VAN HALL LARENSTEIN

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Adoption of Improved Livestock Production Technologies and its Implications for Food Accessibility among Small Ruminant Farmers in Rural Wa Municipality of Ghana

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By

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DEDICATION

This work is dedicated to my late mummy, Rebecca Gamou Tuuli for believing in me that I could study to this level and beyond.

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TABLE OF CONTENT

Contents

PERMISSION TO USE i

DEDICATION ii

ACKNOWLEDGEMENTS iii

TABLE OF CONTENT iv

List of Tables vii

List of Figures viii

List of Abbreviations ix

Abstract x

CHAPTER ONE: INTRODUCTION 1

1.1 Background 1

1.2 Problem Statement 2

1.3 Research Objectives 2

1.4 Main Research Questions and Sub-Questions 2

1.4.1 Research Question 1 2

1.4.2 Research Question 2 3

4.1.3 Research Question 3 3

1.5 Significance of the Study 3

1.6 Report Structure 3

CHAPTER TWO: LITERATURE REVIEW 4

2.1 Concept of Adoption 4

Figure 2.1 Technology- Diffusion Process 4

2.2 Factors Influencing Adoption of Technology 4

2.4 Food Security Situation in Ghana 5

2.5 The Study Area 6

2.6 Interventions in the Study Area 6
2.7 The Livestock Development Project 7
2.8 Conceptual Framework 7
2.7.1 Small Ruminants Farmer 7
2.7.2 Technology Adoption 7
2.7.3 Food Accessibility 8
CHAPTER THREE: METHODOLOGY 9
3.1 Introduction 9
3.2 Sources of Data 9
3.3 Population and Sampling Techniques 9
3.4 Methods of Data Collection 9
3.5 Methods of Data Entry and Analysis 9
CHAPTER FOUR: RESULTS 11
4.1 Introduction 11
4.2 Socio-Economic Characteristics of Small Ruminant Farmers 11
4.2.1 Occupational Distribution of Respondents 12
4.2.2 Belongingness to Group 12
4.3 Crop Production Activities of Farmers 13
4.3.1 Farm Size and Number of Crop Enterprises 13
4.4 Types of Animals kept by Farmers 13
4.5 Awareness of Farmers of Selected Small Ruminant Production Technologies 14
4.6 Adoption of Improved Animal Production Technologies 15
4.7 Reasons for Non-Adoption of Technologies 16
4.8 Factors Determining the Adoption Rate of Small Ruminant Production Technologies 16
4.9 Benefits Associated with Small Ruminant Rearing 17
4.10 Small Ruminant Rearing and Household Food Accessibility 18

CHAPTER FIVE: DISCUSSION 19

5.1 Introduction 19

5.2 Socio-Economic Characteristics of Small Ruminant Farmers and Factors Determining the Adoption Rate of Small Ruminant Production Technologies 19

5.3 Awareness of Farmers of Selected Small Ruminant Production Technologies 20

5.4 Adoption of Improved Animal Production Technologies 21

5.5 Small Ruminant Rearing and Household Food Accessibility 22

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS 23

6.1 Introduction 23

6.2 Conclusion 23

6.4 Recommendation 24

References 26

Appendix 28

Appendix1 Survey for Questionnaire for Small Ruminant Farmers 28

Appendix 2 List of communities under WA Municipal 32

Appendix 3. Stakeholder Analysis. 33

List of Tables

Table 4.1 Socio-economic characstaristics of small ruminant farmers 11
Table 4.2 Occupation of respondents 12
Table 4.3 Belongingness to group 13
Table 4.4 Farmsize and number of crop interprise 13
Table 4.5 Livestock kept by farmers 13
Table 4.6 Awareness of farmers on selected SRPT 14
Table 4.7 Adoption of improved animal production technologies 15
Table 4.8 Reasons for non-adoption of technologies 16
Table 4.9 Multiple Linear Regression results of factors affecting adoption 16

List of Figures

Figure 2.1Technology- Diffusion Process 4
Figure 2.2 Map of the Upper West Region of Ghana 6
Figure 4.1 Sources of information of technologies 15
Figure 4.2 Benefits associated with small ruminant rearing..... 18
Figure 4.3 Small ruminant rearing and food access 18

List of Abbreviations

ADB	-	Agricultural Development Bank
AfDP	-	African Development Bank
CBO	-	Community Based Organization
CDP	-	Cashew Development Project
DDT	-	Dichloro Diphenyl Trichloroethane (DDT)
DFID	-	Danish Fund for International Development
FAO	-	Food and Agriculture Organization of the United Nations
FASDEP	-	Food and Agriculture Sector Development Policy
GDP	-	Gross Domestic Product
GoG	-	Government of Ghana
LDP	-	Livestock Development Project
MADU	-	Municipal Agriculture Development Unit
MoFA	-	Ministry of Food and Agriculture
MTDP	-	Medium Term Development Plan
NGO	-	Non Governmental Organization
SPSS	-	statistical Package for Social Scientist
SRP	-	Small Ruminant Production
SRPT	-	Small Ruminant Production Technology

Abstract

The study was conducted to assess the adoption of improved livestock production technologies and its implications for food accessibility among small ruminant farmers in rural Wa Municipality of Ghana. Multi-stage sampling technique was employed in the study. In all, fifty farmers were sampled for the study from five communities to help in assessing eight improved livestock production technologies. A semi-structured questionnaire was used to obtain the data for the study. The data was analyzed using descriptive statistics and a multiple linear regression. The results show that men by far dominate small ruminant rearing activities in the study area. The average age of the farmers was found to be 46 years. The illiteracy level is relatively high among the farmers as 56% of them had formal education while 44% had no formal education. Most of the farmers practise mixed farming system as they engage in both crop farming and livestock rearing. In addition to chicken, goats and sheep rearing is the most dominant and widespread livestock activity among the farmers. The level of awareness of the improved production technologies among the farmers was high, as indicated by 95% of respondents. Correspondingly, the adoption rate of the technologies was 76% among the farmers. Contrary to previous studies in developing countries, the adoption rate of the technologies is very high. This could be attributed to the livestock management training delivered to the farmers under the Livestock Development Project and the multiplier effect of the LDP project on other non-participant farmers in the study area. It was noted that although the adoption rate was high, most farmers improvised when it came to the use of the technologies. Age, number of groups a farmer belongs to and number of animal enterprises were found to be significantly associated with the rate of adoption of improved small ruminant production technologies in the study area. Rearing small ruminants is very important once accessibility to food for the rural households is concerned in the study area. Ninety six percent (96%) of the farmers indicated that rearing small ruminants have enabled their households to access food especially during the lean season when severe food shortages are experienced. Rearing small ruminants helps the household to access food through sale of animals to buy foodstuff, purchase farm inputs to increase crop yield, manure for crop farming and slaughter of animals for consumption. Even though farmers do not ordinarily slaughter small ruminants for home consumption, they however serve as important source of protein during religious/cultural festivities, naming ceremonies and funeral performances. The study concludes that small ruminant rearing enables the rural households to access food through the income that is generated. Therefore to develop and disseminate improved technologies will increase the animal yield and hence increase farmers' capacity to access food for their households. This will go a long way in improving the food security situation of the municipality and the country as a whole.

CHAPTER ONE: INTRODUCTION

1.1 Background

Livestock production is an important feature of Ghana's agriculture, contributing largely towards meeting food needs, providing draft power and generating cash income. The livestock sub-sector is one of the main contributor to Ghana's GDP. Crops and livestock sub-sector contributes as much as 28% to GDP MoFA/DFID (2002).

The erratic rainfall pattern, coupled with the rudimentary technologies used in livestock production among small ruminant (sheep and goat) farmers contributes to the fluctuation in the stock numbers from season to season leading to food insecurity. Crop failure is rampant among farmers in Ghana due to the erratic rainfall pattern and loss of soil nutrients. According to LDP Appraisal Report (2001), during periods of insufficient crop production, livestock mainly small ruminants and poultry, become the main source of food and income for the household. The report also suggests that small ruminants act as bank and insurance in times of urgent financial needs, since it generates immediate cash income to the farmer.

The Government of Ghana (GoG) (2010) indicates that most small ruminant farmers practise mixed farming systems in all the regions of Ghana, with a prevalence rate of about 98%. MoFA (1997) in their annual report indicated that livestock production constitutes a major component of the farming systems in Ghana among the rural dwellers.

The government of Ghana with funding from the African Development Bank (AfDB) in February 2002 established the Livestock Development Project (LDP) to contribute to poverty reduction, enhanced food security and reduced imports of livestock and dairy products in an environmentally sustainable manner. The project was implemented in 25 selected districts within the country including Wa Municipality. The Wa Municipal Agricultural Development Unit (MADU) is located in the regional capital of the Upper West Region of Ghana. The project has been running in about 41 communities within the Wa Municipality which has been sub-divided into 3 operational zones for the past 8 years (see Appendix 2 for details of communities). The Unit has the mandate to implement policies of the Ministry of Food and Agriculture within the Wa Municipal area in order to achieve the overall goal of ensuring food security, availability of raw materials for agro-industry and employment for poverty reduction while ensuring that issues relating to gender and the environment are adequately addressed as stated in the mission statement of MoFA. MADU has the responsibility of implementing Government's policies and projects on issues relating agriculture within the Municipality.

