AN INVESTIGATION INTO THE POTENTIAL CONTRIBUTION OF SMALL RUMINANTS PRODUCTION TO RURAL LIVELIHOOD IN LOFA COUNTY, LIBERIA: A CASE STUDY OF VOINJAMA, KOLAHUN AND FOYA DISTRICTS

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE (RANGELAND RESOURCE AND MANAGEMENT) IN THE DEPARTMENT OF ANIMAL SCIENCE FACULTY OF AGRICULTURE AND NATURAL RESOURCES OF THE UNIVERSITY OF NAMIBIA

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ABSTRACT

This research was carried out to analyze and evaluate the husbandry system for small ruminant production in Lofa County, Liberia and to estimate its potential contribution to rural livelihoods. Specifically, this research investigated the potential and extent to which small ruminant production contributes towards sustainable rural protein food supply and income generation. The existing opportunities and challenges in rural small ruminant production in the three districts of Lofa County (Voinjama, Kolahun and Foya) were thereby investigated. Structured questionnaires were administered to 438 rural farmers' households to provide demographic information, species and breed of small ruminants kept, the number of animals in the herd, and periodic yield of stock. Baseline statistics on the rural farming community was determined using participatory discussion (face-to-face interview) with members of the rural households, county agricultural staff and agricultural NGO officials. Data was analyzed using SPSS software to determine frequency distributions, cross-tabulation, figures, ANOVA tables and correlations. This research reveals that small ruminant production contributes 30.2% of the household income, which was significant ($P<0.01$) and also was a significant source of meat ($P<0.05$) but had no significant ($P>0.05$) influence on poaching by rural farmers. It reports some of the identified animal health challenges in small ruminant production in the studied area. This makes small ruminant production to be second highest contributor of rural livelihoods to crops. The information derived from this study will serve as baseline for livestock agribusiness development needed especially in post-war Liberia.

Key words: Small ruminants, rural livelihood, rural farmers.

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DECLARATIONS

I, Morlu Korsor declare hereby that this study is a true reflection of my own research, and that this work, or part thereof has not been submitted for a degree in any other institution of higher education.

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ACRONYMS

ACDI/VOCA:	(International Non-governmental Organization)
ACF:	(International Non-governmental Organization)
CLO:	County Livestock Officer
CAC:	County Agriculture Coordinator
CFSNS:	Comprehensive Food Security and Nutrition Survey
CDEP:	Community Development and Empowerment Projects
CAC:	County Agriculture Coordinator
DAC:	District Agriculture Coordinator
EU-Liberia:	European Union Liberia
FOA:	Food and Agriculture Organization of the United Nations
GDP:	Gross Domestic Product
GoL:	Government of Liberia
INGO:	International Non-governmental Organization
LDC:	Least Developed Country
LISGIS:	Liberia Institute of Statistics and Geo-information Services
MOA:	Ministry of Agriculture
NGO:	Non-Governmental Organization
NRC:	Norwegian Refuge Council
PRA:	Participatory Rural Appraisal
PPR:	Pest des Petits Ruminants (diarrhoea)
PRS:	Poverty Reduction Strategy
SP:	Samaritan's Purse (International Non-governmental Organization)

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CHAPTER 1

INTRODUCTION

1.1 Orientation of the Proposed Study

The means of livelihood available to the majority of people in most parts of Liberia is subsistence agriculture. Under the prevailing situation of near-absence of wage jobs and the need for greater increased productivity in the agricultural sector to achieve food security and sustained Gross Domestic Product (GDP) growth, Liberia simply needs more people devoted to farming, agro-processing and agriculture-related enterprise (Women's Refugee Commission, 2009).

Since the end of civil war that raged between 1989 and 2003, Liberia has suffered from chronic food insecurity mainly due to the destruction of its agricultural sector and basic socio-economic infrastructure. According to the 2006 United Nations Food and Agriculture Organization (FAO) State of Food Insecurity in the World statistics for Liberia, 1.6 million or 49% of the Liberian population are malnourished. The Comprehensive Food Security and Nutrition Survey (CFSNS) added very worrying statistics on acute and chronic malnutrition, particularly amongst very young children. Thirty-nine (39) percent was affected by chronic malnutrition and 6.9 % by acute malnutrition. According to the report, the households that are food insecure or highly vulnerable to food insecurity are concentrated in Lofa, Grand Kru, River Gee, Bomi, Gbarpolu, Nimba and Sinoe counties, though pockets of highly food-insecure areas also exist in other counties and in greater Monrovia. In the north-west of

Liberia, food insecurity can be characterised as transitory or temporary as food deficits are directly related to the consequences of the civil war. In the south-east, food insecurity is more chronic due to a longer-term inability to meet minimum food consumption requirements (EU-Liberia, 2008).

Among the 15 counties in Liberia, Lofa County is the second largest, with 7 districts including Voinjama, Kolahun and Foya Districts in which Voinjama is the capital city of the county. Prior to the 14-year civil war Lofa County was considered to be the food basket in Liberia based on the amount of food it produced. In geographic structure, Lofa is composed of large expanses of forests, mountains, hills, rivers and fertile soils. Small ruminants are raised in all towns and villages of the county on subsistence, usually on free-range basis.

Although small ruminants' production contributed largely to rural income and food before the war in these three districts, the present situation in the post-war setting may require substantial improvement in the small ruminant's husbandry and business packages. Mentorship and training of subsistence farmers on ruminant nutrition, pasture management, healthcare and cooperation extension services system to optimize income generation through food production and marketing structure is hypothesized for sustainable and enhanced rural livelihood standards.

1.2 Statement of the Problem

The main agricultural activities in Lofa County revolve primarily around crop production. Crops grown include food crops like rice, beans, groundnuts, cassava, and cash crops such as coffee, cocoa, oil palm and sugarcane, while animal production is secondary. The usual sources of protein for the local people include fish from local rivers and meat from bush hunting and few domestic animals. Even at that, the daily supply is not enough to meet public need. Therefore, in order to conserve wild animals and fish stock, and yet increase animal protein availability, the rural people of Lofa must be encouraged to get involved in small ruminant production that will substitute for bush meat and river fish and generate income concurrently. Although subsistence farmers produce food crops in most parts of Lofa County yielding sufficient food for year-round household consumption, inadequate animal protein in human diets is obviously causing malnutrition in young children. Therefore, since small ruminants can easily survive in every part of the county on the free-range basis, rural farmers must be encouraged to enhance and maintain their productivity.

Records show the total number of goats and sheep in pre-war Voinjama district were 1,187 and 818 respectively (Woiwor, 2011). Similar records for the other two districts were not accessible. The problem is that after the war about 90% of rural farmers in the 3 districts completely lost all their animals to armed fighters, many have relocated and many that returned are not yet into active production of small ruminants. It is well known that small ruminants can easily survive on the free range and reproduce quickly, thus having a quality that makes them suitable for enhancing and maintaining the economy and nutrition of rural households. Illegal hunting (poaching) and fishing is damaging to the economy of Liberia and it endangers wildlife populations. To avoid this, and at the same time meet the protein need of the populace, there is a need to address this problem through small ruminant production which has a high turnover rate. Voinjama, Kolahun and Foya Districts are some of the districts in Lofa County that are endowed with a great variety of species of animals, fishes and plants that can be conserved for eco-tourism purposes. Thus, this research is aimed at investigating the potential of small ruminant production to enhance household economy, ecosystem conservation and sustainable production of protein from animal sources, with concurrent income generation for the rural farmers.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of this study was to investigate the potentials and extent to which small ruminant production can contribute towards sustainable rural food production and income generation.

1.3.2 Specific Objectives

The specific objectives of this study were to:

1. Identify the characteristics of small ruminants production systems and background of their producers;
2. Evaluate the management systems used in the production and marketing of small ruminants;
3. Evaluate the contributions of small ruminant production to livelihood of the people in the Voinjama, Kolahun and Foya Districts to adopt and increase productivity of subsistence farmers; and
4. Identify training needs of small ruminant producers to be included in extension services.

1.4 Hypotheses of the study

1. $\mathbf{H_{o1}}$: Small ruminant production has no significant relationship to rural farmers' income generation.

   $\mathbf{H_{a1}}$: Small ruminant production has a significant relationship to rural farmers' income generation.
2. $\mathbf{H_{o2}}$: Small ruminant production does not significantly serve as source of meat for rural farmers.

   $\mathbf{H_{a2}}$: Small ruminant production significantly serves as source of meat for rural farmers.

3. $\mathbf{H_{o3}}$: Small ruminant production does not significantly influence poaching among rural farmers.

H_{a3}: Small ruminant production significantly influences poaching among rural farmers.

1.5 Significance of the study

Livestock farming in Lofa County, Liberia is one essential sector that is marginally developed and requires concerted efforts to develop it. This study was therefore designed to investigate and analyze the small ruminant production system and its operational performance in meeting the food or dietary, financial, economic and cultural needs of the rural populace in Lofa County. This research investigated the turnover rate of animal production and appraises the impact of small ruminant husbandry system on small-holder farmers in the Voinjama, Kolahun and Foya Districts. The findings of this study will be used to encourage increased productivity through awareness building and sensitization on the benefits of the practice of small ruminant production. The findings will be used to educate farmers on the values of small ruminant production for food, especially in terms of protein content of their diets with additional benefits of generating income without destroying the biodiversity of the ecosystem in the environment. This is so significant in the post-war recovery and integrated developments for ensuring food security and food safety in Liberia.

1.6 Limitation of the study

This study was conducted in the Voinjama, Kolahun and Foya Districts in Lofa County, Liberia. Inadequate financial support for the project was the main limiting factor as money was needed for various activities of the study. Transportation into the rural towns and villages was challenging and potential limiting factor to the study. In addition to these was a language barrier. Only in Foya District could the researcher speak the local language (Kissi). There are diverse languages in the other two districts. The illiteracy of farmers was another limiting factor. There was therefore the need to hire interpreters for data collection in these districts. All these challenges were eventually overcome.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Small ruminants included goats and sheep in this research. These are domestic animals that are raised in almost all parts of Liberia and other parts of the world. In Liberia, goats and sheep are produced on the free-range basis, in which subsistence crop farmers usually keep few heads of goats and sheep in each town and village. Since Liberia has an evergreen forest, goat and sheep forage all year round. The animals feed on milled rice bran on the street and other available household residues. However, these free-roaming animals encounter diseases, some of which are contagious and fatal. Since many of the subsistence farmers do not have the knowledge of animal healthcare, sometimes the animals die of these diseases which could have been easily treated with adequate knowledge and training. If farmers are trained, they could manage minor diseases and equally improve nutrition of their animals for increased profitability.

2.2 Historical Background of Small Ruminants

Ruminants have been described as any of various hoofed, even-toed, usually horned mammals of the suborder Ruminantia, such as cattle, sheep, goats, deer, giraffes, and antelopes, characteristically having a complex stomach divided into four compartments and chewing the cud consisting of regurgitated, partially digested food

(The American Heritage Dictionary of the English Language, 2000). Thus, ruminant animals are those animals that ruminate. They have four stomach compartments: the rumen, reticulum, omasum, and abomasum). They graze and/or browse depending on what is available. Grazing is the process by which animals feed on grasses while browsing is the process by which animals feed on woody plant (trees, shrubs, and so on) leaves. Ruminants are reared in almost every part of the world for multiple purposes, which include meat, milk for human consumption, wool for clothes production, and draught power for farm. Male sheep are known as ram or buck, female as ewe and newborns as lambs. On the other hand, male goat is known as bully or buck, female as nanny or doe and newborn as kid. Both castrated male goat and sheep are known as wethers. In terms of reproduction, gastration period in sheep is 148 days with an estrus cycle of 16 days and have a normal birth of 1 to 3 or even 6 in some species. Goats' gastration period lasts for 150 days with an estrus cycle of 21 days and have a normal birth of 1 to 3 per doe (Ekarius, 1999).

Small ruminants include goats and sheep and belong to the same tribe, called Caprini. This tribe is divided into two parts or genera, Capra and Hemitragus. The Hemitragus, also called Tahrs, are wild goats found in Arabia, the Himalayas and South India. They have short stout horns, no beards, and long shaggy coats. The Bezoar is thought to be the main ancestor of today's domesticated goats, but the Markhor has had a strong influence in Central Asia where many goats have the long coarse hair and scimitar type horns which are characteristic of both species. Goats were probably the first ruminant animal to be domesticated, some 8,000 years ago. This occurred in the ancient civilizations along the rivers of the Nile (Africa), Tigris and Euphrates (Asia), and Indus (India). When populations migrated from these areas the domesticated goat spread throughout the continents, most recently to Europe and Americas (Steele, 1996). Sheep and goats commonly known as small ruminants were once wild and were domesticated in southwest Asia at the time crop agriculture was not fully developed. The animals are classified in the sub family known as Caprinae. Sheep is in the genus of *Ovisaries* whereas goat belong to the genus capra. It is from these species the forest dwarf sheep and goats of West Africa originated (Samaritan's Purse - Liberia, 2005).

Domestic sheep, which are scientific known as *Ovis aries* belong to the Bovidae family, along with other hollow-horned, cloven-hoofed ruminants such as cattle, and to the Caprinae subfamily, the goats known as *Capra hircus*. There are more than 1,000 breeds of domesticated sheep in the world today – more than three score of them in North America alone. While size, shape, type of fleece (or lack thereof), and disposition vary greatly, all domestic sheep have certain traits in common. Sheep, intelligently and quietly handled, are easily trained (Ekarius, 1999 and Weaver, 2005). The difference between goats and sheep are numerous. Goats and sheep are usually easy to tell apart. Behaviorally, in the pasture, sheep maintain a herd, at least loosely, whereas goats spread out and look for food individually. Goats can stand on their hind legs to reach bushes and trees so that they can eat the leaves they particularly like, whereas sheep are not able to do this and prefer grass and weeds. Strange circumstances and people are observed very carefully by goats. Although they remove themselves with a few jumps when danger threatens, they do it only so they can better observe the threat. Sheep on the other hand, are easily panicked and then the whole herd storms away. It is enough if one animal takes off in flight; the others will follow it blindly. For this reason, goat bucks are used as lead animals for sheep herds (Jaudas and Mobini, 2006).

