UNIVERSITY FOR DEVELOPMENT STUDIES

INDIGENOUS KNOWLEDGE IN SMALL RUMINANT LIVESTOCK REARING AND ITS IMPLICATIONS FOR FOOD SECURITY IN THE TOLON-KUMBUNGU DISTRICT OF NORTHERN GHANA

B Y

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DECLARATION

I hereby declare that this thesis is my original work, supervised by Professor David Millar of the University for Development Studies (UDS) for the award of MPHIL Degree in Development Studies in UDS. The work has not been presented in part or whole to any Institution for any purpose. All sources of information have been duly acknowledged.

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Date: 25TH NOVEMBER 2011

Supervisor's Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

Professor David Millar
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Date: 05/12/11

ABSTRACT

Small ruminant livestock play a crucial role towards food security at the global, national and local levels. In rural communities in particular where poverty is high, small ruminants provide the major income for foodstuffs, and farm inputs and manure for crop production, to enhance food security. Although rural livestock production in northern Ghana is largely dependent on indigenous technologies and approaches of small-scale farmers, these technologies and approaches are not being adequately integrated into formal agricultural research and extension systems to enhance productivity and address rural food insecurity.

The objective of this research was therefore to examine the causes of low productivity in small ruminant livestock and poor integration of indigenous knowledge (IK) technologies for household food security improvement in the Tolon-Kumbungu District in Northern Region of Ghana. The study used a survey research approach, employing both qualitative and quantitative methods in data collection and analysis. Questionnaires, interviews and focus group discussions were the main data collection methods used, and involved 239 farmers from twelve (12) communities and fifty (50) field officers from five (5) agricultural agencies operating in the district.

The study found that rural farmers possess a wealth of indigenous husbandry knowledge and technologies for rearing livestock including; traditional breed improvement, use of local feed stuffs under free-range and zero grazing systems, housing in traditional kraals and pens, and using mainly ethno-veterinary medicines to treat livestock diseases. Yet only a moderate 64% of field staff of agricultural agencies in the district actually integrate farmers' IK technologies and practices into their livestock research and extension activities. The study also confirmed the contribution of livestock in household food security, as 68.7% of farmers in the study district sell between one to five small ruminants to buy food stuffs and farm inputs, especially during the hunger period of March to July. Rural farmers must however also share the blame for the low small

ruminants' production as the study discovered that only 13% of farmers integrated or complemented their IK with best modern technologies for livestock production.

On the basis of these findings, the study recommends agricultural agencies to pay greater attention to IK integration into intervention programmes and technologies for sustainable production and enhancement of rural food security. To add impetus, national agricultural policies and programmes should give priority attention to rural farmers' technologies and approaches in order to sustainably improve the livestock sub-sector which rests largely on rural small-scale farmers.

DEDICATION

Dedicated to my dear wife Kadi and children Judith Winibuno, Wedam and Nuyiri for their love, moral support and prayers which continue to inspire success.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES & BOXES

ACRONYMS

AAGDS	Accelerated Agricultural Growth and Development Strategy
ACDEP	Association of Church Development Projects
ADRA	Adventist Development and Relief Agency
AgSSIP	Agricultural Services Sub-Sector Investment Programme
ARI	Animal Research Institute
CIFS	Community-Driven Initiatives for Food Security
CLW	Community Livestock Worker
CSIR	Council for Scientific and Industrial Research
DADU	District Agricultural Development Unit of MOFA
ED	Endogenous Development
ERP	Economic Recovery Programme
FASDEP	Food and Agricultural Sector Development Policy
GDCP	Ghanaian Danish Community Programme
IK	Indigenous Knowledge
LENDEV	Learning Endogenous Development
LEISA	Low External Input and Sustainable Agriculture
LIFE	Livestock for the Future Network
LDP	Livestock Development Project
MOFA	Ministry of Food and Agriculture
MTADP	Medium Term Agricultural Development Programme
NLSP	National Livestock Services Project
OICI	Opportunities Industrialization Centres International
PAS	Presbyterian Agricultural Station
PID	Participatory Innovation Development
PROLINNOVA	Promoting Local Innovation
PTD	Participatory Technology Development
RPK	Rural People's Knowledge

SAP	Structural Adjustment Programme
ToT	Transfer of Technology
T&V	Training and Visit
WB	World Bank
WFP	World Food Programme

CHAPTER ONE: INTRODUCTION

1.1 GENERAL BACKGROUND

Small ruminant livestock (goats and sheep) contribute enormously to food security and livelihoods at the global, national and community levels. Globally, livestock provide a source of livelihood for 800 million poor people and account for 30% of agricultural GDP in developing countries (Spore, 2009). In Ghana, the livestock sector which is dominated by small ruminants contributes about 7% of agricultural Gross Domestic Product (GDP) and serves a major source of income and employment for the growing populations, especially rural people. Nearly 95% of livestock keepers in Ghana are rural small-scale farmers who provide the bulk of the national output (MOFA 2001; 2004).

In the context of food security, small ruminants contribute the highest source of animal protein in enhancing the food and nutrition security of urban populations. They also serve as a major source of savings and security against crop failures, particularly for the rural small-scale marginal farmers. According to Karbo and Bruce (2000), in northern Ghana livestock provide the main source of manure and draught power to increase crop yields and cash for investment in crop production and purchasing of food or grain during the hunger periods when household food stocks are exhausted. Beyond food security roles, livestock are of immense social and cultural significance for the well-being, social status and spiritual harmony of rural families, through its use in traditional marriages, funerals, festivals and sacrifices to the ancestors and gods.

Livestock rearing forms an integral part of the mix farming systems of rural people and provide the main source of manure for crop production in northern Ghana. According to Biotech-Ghana (2001), the three northern regions (Upper West, Upper East and Northern) alone account for 67% of national output of cattle, sheep, goats and poultry, with sheep and goats taking nearly three-quarters of this population. Other studies have attributed the dominance of livestock rearing in the northern regions to favourable agro-

ecological and climatic conditions, abundant natural feed resources, limited alternative economic livelihoods and cultural influences. Honya *et. al.* (2007) have thus concluded that the livestock sector offers a huge potential for enhancing food security and livelihoods for rural people in northern Ghana, especially in the face of increasing threat of climate change on crop-based agriculture.

In spite of its strategic importance in food security enhancement and employment and incomes provision, the livestock sector in Ghana has remained undeveloped and characterized with low production. This is partly attributed to the absence of clear and coherent policies for the sector. Moreover, many past livestock policies and programmes lacked long-term in-built sustainability (MoFA, 2004). As alluded to by Reijntjes *et. al.* (1992), modern conventional livestock interventions and technologies alone have not been able to sustain production and enhance food security of rural communities. This is mainly because the interventions and technologies are most often alien and incompatible with rural people's indigenous knowledge systems and local production conditions, thus resulting in low adoption and integration. According to Millar (2003; 2008) these challenges, including low attention to endogenous development approaches by development agencies, have contributed to poor performance of the rural food production and livestock sectors in northern Ghana.

The issue of poor attention to rural farmers rearing technologies in formal livestock policies and programmes is not limited to Ghana alone, but remains a global concern. Van't Hooft (1999) has indicated that in Africa 75% of small ruminants is associated with rural small-holder farmers who employ traditional technologies in mix farming systems to provide their main source of income and food security, yet these technologies and techniques have not receive adequate support of development experts in their livestock development efforts.

This study is therefore premised on the strong view that an effective integration of appropriate modern technologies with best indigenous practices, where rural farmers IK provides the basis for livestock development, is the best approach to achieve sustainable rural production and food security in northern Ghana.

1.2 THE RESEARCH PROBLEM

Livestock provide a major source of livelihood and food security for a great majority of the population of Ghana, but the sector has not been sustainably developed to contribute effectively in addressing food insecurity and poverty in northern Ghana where small ruminants abound (MoFA, 2004). One major cause of the sector's poor performance has been observed to be poor integration of rural farmers IK technologies and practices into national and local livestock development policies and programmes (Apiiga and Shittu, 2002). Waters-Bayer and van Veldhuizen (2006) have expressed concern that many development interventions aimed to improve livelihood systems of rural people fail because the interventions are based on external technologies which do not incorporate farmers' indigenous knowledge and their skillful use of available local resources. Consequently, Akullo and Kanzikwera (2007) have concluded that incorporating 1K into research and development projects increases farmers' productivity and also contributes to local empowerment and sustainable livestock development.

From experience, past livestock improvement projects of government and many development agencies in northern Ghana have tended to emphasis a modernization approach based on high external-input technologies. At implementation level this is often expressed in poor integration of 1K into livestock research and extension activities, thus contributing to unsustainable production and food insecurity in rural areas. The solution to improving livestock production and food security therefore appear to lie in effective integration of farmers' IK with appropriate modern technologies through strong collaboration between small-scale rural fanners and development agencies.

Therefore, the problem for this research is that small ruminants' productivity is low and unable to contribute adequately in addressing food insecurity in rural communities in northern Ghana, mainly because livestock intervention technologies and approaches of agricultural agencies are not strongly rooted and integrated with rural farmers' IK production practices.

1.3 RESEARCH QUESTIONS

Main Research Question

The main research question is: what are the causes of low small ruminants' productivity and poor integration of indigenous knowledge (IK) technologies for food security improvement in the Tolon-Kumbungu District in Northern Ghana?

Sub-Research Questions

1. What indigenous livestock rearing technologies and practices exist in rural communities?
2. What role does indigenous small ruminants rearing play in rural household food security?
3. To what extent do rural farmers integrate IK in livestock rearing with modern technologies to improve small ruminants' contribution to food security?
4. To what extent do agricultural agencies integrate farmers' IK technologies into formal research and extension systems to influence livestock productivity?
5. What problems hinder effective integration of IK technologies into formal research and extension systems of livestock production?

1.4 RESEARCH OBJECTIVES

Main Objective

The main objective is to examine the causes of low productivity in small ruminants and poor integration of IK technologies for food security improvement in the study district.

Sub-Objectives

1. To identify indigenous small ruminants rearing technologies and practices of rural fanners.
2. To assess the role of indigenous small ruminants in rural household food security.
3. To investigate the extent to which rural farmers integrate IK technologies and practices in livestock rearing with modern technologies influences food security.
4. To assess the extent to which agricultural agencies integrate IK technologies into formal research and extension systems to influence productivity.
5. To identify the problems which hinder effective integration of IK into formal research and extension systems of livestock production.

1.5 RELEVANCE OF THE STUDY

Food security is an important development issue in Ghana. ACDEP (2003) and Dittoh (2008) have indicated that agricultural productivity has consistently declined over the last decade, with a consequent adverse impact on rural food security in particular. Although small ruminant livestock play a major role in enhancing food security systems of rural people in Northern Ghana, productivity has not kept pace with the food security needs and demands of the ever-growing population. External livestock intervention projects have not adequately addressed the situation, or the traditional rearing systems which are based on indigenous technologies and practices. According to Millar (1999; 2008),

blending best IK with appropriate modern technologies in formal research and extension systems appear to offer the best solution towards improving small ruminants' production to enhance food security.

The results of the study will therefore encourage and motivate development agents and researchers to better appreciate rural peoples' practices of rearing livestock. This would enhance technology development and rural livestock improvement efforts of agricultural agencies. Millar (2008) has argued that a thorough understanding and taking advantage of rural people's indigenous knowledge and cosmovisions is a pre-requisite for any "outsider" wanting to participate in small farmers activities geared at increasing productivity.

IK technologies are cheap, flexible, culturally appropriate and ecologically sustainable (Dewalt, 1994). IK technologies and husbandry practices identified by the study will motivate development agents and extension officers to pursue and promote these technologies in livestock research and extension programmes to improve productivity. Furthermore, interaction with rural people during the research investigation will enable them to better appreciate and value their own indigenous knowledge, and will thus encourage them to put more effort in protecting and developing this knowledge system which is rapidly vanishing due to growing impact of modernization and globalization. Lastly, the findings and recommendations will be useful information for stakeholders in the livestock sector for consideration in policy design and field programming to improve small ruminants' production and rural food security.

1.6 SCOPE OF THE STUDY

The study was conducted among rural small-scale farmers and research and extension staff of agricultural development agencies in the Tolon-Kumbungu District of the Northern Region of Ghana. It focused on IK in livestock rearing in rural communities and how this knowledge can be effectively integrated with modern technologies within

formal research and extension delivery to improve food insecurity. The study specifically examined IK small ruminants' practices in the study communities and the roles played by indigenous livestock activities in food security issues of farmers. It also examined ways of promoting more sustainable production technologies through integration of IK and appropriate modern practices and approaches

Throughout the study and thesis report, small ruminants (sheep and goats) used synonymously with livestock. Also, my focus on small ruminants for this study is informed by factors outlined by Koney (1992) and Thiagarajan (2010) as follows:

- ✓ Small ruminants are the most dominant species in communities in northern Ghana
- ✓ They are easy to rear and require low investment
- ✓ They increase more rapidly and have superior market potential over other livestock species
- ✓ They are resistant to diseases and fit well in smallholder mixed farming systems due to their small size and low feed requirements.

Despite this focus, the literature review for the study has been generalized for all common traditional livestock species because of commonalities in their production and management systems.

CHAPTER TWO: LITERATURE REVIEW

2.0 INTRODUCTION

This chapter presents the theoretical premise of the study. It begins with a review of Rural People's Knowledge (RPK) as the main theory underpinning the research. Key concepts such as local innovation, endogenous development, livestock production systems, food security and national agricultural development policies have also been examined to contextualize the review and provide a deeper understanding of the research issues.

2.1 THEORETICAL FRAMEWORK: RURAL PEOPLES' INDIGENOUS KNOWLEDGE

No research problem originates from a vacuum. All have a theory, source or history that helps to understand and explain the prevalence of the problem. The theoretical background shows how the problem came about and why it continues to exist, and hence informs a solution (Kwabia, 2006). The theory on which this study is based is; Rural Peoples' Knowledge (RPK), often also known as Indigenous Knowledge (IK), local knowledge or traditional knowledge, depending on the context.

Many scholars have written extensively on RPK, emphasizing its importance in rural people's lives and their development processes. It is a body of knowledge and skills developed outside the formal educational system, which is used by rural people and enables communities to survive and make a living in a particular environment. Rural people, including farmers, local artisans, and livestock keepers are the custodians of IK systems. They are knowledgeable about their own situations, their resources, what works and what doesn't work, and how one change impacts other parts of their system. IK is dynamic and changes through creativity and innovativeness as well as through contact with other local and external knowledge systems (Warren, 1991).

Reijntjes *et. al.* (1992) and Orskov (1993) have also described IK as knowledge of a people living in a certain area generated by their own and their ancestors' experience and including knowledge gained from other sources which has been fully internalized with the local ways of thinking and doing. They argued further that the economic, social and livelihood activities of the particular people or society are strongly influenced and driven by this knowledge and their cultural values, through social interaction with their environment. They conclude that the local knowledge accumulated over years is also essential in determining the local people's developmental and livelihoods practices and approaches. The practices may include management of crops, livestock, soil, water and trees and cultural resources.

RPK however goes beyond the domain of traditional technologies and practices of rural people. Emery (1996) has gone further in his understanding of RPK to include local people belief systems, social and cultural values, social organization, local skills and practices, traditional structures, local resources as well as political and economic aspects of a local way of life, all of which determine rural people's survival and development.

Adding to the discourse, Warren (1991) has described IK as the systematic body of knowledge acquired by local people through the accumulation of experiences, informal experiments and intimate understanding of the environment in a given culture. However in the view of Gilbert *et. al.* (1980); Chambers *et. al.* (1989); and Haverkort and de Zeeuw (1992), IK is the actual knowledge of a given population that reflects the experiences based on traditions and includes more recent experiences with modern technologies. It is also described as a non-conventional body of knowledge that deals with some aspects of the theory, but more of the beliefs, practices and technologies developed without direct inputs from the modern, formal, scientific establishment; in this case, towards the management of farms.

From experience rural people in northern Ghana derive their main livelihoods from agricultural production relying mainly on traditional knowledge and practices passed down from generation to generation. In particular, rural livestock production is largely based on IK management, husbandry and breeding practices. Millar (1999; 2008) has extensively documented RPK practices and worldviews in crops, livestock, soil and water management to underscore its agricultural and socio-cultural importance for traditional rural societies elsewhere and in northern Ghana.

However, RPK will only make a sustainable impact on agricultural productivity and *rural* livelihoods if there is synergy with modern scientific knowledge and technologies. Modern science with its comparative strength has a huge potential part to play in making things better for the rural vulnerable people. The key is to know where and how the two knowledge systems can combine, such that modern science will not serve the rich and powerful but those who are peripheral and poor, so that there is mutual benefit and development (Chambers, 1997).

Hence, RPK needs to be legitimized and mainstreamed in formal agricultural extension, research and development processes to achieve greater fanner empowerment and sustainable rural development. This study therefore argues for strong recognition of RPK and its integration with formal scientific knowledge to achieve sustainable rural livestock improvement. Nevertheless, development agents need to be aware and mindful of limitations and weaknesses of RPK when promoting and practicing it. These weaknesses, according to Gupta (1989), are:

- ✓ IK can break down when people are faced with an environmental crisis or external interventions although the systems have some flexibility in adapting to a certain threshold of ecological change.
- ✓ Integration of indigenous people with larger societies can lead to break down of the social structures which generate indigenous knowledge and practices. For instance, the growth of national and international markets, impact of modern

Development and dictates of globalization are leading more and more to loss of indigenous beliefs, values, customs and know-how.

- ✓ IK practices are often not documented and standardized, thus limiting replication and promotion of best practices.

2.2 CONCEPTUAL REVIEW

The concepts and themes reviewed under this section, meant to provide understanding of the research subject and guide its efficient execution, include local innovation, endogenous livestock development, modern and traditional livestock systems and food security. The section concludes with examination of relevant national agricultural and livestock development policies.

2.2.1 Local Innovation

Rural people and farmers are constantly faced with numerous issues such as population pressures, social and political challenges and environmental degradation, which compel them to continuously seek for more productive ways to sustainably improve their agricultural productivity and livelihoods systems. In so doing they are constantly creating new local knowledge and innovations to adapt to the challenges. Local innovation is the process in which local people develop new and better ways of doing things using their own resources and on their own initiative, without pressure or direct support from formal research and development agents. The outcomes of rural people and farmers innovation processes therefore normally lead to local innovations that have been developed and understood and owned by them. Local innovations may include technical innovations such as new farming techniques or social innovations such as organization of farming or natural resource management activities. The ultimate aim and result of local innovation and innovations is improvement of the lives, especially the poor and marginalized people in society (Waters-Bayer, 2004).

Reij and Waters-Bayer (2001) have argued that the concept of local innovation has existed since time immemorial but has only of recent times caught increased attention and recognition of development professionals and scientists because of the failure of previous development approaches such as Transfer of Technology (ToT) and Training & Visit (T&V) to make an impact on rural Agricultural research and Development programmes in Africa. Local innovation is not however limited to new creation by local people alone. According to Sanginga (2008), it includes modifying or adapting existing knowledge, be it endogenous or externally conceived, and also encompasses both endogenous (home-grown) initiatives, and local adaptations of exogenous ideas. Local innovation and informal experimentation is constantly being undertaken by rural people throughout the world as a survival strategy in the face of dwindling resources and escalating risks which affect their livelihood systems. Reij and Waters-Bayer (2001) and Chambers *et. al.* (1989) have concluded that farmers are professional specialist in their own survival, whose creativity and knowledge has been the source of their economic and social advancement. Hence, giving recognition to their innovativeness is an entry point to building partnerships between different actors in innovation process and joint technology development.

Although rural farmers are very innovative in their agricultural and livelihood activities, it will be an overstatement to say that all farmers are innovators. Wettasinha *et. al.* (2006) have argued that apart from being very creative and effectively utilizing local knowledge and other knowledge to solve problems, local innovators are often naturally curious people who are willing to take risks and are not necessarily the 'model farmers' who have been groomed by development projects to adopt introduced technologies. Local innovators according to Millar, (2008) could be individuals, groups or entire communities, including male, female, rich or poor, depending on the context. No matter the classification, innovators have normally distinguished themselves from common practice at one time or the other.

Successful local innovation approaches and processes of rural farmers and livestock owners abound in Africa and in Ghana to support the growing importance of the concept in rural agricultural development and natural resources management. Reij and Waters-Bayer (2001) have promoted and documented farmers' innovation and innovations on land husbandry, soil and water conservation, natural resource management and women's livelihoods in countries including Ethiopia, Tunisia, Burkina Faso, Cameroun and Kenya. In northern Ghana, the Animal Research Institute (ARI) and the Association of Church Development Projects (ACDEP), a local ecumenical development network in northern Ghana, have collaborated to support local farmers' innovation in the manufacture and commercialization of local mineral lick blocks to improve livestock feeding (Spore, 2010:8). Millar (2008) has also supported and documented experiences of farmers' innovation in striga weed control in cereal crops and pests control in stored grains for food security improvement in Tuna in Northern Ghana.

Therefore, rural farmers, no matter their social or economic status, have a lot of creativity and innovativeness which need to be harnessed to develop sustainable technologies to improve their situation. Hall (2009) has however argued that farmer innovation is not enough on its own otherwise agricultural development would not face its current problems. It needs to integrate with conventional research and development (R&D) in a participatory innovation development process for sustainable results. Local innovation thus offers entry points for linking IK and scientific knowledge in a community-led participatory R&D and participatory innovation development (PROLINNOVA, 2004). The concept of local innovation is therefore relevant for this study because it underscores farmers' creativity and ability to generate new ideas and knowledge using IK and local resources, which researchers and development agents could use to develop more sustainable technologies. Through innovation, rural farmers worldwide have developed very sustainable technologies for livestock rearing. Hence IK livestock technologies and innovations deserve more attention and recognition in livestock intervention projects.

2.2.2 Endogenous Development

Western models of development dominated the world during the colonial era and after. Agriculture, education and health were based on technologies and conventional science which pursued materialistic goals. The modernization approach and modem technologies tended to replace traditional indigenous forms of development and practices which sustained the livelihoods and social systems of the early traditional societies of Africa. This development trend subjected traditional African societies to crises, manifesting in deteriorating ecological conditions; diminishing bio-cultural diversity; persistent poverty; and social, political and religious conflicts among local people and tribes. Hence Endogenous Development (ED) has emerged as a development approach which attempts to stem the poly-crisis (LENDEV, 2007).

Endogenous Development is based on local people's own criteria for development and takes into account their material, social and spiritual well-being. It is development from within and a process of change that places major importance in working with local communities and on using their own resources, strategies and initiatives as the basis for their development; and considers not only the material , but also the socio-cultural and spiritual resources of people (Haverkort *et. al*., 2003). Endogenous development draws from and harnesses local resources for development. It does not however exclude modern science and technologies, but draws from these and external resource when appropriate, to augment local resources and initiatives. Endogenous development therefore works towards sustainable, functional and people-centered development and empowers local communities to take control of their own development processes based on their local resources and strategies (Millar *et. al.*, 2008).

The foregoing emphasizes shows the relevance of ED approach to this study. An examination of the key concepts and principles of ED as they relate to the study objectives is thus elaborated as follows:

(i) *Maximizing local control of development processes.*

Conventional western development models based on modern technologies and science are often transferred to local communities as development solutions. From experience, this approach has been the major cause of failure of development interventions in rural communities. However according to Millar *et. al* (2004). ED is strongly participatory and aims to empower local communities to take control of their own development processes based on their local resources and strategies, without isolating the communities from the outside world and opportunities therein. I strongly agree with this position as a basis for sustainable rural intervention in livestock development.

(ii) *Taking cultural values seriously*

Many western-based development approaches have a narrow vision which is not founded on traditional cultures. The rich and diverse cultures of indigenous peoples' have a great deal to contribute to the new value system that is needed to achieve sustainable development. The colonial past has had a strong impact on indigenous cultures and intended to replace traditional cultural beliefs with western knowledge. This greatly limited the African capacity to solve their own problems and to develop technologies based on their own knowing (Millar *et. al*., 2005; LENDEV, 2007). This observation therefore lends support to the fact that many development interventions in Northern Ghana in the 1970s and 80s were largely unsuccessful and unsustainable because the projects failed to acknowledge local people's cultural values, cultural diversity and development agenda. An ED approach therefore enhances development by emphasizing not only on the ecological, physical and economic aspects but also focuses on the cultural resources and cultural diversity of local people as a premise and starting point for development.

