No

15. How many of the household members help in the enterprise? _____

16. Household Characteristics

N0.	Relation to the HH-head	Age in years	Education level in years	Main source of income	Amount of income earned
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Codes for relationship with household head
 1= head 2=spouse 3=own child 4=step child 5=parent 6= brother/ sister
 7=nephew/niece 8=son/daughter in law 9= grandchild 10=other relative (specify)

A) Farming characteristics

1. Do you own farm land? _____ Yes/ No
2. What is the total size of the land owned? _____
3. What farm enterprise are you involved in? _____ None/ Crops/
Livestock
4. Have you farmed for the last 12 months? _____ Yes/ No

A5: CROP PRODUCTION

The Table below should be filled with information for three main crop enterprises the respondent was involved in the last 12 months.

1st CROP ENTERPRISE: _____

Item	Unit	Quantity	Unit Cost (P)	Total (P)
A. REVENUE				
Output	Kg			
B. COSTS				
Seeds	Kg/Ha			
Land preparation				
Ploughing				
Harrowing				
Planting	Man-days/ Ha			
Weeding	Man-days/ Hs			
Fertilizer	Kg/Ha			
Fertilizer application	Man-days/ Ha			
Harvesting	Man-days/ Ha			
Storage	Per day			
Transport	Ton			

2nd CROP ENTERPRISE: _____

Item	Unit	Quantity	Unit Cost (P)	Total (P)
A. REVENUE				
Output	Kg			
B. COSTS				
Seeds	Kg/Ha			
Land preparation				
Ploughing				
Harrowing				
Planting	Man-days/ Ha			
Weeding	Man-days/ Hs			
Fertilizer	Kg/Ha			
Fertilizer application	Man-days/ Ha			
Harvesting	Man-days/ Ha			
Storage	Per day			
Transport	Ton			

3rd CROP ENTERPRISE: _____

Item	Unit	Quantity	Unit Cost (P)	Total (P)
A. REVENUE				
Output	Kg			
B. COSTS				
Seeds	Kg/Ha			
Land preparation				
Ploughing				
Harrowing				
Planting	Man-days/ Ha			
Weeding	Man-days/ Hs			
Fertilizer	Kg/Ha			
Fertilizer application	Man-days/ Ha			
Harvesting	Man-days/ Ha			
Storage	Per day			
Transport	Ton			

Question 5 on crop farming

A5.1	What is the cropping system used for each crop enterprises? 1 st [] 2 nd [] 3 rd []	1= Traditional/ mixed 2=intercropping 3=Monocropping 4=Mulching 5=Crop rotation 6= others specify
A5.2	What is your source of water? 1 st [] 2 nd [] 3 rd []	1=borehole 2=well 3=river 4=irrigation 5=others specify
A5.3	What is the distance (<i>km</i>) to water source?	1 st [] 2 nd [] 3 rd []
A5.3.1	If you are using irrigation, which irrigation system? 1 st [] 2 nd [] 3 rd []	1= sprinkler 2= drip 3= Basin 4=others specify
A5.4	What are the two main markets for selling produce? 1 st [] 2 nd [] 3 rd []	1=Individuals 2= Contracts 3= Supermarkets 4=Schools 5= Agents 6=Other specify_____
A5.5	What is the distance to the market in <i>km</i> ?	1 st [] 2 nd [] 3 rd []
A5.5.1	What are the transport costs incurred in each sale?	1 st [] 2 nd [] 3 rd []
A5.5.2	Do you have an employee in charge of your enterprise?	1 st [] 1 Yes [] 2 No 2 nd [] 1 Yes [] 2 No 3 rd [] 1 Yes [] 2 No
A5.6	Total number of labourers in the farm	1 st [] 2 nd [] 3 rd []
A5.6.1	How much each labourer is paid each month?	1 st [] 2 nd [] 3 rd []
A5.6.2	State the number of labourers in each category	Family [] Permanent workers [] Casual workers []

A6 Livestock production in the last 12 months

Livestock assets	N0.Owned	N0. Born male	N0. Birth female	N0. Old male	N0. Old female	N0. Died from sickness	N0. Killed by predators	N0. Stolen	N0. Sold	Price each
Goat										
Sheep										
Chicken										
Cattle										
Pigs										
Donkey										

1st Livestock enterprise _____

Item	Unit	Quantity	Unit Cost (P)	Total (P)
A. REVENUE				
Sale				
B. COSTS				
Livestock purchase				
Vaccines				
Feeds				
Feed storage	ton/Per day			
Ear tags				
Water charges	Per month			
Licence fees				
Marketing				
Electricity and maintenance				
Trace elements				
Casual labour	Per month			
Transport	Ton			

2nd Livestock enterprise _____

Item	Unit	Quantity	Unit Cost (P)	Total (P)
A. REVENUE				
Sale				
B. COSTS				
Livestock purchase				
Vaccines				
Feeds				
Feed storage	ton/Per day			
Ear tags				
Water charges	Per month			
Licence fees				
Marketing				
Electricity and maintenance				
Trace elements				
Casual labour	Per month			
Transport	Ton			

A7 Farm Assets

Does your farm have these assets?