Goats are essentially browsers. They can feed themselves off trees and bushes in places where there is not enough vegetation for sheep and cattle. Their tongues and flexible top lips make it easy for them to pick leaves from between the thorns. They will even eat bark and exposed roots (Jansen, 1991). Goats can keep themselves in reasonable condition in difficult circumstances, because the first part of their stomach system can preserve the food for later use. Their rumen is full of micro-organisms which help them convert poor quality fiber into usable nutrients. Their liking for tree leaves also means that they have an extra supply of protein, with the result that they are usually in better condition at the end of the dry season than sheep and cows that cannot make such good use of tree leaves.

In the tropics, feed can actually contain too much moisture (more than 80%), which can result in inefficient digestion and the goats will have to eat tremendous amounts to take in sufficient nutrients. However, goats need between 3 and 8 liters of clean water per day during the dry season (Jansen, 1991).

Small ruminants are easy to rear based on their size and can easily adapt to many environmental conditions. In West Africa, they are found in almost every town and village mainly on the free range. They contribute to both protein diet and income generation for the rural people. Liberia being globally categorized as one of the least developed country (LDC) raise small ruminants in every town and village which are used during festivals and also sold to generate income whenever there is an emergency financial need in the family or household. Therefore, small ruminants contribute largely to the rural economy of Liberia because they serve as investments that generate income at any time when the need arise.

2.3 Small Ruminants as Sustainable Livelihood for Rural People

The household economy of smallholder farmers is often multisectoral. Farm income is supplemented by income from non-farming sectors such as handicrafts, trade or wage labor. They use innovations because of their difficult ecological and economic circumstances and because they consume most of their farm output themselves, they have little opportunity to accumulate capital. They are therefore more attracted to innovations that involve low risk, require little outside capital, can be tested on a small scale and be adopted gradually (Coste and Smith, 1998). Albeit, the income made from small ruminants, has contributed to the welfare of the rural farmers. As it is known, rural people have lots of activities that contribute to their livelihoods and only need to attain improvement in those sectors to improve their living standards. The relative advantage of animal production integrated with farming is the availability of by-products or harvest remains from the crops by animals, which is converted to meat or milk. The integration of animal production into crop production in the small-holder production system usually works to the disadvantage of the animal production and does not exploit the resources of farming for animal production optimally (Seifert, 1996).

Agricultural groups derive most of their food and cash income primarily from cultivation. Small ruminants are kept largely as a readily convertible source of income. In humid zones, such as the west coast or Central Africa, a great deal of farming is done as shifting cultivation (bush fallow), so that there is apparently more land and forage available per family than in drier areas. Actually, the African humid zones do not currently support much livestock. In both zones small ruminants are considered primarily as readily convertible savings, and as a source of meat for home consumption. Contrary to the practices of agro-pastoral and pastoral people amongst agricultural groups, and particularly in the humid zone, small ruminants are not herded, no breeding control or selection is carried out, and little veterinary care is extended (Sumberg, 1985).

In Liberia, the major farming system is crop production as in the case of many humid zones or countries. Voinjama, Kolahun and Foya Districts, although having abundant green forage and crops residues for small ruminants’ grazing throughout the year, the sector remains dormant. If subsistence farmers are encouraged or trained to increase their herds per household, it would automatically serve as financial savings for them and at the same time used as source of protein.

Goats are an important component in the livelihoods of rural people in Nepal, especially those of poor and medium resource endowment. Goats are kept for meat and manure, and are also used as a form of security since they can be sold to raise cash when necessary. The constraints associated with goat keeping in Nepal include the shortage of forage in the dry season, and the susceptibility of goats to disease, particularly during the wet season. In Karnataka goats are reared under extensive management system and are given very little supplementary feed. Most of the grazing takes place in the harvested fields, along roadsides, river banks, in forests, and on hill slopes. Goats are not given healthcare (Smith, Godfrey, Buttery and Owen, 2002).

In Liberia, like Nepal and Karnataka, goats and sheep are kept for meat and partly manure used to fertilize the soil; however, they graze on roadsides, harvested fields, forests, river banks, etc. without any supplementary feeds except for household wastes. Even though there is no supplementary feeds and healthcare, they contribute to livelihoods of the rural people financially and nutritionally. The reason for sheep and goats keeping according to Smith et al. (2002) is that, they are an easily liquidated resource that can be used for saving or raising cash; for home or village consumption of meat and milk; goats for their ability to survive on browse material during the dry season; for social status, to pay bride dowries and gifts at other important social occasions.

All the available evidence suggests that small ruminants are owned by a large proportion of the rural population in the humid zone: ILCA's village surveys in southwest Nigeria indicate that up to 75% of the population in some villages may own these animals. Small ruminants are also widely reported to be owned by individual men and women rather than by domestic units or kin groups. Both male and female owners have relatively limited skills in livestock husbandry (French, 1970).

Dwarf goats can contribute to meat if you want to be self-supporting, and they provide manure for the garden. Goats for markets or self-use should be meat goats. Meat goats can be raised without much attention and do well. Besides the reasonable cost of purchasing goats, they can be maintained with less feed. If several goats are kept instead of a cow, enough milk and meat may be produced for the needs of a family. Goats can survive a lot of diseases and can quickly build up a herd since twin and triple births are not uncommon with goats. The reasons for keeping goats are that they supply milk, meat, leather and fertilize the soil by their dung (Jaudas and Mobini, 2006). The feature of livestock is that they represent a capital asset – for many people, their main capital asset. For livestock owners with limited access to the cash economy, and in economies with high inflation and unreliable financial institutions, livestock have an important function as a capital reserve. Livestock owners may consider it worthwhile to hold livestock, even if they do not produce anything, as a means of preserving the value of capital (James, 1996).

2.4 Buying of sheep and Goats to Rear

Buying of goats and sheep entails choosing of the breeds that can locally withstand the environmental factors of the area that they will be raised. They should also be healthy and productive. It is wise to make a list of qualities you are looking for before going to purchase those animals (Weaver, 2005). Farmers who wish to keep goats must consider the purposes such as pets, milk production, meat production, fiber production, etc. before purchasing them. Meat goats are easy to keep with less work because most of the time they must take care of themselves (Jaudas and Mobini, 2006).

There are different types of breeds such as purebred, crossbred or registered. Purebred sheep are those whose parents, grandparents, and beyond were all the same breed. Registered purebreds have papers to prove it. Purebreds “breed true,” meaning their offspring inherit their parents’ looks as well as many other traits, including elements of their dispositions and personalities. Crossbred sheep have parents of two different breeds: sometimes the parents are themselves crossbred. Because the parents are genetically dissimilar, this may translate into hardier, faster-growing animals. A crossbred often proves more productive than either parent due to hybrid vigor. Registered breeds are generally more uniform looking than crossbred or grade (unregistered) ones. If uniformity characteristics are the buyer's choice, then buy registered sheep (Weaver, 2005).

2.5 Marketing of Goats and Sheep

Many sheep are sold for local consumption, but with the growing demand for sheep meat in cities and large towns more and more sheep are destined for urban markets. In rural markets there is rarely any grading of meat, and all parts of the carcass are sold at a uniform price (Gatenby, 1991). Most goats in the tropics are either killed at home for use by the owner's family, friends, and relatives, or sold alive at a livestock market for subsequent slaughter. Being small in size, goats are easy to slaughter for home use, or conveniently slaughtered by a butcher for sale during the day. In parts of Africa, raw blood is highly prized, and the goat's head may be valued to make a medicinal soup, common in East Africa. This is not scientifically proven and so needs research (Peacock, 1996). Sheep and goats are usually sold alive in Liberia because there is no butchery for goat and sheep meat. Many a time, they are slaughtered during festivals and sacrifices of different kinds in the rural areas, including Voinjama, Kolahun and Foya Districts. Furthermore, they are slaughtered for meat roasters and restaurants but they are eaten with all the skins because the skins have certain aroma that many people like or enjoy. According to Steele (1996), the hide or skin of the goat is small compared to that from buffalo or cattle but is a very valuable by-product if properly prepared and preserved. It can be worth 10% of the total value of the animal. The most valuable skins are those that are strong, sound, thin and light because these are suitable for making fashion items like handbags and wallets. Thicker, coarser skins are made into shoes. The Red Sokoto in Nigeria and the Black Bengal in India are well known for the quality of their skins and are often kept solely for this purpose. The value of the skin is reduced when care is not taken during the slaughter and curing process. Some skins are damaged when the goat suffers disease or physical damaged and this will reduce their value (Steele, 1996).

2.6 Diseases of small Ruminants

Coste and Smith (1996) define disease as any process which disrupts an animal's normal function. According to them, an animal with a broken leg has a disease because it cannot walk properly, but in practice we tend to exclude malfunctions caused by accidents when referring to diseases. Productivity of sheep is lowered if they are not healthy. Most losses come from chronic diseases. These cause the productivity of the flock to be lowered because many animals are ill although few die (Gatenby, 1991). Since rural farmers in the study area have very few animals, the death of even one animal is a great loss to them.

According to Forse (1999), **paraphimosis** is caused by an abnormal discharge from the penis or the sheath around it (prepuce) retraction. The word paraphimosis means an abnormal tightness of the foreskin when it is retracted (pulled back).The discharge is often white or yellow. The animal rubs the penis or sheath on things because it is irritated. The penis extends out of the sheath. There are waxy scabs and pus in the folds of the penis.

Prolapsed vagina is a disease where the vagina is pushed out through the vulva. Most female animals can get a prolapsed vagina. Sometimes it happens again the next time they are pregnant. It usually happens when the animal has been pregnant for a long time, before it gives birth. The signs of prolapsed vagina are red swelling coming out of the vulva and infection that can cause abortion or make the animal very sick. They are curable diseases but because of lack of veterinary technician in the rural areas, these sicknesses are killing lots of animals.

Dermatophilosis (also called Streptothericosis, Lumpy wool disease of sheep, mycotic dermatitis, Senkebo diseases of cattle) is a bacterial infection of the skin of domestic ruminants and horses with *Dermatophiluscongolensis*. This disease is particularly severe in the humid tropics of West and Central Africa, some Caribbean islands, Zambia and Madagascar. The infection causes an inflammation of the skin with an oozing serum discharge. The outward clinical signs depend on which area of the body is affected and whether it is covered in hair or wool. In sheep, both wool or hair areas may be affected. In wool areas, the discharges into the fleece form a crusty layer and in repeat infections several layers may develop. These lesions are often only detected when sheep are clipped. Lesions in adults are usually along the back, sides of the body, and neck; sometimes the muzzle, face and ears are affected. Lambs are usually affected in the hair covered areas of the head and lower limbs. Sheep are rarely as severely affected as cattle, although heavy mortalities can arise in very young lambs. In goats, lesions tend to appear initially around the lips and muzzle, and latter around the feet and scrotum. Infected animals are the main sources of infection, but several predisposing factors are required for the disease to spread. The skin's normal defensive barriers need to be damaged in some way in order for infection to occur. Other predisposing factors are prolonged wetting, mechanical damage and wounds by other ticks, biting flies, thorns, and so on. Thus the disease is often associated with humid climates or rainy seasons when ticks and biting flies are most active. Infection occurs by direct contact between animals, but spread by flies is also suspected. Some animals have persistent infections and provide an important source of infection between seasons. Animals in poor condition and suffering from other diseases are especially susceptible and more likely to suffer a severe form of dermatophilosis. In order for external treatment to be effective, the scabs have first to be removed and thus topical treatment is rarely practicable. *Dermatophilus congolensis* is susceptible to a wide range of antibiotics, however, and affected animals can be treated individually with injections of high doses of Oxytetracycline, or penicillin and streptomycin combined over several days. High doses are required in order for effective concentrations of the antibiotic to reach the infected skin. He concluded that there are no effective vaccines and control depends on an appreciation of the predisposing factors outlined above. Ticks should be controlled by regular treatment with an acaricide; and, shelter from rain should be provided particularly at night when animals are usually enclosed and cannot seek shelter from the rain themselves. Clipping of sheep can spread infection and should be avoided in wet weather. Aluminium sulphate can be used to control the condition in sheep, either in dip tanks or as a dusting powder in small flocks (Hunter, 1994 and Forse, 1999). Dermatophilosis was one of the numerous diseases that affected many sheep in the studied districts; however, with the absence of veterinary technicians, animals die from this disease. The reason of its occurrence is the constant rain in Liberia as a tropical country and lack of shelters for the animals.

Goat plaque or Peste des Petits ruminants (PPR) is a viral infection of goats and sometimes sheep. Outbreaks are common in West Africa, but have also occurred in the Sudan, Saudi Arabia, India and Ethiopia. Infection with the virus is known to have a wider distribution, however, it occurs in the Arabian Peninsula, Israel, India and in a band across the Sahel region of Africa from Senegal to Ethiopia extending south to the Equator. The clinical signs of PPR may be peracute, acute or subacute. The peracute form of the disease lasts four to six days. The first sign is a profuse catarrhal nasal discharge followed quickly by a high fever. Animals are depressed, stop eating and have difficulty breathing. The eyes and linings of the nose and mouth are reddened and may have erosions. Within four days, diarrhoea develops and death usually occurs about one or two days later. The acute form of the disease lasts for about ten days and starts with a watery discharge from the eyes and nose accompanied by fever which persists for about a week. The discharge becomes thick and profuse, matting the eyelids and blocking the nostrils forcing the affected animal to breathe through the mouth. Erosions develop in the lining of the mouth and throat, salivation is excessive and there is a general foul foetid odour. Animals are very depressed, go off feed and develop severe diarrhoea. Many develop a complicating pneumonia and most die within ten days; the few survivors have a prolonged convalescence. The subacute form lasts about two weeks and is more common in sheep. There is catarrhal discharge from the nose, low grade fever and intermittent diarrhoea, however most animals recover. Goats are more susceptible to the diseases than sheep, and in West Africa Sahelian goats are more resistant than the West Africa dwarf goats. The disease spreads from the source of infection to susceptible animals by virus that is released into the air in discharges of sick animals. Infection is by inhalation of the virus and thus requires direct contact with sick animals. The incubation period is usually about two to six days. Infections can be spread by movement of infected animals. There is no treatment for the plaque. The main cause of death is dehydration. The fluid therapy combined with antibiotics for secondary bacterial infections may help. In dry regions where goat plaque occurs, settled village flocks of sheep and goats come into contact with mobile transhumant flocks and outbreaks occur regularly. Control also depends on normal sanitary practices. In an outbreak, sick animals should be segregated and the remaining ones vaccinated (Hunter, 1994 and Forse, 1999). This disease affects many animals in Liberia even where there are veterinary technicians to treat. It reduces productivity and income generation from goats and sheep sales.