(iii) *Appreciating worldviews of local people and building on local resources*

ED strongly recognizes the role of local people's worldviews or cosmovision in their development process. The cosmovision of any society or local community determines

how they use their local resources. Cosmovision is the way a certain population or a local society perceives the world or cosmos. It includes the relationship between the spiritual, the natural and the human worlds, and embodies the premise on which people organize themselves.

It also dictates the way land, water, plants and animals are used, how decisions are made, problems are solved and informal experimentation takes place (Haverkort and Hiemstra, 1999; Apusigah *et. al.,* 2008). Six categories of local resources are identified namely: Natural resources, Human resources, Produced or Human-made resources, Economic resources, Social resources and Cultural and Spiritual resources (LENDEV, 2007). ED seeks a harmonious interrelationship of all the six categories of resources to achieve a balanced, holistic and sustainable development and improved rural livelihoods. It admits that the interaction of the human, natural and spiritual spheres is key in determining and directing sustainable agricultural production where IK, culture and biodiversity are essential ingredients. Therefore sustainable development can be achieved if it seeks a balance between local and external resources and knowledge in a combination that does not sacrifice or replace the local ones.

(iv) Keeping and sharing benefits and products in the local area

Conventional projects are characterized by their high use of external inputs and sophisticated technologies with the aim to maximize production output. Most often the technologies have led to overexploitation of the natural resources, with detrimental ecological consequences on rural production and livelihood systems. However, Apusigah *et. al.* (2008) and Ploeg (1999) have argued that ED leads to local control of development processes and the retention of the benefits of development within the local area. It also builds local capacities which empower local communities to solve their own problems with available resources.

The foregoing examination makes ED a very important development concept which must be exploited to empower rural communities to realize their development goals by looking more from within, using local knowledge, capabilities and resources. It is only then would agricultural development interventions ensure sustainable impact on rural people. Therefore designing and implementing livestock technologies and interventions from an endogenous development perspective is key to achieving sustainable livestock development and food security in rural Northern Ghana.

2.2.3 Endogenous Livestock Development

Endogenous livestock development (ELD) is an approach which puts the farmer or livestock owner at the centre of livestock development instead of focusing on production goals alone, as is characteristic with conventional approach. ELD therefore uses an endogenous development approach to livestock rearing and is people-focused (van't Hooft *et. al.,* 2008). Furthermore, ELD is an approach that puts the livestock keepers' own strategies, culture, views, beliefs, values and aspirations at the centre of development efforts and determining factors for livestock rearing. It is a people-centered approach rather than an animal-productivity centered and thus stands for supporting the husbandry systems based on the livestock keeper's own innovative strategies, local capacities, knowledge, initiatives and resources (van't Hooft, *et. al.,* 2005; 2008).

Livestock are not only critical in rural poverty alleviation. Development experts and researchers are therefore continuously seeking ways to improve livestock productivity, but have often encountered difficulties due to inappropriate approaches and technologies. Conventional approaches have focused on increasing animal productivity rather than on strategies of the livestock keepers themselves, hence making long term sustainable livestock development elusive. Millar (2003) and van't Hooft *et. al.* (2008) have indicated that ELD enables us to appreciate that livestock keeping take place within a complex and integrated cultural and agro-ecological systems and livelihood activities in

which various species play multifunctional roles in human society such as economic, ecological, agricultural, cultural, spiritual and social roles. These roles include provision of manure and draught power, food security, income, employment, rituals, festivals and funerals. Hence these multi-functional roles should be included in livestock development initiatives in order to achieve holistic development and poverty reduction among rural communities.

The ELD approach provides a better understanding of local people's worldviews about livestock and human-animal relationship. Van't Hooft *et. al.* (2005) have stressed that if development experts and field worker have an appreciation of this relationship and dimension, they would be able to support farmers agricultural and livestock improvement initiatives more effectively. It is within these worldviews that fanners interpret development and define their relationship with outside knowledge and agencies. Supporting and promoting ELD approach should not however be misunderstood or misconceived as unprogressive and conservative because ELD's emphasis on farmers world views, spiritual and cultural values in addition to the economic and social values. Van't Hooft *et. al.* (2008) have intimated that when local peoples IK, culture and resources are properly combined with appropriate external inputs within an ED context, it enhances productivity and could produce livestock for the local, national and international markets. Apusigah *et. al.* (2008) have thus concluded that ELD approaches and innovations including; ethno-veterinary medicine, community-based management of animal genetic resources or indigenous breed improvement, livestock keepers rights and organic animal husbandry, have the potential of increasing livestock productivity of rural people if carefully developed.

The concept of ELD will therefore guide the field investigation and analysis of this study because it encourages and motivates livestock keepers to build on what they already do, drawing on their IK. It also supports and strengthens livestock development

technologies and innovations which are based on farmers own knowledge, resources and worldviews, thus enhancing sustainability.

2.3 LIVESTOCK PRODUCTION SYSTEMS

About 75% of livestock in Africa is owned by small-holder rural farmers who derive their subsistence from crops, with livestock providing the major source of cash income (van't Hooft, 1999). Livestock rearing in Africa is classified under varied management and production systems based on various factors and criteria. These include type of agricultural system , socio-cultural factors, the degree of movement of animals (nomadic, transhumant, sedentary), geographical considerations, land use intensity, the type of animal or associated crops, and the production objectives such as cash, meat, milk and fibre (Wilson, 1995). Notwithstanding these various classifications, the classification by Pagot (1992) and Wilson (2005) into modern (intensive) and traditional (extensive) production systems, appears more defined and comprehensive and will thus be my basis for reviewing livestock systems.

2.3.1 Modern Livestock Systems

These systems are commercial and market-based systems, which depend on heavy capital investment and advanced technology. They are intensive, sedentary and more specialized in production output. The most common types are; ranching, fattening, dairy production and research stations (Wilson, 1995). Intensive systems contribute immensely to food security by providing nearly 45% of the world's meat supply, a relatively cheap source of protein for the world's growing urban populations (Pagot, 1992). Common modern livestock systems are described below.

(i) Ranching

Ranching systems consist of labour-intensive enterprises specializing in one or more livestock species and producing mainly live animals for meat, skin and hides and milk. It

relies on exclusive exploitation of natural pastures within fixed grazing boundaries where farm structures such as stock marshalling enclosures and watering points are reduced to absolute minimum. The stock rate per hectare of pastures is extremely low to enable stocks to exploit large areas of the pastures. Ranches are more suitably established in countries and regions with low population density and tend to be replaced by more agricultural-based livestock systems as human population density increases in those areas (Pagot, 1992). Ranches generally exhibit improved herd, pasture and water management. Ranching of cattle for beef and milk production dominates this system.

Ranching is distinguished from other livestock systems based on the following features; the rancher produces the livestock and animals for sale and holds the land on a private and individual basis; the system uses a permanent base with very much limited movement of stock; and it normally involves one type or even a single breed of livestock (Poostchi, 1986). In Ghana, many government-owned ranches established in the 1960s and 1970s have collapsed due to poor management and changes in agricultural development policy.

(ii) Fattening

This production system refers to the preparation of animals for butchering. Fattening is achieved not only through improvement in feeding, but also by improving genetic qualities of animals to increase the efficiency in feed utilization, and improvement in the environmental conditions. Fattening is mostly associated with intensive and semi-intensive rearing systems. Feed sources essentially include forage and agro-industrial by-products (molasses, bagasses, crops wastes, cotton seed and silage). Fattening techniques have enabled tropical cattle breeds which are often suppressed by natural conditions to achieve their potential. The system also makes profitable use of agro-industrial by-products and crops residues which normally go wasted, and the finishing of animals coming from extensive rearing situations (Pagot, 1992). The following fattening techniques are identified based on feed type and management approach:

✓ *Grass fattening:* Animals destined for slaughter are fed on best reserved pastures. The animals are permanently maintained on this pasture, sometimes with small supplementation with minerals or concentrate.

✓ *Intensive fattening:* Animals are confined in feedlots or pens where they receive a completely balanced ration of forage, concentrate feed or diverse agro-wastes. The technique has high potential in regions where agricultural activities produce considerable amounts of residues and by-products.

✓ *Industrial fattening:* This technique uses wastes or by-products from industrial processing activities from sugar refineries, oil mills, breweries, cotton ginneries, fruit canneries. These feeds are supplemented with forage in order to provide part of the protein or energy requirement of the diet.

In Northern Ghana, traditional fattening of small ruminants with local feed products for special purposes and ceremonies exists among rural farmers and urban dwellers. Apiiga and Shittu (2002) have noted that in such fattening process, the animals are confined in stalls around the compound and fed with dried groundnut haulms, bean vines, soya husks, cassava peels, dried remains of millet porridge and pito wastes.

(iii) Dairy Farms

This is a modern intensive livestock system that involves the management of cattle purposely for milk production. Rapid urbanization in the eighteenth and nineteenth centuries has led to increase in milk consumption and thus compelling the intensification of production. Before then, in most cases in Africa, the level of milk production from local breeds was enough to satisfy the needs of traditional societies who were mostly pastoralists. Exploitation of cattle for milk is in fact one of the ancestral features of indigenous pastoral economies in Africa. The major part of cattle production in Africa is still the premise of traditionally specialized populations who lived symbiotically with the cattle for a livelihood and had only entered the market economy in the last decades

(Pagot, 1992). Hence modern livestock systems have evolved from the traditional extensive systems following the emergence of industrialization and market economies.

2.3.2 Traditional Livestock Systems

Traditional livestock systems are more widespread in Africa, where livestock provide a major source of livelihood for rural societies. These systems are managed mostly by small scale rural farmers for subsistence and provide over 50% of the household income. Extensive small scale systems have traditionally made a very important contribution to food security and livelihoods. Grazing of animals can convert grass, crop residues and household waste into food (meat, milk) draught power and soil fertilizer (Neumann *et. al.,* 2002). Traditional systems rely to a large extent on IK and traditional practices as well as local resources as inputs, with the natural vegetable providing the main feed resources. Pagot (1992) and Wilson (1995) have identified four main types of traditional livestock systems namely; Pastoral (nomadism, transhumance), Agro-pastoral, smallholder mix farming and peri-urban landless systems.

(i) Pastoral System (Nomadism and Transhumance)

Over 180 million people in developing countries broadly termed “pastoralists” depend on rangelands for their livelihoods. Pastoralism is an effective and efficient land use system for livestock production in these areas, characterized by low rainfall and high rainfall variability (Flintan, 2010). In this system the herder or livestock keeper uses the natural vegetation for extensive grazing of his animals. This system is practiced mainly in the semi-arid areas where the quest for scarce water and forage compels continuous movement of the stock. In the arid and semi-arid regions the vegetation is sparse and the amount of feed available for the animals is very limited, hence an unending search for feed. It thus becomes a natural practice and habit to move hundreds of kilometers because the food supply and water at any given time and place is limited (Poostchi, 1986).

Pastoralism is heterogeneous, comprising nomadism and transhumance rearing systems. Nomadism is a non-cyclical movement of herds and encampments or migration for feed in response to a risk or destruction or depletion of the vegetation and water at a given location. This therefore means that nomads have no permanent homes but move between established territories and pastures. Transhumance is a regular cyclical seasonal movement of herds in synchrony with the rainfall regime in order to exploit forage and temporary water resources. Therefore, whereas nomads and their herds are almost continuously on the move, transhumants migrate seasonally between wet-season and dry-season pastures (Pagot, 1992).

The Fulani in West Africa and the Turkana in East Africa who are transhumant have permanent bases in areas of seasonal crop production. In the rainy seasons they move into tropical savanna and desert scrub, and return to cultivated areas in the dry season where their animals feed on crop residues. Transhumant herders may also depend on crop cultivation besides their mainstay livestock rearing. They may plant millet at the start of the rainy season, leaving the crop to grow while they herd their livestock to more northerly pastures, returning to harvest their crop when the season is over. Pastoralism is practiced among the Baggara Arabs in Sudan, the Massai in East Africa, and the Tuaregs in Mali, Niger, Algeria and the Fulani (Gatenby, 1991).

The major part of pastoral herders (nomads) food such as milk and dairy, and income come from their livestock. Meat is used sparingly and animals are only slaughtered at special occasions such as weddings and festivals or when the animal is dying from sickness (Poostchi, 1986). This shows the multi-purpose role of traditional rearing systems. One negative aspect of pastoralism however, is the communal grazing of pastures which often leads to severe land degradation and soil erosion. This has often caused conflicts with settled farming communities, whose agricultural livelihoods are threatened by grazing activities. Apart from environmental issues, the once sustainable pastoral systems are increasingly facing political and social challenges which compel them to adopt new strategies for survival. They are reducing their movement and starting

to rely more on crop production than their traditional livestock-dominated livelihood systems (Niamir, 1990). This has had a serious impact on their access to and control over resources (land, pastures and water), and on the social relations linked to these resources. Yet, according Wilson (1995) and van't Hooft, 1999), pastoralism is a system that adds value to vast areas which cannot produce anything else.

(ii) Agro-pastoral Systems

Many pastoralists are becoming agro - pastoralists by closely integrating their livestock with subsistence crop production. Wilson (1995) has described an agro - pastoral system as a livestock production system in which 10 -50 % of total income is derived from livestock or livestock products. Agro - pastoral systems differ from the pure pastoralism in which livestock and its products (milk, etc) provide the main source of livelihoods. It also differs from the smallholder mixed cropping in which arable crop farmers engage in livestock production as a supplementary livelihood, with the components interacting in a mutually supportive system.

Agro - pastoralism offers many advantages such as food for the livestock keeper, manure and crops residues for the livestock. According to Gatenby (1991), apart from better access to crops residues, pastoralist are becoming more sedentary and integrating their livestock with crop production for the following reasons:

- ✓ The inability to survive on livestock products and revenues because of drought or disease.
- ✓ Pastoral husbandry systems are becoming more difficult to sustain due to the encroachment on grazing land by crop producers.
- ✓ Enactment of policies and sanctions which restrict cattle movement.
- ✓ The need to obtain access to veterinary services and social amenities such as education and health.

Agro-pastoralists may be either transhumant agro-pastoralists, who crop at a location but move all or most of their livestock to other grazing areas during the cropping season; and/or sedentary agro-pastoralists, who keep livestock throughout the year near cropping activities. The Fulani in northern Nigeria are well known for practicing both systems. They grow crops such as millet and sorghum, which are adapted to hash semi-arid conditions. Food legumes such as cowpea and groundnuts are grown in better areas, as well as peppers and vegetables, which are planted close to the home compound where manure from kraals can be applied (Wilson, 1995).

(iii) Smallholder Mixed System

This system is a combination of livestock rearing and crops production that enables complementary interactions between the two systems. It is the most prevalent livestock system among small-scale rural farmers in developing countries. MOFA (2001) has described mix farming as the most dominant system in Ghana, accounting for 95% of livestock production. Until the mid - 1970s, the advantages of integrating crops and livestock production in tropical smallholder farming systems had largely escaped the attention of research and development. As observed by Wilson (1995), since that time there has been a gradual change in emphasis, with more attention paid to the livestock component and its links with the cropping enterprise. This was more necessitated by sustainability concerns associated with intensive mono-cropping systems of the Green revolution era which relied on the use of external chemical inputs.

The complementary functions of crops and livestock in mixed farming system are important in sustaining the system, enhancing productivity of each component and providing diverse benefits. In mixed farming systems, livestock provide manure to improve soil fertility thereby increasing crop productivity. When animals consume vegetation and produce dung, nutrients are recycled more quickly. Grazing livestock transfer nutrients from range to cropland. Reijntjes *et. al.* (1992) have corroborated that in rural communities, manure from livestock is a more sustainable and appropriate means of

fertilizing farmlands. This is more so, given the increasingly high cost of chemical fertilizers and their long-term destructive effects on soil, coupled high rate of soil degradation. Hence organic manure from livestock remains an invaluable low-input local resource for sustaining crop production for smallholder farmers.

In mixed integrated systems livestock also provide draught power in tilling the land and providing transportation mainly in the form of animal drawn carts. Draught power (including animal traction) increases cultivated area and crop yields, uses lower levels of external inputs and is more affordable for rural smallholder farmers than tractors. On the other hand, crops directly contribute to livestock by the providing feed and fodder. Crops residues and by-products are efficiently used as livestock feed who intend covert this to soil nutrients through manure. Forage crops also play an important role in nutrient transfer within the farm by providing better quality feed which, in turn results in quality manure.

The economic benefits of livestock in a mixed system to the smallholder farmer are numerous. According to Karbo and Bruce (2000), the cultivation of crops and rearing of sheep, goats, cattle and pigs contribute in diverse ways to the livelihoods of rural farmers in Northern Ghana. Livestock provide cash for investment in crop production activities and purchase of food especially in the lean periods when the food stocks run out. Apart from contributing about 45% of the family income for meeting food and other basic needs, livestock also provide employment through trading of products such as hides for handicrafts and leather works.

Hence mixed farming systems make the most impact on rural food security and livelihoods in Northern Ghana than any other livestock systems because of their high potential for diversification and sustainability, in addition to its high dependence on low external inputs and indigenous knowledge.

2.3.3 Sustainability of Traditional Livestock Systems

The over-riding goal of any traditional production system is not achieving higher productivity alone, but more importantly, to attain sustainability in the ecological, economic and socio - cultural dimensions. Reijntjes *et. al.* (1992) have referred to sustainability in agriculture as successful management of resources to satisfy diverse and ever-changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources. Thus sustainable production systems must be ecologically sound, economically viable and cost - effective and socio - cultural fair and just. From the foregoing it is therefore clear that sustainability is judged by the interplay of economic, ecological and socio-cultural criteria, and any conflict among the criteria may affect the balance and sustainability of the production system.

(i) Economic criterion.

The pre-requisite of any livestock system is that it should be profitable and capable of meeting the economic objective of producer in addition to other needs. Production should therefore aim to achieve cheaper production costs and higher income returns (Preston and Murguitio, 1994). Fortunately due to their integrated nature and high dependence on the natural environment and resources, traditional systems largely utilize locally - available and cheap inputs and feed resources including pastures, fodder, crops residues and agro-wastes, thus minimizing the use of expensive external inputs. Management of the livestock systems with respect to labour requirements, skills and technologies, is often largely derived from indigenous knowledge resources of the livestock owner, thereby minimizing overall cost of production and reducing risks. Thrupp (1989) has argued that IK technologies and know - how have an advantage over external ones in that they rely on locally available skills and materials and are often most cost - effective than introducing exotic technologies. This makes economic sense.

The diversity of traditional production systems, which often integrate livestock keeping and crop production, tend to spread the risks through diversification of benefits from both components, thus increasing the economic stability and sustainability of the system. According to Reijntjes *et. al.* (1992), spreading risks in mix-system may lead to lower productivity within each component, but total production per unit area may be achieved as yields of both crops and livestock can be gained from the same area of land. Diversification associated with traditional systems also minimizes market risks because of diversified market opportunities for the products. However, a major threat to the economic sustainability of traditional systems in Ghana is the increasingly uncompetitive domestic market for traditional products, caused by flooding of the markets by cheaper highly-subsidized foreign substitutes (frozen beef, chicken, pork etc), due to liberalized trade policies and the dictates of globalization.

(ii)Agro-ecological criterion

In traditional smallholder mix-systems, livestock rearing and crop production are closely integrated. Crops provide feed and fodder, while in turn, livestock supply draught power and manure, as well as milk and meat as sources of cash income. Nutrients from trees, grazing lands and crops residues fed to animals are recycled back to crop lands as manure. This complex symbiotic interrelationship between trees, grazing land, livestock, crops and soil components in the ecosystem contributes to the ecological and economic sustainability of the production system.

In mix livestock systems, an increase in crops production leads to greater availability of by-products and biomass as feed for livestock, leading to enhanced production and sustainability. Thus, a traditional smallholder mix production system is more sustainable by incorporating the principle of recycling so that biomass and residues are managed as inputs for production, thus reducing the cost of external inputs. The advantage of mixed or integrated production system is that there are complementary activities played by the different components within the system, such that the residues or outputs from one activity are inputs for the other components (Preston and Murguitio, 1994).

From this discourse therefore, sustainability requires that the interactions among the production components must be constantly maintained, managed and controlled for equilibrium, without which the system is disrupted and productivity and sustainability are compromised. To this end, Dankelman and Ramprasad (1999) have alluded that properly managed livestock production systems can enhance land and water quality, biodiversity, and social and economic well-being. However, improper management may cause significant economic, social and environmental damage. For instance, overgrazing, overstocking, deforestation, burning, overuse of chemical inputs and pollution tend to disrupt natural ecological processes, thus leading to unstable production.

Therefore in seeking to achieve ecological stability and sustainability in order to optimize production, the technologies and management practices of traditional production systems must be unpinned and guided by sound agro-ecological principles and ideals.

(iii) Socio-cultural criterion.

Sustainability of traditional production systems should not be considered only from the economic and ecological perspectives, but must be viewed and managed from an endogenous livestock development context if the economic, social, cultural and spiritual objectives of rural producers are to be holistically met. Endogenous livestock development (ELD), according to van't Hooft *et. al.* (2008) recognizes that livestock keeping takes place within a complex agro-ecological system in which animals play multi-functional roles namely agricultural, economic, social, cultural, spiritual and ecological, ultimately leading not only to higher productivity and sustainability but also the wellbeing of the livestock keeper and harmony between humans, animals and the spiritual world. Hence it is important that rural production systems conform to endogenous development principles to be more relevant and for sustainability.

LIFE Network (2008) have alluded to the fact ELD-based production systems are sustainable because they are driven by the livestock keepers using their IK; they are environmentally friendly through the use of local resources which conserve the environment; and they make economic sense by using fewer expensive external inputs, generate competitive levels of outputs and are profitable. Traditional production systems also achieve socio-cultural and economic sustainability by promoting diverse traditional breeds which are well adapted to local ecological conditions for meeting different socio-cultural needs, while preserving genetic diversity for future generations.

In endogenous development production systems, agro-ecological and ethno-ecological production systems interact harmoniously in the context of IK to achieve increased productivity and sustainability of the system. While agro-ecological processes aim more to achieve productivity, ethno-ecology, which includes cosmovision, culture, IK, folk taxonomies issues, is geared at attaining sustainability of the production system. Hence interaction of the two components enhances productivity and sustainability of traditional production systems, and also promotes spiritual harmony and wellbeing of rural people (van't Hooft, 1999). Hence, it is important for livestock systems to be managed with a sustainability lens, in which interventions, technologies and practices integrate economic, ecological and socio-cultural sustainability issues, in order to achieve higher productivity, reduce recurrent food insecurity and alleviate poverty in rural smallholder households in northern Ghana.

2.3.4 Women in Livestock Production

Livestock act as financial, social and natural asset, contributing to the livelihoods of about 70% of the world's rural poor women and men. For many of these women and men, livestock provide a source of food security, income and primary savings and insurance against difficult situations such as hunger, illness, death and natural disasters (Dorward *et. al.*, 2005). Women play a major role in livestock production which is often underestimated or worse, ignored. This is explicitly expressed in their often limited

control and ownership of livestock assets and resources. In most traditional production systems women provide labour for various tasks in livestock management, including collecting and storing fodder, feeding and watering the animals, caring for sick animals, cleaning the pens and kraals and milking. However they often have less control over decision-making process regarding the disposal, sale and use of the products and proceeds. Similarly, women generally have less access to the means of production in comparison with the extent of their labour contribution to family livestock production.

The disadvantaged position of women in livestock production is universally known. Niamir-Fuller (1994) has observed that though women are the main actors in poultry, small ruminant and micro-livestock production, as well as processing and marketing of milk and milk products, increasingly their labour contribution remain underappreciated and less rewarded. Furthermore, Okali (2004) has indicated that in societies where women manage only the domestic livestock, they may not control the overall management strategies such as animal disposal and marketing. For instance, among the agro-pastoral Fulani of Nigeria, women control milk processing and marketing but do not milk the animals or have control of decisions on selection of grazing sites, length of grazing, feed supplementation, veterinary care and breeding, all of which affect milk production.

In northern Ghana, within the smallholder mixed production systems, women play key roles in supporting their husbands and families to raise goats, sheep, cattle, guinea fowls and pigs. These roles include feeding, watering, tethering, cleaning the kraals, plastering animal pens and carrying and applying manure to crops. Yet patriarchal - dominated customs do permit them to own or inherit vital household property and assets such as land, houses, and cattle and in some cases small ruminants, to support their livelihoods. They most often do not also control the income from livestock which they have helped to raise, in order to pay for their energy and time investments. According to CIFS Livestock Report (2009), women beneficiaries of the CIDA - funded Community-Driven Initiatives for Food Security (CIFS) project in northern Ghana contributed approximately

70% of their labour in managing small ruminants as comparea to Jun) oy men; out we men were responsible for selling the animals and appropriating the income. These issues have continued to work against women's progress in rural societies, thereby perpetuating gender inequality and poverty among them.