In order to achieve the overall goal of the project, activities were drawn up to train livestock farmers on improved animal husbandry practices. Training took the form of practical demonstration as well as oral presentation on topics such as feeding of small ruminants, housing and health. The training sessions are usually conducted either at the community level where interested livestock farmers are brought together and taught new technologies or selected small ruminant farmers are periodically invited to the municipal office for training. The intention of the latter approach is to train the selected farmers to also train their colleague farmers when they get back to the communities. The technical change approach to technology transfer where innovations are disseminated by the diffusion method is used as depicted by Rogers (1995). The adoption of these improved production technologies will be reflective in faster growth of animals, increase in weight gain and expansion in flock numbers. This will enhance the capacity of small ruminant farmers to access food through the sale of animals to buy foodstuffs during periods of total crop failure or during the lean season.

Small ruminant production in the Wa Municipality is an important contributor to household income. It serves as a form of security against crop failure since these animals are sold for money to provide for the basic needs of the household, they also serve as sources of protein during festive times or when the household need meat for consumption. However, the traditional system of rearing these animals has

made their contribution to household income less significant thereby reducing their effective contribution to household needs. This situation coupled with the long period of the dry season when most of the grasses get destroyed through bush burning and the system of rearing practised where small ruminant farmers do not see the need of providing extra feed for their animals, causes these animals to scavenge for their own food which leaves them malnourished and less able to reproduce.

1.2 Problem Statement

In spite of the benefits associated with the adoption of these improved production technologies, monthly and quarterly monitoring reports of the project by staff suggest that some small ruminant farmers are not practising the technologies they have been trained on in order to improve their production. It is therefore important for an empirical study to be conducted in order to determine the adoption rate of the improved production technologies among the farmers in the study area and to determine factors influencing the adoption of the technologies. This will not only provide an indicator of the project success or otherwise, but it will also inform MoFA and government in formulating and implementing policies, and designing strategies towards technology adoption as a strategy for improved agricultural production. This study is therefore designed to fill this knowledge gap.

1.3 Research Objectives

The study is designed to achieve the following objectives

- To determine the adoption rate of improved small ruminant production technologies among farmers in rural Wa Municipal
- To identify the factors that influence adoption of improved small ruminants production technologies among farmers in rural Wa Municipal
- To determine the contribution of small ruminants activities to food accessibility among farmers in rural Wa Municipal.

1.4 Main Research Questions and Sub-Questions

Three main research questions have been formulated to address the objectives of the research. Subsequently sub research questions have been designed under each main question which will answer issues raised in the main questions.

1.4.1 Research Question 1

What is the rate of adoption of improved small ruminant production technologies among farmers in rural Wa Municipal?

Sub-questions

1.1 What is the level of awareness of farmers on the improved small ruminant production technologies?

1.2 What are the sources of information/training on the improved small ruminant production technologies?

1.3 What is the perception of farmers regarding the improved animal production technologies taught at the LDP training sessions?

1.4 What is the rate of adoption for each of the improved small ruminant production technologies?

1.4.2 Research Question 2

What factors affect the adoption of improved small ruminants' production technologies among farmers in rural Wa Municipal?

Sub-questions

2.1 What personal and household characteristics of farmers affect the adoption of small ruminants' production technologies?

2.2 What socio-economic characteristics of farmers affect the adoption of small ruminants' production technologies?

4.1.3 Research Question 3

What are the stock numbers of small ruminants kept by farmers and how does keeping small ruminants enable households to access food in rural Wa Municipal?

Sub-questions

3.1 What are the average stock numbers of small ruminants (goats and sheep) among farmers?

3.2 What are the benefits associated with small ruminant rearing for the households?

1.5 Significance of the Study

The results of this research will help the Ministry of Food and Agriculture and other NGOs operating within Wa Municipality in formulating intervention policies that will take into consideration factors that are likely to affect the impact of developmental interventions especially regarding small ruminant production. The findings will also help the ministry design appropriate training packages for the small ruminant farmers in order to improve their production.

1.6 Report Structure

The report is organized into six chapters. Chapter one contains an introduction which serves as a background information to the study, it also contains the research objectives, main and sub research questions, an outline of the significance of the study is also presented. The chapter serves as a guide to the research. Chapter two contains literature review and discusses the conceptual framework to the study; the chapter also looks at the food security situation in Ghana, explores the study area and looks at the concept of adoption and the factors affecting adoption of technology. Chapter three discusses methods for the collection of empirical data during the field research and the sources of data. This chapter includes information on population sampling technique, as well as method of data collection, entry and analysis. Chapter four presents the results of empirical findings of the field research. The results of this research are discussed in Chapter five. The final chapter of this report contains the conclusions and recommendations of the research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Concept of Adoption

Feder et al. (1985) defined adoption as the degree of use of a new technology in a long run equilibrium when a farmer has full information about the new technology and its potential. Previous studies on adoption has shown that the adoption of new innovations or technology does not just happen and that it takes time and sequence of steps before the final results can be realised (Rogers, 2003). The studies further suggest that the series of sequence people may go through to adopt new technologies involves five stages. In the awareness stage people know the existence of the new technology. This stage is very critical in adoption since it involves educating the person about the technology, decision the person will take as to whether he or she will adopt the technology will depend on the understanding the individual will get from such training and this leads to the interest stage where they collect additional information about the technology. At this stage the individual moves to the evaluation stage where they reflect on the advantages and disadvantages of the technology. They may then test the innovation usually on a small scale in the trial stage. The final stage will then come about at the adoption or acceptance stage where the individual start applying or using the technologies. These steps are seen very important by the writer in sending or passing on a technology since it allows time for the beneficiary to move through all these stages to finally adopt the technology (Fig. 2.1).

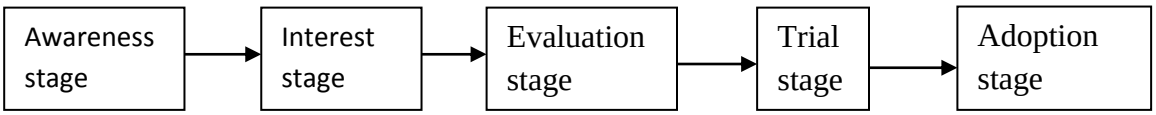

Figure 2.1 Technology- Diffusion Process

Rogers again in 1995 identified five attributes of an innovation that influenced its adoption. The relative advantage, compatibility, complexity, trialability and observability. A person goes through all this stages in one way or another before a technology is adopted. The duration might however vary from person to person as some are early adopters of technology while some are middle and there are yet another group that are called late adopters. It should be noted that these are perception the individual adopter holds and which might cause them to take a step toward adoption or not. For instance a person who assumes the relative advantage of an innovation might consider how it is better or worse off than existing ones. Compatibility comes in when a person perceive that the new technology is similar or have some traits with existing ones. Complexity has a negative effect on adoption of technology and might cause an adopter not to adopt since a person perceive the difficulty involved in understanding the innovation. Trialability talks about how accessible a technology is to an individual; it has a positive effect on adoption since persons are likely to adopt technologies they have tried themselves. The final attribute of an innovation is observation which is about how readily available and visible an individual is to a technology. Rogers argue that this could be a social threshold, the point an innovation becomes so persuasive in a society that even those who will not usually adopt new technologies consider doing that.

2.2 Factors Influencing Adoption of Technology

There are several factors that determine whether a farmer will or will not adopt a certain technology. Studies have shown that farmers' decision to adopt or not to depend on their needs, cost incurred and benefit accruing from the adoption of the technology (Karki, 2004). The decision of a farmer to adopt a technology will also depend on the characteristics of an innovation (Kinnucan et al., 1990). These characteristics do not take into account whether the proposed technology is better than the one it intends to replace. What matters is whether farmers see the new technology to have an advantage over the one it is replacing and to what extent they stand to benefit from the new technology. Farmers consider a range of characteristics such as household (education, age, and family size), farm characteristics, technology characteristics, wealth (economic status), contact with extension agents, farmers knowledge of specific technologies, price, access to credit and the position of a farmer in farmers organization to

determine the adoption of new technologies (Legesse, 1992; Teressa, 1997; Walday, 1999). Oladele (2005) also mentioned a range of economic, social, physical, and technical aspects of farming that influences the adoption of agricultural production technologies.

The adoption of the technologies promoted could also be determined by the profitability from the agro pastoralists' point of view (Giger *et al.,* 1999). This goes to suggest that farmers will abandon or discontinue the use of a technology if they feel that it is not beneficial either in the short or long run. The irony lies in the fact that the economic impact of the adoption of a technology cannot be known in advance with certainty (Karki, 2004).

Just and Zilberman (1983) argued on the existence of a relationship between economic size and technology adoption and the quadratic effect was possible to occur, because large businesses were prone to adopt new technology earlier than smaller ones. The bigger an establishment the more likely it is for the owner to practice new innovation to improve on their production. Bigger companies usually consider the overall benefit they stand to gain, and once the benefit outstrips the loss, most of them will give such new technologies a try. A farmer who keeps livestock in large quantities, with different species will for instance not see a problem with buying salt lick since a wide range of his animals stand to benefit from the adopted technology.