Worms (roundworms or hookworms), Parasitic gastro-enteritis affect all animals including birds; however, goats and sheep suffer very severely of those diseases. Adult goats suffer as much as younger ones. Worms are only a problem near to water and when it rains. Animals do not get worms in very dry places. Poorly fed animals often have worms. They need treatment and better food to improve the thin body conditions. Clinical signs include poor growth even with good food, eat less than normal, thin, weak and easily tired, have rough coats, often suffer of diarrhoea, blood in the faeces and become dehydrated, pale mucous membranes, swelling under the jaw (submandibular edema) and abdomen (anasarca). Animals get worms from contaminated pasture with many worm eggs or larvae at the start of the wet season because worm larvae all start to develop on the pasture at the same time. Severe worm infection can block the intestine, damage liver or lungs, and lead to anaemia. Give worm medicines to animals that become thin and have diarrhoea but no fever. Control worms to stop animals becoming sick and unproductive (Forse, 1999).

Forse (1999), Coste and Smith (1996) and Jansen (1991) explained that animals with **diarrhoea** have watery faeces and pass them often or a temporary change to animals' normal faeces while adapting to a change in diet. Diarrhoea is a disease usually due to pathological changes in the intestines, and such changes may include haemorrhage with blood appearing in the faeces (dysentery). If the haemorrhages occur high up in the intestines, the faeces have a brownish-black color, but if they are lower down, the haemorrhagic blood is passed unchanged in the faeces which are red in color; the blood may be obvious as clots. Sometimes the faeces are an unusual color and smell foul. The back legs are dirty with faeces. Diarrhoea is a common sign of many diseases, especially worms or flukes. The problems of diarrhea are dehydration, weakness, dry skins, rough coat; eyes sink into the head of animals and unable to ruminate. Animals often have diarrhea when their food suddenly changes, especially when they are weaned from milk; they have too much milk or wet, green food or too much of one kind of food, for example, grains; and they are infected by microbes. To prevent diarrhoea, they further outlined that it is good to make sure new-born animals get colostrum to drink as soon as possible; control worms; give proper food and clean drinking water; do not suddenly graze animals on wet pasture; vaccinate animals when severe and when young, vaccinate the mother; remove faeces often from where they live; and avoid keeping too many animals in one place. For treatments of diarrhoea, Forse (1999), Coste and Smith (1996) and Jansen (1991) further said that traditional and modern methods are used as follows: in Kenya, the bark or roots of *Acacia seyal trees* are soaked in cold or hot water and give to animal by mouth to drink.

Animals get **mange** by direct contact with infected animals because they live on animals and some feed on the surface of an animal's skin, others dig deep into the skin. All animals get Flystrike but sheep get it worst and most often, which causes irritation and scratch and rub at wounds with fly larvae in them. Animals get flystrike from eggs that blowflies lay in a wound; they lay eggs in very small wounds, such as tick bites and on larger wounds, such as castration wounds. One severe kind of flystrike is caused by screw-worm fly larvae. Treat wounds as soon as possible and use wound dressing that kills fly eggs or larvae. These disease retard growth and productivity, thus, leading to less income generation for farmers. Sometimes leads to the death of animals reducing the animal number. The ability to control the spread of small ruminant diseases via preventive methods will lead to immense productivity in Lofa County.

According to Hunter (1994), **foot-and-mouth disease (FMD)** is a very important and extremely infectious viral disease of cloven hoofed animals and occasionally man. It is found in Africa, Middle East and Asia and South America. Although it can be severe, FMD is normally much milder in small ruminants resulting in relatively small lesions which heal rapidly and may be difficult to detect. For all animals, although an extremely infectious disease, less than 5% of affected animals die. The mortality rate may be much higher in young animals, however, due to heart lesions causing sudden death without typical FMD symptoms. He further explained that FMD spreads for about a week after the vesicles rupture infected animals excrete virus in saliva, milk, semen, faeces, urine and exhaled air. The virus can survive outside the infected host for several months if not subjected to heat or change of pH, for example fifteen weeks on hay and straw. In frozen carcasses, the virus, can survive for prolonged periods in lymph nodes, viscera and bone marrow. The virus is extremely infectious and susceptible animals may be infected by inhalation or ingestion of the virus by various means, for example, from nearby infected animals, virus contaminated environment or in feed, notably uncooked swill containing animals tissues such as lymph nodes, bone marrow and viscera. The virus can be transferred from location to location on vehicles, clothing, and so on. In cool humid conditions it can be wind-borne for long distances so wind-borne spread is probably more common in temperate regions than tropical regions. In endemic areas where

FMD is common, the disease may follow a mild course in which animals recover rapidly. If necessary, local antiseptic treatment of the lesions together with antibiotic therapy can be administered to minimise the risk of secondary bacterial infections. FMD can be controlled. Because of the highly infectious nature of the disease and its debilitating effect, particularly on high producing live-stock and draught animals, in many situations it is essential to prevent infection. Animals at risk should be vaccinated at least twice A year with vaccines against the local virus serotypes and sub-types. In the event of an outbreak, the spread of infection can be reduced by hygienic measures; for example, destruction of feed and bedding of infected animals, restriction of movement of livestock and personnel from, and disinfection of, premises where disease has occurred. Hunter concluded that because of the importance of FMD, the veterinary authorities should always be informed if it is suspected to ensure appropriate action is taken. In some countries, it is a notifiable disease which must be reported by law.

FAO (2007) also defined foot-and-mouth disease (FMD) as the most contagious transboundary animal disease (TAD) affecting cloven hoofed animals. Significant economic losses are produced by its high morbidity and the export trade restrictions imposed on affected countries. It recorded that there are seven recognised serotypes of FMD (O, A, C, Asia 1, SAT 1, SAT 2 and SAT 3), which differ in distribution across the world. Serotypes A and O have the widest distribution, occurring in Africa, Asia and South America. Types SAT 1, 2 and 3 are currently restricted to Africa only and Asia 1 to Asia; the capacity to invade free areas is common to all types and periodically SATs are introduced into the Near East, and Asia-1 into western and eastern parts of Eurasia. Infection or vaccination against one serotype does not provide protection against the other serotypes. Forse (1999) outlined the clinical signs as painful feet, tiredness associated with fever, loss of weight, rough and dull coats, blisters inside the mouth especially on the tongue and much saliva comes out from the mouth, blisters on the feet above and between the claws, blisters on the teats and the animal become lame. This disease also affects animals in Liberia. On the contrary in Liberia, there is only one recognized veterinarian who has no chance of being everywhere to take care of disease outbreaks. As a result of this shortage, there are no veterinary services in the hinterland like Lofa County to treat animals. This leads to the death of animals, thus reduction in productivity.

Hunter (1994) defined **Caseous Lymphadenitis (CL**) as a chronic bacterial infection of sheep and goats caused by *Corynebacterium pseudotuberculosis*, sometimes called *C. Ovis*. Infection has also been recorded sporadically in most other domestic animals, and infection with one strain of the organism in equids causes a chronic ulcerative condition called ulcerative lymphangitis. It can occur worldwide. It can be recognized by abscesses develop in lymph nodes and internal organs. Superficial lymph nodes under the skin are particularly involved, for example in the head, in the front of the shoulder, and in the hind leg. Affected lymph nodes are enlarged, can be palpated, and commonly rupture discharging thick, green pus. Abscesses in internal organs cause other clinical signs such as loss of condition, pneumonia, paralysis and drop in milk yield. Hunter said that CL spreads when discharges from ruptured lymph nodes contaminate the environment with the organism, which can survive for long periods outside the host. Infection can then gain entry by contamination of skin abrasions and wounds which arise for a variety of reasons, for example, the shearing of sheep, castrations and fighting amongst goats. Contaminated surgical instruments can also spread infection from animal to animal. The organism can survive for about a day in commercial dips and dipping of sheep, particularly if they have recently been sheared, can spread infection. Caseous lymphadenitis abscesses may result in condemnation of all or parts of carcasses at meat inspection in the abattoir, and can be of significance where sheep are reared intensively. In extensive pastoral conditions, however, animals are affected sporadically and the disease may be of little importance. Although the organism is susceptible to a wide range of antibiotics, treatment has little effect on abscesses once they are formed. Abscesses can be incised, the pus drained, and topical antiseptic treatment applied but is rarely considered necessary because of the non-progressive nature of the disease. He finalized that there is no vaccine available and although it is not possible to prevent this disease, steps can be taken to keep it to a minimum. General hygienic measures taken in sheep and goat yards and pens should prevent a build up of environmental contamination and also during shearing and castration.

Liver fluke of ruminants (*Fascioliasis*) is an infection of the liver of grazing animals, mainly ruminants, with leaf-shaped trematodes (flukes), *Fasciola hepatica* and *F.gigantica*. It is a cosmopolitan disease. The parasites have complex life-cycles involving various *Lymnaea* species of amphibian and aquatic snails as intermediate hosts; infection occurs where livestock graze the habitat of these snails, for example, ditches, marshy areas, edges of water channels, flood plains, and so on. Those species of snails that transmit *F. Hepatica* are found worldwide although in tropical regions they may be confined to cooler areas of high altitude. Following infection, the young flukes migrate through the liver to the bile ducts and gall bladder. Acute fasciolosis is caused by the ingestion of large numbers of the parasites from infected grazing over a short period of time. The large numbers of migrating immature flukes cause acute damage and haemorrhage in the liver. Animals are depressed, weak, have pale gums and eyes and die quickly within one or two days. This form of disease is seen most commonly in young sheep. Chronic fasciolosis causes liver damage, loss of serum protein and anaemia. Animals also become emaciated, have pale eyes and gums and typically develop "bottle-jaw" due to oedema under the jaw; and depending on the severity, untreated animals may die in two to three months but if survive for long period, they may eventually recover if not reinfected. The disease spreads when flukes eggs passed out in the faeces hatch about nine days at optimal temperature (22to 26^{o}C) releasing a motile stage which must locate and penetrate a lymnaeid snail within a few hours. It can be treated by using modern flukicides. They are very effective and several are available. Triclabendazole has the advantage of being effective against all stages of flukes from one week old and is the drug choice for acute fascioliasis. It can be controlled by preventing access by hosts to snail habitat, by controlling the snails or by strategic treatment, which is the routine treatment of animals at times of the year when they are at risk (Hunter, 1994).

2.7 Extension and Training of Rural Farmers

Agricultural extension is a crucial point for the revitalization of the post-war agricultural sector of Liberia especially in the animal subsector. Norton, Alwang and Masters (2010) concluded that countries unable to develop the skills and knowledge of their farmers and their families find it difficult to develop anything else. The utilization of new technologies and institutions is critically dependent on a workforce that is aware of them and understands how to use them. Agricultural extension education can help motivate farmers toward change, teach farmers improved decision-making methods, and provide farmers with technical and practical information. Extension is complementary to other sources of information because it speeds up the transfer of knowledge about new agricultural technologies and other research results. It helps farmers deal with technological and economic change. Thus, as agriculture in a country moves from a traditional to a more dynamic, science-based mode, the value of extension education increases. Norton, Alwang and Masters further explained that in agriculture extension education, farmers are the primary clientele and the programs are mostly oriented toward production problems they face. Extension accelerates the dissemination of research results to farmers and in some cases, helps transmit farmers' problems back to researchers, extension workers provide training for farmers on a variety of subjects and must have technical competence, economic competence, farming competence, and communication skills. Thus extension workers require extensive training and retraining to maintain their credibility with farmers.

Scarborough, Killough and Johnson (1997) pointed out that governments and other development agencies (NGOs, donors, etc.) are experimenting with approaches to agricultural extension; for example, some extension services are located alongside research services or in integrated rural development projects. Others are located in a separate government department or in agricultural universities. Some extension services are commodity-specific, others cover the range of farming requirements; some disseminate information through visits to individual contact farmers, others focus on farmer groups. Public extension networks, however, have limited effectiveness in making available a range of technology options from which farmers can choose. The reasons for this limited impact include the inappropriateness of "contact farmer" methods; they lack relevant technological messages, inadequate feedback of farmers' requirements into research agendas, and the increasingly commonplace fact that public sector budgets are too stretched to support a large number of extensionists adequately in the field. Scarborough et al. (1997) also said that for effectiveness, a number of organizations have sought models which might be both more effective in serving farmers' needs and institutionally more sustainable. They are promoting farmers and other rural people as the principal agents of change. Most of these 'farmer-led extension' projects have been in the voluntary sector; few as yet have been sponsored by government organizations. This method has been practised in countries as diverse as Bolivia, Chile, Ecuador, Guatemala, Honduras, and Nicaragua in Latin America; Egypt, Kenya, and Zimbabwe in Africa, and Bangladesh, India, Indonesia, Nepal, and the Philippines in Asia. The decentralization of extension services has provided a potentially favourable context for farmer-based approaches. The evidence, as yet fragmentary, suggests that these approaches have achieved considerable success in identifying productivity-enhancing technologies which become widely adopted and in doing so at relatively low cost. Norton et al. (2010) detailed that many types of organizational structures for extension exist in developing countries. A highly structured approach encouraged by the World Bank and applied in several countries is called the *training and visit* (T&V) system. The T &V system includes a single line of command, a set schedule of visits to farmers' groups, regular and continuous training of extension officers and workers by subject-market specialists, and no non-extension responsibilities. This system facilitates discipline, accountability, and research linkages and experienced apparent success in some countries for a period of time. On the other hand, more common extension structure is the village agent model that assigns extension agents to live in villages and provide one-on-one and group training of farmers on a variety of agricultural topics. However, too often extension agents are poorly trained and little-motivated. They may not visit enough farms, and they become diverted into non-extension activities. The extension service itself may become politicized, corrupt and unconnected to research. A well-functioning system needs clear lines of authority, adequate training, and financial rewards for personnel, or the system becomes relatively ineffective.