The gender asymmetries in access and control of livestock assets and productive resources have vast negative impacts on women's development, rural food security, livelihood improvement and preservation of indigenous knowledge (IK). In view of the significant role of women in livestock production, it is therefore necessary to address gender concerns in the sustainable management of rural livestock. According to World policies and programmes, higher level of poverty and food and nutrition insecurity. Hence addressing ownership issues can enable women to earn substantial incomes from livestock to improve their livelihoods and better develop their children. Thomas-Slayter and Bhatt (1994) have alluded to the fact that disproportionate challenges facing women regards their limited access to assets, credit, services and technologies tend to decrease their ability to improve productivity and benefit from a growing livestock sector. Therefore addressing these issues, mainstreaming gender in rural livestock production and development initiatives, and also eliminating negative traditional customs and beliefs which prohibit women's involvement and ownership of livestock, can bring sustainable and equitable benefits, including improved productivity, food security, incomes and reduced poverty.

Rural women in northern Ghana and elsewhere in developing countries also have considerable indigenous knowledge in livestock production because of their close involvement in daily care and tending of livestock. Such knowledge often includes animal management, healthcare, feeding, watering, breeding and use of animal products. Similarly, Niamir-Fuller (1994) has observed that women in the Dhamar Plains of Yemen have detailed knowledge about the best kinds of local feeds for different animals.

Food access: This connotes access by individuals and households to appropriate foods for a nutritious diet. An adequate supply of food at the national or international level does not in itself guarantee household level food security. People's access to food depend both on the purchasing power of their income and on their non-market entitlements including land. Households seeking to preserve food security levels may resort to a number of coping strategies to gain access to food such as; maintaining normal income generating patterns, innovative use of available resources, divestment of productive assets, and out-migration and destitution.

Food utilization: This relates to the utilization of food through adequate diet, clean water, sanitation and health care in order to reach a state of nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs in food security.

Food Stability: To be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity). The concept of stability can therefore refer to both availability and access of food security.

2.4.2 Types of Food Insecurity

There are two types of food insecurity, which are closely intertwined. These are chronic and transitory food insecurities. FAO (1992) describes chronic food insecurity as persistent inadequate diet caused by persistent inability of households to acquire needed or adequate food, either through market purchases or production. Chronic food insecurity arises out of inadequate assets and resources and thus rooted in poverty. Transitory food insecurity, on the other hand is a temporary or short - term decline of availability and access to food by households due to instability of food prices, incomes and food production. Transitory food insecurity, which can also affect communities and larger

Furthermore, Masai women of Kenyan Highlands have extensive indigenous knowledge about range and natural resource management and natural water resources which the animals depend on. According to FAO (2002) rural women are custodians of local knowledge and contribute to the enhancement of indigenous animal bio-diversity. They are also knowledgeable in ethno-veterinary medicine. Therefore an understanding of women's IK of livestock production is a key factor in upgrading knowledge in rural production and also developing or adapting appropriate technologies to meet women and gender needs in livestock production.

Therefore the various roles and contributions of rural women in traditional livestock production needs to recognized and supported in order to achieve sustainable household food security, poverty reduction and rural socio-economic development.

2.4 FOOD SECURITY

Food security is one of the issues being investigated by this study. This section discusses the concepts of food security and food insecurity, explains the inter-linkage between global, national and household food security and the influence of policies and concludes with case examples of food security interventions in northern Ghana.

2.4.1 Concepts of Food Security

he World Food Summit held in Rome in 1996 defined food security as: *when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life* (FAO, 2006:2). This definition points to four dimensions of food security as follows:

Food availability: The availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports. Food availability is determined by the level of food production, stock levels and net trade. However food may be available but a household may not have access because it lacks the means to access it.

populations of a country, arise from shocks, economic failure, human induced situations as well as natural disasters. A combination of both chronic and transitory is prevalent in rural communities of Northern Ghana where poverty is high and the main source of livelihood is seasonal crop production, which is increasing being constrained by climate change effects and rapid environmental degradation.

2.4.3 Global, National and Household Food Security

Both developed and developing nations are constantly confronted with food insecurity at the regional, community and household levels. In the developed nations the problem is addressed by targeted policies and food security intervention programmes including food relief, increased food inputs and subsidized agricultural production. In the developing nations, Mwaniki (2003) has however observed that the magnitude and severity of the problem is higher and intervention measures have often failed to successfully address the situation due to factors including; insufficient resource base (economic and natural resources), short duration of interventions, wars, political instability and climatic and environmental factors. She concludes that the root cause of food insecurity in developing nations is poverty which undermines people's ability to gain access to food.

National, regional, and household food security are interrelated, with consequential effects on each when a variation in food supply occurs at a particular level. In this era of globalization, international food security can even have a much greater impact on national and local food security. Although adequate national or local food availability remains a necessary condition for household food security, it does not automatically lead to food security for all households as poor households may lack the means to produce or purchase the food they need (FAO, 1992). Hence any national policy or strategy aimed at sustainable rural and household food security should holistically and comprehensively approach the issue from the national to the local level.

Inadequate policies and their effective implementation have been identified as a major constraint to achieving sustainable food security at the global, national and local levels. According to Mwanike (2003), although an array of policy options may exist, the choice of any problem the nature of the food insecure pro of a country's food security capacity. The selected policy need to ensure that all households have the means to secure the food they need on a sustainable basis. Consequently, Dittoh (2009) has argued that the challenge confronting Ghana is a general weakness and neglect in formulating and implementing realistic and sustainable food security policies, or how to adopt the appropriate policy mix to meet its national food security needs. MOFA (2004:1) similarly agrees that: *"The undesirable pace of livestock growth and development in the country is attributed largely to inadequate, ineffective and inefficient policies and strategies to implement them"*.

Gittinger (1990) has reported that over 70% of the food insecure populations in Africa are rural people, yet a bulk of the continents food supply is attributed to rural smallholder farmers. Mwanike (2003) has attributed the unsustainable food security in Africa to its under developed agricultural sector, use of unsustainable production technologies, environmental degradation and rapid loss of soil fertility leading to low productivity, as well as high input prices, low product prices and unfavourable global trade policies. According to ACDEP (2003) the major factors which pose a threat to food production and food security in Ghana include; irregular climatic conditions (rainfall and drought), soil degradation, outbreak of diseases and pests, bushfires, poor infrastructure (roads, storage facilities etc), rural-urban migration, ethnic conflicts, unfavourable government policies and inappropriate technologies.

2.4.4 Food Security Intervention in Northern Ghana

High poverty in rural areas, coupled with declining agricultural productivity is the main causes of food insecurity in rural communities and households in northern Ghana. The

reliance on a single rain-fed agricultural season in the region, coupled with few alternative livelihood opportunities, often leads to seasonal food shortages, with poorer households bearing the most brunt. Rural people of northern Ghana derive their main source of livelihood and food security from traditional subsistence agriculture which is based on mixed farming systems. The main crops such as maize, rice, sorghum, millet, beans, groundnuts and yams directly provide families with food, while the surplus produce is sold for income to meet basic family needs. Livestock mainly goats, sheep, poultry (including guinea fowls), and pigs are reared in almost all households for incomes for meeting basic and urgent needs and to augment food security. In fact, with the annual recurrent food insecurity situation in rural households, livestock rearing has become a very important source of livelihood and coping strategy in the most difficult famine periods. Livestock provide a security against crop failures and are frequently sold to buy food during the hunger period when the food stocks are exhausted. MoFA (2004) has intimated that livestock indirectly increases availability of food by providing inputs for crop production, sustains livelihoods, and provides quick income to rural households for buying food during crisis periods.

The increasing poverty and food insecurity situation of rural communities in northern Ghana have thus led to sustained development intervention of government agencies, nongovernmental organizations (NGOs) and bilateral international agencies. The Canadian International Development Agency (CIDA), UNICEF, the World Food Programme (WFP), World Bank (WB) and FAO are but a few international agencies which have assisted and funded development programmes for food security and poverty reduction. The Community-Driven Initiatives for Food Security (CIFS) is a 7-year CIDA-funded project which aims to improve household food security in ten Districts in the Northern Region, by supporting community-based and district-wide food security initiatives. CIFS also strengthens decentralized local government structures to support community-driven development, civil society and local government working together to improve food security (CIFS, 2009).

The Ministry of Food and Agriculture (MoFA), Savanna Agricultural Research Institute (SARI) and Animal Research Institute (ARI) have relentlessly promoted agricultural production and food security improvement using collaborative action research and extension strategies. CARE International, Action AID-Ghana, Opportunities Industrialization Centre International (OICI) and have made a significant contribution towards improving rural livelihoods and food security in the Northern Region, using small ruminants improvement, crops value chain enhancement, climate change adaptation and micro-finance income generation strategies. Local NGOs like Association of Church Development Projects (ACDEP), and its network NGOs in the three Northern regions have also played enormous roles in addressing poverty and food insecurity in deprived communities, using sustainable and low-input technologies and participatory approaches and best IK and conventional technologies (ACDEP, 2003).

Dittoh (2009) has argued that despite these intervention efforts, poverty and food insecurity still persist among the rural folk. Empowering communities to champion their sustainable development agenda is still far from being achieved as development projects are often not designed based on felt needs of the beneficiaries, neither are they based on their understanding and approaches to development.

2.5 AGRICULTURAL DEVELOPMENT POLICIES IN GHANA

2.5.1 2.5.1 Introduction

The Ministry of Food and Agriculture (MOFA) has the overall mandate and responsibility for formulating and implementing national agricultural development and food security policies in Ghana. MOFA's overall goal is create an environment for sustainable growth and development of the agricultural sector that would ensure food and raw material security, higher employment, reduction in poverty, wealth creation, as well as increased GDP and foreign exchange earnings (Agricultural Extension Handbook, 2006).

Consequently various national agricultural development policies have been formulated and implemented to achieve this goal. The policies include the Medium Term Agricultural Development Project (MTADP), Accelerated Agricultural Growth and Development Strategy (AAGDS) and the Food and Agricultural Sector Development Policy (FASDEP). The livestock sub-sector policies, which aim to reduce poverty, improve food security and reduce imports, in an environmentally sustainable manner (MoFA/DFID, 2002; MoFA, 2004), are the National Livestock Services Project (NLSP) and the Livestock Development Project (LDP). This section examines these national agricultural policies and programmes in context of the objectives of this study.

2.5.2 The Medium Term Agricultural Development Programme (MTADP): 1991- 2000

Following the Economic Recovery Programme (ERP) and the Structural Adjustment Programme (SAP) in the 1980's, the MTADP was developed to further enhance agricultural development in Ghana. It was designed to respond to the Vision 2020 goal, and provided an overall framework for an agricultural policy which aimed to build a conducive enabling environment for promoting national growth and development. The specific goals were to improve national food security, create employment opportunities, increase essential agricultural products that will be very competitive both in the domestic and export market to maximize foreign exchange. It also aims to promote a balanced regional growth that will improve the poverty gap between poor and more endowed regions (MTADP Report, 1991; FASDEP, 2003).

Although this programme emphasized improvement in food security, the overall impact on food security, especially for rural poor was not felt. Furthermore, the institutional reforms introduced by the programme only helped to improve MoFAs efficiency in service delivery, which did not translate into the expected improvement in agricultural productivity and food security. Again, the privatization policy reforms which aimed to improve efficiency and sustainability rather became a disincentive for rural agricultural production since inputs subsidies were removed, thus creating unfair markets for local

agricultural products. In fact, Millar (2008) has pointed out that the role of indigenous knowledge suffered a set-back under the IMF and World Bank-led privatization policy, because the concept does not fit the psyche of capitalists principles, and that there was also undue emphasis on non-traditional exports to the disadvantage of indigenous food production and feeding.

2.5.3 Accelerated Agricultural Growth and Development Strategy (AAGDS): 2001-2007

The AAGDS succeeded the MTADP, and aimed to increase national agricultural growth rate to between 6% and 8% to enable Ghana to become a middle income country by 2020. The AAGDS which also sought to enhance the Vision 2020 development policy, promoted strategies to further transform the agricultural sector through new policy reforms and programmes. One of these was the Agricultural Services Sub-sector Investment Programme (AgSSIP) which aimed to promote equitable growth, poverty reduction and food security by improving access to markets and technology, and enhancing human and institutional capacities. A key focus of AgSSIP was to improve rural infrastructure and access to agricultural financial services that will enable rural farmers in particular to improve production, storage and transport of farm produce to markets (MoFA, 2004; Agricultural Extension Handbook, 2006). A major underachievement of AADGS was the fact that rural small-scale producers were not empowered to sustainably increase agricultural output, improve food security and rise above poverty. Furthermore, according to Millar (2008), though the policy framework emphasized private sector development and greater support for small-scale farmers, opportunities were not created for them to realize their potential.

2.5.4 Food and Agricultural Sector Development Policy (FASDEP): 2003-2015

FASDEP is a holistic policy framework of MoFA which takes cognizance of all on-going efforts in the agricultural sector. It adopts a sector-wide approach to managing agricultural development as against the discrete project approach pursued in the past.

This is against the background that implementation of agricultural projects in the past has been largely uncoordinated, resulting in duplication, wastes of funds and low impact. FASDEP is therefore to effectively and efficiently utilize available and limited resources, promote substantial investment and technological resources within the private sector and modernize agriculture as a catalyst for national growth and rural transformation (FASDEP, 2003).

FASDEP is implemented under the broad national development agenda and policy frameworks of the Ghana Poverty Reduction Strategy (GPRS I) and the Growth and Poverty Reduction Strategy (GPRS II). Hence it is expected to contribute to equitable growth and poverty reduction through agricultural development. The strategic focus of FASDEP is in three intervention areas, namely (FASDEP, 2003; Agricultural Extension Handbook, 2006):

- ✓ Rural infrastructural development such as roads, irrigation, storage and market facilities, to link rural production to markets for increased incomes.
- ✓ Development and dissemination of appropriate technology to increase productivity of crops and livestock, and enhance value addition.
- ✓ Provision of efficient and relevant pro-poor extension services to empower farmers towards increased productivity, food security and poverty reduction.

FASDEP has so far made some modest improvement in the coordination and implementation of the agricultural sector projects and rural infrastructure (feeder roads, market infrastructure and irrigation facilities). However agricultural extension has not been adapted to empower rural farmers for sustainability, through effective harnessing of local resources and farmers' own agricultural knowledge and capabilities. The promotion of appropriate technology which is a focus of FASDEP appears to target modem technologies, and neglecting the development of rural appropriate technologies that are more suited to rural ecological, production and socio-cultural conditions.

2.5.5 National Livestock Services Project (NLSP): 1992-1999

The NLSP was developed to support the Medium Term Agricultural Development Programme (MTADP) and therefore conformed to the privatization, decentralization and liberalization policies introduced by the MTADP. The specific goals of NLSP were to improve access to livestock health services, improve production technology and breeding and better range and natural resource management. The major strategic institutional and policy reforms pursued by NLSP were; full cost recovery for production and veterinary services, restructuring MoFA's animal production and health services, and community participation in livestock development services (MoFA, 2004).

The NLSP made significant contribution to livestock development in Ghana , with key successes in improving mass vaccinations against Newcastle diseases, provision of dug outs and small dams for livestock watering, introduction of out-grower progammes, and improvement in extension delivery on improved husbandry practices, among others. The programme also introduced the Community Livestock Worker (CLW) concept to improve access to more affordable basic animal healthcare and extension services using trained community volunteers (MoFA, 2004). Although some agricultural NGOs have adopted and are promoting the CLW concept in their livestock improvement programmes, MoFA has not been able to sustain it due to poor supervision and lack of logistical support to incentivize the CLWs. The privatization policy (full cost recovery) of the NLSP also effectively abolished subsidies on veterinary treatment and drugs which hitherto supported rural livestock production. The policy has also encouraged importation of livestock products which destabilized the local livestock industry.

2.5.6 Livestock Development Project (LDP): 2003- 2010

The specific objective of the Livestock Development Project (LDP), which has been conceptualized within the Accelerated Agricultural Growth and Development Strategy (AAGDS) policy framework, is to increase incomes of smallholder livestock and dairy

farmers, processors and traders in twenty-five (25) districts in Ghana. The expected impact is improved food security and incomes of smallholder farmers. It is unique among the previous projects by focusing on smallholder farmers and concentrating the thrust of its activities in the three northern regions where livestock constitute a major livelihood of rural people. The strategic components of LDP outlined by MoFA (2001) are as follows:

a) Development of animal production through the use of improved breeds of sheep, goats, cattle and pigs, employing the open nucleus breeding technique. This is expected to lead to genetically improved stocks and enhance farmers' incomes.

b) Development of animal health through expansion in disease control programmes against major livestock diseases and resourcing the Veterinary Department to effectively perform its functions. As livestock mortality continues to challenge rural production, accentuated by the removal of subsidies on veterinary services and drugs, the importance of this intervention cannot be overemphasized.

c) Provision of short-term credit facilities for production, processing and marketing, targeting livestock farmers, processors and traders. This is expected to enhance access to drugs, veterinary services and animal feed. It will also support the construction of animal housing and feed storage facilities, and purchase of breeding and start-up stock. Active CLWs are to be assisted with loan facilities to enhance delivery of basic animal healthcare services. However, compared with the crops sector, the livestock industry has not received deserved funding support, thus hampering sustainable enterprise development. Hence the sector needs more capital injection and credit financing to achieve its goal of sustainable poverty reduction and food security.

d) Training of extension staff, farmers and entrepreneurs in husbandry and relevant livestock production and management issues, to improve productivity and profitability. This also includes training of CLWs and equipping them with the needed tools and logistics to effectively function.

2.5.7 Conclusion

Concluding, it is important to acknowledge and appreciate that over the years government has pursued some laudable agricultural policies and programmes to improve agricultural productivity and food security for its citizens, with modest achievements. However, the livestock sector in particular has yet to make the desired impact on national food security and economic development. Moreover, achieving rural poverty reduction in Northern Ghana by harnessing the rich livestock potential and smallholder farmers' capacities still remains an illusion. The modernization approach which is perceived to be the key to achieving a productive and sustainable livestock industry, cannot provide the solution if rural farmers IK technologies and practices are ignored in livestock intervention projects and technology development. Integrating rural farmers' ways and objectives of rearing livestock in policy, and programmes is therefore an imperative. Accordingly, van't Hooft *et. al.* (2008) have alluded to the fact that policies and programmes in livestock improvement are more likely to make an impact when they are pro-poor and respond to the varied needs of livestock keepers.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 INTRODUCTION

Methodology is a framework for the research study, and comprises the research methods, procedures and tools for collecting and analyzing data in order to find answers or solution to the research problem (Kumekpor, 2002). It is therefore absolutely important that research methodology is properly designed and conducted to obtain accurate and valid data for analysis and interpretation to answer the research questions and objectives. This chapter presents the methodology for the study. It elaborates the background of the study district, the research approach and design, the sampling procedure, methods of data collection, and data analysis procedure.

3.1 PROFILE OF THE STUDY AREA: TOLON-KUMBUNGU DISTRICT

The research was conducted in the Tolon-Kumbungu District in the Northern Region of Ghana, and involved rural communities and agricultural development agencies operating in the district. The specific target was programme staff of the Ministry of Food and Agriculture (MoFA), the Animal Research Institute (ARI) and three non-governmental development organizations (NG0s) namely; Opportunities Industrialization Centres International (OICD, the Ghanaian-Danish Community Programme (GDCP) and Presbyterian Farmers' Training Programme (PAS-Mile 7).

The Tolon-Kumbungu District was carved from the then Western Dagomba District in 1998, and has Tolon as its District Capital. The district lies between latitude 10-20 degrees north and longitude 10-50 degrees west. It shares borders with the West Mamprusi District to the north, West Gonja District to the west and south, and Savelugu-Nanton District and Tamale Metropolitan to the east. It covers an area of about 2,741 square kilometers with an estimated population of 135,081, according to the 2000 national population census. The Dagomba ethnic tribe dominates the population, with the

remaining being Gonja and a few migrant tribes. Over 90% of the rural population is engage in agriculture (MoFA-DADU, 2007).

The district is located in the Guinea Savanna zone, characterized by a single rainy season from May to October and a dry season from November to April. Annual relative humidity ranges from 65-85%, but can be as low as 10% during the dry *Harmattan* period. Average temperatures range from 22- 40 degrees Celsius, while annual rainfall is 1,000 millimeters and often unevenly distributed and erratic during the cropping season, thus posing a challenge to crop production and food security in the District (Agricultural Extension Handbook, 2006). The vegetation is dominated by low-growing woody tree species dispersed in grassland. The dominant local tree species are dawadada *(Parkia biglobosa)* and sheanut (*Vitellaria paradoxa),* with exotic species such as mango and neem trees are the commonly found around the settlements. The soils are generally sandy-loam, except in lowlands where alluvial deposits are found, and are usually well-drained, thus posing no major limitation to root development except generally being low in nitrogen and organic matter (Donhauser *et. al.*, 1994).

The district has a huge agricultural potential, dominated by crop farming and livestock rearing. The average holding per farm family is 6.7 acres. The dominant farming systems are mono-cropping, mixed cropping, smallholder mixed system (crops-livestock integration) and limited agro-pastoral system. Maize, rice, sorghum, cassava, yam, groundnuts, cowpea, soya beans, pigeon pea, cotton, sheanuts and various vegetables constitute the main cash and subsistence crops in the area. Livestock include sheep, goats, cattle, local fowls, guinea fowls and pigs, and are mainly kept in a mixed fanning system. They play an important role in the farm family's risk management strategy and provide a reliable source of income and food security. Sheep and goats are also used for socio-cultural purposes such as traditional festivals, funerals and marriages. The Bontanga and the Golinga irrigation projects are notable for supporting large-scale rice and vegetable production in the district, thus augmenting food security and incomes of

local farmers, and providing employment to about 2.5% of the population during the dry season (MoFA-DADU, 2007).

Tolon-Kumbungu District also hosts three major agricultural research and educational institutions in Ghana. These are the Savanna Agricultural Research Institute (SARI), responsible for crops research in the Savannah Zone; the Animal Research Institute (ART) which conducts research towards livestock improvement in Northern Ghana; and the Faculties of Agriculture and Natural Resources of the University for Development Studies. The Ministry of Food and Agriculture as well as development NGOs also exist and providing agricultural development support and extension services to improve food production and livelihoods of rural farmers. The NGOs are notably; the Opportunities Industrialization Centre International (OICD, the Ghanaian-Danish Community Programme (GCDP), Adventist Relief Agency (ADRA), World Food Programme (WFP) and the Presbyterian Farmers' Training Programme (PAS-Mile 7).

Apart from its the rich agriculture potential, the district abounds in tourist attractions, including the White Volta, the Jaagbo Sacred Groove which offers very beautiful vegetation and scenery with many birds' species, reptiles and rodents, and the Nawuni Shrine which has a sacred crocodile held in reverence and believed to be capable of discovering and predicting good and evil omens for the socio-cultural development of the inhabitants (Tourist potential of Tolon-Kumbungu District (2008). *http://www.ghana districts. com /districts.*

3.2 RESEARCH APPROACH

In social research two major distinct approaches are used to collect and analyze data. These are qualitative and quantitative approaches. Each of these approaches has its weaknesses and strengths. However, the choice of a particular approach often depends on primary factors including the research focus, purpose of the research, the target audience

and availability of financial resources. Whatever the decision is, it is often best to use a complementary and mix approach of both the qualitative and quantitative approaches to collect, triangulate and analyze research data to obtain very reliable and valid research findings (Laws *et. al.*, 2003; Babbie, 2005; and Osuala, 2005). This study has adopted a mix of both qualitative and quantitative research approaches.