Farm assets	No. owned now	Who owns (codes)	Household assets	No. owned now	Who owns (codes)
Shovel			Radio		
Rake			Television		
Scorch cart			Mobile phone		
Axe			Landline phone		
Hoe			Vehicle(car)		
Plough			Truck		
Wheel burrow			Bicycle		
Tractor			Motorbike		
Spray pump			Refrigerator		
Draft animal (ox)			Solar panels		
Irrigation pump			No. of Houses		
Other (specify)			Others specify		

8 What are the main challenges of cropping or keeping livestock in this area?

9 Are you involved in any community group? _____ Yes/ No *if yes answer 11 & 12 if no proceed to 13*

10 What is the name of the group you are involved in? _____

11 How does the group help you or your household?

12 Why don't you participate in TBA?

B) QUESTIONS FOR HOUSEHOLDS IN TOURISM BASED ACTIVITIES

1st TBA enterprise _____

Item	Unit	Quantity	Unit Cost (P)	Total (P)
A. REVENUE				
Sale				
B. COSTS				
Materials				
Training				
Licence				
Storage	ton/Per day			
Electricity and maintenance				
Water charges	Per month			
Marketing				
Casual labour	Per month			
Transport				

2nd TBA enterprise _____

Item	Unit	Quantity	Unit Cost (P)	Total (P)
A. REVENUE				
Sale				
B. COSTS				
Materials				
Training				
Licence				
Storage	ton/Per day			
Electricity and maintenance				
Water charges	Per month			
Marketing				
Casual labour	Per month			
Transport				

3rd TBA enterprise _____

Item	Unit	Quantity	Unit Cost (P)	Total (P)
A. REVENUE				
Sale				
B. COSTS				
Materials				
Training				
Licence				
Storage	ton/Per day			
Electricity and maintenance				
Water charges	Per month			
Marketing				
Casual labour	Per month			
Transport				

B1.1	What TBA are you involved in? 1 st [] 2 nd [] 3 rd []	1= Basket waving 2= accommodation 3=Restaurant 4= Traditional performance 5= transport 6= others specify
B1.1.1	When did you start this activity?	1 st [] 2 nd [] 3 rd []
B1.2	Have you ever been to any training?	1 st [] 1 Yes [] 2 No 2 nd [] 1 Yes [] 2 No 3 rd [] 1 Yes [] 2 No
B1.2.1	Which year was the last training done?	1 st [] 2 nd [] 3 rd []
B1.2.2	Did you pay for the training?	1 st [] 1 Yes [] 2 No 2 nd [] 1 Yes [] 2 No 3 rd [] 1 Yes [] 2 No
B1.3	Where did you get funds to start your business?	1= Youth grant 2= Own funds 3= NDB 4=others specify _____
B1.3.1	How much was the start-up capital?	1 st [] 2 nd [] 3 rd []
B1.5	Where do you get materials to make your products?	1 st [] 2 nd [] 3 rd []
B1.7	How many products did you make in the last 12 months?	1 st [] 2 nd [] 3 rd []
B1.8	Do you have a market for your products?	1 st [] 1 Yes [] 2 No 2 nd [] 1 Yes [] 2 No 3 rd [] 1 Yes [] 2 No
B1.9	Have you sold your products in the last 12 months?	1 st [] 1 Yes [] 2 No 2 nd [] 1 Yes [] 2 No 3 rd [] 1 Yes [] 2 No

1. Are you involved in any group in the community for economic activities _____

? Yes/ No *if yes answer Q 2*

2. How does membership in the group help you?

3. Have you been involved in farming before the last 12 months? _____ Yes/ No *if yes please answer Q4*

4. If Yes what are your reasons from shifting from farming to TBA?

5. Are there any challenges of being involved in TBA? _____ Yes/ No *if yes please answer Q6*

6. What are the main challenges you have faced in the past 12 months?

TBA assets

TBA assets	No. owned now	Who owns (codes)	Household assets	No. owned now	Who owns (codes)
Needle			Radio		
Pixel			Television		
Alloyfurnace			Mobile phone		
Axe			Landline phone		
Iron crafting table			Vehicle(car)		
Scripts			Truck		
Wheel burrow			Bicycle		
Others specify			Motorbike		
			Refrigerator		
			Solar panels		
			No. of Houses		
			Others specify		