In Liberia, extension is lacking completely in the rural communities. This may be attributed to lack of sufficient and trained manpower (workforce), politics, corruptions and the inability of Ministry of Agriculture (MOA) to prioritize extension as the key to agricultural development. Based on this inability, all sectors of agriculture are presently underdeveloped and unable to maximize productivity. The animal sector is no exception to this nationwide extension problem in Liberia, thus making the sector dormant. If MOA can get involved with farmers' training and education through farmer-led extension, the small ruminant industry will be of great benefit to the rural communities since the country is evergreen throughout the year.

CHAPTER 3

METHODOLOGY

3.1 Research Design

This study was designed to serve as a case study of small ruminant producing households in selected districts of Lofa County. A purposive stratified sampling method was carried out to arrive at selected towns and villages for in-depth study of household situations as they respond to post-war recovery and development of livestock production in Liberia. Case study method was used to narrow down a broad field of research into one easily manageable and researchable, providing crucial baseline information, especially in a county without adequate records of the post-war situation, using cases of Voinjama, Kolahun and Foya Districts.

Liberia in West Africa is a country bounded by Guinea in the north, Sierra Leone in the west, Ivory Coast in the east and the Atlantic Ocean in the south. It islocated at latitude 6° 30' North and longitude 9° 30' West. Thus Liberia is situated at the northern coast of the Atlantic Ocean. Monrovia, the capital city of Liberia is on latitude 6° 18' North and longitude 10° 48' West. Liberia is in a climatic zone that is tropical.Rainfall is very high around the coastline. There are two distinctive seasons, namely the dry season (runs from mid October to mid April) and the rainy season (runs from mid April to mid October) in the country (LISGIS-Liberia, 2008*).*

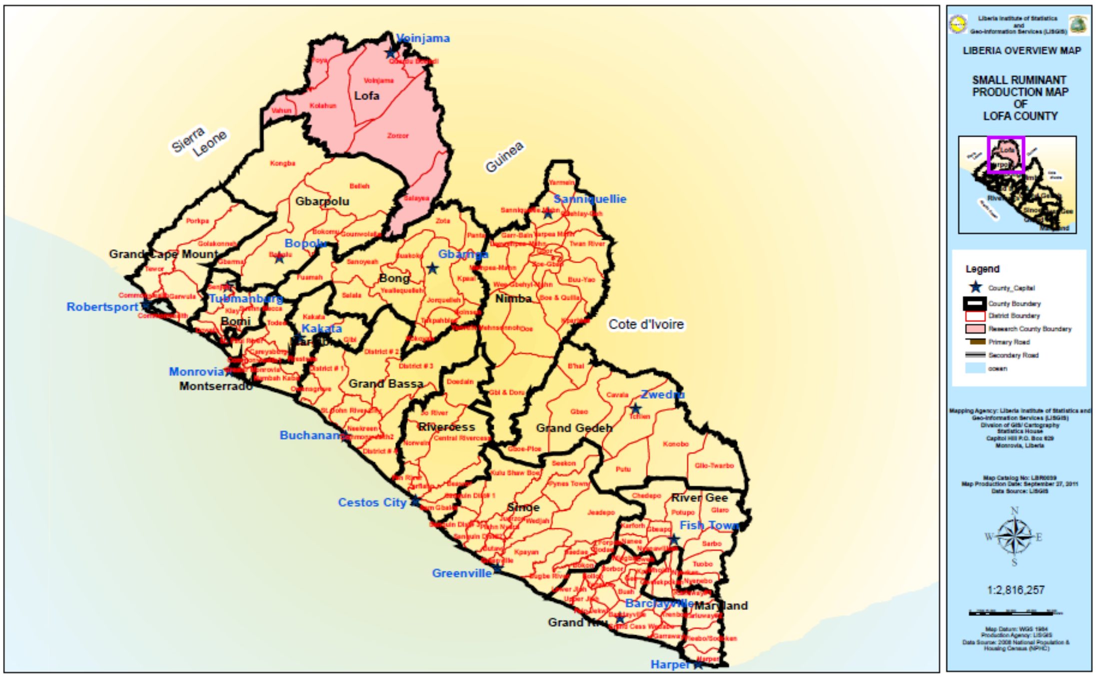

Figure 1: Map of Liberia, highlighting Lofa County as the study area.

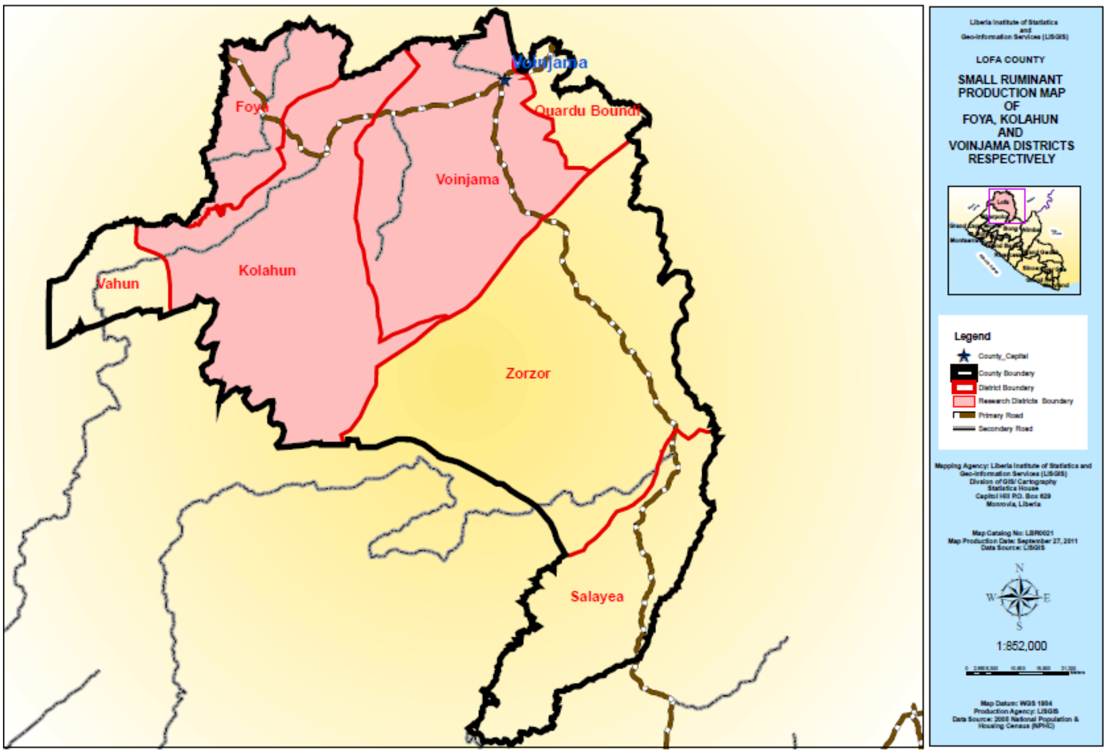

Figure 2: Map of Lofa County highlighting Districts of the Study Areas

3.2 Population of the Study Area

The human population in the entire Lofa County was 276,863 (LISGIS-Liberia, 2008). That in Voinjama District was 42,790, in Kolahun District was 60,557 and in Foya District was 73,312. The three districts studied represent 63.81% (176,659/276,863) of human population in Lofa County. The number of households in the entire Lofa County was 62,923 (LISGIS-Liberia, 2008). That in Voinjama District was 9,725; in Kolahun District 13,663; and in Foya District 16,661. The three districts studied represent 63.64% (40,049/62,923) of households in Lofa County.

Voinjama District is divided into 3 clans: Bunde, Lower Workor and Upper Workor. These clans have land areas of 360 square miles with 30 towns, 205 square miles with 25 towns and 105 square miles with 34 towns respectively. Kolahun District is divided into 6 clans: Hasala has an area of 304.490637 square kilometers, Hembe has an area of742.749747 square kilometers, Lucasu has an area of685.428659 square kilometers, Tahamba has an area of clan 317.348326 square kilometers, Wanwuma has an area of 103.301831 and Wulukoha has an area of 84.946584 squarekilometerclans respectively. Foya district is divided into 3 clans: Tengia clan has an area of 178.452938 square kilometers, Luankollie clan has an area of 250.269910 square kilometersand Waum clan has an area of186.487912 square kilometers.

The towns and villages studied in Voinjama District included in Upper Worker Clan -Kugbemai,Tobogizizu, andBazagizia and in Bondi Clan wereKpademai, Balakpalasu and Gbegbe respectively. Voinjama District has 3 clans with 133 towns and village, out of which 6 towns were investigated. In the Kolahun District, the study towns and villages in Tahamba Clan were Kambolahun, Fassawolo, and Korworhun and in Hassala Clan were Popalahun, Kamatahun and Kiantahun respectively. Kolahun District has 6 clans with 130 towns. The Waum Clan of Foya district were Porluma, Kornorsue, and Solumba and in the Tengia Clan were Kwendemba, Medicorma and Worsongar respectively. Foya District has 3 clans with 216 towns and villages, out of which 6 towns were investigated. The total number of towns investigated was 18, out of 6 in each district and 3 in each clan. The 3 districts are bordered with the Republic of Guinea in the north and Foya District borders Sierra Leone in the west as seen in the map of Liberia (figure 1).

3.3 Sample and sampling procedure

Although the target population of this study was primarily the rural subsistence farmers, with the limitation of lack of organised farmers' associations, it was challenging describing this. Thus, a purposive selection of three districts in Lofa County, Liberia, that were known for active livestock production before the civil war in Liberia was made. Specially, the sample considered all small ruminant farming households in the three districts of Foya, Kolahun and Voinjama. Any household in these three districts that produces goat(s) and/or sheep was considered for the study.

Multistage sampling technique was used. First, a stratified sampling method was used to categorize the study area into the three districts. This was followed by a purposive (clans well known for small ruminants production) sampling method to select 2 clans from each district. Thereafter, 3 towns and villages were purposively (towns/villages well known for small ruminants production) selected from each clan. This means that 6 towns or villages were selected from each of the three districts studied. Finally, a quota of 25 small ruminant farmers was selected using accidental sampling method in each town or village. Thus, a total of seventy-five (75) households of small ruminant farmers were selected in each clan and a total of 150 in each district. In all, a sample size of 450 households was interviewed for the study.

Each district was to have 150 respondents. Liberia has decentralized sub-divisions known as counties to increase citizens' participation in national decisions at local levels to focus social and economic needs and has the potential to foster integrated development in local communities (Weh-Dorliae, 2004). These counties are further sub-divided into districts and districts sub-divided into clans and clans into chiefdoms for governance and development purposes. Figure 2 map highlights the districts and clans where the study was conducted. The maps below (figures 3 - 8) show the clans and towns in which the research was conducted.