Quantitative research is concerned with numbers, and qualitative is more concerned with meanings. The choice between the approaches has long been a key issue in social science research (Laws *et. al.*, 2003). Although qualitative and quantitative approaches are derived from different philosophies, both are legitimate tools of research that can supplement each other, providing alternative insights into human behaviour (Osuala, 2005). Babbie (2005) has alluded to the fact that quantitative approach employs quantitative measurements and the use of statistical analysis to achieve results and normally adheres to standards of strict research design. It holds the view that there are definable quantifiable social facts. He therefore concludes that quantitative tradition is sometimes less privileged for social research because of its use of highly predetermined and strict technological data instruments, which limit flexibility, imaginative input and a better grasp of social phenomena. On the other hand, as argued by Osuala (2005), qualitative methods enable the researcher to observe social life in its natural habitat and produce a richer understanding of social phenomena. Qualitative research is also based on methods of data collection and analysis that aims at exploring social relations and description of reality. It is based on the recognition of the importance of subjective experiential 'lifeworld' of human beings.

Consequently, both quantitative and qualitative approaches were adopted for this study. Qualitative approach was applied to gain in-depth knowledge of different opinions of the respondents about the research issues pertaining, through observations, listening, recording and interpreting farmers own stories, their lived realities and experiences. The approach was also applied in data collection and analysis that provided fair representative

results from which the overall research outcomes were derived. The quantitative approach was meticulously used to collect and analyze quantitative data and to illustrate the research findings.

3.3 RESEARCH DESIGN

The choice of an appropriate research design is very important in determining the quality of the outcomes of any research study. Yin (1994) has described a research design as the logic that links the data to be collected and the conclusions to be drawn to the research questions. It deals with a logical problem to avoid a situation in which the evidence does not address the initial research questions, and hence maximizes validity and reliability of the research findings. Hence Brown's (1996) *Non-experimental Descriptive Survey Research Design* was adopted for this study.

Survey research designs use methods of data collection in which information is obtained through questioning of individuals from a selected group (sample) or a cross-section of the target population for their response to the study variables. Survey methods can be used for other units of analysis such as groups or interactions; however, individuals must serve as informants or respondents. It analyzes data from respondents in order to answer a hypothesis or describe a set of characteristics. The information collected covers issues ranging from attitudes, values, opinions, and description of past and present situations and incidents (Babbie, 2005). The advantages of the survey research design as outlined by Brown (1996) and Babbie (2005) are: It is useful in describing the characteristics of a large population; it makes collection of large samples of data faster and cheaper because it relies on representative samples; helpful in obtaining retrospective information; and it makes it possible to collect data from a large cross-section of the population which would not be feasible using other methods.

Based on the above stated advantages and good attributes, the survey research approach was employed for this research. In this regard, questionnaires and interviews were the two main survey research instruments used to gather data from the study area. Questionnaires containing close-ended (pre-coded) and open-ended questions were administered to farmers and five agricultural agencies (MoFA, ARI, GDCP, OICI and PAS-Mile 7) for quantitative data which was analyzed using SPSS package (Statistical Package for Social Research). In-depth interviews and discussions were also used at both community and the agricultural agency levels to collect qualitative information from key informants and farmer focus groups. The key informants included opinion leaders, local chiefs, traditional livestock healers and key staff of agricultural agencies. Indeed, the interviews facilitated collection of very detailed information about experiences, perceptions and opinions from respondents thereby enriching the information obtained from structured questionnaires. Participant observation was also used appropriately alongside interviews and questionnaires administration to capture very useful additional without extra cost. Secondary information relating to the research theme was also sourced from project reports, journals, the internet and other publications to support the primary data.

3.4 SAMPLING METHOD AND SAMPLE SIZE

The concept of sampling is very fundamental in conducting and interpreting research results in quantitative research and surveys. Except when a complete census is required, research is almost invariably conducted by means of a sample, on the basis of which generalizations are made about the population from which the sample was obtained (Osuala, 2005). There is usually no need to cover the whole target population in a survey research, more so, time and resource constraints make it impossible to do so. Therefore it is necessary to select a representative sample or units from which results of the analysis are extended or generalized for the population. However, in so doing care

must be taken to ensure that the sample is practically representative of its target population, to provide valid outcomes (Kumekpor, 2002; Conroy, 2005).

Essentially two main types of sampling methods are known; Probability and Non-Probability sampling (Twumasi, 2001; Laws *et. al.,* 2003; Osuala, 2005; and Kwabia, 2006). Probability sampling, also known as random sampling, is where each and every unit within the population is given an equal chance of being selected. In other words, each unit or element is chosen at random and has a non-zero chance of inclusion in the sample. Hence, probability sampling methods permit accuracy of selection and offer a high degree of representativeness. Common probability sampling methods include, simple random, systematic, stratified, and cluster sampling (Twumasi, 2001; Laws *et. al.,* 2003).

Non-probability sampling is where there is no possibility of estimating the chance or probability of each unit of the population being included in the selected sample. The researcher decides what he thinks is the representative unit of the group. Non-probability sampling methods include; quota, snowball, purposive, and convenience sampling. In purposive sampling the researcher, basing on the objectives and purpose of his research, selects respondents or elements of the population he wants to include in his sample (Twumasi, 2001; Kumekpor, 2002). In fact, non-probability samples are very convenient to use, relatively cheaper in cost and provide quick results if only such results are indicative of the situation or phenomenon studied. Purposive samples, in particular, are ideal for developing interview instruments in qualitative research (Twumasi, 2001; Laws *et. al.,* 2003).

Hence, given this background information about their relative strengths, advantages and suitability, both probability and non-probability sampling methods were employed for this study depending on each situation. Another important issue that needed attention in the sampling procedure was to determine the right sample size to produce representative data leading to valid results. Laws *et. al.* (2003) and Osuala (2005) have

argued that using a sample that is too large is a waste of resources, while too small a sample will yield invalid results. Therefore the size of an adequate sample is determined by the nature of the population, the type of sampling design, the purpose of the investigation, the size of the population and time available. These considerations therefore influenced the determination of the sample size and sampling procedure for this study, as described below.

The study district has four (4) extension zones with approximately 250 communities. Three (3) communities were randomly selected from each zone leading to twelve (12) communities for the survey. Twenty (20) farmers were then sampled from each community, using a combination of purposive and quota sampling methods which ensured inclusion of key informants and female respondents, totaling 240 individual respondents. However, 239 farmer respondents (198 males, 41 females) actually participated in the questionnaires and interviews.

Table 3.1: The Sampling Process

Activity	Methods	Results
1. Identification of communities for the study	Consultation with MoFA and NGOs, reviews of agencies documents, reconnaissance visits	250 communities
3. Selection of study communities from the 4 MoFA district extension zones	Simple random sampling	12 communities
4. Selection of respondents (male and female) from 12 sampled communities	Purposive and quota sampling of 20 respondents per community	240 respondents
5. Identification of agricultural development agencies	Consultation with the agencies, review of documents and reports, personal experience	5 agencies
6. Selection of respondents from Agricultural agencies	Quota sampling among agencies and purposive sampling within agencies	50 respondents
7. Selection of key informants and groups for in-depth interviews and discussion	Purposive sampling, group discussions, critical arena and life histories analyses	Enhanced research data

Focus groups, including NGO livestock farmer groups, women livelihood groups and traditional livestock healers and practitioners were purposefully identified and engaged in discussions to triangulate and enrich information obtained from questionnaires and key informant interviews. Key interest of the groups discussions centered on exploring ideas, experiences and opinions on IK rearing practices and modem technologies, innovative strategies to increase small ruminants production, gender issues in relation to livestock and household food security, opinions about ethno-veterinary medicinal practices and ways of revitalizing it and other IK being eroded by modernization. Village market meetings, farm visits and life histories were used as additional tools to gain in-depth understanding of attitudes, perceptions and lived experiences on the research issues.

Fifty (50) respondents were purposively sampled for questionnaires administration at the level of the five (5) agricultural agencies. However, quota sampling was used to allocate the questionnaires among the agencies to ensure equity in relation to differences in their extension coverage and presence in the study area. The quotas were: MoFA-24, Presbyterian Agric- 9, GDCP-6, 010-6 and ARI-5. Purposive sampling method was then used to identify respondents for self-administered questionnaires, which ensured the inclusion of relevant staff categories and gender in the samples. Additionally, in-depth interviews were held with five (5) heads (managers or directors) and key staff of the agricultural agencies, for their perspectives and experiences which enabled crosschecking, enrichment and validation of the farmers' information on the research issues.

3.5 DATA COLLECTION METHODS

Scientific problems can be solved only on the basis of accurate and reliable data. Many methods are used in social research to collect data, including questionnaire, interviews, documentary sources, observation, case studies, life histories and group discussions. However the selection of a particular method depends on the nature of the research problem, the type of people being encountered, the nature of the social situation and the

skills of the researcher. It is also necessary to use more than one method to collect data, since mix methods will provide complementary strengthens and non-overlapping weaknesses, thus enabling the researcher to obtain reliable and valid data (Twumasi, 2001; Osuala, 2005). During data collection, researchers are also often faced with obtaining the right amount and level of detail of data that is relevant to the research objectives. Under this circumstance, Conroy (2005) has argued for the application of the principle of *optimal ignorance* in survey research to guide the amount and quality of data to be collected, on the grounds that time of respondents is always limited and need not be wasted by soliciting lengthy and irrelevant information; and large amounts of detailed information often makes data analysis lengthy and complicated, and can thus undermine reliability of results. Accordingly, this study applied the principles of mixed data collection methods and triangulation of the methods, in the context of optimal ignorance to achieve quality data. The data collection methods used for the study are elaborated as follows.

3.5.1 Questionnaires

This is one of the main instruments and tool used in survey research. It is a set of questions that have been structured with the sole aim of collecting information on specific problems from knowledgeable informants, who are required to answer in writing either by the respondent or by the researcher in the case of illiterate respondents (Kwabia, 2006). Laws *et. al.* (2006) have argued that questionnaire is a efficient and useful research method on the grounds that it enables collection of information from a large number of respondents who are geographically scattered; it is a relatively cheaper method for collecting data from a very large sample of respondents; it enables the researcher to collect information about respondent's internal meanings and ways of thinking about the subject issues; and it protects the privacy of the respondents and confidentiality of the information, hence ensuring honest responses.

There are two main types of questionnaires for collecting data on the field. These are self-administered and personal interview questionnaires, their basic difference being the mode of administration. Self-administered questionnaire is intended to be understood and completed by the respondent, unaided or with minimum guidance, and hence is usually characterized by the absence of an interviewer. In the case of personal interview questionnaire, an interviewer in a face-to-face situation asks questions and records enumerator is trained to handle both the questionnaires and the respondent. This technique is often appropriate for collecting data from illiterate population (Twumasi, 2001; Kumekpor, 2002).

Motivated and convinced by the above strengths and desirable characteristics, the study relied heavily on questionnaire as a main instrument for data collection. Hence, self-administered questionnaire was used to collect information from staff of the five (5) agricultural agencies namely; MoFA, ARI, GDCP, OICI and PAS-Mile7, which promote rural livestock improvement through research, development and extension support. On the other hand personal interview questionnaires were used in collecting data from the farmer respondents, who were mostly illiterate.

3.5.2 Interviews

This is a method whereby the researcher interacts with his respondents during which he/she asks planned sequence of questions and the responses recorded as information for answering the research problem Kumekpor (2002). The interview method is very useful because there is immediate feedback and cross-checking of data within a relaxed atmosphere. It is also a very suitable instrument for collecting data from rural and illiterate people, and it allows individual respondents to tell their story in their own way. Furthermore, the interview method is a quick method of collecting survey data. Rather than asking people to answer formal written down questions and enter their own answers,

the researcher or interviewer ask questions orally in the field around a research topic and objectives and then records the answers and other emerging issues clarified in the field situation. An important advantage of interviews is high response rate, since respondents will be reluctant to turn down an interviewer standing by the door step (Twumasi, 2001). There are two types of interviews namely, structured and unstructured interviews. The former uses a strict procedure and a guide to obtain precise information, while the latter follows no strict procedures or protocol, thus allowing flexible, open-ended discussion and spontaneous responses (Twumasi, 2001; Kumekpor, 2002).

Accordingly, structured interviews were used in this study to elicit detailed information from individual respondents, precisely, heads and key staff of the agricultural agencies as additional detailed information to enhance earlier data from questionnaires. Unstructured interviews were employed at the community level targeting livelihoods groups (including focus groups) and key informants including traditional leaders, livestock groups leaders, ethno-veterinary medicine practitioners. This helped to gain deeper insights about the experiences and worldviews of the community people on the research issues. In interviews, language barrier between the interviewer and the respondents can undermine effective communication and the quality of the information or responses. This was however addressed by using experienced local interpreters with good knowledge of the local language and culture.

3.5.3 Observation

Observation plays a key role in all research. By directly observing participants in their natural or structured environments, the researcher collects additional information and checks whether what the participants think or say they do, is reflected in their actual behaviour (Laws *et. al.,* 2003). There are two main types of observation; participant and non-participant observations. In participant observation the field worker or researcher goes to live and participate in the daily activities of the people he is studying and observes and gets relevant insights of the situation for answers to his research questions.

Non-participant observation is where the researcher is physically present only as a spectator rather than an actor and does not become directly involved in the activities of the people being studied. He thus remains socially isolated from the group, yet carefully notes and records the issues of his interest. Observation method is relatively inexpensive, less time-consuming, yields more objective data, and permits collection of a wide range of information while approaching reality in its natural state (Twumasi, 2001; Kumekpor, 2002).

Hence non-participant observation was employed as a supplementary information collection tool during the reconnaissance visits and the interviews and questionnaire administration stages. It helped to gain a practical understanding of the agricultural, livestock and livelihoods and cultural issues and challenges pertaining in the communities.

3.5.4 Secondary Sources

Studying and reviewing relevant documents for secondary information to supplement other sources of data is an essential necessity in social and scientific research. The researcher needs to know about prior research related to his research issues and also orient himself to the field situation and methods of research investigation. Hence he needs to consult and read extensively on existing documents. According to Twumasi (2001), the researcher needs to review relevant literature of past and present works, official reports, statistical data, and many related writings in the course of his research to help him outline his ideas and shape his work. Data from these documents are usually reliable, valid and tend to be free from response bias. Laws *et. al.* (2003) have stated further that using secondary information can add authority to the study and avoids wasteful duplication of research already done. It can also enhance policy influence since it informs and builds the research on existing works and evidence in the field.

Consequently, I reviewed and made use of relevant secondary information at all stages of this research, from conceptualization to design, field execution, data analysis and the thesis write-up. Information was specifically obtained from research reports, journals, magazines, and project documents and reports, sourced from researchers, libraries, government and non-governmental organizations and the internet.

3.5.5 Stages of Data Collection

The study was conducted in three phases namely; reconnaissance survey, main survey and in-depth survey, during which data was collected from communities and agricultural agencies on livestock issues in relation to food security, IK and modern technologies integration, and livestock improvement activities of agricultural agencies, among others.

(i)Reconnaissance Survey

Preliminary visits were made to the study area for acquaintance and familiarization with the geographical, agro-ecological and social settings, cultural and agricultural issues and formal and traditional institutions and structures. This led to establishment of contact and relationships with key stakeholders at institutional and community levels, and hence identification and selection of communities and agricultural agencies to participate in the study. Individual technical and contact persons were identified at the MoFA and NGOs as well as at community level, to facilitate subsequent interactions and field research activities. During this phase secondary information was collected from relevant organizations, libraries, individuals, and reviewed and used for the study and final report.

(ii) Main Survey

This phase involved the administration 239 questionnaires and 30 interviews, as the principal means of collecting data for the study. Questionnaires were administered to community respondents as well as sampled staff of the participating agricultural agencies namely; MoFA, ARI, GDCP, OICI and PAS Mile 7. Simple random, purposive and

quota sampling techniques were used to select communities and respondents from both the communities and agricultural agencies for interviews and questionnaire administration. During this stage focused group discussions were held to gather information on indigenous knowledge technologies and practices in livestock rearing, food security issues and the specific role of indigenous rearing on food security. Advantage was also taken of market gatherings, cultural occasions, funerals, and local drinking places to collect on-the-spot information through non-participant observation, while engaging individuals and groups in conversation to obtain additional information the research questions and issues.

(iii) In-depth Survey

In-depth interviews were held with ten (20) individuals, fifteen (15) key informants and twelve (12) selected groups at the community level to obtain detail information about people's perceptions and thoughts of the issues to enrich the data and information gathered during the reconnaissance and main surveys. Follow-ups were also made to the agricultural agencies to cross-check and confirm earlier field data. Non-participant observation was also employed through home and field visits to gain better insights and practical knowledge of livestock issues, food security activities and role of IK in rural livelihoods. Yin (1984) as cited in Millar (2008) has observed that using these methods at this stage is important for obtaining detailed information and cross-checking and validating information from earlier respondents and informants.

3.6 DATA ANALYSIS

When the field data is processed and interpreted and the results incorporated in the final report, then the research study is deemed completed. In fact, the process of analysis is crucial in determining what the research study has found. Osuala (2005) has defined data analysis as the ordering and breaking down of data into constituent parts using qualitative techniques and statistical calculations to provide answers to the research questions and

problem. According to Twumasi (2001), data analysis is a continuous process involving editing, tabulation, coding and computer processing, each stage requiring asking of questions related to the research objectives in order to obtain meaningful answers.

There are two methods of data analysis; qualitative and quantitative methods. The former uses qualitative data, while the latter deals with quantitative material, normally. This study used a combination of qualitative and quantitative and quantitative methods in analyzing data. After the data was collected and properly checked against missing gaps, appropriateness and accuracy, a coding system was developed for quantitative data obtained from questionnaires and analyzed using SPSS programme (Statistical Package for Social Research). This generated all necessary tables, charts and descriptive statistics (frequency and percentages) from which the survey results were interpreted.

Meanwhile, qualitative data or information collected from interviews, focus groups discussions and key informant stories and lived experiences on the research issues were analyzed on a daily basis during the data collection process. This enabled checking for consistencies and ensured a systematic and coordinated data collection process. However the major part of the qualitative analyses occurred during and after the quantitative analyses in order to substantiate the quantitative data. Analyzed quantitative and qualitative data and information then provided me the basis on which interpretations, inferences, deductions and meanings were made towards addressing the research questions and objectives, thus culminating in the final research report.

CHAPTER FOUR: FINDINGS AND DISCUSSIONS

4.0 INTRODUCTION

This chapter presents the findings of the study, which used various data collection methods and techniques as captured in the methodology. The chapter begins with analyses of the socio-demographic characteristics of respondents both at community and institutional levels, followed by presentation and discussions of data and information from the structured questionnaires, key informant interviews, focus groups discussions and observations.

4.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS

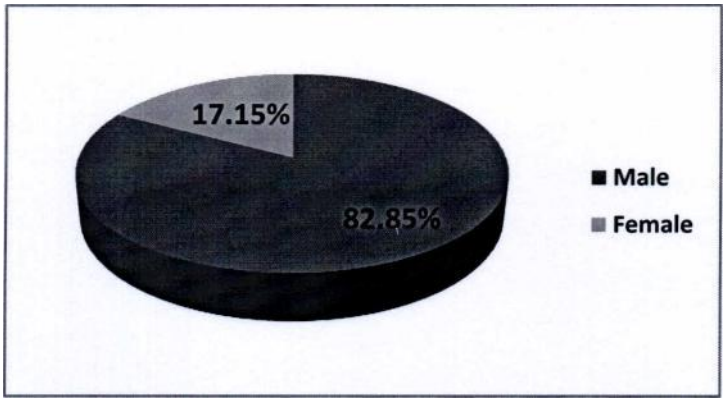
This section captures the socio-demographic characteristics of the respondents who comprised of 239 people (198 male, 41 female) from twelve (12) communities, and fifty (50) extension officers and researchers from the Ministry of Food and Agriculture (MoFA), Presbyterian Farmers' Training Programme-Tamale (PAS-Mile 7), Animal Research Institute in Nyankpala (ARI), Opportunities Industrialization Centres International (OICI) and the Ghanaian-Danish Community Programme (GDCP). The study communities were; Voggu, Zuguyipiligu, Napagyilli, Golinga, Tuunaayilli, Jakpahi, Woribogu, Talizoonayilli, Talli, Kasulyilli, Wantugu and Chirifoyilli. The characteristics covered are sex and age distribution, marital status, religion, occupation and educational status of community respondents, as well as designations of the institutional respondents.

4.1.1 Sea and Age of Respondents

Of the 239 community respondents interviewed, 198 (82.8%) and 41 (17.1%) represented male and female respectively, as shown in Figure 4.1. Livestock rearing is traditionally a

male occupation; the results however, indicated that rural women also rear small ruminants, to a lesser extent, for a livelihood.

Figure 4.1: Sex distribution of Respondents



Source: This Study, 2011.

As indicated in Table 4.1, all age groups were represented in the 239 people interviewed. However, the analyses show that 10 (4.2%) were 25 years or below; 61 (25.5%) were between 21-30 years; 87 (36.4%) were in the 31-40 age group; 58 (24.3%) were between 41-50 years; 17 (7.1%) were between 51-60 years; and 6 (2.5%) were 61 years and above. It is abundantly depicted from the results that majority of the respondents fall in the adult and occupationally active age bracket of 21 to 50 years. It further shows that people in the 61 years and above group are the least engaged in agriculture including livestock rearing in the area.

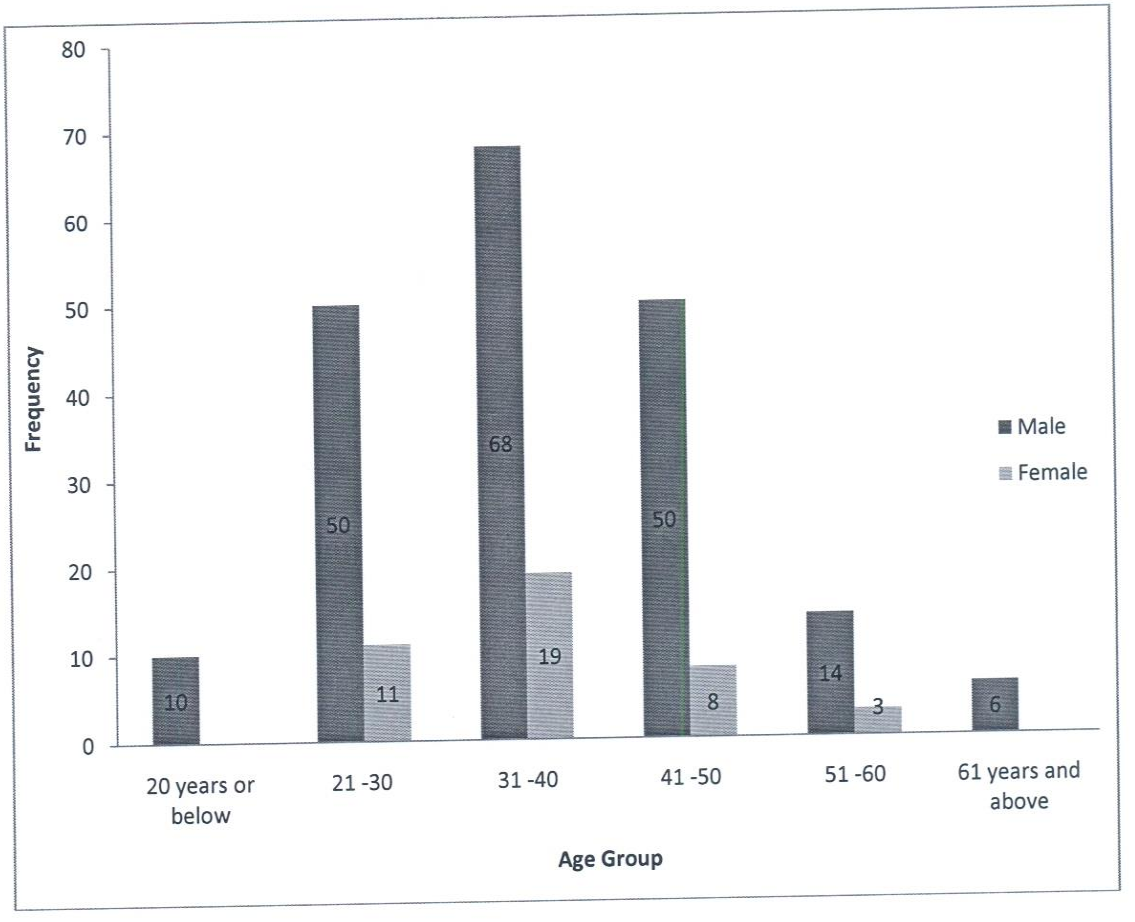
Table 4.1: Age Distribution of Farmer by Sex

Age Group	Male	Female	Total	
			Frequency	Percent (%)
20 yrs or below	10	0	10	4.2
21 — 30 yrs	50	11	61	25.5
31 — 40 yrs	68	19	87	36.4
41 — 50 yrs	50	8	58	24.3
51 — 60 yrs	14	3	17	7.1
61 yrs and above	6	0	6	2.5
Total	**198**	**41**	**239**	**100**

Source: This Study, 2011.