2.4 Food Security Situation in Ghana

Food security in Ghana is defined as good quality nutritious food, hygienically packaged, attractively presented, available in sufficient quantities all year round and located at the right place at affordable prices (FASDEP, 2003).This is similar to what the Food and Agricultural Organization define as access by all people at all times to enough food for an active, healthy life. This definition covers the four dimensions of food security, that is, availability, accessibility, utilization and sustainability. A person is said to be food secure if they can ensure that all four dimensions are met. Many development workers define food security as the availability of food in the world market and on the food production system of developing countries (FANTA, 2003). It should be noted that global food availability does not necessarily mean that countries especially from the developing world can access it. This goes to emphasize the four dimensions of food security.

About 1.2 million people, representing 5 percent of Ghana's population, are food insecure. Thirty four percent (34%) of the population are in Upper West region, followed by Upper East with 15% and Northern region with 10%, amounting to approximately 453,000 people (WFP, 2009). In Ghana, food security is perceived to be affected by external factors such as deterioration of the environment, social and other factors that threaten increase in crop production within the country (Nyanteng and Asuming-Brempong, 2003). The factors they stated include rainfall and drought, soil degradation, disease and pest outbreak, bushfires, poor market linkages, irregular climatic conditions, increase in non-food prices, rural urban migration, internal ethnic conflicts and government policies.

However Ghana has remained a food deficit country for the past fifteen years. Its overall performance in terms of agricultural production and productivity remains inadequate and has failed to make progress on the food security front. Average yields have remained stagnant. Commercial food imports and food aid constitute about 4.7% of food needs in the last fifteen years. The slow growth of agriculture is due to a combination of factors that reduce farmers' incentives to invest and produce. These include inappropriate policies, lack of technological change and poor basic infrastructure at the rural level.

On the physical supply side of food, sometimes inadequate and at times impassable road links between the urban and the rural areas creates situation of rural glut and urban scarcities in food in the last two decades.

Growing urbanization (43.8% in 2000) has created slums in the cities where unemployment and low incomes appear to be the main constraint to increased calorie consumption.

Agriculture is predominantly on a smallholder basis on family–operated farms using rudimentary technology to produce about 80% of the total agricultural production. It is estimated that about 2.74 million households operate a farm or keep livestock in Ghana.

2.5 The Study Area

Wa municipality is the regional capital of the upper west region, the youngest of the ten (10) regions of Ghana located in north-western corner of the country (see Fig. 2.2). The district is situated in the Guinea savanna zone and hence characterized by sparse tree cover and dominated mostly by grasses. The area experiences unimodal rainfall. Although mean annual rainfall is adequate to support sustained plant growth, very irregular distribution within a rainy season and greater differences from year to year lead to high risk in agricultural production (Donhouser et al., 1994). Generally, agriculture is the primary occupation of farmers while their secondary occupation is trading and processing.

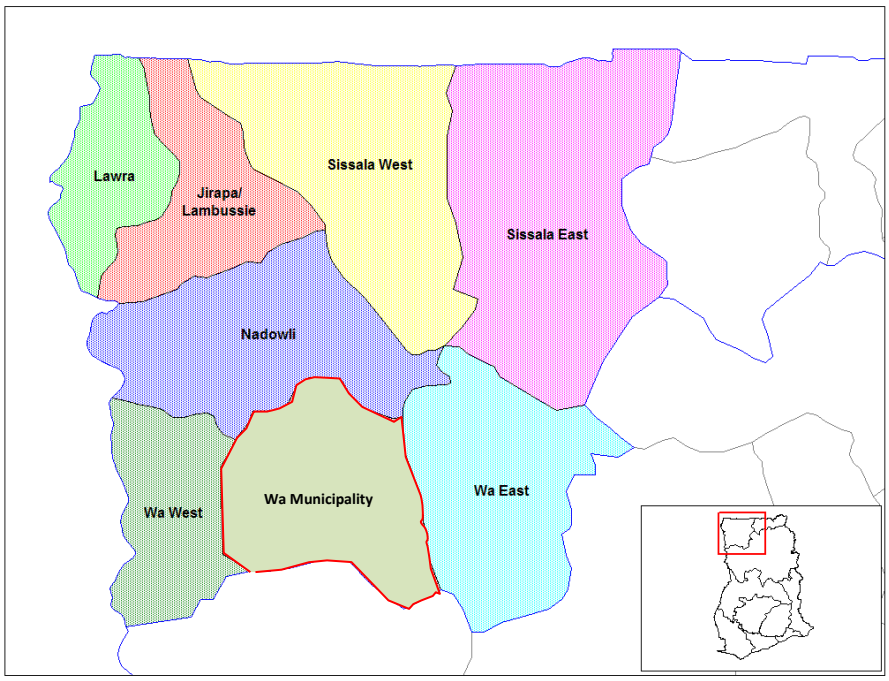

Figure 1.2 Map of the Upper West Region of Ghana

The Municipality has landmass area of approximately 23,474 square kilometres, which takes about 6.4% of the total land area of the region and covers 234.74 square kilometres in terms of settlement and land development (Wa Municipal M.T.D.P, 2009). In 2006, the Wa Municipal population was estimated as 119.386 (male: 57,985/ female: 61,402).

2.6 Interventions in the Study Area

The Upper West Region is the last Region to be created in the country from the nine other regions. The Region, with Wa as the capital, was formerly part of the then Upper Region which was itself carved out of the Northern Region in July 1960. In pursuance of the decentralization policy, the Government, in 1983, divided the Upper Region into Upper East and Upper West. Since the region was the last to be created in the country, it has and still suffers institutional and infrastructural setbacks in terms of its developmental agenda. As part of bringing development to the Region, various governments have brought intervention strategies to improve the living conditions of the people. Since the growth in the agricultural sector stimulates higher rate of growth in the economy through forward linkage (FAO, 1983), the GoG through

several bilateral and multilateral organizations have brought several projects and programs to the region to improve livelihoods.

The Ministry of Food and Agriculture implements many projects and programmes through its development partners and donor agencies especially in the area of food security. The African Development bank (AfDB) is the main stakeholder of the ministry, especially in the area of food security. It has helped in establishing projects such as Livestock Development Project (LDP), Food Crops Development Project (FCDP), Cashew Development Project (CDP) and the Special Programme for Food Security (SPFS). These projects are aimed at reducing poverty, development of animal production, capacity building for farmers, attainment of higher incomes by farmers and to ensure food security for all. Appendix 3 shows the stakeholders of MADU.

2.7 The Livestock Development Project

The project was funded by the ADB. In response to the Government to achieve the objective of the project, livestock breeding stations were to be strengthened, to ensure that a sustainable improved livestock breeding scheme will be put in place. The project was also to strengthen disease surveillance and control by providing the needed support to the ministry. The aim was to reduce the mortality rate of various types of livestock by at least 30%. To ensure an improvement in the livestock productivity, the production of forage was increased to serve as feed for Livestock in order to meet the nutritional requirement for such functions. Animal husbandry practices will be improved through the training of livestock farmers especially the small-scale producers. The LDP is made up of five main components, *viz*. Development of Animal Production, Development of Animal Health, Credit Provision, Capacity Building, and Project Management.

2.8 Conceptual Framework

For the purpose of this study, there will be conceptualization of key words that have importance to the study. The researcher will seek to conceptualize small ruminant farmers, technology adoption, and food accessibility.

2.7.1 Small Ruminants Farmer

The study defines small ruminant farmers as all farmers who own sheep and goats within the Wa Municipality, with stock numbers ranging between two (2) and thirty (30). They mostly practise mixed farming. These farmers may have or have not received any form of training with regard to small ruminant production. The ownership can either be by purchase or by inheritance. The farmer could have owned these small ruminants before the project began, during and after the project's life cycle.

2.7.2 Technology Adoption

The phrase technology or innovation adoption gives different meanings to different people. Rogers and Shoemaker (1971) state that adoption of innovation refers to the decision to apply an innovation and to continue to use it. They argued that the decision to adopt an intervention depends on the set of alternatives and constraints facing the decision maker. Bridges to Technology, a knowledge site, also defines technology adoption as a process that begins with awareness of the technology and progresses through a series of steps that end in appropriate and effective usage. These suggest that the transfer of technology from one level to the other requires time before the end user can implement the technology. The above definition agrees with that of Getahun et al. (2000) who defined adoption as the degree of use of a new technology in a long-term equilibrium when a farmer has all of the information about the new technology and its potential.

For the purpose of this research, technology adoption will be defined as the adoption and use of improved livestock husbandry practices. The technologies to be accessed will be supplementary feeding, routine vaccination, housing of animals, mineral supplementation, cleaning of housing, detection and isolation of sick animals, de-ticking and hoof trimming. It is expected that the adoption of these technologies will result in an increase in stock numbers and will help the household in accessing food to ensure an all year round household food security. The word 'improved' is used to distinguish the

difference in husbandry practices after the technology has been accepted by the farmers and they subsequently practising them. Stock numbers will be the number of sheep and goats that the farmer has before, during and after the completion of the project.