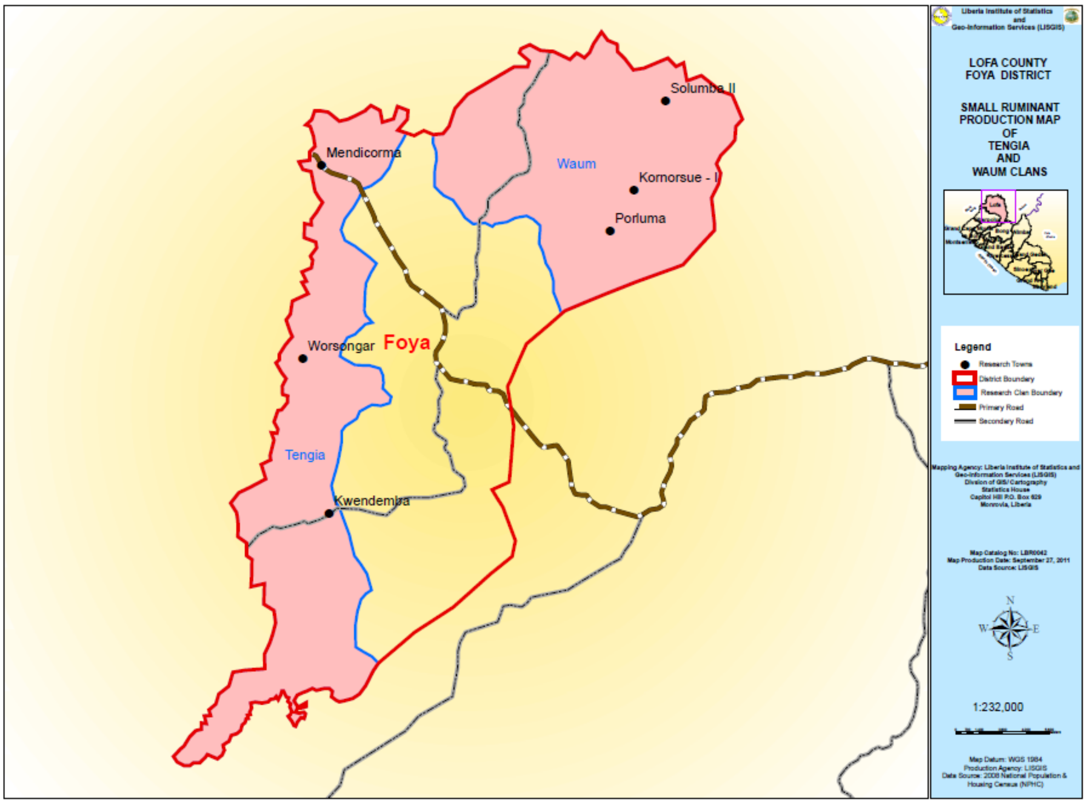

Figure 3: Map of Foya District highlighting Clans and Towns in the Study Area

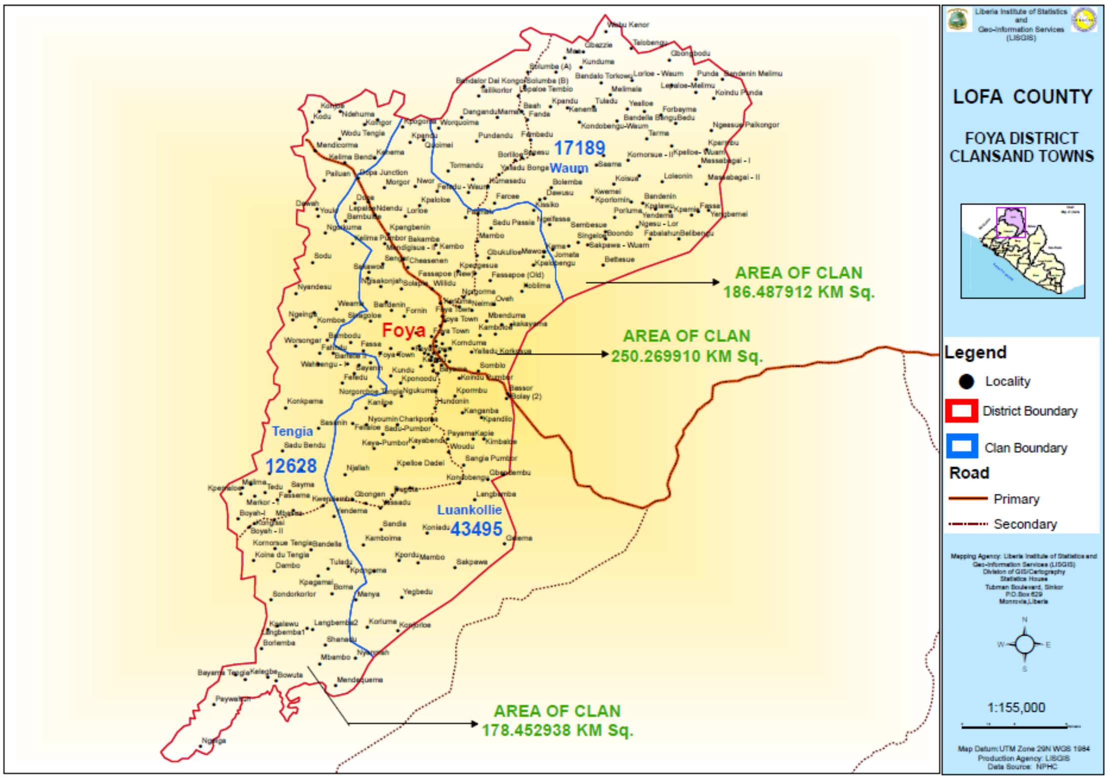

Figure 4: Map of Foya District showing all Clans and Towns and Villages and land area

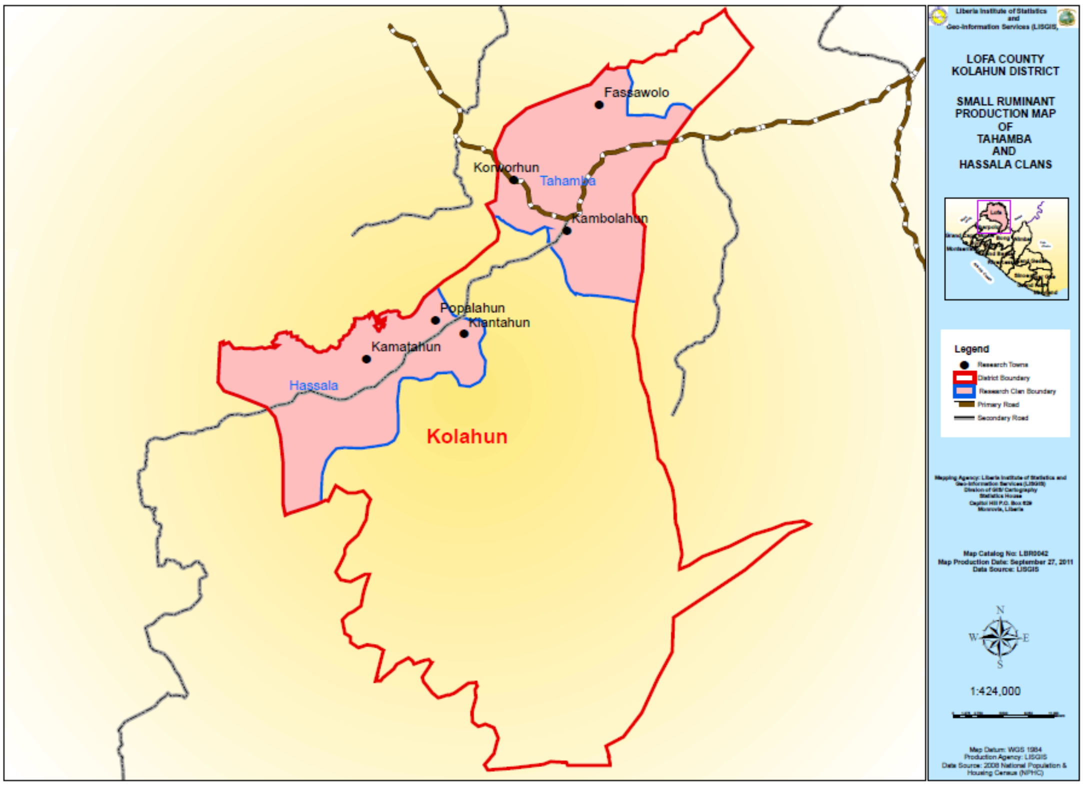

Figure 5: Map of Kolahun District highlighting Clans and Towns in Study Area

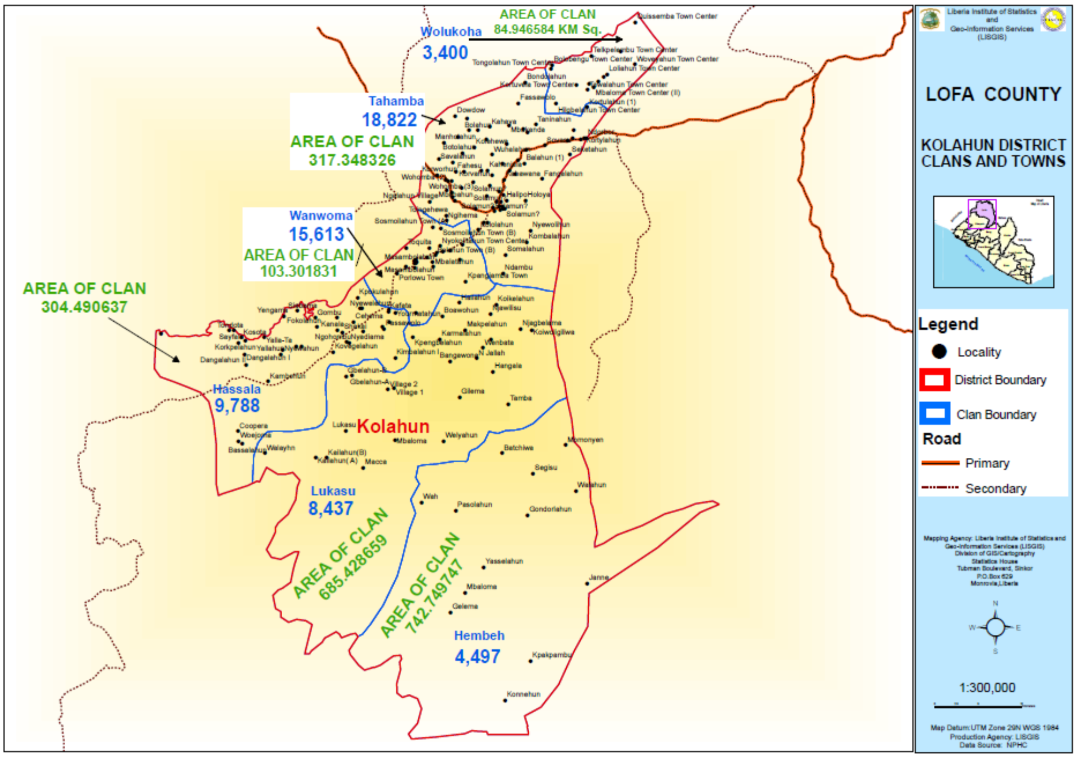

Figure 6: Map of Kolahun District showing all Clans, Towns, Villages and Land Areas

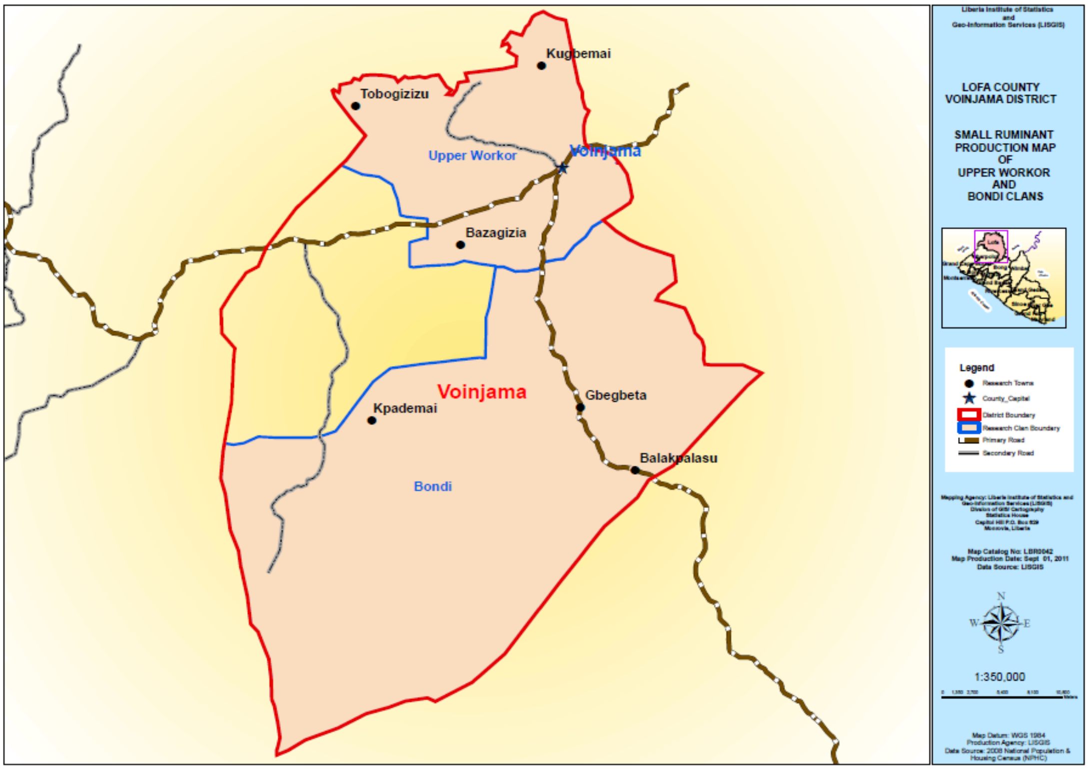

Figure 7: Map of Voinjama District highlighting Clans and Towns of Study Area

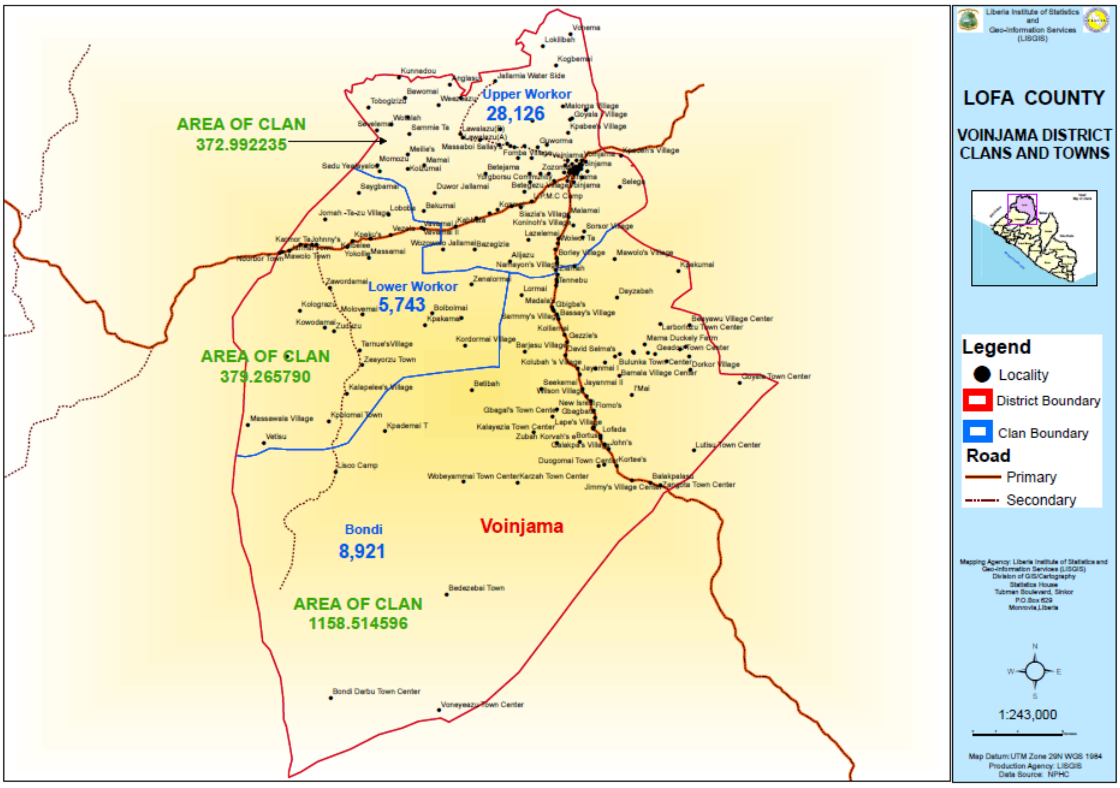

Figure 8: Map of Voinjama District's Clan, Town, Villages and Land Areas

3.4 Research Instruments

Questionnaires and a structured interview guide were used in the field as research instruments for data collection. In-depth interview of key informants, namely agricultural extension staff and Agricultural NGO officials were carried out to gather information on government policy on livestock production and present extent of implementation of the policies. Farmers who could read and write in English completed the questionnaires with minimal supervision, while those who could not read nor write in English language were assisted using interpreters to complete the instrument.