The following questions should be answered by all respondents

7. What is the distance to the nearest infrastructure facilities and how long it takes you?

a. Infrastructure facilities	b. Distance in km	c. Time used
a. Main road		
b. Health centre		
c. School		
d. Park gates		
e. Extension offices		
f. Others specify _____		

8. What is your role in the management of Chobe National Park?
-

9. Credit, Insurance and Extension services

- a. Do you have access to credit? (Farming or TBA) _____ Yes/ No
- b. Where do you source credit from? _____
- c. Have you got any loan in the last 12 months? _____ Yes/ No
- d. How much in pula did you get in the last 12 months? _____
- e. What is the interest rate for the loan? _____
- f. Do you have insurance for the enterprise you are involved in? _____ Yes/ NO
- g. If Yes, how much in pula did you spend on insurance in the last 12 months?
[]
- h. Have you been compensated for crop, livestock or TBA due to animal destruction in the last 12 months? _____ Yes/ No
- i. How much was the compensation? []
- j. Did it cover for all the damages or to what percentage did it help? []

Access to extension services

- k. Distance to nearest extension service provider? _____
- l. What mode of transport do you use to go to the extension offices? _____
- m. How much in pula does it cost you to reach the offices? []
- n. How many times have you gone there in the last 12 months? []

o. Have you been visited by an extension worker in the last 12 months?_____

Yes/ No

p. If Yes, how many times? _____

q. What topic did the extension worker dwell on in the last visit?

10. Perceptions on livelihood and their characteristics

Statements	Strongly disagree	Moderately disagree	Disagree	Neutral	Agree	Moderately agree	Strongly agree
The current management policy of no poaching quotas is good for your enterprise.							
There can be co-existence of tourism and agriculture will in this area?							
Livelihood would improve if Government involved farmers and private sector in decision making of park management							
Human-wildlife conflict has affected people's access to natural resources in this area							
There are economic benefits of being involved in TBA in this area?							
There are economic benefits of being in crop production?							
There are economic benefits of being in livestock keeping?							

Appendix II: Multicollinearity tests

a) Pearson correlation matrix

	HHSZ	GND	AG	MAR	EDU	INC	ASSTCAT	MRKT	LNDOWN	FMSZ	CMP	EXTNs
HHSZ Pearson crr	1	.112	-0.169*	0.052	0.092	0.074	0.101	0.146*	0.033	-0.056	-0.049	-0.099
Sig		0.119	0.018	0.469	0.202	0.306	0.159	0.042	0.643	0.435	0.494	0.169
GND Pearson crr	0.112	1	0.075	0.113	- 0.153 *	- 0.182*	-0.163*	0.012	0.011	-0.012	0.027	.062
Sig	0.119		0.296	0.115	0.032	0.011	0.022	0.867	0.879	0.863	0.708	0.390
AG Pearson crr	-0.169*	0.075	1	0.216 **	- 0.589 **	-0.084	-0.072	-0.013	0.147*	0.034	-0.120	-0.133
Sig	0.018	0.296		0.002	0.000	0.243	0.319	0.858	0.040	0.637	0.095	0.064
EDU Pearson crr	0.092	- 0.153 *	- 0.589* *	- 0.197 **	1	0.258* *	0.180* *	0.107	-0.139	- 0.147* *	0.057	0.053
Sig	0.202	0.032	0.000	0.006		0.000	0.012	0.137	0.052	0.041	0.432	0.465
INC Pearson crr	0.074	- 0.182 *	-0.084	0.037	0.258 **	1	0.240**	0.147*	-0.075	-0.014	0.003	0.096
Sig	0.306	0.011	0.243	0.610	0.000		0.001	0.040	0.300	0.848	0.968	0.181
ASSTCAT Pearson crr	0.101	- 0.163 *	-0.072	0.071	0.180 *	0.240* *	1	0.314* *	-0.064	-0.069	0.080	0.036
Sig	0.159	0.022	0.319	0.321	0.012	0.001		0.000	0.377	0.339	0.265	0.615
DISMRKT Pearson crr	0.146*	0.012	-0.013	0.058	0.107	0.147*	0.314**	1	-0.010	-0.092	0.051	-0.023
Sig	0.042	0.867	0.858	0.421	0.137	0.040	0.000		0.886	0.199	0.476	0.753