2.7.3 Food Accessibility

Food security according to the World Bank (1986) refers to the access by all people at all times to enough food for an active and healthy life. FAO (1983) also defines food security as a condition in which all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food security comprises four dimensions, namely, availability, accessibility, utilization and sustainability. Food access is having sufficient resources to obtain appropriate foods for a nutritious diet (World Bank, 1986). For the purpose this study, food accessibility will be defined as the ability of the farmer to obtain sufficient and nutritious food with income from small ruminant sale.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter presents the methodology, elaborates the sources of data, presents the population sampling technique, explores the data collection and analysis. Both primary and secondary data sources were used and are discussed in the following sections.

3.2 Sources of Data

The primary source of data was small ruminant farmers who attended the Livestock Development Project's training within five selected communities of the Wa municipality, as well as those who did not attend the training sessions but are in the selected communities. Secondary data was obtained from projects reports as well as research conducted in the field of study. Journals, publications and books were also used. The data also comprised review of literature on small ruminant production and adoption of improved technologies providing the foundation for this study.

3.3 Population and Sampling Techniques

Multi-stage sampling was employed in the study. The communities were selected purposively based on the presence of Livestock Development Project activities. There are 41 communities in the Wa Municipality where the LDP activities are being implemented. A simple random sampling technique was employed to select five (5) communities (out of the 41) for the study. The five communities selected are Charia, Jonga, Kperise, Wa North and Kpongu. Livestock farmers in each community were divided into two; those that attended the livestock management training sessions under the LDP project and those who did not attend the livestock management training sessions. In each community, simple probability sampling techniques was employed in sampling seven (7) farmers with livestock management training and three (3) farmers without livestock management training. The total sample is 50 respondents.

3.4 Methods of Data Collection

A semi-structured interview of individual farmers with both open and close questions was administered to the sampled small ruminants' farmers in the study area. A semi-structured questionnaire was designed to obtain information on the socio-economic characteristics of farmers, the types of small ruminants kept, improved small ruminants' technologies taught and adopted by farmers such as supplementary feeding, routine vaccination, housing of animals, mineral supplementation, cleaning of housing, detection and isolation of sick animals, de-ticking and hoof trimming. The Benefits associated with rearing small ruminants as well as the possibility of accessing food through SRP was probed.

3.5 Methods of Data Entry and Analysis

- The Statistical Package for Social Scientists (SPSS) and Microsoft Excel were used as software for data entry and analysis.

  The socio-economic characteristics of farmers were analyzed using frequencies, means and percentages and presented using tables, graphs, bar charts and pie charts.

- The adoption rate of the improved small ruminant livestock production technologies was determined by constructing an adoption index. It is given by

$$\textbf{\textit{Adoption index}} = \frac{\textit{Respondents' total score}}{\textit{Total possible score}} \times 100$$

Under the LDP training programme, farmers were trained on eight (8) technologies listed below:

a) Supplementary feeding
b) Routine vaccination
c) Housing of animals
d) Mineral supplementation
e) Cleaning of housing
f) Detection and isolation of sick animals
g) De-ticking
h) Hoof trimming

- To determine the factors influencing the adoption of improved technologies among small ruminant farmers, the study employed multiple linear regression analysis. The dependent variable (Y) was the adoption rate, which was determined by the personal, household and socio-economic characteristics of the livestock farmers. From the literature review, age, sex, education, household size, farm size, number of small ruminant enterprises, number of crop enterprises, herd size and belonging to group/association were identified as factors that could affect the adoption rate of improved technologies. The study tested which of these identified factors influence adoption rate of improved technologies among small ruminant farmers in the study area.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter analyzes the collected data from the field and presents findings of the interviews carried out with fifty small ruminant farmers within Wa Municipality on the adoption of improved small ruminant production technologies. It presents the socio-economic characteristics of small ruminant farmers, the types of small ruminants kept, improved small ruminants' technologies taught and adopted by farmers, benefits of small ruminant rearing as well as the benefits associated with small ruminant production in relation to food accessibility.

4.2 Socio-Economic Characteristics of Small Ruminant Farmers

Table 4.1 Socio-economic characteristics of small ruminant farmers

Category	Frequency	Percentage Frequency
Age Category		
20-29	10	20
30-39	12	24
40-49	8	16
50-59	6	12
60 and Above	14	28
Sex Distributions of Farmers		
Male	42	84
Female	8	16
Marital Status of Farmers		
Single	3	6
Married	47	94
Religion of Farmers		
Christian	15	30
Muslim	35	70
Ethnic Group of Farmers		
Waala	35	70
Dagaaba	12	24
Lobbi	1	2
Mossi	2	4
Formal Education		
Yes	28	56
No	22	44
Level of Education		
Primary	2	7
JSS/Middle	10	36
Secondary	7	25
Tertiary	9	32
Household size Distribution of Farmers		
1-5	5	10
6-10	28	56
11-15	10	20
16-20	2	4
Above 20	5	10

Source: Field Survey Data, 2011

The results in Table 4.1 show that the age categories involved in small ruminant production range between the ages of 20 and above 60. Farmers who were sixty (60) and above were the majority that engaged in small ruminant production. It was realized that 42 farmers representing 84% of respondents

were males while 8 farmers representing 16% of the sampled farmers were females as depicted by the table. The results show clearly that men dominate small ruminant production in the study area. Out of the fifty small ruminant farmers interviewed, forty seven were married while three were single, representing 94% and 6% respectively.

The dominant religion in the area is Islam as 35 of the respondents, representing 70%, are Muslims whiles 15 respondents, representing 30%, are Christians as shown in Table 4.1. The ethnicity of the respondents is summarized in the table; Waala 70 percent, Dagaaba 24 percent, Mossi 4 percent and Lobbi 2 percent**.**

Majority of respondents (56%) indicated they have had formal education while the remaining 44% said they have not had any form of formal education. The results further show that although majority of respondents indicated that they had formal education, 32% had tertiary education, 25% had secondary education, 36% had JSS/Middle school education and 7% had primary education. The household size of respondents is also presented.

4.2.1 Occupational Distribution of Respondents

The results in Table 4.2 show that 84% of respondents indicated farming as their primary occupation, 12% indicated that they are salaried workers while 4% showed they are traders. On the issue of secondary occupation, it was realized that only 19 of farmers indicated they had a secondary occupation. Majority (73%) of farmers had trading as their secondary occupation, 16% mentioned salaried work while 11% said their secondary occupation was artisanal work.

Table 4.2 Occupation of respondents

Occupation	Primary Occupation		Secondary Occupation	
	Frequency	Percentage Frequency	Frequency	Percentage Frequency
Farming	42	84	-	-
Trading	2	4	14	73
Artisan	-	-	2	11
Salaried worker	6	12	3	16
Total	50	100	19	100

Source: Field Survey Data, 2011

4.2.2 Belongingness to Group

Table 4.3 shows that out of the 50 respondents, 37 indicated that they belonged to a group(s) representing 74%, while 13 farmers (representing 26%) indicated they did not belong to any group. The minimum number of groups a farmer belonged to was 1 while the maximum number is 7. A typical farmer in the study area belongs to at least 2 groups/associations. Belonging to groups can have a positive effect on adoption of technology since farmers are likely to share ideas as they meet in those groups or associations.

Table 4.3 Belongingness to group

Category	Response	Frequency	Percentage Frequency
Belongingness to a group	**Yes**	**37**	**74**
	No	**13**	**26**
	Total	**50**	**100**

	N	Minimum	Maximum	Mean	Std. Deviation
Number of groups belong to	**37**	**1**	**7**	**2.32**	**1.355**

Source: Field Survey Data, 2011

4.3 Crop Production Activities of Farmers

4.3.1 Farm Size and Number of Crop Enterprises

The results of the crop production activities of farmers are presented in Table 4.4. Forty eight percent (48%) of the respondents grow crops in addition to livestock rearing. The minimum number of acreage held by farmers is one acre and the maximum acreage held is 20. The average acreage held by a farmer in the study area is about 6.

Table 1.4 Farm size and number of crop enterprise

	N	Minimum	Maximum	Mean	Std. Deviation
Farm size/cropping area	48	1	20	5.78	3.740
number of crop enterprises	48	1	8	3.96	1.901

Source: Field Survey Data, 2011

Farmers produce various kinds of crops on these farms ranging from cereals, root and tuber to vegetables with the mean number of crops on a farm being about 4.

4.4 Types of Animals kept by Farmers

Table 4.5 presents the types of livestock kept by farmers in the study area. The number of farmers engaged in each animal enterprise, the minimum and maximum number of animals kept for each animal enterprise, the mean number of animals kept and the standard deviation from the mean are also presented. From the table, the common animals reared in the study area are chicken, guinea fowls, ducks, turkeys, pigs, goats, sheep and cattle. The results show that 90% of the farmers keep chicken, 22% keep guinea fowl, 6% each keep ducks and turkeys, 12% keep pigs, 90% keep goats, 80% keep sheep and 54% keep cattle. In addition to chicken, goats and sheep rearing is predominant among farmers in the study area. Therefore any development intervention targeting small ruminants will catch up well with the farmers, which can result in improved livelihoods for the farming households. The average number of chicken, guinea fowls, sheep, goats and pigs kept by a farmer are 23, 15, 11, 10 and 10 respectively. The rest are 9 for cattle, 8 for ducks and 6 for turkeys.