The questionnaire, which had 6 pages, comprised both closed and open ended questions. Fifty two (52) items on the instrument covered the following four sections of the set objectives: background characteristics of small ruminant production systems and their producers; management systems used in the production and marketing of small ruminants; contributions of small ruminant production to livelihood of subsistence farmers; and training needs of small ruminant producers.

3.5 Procedure

Participatory rural appraisal was used with some modifications as a procedure to collect confidential data about financial returns from livestock production and other sources of income. This procedure was particularly essential in view of the fact that several individuals considered income as a personal and sensitive issue that should not be made a public discussion and in some cases not an issue for research questionnaire documentation except to someone they could trust. This personal interview procedure in addition was combined at the end with a wrap up group discussion on general challenges faced and diseases of animals presented in the communities. This therefore generated data in support of the case study in addition to the questionnaire responds received. In the same way, agricultural officials and NGO's in agricultural services were interviewed individually to achieve open results.

The study was conducted from March 28, 2011 to April 20, 2011 in the three districts. Data collectors and/or interpreters were trained and worked along with the researcher in the collection of the data. This guided and hastened the conduct of the research on the field. The interpreters were the same persons that assisted along with the researcher in collection of data.

3.6 Data analysis

Statistical Package for Social Sciences (SPSS) software was used for data analysis. Data gathered in the field were entered into the software in a coded format and stored. The programme was subsequently used to generate descriptive statistics of the variables presented. The frequency of attributes and percentage of their occurrence in the study instrument (questionnaire) was determined for each of the three districts investigated. A Correlation Coefficient (R) was determined in each of the four hypotheses tested in this study to evaluate the presence or otherwise of statistical significance in the relationships considered. Also, a one-way ANOVA was used for data analysis and determination of the significant differences of the mean among the three districts. A total of 438 households out of 450 target sample size were used in the computation of the descriptive statistics and analyses. This gives a response rate of 97.3% in the study population. Some towns or villages had less than 25 farmers, while some three returned questionnaires were incomplete and could not be used in the computation and analysis of the sample data.

3.7 Research Ethics

Farmers were interviewed observing national ethical requirements. All personal information captured was kept confidential for purely research use. All data collected are realistic and truthful. The results generated from their processing and computations were also realistic.

CHAPTER 4

RESULTS

4.1 Distribution of small ruminant production

Table 1 shows the distribution of respondents who keep small ruminants and the percentages for each district. Foya had the highest number of respondents 149 (34.0%), followed by Voinjama 145 (33.1%), and Kolahun had the least number of respondents 144 (32.9%). Among the eighteen (18) towns investigated in the three Districts, Fassawolo (Kolahun District) had the least number of respondents 19 (13.2%) and Gbegbeta (Voinjama District) 20 (13.8%). This situation was due to few small ruminant farmers in those towns (Appendix 2).

Districts	Number of small ruminants keeping Households	Percentage Contribution (%)
Foya	149	34.0
Kolahun	144	32.9
Voinjama	145	33.1
Total	438	100.0

Table 1: Distribution of respondents who keep small ruminants

In Foya District, Tengia Clan had higher numbers of small ruminant farmers 75 (50.3%). This may be due to its long land border with Sierra Leone that has higher small ruminant production records. The common cultures and norms between people in Tengia and Sierra Leone enable them to interact freely without any cultural or language barrier and to share small ruminant resources and production value systems. For Kolahun District, Hassala had the higher number of small ruminant farmers 75 (52.1%). This may be attributed to a large Muslim population found in the clan and use their small ruminants for ceremonial and religious rituals. In Voinjama District, Upper Workor Clan had 75 (51.7%) small ruminant farmers. This clan has a border with the Republic of Guinea-Conakry (another prominent small ruminant producing country) where farmers often buy small ruminants.

4.2 Demographic characteristics of households

Household sizes varied from 1 to 36 members. The modal household size was 7-9, which was 156 (35.6%). Three hundred and thirty five (76.5%) of these households were headed by male while the remaining 103 (23.5%) were headed by female. Foya District had the highest female heads of households, 39 (26.2%) followed by Kolahun, 33 (22.9%) and Voinjama the least, 31 (21.4%). These findings might be due to the cultural norms that a female cannot serve as head of a household except when divorced, widowed or single. Even in the aforementioned situations, the female still depends to some extent on the male relatives for some major decisions and undertakings such as selling and purchasing of animals and sometimes caring for them (Appendix 2). According to LISGIS-Liberia (2008), Lofa has 133, 611 male and 143,252 female inhabitants. Household sizes varied from 1 member to 36 members. The modal household size was 7-9 members, which was 156 (35.6%), while LISGIS' 2008 census is 4.4. This slight increment may be due to the absence of war and the inadequate education of women on birth control among the rural people. According to LISGIS-Liberia (2008) housing and population census, the number of persons per household is an important index in planning for the population since most of the people can be found in such social arrangements. This implies that at the household level, there are now fewer numbers of people living and eating together. The household size normally reduces in a situation of increasing urbanization and modernization, and as people become more educated and individualistic. Also, LISGIS-Liberia gave an annual growth rate of 1.3 for 2008 census, 5.2 household size for 1984 census and 4.4 household size for 2008 census respectively for Lofa County.

The level of education of rural household in Lofa County was low with low employment opportunities. Foya had highest number of 'no formal education' respondents 95 (21.6%) followed by Voinjama 62 (14.2%) and Kolahun 58 (13.2 percent). Generally, forty-nine point one (49.1%) have "no formal education." The most important farming activity is crop farming (95.2%) of total respondents in which Foya had highest (32.6%), followed by Voinjama (32.2%) and Kolahun (29.7%). Small ruminant production is secondary (3.9%) of the farmers' farming activities. All of the above information can be seen in appendix 2.

Variables	Sum of Squares	Degrees of Freedom	Mean Square	Observed F-value	Significance levels (5%).
Status of respondent in household	1.402 248.625 250.027	2 435 437	.701 .572	1.226	.294
Gender	.177 78.602 78.779	2 435 437	.088 .181	.489	.614
Household size	7.296 332.661 339.957	2 435 437	3.648 .765	4.770	.009
Total number of goats	48.031 274.063 322.094	2 435 437	24.015 .630	38.118	.000
Total number of sheep	28.408 484.918 513.326	2 435 437	14.204 1.115	12.742	.000
Total number of small ruminants in the household	28.732 497.143 525.874	2 435 437	14.366 1.143	12.570	.000
Ownership of small ruminants	6.900 422.926 429.826	2 435 437	3.450 .972	3.549	.030
Main sources of household income	.300 47.646 47.945	2 435 437	.150 .110	1.368	.256
Other sources of income	133.135 525.534 658.669	2 435 437	66.568 1.208	55.100	.000

The mean difference is significant at the 0.05% level (P<0.05)

Table 2: ANOVA Table showing significant and non-significant differences between Foya, Kolahun and Voinjama districts

Table 2 shows an ANOVA of significant differences in the mean among the three districts. It was revealed that there were no significant differences (P>0.05) in the mean of the three districts in the status of the household respondents, gender and main sources of household income; however, there were significant differences (P<0.05) in the mean of the household size, total number of goats, total number of sheep, total number of small ruminants in the household, ownership of small ruminants and other sources of household income in the three districts. Table 2 shows the output of statistical comparisons between districts and statistically analyzed the background characteristics of small ruminant farmers and shows their mean significant differences at district levels and those that had no differences.

4.3 Ownership of small ruminants and number of small ruminants per district

Small ruminants were mostly owned by families because they generate income for the households in many instances. Two hundred and twenty-two (222 or 50.9%) small ruminants were family owned. Within the family (household), subdivision into individual owned livestock and so individually controlled income were recognized. Thus, some 153 (35.1%) and 46 (10.6%) were owned by fathers and mothers respectively. Culturally, in this setting, children do not own assets in households because they still belong to their parents who own everything in the households. There were 131 goats in Foya district, 80 goats in Kolahun and 133 goats in Voinjama. The sum up was 344 goats. Kolahun had the least number of goats but mainly sheep used for sacrificial purposes instead of financial income. Foya and Voinjama are Christian dominated communities and raise more goats since they were more resistant to diseases and tolerant of adverse conditions for the purpose of financial gains. Foya had the largest number 29 (22.1%) of farmers with 3 goats, while Voinjama had the largest number 20 (15.0%) of farmers who have 5 goats. There were about 165 sheep in total of which Foya had 46, Kolahun 82 and Voinjama 37 sheep respectively. Kolahun district had the highest number of people who have 2 and 3 sheep 19 (32.2%) and 19 (23.2%) respectively. This might be due to the large Muslim community in that district. They use sheep for sacrifices. Very few farmers sell their sheep but the rest of the population use them for ceremonial or sacrificial purposes which form part of their religion. The total number of small ruminants in households was 434, which includes sheep and goats. Foya had 148, Kolahun 143 and Voinjama 143 goats and sheep (Appendix 2).

4.4 Sources of Household Income

The main source of farmers' income was crop production, especially cash crops such as cocoa, coffee, sugar cane, oil palm, while rice was mainly produced for home consumption. The highest number of crop producers 140 (32.1%) was recorded in Foya district, Voinjama had 135 (30.9%) and Kolahun 119 (27.3%). This means that 394 (90.3%) of these farmers had some regular income from crop production; 34 (7.8 %) of the farmers had some income from small ruminant production and 8 (1.8 %) of the farmers had some income from other livestock production ventures, such as poultry and rabbit, piggery and cattle. The higher proportion of crop producers may be partly due to its relative convenience, the impact of the civil war that decimated livestock and inadequate knowledge of raising small ruminants (Appendix 2).

4.5 Contribution of small ruminant production to household Income or Livelihood

As seen in figure 1, 423 (52%) of households keep goats and sheep for income generation and 332 (41%) for ceremonial or socio-cultural purposes. Only 60 (7%) used these animals for home consumption. Smallholders often keep animals as a means of low-input capital formation. The animals make use of crop by-products and food wastes, but the farmers do not make large investments to maintain or increase the capital.

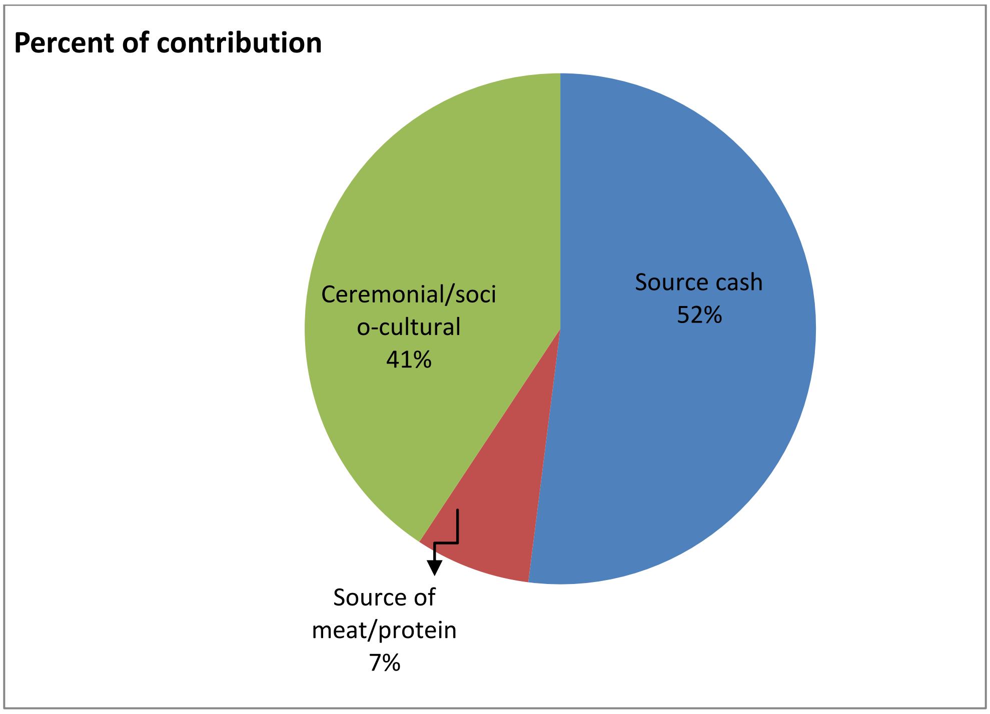

Figure 9: Reasons for keeping goats and sheep by respondent per district in percent

4.6 Sources of Protein (meat) for household intake

Figure 2 shows the important household source of meat was purchased meat and fish from market which was 382 (40.8%). The next important source of household protein (meat) needs was fishing, which was 318 (33.9%) and wild animal hunting (poaching) was 199 (21.3%). Small ruminants were the least household source of meat 37 (3.9%). This little contribution of small ruminants to household sources of meat may be attributed to the low production and the generation of income to solve households' financial problems and the use of those animals for ceremonial or sacrificial purposes.