With respect to the gender distribution by age group, the pattern is almost similar for both male and female, with majority of the women (19) occurring in the 31-40 age group, followed by 11 respondents in the 21-30 years age group. The trend suggests that middle-aged married women are more engaged in small ruminant rearing to support their families, compared to younger, unmarried and aged women, who appear to have less responsibility for upkeep of the household and family.

Figure 4.2: Age Distribution of Respondents by Sex



Source: This Study, 2011.

4.1.2 Marital Status

From Table 4.2, majority, 212 (88.7%), of the respondents were married; 21 (8.8%) were single males; 5 (2.1%) were widowed females; and 1 male (0.4%) was divorced.

Table 4.2: Marital Status by Sex of Respondents

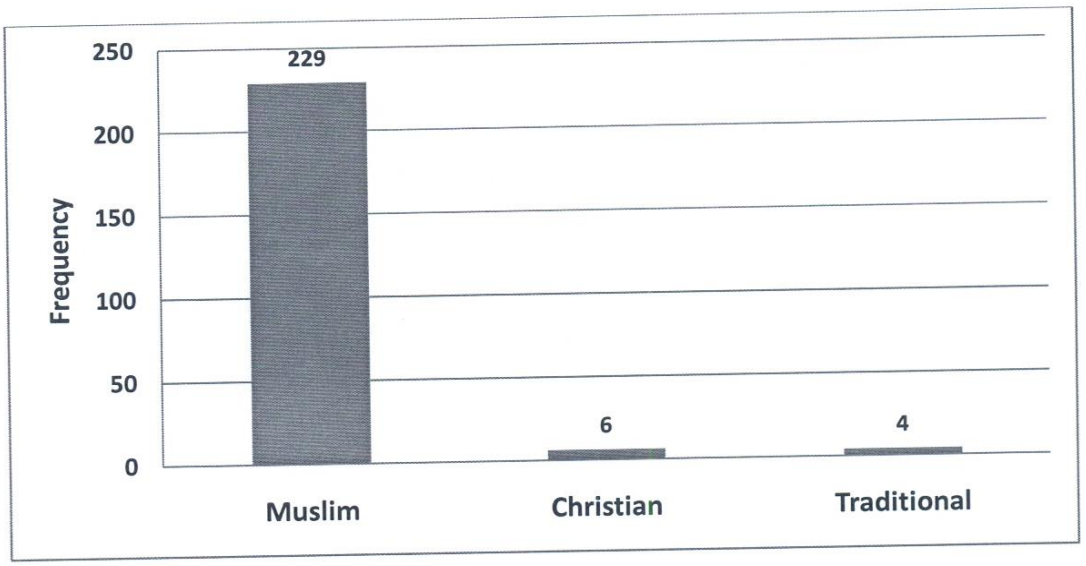
Marital Status	Sex		Total	
	Male	Female	Frequency	Percent (%)
Single	21	0	21	8.8
Married	176	36	212	88.7
Divorced	1	0	1	0.4
Widowed	0	5	5	2.1
Total	**198**	**41**	**239**	**100**

Source: This Study 2011.

4.1.3 Religion of Respondents

The rural inhabitants of the Tolon-Kumbungu District are predominantly Muslim, with a few Christians and traditional worshippers (MoFA-DADU, 2007). It's therefore not a surprise that 95.9 % of the respondents were Muslim, followed by Christians (2.5%) and traditionalists (1.7%), as captured in Figure 4.3 below. The dominance of Muslim and Christian religions, which are considered foreign have probably contributed to eroding and displacement of the rich traditional African indigenous knowledge and cultures which have for decades sustained rural livelihoods and agriculture systems including livestock. Apusigah and Boonzaaijer (2008) have alluded to the fact that Western and Eastern religions have taken a toll on traditional systems, often regarding traditional religion or forms of spirituality as demonic, superstitious and outmoded. They conclude that indigenous African religions are often a means to an end, enhancing health and harmonious relationships and constitute a survival strategy for indigenous rural people.

Figure 4.3: Religious Inclination of Respondents



Source: This Study, 2011.

4.1.4 Educational Status of Respondents

Table 4.3 presents the educational status of respondents, where majority of them, 82.8%, never attended school or have had formal education. On the other hand, only 13.8% had basic education up to Middle School or Junior High School, while 2.1 % and 1.3% attained secondary and tertiary educational levels respectively.

Table 4.3: Level of Education of Respondents

Level of Education	Sex		Total	
	Male	Female	Frequency	Percent (%)
Never attended School	163	38	201	82.8
Basic	28	2	30	13.8
Secondary	5	0	5	2.1
Tertiary	2	1	3	1.3
Total	**198**	**41**	**239**	**100**

Source: This Study, 2011.

High illiteracy among rural populations obviously has a negative effect on rate of adoption and integration of proven modern technologies, as complementary to indigenous knowledge, to improve livestock production. From experience, educated and enlightened persons are often more likely to adopt introduced technologies as compared to illiterate persons. It is also evident from the results that in spite of the larger male representation in the sample, the educational level of female respondents across all the educational categories was disproportionately low compared to the males in the same age groups. This observation supports arguments and existing statistics that in northern Ghana, there is gender inequality and discrimination with regards to access to formal by males and females. In many situations, rural young girls are often retained at home to carry out the household activities and later forced into early marriage for bride prices for their parents, or migrate to southern cities for menial jobs, popularly called *"Kayayee", for* a livelihood.

4.1.5 Occupation of Respondents

In assessing the occupations of respondents by gender, it was observed, (Table 4.4), that 233 respondents (93.4%) undertake farming as their main source of livelihood. Majority of female respondents (83%) were also found in this category. 8 respondents, all males,

were known to be in public sector employment, precisely teaching. 1 male was engaged in trading as compared to 7 females. This was not unexpected, because traditionally, rural men rarely trade as a main occupation. The results therefore support the fact that agriculture, including livestock rearing is critical to the livelihoods of rural communities in northern Ghana.

Table 4.4: Occupation of Farmer Respondents by Sex

Occupation	Sex		Total	
	Male	Female	Frequency	Percent (%)
Farming	189	34	223	93.4
Trading	1	7	8	3.3
Public Sector Worker	8	0	8	3.3
Total	**198**	**41**	**239**	**100**

Source: This Study, 2011.

4.1.6 Designations of Institutional Respondents

Figure 4.5 shows the distribution of the positions or designations of the 50 respondents sampled from five agricultural development agencies. Majority (60%) were field extension officers, followed by supervisors (26%). The supervisors are team leaders of NGOs extension programmes and zonal supervisors or subject matter specialists of MoFA. The rest were researchers (6%), research technicians (4%) and programme managers or institutional heads (4%). Only 12% of the respondents (5 extension officers and a research technician) were female, which buttresses the gender disparity and inequality in the agricultural profession.

Table 4.5: Designations of Respondents of Agricultural Agencies

Designation	Agricultural Agencies			Total	Percent (%)
	MoFA	NGOs	ARI		
Director/Manager	-	2	-	2	4
Supervisor	9	4	-	13	26
Extension Officer	15	15	-	30	60
Researcher	-	-	3	3	6
Research technician	-	-	2	2	4
Totals	**24**	**21**	**5**	**50**	**100**

Source: This Study, 2011.

4.2 INDIGENOUS TECHNOLOGIES AND PRACTICES IN SMALL RUMINANTS PRODUCTION

Rural farmers have largely depended on their indigenous technologies and practices to keep their livestock production systems. MoFA (2004) has alluded that small ruminants' production in northern Ghana relies mainly on low-cost traditional husbandry methods and practices of smallholder livestock keepers, which have contributed immensely to household food security. This section presents findings on indigenous technologies and husbandry practices used in small ruminants rearing in the study communities. It covers feeding, housing, healthcare and breed improvement issues.

4.2.1 Feeding Practices

Small ruminant livestock generally depend primarily on the natural vegetation and agricultural crops and products as their main feed sources. However the type of feeding practice is determined by the size of the stock, the local culture and availability of feed

(season of the year). Under this section the study assessed the types of local feeding systems, feed resources, feeding constraints and indigenous coping strategies to the constraints.

Multiple responses were recorded when respondent were asked to indicate the feed management systems practiced. Hence as indicated in Table 4.6, the most prevalent is the free-range grazing system which scored 115%, followed by 19.1% for shepherd grazing. Other systems are stall feeding or zero grazing and tethering which recorded 12% and 5% respectively. Free range system is practiced mostly in the dry season when animals are released to roam freely and extensively for scarce forage. These findings seem to agree with that of Alhassan (2006) who observed that in northern Ghana, a combination of various traditional feeding practices and systems is the norm, the commonest being the free range system where livestock graze freely during the dry season and are shepherd-herded or tethered away from crop farms to feed during the rainy season, especially for goats and sheep.

Table 4.6: Livestock Feeding Systems

System	Frequency	Percent (%)
Free- range grazing	230	115
Shepherd grazing	30	19.1
Stall feeding	24	12
Tethering	10	5

Source: This Study 2011.

With regard to local feed resources most used for livestock, as portrayed in Table 4.7, 49.1% indicated crops residues, 37.8% use tree and grass fodder, 41.3% for agricultural by-products (rice bran, corn chaff, pito mash and yam and cassava peels), and 24.1% use

nutrient supplements (local saltlicks, soya cake), Apiiga and Shittu (2002:7) have observed that; *"During the lean season small ruminants are fed with crop residues of maize, millet, sorghum, groundnuts haulm, bean vines and cassava and yam peels. In few cases, small quantities of dried remains of fermented maize and millet porridge and pito waste are also used"*. It was observed during reconnaissance visits that most farmers stored dried groundnuts and bean vines on raised platforms, which are fed to small ruminants as supplementary feed, thus preventing them from roaming far distances for feed.

Table 4.7: Feed Types for Livestock

Feed type	Frequency	Percent (%)
Crops residues	110	49.1
Tree and grass fodder	85	37.8
Agric by-products	93	41.3
Nutrient supplements	54	24.1

Source: This Study 2011.

Indiscriminate bush burning, deforestation and land degradation are major factors in the Savanna ecological zone which threaten livestock feed and water resources, and consequently affect rural livestock productivity. In sharing their challenges relating to feeding during focus group discussions, farmers indicated that apart from these constraints, inadequate grazing land, lack of quality feedstuffs, high cost of nutrient supplements (mineral licks, soya cake), and inadequate technical knowledge and facilities for feed preparation and preservation, were other major challenges to livestock feeding in rural communities. As experts in their environment, farmers cited their coping strategies for addressing the constraints as; collection and storage of crops residues, planting and use of tree and grass fodder, undertaking early burning of the natural vegetation to

encourage early growth of fresh green grass, and the use of domestic agro-processed wastes.

4.2.2 Housing Practices

Housing small ruminants is necessary for enhancing productivity. Rural livestock farmers are skilled in using their indigenous knowledge and local materials such as mud, thatch and wood in constructing pens and kraals for their animals. From experience, houses are often located within or in front of the compounds, or at a reasonable distance to compound settlements to be able to keep watch against thieves and predators. Respondents were asked whether they house their livestock, and if they do, which period of the year was it more practiced. An overwhelming 96% indicated yes, while 4% do not house their livestock at all. Of the 229 farmers who practiced housing, 155 (68%) did this in the rainy season only, and 74 (32%) during the dry season only. The encouraging rate of housing practice in the area could be attributed partly to expansion in livestock training and extension services offered by MoFA and non-governmental organizations (NGOs) in the area. Hitherto, farmers would usually care little about housing their animals particularly during dry season.

During focus group discussions, farmers gave various reasons and benefits derived from housing their animals. These include protection against adverse weather conditions such as sun and rain, prevention from theft and facilitating access to the animals for examination and treatment. Others said it facilitates supplementary feeding and breeding, while curtailing losses from vehicles accidents. Most important however was the manure harvested from kraals and pens as a result of housing or confinement. Farmers said with high prices of chemical fertilizers, manure is mostly relied on as a local resource for supporting subsistence crop production. As corroborated by Reijntjes *et. al.* (1992), in rural communities manure from livestock is a more sustainable and appropriate means of fertilizing farmlands, especially in the face of increasingly high cost of chemical fertilizers and their long-term destructive effects on soils.

4.2.3 Healthcare Practices

Animal healthcare is crucial for sustainable livestock development. Rural smallholder farmers have since time immemorial depended on a wide range of indigenous healthcare practices or herbal medicines to control livestock diseases and conditions. These traditional healthcare practices, methods and beliefs, is also called ethno-veterinary medicine (EVM) and is based on rural people's indigenous knowledge systems and innovation (Ethno-veterinary Medicine in Kenya, 1996). The research study looked at the extent of use of EVM by farmers compared to modem veterinary medicine (MVM) and their motives for using the approach. The spirituality of EVM was also examined.

(i) Comparing the use of traditional and modern healthcare approaches

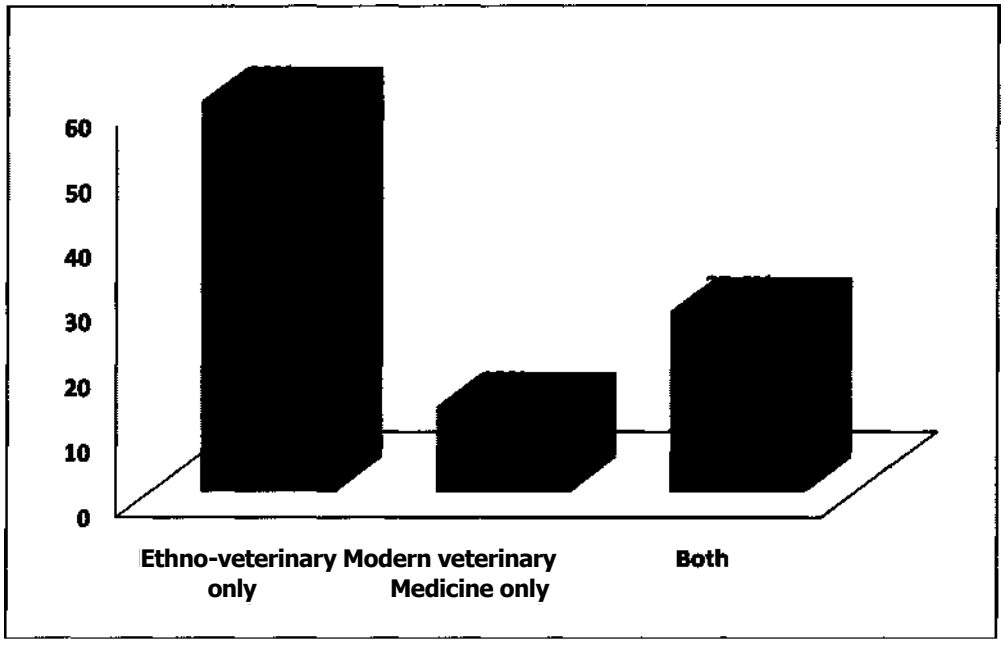
The use of EVM and MVM for treatment of livestock diseases by farmers was compared. The results obtained, as in Table 4.8 and Fig 4.4, showed 60% used EVM, 13% used MVM and 27.6% used a combination of both approaches.

Table 4.8: Healthcare Approach of Farmers

Approach	Frequency	Percent (%)
Ethno-veterinary only	143	60
Modem veterinary Medicine only	30	13
Both	66	27.6
Total	**239**	**100**

Source: This Study, 2011

Figure 4.4: Healthcare Approaches of Farmers



Source: This Study 2011.

When the farmers were asked for their reasons for practicing EVM, 40% said it was very effective in treating very common diseases and hence a reliable healthcare approach; 31% said the materials for preparing the medicines were easily available in the communities and involves no costs to acquire; 13% said the practice requires little or no training or expertise in preparation and application to control diseases. Adda *et. al.* (2006) have alluded that in spite of the advantages of modern veterinary medicine, traditional methods, of controlling and treating livestock diseases remains popular and in fact, growing in rural northern Ghana, because of its effectiveness, availability and low cost.

Furthermore, 11% indicated that the lack of veterinary officers in rural areas compels them to resort to EVM. They blamed the government for not providing adequate veterinary services to support rural livestock activities. In this present era where

traditional cultures and IK practices of rural people are increasing being lost due to modernization and scientific technologies, the dominance of EVM in the study area shows the value and premium placed on IK as a livelihood strategy by rural smallholder fanners. Finally, 5% of the respondents who could be traditional healers said they indulged in EVM approach mainly for its cultural importance which they did not want to lose. The intimated that they inherited the practice from their forefathers and were obliged to use, promote and pass on to the next generations, failing which the gods and ancestral spirits may visit serious curses on them.

(ii) EVM and Spiritual Beliefs

In investigating the spiritual underpinnings of EVM, the results in Table 4.9, indicate that 56.1% strongly agreed that EVM was linked to the spiritual beliefs of the local people or the practitioners, and 20.5% somehow agreed. 13% did not believe that a relationship exists between practice and spirits, while 43% had no idea. Most of the farmers who strongly believed in the relationship were the experienced traditional healers and practitioners who provide healthcare services in the communities. The others who doubted or did not believe in the relationship were farmers who occasionally administered the medicines themselves based on the medicinal value of the herbs. Apiiga (2003) argued that in northern Ghana, the practice of EVM depends on the local belief system; some traditional healers consult soothsayers before administering treatments because some diseases are attributed to supernatural forces. Therefore these findings agree that an EVM practice is not only based on herbal properties of plants and other materials but has a spiritual basis which is influenced by the local belief and IK systems.

Table 4.9: EVM is related to Spirituality: Respondents Perspectives

Any Spirituality with EVM?	Frequency	Percent (%)
Strongly Agree	134	56.1
Somehow Agree	49	20.5
Does not Agree	13	5.4
No Idea	43	18
Total	**239**	**100**

Source: This Study, 2011.

An interview with a traditional healer about his profession is captured in Box 4.1 below.

Box 4.1: Traditional Healer's Story

"I am called Nindow Dokurugu. I was trained by my father as a traditional livestock healer when I was only 15 years. My father, who inherited this gift from his late grandfather, taught me how to prepare the herbs and perform the accompanying rituals. When he died later, I visited communities and treated sick animals with high success. Before I prepare the medicines to treat the sick animals I always perform sacrifices to the ancestors and gods to seek their permission, for it is they who cure the diseases and not me or the herbs. Certain dangerous diseases like 'Yoggu' (anthrax) are spiritual and one has to consult the gods for permission and spiritual power before the medicine can work. Being a traditional healer is a spiritual calling from one's ancestors, people who do not meet certain qualities do not often succeed in the practice. That is why many of the young healers in the community are failing and the animals are dying. Their medicines lack potency and spiritual power, as they only seek after money".

23rd January 2011, Jakpahi Community

Source: This Study, 2011.

(iii) Experiences with EVM Practices

In-depth interviews with key informants revealed that traditional healers have good knowledge about livestock diseases and the type of treatment to apply in each case. It was revealed that farmers and healers use various plants parts such as leaves, roots, bark, fruits, seeds, sap and other materials like salt, ash, clay, salt petre, to prepare medicines. The medicines are usually in the form of powder, bolus, concoctions, ointments and fractures, wounds, birth complications, snake bites and bloat. However, a disease- like anthrax was said to be caused by evil spirits, and when there is an outbreak, the ancestors and other spirits are consulted by the herbalist before administering treatment. The study further found that knowledge on EVM including the medicinal qualities of the herbs and mode of preparation is not usually easily disclosed but kept in secret by the healer and his close family. Payment for services of traditional healers was said to be largely in-kind, including fowls and animals of special breeds and colour, cowries, coins, and food items, depending on the cultural system. However the desire of young and inexperienced practitioners for monetary gains is said to compromise the quality and potency of EVM.

4.2.4 Breed Improvement Practices

Rural farmers worldwide are known for their ability to develop indigenous and traditional livestock breeds to meet their varied needs. Kohler-Rollefson and Rathore (2006) have observed that local people shape a breed to suit their livelihood needs, and that local breeds play multi-functional roles in rural livelihoods by contributing not only cash products but also manure and traction to enhance food security. Smallholder rural farmers in northern Ghana depend mainly on indigenous small ruminant breeds, which are well adapted to the harsh climate conditions and fragile ecosystem of the Savanna ecological zone. These breeds and breeding practices form the basis of their livestock systems, enhancing food security, and providing economic and socio- cultural benefits to rural

folk. The study examined farmers IK breeding practices in small ruminants, with reference to breed preference, breeding objectives, criteria and practices.

From the data, 93.3 % farmers reared local breeds of sheep and goats only, while only 6% reared exotic breeds only. They argued that local breeds are hardier and can withstand severe heat, drought and humid conditions. They are also more resistant to diseases, require less veterinary care and can live on local feedstuffs. They are thus cheaper and easier to rear than exotic breeds. They also intimated that indigenous breeds have very important spiritual and socio-cultural values, including their use in traditional healing, sacrifices, dowry, funerals and festivals, which all taboo the use of exotic breeds. On the other hand, only 2.4% and 4.3% reared exotic and crossed improved breeds respectively. Apparently, most of these were MoFA and NGO-assisted farmers, who said exotic and crossed breeds, grew faster, are weightier and have higher market value.

During focus group discussions and key informant interviews, farmers cited common breeding techniques as; closed-castration, culling of sick and older stock from healthy stock and crossing of indigenous breeds with improved exotic ones, all aimed to improve the local breeds or to obtain desirable traits. However, in so doing, they usually pay particular attention to certain special features and characteristics in their selection for breeding. These include size and shape, ability to twin, skin colour, and good mothering ability and temperament. These finding are in consonance with the observation of Millar (2003:156), that: *"In indigenous communities in northern Ghana, cultural considerations feature strongly in farmers' preferences for special breeds of animals. For example, the rituals to revitalize the family land for agricultural purpose require special colour and breed of sheep and fowls"*.

Hence, aside their vital contributions to food security, indigenous breeds represent products of IK and cultural expression of livestock keepers. Therefore development stakeholders owe it a responsibility to help protect and promote indigenous breeds in order to maintain livestock diversity for present and future generations.

4.3 ROLE OF INDIGENOUS SMALL RUMINANTS IN RURAL FOOD SECURITY

Small ruminants play a key role in enhancing food security in northern Ghana and are particularly used as a coping strategy to combat hunger in rural households during the lean period of the year (Karbo and Bruce, 2000). This section assessed the specific roles and contributions of indigenous small ruminants rearing to household food security in the study area. To achieve this, the section has sought to answer questions bordering on whether farmers sell small ruminants for food stuffs and farming inputs, the species most sold (sheep or goats), the period when sale is highest, the average number sold per household for food security, and the gender dimension of the subject since women play a central role in ensuring household food security.

4.3.1 Sale of Small Ruminants for Food

In finding out whether farmers sell small ruminants for food stuffs, the results were 68.7% in favour of a yes response, while 31.3% of farmers indicated they did not depend on livestock income for food stuffs. Apart from selling their animals during critical periods to buy food stuffs like maize, millet, rice and beans, they also mentioned that the animals produce manure for crops production, and provide immediate cash for seeds and fertilizer, land preparation and farm labour. Others said the animals provide meat or protein which enhances the family diet when occasionally slaughtered at child-naming, funerals and marriage ceremonies and traditional festivals. Farmers who do not sell small ruminants for food stuffs are among those who produce enough food to feed their

families all year round or undertake alternative livelihoods for supplementary incomes for meeting their food security and basic needs.

Traditionally, most rural women do not own livestock or control incomes from livestock (CIFS, 2009), yet 45 out of 49 women also indicated they sold small ruminants for food security such as for soup ingredients, milling the grains, buying planting seeds and hiring labour to weed their farms. The findings therefore agree with the observations of Karbo and Avomyo (2006) that the diversity of livestock owned by farm families in northern Ghana impacts positively on their livelihoods by directly providing food and nutrition security, cash incomes and savings, power for traction and manure to increase crop yields.

During group discussions, farmers indicated that though they rear sheep and goats, they sold more goats than sheep for food security. Their reasons were that goats were much easier to rear, these do not easily die from diseases and are more adaptive to adverse climatic conditions. Goats were also said to be more prolific producers than sheep and that sheep are more for prestige as well as for festivals, dowries, and ritual sacrifices.