Table 4.2 livestock kept by farmers

Type of Animal	Respondents (N)	Statistics on number of animals			
		Minimum	Maximum	Mean	Std. Deviation
Chicken	45	2	56	22.53	13.682
Guinea fowl	11	7	44	15.82	12.040
Ducks	3	1	22	8.33	11.846
Turkey	3	4	8	5.67	2.082
Pigs	6	1	25	10.00	8.899
Goats	45	1	30	10.16	6.619
Sheep	40	1	50	11.40	10.563
Cattle	27	1	40	8.56	9.803

Source: Field Survey Data, 2011

4.5 Awareness of Farmers of Selected Small Ruminant Production Technologies

As can be seen from Table 4.6, the level of awareness of small ruminant production technologies is very high among the farmers. This could be attributed to the presence of the livestock development projects for the past eight years.

Table 4.3 Awareness of farmers on selected SRPT

Technology	Number of Responses	Level of Awareness
Supplementary feeding	50	100
Routine vaccination	50	100
Housing of animals	50	100
Mineral supplementation	49	98
Cleaning of Pens	48	96
Detection and isolation of sick animals	40	80
De-ticking of animals	46	92
Hoof trimming	48	96

Source: Field Survey Data, 2011

The sources of awareness of the improved technologies are presented in Figure 4.1 below. LDP training dominated the sources of information of technology as 50% of respondents indicated LDP, this was followed by other sources which included own knowledge, formal education and knowledge handed down by parents. Radio/TV education and other farmers were also mentioned as sources of information.

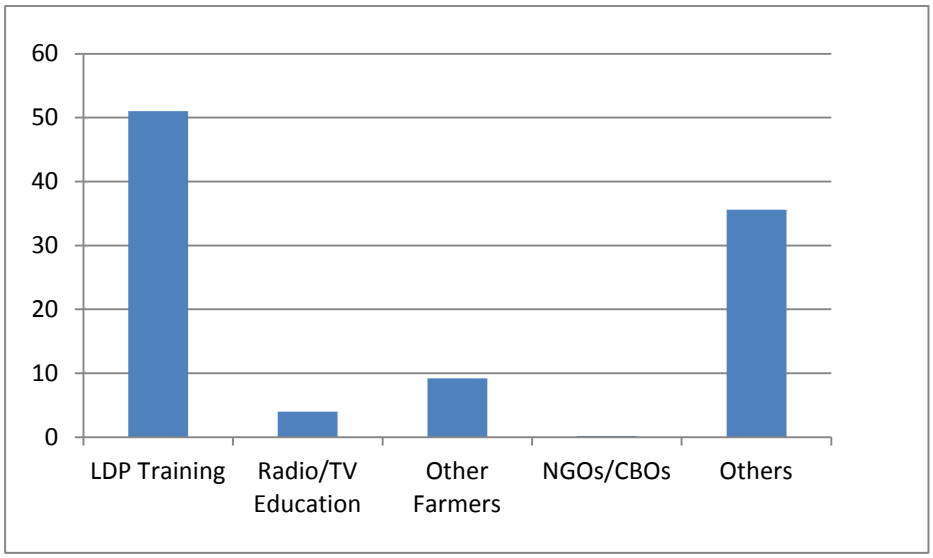

Figure 4.1 Sources of information of technologies

4.6 Adoption of Improved Animal Production Technologies

Table 4.7 below presents the results of the adoption levels of each of the eight technologies farmers were presented with. With the exception of hoof trimming, detection and isolation of sick animals, and mineral supplementation where the adoption rates are relatively low, the adoption rates are very high for all the other technologies. Supplementary feeding, routine vaccination, housing of animals, cleaning of pens and de-ticking of animals recorded adoption rates of 92%, 96%, 98%, 92% and 70% respectively.

Table 4.4 Adoption of improved animal production technologies

Technology	Rate of Adoption for all		Rate of Adoption for LDP Participants		Rate of Adoption for LDP non-Participants	
	Number of Responses	Rate of Adoption	Number of Responses	Rate of Adoption	Number of Responses	Rate of Adoption
Supplementary feeding	46	92	31	89	15	100
Routine vaccination	48	96	34	97	14	93
Housing of animals	49	98	34	97	15	100
Mineral supplementation	33	66	21	60	12	80
Cleaning of Pens	46	92	33	94	13	87
Detection and isolation of sick animals	27	54	23	66	4	27
De-ticking of animals	35	70	24	69	11	73
Hoof trimming	19	38	14	40	5	33

Source: Field Survey Data, 2011

4.7 Reasons for Non-Adoption of Technologies

The reasons that farmers gave for not adopting the technologies are presented in Table 4.8. Among the reasons presented, lack of finances dominated. This means that farmers will need money in order for them to implement the technologies taught them.

Table 4. 5 Reasons for non-adoption of technologies

Technology	Reason(s) for non-adoption
Supplementary feeding	Lack of finances to buy supplementary feed Abundant grassland for animals to grace
Routine vaccination	Lack of finances to pay for veterinary services Inadequate and Inaccessible veterinary staff/services
Mineral supplementation	Lack of finances to purchase mineral supplements
Detection and isolation of sick animals	Lack of additional rooms to isolate sick animals
De-ticking of animals	Animals do not have tick problem The ticks will fall off by themselves
Hoof trimming	Have not experienced animals with hoof problems No reason for not doing it

Source: Field Survey Data, 2011

4.8 Factors Determining the Adoption Rate of Small Ruminant Production Technologies

The results of the factors influencing adoption rate of small ruminant production technologies among farmers using a multiple linear regression is presented in Table 4.9. The R-Square and the adjusted R-Square are found to be 79% and 63.4% respectively. This shows that 79% of the variation in the dependent variable (adoption rate) is explained by the independent variables in the model. The overall significance of the regression equation as measured by the F-Statistic is significant at the 1% level.

From the results in the table, age, number of groups a farmer belongs to and number of animal enterprises are found to be significantly associated with the rate of adoption of improved small ruminant production technologies in the study area. The sex of the farmer, marital status, years of schooling, size of flock (goats and sheep combined) and number of crop enterprises were found not be significant in determining adoption rate among the small ruminant farmers.

Table4. 6 Multiple Linear Regression results of factors affecting adoption

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	42.023	20.333		2.067	0.063
	Age	**0.484**	**0.190**	**0.382**	**2.540**	**0.027**
	Sex	13.158	8.146	0.297	1.615	0.135
	Marital status	-15.178	10.760	-0.237	-1.411	0.186
	number of groups belong to	**3.452**	**1.698**	**0.308**	**2.033**	**0.067**
	number of crop enterprises	-0.805	1.687	-0.079	-0.477	0.643
	number of animal enterprises	**9.280**	**2.962**	**0.577**	**3.132**	**0.010**
	number of small ruminants	-0.438	0.307	-0.279	-1.427	0.181
	years of schooling	-1.561	1.036	-0.249	-1.507	0.160

R-Square = 79%
Adjusted R-Square = 63.4%
F-Statistic = 5.114
Significance of the F-Statistics 0.008**

Source: Field Survey Data, 2011

4.9 Benefits Associated with Small Ruminant Rearing

Small ruminant rearing is not only important for economic reasons, it is important in the socio-cultural lives of the farmers. As outlined in Fig. 4.2, farmers keep small ruminants for income, meat, manure and religious/cultural reasons. Income, however, ranks highest as indicated by 42.2% of the responses. Farmers indicated that small ruminant rearing helps them to generate income which is used to pay for their wards' school fees, buy school uniforms, pay medical bills, and purchase foodstuff during the lean season. Small ruminants are an important source of protein during festivities such as Christmas, New Year, Easter, Idi fitr, Idi adha and out-dooring ceremonies. Apart from festivities, farmers will not naturally slaughter small ruminants for the household consumption, instead poultry and other smaller animals like bush meat are used. The farmers use the animal droppings as manure for their backyard farms to increase crop yield, hence ensuring household food security. Small ruminants are also sacrificed during cultural festivities and religious celebrations such as Idi Fitr celebration among Muslims where rams are sacrificed.