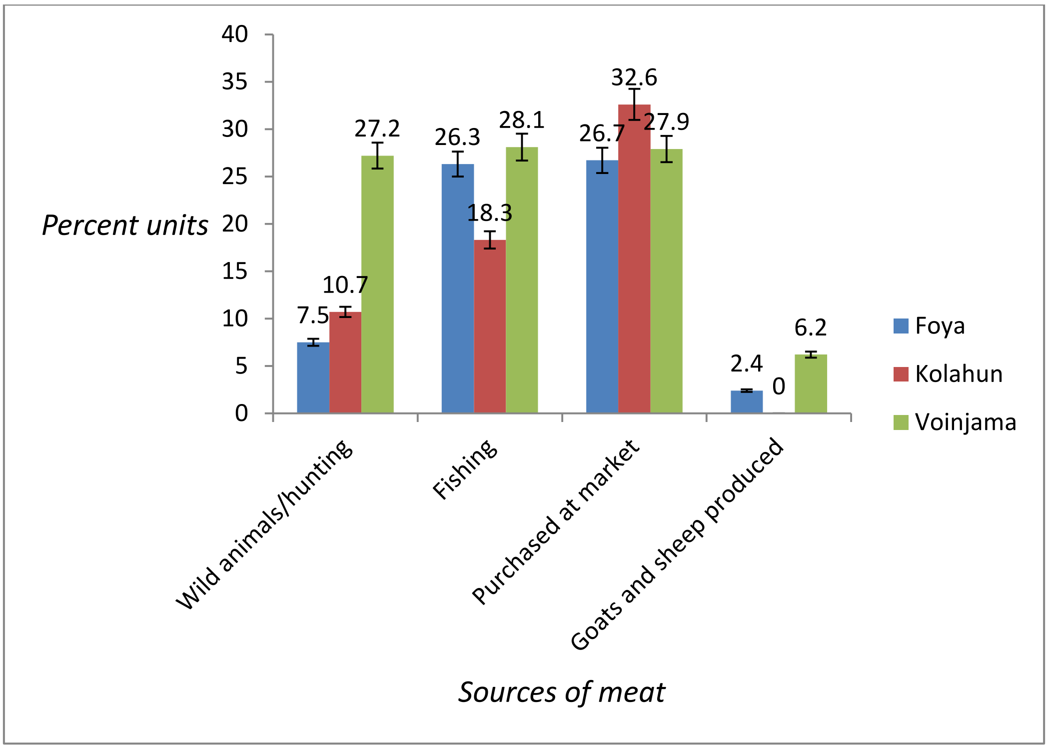

Figure 10: Important households' sources of meat of respondents per district

Figure 3 also reveals that only about 16.8% of respondents said that they will still hunt or fish even if their production of small ruminants increases because they like the taste of wild animals to domesticated animals such as sheep and goats. On the other hand, 83.2% of respondents said that they will consume small ruminants they produce if they can increase production to cater for home consumption and sell the surpluses at the same time.

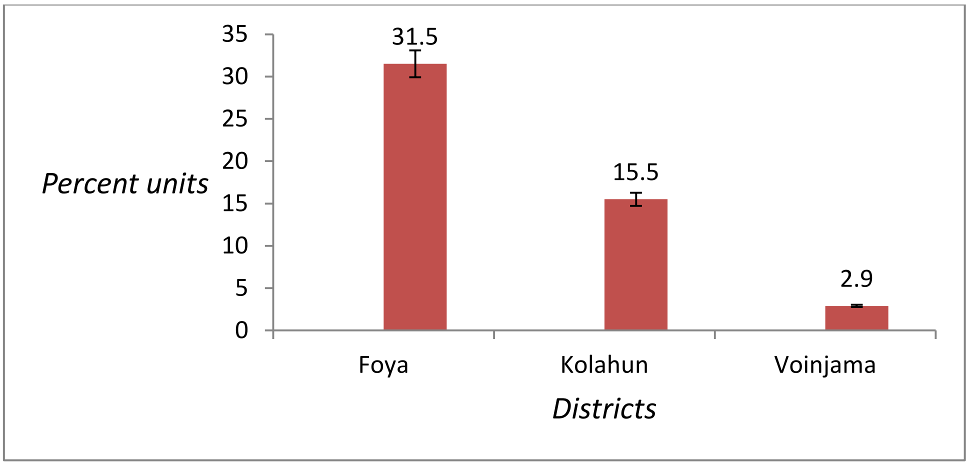

Figure 11: Respondents' answers of hunting wild animals (poaching) or fishing if their capacity built in animal production

Table 3 shows the correlations coefficients (relationships) among sources of meat for the rural farmers' households. The use of wild animals as source meat had a significant association ($P<0.05$) with the use of small ruminants as source of meat. Fish as source of meat had a significant association ($P<0.05$) with small ruminant as sources of meat, and had a highly significant association ($P<0.01$) with wild animals as source of meat. It actually means the more small ruminants one had the more one uses fish and wild animals as sources of meat for rural farmers' household. Market as source of meat had no significant relationship with ruminants and wild animals as sources of meat at any levels. However, market as a source of meat had an inverse association ($P<0.01$) with wild fish as source of meat. That means, the market as source of meat do not stop fishing instead it coexists with increasing fishing activities by rural farmers. This may be due to various reasons such as increase in market price of fish, options in fish at both sources, and individual taste preference for fish. Number of goats owned by household also had a highly significant association ($P<0.01$) with use of ruminants as source of meat. It means that the more goats a farmer produces, the more goat meat he or she eats. Number of goats owned by household had no relationship with hunting of wild animals and fish for market sales. This means that whether the production of goats increased, farmers still engaged in wild animals hunting and fishing as source of meat, while their sheep and goats were sold at appropriate times to derive financial benefit. This means that small ruminant production will not reduce poaching (hunting) and fishing among rural farmers, because small ruminants are not only reared for household consumption but for income generation and ceremonial or socio-cultural purposes. Therefore, accept the null hypothesis that states that small ruminant production does not significantly influence poaching (hunting) and fishing among rural farmers because small ruminants are not reared for household consumption but mainly for income generation. Sheep production had no significance relationship with wild animals hunting and fishing as source of meat. The reason for this was that sheep were usually used for ritual (sacrificial) and ceremonial purposes according to respondents. Sheep production had a significant relationship ($P<0.05$) with small ruminants as source of meat and highly significant relationship ($P<0.01$) with number of goats as source of meat. The reason is that sheep production contributes to sources of meat as small ruminants and reduced the consumption of goats only for meat and ceremonial purposes.

In all, number of small ruminants in households had a highly significant association ($P<0.01$) with use of ruminants as source of meat for human consumption. This means that if production increased, households will turn to them for home consumption. Reject the null hypothesis that states that small ruminant production does not significantly serve as source of meat for rural famers because small ruminants had a significant relationship to rural farmers' sources meat (alternative hypothesis accepted).This suggests that as small ruminant production increases, farmers consumed them as sources of meat for the household especially sheep mostly used for ceremonial purposes. The number of small ruminants in households also had significant negative (or inverse) association ($P<0.05$) with use of meat sourced from the market. This means that as the production of small ruminant increased, the purchase of meat and fish from the market for household consumption also increased significantly. On the other hand, the number of small ruminants in households has highly significant relationships ($P<0.01$) to number of goats and sheep as sources of meat for household consumption. Capacity building for increased small ruminant production had a significant negative (or inverse) correlationship ($P<0.05$) with wild animals as sources of meatand highly significant negative (or inverse) correlationship ($P<0.01$) with market sourced of meat.That is, farmers had the view that as their capacity is built (or increases) for small ruminant production, their consumption of wild animals will still increase and that they will still purchase meat from market. However, capacity building for increased small ruminant production had no correlationship with use of small ruminants as sources of meat. That is, capacity building of rural farmers for increased small ruminant production may not increase their consumption rate for small ruminants.

Variables	Ruminants as source of meat	Wild animals as source of meat	River or Wild Fish as source of meat	Market as source of meat	Number of goats	Number of sheep	Number of small ruminants in household
Wild animals as source of meat	.119(*)						
Fish as source of meat	.110(*)	.375(**)					
Market as source of meat	.040	-.022	-.129(**)				
Number of goats	.226(**)	.097	.029	-.085			
Number of sheep	.196(*)	.010	.012	-.146	.754(**)		
Number of small ruminants in the households	.207(**)	.071	.032	-.098(*)	.905(**)	.827(**)	
Capacity building for increased small ruminant production	-.094	-.096(*)	.038	-.201(**)	.019	.101	.053

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 3: Correlations of rural farmers' households' sources of meat (protein) from small ruminants, hunting wild animals, fishing and buying from the market

4.7 Financial income derived from Sheep and Goats sales

The frequencies of sales of sheep and goats in a year vary from farmer to farmer and from 1 to 5 times for goats and 1 to 4 times for sheep per year while others have not sold their animals yet. One hundred and eighty-six (186 or 47.2%) farmers sold their animals once a year. They do not have many animals to sell and sometimes no buyers or markets to sell because, they do not have a market where they can take the animals for sale until someone comes to them and ask them to buy before they can sell. One hundred and fifty-one (151 or 38.3%) farmers sold their animals twice a year, 26 (6.6%) farmers sold thrice per year and 6 (1.5%) farmers sold four times per year and 1 (0.3%) farmer sold five times per year. However, 25 (6.3%) farmers have not sold their animals because some farmers just started raising them while some want to multiply their sheep and/or goats before selling. On the district level, Foya has the highest one-time sale per year 70.8%, followed by Kolahun 48.2% and Voinjama with highest two-times sale per year 54.2% (Appendix 2). These sales depend on the number of animals a farmer has and sometimes the availability of buyers, because sometimes there are no buyers even though the farmer may have more animals that are ready for sale. Sheep are usually sold when need arises for sacrifice or other socio-cultural ceremonies by rural farmers since they are most of the times used for such purposes rather than for just raising money.

Table 4 shows the estimated total income derived per year from the sales of goats and sheep is US$27,502.41 and US$16,940.07 respectively; an average estimated income derived from the sales of goats and sheep per household per year is

US$89.87 and US$141.16 respectively. The maximum estimated income derived from the sales of goats and sheep per household per year is US$1,000.00 and US$5,000.00 and the minimum income is US$14.28 and US$20.00 respectively. Finally, the highest price for a goat and sheep was US$114.28 and US$121.42 respectively. Small ruminants are sold for such prices and sometimes according to some of the respondents, there are fixed prices charged for goats as long as they are bought by a resident in the town. In this case, the size of the animal does not matter. The only time the price change is when an alien of the town comes to buy. This practice is very common in the Muslim towns of Kolahun District. Other prices either below or above this price are very rare for both goats and sheep. These animals are both sold in an open market or by private sale and/or by abattoirs (slaughtered animals and sold by pieces or parts). In Foya, 4.8% of respondents sold their animals in an open market; 36.5% did private sales and 0.9% did abattoir sales; in Kolahun, 4.1% sold in an open market, 31.1% did private sales and 0.2% did abattoir sales; and in Voinjama, 29.6% sold in an open market, 35.4% did private sales and 0.5% did abattoir sales.

Annual income from small ruminants	Goat	Sheep
Estimated total income per year (US$)	27502.41	16940.07
Average estimated income per year (US$)	89.87	141.16
Maximum estimated income per year (US$)	1000.00	5000.00
Minimum estimated income per year (US$)	14.28	20.00
Average highest price (US$)	55.21	71.60
Average Lowest price (US$)	29.41	44.18
Highest price (US$)	114.28	121.42
Lowest price (US$)	7.14	10.79
Number of respondents	306	120

Table 4: Estimated Income from the Sale of Goats and Sheep per year and Highest and Lowest prices for Foya, Kolahun and Voinjama Districts

4.8 Contributions of small ruminants' sales to household livelihoods

Income generated from the sales of small ruminants was used for many purposes. Some 411 (93.8%) of cash income was used for school fees and 315 (71.9%) used for hospital bills. One hundred and forty-two (142 or 32.4%) farmers used the money obtained from the sales of small ruminants to purchase food for household consumption during food scarcity, 151 (34.5%) used the money to purchase clothes, and 14 (3.2%) farmers used the money for other purposes such as businesses, contingencies and farming (Appendix 2).

Table 5 shows the correlation coefficients (relationships) among the estimated household income and their sources. Income from small ruminant production had a highly significant association ($P<0.01$) with total income of respondent's households. That is, small ruminant production increased household's income significantly. Therefore, if small ruminant production increased among rural farmers, households' income will increase concurrently. Therefore, reject the null hypothesis that stated that small ruminant production does not significantly contribute to rural farmers' income generation because, small ruminant production contributes significantly to rural household's income generation (alternative hypothesis accepted).

Variables	Total estimated income for respondent households	Total income from small ruminants	Income derived from other livestock	Income derived from crop production	Income derived from non-agricultural activities
Total income from small ruminants	.344(**)				
Income derived from other livestock	.799(**)	.014			
Income derived from crop production	.280(**)	.007	-.009		
Income derived from non-agricultural activities	.476(**)	-.054	-.006	.294(**)	
Remittances from friends and relatives	.058	-.005	-.187	-.096	.273

** Correlation is significant at the 0.01 level (2-tailed).

Table 5: Correlation of total income of respondent households to income from small ruminants, other livestock, crop production and non-agricultural activities

Income derived from other livestock had a highly significant relationship (P<0.01) with total estimated income from respondent's households. This means that both small ruminants and other livestock also contributed directly to respondents' household income. Income derived from crop production had a highly significant relationship (P<0.01) with total estimated income for respondent households,but had no significant association (P>0.01) with income from small ruminants and other livestock production. Income derived from crop production increased household income significantly and thus improving the livelihoods of rural farmers. Income derived from non-agricultural activities had a highly significant association ($P<0.01$) with total estimated income for respondents' households and that of income derived from crop production, but had no significant relationship ($P>0.01$) with total income from small ruminants and other livestock production. This means that an increase in income from non-agricultural activities will increase households' income and income from crop production. It also revealed that an increase in income from non-agricultural activities does not affect income from those sources. Remittances from friends and relatives have no significant association ($P>0.01$) with total estimated income for respondent households, income from other livestock, crop production and non-agricultural activities. This means that income from friends and relatives did not increase household income significantly.