It is a strong belief among the traditional folk that a child-bearing woman will not live to see her animals multiply but will die if she violates the custom and attempts to rear. During an interview with Rabiatu Musah, a 65-year old women's leader in Woribogu community, she remarked that: *"Younger and child-bearing women in the community are tabooed from owning small ruminants especially sheep. Even older women like me can only rear in the name of our sons or husbands otherwise one will be sanctioned".* This is one of many unprogressive traditional customs confronting rural women's progress and their effort to overcome gender inequality relating to access and control of important livelihood assets to enhance household food security and overcome poverty.

4.3.2 Period of Sale of Small Ruminants for Food

Although most rural farmers rely on small ruminants' resources for their food security, the research took further interest to determine the period of the year or season when animals are most sold for that purpose. Multiple responses were recorded as indicated in Table 4.10.

Table 4.10: Period of Sale of Animals for Food Security

Period of the Year	Sex		Total	
	Male	Female	Frequency	Percent (%)
During & immediately after harvesting (Sept - Feb)	20	6	26	13
Just before planting (Mar - May)	122	25	147	73.5
During early cropping period (April - July)	156	17	173	86.5

Source: This Study, 2011.

The results however indicate that only 13% of the fanners would normally sell their animals during or immediately after the major crops harvest (September to February). This is because this is the period of food abundance. Thus during this period animals are sold mainly to meet economic and social needs such as school fees, hospital bills, clothing, funerals and dowry.

73.5% sell their animals just before the start of the major crops season (approximately from March to May). This is the period when the family food stocks are getting exhausted and farmers are compelled to rely on small ruminants incomes for basic staples like maize, millet and beans. This is the critical period when planting seeds, fertilizer and

cash to plough the fields have to be sourced, for which small ruminants may be relied on. The women sell their goats during this period to buy planting seeds and to enable them hire tractors and labour to prepare their lands and for weeding. This explains why 25 out of 48 women would sell livestock in March to May. In the last scenario, majority, 86.5% of farmers sell their animals during the early cropping period of April to July, popularly known as the hunger period or lean season. For most average families, there is little or no food stocks left during this period and livestock provide the much needed income to enable households acquire food stuffs, buy seeds, fertilizer and hire labour for crop production activities.

The high reliance on small ruminants as the main coping strategy to fight hunger during this period is also partly attributed to the fact that most rural people are then engaged in farming activities with no time left to undertake other activities for supplementary incomes to support the family needs. It was however revealed during key informant interviews that farmers usually sold between one to five animals to meet their food security needs, depending on the crop yield situation in a year, the size of the household, stock holdings and the need situation, among others. In a year of bad harvests, more animals are sold, and bigger households tend to sell more animals at a time than smaller households. Also, more endowed households would sell fewer animals for food than poorer ones, who have limited alternative incomes. The findings therefore confirm the important and strategic role of livestock rearing in household food security improvement in rural communities in northern Ghana.

4.4 INTEGRATION OF INDIGENOUS AND MODERN TECHNOLOGIES FOR SMALL RUMINANTS PRODUCTION

Livestock rearing in northern Ghana largely depends on indigenous technologies, husbandry practices and local resources. According to Dewalt (1994), IK technologies are cheap, culturally appropriate, and ecologically sustainable and provide the basis for rural peoples' livelihoods, developmental activities and survival. This section examines

findings of integrating IK technologies and practices with modern external technologies being promoted by development agencies to improve small ruminants' production. Specific issues covered include famers' perspectives about modern technologies, challenges hindering integration and strategies to achieve effective integration of IK and modern technologies.

4.4.1 Level of Exposure of Farmers to Modern Technologies

The study took interest to find out the level of farmers' exposure to modern technologies in livestock production. From the data, 34.7% indicated they had been exposed either by ordinary knowledge or through practice, and 65.3% had no knowledge or exposure at all. As to the kind of modern technologies known, the respondents cited veterinary treatments and vaccinations, use of improved breeds provided by NGOs, feed supplementation with mineral licks and benefiting from training on improved husbandry. They went further to mention some the benefits gained from using modern technologies; as faster growth and healthier animals, use of modem veterinary approaches was faster and very effective in controlling diseases, and use of improved small ruminant breeds yielded higher incomes than the traditional local breeds. These results point to the fact that the level of exposure of farmers to modern technologies can likely influence the rate and extent to which they integrate the technologies with the IK practices to improve production.

4.4.2 Frequency of Integrating IK and Modern Technologies.

Rural farmers are known for their ability to innovate to improve their farming and livelihood systems by adapting or modifying their own knowledge and strategies with appropriate external knowledge. This section examined the frequency at which respondents combined their IK rearing practices with external modern technologies in small ruminants' production. As indicated in Table 4.11 (and Figure 4.5), 57% do not use any form of external or modern technologies but depend only on their indigenous knowledge and practices. These farmers are very traditional in their way of living such

that modern technologies are culturally unsuitable to them. They may not also have been exposed to modern technologies. Akullo and Kanzikwera (2007) have attributed the low adoption of scientific technologies by rural farmers in Kenya to the fact that the technologies were designed without considering the farmers traditional farming practices and cultural values.

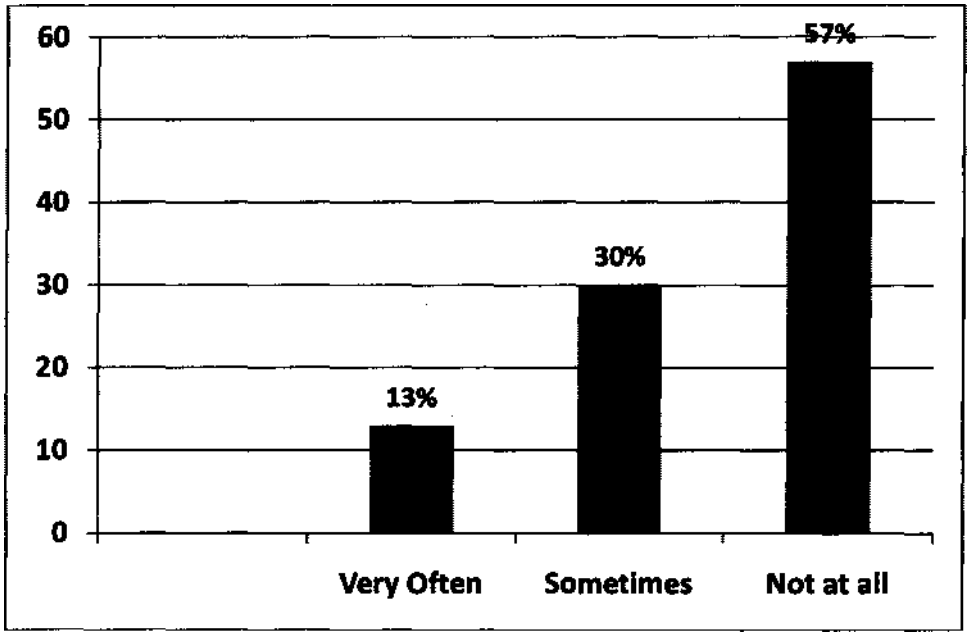
On the other hand, 13% of the respondents indicated they often integrated or complemented their IK practices with modern technologies. These farmers are usually regarded by development agents as progressive and enlightened because they readily accept or try outside ideas or knowledge. They may also have been privileged in accessing extension services and training by external agencies. In the last case 30% indicated they sometimes combined both technologies for rearing. A suitable blend of best scientific knowledge with indigenous practices has the greatest potential to enhance rural production systems for their sustainability (Chambers, 1997).

Table 4.11: How often Farmers integrate Technologies

How often do farmers integrate technologies?	Frequency	Percent
Very Often	28	13
Sometimes	64	30
Not at all	124	57
Total	**216**	**100**

Source: This Study, 2011.

Figure 4.5: How often Farmers integrate Technologies



Source: This Study, 2011.

4.4.3 Constraints to Integrating Technologies by Farmers

Numerous challenges confront effective integration of IK with modern technologies to enhance livestock production in rural communities. Farmers were asked to indicate their challenges in this regard. Since they could provide more than one answer, 312 responses were received and categorized under five key themes, as in Table 4.12.

Table 4.12: Constraints to Integration of Technologies

Constraints	Frequency	Percent (%)
Lack of exposure and access to modern technologies	52	26
Inadequate knowledge and skills to apply modern technologies	68	34
Cultural beliefs against modern technologies	18	9
Inappropriate design and promotion of modern technologies	32	16

Source: This Study, 2011.

From the table, the majority of respondents, 71%, attribute their inability to combine IK technologies with modern technologies to the high cost associated with the latter. For instance, they explained that costs of veterinary drugs and services are considerably high, compelling them to rely more on EVM. They also intimated that though they desired to acquire exotic breeds to improve their local breed for higher productivity and income, the breeds were expensive. Secondly, 34% said although they knew the benefits of integrating the technologies, they lacked the technical knowledge and skills in using modern technologies and husbandry practices to complement their IK. Thirdly, 26% blamed their situation on lack of access to modern practices, saying they have hardly had any extension agent visit and advised them on improved livestock rearing. This could be attributed partly to limited field staff for effective extension coverage in the district. Lastly, 16% and 9% of farmers indicated technical inappropriateness and cultural unsuitability of modern technologies respectively. They explained that the technologies and practices disregard local issues, practices and cultural values.

4.4.4 Strategies to Improve Integration of IK and Modern Technologies.

Using focus groups discussions and in-depth interviews with key informants, recommendations as to how to improve integration of IK rearing practices with modem technologies were obtained. They include the need to expand training and extension on best husbandry practices including the use of demonstrations and learning visits to modem livestock farms and institutions. Secondly, development agencies should assist more farmers to access credit and inputs to enhance adoption of improved husbandry practices. Farmers also emphasized the need for development agencies and extension officers to promote interventions and technologies strongly grounded on indigenous knowledge, available local resources and local skills, in order for the technologies to be sustainable, affordable and culturally appropriate for rural resource-poor farmers.

Experience has shown that many livestock interventions in northern Ghana failed to achieve their intended objectives and outcomes mainly because of their over dependence on sophisticated technologies, approaches and external inputs, without regard to indigenous approaches, practices and resources which were branded as outmoded and unproductive by the project owners. However Reijntjes *et. al.* (1992) have noted that working with rural farmers is of paramount importance for creating ecologically and economically sustainable livestock systems where IK and formal scientific knowledge play re-enforcing and complementary roles.

4.5 INTEGRATION OF INDIGENOUS TECHNOLOGIES INTO FORMAL RESEARCH AND EXTENSION SYSTEMS

Under this section, the study investigated the extent to which agricultural development agencies have integrated and promoting local farmers' indigenous rearing technologies and practices within formal research and extension systems. The specific issues covered include livestock improvement activities of the agricultural agencies in the study district,

the level of IK integration in extension delivery, problems with 1K extension in R&D activities, and strategies to improve IK integration by the agencies.

4.5.1 Profile of the Agricultural Agencies in context of Livestock and 1K

In the last decade agricultural development organizations have intensified and expanded their livestock improvement interventions towards addressing the increasing poverty and food insecurity in rural communities of northern Ghana. MoFA, Animal Research Institute, and NGOs like OICI, ADRA, GDCP, PAS Mile 7 are some key organizations which provide livestock extension and research services in Tolon-Kumbungu, and were sampled for the study. The following section presents background information about the organizations in relation to livestock development.

(i) Ghanaian Danish Community Programme (GDCP)

GDCP is an integrated rural development programme established in 1979 through cooperation between community friendship groups in Ghanaian and Denmark. The NGO which is funded mainly by DANIDA operates in the Tolon-Kumbungu, Savelugu-Nanton Districts and part of Tamale Metropolis of the Northern Region of Ghana, covering about 200 rural communities. GDCP has four main intervention areas namely; Community development, Agriculture, Education and Health, which are being implemented with a local staff capacity of 53 personnel. In agriculture, IK forms the basis and key philosophy for technology development and extension. The organization promotes organic soil fertility improvement methods for rejuvenating degraded soils to improve crops yields. It also provides improved seeds and training on recommended agronomic methods. Its livestock programme focuses on small ruminants and rural poultry, where farmers including women are trained on improved husbandry and assisted with foundation and improved breeds of sheep and goats. Agro-forestry and animal traction are also being promoted as sustainable systems to enhance agricultural productivity and food security (GDCP, 2006).

The director of GDCP stated in an interview that the organization contributes immensely in improving the living conditions and food security situation of the local people through its agricultural interventions including small ruminant improvement. However, poor road network coupled with limited and irregular funding activities are the major constraints impeding progress.

(ii) Animal Research Institute (ARI)

The ARI of the Council for Scientific and Industrial Research (CSIR) has a mandate to develop and transfer technologies related to livestock and poultry production in Ghana. It has five research stations located in different ecological zones of Ghana. The Nyankpala station which was sampled for this study undertakes research into livestock production systems and introduction of improved technologies to develop and improve the productivity of the livestock sector in the Guinea Savanna ecological zone in northern Ghana. Research activities are focused on animal production; diseases, health and reproduction; dairy production; animal nutrition and feed improvement; crops-livestock integration and socio-economic issues Apart from on-station activities, ARI also engages in collaborative on-farm research and extension programmes in partnership with livestock-based local NGOs in order to help rural farmers adopt proven technologies to improve their production (CSIR Hand Book, 2006).

During an interview with the ARI-Nyankpala Station officer on the research issues, it was revealed that farmers' indigenous rearing practices forms an integral part of the research agenda; the Station undertakes research and training of rural farmers on local feed resources, diseases control, and husbandry management, taking farmers IK into consideration. Consequently, there was need for development agencies to collaborate with the research station to carry out scientific research on ethno-veterinary medicines to assess their efficacies before introducing to livestock fanners.

(iii) Opportunities Industrialization Centres International (OICI)

OICI is a USAID-funded NGO which was established in 1999 and operates in over 40 rural communities in the Tolon-Kumbungu District. Its goal is to reduce food and livelihood insecurity in vulnerable households. It seeks to achieve this goal by creating economic opportunities through income generating activities, implementing health, nutrition and educational programmes and supporting food and animal production. The Agricultural programme covers three aspects of food security namely: *food availability* training farmers in post-harvest management, construction of storage facilities, and training in farm management and marketing; *food access* - promoting diversified income generating activities and business skills development to increase women's incomes; and *food utilization* - provision of potable water and training in sanitation to reduce in incidence of water-borne and related diseases.

An interaction with the OICI Programme Manager revealed that the NGO place premium value on rural people's IK in agriculture and livestock rearing as complementary to conventional agricultural technologies. Salient results achieved under the agricultural programme were: 3,042 households trained in improved production methods; 792 farmers trained in animal husbandry; 120 volunteers trained as community livestock workers (CLWs); 3,042 mud silos constructed by households for food storage; and 900 sheep, 720 goats and 2,120 poultry distributed to households (OM, 2009). Major constraints to the livestock programme were cited to include mortality of small ruminants supplied to farmers because of poor veterinary services, and inadequate funds to scale up the interventions.

(iv) Presbyterian Farmers Training Programme (PAS Mile 7)

This church-based NGO was established in 1967 to improve the living standards of rural people in its catchment area through evangelism, agricultural services and community-based self-help initiatives. The organization is located in Tamale and operates in the

Tolon-Kumbungu, East Gonja, Central Gonja, Tamale Metropolis and Savelugu-Nanton Districts. It covers 54 rural communities targeting 2,050 farmers (male/female) who are engaged in crops and livestock production. The Programme's main objective is to enhance food and income security among farm families, focusing on four main intervention areas namely: organizational strengthening; farmer self-empowerment; advocacy, gender and HIV/AIDS mainstreaming; and sustainable agriculture.

The project's main development strategies and approaches are participatory technology and innovation development approach; sustainable livelihoods approach; building on indigenous knowledge systems; forging stakeholder partnership and networking; and business approach to agricultural development. Major achievements in agriculture and food security include: 1000 farmers supported in organic and ecological farming and rearing practices; 300 farmers supported with revolving credit for small ruminants production; 15 Community Animal Health Workers trained to provide basic animal healthcare; and over 1000 farmers trained on ethno-veterinary medicine for animal healthcare (PAS Mile 7 Profile, 2010).

(v) Ministry of Food and Agriculture (MoFA)

MoFA is government's statutory institution mandated for formulating and implementing national agricultural development policies to ensure sustainable agricultural growth and food security through provision of efficient technical and extension services in an environmentally sustainable manner (Agricultural Extension Handbook, 2006). The Tolon-Kumbungu District office of MoFA, otherwise called District Agricultural Development Unit (DADU) has the responsibility for operationalizing national policies and programmes at the district level to achieve agricultural production and local food security while contributing to national growth. Hence, apart from crops and livestock production, other key activities include; fisheries, agro-forestry, post-harvest management, agro-processing, animal traction, disease and pest management, marketing and monitoring and evaluation.

According to the District Agricultural Officer in charge of extension, the district has over 400 communities classified under four (4) agricultural zones, each of which is supervised by a District Development Officer (DDO). The DDOs supervise Agricultural Extension Agents (AEA's) who work directly with rural farmers. He indicated that there were currently only 20 AEA's as against the stipulated 40 AEA's for ensuring effective extension coverage. This shortfall expresses a very low extension officer -to-farmer ratio, although better than the NGOs. Aside the low extension reach of MoFA in the district, it was apparent that technology development and extension approach was largely conventional.

4.5.2 Livestock Improvement Activities of Agricultural Agencies

The questionnaire requested organizational respondents to indicate their major livestock improvement activities being implemented to support rural livestock production in the study district. 102 multiple responses were received from 50 respondents, with results displayed in Table 4.13.

Table 4.13 Livestock Activities of Agricultural Agencies

Activity	Frequency	Percent (%)
Extension and Training	37	76.7
Supplying improved breeds	19	39.3
Facilitating access to credit	12	24.8
Providing husbandry inputs	10	20.7
Others	4	8.3

Source: This Study 2011.

As can seen from the table, provision of extension and training of farmers, representing 76.7%, constitute the most important activity of the agencies. They elaborated this activity to include training and sensitization on improved husbandry (healthcare, housing and feed management practices), business management skills, livestock groups' development, and crops-livestock integration practices. The next important support area, which scored 39.3%, is provision of improved small ruminant breeding and starter stocks to farmers on credit. Rural women are known to have benefitted from this assistance especially under the NGOs programmes, due to existing gender inequality in ownership of livestock assets by rural women. The third major activity is supporting farmers to access cash and inputs credit (24.8%). Most smallholder rural farmers have very low incomes and therefore unable to invest substantially in livestock enterprises. Hence improving their access to credit can boost small ruminants production to reduce rural poverty.

Provision of husbandry inputs (20.7%) was the fourth support activity. The inputs include cement, wire mesh and roofing sheets and tools for constructing livestock houses; veterinary drugs and equipment for community animal health volunteers; and feed processing equipment, feeding troughs, feed storage facilities, and planting material for establishing fodder banks. The last activity classified under others (8.3%), include research on forage species and superior breeds, organizing farmers' exchange and learning visits and staging exhibitions to showcase best livestock practices and products at Agricultural Shows and National Farmers Days.

4.5.3 Integration of IK Technologies and Practices into Research and Extension Systems

Incorporating and promoting IK practices in research and extension delivery can lead to sustainable livestock production in rural communities. Table 4.14 (and Figure 4.6) shows the extent to which field extension officers incorporate IK in research and extension systems. 64% of the officers were assessed as incorporating IK as against 36% who do

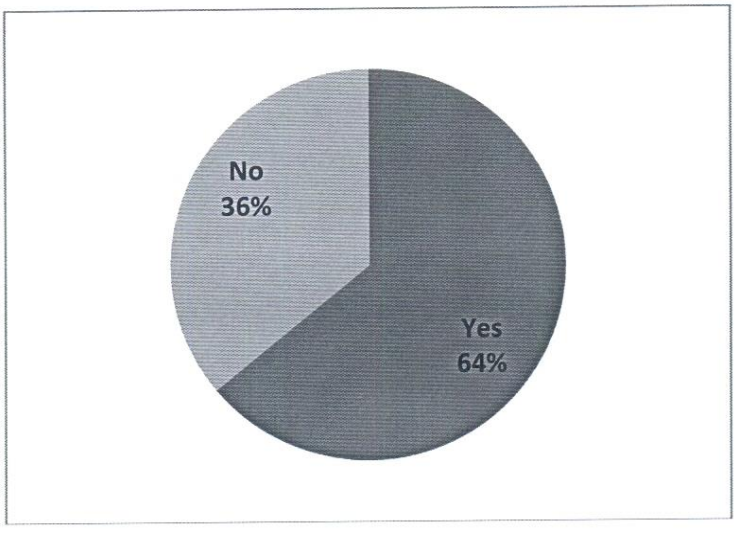
not pay attention to IK. Although the results show an appreciable level IK integration, it is below expectation. This is because no rural development intervention can be sustainable and be able to meet rural peoples' needs and aspirations without IK being a basis and an entry point. Therefore it was expected that livestock intervention and extension approach would strongly be based on IK. In the same light Orskov (1993) has observed that indigenous knowledge is critical in determining local people's developmental practices and approaches, but has often not been sufficiently incorporated into research and development interventions to achieve sustainable development.

Table 4.14: Integration of IK into Formal Systems

Do you integrate IK in livestock activities?	Frequencies			Total	Percent (%)
	MoFA	ARI	NGOs		
Yes	9	4	19	32	**64**
No	15	1	2	18	**36**
Total	**24**	**5**	**21**	**50**	**100**

Source: This Study, 2011.

Figure 4.6: Extent of IK integration by Agric Agencies



Source: This Study, 2011.

During in-depth interviews with key staff of the agencies , it became evident that while the NGOs (PAS-Mile 7, OICI and GDCP) show high regard and commitment to IK in technology development and extension delivery, MoFA on the other hand are more inclined to the conventional high external technologies and transfer-of-technology approach which incorporate farmers IK practices only on a limited scale. Some interviewees said IK approach is outmoded, unproductive and cannot support market scale production. Others said traditional healthcare which are IK-based are not very effective in treating major livestock diseases as compared to modern veterinary medicine, and that IK technologies have no scientific basis to be relied on for production decisions.

These findings have therefore revealed that though agricultural agencies have put much effort to improve rural livestock production through various interventions and activities, the expected results and impact on production and incomes have not been sufficiently

realized. This is because of the overemphasis on modern technologies and extension approaches which have disregarded IK practices that have kept rural production systems for decades.

4.5.4 Strategies to Improve Integration of IK into Research and Extension

Appropriate strategies are needed to improve IK integration in formal research and extension to improve rural livestock production to help address food insecurity and poverty in the Tolon-Kumbungu District. Table 4.11 presents recommended strategies as obtained by the study. They cut across policy, research, advocacy, capacity building and collaboration issues. 65.2% indicated joint capacity building on IK including training workshops, field days and learning visits for farmers, researchers and development workers. The second highest recommendation which scored 50.2% was to mainstream IK practices and approaches in agricultural policies, programmes and academic curricula of agricultural training and research institutions. 32.6% indicated recognizing farmers' achievements in IK through incentives and rewards and mounting IK exhibitions at Farmers' Days and agricultural shows, as a way to promote integration into agricultural programmes and interventions.

One serious weakness of IK is lack of documentation since it is most often orally and visually transmitted. This, coupled with farmers' unwillingness to share their 1K with outsiders due to suspicion, is contributing to its gradual loss. Hence, 29.3% recommended support for formal documentation of best practices and innovations in appropriate forms to facilitate its promotion and replication. Organizing local and national stakeholders' workshops for advocacy, learning and experience-sharing on IK technologies and carrying out research into best IK practices, scored the least scores of 21.2% each.

Table 4.15: Recommended Strategies for Integrating IK into Formal Systems

Strategies	Frequencies			Total	Percent (%)
	MoFA	ARI	NGOs		
Promote documentation & dissemination of best IK practices	6	2	10	18	29.3
Mainstream IK into national agric policies and programmes	15	3	13	31	50.5
Establish platforms for advocacy and sharing knowledge on IK	9	1	3	13	21.2
Promote capacity building on IK integration into agriculture	17	2	21	40	65.2
Promote awards and exhibitions on IK issues on regular basis	11	1	8	20	32.6
Undertake research on IK practices & technologies	3	4	6	13	21.2

Source: This Study, 2011.