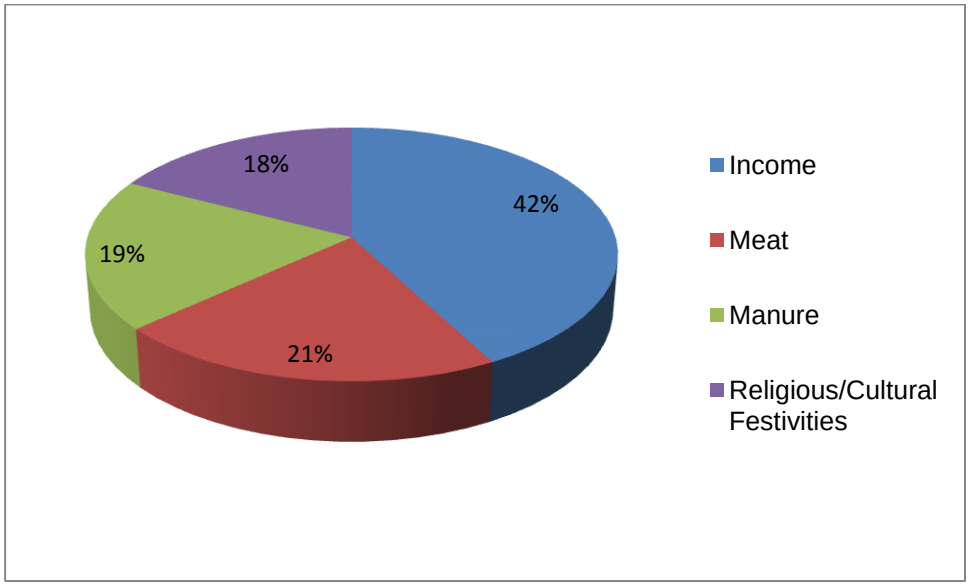

Figure 2.2 Benefits associated with small ruminant rearing

4.10 Small Ruminant Rearing and Household Food Accessibility

Figure 4.3 presents the responses of farmers on small ruminant rearing and access to food. Small ruminant farmers in their response on the issue of food accessibility from small ruminant rearing indicated that they access food from sale of animals as well as slaughter for meat during festive seasons and when household really need meat but not on daily basis as shown in the figure.

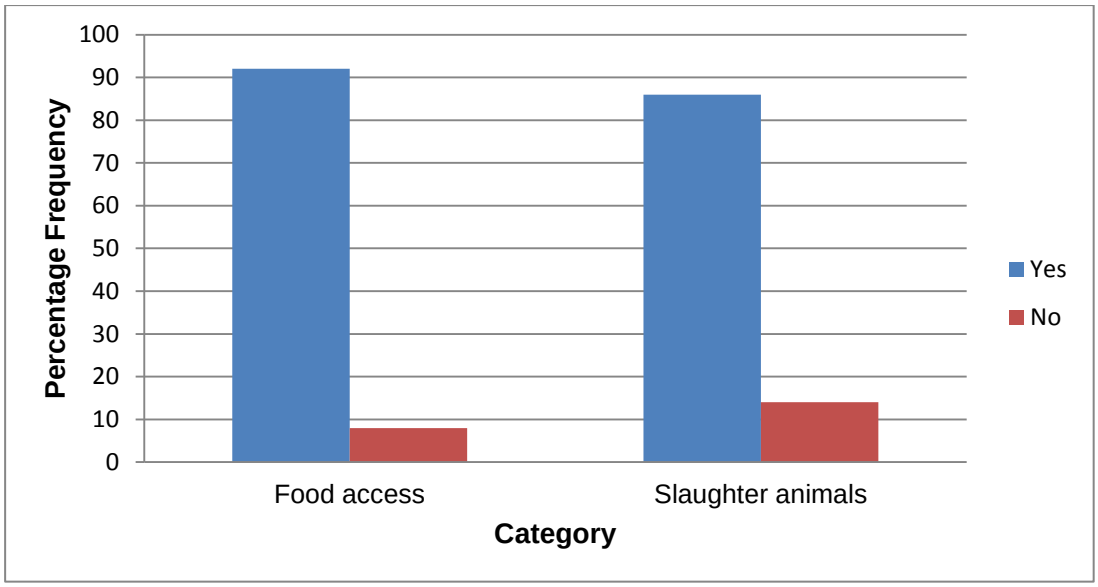

Figure 34.3 Small Ruminant Rearing and Food Security

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter discusses the findings from the study in relation to small ruminant production. It also looks at the results in relation to previous work done on the subject matter in other parts of the world.

5.2 Socio-Economic Characteristics of Small Ruminant Farmers and Factors Determining the Adoption Rate of Small Ruminant Production Technologies

From the results presented in chapter four, the factors determining the adoption of technologies are age, number of groups a farmer belongs to and numbers of animal enterprises. These factors are found to be significantly associated with the rate of adoption of improved small ruminant production technologies in the study area. Sex of the farmer, marital status, years of schooling, size of flock (goats and sheep combined) and number of crop enterprises were found not be significant in determining adoption rate among the small ruminant farmers. This was tested at the 10% significance level. Studies by Ajala (1992) and Ikani et al. (1998) also showed that age, organizational and farming experience significantly affected adoption. They however attributed the differences to the type of technologies studied and other factors. Previous studies by Haji (2003), Mesfin (2006) and Yenealem (2006) have shown that there is a positive relationship between age and adoption behavior of farmers as older farmers are more likely to adopt improved technologies than younger farmers. These results however contrast with Bulale (2000) who found age to have no influence on adoption of dairy production technologies.

The number of groups/associations a farmer belongs to was also found to be positive and significant in determining the rate of adoption of small ruminant production technologies at the 10% level. The results show that, the more groups/associations a farmer belongs to, the higher will be his rate of adoption of the technologies. This is expected in that, groups or associations whether farmer-based or otherwise serve as platforms where farmers interact and share ideas, and this may include new technologies. Therefore, they are more likely to be exposed to and adopt new technologies compared to farmers who do not belong to any group/association. Belongingness to group(s) or association(s) can positively influence the adoption of new technology as farmers interact and share new ideas during group/association activities. This agrees with earlier findings by Foster and Rosenzweig (1995) that showed that learning from own and neighbours' experience are both important determinants of adoption.

Number of animal enterprises a farmer holds is also significant, at the 1% level, in determining the adoption rate of small ruminant production technologies among the farmers. The sign of the coefficient is positive, showing that the more animal enterprises a farmer holds, the higher will be his rate of adoption of technologies. This could be as a result of the fact that the technologies being examined can be applicable to other animal enterprises besides small ruminants, especially cattle. A farmer applying these technologies in other animal enterprises may also extend them to small ruminants and vice versa.

The study showed that males dominate small ruminant rearing activities compared to their female counterparts. Traditionally, non-Muslim females in the study area are more inclined to keep swine than small ruminants and poultry. Females even if they own small ruminants, credit them to their husbands as the household heads. The less involvement of women in small ruminant rearing is attributable to socio-cultural barriers. Islam and Christianity are the predominant religions in the study area, with Muslims constituting the majority. The dominance of Islam in the sample is explained by the fact that the Wa Municipal area is inhabited by the Waala ethnic group who predominantly practise Islam.

The study area recorded a high household size ranging between three and thirty two members, this could be because of the polygamous marriage and the extended family system practised in the study area. However, a larger household size may mean availability of labour for both farming and livestock rearing activities. It could also have an implication on their food security situation since more household members will mean more food to meet individual food requirements.

From the results presented on the level of education of small ruminant farmers, the illiteracy rate is relatively high among the farmers and this can affect their adoption of improved small ruminant production technologies. This is, however, not the case for the sample used for the current study since the adoption rate is high. The results agree with earlier finding by Cramb and Nelson (1998) who found education not to be important in explaining adoption. They explained that whether an individual has formal education or not had no relationship with his or her adoption behaviour. This, however, contradicts results of studies by Teressa (1997) and Walday (1999) who found adoption to be positively related to the level of education. According to them, the higher the level of education a farmer attains the better the chances of understanding and adopting a technology. From their analogy it means that understanding had a significant role to play in adoption of technologies. The reasons for the difference in opinion presented by the writers are not known, but the contradiction could be as a result of the difference in technology presented. There are certain technologies that require a certain level of education to be able to understand and adopt such as the technology of receiving and sending SMS messages as a tool for extension delivery practices by some provinces in India. Other technologies however might not require education to understand such as supplementary feeding and housing of animals. This was the case in the study area.

Farming is the major primary occupation of small ruminant farmers in the study area as most of them indicated it as their primary occupation. Out of the fifty farmers sampled for the study only nineteen had a secondary occupation with majority of farmers trading as their secondary occupation. It was also realized that not so many farmers had a secondary occupation. Studies have shown that there is a relationship between level of income of a farmer and adoption of innovation. It has been observed by Kinucan et al. (1990) that farmers having higher level of income make better use of innovative farming techniques. The higher the level of income of farmers, the more comfortable it is for them to be in the position of taking financial risks.

5.3 Awareness of Farmers of Selected Small Ruminant Production Technologies

The results show the level of awareness of small ruminant production technologies is very high among farmers in the study area. The level of awareness was taken to be the possibility of the farmer hearing about the technology. This could be attributed to the fact that more than fifty percent of respondents attended the LDP training for the past eight years and might have heard about those technologies at one time or the other. It was also realized that the remaining farmers who did not attend any of such training sessions were equally aware of the existence of the technologies partly from other farmers through diffusion of information. The overall level of awareness of the selected improved small ruminants' production technologies is very high. The high level of awareness of the improved technologies can influence adoption of these technologies.

Among the sources of information on the improved technologies, LDP management training, other farmers, NGOs/CBOs, and other sources were sited. LDP management training recorded the highest frequency as a source of information on improved technologies. The results show that the LDP management training and other sources such as inter-generational knowledge transfers are the most important sources of awareness of the selected improved small ruminant production technologies. The results is expected since the LDP project has been in existence for the past eight years and has been the major source through which training is conducted on livestock production within the municipality.