LNDOW Pearson crr	0.033	0.011	0.147*	0.129	- 0.139	-0.075	-0.064	0-.010	1	0.104	-0.054	-0.027
Sig	0.643	0.879	0.040	0.072	0.052	0.300	0.377	0.886		0.147	0.454	0.712
FMSZ Pearson crr	-0.056	- 0.012	0.034	0.046	- 0.147 *	-0.014	-0.069	-0.092	0.104	1	-0.098	0.067
Sig	0.435	0.863	0.637	0.524	0.041	0.848	0.339	0.199	0.147		0.171	0.351
CMP Pearson crr	-0.049	0.027	-0.120	0.132	0.057	0.003	0.080	0.051	-0.054	-0.098	1	0.014
Sig	0.494	0.708	0.095	0.066	0.432	0.968	0.265	0.476	0.454	0.171		0.843
EXTNs Pearson crr	-0.099	0.062	-0.133	- 0.048	0.053	0.096	0.036	-0.023	-0.027	0.067	0.014	1
Sig	0.169	0.390	0.064	0.509	0.465	0.181	0.615	0.753	0.712	0.351	0.843	

b) Variance of inflation factor (VIF)

Variable	VIF	1/VIF
HHSZ	1.14	0.873560
GND	1.07	0.934781
AG	1.60	0.626368
EDU	1.57	0.637032
INC	1.09	0.918022
ASSTCAT	1.07	0.935970
DISMRKT	1.08	0.929851
LNDOWN	1.07	0.936084
FMSZ	1.05	0.953909
CMP	1.07	0.934811
EXTNs	1.06	0.947325
Total	12.87	
Mean VIF	1.17	

Appendix III: Heteroskedasticity test

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: HHSZ GND AG AGSQ EDU INC ASSTCAT DISMRKT LNDOWN FMSZ

CMP EXTNs

$\chi^2(12) = 23.39$

Prob > $\chi^2 = 0.372$

Appendix IV: Goodness of Fit

Log likelihood	-199.96
----------------	---------

Number of obs	195
LR chi ² (36)	101.49
Prob>chi ²	0.0000
Pseudo R ²	0.2017

Appendix V: Independence of Irrelevant Alternatives

Testing for IIA: Full model (B)*Omitted (b) (Crop farming as focus)

Variable	(b) Omitted	(B) no omitted	b-B) difference
HHSZ	-0.235	-0.231	-0.004
GND	0.68	0.65	0.03
AG	-0.0049	-0.0025	0.0024
EDU	-0.24	-0.23	-0.01
INC	4.77e-06	1.91e-06	2.87e-06
ASSTCAT	-0.26	-0.25	-0.01
DISMRKT	-0.054	-0.046	-0.008
LNDOWN	-0.077	0.049	-0.13
FMSZ	-0.98	-0.81	-0.17
CMP	0.65	0.62	0.030
EXTNs	0.043	0.068	-0.025
Constant	1.99	1.49	0.50

Test: H0: difference in coefficient not systematic

$$\chi^2 (24) = (b-B)' [(V_b - V_B)^{-1}] (b-B)$$

$$= 0.21$$

$$\text{Prob} > \chi^2 = 1.0000$$

Testing for IIA: Full model (B)*Omitted (b) (Crop and livestock farming as focus)

Variable	(b) Omitted	(B) no omitted	(b-B) difference
HHSZ	0.038	-0.019	0.057
GND	1.13	1.0	0.13
AG	-0.12	-0.26	0.14
EDU	0.32	0.13	0.19
INC	1.79e-06	1.35e-06	4.42e-07
ASSTCAT	0.46	0.33	0.13
DISMRKT	0.015	0.018	-0.003
LNDOWN	-0.31	-0.59	0.28
FMSZ	-0.90	-1.15	0.25
CMP	0.21	0.12	0.09
EXTNs	-1.46	-1.37	-0.09
Constant	0.090	2.25	-2.16

$$\chi^2(24) = (b-B)' [(V_b - V_B)^{-1}] (b-B)$$

$$= 1.95$$

$$\text{Prob} > \chi^2 = 0.9995$$

Testing for IIA: Full model (B)*Omitted (b) (TBA, crop and livestock farming as focus)

Variable	(b) Omitted	(B) no omitted	(b-B) difference
HHSZ	-0.019	0.038	-0.057
GND	0.99	1.10	-0.11
AG	-0.26	-0.15	-0.11
EDU	0.13	0.26	-0.13
INC	1.35e-06	1.79e-06	-4.41e-07
ASSTCAT	0.33	0.42	-0.090
DISMRKT	0.017	0.015	0.002
LNDOWN	-0.59	-0.36	-0.23
FMSZ	-1.15	-0.91	-0.24
CMP	0.12	0.24	-0.12
EXTNs	-1.37	-1.44	0.07
Constant	2.24	0.36	1.88

$$\text{Chi}^2 (24) = (b-B)' [(V_b - V_B)^{-1}] (b-B)$$

$$= 20.09$$

$$\text{Prob} > \text{chi}^2 = 0.6918$$