4.6 PROBLEMS HINDERING EFFECTIVE INTEGRATION OF IK INTO RESEARCH AND EXTENSION SYSTEMS OF LIVESTOCK PRODUCTION

The study set out, as part of its objectives, to identify problems hindering integration of IK with modern technologies and IK promotion within formal research and extension for livestock production, and to make appropriate recommendations for improvement. The issue was assessed at two levels; integration of modern technologies by rural farmers and integration of IK into formal research and extension systems by Agricultural agencies. However, given that the issues of problems of IK integration and strategies for improvement have been discussed under Sections 4.4 and 4.5, the discussions here are thus brief to re-emphasize the findings already made in respect of the theme.

4.6.1 Problems of Integrating Modern Technologies with IK by Farmers.

In identifying the constraints that affect farmers' adoption of modem production and husbandry technologies, 45.5% of respondents attributed it to the high cost associated with using the technologies. For example some explained that they rely on traditional ethno-veterinary approach for treating animal diseases because of the high cost of veterinary drugs and services provided veterinary officers. For instance a veterinary officer in Tolon indicated the total cost of de-worming, vaccinating and ecto-parasite treatment for one animal as Forty to Sixty Ghana Cedis (Gh¢40-60). Soya cake and mineral licks for feed supplementation were also said to be quite expensive and scarce in rural communities. The same was said about exotic breeds; informant interviews revealed an improved ram to cost between One Hundred and Fifty to Two Hundred Ghana Cedis (Gh¢50-200) depending on the size, as compared to local ones which cost only a third of this price. 21.8% of the farmers do not adopt modem technologies because they lack adequate skills and knowledge in applying the technologies.

The third constraint is related to lack of exposure and access to modem technologies by rural farmers (16.7%). These farmers indicated they have hardly had visits from extension agents to train and educate them on improved husbandry and production practices, and hence tend to depend on their IK. This can be attributed to limited extension staff of MoFA and NGOs in rural communities. Some 10.2% of farmers said the design and mode of delivery and promotion of external technologies by extension officers ignored IK rearing, and hence makes them to disregard external technologies. Yet another 5.8% do not adopt or use modem technologies because the technologies conflict with their traditional beliefs and culture, which they are very proud of. A farmer mentioned in an interview that he did not see any reason buying veterinary drugs to de-worm his animals when his forefathers have trained him to use local herbs for controlling diseases.

On strategies to improve integration of modern technologies with IK practices, results from the focus groups and key informant interviews identified the following:

- ✓ Expand training and extension on best and appropriate modern technologies and husbandry practices using demonstrations and learning visits to livestock projects and institutions.
- ✓ Agricultural agencies should assist rural fanners to access cheap credit facilities and inputs such as feeds, veterinary drugs and improved breeds to improve rural production.
- ✓ Need for Agricultural agencies and extension officers to promote technologies that integrate or build on IK to make them more appropriate and cheap for farmers.

4.6.2 Problems of Integrating IK into Formal Systems by Agricultural Agencies.

Using structured questionnaires and follow-up in-depth interviews with key persons from target institutions, the study identified the extent to which they integrate and promote IK within research and extension in livestock improvement. It was found that the NGOs and MoFA focus their activities on extension, training and inputs and credit support, while ARI deals more with research on feeds and breeds. However, the interventions and activities are not strongly founded on IK, as supported by the data in Section 4.5.3 of this report, which showed only 64% of respondents paying attention to IK and 36% did not. Though these results were quite encouraging, one expected a much higher outcome in favour of IK integration, given its important role and influence on rural livelihood activities and development interventions. In identifying the specific reasons hindering IK integration by the Agricultural agencies, a total of 87 multiple responses were recorded and classified under four major themes as in Table 4.16.

Table 4.16: Reasons for Low Integration of IK by Agricultural Agencies

Reason	Frequency	Percent (%)
IK technologies are not effective enough to support economic and commercial livestock production	45	94.1
IK lacks scientific basis for technology development and production decisions	12	25.1
There are inadequate institutional systems, structures and policies to promote IK integration	22	46.0
IK is associated with superstition and spirituality	8	16.7

Source: This Study, 2011.

94.1% of respondents attributed their reasons to the fact that IK technologies and practices are inefficient and not effective enough to achieve economic and commercial production as compared to modern technologies. For instance one cannot rely solely on ethno-veterinary medicine for healthcare management of large stock numbers. The second major reason which recorded 46% was inadequate institutional support systems, structures and policies for developing and promoting IK integration. The recommendation was thus for government and key agricultural stakeholders to mainstream IK into national agricultural policies, programmes and academic training. The third reason (25.1%) was that IK is primitive and often lacks scientific basis and evidence and hence cannot be relied on for major decisions including technology development, production and promotion. Lastly, 16.7% of the respondents associate IK with superstition and spirituality, which lacks the basis to integrate it into formal research and extension programmes.

During interviews with key staff of the agencies, it became evident that the staff of NGOs (PAS Mile 7, OICI and GDCP) exhibited better orientation to IK than those of MoFA and ARI who were more stuck to conventional high external technology approach to research and extension delivery. This shows a gap in IK integration with regards to government agricultural programmes.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

The research set out to study indigenous knowledge (IK) as applied in small ruminants rearing which is a key food security strategy of rural farmers in the Tolon-Kumbungu District in northern Ghana. The objective was to examine the causes of low small ruminant productivity and poor integration of IK for food security enhancement. This chapter contains summary conclusions of the research outcomes, a re-visit of the research questions and objectives to ascertain whether they have been addressed by the study, and final recommendations.

5.1 CONCLUSIONS

(i) Socio-Demographic Characteristics of Respondents

A total of 239 respondents (198 male, 41 female) from twelve (12) communities and fifty (50) extension officers and researchers from five agricultural development agencies participated in the study. The study showed livestock rearing is dominated by men (82.8% male; 17.1% female) who fall in the age range of 21 to 50 years. Fewer women are involved in livestock rearing in spite of their important contribution to household food security. The study further found that majority (95.9%), of the community participants were Muslim by religion, portraying the dominance of foreign religions and cultures over local cultures and IK which may have which sustained rural livelihoods for decades. Again, 82.8% of the farmers were illiterates, which is typical of Muslim-dominated communities where formal education has not received serious attention by most parents until recent years. From experience, illiteracy negatively affects the rate of adoption of modem technologies by rural farmers. Majority of the respondents were known to engage in small-scale mix farming as their main occupation, with women also doing trading as a supplementary livelihood.

(ii) Indigenous Technologies and Practices in Small Ruminants Production

Rural farmers depend mainly on their indigenous technologies and practices to sustain livestock production, including small ruminants. Indigenous feeding, housing, healthcare and breed improvement practices were the main issues examined. Though feed management systems for small ruminants include free-range grazing, tethering, shepherd grazing and stall feeding, majority (83.2%) of farmers practice free-range grazing, particularly during the dry season when there is less feed and the animals are released to roam freely and extensively for feed. However, during the rainy season when the crops are established and feed is abundant, shepherd grazing, tethering and stall feeding become the main feed management practices. Tree fodder, crops residues and agricultural by-products (rice bran, corn chaffs, pito mash and yam and cassava peels) are the main local feed resources for small ruminants. Inadequate feeds is a major challenge to livestock production, which is often caused by: indiscriminate burning of vegetation, deforestation due to farming activities and charcoal burning, inadequate water sources, high cost and scarcity of nutrient supplements, and inadequate knowledge in quality feed preparation and preservation.

Housing small ruminants is necessary for enhancing productivity and providing other benefits. Most farmers (96%) are known to house their small ruminants in pens constructed with mud, thatch and wood, often located within or very close to the compound house. However, housing was more practiced in the rainy season to protect animals from rain and to prevent destruction of crops, but also due to abundance of feed which require restricted movement during this period. In addition to protection from adverse weather (rain and sun), farmers also housed livestock against thieves; to facilitate supplementary feeding, examination and treatment; and more importantly to harvest manure for crops cultivation. Farmers admitted practicing more housing activities now than five to ten years ago because of the increasing value of manure for crops production in the light of escalating prices of chemical fertilizers which also have long term harmful effects on the fragile soils.

With regards to healthcare technologies, traditional healthcare approach or ethno-veterinary medicine was known to be the most popular healthcare approach in the study area. However a significant number of fanners (27%) also use a combination of ethno-veterinary (EVM) and modem veterinary medicine (MVM) being promoted by agricultural agencies. Farmers attribute their high patronage of EVM to its effectiveness in treating common diseases and its affordability since it uses local materials; especially that modern veterinary medicine and services getting more expensive and scarce. Yet others practice EVM for its cultural and spiritual significance.

The study also discovered that rural farmers depend mainly on indigenous breeding practices to develop local small ruminant breeds to meet various needs, which exotic breeds cannot provide. Indigenous breeds are known to be more adapted to the local climatic conditions, more resistant to diseases, and easier to rear due to their dependence on local feedstuffs, and also require less veterinary care, compared to exotic breeds. It was also revealed that, apart from economic benefits, local breeds also serve cultural, social and spiritual roles such as sacrifices, funerals and festivals, because they possess special characteristics, which exotic breeds lack. Indigenous breeding techniques include castration, culling of sick and older stock and cross-breeding with special exotic species. In selecting animals for breeding, local farmers looked for special characteristics such as size, shape, ability to twin, skin colour, good mothering and moderate temperament. Therefore local breeds are products of IK and need to be protected and promoted to maintain livestock diversity for meeting multi-functional needs of rural people and future generations.

(iii) Role of Small Ruminants in Rural Food Security

In assessing the role and contribution of indigenous livestock to household food security the study found that 68.7% of farmers sold small ruminants to purchase basic food stuffs and crop production inputs such as seeds, fertilizers and labour for family food production. It was also confirmed by the farmers that they obtain significant manure from

livestock for fertilizing croplands, and livestock (cattle and donkeys) provide draught power for cultivating croplands and carting farm inputs and produce, which all enhance food security. It was also revealed that more goats are usually sold than sheep for food security because of their numerous advantages including their high rate of production and growth. It was also discovered that although livestock is very important to women for various purposes, traditional customs do not normally permit child-bearing women to own small ruminants in their families, especially sheep.

Though small ruminants are sold anytime to meet pressing needs, the study however discovered that the peak period when small ruminants are sold for food stuff occurred from April to June. This is the period when the cropping season is just beginning and all the family food banks are exhausted, compelling families to depend on small ruminants as a means of securing food supplies. This is also the period when planting seeds, fertilizers, as well as land preparation are badly needed to start cropping and small ruminants are relied upon for the immediate cash. The findings have therefore underscored and confirmed the strategic contribution of small ruminants in the food security improvement of rural farm families in northern Ghana.

(iv) Integration of Indigenous Technologies with Modern Technologies by Farmers

Rural smallholder farmers in northern Ghana depend mainly on their indigenous technologies, husbandry practices and local resources to sustain livestock production systems. They are however not adequately combining their IK with appropriate external or modern technologies to enhance productivity. 65.3% of farmers had no knowledge or experience with modern technologies, while 37.7% had been exposed to some modern practices. This situation has a significant effect on the extent of adoption of external technologies by rural fanners. With regards to the actual extent or frequency of integration of technologies, the study found that only 13% of fanners frequently integrated or used both technologies, while a significant 57% of farmers did not.

Only 30% of farmers sometimes used both approaches. Reasons for their low adoption or complementary use of modem technologies include:

- ✓ Lack of exposure and access to modem technologies
- ✓ Inadequate knowledge and skills in application of modem technologies
- ✓ High cost associated with adoption and application of modem technologies
- ✓ Cultural beliefs which conflict with modem technologies
- ✓ Inappropriate design and promotion of modem technologies

Low adoption rate of modem technologies could also be partly linked to the high illiteracy rate of the farmers in the area, which was found to be 82.8%. Studies and experience have shown that rural farmers who possess some level of formal education tend to appreciate and associate more with modem technologies than illiterate farmers.

Ways to improve integration of technologies to enhance farmers' livestock production were identified to include: increasing training and extension on best modem practices, including demonstrations and exposure visits; facilitating greater access of farmers to modem inputs and credit facilities to acquire veterinary drugs, improved breeds, feeds and housing materials; and incorporating IK approaches in formal extension delivery. Past experience about failed livestock interventions in northern Ghana pointed to poor project design, wrong assumptions and inappropriate implementation approaches. It is therefore absolutely necessary for farmers and development agents to give serious attention to technology development which focuses on integration of technologies so as to achieve sustainable livestock production and rural food security.

(v) Integration of indigenous technologies into formal research and extension systems by agricultural agencies

In assessing the issue of IK integration in formal research and extension, the study first identified the major livestock improvement activities of the agricultural agencies as: training and extension on improved husbandry practices, supplying improved small

ruminants breeds and husbandry inputs; provision and facilitating access to production credit; and conducting research into forage species and superior breeds. However, as to whether IK was being integrated in these research and extension activities, 64% responded in the positive, while 36% did not. NGOs showed more commitment to IK promotion in their R&D than MoFA. Respondents' reasons for low integration of IK included: inability of IK practices to promote and support economic scale production; traditional healthcare practices not being very effective against major diseases; IK technologies lacking scientific basis and cannot be relied on for production decisions; lack of institutional structures and systems to support IK training and promotion; and IK practices being linked to superstition and spiritual beliefs.

The strategies identified to improve integration of IK in research and extension were: organize joint capacity building activities on IK for farmers and development agents; organize regular stakeholders' workshops for experience-sharing and advocacy focusing on IK; mainstream IK in agricultural policy, extension programmes and academic training; facilitate documentation of best IK practices and innovations for promotion and replication; and conduct research to test and validate best IK practices for adoption and promotion. Hence, notwithstanding great effort of agricultural agencies towards improving rural livestock production, the expected benefits and results are not being fully achieved, because of overemphasis on modern approaches and technologies with little regard for farmers own rearing practices and strategies.

(v) Problems hindering integration of IK into formal systems

Problems hindering IK integration both the farmers and institutional levels have been discussed under the previous sections. The main constraints identified at farmers' level include the following:

- ✓ Lack of exposure and access to modern technologies by farmers,
- ✓ Inadequate knowledge and skills in using the technologies,
- ✓ High cost associated with modern technologies,

- ✓ Cultural beliefs against modern technologies and
- ✓ Inappropriate design and delivery approaches of the technologies.

At the institutional level, the finding revealed 64% of staff integrating IK as against 36% who do not, and identified the main reasons as follows:

- ✓ IK technologies cannot support economic and commercial scale of production, traditional healthcare practices are seen as ineffective against livestock diseases
- ✓ IK lacks adequate scientific basis for technology development and production decisions.
- ✓ There are inadequate institutional systems, structures and policies to promote IK in formal agricultural training and extension.
- ✓ IK is associated with superstitious beliefs and spirituality.

5.2 REVISIT OF THE RESEARCH QUESTIONS AND OBJECTIVES

The first specific research question deals with the types of indigenous livestock rearing technologies in the area and relates to the research objective, "to identify indigenous small ruminants rearing technologies and practices of rural farmers". The study found that rural farmers possess a wealth of indigenous production and husbandry technologies and innovations for raising livestock. These bother on feed management, housing, healthcare and breed improvement issues. Feeding systems include tethering, free range grazing, stall feeding and shepherd grazing, while fodder, crops residues and agricultural by-products (pito mash, yam and cassava peels, corn chaff) are the main feed resources. Animals are mostly housed in traditional pens and kraals constructed with wood, mud and thatch, for protection from adverse weather and thieves, and to facilitate management and manure production for food crops.

On animal healthcare, ethno-veterinary medicine was identified as the most common healthcare approach. The medicinal preparations are usually in forms of powder, concoctions, ointments and bolus and used in treating diarrhoea, worms, skin infections and wounds. Successful practice and treatment depend not only on the herbal properties, but also on the belief systems of the practitioners and healers. On breed improvement, it was found that indigenous breeds dominate rural livestock systems because of their ability to adapt to local conditions. The breeds are also more resistant to diseases and multi-functional, which exotic breeds lack. Selection for breeding is largely based on size, colour, size, temperament and good mothering abilities.

The second research question borders on the relationship between small ruminants and food security. The related research objective is, "to assess the role of indigenous small ruminants in rural household food security". The study found that livestock and small ruminants in particular play many important roles and contributions towards rural household food security as 68.7% of farmers sell their livestock for food stuffs and cash to meet food security needs especially during the hunger period of April to July when the family food stocks are exhausted. They also rely on livestock income to purchase crop production inputs such as seeds, fertilizers, labour etc. Therefore indigenous small ruminants play a vital role in addressing food insecurity of rural families in the study district.

The third research question deals with integration of indigenous livestock technologies and modern external knowledge and technologies for productivity and sustainability. The corresponding research objective is, "to investigate the extent to which rural fanners integrate IK technologies and practices in livestock rearing with modern technologies to influence food security". The study discovered that though modern livestock technologies are being introduced and promoted in the study communities by agricultural agencies, only 37.7% of fanners were exposed to modern technologies. Only 13% of farmers also combined their IK practices with modern technologies. The main reasons were that

external technologies are expensive to use and farmers lacked skills in modern technologies and approaches which are also less accessible to them. The findings have therefore confirmed the research problem that rural farmers are not adequately and effectively combining their indigenous knowledge practices with modern external technologies to improve livestock production.

The fourth research question deals with IK integration in formal research and extension delivery for livestock improvement. It gave rise to the research objective, "to assess the extent to which agricultural agencies integrate IK technologies into formal research and extension systems to influence productivity." The study found that though the agricultural agencies engage in various livestock improvement activities, only a moderate number (64%) of field officers integrate and promote IK within their research and extension activities, in spite of the important place of IK in any sustainable development intervention and process. The findings therefore confirm poor IK integration, contributing to low livestock production in rural communities.

The fifth research question focuses on challenges affecting integration of IK with modern technologies and in formal research and extension and how they can be addressed. This relates to the research objective, "to identify the problems which hinder effective integration of IK into formal research and extension systems of livestock production." The major problems identified were:

- ✓ Lack of exposure and access to modern technologies by rural farmers
- ✓ Inadequate knowledge and skills in application of modern technologies
- ✓ High cost associated with adoption and application of modern technologies
- ✓ Cultural beliefs against modern technologies and practices
- ✓ Inappropriate design and promotion of modern technologies
- ✓ Lack of interest and negative perception about IK by development agents
- ✓ Lack of documentation of proven or best IK practices to facilitate up-scaling.

The recommendations to address these challenges in order to improve IK integration for improved livestock production and food security in the district and northern Ghana in general are presented in the next section.

5.3 RECOMMENDATIONS

On the basis of the findings and conclusions reached by the study, the following recommendations are proposed towards addressing the research problem:

The research discovered and confirmed that rural farmers sustain livestock production mainly using their indigenous technologies and practices. It is therefore recommended that local agricultural agencies provided increased capacity support towards developing and scaling up the use of best IK practices alongside appropriate modern technologies. This will ensure more sustainable production systems to effectively combat rural food insecurity.

The study has ascertained and confirmed the crucial role of small ruminants in ensuring and enhancing rural household food security in the Tolon-Kumbungu District. Small ruminants are also known to possess unique characteristics and advantages over other traditional livestock species. Hence the study recommends that livestock intervention programmes in rural northern Ghana should focus more on small ruminants to economically empower rural people for addressing food insecurity more sustainably.

Women play a central role in ensuring food security and the wellbeing of the household, and with livestock being a major contributor to food security, the study therefore recommends that development agencies should target and increase support to rural women in livestock development and intervention activities in order to enhance their contribution to household food security and economic empowerment.

Since IK technologies and practices are only being moderately promoted by agricultural agencies in spite of its crucial role in enhancing rural production systems, the study recommends adoption of the following strategies to improve IK integration into research and development programmes for sustainable results:

- ✓ Forge stronger collaboration with rural farmers through joint capacity building focusing of best IK practices.
- ✓ Advocate the mainstreaming of IK in national livestock development policies and programmes to ensure effective integration and promotion.
- ✓ Document proven IK practices and innovations to facilitate greater adoption.
- ✓ Expand research on IK practices and results to validate and standardize the practices for increased use in livestock improvement.

REFERENCES

Adda, C. Y., Shittu, M. and Karbo, N. (2006). Manual on Ethno-veterinary practices in Northern Ghana. Publication of Association of Church Development Projects (ACDEP), Tamale, Ghana.

Agricultural Extension Handbook (2006). Published by Ministry of Food and Agriculture. Sponsored by AgSSIP and CIDA FARMER Project. Tamale, Ghana.

Akullo, D. and Kanzikwera, R., (2007). Indigenous Knowledge in Agriculture: A case study of the challenges in sharing knowledge of past generations in a globalized content in Uganda. World Library and Information Congress: 73[11] IFLA General Conference and Council, 19-23 August 2007, Durban, South Africa. 14pp.

Alhassan, I. (2006). Investigating Creativity in Rural Technologies: *Where are the Rural People.* In: Millar, D. and Apusigah, A. A. (eds.) The Harmattan Series No. 2. Publication of the University for Development Studies, Ghana. GILLBT Printing Press, Tamale, Ghana. pp.43-60.

Apiiga, S. Y. and Shittu, M., (2002). Towards a Sustainable Integrated Small Ruminant Production in Northern Ghana. Savanna Farmer Magazine, vol. 3, no. 1. pp.6-9. Publication of ACDEP, Tamale, Ghana.

Apiiga, S. Y., (2003). Ethnoveterinary medicine and the future of Animal Production in Northern Ghana. Savanna Farmer Magazine vol. 3, no. 1. pp.6-9.

Apusigah, A., Millar, D., and Boonzaaijer, C., (eds.). (2008). Endogenous Development in Africa: Towards Systematization of Experiences. BDU, Barneveld, Netherlands. pp. 8-22.

Association of Church Development Projects (ACDEP), (2003). ACDEP Household Food Security Project proposal (2003-2006). Tamale, Ghana.

Babbie, E., (2005). The Basics of Social Research. Thomson Wadsworth, Belmont, USA.

Biotech-Ghana Newsletter Vol. 3, No. 2 (2002). Accra, Ghana.

Brown, P., (1996). An Introduction to Research. Ashgate Limited, England.

Chambers, R., Pacey, A., Thrupp, L. A., (eds.). (1989). Farmers First: Farmer Innovation and Agricultural Research. Intermediate Technology Publications, London. 218pp. Chambers, R., (1997). Whose Reality: Putting the first last. ITDG Publishing, London, UK.

Community-Driven Initiatives for Food Security (CIFS), (2009). Livestock Study Report. Tamale, Ghana.

Conroy, C., (2005). Participatory Livestock Research: A Guide. ITDG Publishing. Warwickshire, UK.

CSIR Hand Book (2006). Council for Scientific and Industrial Research, Accra, Ghana

Dankelman, I. and Ramprasad, V., (1999). Biodiversity in a Cultural Perspective. In: COMPAS Newsletter, October 1999. No. 2, pp. 4-6.

Dewalt, B. R. (1994). Using Indigenous Knowledge to Improve Agriculture and Natural Resource Management". Human Resource Organization Magazine 53 (2). pp. 123-131.

Dittoh, S., (2008). (Unpublished). Poverty Alleviation in Northern Ghana: Fantasy or Realism? Paper presented at the 2008 Harmattan School of the University for Development Studies. Tamale, Ghana.

Dittoh, S., (2009). (Unpublished). Food Policies of the South: Any Hope for Food Security and Poverty Reduction?. Paper presented at the 2009 Harmattan School organized by the University for Development Studies. Tamale, Ghana.

Donhauser, F., Baur, H., and Langyintuo, A., (1994). (Unpublished). Smallholder Agriculture in West Dagbon: A Farming System in Northern Ghana. Nyankpala Agricultural Research Report (101). Tamale, Ghana.

Dorward, A., Anderson, S., Nava, Y., Pattison, J., Rodrigo, P., Rushton, J., and Sanchez Vera, E. (2005). Guide to Indicators & Methods for Assessing the Contribution of Livestock Keeping to Livelihoods of the Poor. Department of Agricultural Science, Imperial College, London.

Emery, A. R., (1996). The Participation of Indigenous People and Their Knowledge in Environmental Assessment and Development Planning (Unpublished paper). Centre for Traditional Knowledge: Ottawa, Canada.

Ethno-veterinary Medicine in Kenya. (1996). A field manual of traditional animal healthcare practices. Intermediate Technology and International Institute of Rural Reconstruction, Kenya.

FAO, (1992). Improving Household Food Security: major issues for nutrition strategies. Thematic paper No. 1.

FAO, (2002). "Rural Women: Crucial Partners in the Fight against Hunger and Poverty: Side Event Report." FAO, Rome.