5.4 Adoption of Improved Animal Production Technologies

The overall adoption rate for all the technologies is high. These findings contrast findings from many adoption studies in developing countries that establish adoption rate to be generally low. The high adoption rate of adoption is attributed to the livestock management training delivered to the farmers under the Livestock Development Project and the multiplier effect of the LDP project on other non-participant farmers in the study area. The very strong social ties in the communities enhance the spread of technologies.

All the farmers responded in the affirmative to understanding the training given on the improved technologies and further indicated that the training sessions have helped them to know the benefits associated with the use of improved technologies in small ruminant rearing. The reasons farmers give for adoption of improved technologies are; to prevent diseases and make the animals' healthier, faster growth and increase in weight gain of animals, increased stock numbers and increased revenue from small ruminant production.

Even though the adoption rate is high, it was observed that many farmers improvised most of the technologies or did not adopt the technologies for some other reasons. For instance, because farmers lack the appropriate equipment to trim the hooves of their animals, they use instruments such as knives and hot irons to perform the task. Farmers also understand that plugging the ticks from the animals create sores that predispose them to other infections. They therefore use needles to puncher the ticks for them to die and fall off or use chemicals such as Dichloro Diphenyl Trichloroethane (DDT) to spray on the animals. The use of DDT is not appropriate since it is toxic and the animals can die through licking these chemicals on their bodies. When signs of ill health are noticed in animals, they are tied outside the pen. This predisposes the animal to further infections/diseases as they are left to the elements of the weather such as cold temperatures and rains. Almost all the farmers have single pens where both sheep and goats are kept and hence lack additional rooms to keep sick animals that are isolated.

Apart from removing droppings from the pens to keep them clean for the animals' habitation, an important driving force that encouraged farmers to adopt the technology of housing of animals is to obtain manure for their gardens/backyard farms.

Most farmers indicated they are unable to purchase salt licks to serve as mineral supplement for the animals. Apparently very few farmers use salt licks. For the majority of the adopters, iodated or ordinary salt is mixed with feed and given to the animals. This is a good substitution for salt licks in situations where salt licks are either inaccessible to farmers or that farmers do not have the financial resources to procure them. Though farmers know the mineral benefit to the animals, they are also motivated to adopt this technology for the reason that the animals will always return home. The same goes with supplementary feeding where animals usually return home with the expectation of being fed with grains and other food by-products.

It was observed that most of the farmers had their indigenous ways of managing their small ruminants which seem conducive for their situation. However, the Project did not include the knowledge of farmers which could have contributed to its cost-effectiveness. This could be a reason why farmers improvised with most of the technologies. Another aspect the study did not consider which could also affect the complete adoption of the technologies that were taught them is the cost involved in the adoption of each technology. It was observed during the study that each technology had a cost component, the issue of whether a farmer could afford the cost of the technology was not discussed in the study.

Among the reasons for non-adoption of technologies, lack of money was cited to be the main reason, a situation which reflected in the improvisation of technologies employed by some farmers.

5.5 Small Ruminant Rearing and Household Food Accessibility

Rearing small ruminants is very important once accessibility to food for the rural households is concerned. This was evident when majority of households indicated that rearing small ruminants has enabled their households to access food. A few households however said they did not access food through small ruminants. They explained that their households have not experienced food shortage to the point where animals will be sold. However the animals provided security for the household against any food shortage that the household may experience. The following are the ways households indicated they accessed food through small ruminant rearing activities.

Sale of animals to buy foodstuff: This is the most important way households access food through small ruminant rearing. The animals serve as a guarantee against food shortages that may occur in the household due to poor yields from crop farming and in some cases total crop failure. The study area experiences a unimodal rainfall and low yields due to loss of soil fertility because of continual cultivation of the same land for a long period of time. The foodstuff they produce is not able to keep the household throughout the year. Most households therefore sell small ruminants during the dry spells of the year where serious food shortages occur. The study revealed that the foodstuff the household buy with livestock income are mostly grains such as maize, millet, sorghum, and cowpea, yam and roots such as dry cassava (Konkonte).

Slaughter of animals during festivities: Small ruminants are slaughtered to provide meat for the households during festivities such as Christmas, New Year, Easter, Idi fitr, Idi adha, child out-dooring and funeral rites. Besides such occasions, small ruminants are not normally slaughtered for consumption within the household. Many of the households do not have money to buy animals, therefore keeping the animals enable them to have direct access to protein/meat during such occasions.

Sale of animals to buy farm inputs: Farmers also indicated that they sell animals at the beginning of the rainy season to buy important farm inputs such as fertilizer, seeds, and insecticides as well as hiring labour and ploughing of land. Animals are also sold to buy foodstuff to feed farm workers during the rainy season. The application of farm inputs such as fertilizer, insecticide and improved seeds increases crop yield and hence increases accessibility of the households to food.

Manure for gardens and backyard farms: All the farmers indicated they accumulate the animal droppings and apply them to their gardens and backyard farms. The application of manure to their farms increases crop yields and hence enhances their accessibility to food.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

Conclusion and recommendations of the study are drawn from survey results and discussions that came up from the results. The researchers observations made during the study have also been used.

6.2 Conclusion

Small ruminant production in the Wa Municipality is relevant in the household of farmers. Most farmers keep other animals such as poultry, guinea fowls and cattle, besides sheep and goats.

Age, number of groups a farmer belongs to and number of animal enterprises are found to be significantly associated with the rate of adoption of improved small ruminant production technologies in the study area. It was observed that the older the farmer the more likely it was for them to adopt the technology. This might be because of the type of technology being taught.

The study also showed that the average household size of a farmer is high, which can be as a result of the polygamous nature of marriages and the extended family system. This may however have implication on household labour available and the food needs of the household.

The illiteracy rate in the study area is considered high, this is noted to affects the adoption of improved small ruminant technologies in other studies. It was however not the case in this study since it did not affect the adoption rate. The reason could be because of the types of technology.

Farming which include livestock production is indicated as their primary source of income while a few indicated salaried work and trading. A few had trading as their secondary occupation. This means that most farmers still rely on farming as a source of income. Farming is very important in the improvement of the livelihood of small ruminant farmers and any intervention that is targeted at improving their farming system will go a long way in improving their livelihood and food security situation.

Most farmers belonged to one group or another, belonging to group(s) or association(s) by small ruminant farmers can positively influence the adoption of new technology as they interact and share new ideas during group/association activities.

The level of awareness of the improved livestock production technologies is high in the municipality. This could be attributed to the presence of the LDP for the past eight years in the Municipality and the fact that those training sessions have been on-going since the inception of the project. It was also realized that farmers additionally heard about the improved livestock production technologies from other sources other than the LDP, with some of the sources being radio/TV education, other farmers and NGOs/CBOs.

The adoption of improved livestock production technology has been high from the results of the study, contradicting earlier monitoring reports from MADU that suggest a low adoption rate. The exact cause of the high adoption rate is not known. It was, however, realized from the responses to question on the level of adoption that most of the small ruminant farmers improvised the adopted technologies since they could not afford to apply the technologies exactly as was taught them for various reasons. It was difficult to categorize them as non-adopters since they were applying information from the training. Small ruminant farmers that did not attend the LDP training also had a high adoption rate because they mentioned other farmers as sources of information on improved technology.

Rearing small ruminants is very important once accessibility to food for the rural households in Wa Municipality is concerned. This is evident in that households indicated that rearing small ruminants have enabled their households to access food, a few households that did not accessed food through the small ruminants explained that their households have not experienced food shortage to the point where animals will be sold. It was noted that they rather sold them to pay bills and purchase other necessities and therefore did not have to sell their foodstuff to meet such costs. The animals also provide security for the household against any food shortage that the household may experience. Households indicate they access food through small ruminant rearing by selling of animals to buy foodstuff, Slaughtering of animals during festivities, sale of animals to buy farm inputs for farming and using the droppings of the animals as manure for gardens and backyard farms.

Some farmers are into multiple income generation activities as respondents have a secondary occupation besides farming. Farmers lack specialization as they are into both crops farming and livestock rearing. Within the crops and livestock categories, farmers keep multiple crop and livestock enterprises. This is attributable to the fact that agriculture is practised at the subsistence level among the farmers. It is also a risk management strategy so that if some enterprises fail, the others can still support their livelihood.

Small ruminant rearing positively affects the ability of the households to access food. Besides small ruminants serving as sources of protein at crucial moments for the households, the manure is applied to increase crop yield and hence increasing food availability. More importantly, however, is the use of income from sale of small ruminants to procure crop inputs to increase productivity and to buy foodstuff mostly grains during food deficit periods of the year.

The level of awareness and adoption of the improved small ruminant production technologies is very high among farmers in the study area. It can be concluded that the Livestock Development Project has been very successful not only in making farmers know these technologies, but also encouraging farmers to adopt the technologies. If the project is extended extensively to cover all geographical areas and other animals, it will boost livestock production in Ghana.

6.4 Recommendation

The following recommendations are made based on observations and subsequent analysis of results on improved livestock production technologies within the Wa municipality.

- It was realized during the study that most small ruminant farmers had their indigenous ways of managing their small ruminants which could be improved to enhance the profitability of their production. It is therefore recommended that future interventions by the Ministry of Food and Agriculture should consider putting farmers' indigenous methods of management into consideration for sustainability of those interventions since it will make them accept the technologies as their own and not to satisfy a project.

- To ensure that farmers adopt improved technologies fully as has been taught them, it is recommended that government and MoFA make inputs available or direct farmers to places where inputs necessary for implementation of the improved technology can be purchased. It will also be helpful if subsidies could be given for those inputs, since the inputs may be available but the cost might be too high to the farmer. This will prevent farmers from improvising the technologies since some of the improvised methods can endanger the animals.

- The project should be replicated in other areas for the farmers to benefit. Similar projects in other livestock sub-sectors should also be considered.

- Women should be encouraged by MoFA and all socio-cultural barriers removed for them to participate fully in small ruminant production activities.

- Any intervention to increase small ruminant technology adoption, among other things should focus on addressing the specific factors such as number of livestock enterprises and belongingness to groups or association that influence adoption as identified in the study.

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Appendix

Appendix1 Survey for Questionnaire for Small Ruminant Farmers
THE ROLE OF IMPROVED TECHNOLOGY ADOPTION AMONG SMALL RUMINANTS FARMERS AND ITS CONTRIBUTION TO FOOD ACCESSIBILITY IN RURAL WA MUNICIPALITY IN GHANA

Introduction

The researcher is a Graduate student at the Van Hall Larenstein University of Applied Sciences, Netherlands. This study is conducted as part of the requirement for the award of Master of Management in Food Security and Rural Development. The information will be treated as highly confidential. I also assure you that the result from the study will be used strictly for academic purposes and for future developmental interventions that will benefit the municipality.

Name of Community: **Questionnaire Number:** **Date:**

Section A: Background Information of Farmers

1. Age of farmer.....

2. Sex of farmer: Male ☐ Female ☐

3. Marital Status: Single ☐ Married ☐ Divorced/Separated ☐ Widowed ☐

4. Religious status Christian: ☐ Muslim ☐ Animist ☐ Others (specify).....

5. Ethnicity: Waala ☐ Dagaaba ☐ Lobi ☐ Others (specify).....

6. Have you ever had formal education? Yes ☐ No ☐

7. If yes, what is your level of education? Primary ☐ JHS/ Middle ☐ Secondary ☐ ☐ Tertiary

8. Household size: .....

9. Occupation: Primary..... Secondary.....

10. Belongingness to groups/ associations: Yes ☐ No ☐ If yes indicates number.....

Section B: Agricultural Activities of Farmers

11Are you into crops cultivation? Yes ☐ No ☐

12.If yes, indicate your farm size (cropping area) in acreage.....

13. Number of crop enterprises.....

14. Mention the crops grown.....

.....

15. Please provide information on the following table regarding animal rearing

Animal Enterprise	Response: 1=Yes, 0=No	Number of Animals

Chicken		
Guinea Fowls		
Ducks		
Turkey		
Pigs		
Goats		
Sheep		
Cattle		
Others (specify)		
Grand Total		

Section C: Adoption of Improved Small Ruminant Production Technologies

15**.** Indicate your years of experience in small ruminant rearing.....

16. How many sheep did you have before the LDP?.....

17. How many goats did you have before the LDP?.....

18. How many sheep do you have now?.....

19. How many goats do you have now?.....

20. Have you attended the LDP trainings? Yes ☐ No ☐

21. Please indicate your awareness of existence of the following small ruminants' production technologies and the source of information/training

Technology	**Aware? 1=Yes, 0=No**	**Source of Information**				
		LDP training	Radio/TV Education	Other Farmers	NGOs/CBOs	Others (specify)
Supplementary feeding						
Routine vaccination						
Housing of animals						
Minerals supplementation						
Cleaning of housing						
Detection and isolation of sick animals						
De-ticking of animals						
Hoof trimming						

22. Indicate which of the following technologies you have adopted and the frequency of usage

Technology	**Adopted? 1=Yes, 0=No**	**Frequency of Usage**		
		Frequent	Infrequent	Hardly practise
Supplementary feeding				
Routine vaccination				
Housing of animals				
Minerals supplementation				
Cleaning of housing				
Detection and isolation of sick animals				
De-ticking of animals				
Hoof trimming				

23. Why are you using the selected technologies above?.....

……

24. Why are you not using the remaining technologies?.....

……

25. Do you always understand the training that are taught to you? Yes ☐ No ☐

26. Do you think the trainings are helpful to your rearing? Yes ☐ No ☐

If No

27. What management practices are you using in rearing your small ruminants ?

……

……

Section D: Small Ruminant Rearing and Food Accessibility

28. Enumerate all the benefits associated with keeping small ruminants.

……

……

……

29. Averagely, how many small ruminants do you sell per year?.....

30. (a) What period of the year do you sell the animals?.....

(b) Why? .....

31. (a) On which occasions do you sell animals? .....

(b) What is the purpose? .....

32. Do rearing small ruminants enable your household in accessing food? Yes ☐ No ☐

33. If yes, how? .....

.....
.....
.....

34. If no, why not?.....

……

35. What type of food items do you buy with the income from sale of small ruminants.....

.....
.....

36. Do you sometimes slaughter small ruminants for home consumption? Yes☐ No ☐

37. If yes, on what occasions? .....

.....
.....

If no, why?.....

…….

……

Appendix 2 List of communities under WA Municipal
ARGRICULTURAL ZONES AND COMMUNITIES UNDER WA MUNICIPALITY

ZONE A

1. Sing
2. Singbakpong
3. Kulkpara
4. Jimkpang
5. Danku
6. Boli
7. Seyiri
8. Dapuoha
9. Logipora
10. Kpongu
11. Kagu
12. Dandafuro
13. Gurimuni
14. Tampieni
15. Muguluu
16. Piisi
17. Kpalsaga
18. Kunfabiala
19. Kpongpaala
20. Bamahu

ZONE B

1. Kpersi
2. Guli
3. Nyagli
4. Konjiahi
5. Sagu
6. Chegli
7. Mojon
8. Kpankole
9. Yibile
10. Kadoli
11. Cheringu
12. Sanchiga
13. Liman Kombo
14. Busa
15. Dordiyiri
16. Biihee
17. Tangaju
18. Kampaaha
19. Jonga
20. Tabiasi
21. Dinaso
22. Saamanbo
23. Tambilieju

ZONE C

1. Charia
2. Zingu
3. Gbegru
4. Aheweu
5. Namberi
6. Chansa
7. Nakori
8. Sombo
9. Kambali
10. Kpaguri
11. Mangu
12. Xavier
13. Jengbeyiri
14. Tagrayiri
15. Dzudzeidayiri
16. Limanyiri
17. Nayiri
18. Fongu
19. Dondoli
20. Suuriyiri
21. Gonbilimuni
22. Sambeleyiri
23. Bamarayiri Zongo
24. Kaabanye
25. Kunta
26. Wapaani
27. Kumbiehi
28. Sawaba
29. Airstrip
30. Dopkong
31. Jahan
32. Tampaalipaai
33. Bomiyiri
34. Nipayiri
35. Tendaaba
36. Jabogu
37. Limanpaalayiri
38. Bugliyiri
39. Tamaramuni
40. Dobile

Appendix 3. Stakeholder Analysis.

Programs /Projects of my organization	Partners /Donors	Importance to Food Security
Livestock Development Project (LDP)	African Development Bank (ADB).	The project is focused on reducing poverty and contributing to food security through the development of animal production, animal health, credit provision and capacity building for farmers.
Food Crops Development Project (FCDP)	African Development Bank (ADB).	The project seeks to assist participating farmers in the districts to attain higher income and improve their overall food security on a sustainable basis.
Cashew Development Project (CDP)	African Development Bank (ADB).	The project is to improve the living standards of the rural population by generating rural employment in order to contribute to poverty reduction and earn foreign exchange for the country as a whole.
Special Programs for Food Security (SPFS)	African Development Bank (ADB) and Food and Agriculture Organization (FAO)	The focus is on water control system development, with emphasis on low–cost irrigation facilities, crop intensification, and diversification of agricultural production systems to include small ruminant production, local poultry improvement, seed multiplication and fishing.
Community–Based Rural Development Project (CBRDP)	International Development Association (IDA)	The project is to strengthen the capacity of the rural population and reduce poverty by improving their productive assets, rural infrastructure and access to key support services from private and public sources.
Root and Tuber Improvement Programs (RTIP)	International Fund for Agriculture Development (IFAD) and the Government of Ghana.	To enhance food security and increase the incomes of resource–poor farmers on a sustainable basis by facilitating access to new but proven locally–adapted technologies of root and tuber crops (cassava, yam, cocoyam, sweet potato and frafra potato).

In land Valleys Rice Development Project	Africa Development Bank (ADB).	The project aims at contributing to food security and reduction in rice imports, increasing the production of rice and incomes of smallholder rice producers, traders and processors in the project area and neighboring areas.

Source: Authors Construct, 2011