FAO, (2006). Food Security Policy brief. Issue 2. Rome.

FASDEP (2003) Food and Agriculture Sector Development Policy. Ministry of Food and Agriculture. Accra, Ghana.

Flintan, F., (2010). "Sitting at the table: securing benefits for pastoral women from land tenure reform in Ethiopia". Journal of Eastern African Studies, 4:1, 153-178.

Gatenby, R. M., (1991). Sheep. *The Tropical Agriculturist series.* CTA, Netherlands and Macmillan, London.

Ghanaian Danish Community Programme (GDCP) (2006). Programme Brochure, Vol. 2. Tamale, Ghana.

Gilbert, E. H., Norman, D. W., and Winch, F. E., (1980). Farming Systems Research: A Critical Appraisal. MSU Rural Development Paper No. 6; Department of Agricultural Economics, Michigan State University, East Lansing, Michigan, USA.

Gittinger, J. P., (1990). Household Food Security and the Role of Women. World Bank Discussion Paper: 96. Washington. D.C.

Gupta, A. K., (1989). Scientists' views of farmers' practices in India: Barriers to effective interaction. In: Chambers, R., Pacey, A., Thrupp, L. A., (eds.). Fanners First: Farmer Innovation and Agricultural Research. Intermediate Technology Publications. Pp. 24-30.

Hall, A., (2009). Challenges to strengthening agricultural innovation systems: where do we go from here? In: Scoones, I., and Thompson, J. (eds.). Farmer First Revisited. Innovation for Agricultural Research and Development. Practical Action Publishing, Warwickshire, UK. Pp 30-38.

Haverkort, B. and de Zeeuw H., (1992). Development of Technologies towards Sustainable Agriculture: Institutional Implications. 231-242, In: Rivera, W. M, and Gustafson, D. J (eds.). Agricultural Extension: Worldwide Institutional Evolution and Forces of Change. Elsevier Science Publishing Company. Kegan Paul International, New York, USA.

Haverkort, B. and Hiemstra, W., (1999). Experimenting with farmers' worldviews. COMPAS Newsletter, No. 1.

Haverkort, B., Hiemstra, W., and van 't Hooft, K., (2003). Ancient Roots, New Shoots. Zed Books, London.

Honya, G., Karbo, N., and Avornyo, F., (2007). Micro-Credit, Household Livestock Production and Food and Nutrition Security in Northern Ghana. Savanna Farmer Magazine, vol. 8, no. 1, pp.7-9. Publication of ACDEP, Tamale, Ghana.

Karbo, N. and Bruce, J., (2000). The contribution of livestock to food security in northern Ghana: An Overview. Technical Report, CIDA-Ghana Food Security Programme, Tamale, Ghana. 44pp.

Karbo, N. and Avornyo, F. K. (2006). State of the Guinea Fowl Industry in the northern Region of Ghana. ActionAlD-Ghana study report.

Kohler-Rollefson, I. and Rathore, H. S. (2006).Documentation of animal genetic resources: The LIFE method. LEISA magazine, vol. 22, no. 1. pp.13-15.

Koney, E. M. B (1992) Livestock Production and Health in Ghana. Advent Press, Accra, Ghana

Kumekpor, T. K. B., (2002). Research Methods and Techniques of Social Research. SonLife Press and Services, Accra, Ghana.

Kwabia, K., (2006). Theory in Social Research. The Link between Literature and Observation. Woeli Publishing Services, Accra, Ghana.

Laws, S., Harper, C., and Marcus, R., (2003). Research for Development. A Practical Guide. SAGE Publications, London.

LIFE Network (Livestock for the Future), (2008). *Thinking Differently about Livestock.* LIFE Newsletter

Learning Endogenous Development (LENDEV), (2007). (ETC-Compas Publication). Learning Endogenous Development. *Building on Bio-cultural Diversity.* Practical Action Publishing, Warwickshire, UK.

Millar, D., (1999). The Ghana study report on Enhancing the Dynamics of Indigenous Agricultural Knowledge in Africa. In: Haverkort, B., Hiemstra, W., van Nijekerken, B. and Millar, D. (eds.). Building on African Cultures. Workshop proceedings on enhancing the dynamics of indigenous Agricultural Knowledge, 13-17 December 1999 in Zimbabwe. pp.61-82.

Millar, D., (2003). Improving Farming with Ancestral Support. In: Haverkort, B., van 't Hooft, K., and Hiemstra, W. (eds.) Ancient Roots, New Shoots. Endogenous Development in Practice. Zed Books, London. pp. 153-180.

Millar, D. and Haverkort, B., (2005). Africa Knowledge and sciences: Exploring the ways of knowing of Sub-Saharan Africa. In: Millar, D., Kendie, S. B., Apusigah, A., and Haverkort, B., (eds.). African Knowledge and Sciences: Understanding and supporting the ways of knowing in Sub-Saharan Africa. BDU, Barneveld, Netherlands. pp.11-37.

Millar, D., (2008). Farmers' Experimentation: *An Alternative Logic*. GILLBT Printing Press, Tamale, Ghana.

Ministry of Food and Agriculture-Republic of Ghana, (2001). (Unpublished). Livestock Development Project: Appraisal Report. Accra, Ghana.

Ministry of Food and Agriculture-Republic of Ghana, (2004). (Unpublished). Livestock Development in Ghana: Policies and Strategies. Accra, Ghana.

Ministry of Food and Agriculture-DADU (2007). (Unpublished). Tolon-Kumbungu District Agricultural Profile. District Agricultural Development Unit (DADU), Tolon-Kumbungu, Ghana.

MoFA/DFID (2002). The Role of Livestock in Rural Livelihoods in Ghana: Final Report presented to Ministry of Food and Agriculture (MoFA) and DFID, Accra, Ghana.

MTADP (Medium Term Agricultural Development Programme (1991). (Unpublished). Ministry of Agric, Republic of Ghana an Agenda for Sustainable Agricultural Growth and Development. Accra, Ghana.

Mwanild, A., (2003) (Unpublished). Achieving Food Security in Africa: Challenges and Issues. Cornell University, USA.

Neumann, C., Harris, D. M. and Rogers, L. M., (2002). Contribution of animal source foods in improving diet quality and function in children in the developing world. *Nutrition Research* 22(1-2), 193-220.

Niamir, M., (1990). Working with local knowledge in range and livestock development. In: ILEIA Newsletter, March 1990.

Niamir-Fuller, M., (1994). Women Livestock Managers in the Third World: A Focus on Technical Issues Related to Gender Roles in Livestock Production. IFAD, Rome.

OICI Annual Report (2009). Tamale, Ghana.

Okali, C., (2004). Gender Issues in Changing Domestic Markets for Livestock Production in Developing Countries. Paper for Expert Consultation. FAO, Rome, June 22-24.

Orskov, E. R., (1993). Reality in Rural Development Aid, with Emphasis on Livestock Rowett Research Services Ltd., Aberdeen, UK.

Osuala, E. C., (2005). Introduction to Research Methodology (3rd. Edition). Africana-First Publishers Limited, Nsukka, Nigeria.

Pagot, J., (1992). Animal Production in the Tropics and Sub-tropics. Macmillan Press Ltd., London.

Ploeg, J. D. van der., (1999). Endogenous Development: *Practices and Perspectives in Europe*. COMPAS Newsletter Feb. 1999. No. 1. pp 24-25.

Poostchi, I., (1986). Rural Development and the Developing Countries. Alger Press Ltd., Canada.

Presbyterian Farmers' Training Programme (PAS-Mile 7), (2010). Organizational Profile. Tamale, Ghana.

Preston, T. R. and Murgueito, E., (1994). Strategy for Sustainable Livestock Production in the Tropics. Editorial Claridad Ltd., Cali, Colombia.

PROLINNOVA (2004). Proceedings of the First International PROLINNOVA Workshop, 8-12 March 2004 in Yirgalem, Ethiopia. 210pp.

Reij, C. and Waters-Bayer, A., (2001). Entering research and development in land husbandry through farmer innovation. In: Reij, C and Waters-Bayer, A. (eds.). Farmer Innovation in Africa: A Source of Inspiration for Agricultural Development. Earthscan Publications Ltd., London. pp. 3-20.

Reijtnes, C., Haverkort, B. and Waters-Bayer, A., (1992). Farming for the Future: An introduction to Low-External-input and Sustainable Agriculture. Macmillan, London.

Sanginga, P., Waters-Bayer, A., Kaaria, S., Njuki, J., and Wettasinha, C., (2008). 'Innovation Africa: Enriching Farmers Livelihoods.' Earthscan Publications Ltd., London.

Spore Magazine, (2009). Food Crisis: Tackling price instability. CTA, Netherlands. No. 143.

Spore Magazine (2010). Fertilizer: Bringing Down the Price. CTA, Netherlands. No.146, pp. 8.

Thiagarajan, V. (2010). Small Ruminants Genetic Resources: *Sustaining domestic animal diversity for current and future use.* In: Naire, M. N. B and Punniamurthy, N. (eds.). Proceedings of the International Conference on Ethno-veterinary Practices held on 4-6 January 2010 in India. pp 92-105.

Thomas-Slayter, B. and Bhatt, N., (1994). Land, Livestock and Livelihoods: Changing Dynamics of Gender, Caste and Ethnicity in a Nepalese Village." *Human Ecology 22* (4): 467-494.

Thrupp, L. A., (1989). "Legitimizing Local Knowledge: From Displacement to Empowerment for Third World People". Agriculture and Human Values. Summer Issue. pp. 13-24.

Tourist Potential of the Tolon-Kumbungu District, (2008). *http://www.ghana districts. corn /districts.*

Twumasi, P.A., (2001). Social Research in Rural Communities (2nd. Edition). Ghana Universities Press, Accra.

van't Hooft, K. (1999). Practices and beliefs related to livestock. In: Haverkort, B., Hiemstra, W., van Nijekerken, B. and Millar, D. (eds.). Building on African Cultures. Workshop proceedings on enhancing the dynamics of indigenous Agricultural Knowledge held from 13-17 December 1999 in Zimbabwe. pp.61-82.

van't Hooft, K., Millar, D., Geerlings, E., and Django, S., (eds.). (2008). Endogenous Livestock Development in Cameroun. Exploring the potential of local initiatives for livestock development. Agromisa Publishers, Netherlands.

van 't Hooft, K., Millar, D., and Django, S., (2005). Endogenous Livestock Development Workshop Report . COMPAS Magazine, No. 9. pp.38-39.

World Development Report (2008). Agriculture for Development Policy Brief of the World Bank. World Bank, Geneva.

Warren, D. M., (1991). Using Indigenous Knowledge for Agricultural Development. World Bank Discussion Paper 127. Washington, D.C.

Waters-Bayer, A., (2004). Some key concepts in PROLINNOVA. In: Molla, A. (ed.). Proceedings of the International PROLINNOVA Workshop held from 8-12 March 2004 in Addis Ababa, Ethiopia. pp. 22-27.

Waters-Bayer, A. and van Veldhuizen, L., (2006). Promoting Local Innovation : Enhancing Indigenous Knowledge Dynamics and links with Scientific Knowledge. In: Savanna Farmer Magazine 2006, vol. 7, no. 2. Publication of ACDEP, Tamale, Ghana.

Wettasinha, C., Wongtschowski, M., and Waters-Bayer, A., (eds.). (2006). Recognizing Local Innovation: Experiences of PROLINNOVA Partners. Inktank Printing Press, Silang, Cavite, Philippines.

Wilson, R. T., (1995). Livestock Production Systems. *The Tropical Agriculturist series.* CTA, Netherlands and Macmillan, London.

Yin, R. K., (1994). Case Study Research Design and Methods. SAGE Publications, New Delhi.

APPENDICES

APPENDIX 1: QUESTIONNAIRE FOR FARMER RESPONDENTS

SECTION 1: GENERAL INFORMATION:

1.1 Questionnaire No. .....

1.2 Name of Interviewer.....

1.3 Date of Interview.....

1.4 Name of Community .....

1.5 Name of respondent.....

SECTION 2: SOCIO-DEMOGRAPHIC DATA

2.1 Sex: (a) Male [ ] (b) Female [ ]

2.2 Age:

(a) 20 years or below [ ]
(b) 21 -30 years [ ]
(c) 31 -40 years [ ]
(d) 41 -50 years [ ]
(e) 51- 60 years [ ]
(f) 61 years and above [ ]

2.3 Marital Status:

(a) Single [ ] (b) Married [ ] (c) Divorced [ ] (d) Widowed [ ]

(e) Living together [ ]

2.4 What is your Religion?

(a) Muslim [ ] (b) Christian [ ] (c) Traditional [ ]

(d)Other (specify) .....

2.5 Main Occupation

(a) Farming [ ] (b) Trading [ ] (c) Public sector worker [ ]

(d) Other (specify……

2.6 Level of education

(a) Never attended school [ ]
(b) Basic (Primary, middle, JHS) [ ]
(c) Secondary / SHS [ ]
(d) Tertiary [ ]

(e) Others (specify)……

SECTION 3: INDIGNEOUS TECHNOLOGIES AND PRACTICES IN SMALL RUMINANTS REARING

Feeding Practices

3.1 Which of the following feed management system (s) do you use for your animals?

(a) Free-range grazing [ ]
(b) tethering [ ]
(c) shepherd grazing [ ]
(d) stall feeding [ ]

3.2 What supplementary feedstuffs do you feed to your animals?
(a) Tree and grass fodder [ ]
(b) Crops residues [ ]
(c) agricultural by-products [ ]
(d) Nutrient supplements (mineral licks, urea, groundnut/Soya cake) [ ]
(e) Others (specify) [ ]

3.3 What problems do you face with regards to feeding
(a) ……..

(a) ……..

(b) ……

3.4 What measures or coping strategies do you use to address the feeding problems?

(a) .....

(b) .....

(c) .....

Housing Practices

3.5 Do you house your animals?

(a) Yes [ ] (b) No [ ]

3.6 If yes, what time of the year do you house them?

(a) Rainy season [ ]
(b) Dry season [ ]
(c) Throughout the year [ ]

3.7 Indicate the type of houses you use

(a) Pens [ ]
(b) Kraals [ ]
(c) Other (specify) [ ] .....

3.8 What local materials do you use to construct your animal houses?

(a) ..... (b).....

(c)..... (d).....

3.9 Where do you locate your livestock houses

(a) Within the compound house [ ]

(b) Near the compound house [ ]

(c) Far away in the bush [ ]

(d) Other (specify).....

3.10 What are the benefits of housing your animals?

(a) .....

(b) .....

(c) .....

Healthcare practices

3.11 What healthcare approach do you use for your animals?

(a) Ethno-veterinary Medicine (EVM) [ ] (b) Modern veterinary medicine [ ]
(c) Both [ ]

3.12 If you practice EVM, indicate your reasons for using this approach

(a) .....

(b) .....

(c) .....

3.13 List 5 most common animal diseases you treat with EVM

(a)..... (e).....

(b)..... (f).....

(c).....

3.14 EVM is underpinned by spirituality or spiritual beliefs

(a) Somehow agree [ ] (b) Strongly agree [ ] (c) Does not agree [ ] (d) No idea [ ]

Breed improvement practices

3.15 What types of livestock breeds do you rear?

(a) Local [ ] (b) Exotic [ ] (c) Both [ ] (d) Crossed improved [ ]

3.16 What are the main benefits of rearing local breeds ?

(a).....

(b).....

(c).....

(d).....

3.17 Which of the following breeding techniques have you practiced?

(a) Local castration of males [ ]

(b) Culling of sick and older stock [ ]

(c) Isolation of males from females [ ]

(d) Other (specify) [
]..... .....

3.18 What desirable characteristics do you consider when selecting animals for rearing and breeding?

(a) ....

(b) .....

(c) .....

SECTION 4: ROLE OF SMALL RUMINANTS IN ENHANCING RURAL FOOD SECURITY

4.1 Do you sell your animals to purchase foodstuffs (a) Yes [ ] (b) No [ ]

4.2 If yes, which of them do you sell most and why?

(a) Goats [ ] (b) Sheep [ ]

4.3 What period (s) of the year do you sell animals to purchase foodstuffs?

(a) During & immediately after harvesting [ ]

(b) Just before the planting season [ ]

(c) During the crops tending period [ ]

4.4 How many animals (on the average) do you sell in a year for foodstuffs?

SECTION 5: INTEGRATION OF INDIGNEOUS AND MODERN TECHNOLOGIES FOR SMALL RUMINANTS' REARING

5.1 To what extent have you been exposed to modern technologies in animal rearing?

(a) Have no knowledge or exposure [ ]
(b) Have been exposed but does not practice [ ]
(c) Have adequate exposure and practicing [ ]

5.2 What modern technologies or practices do you use in your rearing?

(a) .....
(b) .....
(c) .....

5.3 What benefits are derived from using modern technologies or practices?

(a) .....
(b) .....
(c) .....

5.4 What problems affect your adoption modern technologies (tick as applicable)

(a) Not exposed to the technologies [ ]
(b) Not trained on know how to apply them [ ]
(c) The technologies do not conform with my culture [ ]
(d) They are not useful to me [ ]
(e) Too expensive to use [ ]
(f) Other (specify) [ ].....

5.5 How often do you combine your IK with and modern technologies/practices?

(a) Very often [ ] (b) Les often [ ] (d) Not at all [ ]

5.6 What benefits do you gain by combining your IK and modern technologies and practices?

(a) .....

(b) .....

(c) .....

5.7 Give suggestions to improve integration of IK with modern technologies

(a) .....

(b) .....

(c) .....

SECTION 6: INTEGRATION OF IK INTO AND FORMAL RESEARCH & EXTENSION SYSTEMS

6.1 Which organization (s) assists you in livestock rearing

(a) MoFA [ ]
(b) Presby Agric [ ]
(c) OIC international [ ]
(d) Animal Research Institute [ ]
(e) Ghanaian Danish Community Program [ ]
(f) others (specify).....

.....

6.2 What kind of assistance has the Organization(s) or extension officer provided you in livestock improvement

(a) Extension education and training [ ]
(b) Inputs (tools, feed, vet drugs) [ ]
(c) Livestock breeds [ ]
(d) Financial credit [ ]

(c) Others (specify) .....

6.3 How often have the officers trained or assisted you to develop or use IK for rearing?

(a) Very often [ ]
(b) Rarely [ ]
(c) Not at all [ ]

6.4 Suggest ways to effectively integrate IK into formal research & extension systems.

(a) .....

(b) .....

(c) .....

(d) .....

APPENDIX 2: QUESTIONNAIRE FOR AGRICULTURAL AGENCIES

SECTION 1: GENERAL INFORMATION:

1.1 Questionnaire No……

1.2 Organization……

1.3 Date of Interview ……

1.4 Staff Designation (Tick as applicable):

(a) Director /Manager [ ] (b) Supervisor [ ] (c) Extension Officer [ ]

(d) Researcher [ ] (e) Technician [ ]

SECTION 2: LIVESTOCK TECHNOLOGIES AND PRACTICES

Feeding

2.1 What modern feedstuffs do you promote for animal feeding in your operational area?

a) …… b)…….. c) …… d)……

2.2 What specific support does your organization provide in animal feeding?

a)…… b)……

c)……

2.3 What livestock feeding constraints affect farmers in your operational areas?

a)……

b) ……

c)……

d)……

2.4 How does your organization address these constraints?

a)……

b) ……

c)……

Housing

2.5 What specific support does your organization provide to rural farmers on livestock housing?

a)……

b) ……

c)……

2.6What are the main constraints to animal housing?

a)……

b) ……

c)……...

2.7 How does your organization address these constraints?

a)……

b) ……..

c)……

Healthcare

2.8 Do you promote ethno-veterinary medicine (EVM) in animal rearing ?

a) Yes [ ] b) No [ ]

2.9 If yes, what are your reasons for promoting EVM?

a)……

b) ……..

c)……..

2.10 If no, what are your reasons?

a).....

b) .....

c).....

2.11 How often do farmers practice modern veterinary healthcare?

(a) Very often [ ] b) Less often [ ] c) Not at all [ ]

Breed improvement

2.12 What specific support do you provide in breed improvement

a).....

b) .....

c).....

SECTION 3: ROLE OF SMALL RUMINANTS IN RURAL FOOD SECURITY

3.1 What period (s) of the year do farmers sells their animals most to support household food security

a) During & immediately after harvesting period [ ] c) Before planting season [ ]

d) during the crop season [ ]

3.2 What does your organization do to improve livestock production for food security?

a).....

b) .....

c).....

SECTION 4: INTEGRATING IK INTO FORMAL RESEARCH AND EXTENSION

4.1 What are your major activities in rural livestock improvement?

a) Extension and training [ ] b) Inputs support (drugs, tools material etc. [ ]

c) Supplying livestock/improved breeds [ ] d) Financial/Revolving credit [ ]

e) Others (specify)……..

4.2 Do you promote or integrate indigenous technologies into research and extension activities?

a) Yes [ ] b) No [ ]

4.3 What are your reasons if you do or do not?

a)……

b) ……

c)……

d)……

4.4 What problems hinder effective integration of IK into formal research and extension for livestock improvement?

a)……
b) ……
c)……
d) ……

4.5 What measures/strategies can improve integration of IK into research and extension?

a)……
b) ……
c)……
d)……

2.1 What modern feedstuffs do you promote for animal feeding in your operational area?

2.2 What specific support does your organization provide in animal feeding?

2.3 What livestock feeding constraints affect farmers in your operational areas?

2.4 How does your organization address these constraints?

2.5 What specific support does your organization provide to rural farmers on livestock housing?

2.6 What are the main constraints to animal housing?

2.7 Do you promote ethno-veterinary medicine (EVM) in animal rearing?

2.8 If yes, what are your reasons for promoting EVM?

2.9 If no, what are your reasons?

2.10 How often do farmers practice modern veterinary healthcare?

2.11 What specific support do you provide in breed improvement?

3. ROLE OF SMALL RUMINANTS IN RURAL FOOD SECURITY

3.1 What period (s) of the year do farmers sells their animals most for household food security?

3.2 What does your organization do to improve livestock production for food security?

4. INTEGRATING IK INTO FORMAL RESEARCH AND EXTENSION

4.1 What are your major activities in rural livestock improvement?

4.2 Do you promote or integrate indigenous technologies into research and extension activities?

4.3 What are your reasons if you do or do not?

4.4 What problems affect integration of IK into formal research and extension for livestock improvement?

4.5 What measures/strategies can improve integration of IK into research and extension?

B) FARMERS

1. GENERAL INFORMATION:

1.1 Name of Community

1.2 Name of Respondent or Group

2. INDIGNEOUS TECHNOLOGIES AND PRACTICES IN SMALL RUMINANTS REARING

2.1 What feed management system (s) do you use for your animals?

2.2 What supplementary feedstuffs do you feed to your animals?

2.3 What problems do you face with regards to feeding?

2.4 What measures or coping strategies do you use to address the feeding problems?

2.5 Do you house your animals?

2.6 If yes, what time of the year do you house them?

2.7 Mention the type of houses you use

2.8 What local materials do you use to construct your animal houses?

2.9 Where do you locate your livestock houses?

2.10 What are the benefits of housing your animals?

2.11 What healthcare approach do you use for your animals?

2.12 If you practice EVM, indicate your reasons for using this approach?

3. ROLE OF SMALL RUMINANTS IN ENHANCING RURAL FOOD SECURITY

3.1 Do you sell your animals to purchase foodstuffs?

3.2 If yes, which of them do you sell most and why?

3.3 What period (s) of the year do you sell animals to purchase foodstuffs?

3.4 How many animals (on the average) do you sell in a year for foodstuffs?

4. INTEGRATION OF INDIGNEOUS AND MODERN TECHNOLOGIES

4.1 To what extent have you been exposed to modern technologies in animal rearing?

4.2 What modern technologies or practices do you use in your rearing?

4.3 What benefits are derived from using modern technologies or practices?

4.4 What problems affect your adoption modern technologies?

4.5 How often do you combine your IK with and modern technologies/practices?

4.6 What benefits do you gain by combining your IK and modern technologies and practices?

4.7 Give suggestions to improve integration of IK with modern technologies

5. INTEGRATION OF IK INTO AND FORMAL RESEARCH & EXTENSION

5.1 Which organization (s) assists you in livestock rearing?

5.2 What kind of assistance has an extension officer provided you in livestock?

5.3 How often have the officers trained or assisted you to develop or use IK for rearing?

5.4 Mention ways to improve IK integration into formal research & extension systems.