Table 6 shows that even though farmers said that small ruminant production contributed to household finances in diverse ways, upon the analysis of the amount of money raised from various livelihood activities, it was revealed that small ruminants contribute 30.2% of the total household income (US$44, 42.48); crop production 32.3% (US$47,437.61); other livestock 16.0% (US$23,590.94); non-agricultural activities 20.3% (US$29,897.26); and remittances 1.2% (US$1,717.49) respectively. This supports the alternative hypothesis that states that small ruminant production contributes significantly to rural farmers' income generation. Therefore, small ruminant productions must be encouraged through the MOA and agricultural

NGOs to enhance the rural economy. On the other hand, these livelihood activities contribute to household finances at different levels or degrees. In summary, contributions less than 10% were reported in 324 (76.8%) respondents. Only 0.9% of respondents derived greater than 89% of financial capacity from sheep and goats sales.

Variables	Income in US$	% contribution
Small ruminants	44442.48	30.2
Crop production	47437.61	32.3
Other livestock	23590.94	16.0
Non-agric. Activities	29897.26	20.3
Remittances	1717.49	1.2
Total	147085.78	100.0

Table 6: Total estimated income for respondents' finances

Table 7 shows the correlation coefficient analysis in which total income from small ruminant production and sheep's estimated income per year had highly significantly association ($P<0.01$) with total estimated income for respondent household, and goat's estimated income per year had a significantly relationship ($P<0.05$) with total estimated income for respondents' household. Goat's estimated income per year and sheep's estimated income per year had highly significant relationship ($P<0.01$) with total income from small ruminants. Therefore, reject the null hypothesis that states that small ruminant production has no significant relationship to rural farmers' income generation because small ruminant production had a highly significant relationship with rural household income generation. In real life and as demonstrated by the statistical analysis, small ruminant production contributes significantly to rural farmers' livelihood by providing income and meat for the household.

Variables	Total estimated income for respondent households	Total income from small ruminants	Goat's estimated income per year
Total income from small ruminants	.344(**)		
Goat's estimated income per year	.118(*)	.256(**)	
Sheep's estimated income per year	.366(**)	.993(**)	.082

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 7: Correlations of total estimated income of respondent households to income from small ruminants

Table 8 is an ANOVA that analyses the mean differences of the three studied districts. According to this analysis, total income from small ruminant production, income from other livestock, income from crop production, income from non-agricultural activities and remittances had significant differences (P<0.01) in the mean of the three districts. Although production levels were low, but farmers keep small ruminants for sales during financial needs and sometimes for ceremonial or ritual purposes when such needs arise. Income from other livestock (poultry, piggery and rabbits), income from crop production, income from non-agricultural activities (pension, salaries, petty businesses, trades) and remittances were financial sources that also contributed significantly to rural livelihoods in the studied districts. All of the aforementioned financial sources were contributing to or make up the total household income per year. Even though very few persons are employed in the rural areas, but those salaries contribute a lot to the rural economy as the other sources.

Variable	Sum of Squares	Degrees of Freedom	Mean Square	Observed F-Value	Significance Levels (5%).
Total income from small ruminant production	147.276 1230.138 1377.414	2 434 436	73.638 2.834	25.980	.000
Income from other livestock	21.104 271.520 292.623	2 435 437	10.552 .624	16.905	.000
Income from crop production	40.319 939.900 980.219	2 435 437	20.160 2.161	9.330	.000
Income from non-agricultural activities	73.057 907.052 980.110	2 435 437	36.529 2.085	17.518	.000
Remittances	28.148 93.571 121.719	2 435 437	14.074 .215	65.427	.000

(The mean significant difference at the 5% level)

Table 8: ANOVA of the various income sources for rural households in the three districts

4.9 Production problems and challenges of small ruminant production

The major problems faced by the small scale rural farmers are the lack of markets to sell at anytime the farmers wish to sell. There are 3 types of markets that they use to sell their animals: open market, which is 26.8%, private sales 72.0% and abattoirs 1.1% respectively. An open market is a place where marketers converged on a specific week day to sell their goods. Being that there are no cars available in some communities, it is very hard to transport their animals to the market and keep the animals until someone comes and buys (private sale). Very few farmers slaughter their animals and sell by piles or parts because they do not make much profit if they slaughter and sell as compare to selling of the live animal. Therefore, the Ministry of Agriculture needs to create markets for the sale of animals in order to encourage farmers to produce more.

4.10 Production and marketing management systems of small ruminants

Figure 4 shows the three main kinds of systems used in keeping small ruminants were intensive, extensive, and semi-intensive. However, on the district levels, 97.3%, 78.5% and 96.4% of small-scale rural farmers used extensive systems in Foya, Kolahun and Voinjama respectively in which animals are left to roam freely, graze themselves and sleep beside houses in towns and or villages. The reason for this may be attributed to the small number of animals that each farmer has and the lack of knowledge to build shelter for those to use during the night and wet weather. Very few farmers used intensive and semi-intensive systems for their animals. Those farmers who use semi-intensive systems are those who were trained by Samaritan's Purse before the animals were given them and those who had training from other organizations. Samaritan's Purse has a livelihood program for rural farmers on the household basis in which they trained a member of the household on behalf of the household and supply them with either a pair of goats or sheep.

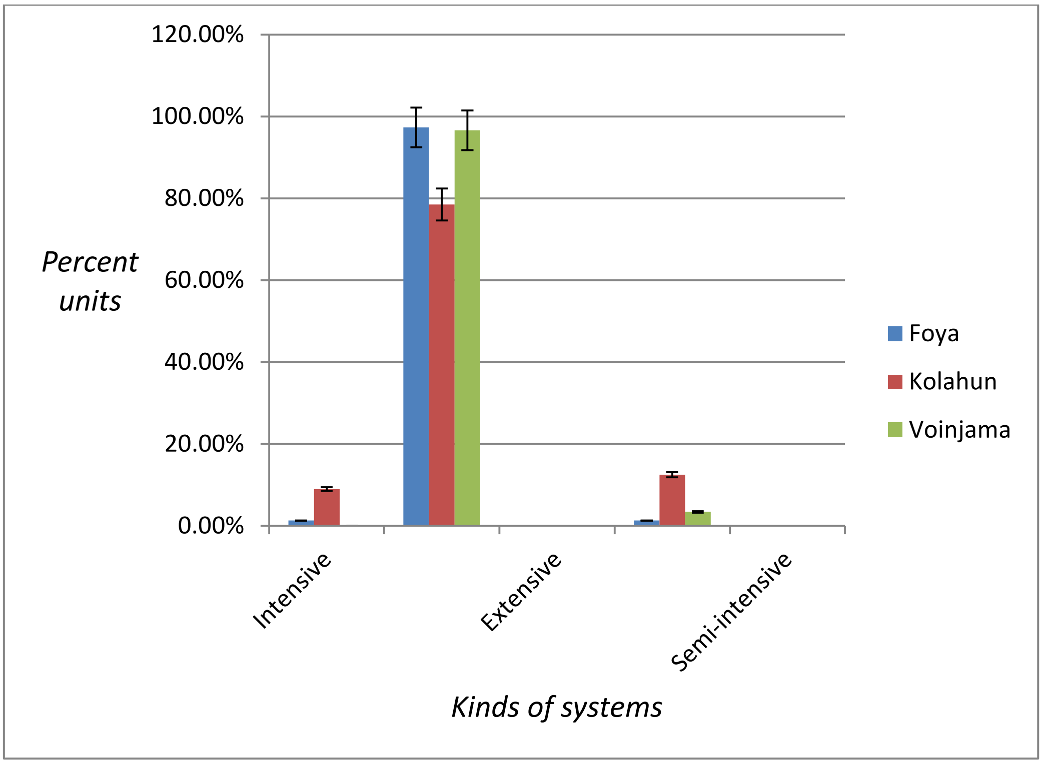

Figure 12: Kind of system used in keeping small ruminants by respondents per district

However, after they give birth, respondents are required to give back two kids or lambs to Samaritan's Purse at a time to supply other farmers who never got for the first time. This cycle continues until all the farmers in the project community benefit.

Supplements are made of concentrates, forages, and others (banana, salt and oranges). Concentrates as supplements made up 17.1% of total; forages 32.2%; while others such as banana, salt and oranges as supplements made up 5.9%. This means that forages are abundant in the study area and therefore have the capacity to accommodate large- or middle-level small ruminant production. Concentrates were not readily available to supplement animal feeds during feed shortage. Most of those feeds were given to animals occasionally because of the lack of knowledge on the importance of feed supplements to animals. Concentrates are usually expensive for rural ruminant farmers; however, household leftovers were given to animals to customize them to their owners. An extensive system of goat management is practiced by goat keepers who hardly paid for supplementary feed of these animals. In Bhilwara district of Rajasthan, there is evidence that feed scarcity in the dry season affects the reproductive performance, particularly conception rates of does belonging to poor people (Natural Resources Institut, 2002). In the Foya District, animals are tethered during the farming season to avoid destruction of crops (Appendix 2).

4.11 Small Ruminant Production Constraints and Challenges

Table 9 shows the problems faced during the purchasing and selling of small ruminants by farmers. The high cost of animals, long distance to market, unavailability of transportation to market, high cost of transportation were major problems during purchase of animals to rear. Many of those animals are bought from neighboring countries: Guinea and Sierra Leone. Therefore, if the MOA can breed animals in Liberia, rural farmers can easily go to the district headquarters and purchase without much problem. As it was with purchasing to rear, there were also problems of selling those animals after rearing them for the market. The problems faced during the sale of small ruminants included low prices, long distance to market, high cost of transportation, and no transportation. Sixty-eight percent (68.0%) of the total respondents faced problems of low prices during sale of animals. The reason for this price is that there is no fixed market where animals are taken for sale. According to (James, 1996), livestock owners will be motivated to adopt higher-output systems only if they have access to good markets for the produce. Besides, sales are mostly done when people come looking for the animals once in the while and so they determine the price of the animals according to the amount they desire to pay. Because there were more sellers than buyers, farmers are constrained to sell at low prices. Besides, 33.8% faced problems of long distance to market. Those were farmers who took their animals to the district headquarters periodic market because they were in dire need for money at that time. Given that some town are far away from those markets, they have to travel long way walking or use car or motorcycle, which costs are high because of bad roads, high cost of gasoline and scarcity of vehicles. Thirty-five point eight percent (35.8%) faced problems of high costs of transportation to market. Ten percent (10.0%) faced problems of no transportation in their towns or villages to transport their animals to the market for sale. This is so because during the 14-year civil war, most of the feeder roads were closed up when inhabitants deserted those towns to seek refuge elsewhere. Others included lack of market to sell those animals at the time one wishes to sell 18%. Therefore, if the

Government of Liberia can reconstruct feeder roads and set up markets for buying and selling goats and sheep, many farmers could have better lives than they do now.

Problems of purchase and sale of small ruminants	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	frequency	%	Frequency	%	frequency	%	frequency	%
High cost of animal	83	18.9	79	18.0	130	29.7	292	66.7
Long distance to market	113	25.8	72	16.4	112	25.6	297	67.8
Unavailability of transportation to market	31	7.1	11	2.5	23	5.3	65	14.8
High cost of transportation	87	19.9	61	13.9	110	25.1	258	58.9
Others during purchase	14	3.2	62	14.6	2	0.5	78	17.8
Low price during sale	84	19.2	81	18.5	133	30.4	298	68.0
Long distance to market for sale	54	12.3	11	2.5	83	18.9	148	33.8
High cost of transportation for animal	53	12.1	11	2.5	93	21.2	157	35.8
No transportation to carry animal	15	3.4	3	0.7	26	5.9	44	10.0
Others during sale	7	1.6	62	14.2	4	0.9	83	18.9

Table 9: Problems faced during the purchase and sale of small ruminants per district

Table 10 shows the major production constraints of small ruminant production. They are inadequate feed, disease, lack of veterinary services, lack of training or knowledge of small ruminant production, lack of shelter for animals and others such as reproduction and types of breed. According to farmers, 329 (75.1%) lack of veterinary services, 313 (71.5%) lack training or knowledge of production and 181 (41.3%) faced disease problems, 111 (25.3%) had inadequate feed for their animals in their various communities. These problems can be resolved through extension services to improve productivity. Because of the lack of training in management, treatment and presence of veterinary technician, curable disease cannot be treated. Other contributing factors that lead to sheep and goats losses in the study areas were theft, snake bites or swallowing of animals by pythons, wild animals eating them and car accidents especially for those towns on the roadside. These factors reduce the production rates and income accumulations from small ruminant sales.

Major production constraints/problems	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	frequency	%	frequency	%	frequency	%	frequency	%
Inadequate feed	36	8.2	66	15.1	9	2.1	111	25.3
Disease	95	21.7	65	14.8	21	4.8	181	41.3
Lack of veterinary services	96	21.9	99	22.6	134	30.6	329	75.1
Lack training/knowledge	82	18.7	93	21.2	138	31.5	313	71.5
Lack of shelter for animals	11	2.5	22	5.0	6	1.4	39	8.9
Others	3	0.7	6	1.4	11	2.5	20	4.6

Table 10: Major production constraints of respondents per district

Although not available, all farmers said that the services of veterinary technicians are very important to them. They also said that if the services can be effective, many of them can rely heavily on small ruminant production to generate more income than any other aspect of their livelihoods. Most of the respondents (91.6%) said that veterinary technician services are important to them; while, 8.4% said that such services are not important to them because they can treat their animals by themselves without any help (had previously been trained). If rural farmers should realize increased production in order to generate income to improve their livelihoods status, MOA should directly assign technicians to work in the hinterlands or funds INGOs or local NGOs that are capable of working along with farmers to keep their animals alive and healthy (Appendix 2).

Figure 5 shows that majority of the respondents had experienced major small ruminant disease outbreaks in their localities in a year time. This might be due to lack of training or knowledge to manage those animals properly and other environmental problems such as poisonous plant grazing or browsing. Only a few of total respondents have not experienced any major disease outbreaks in a year against small ruminants in their communities. This may be due to bringing of healthy animals to rear and the towns that the NGOs supplied have constant visitations by animal technicians and treatment of animals. On the district level, 82.1%, 73.9% and 42% experienced disease outbreaks in Foya, Kolahun and Voinjama respectively. The specific diseases experienced by small ruminant farmers are shown in Table 11 below. These diseases contribute greatly to the losses of small ruminant and the declining of the industry for the rural farmers.

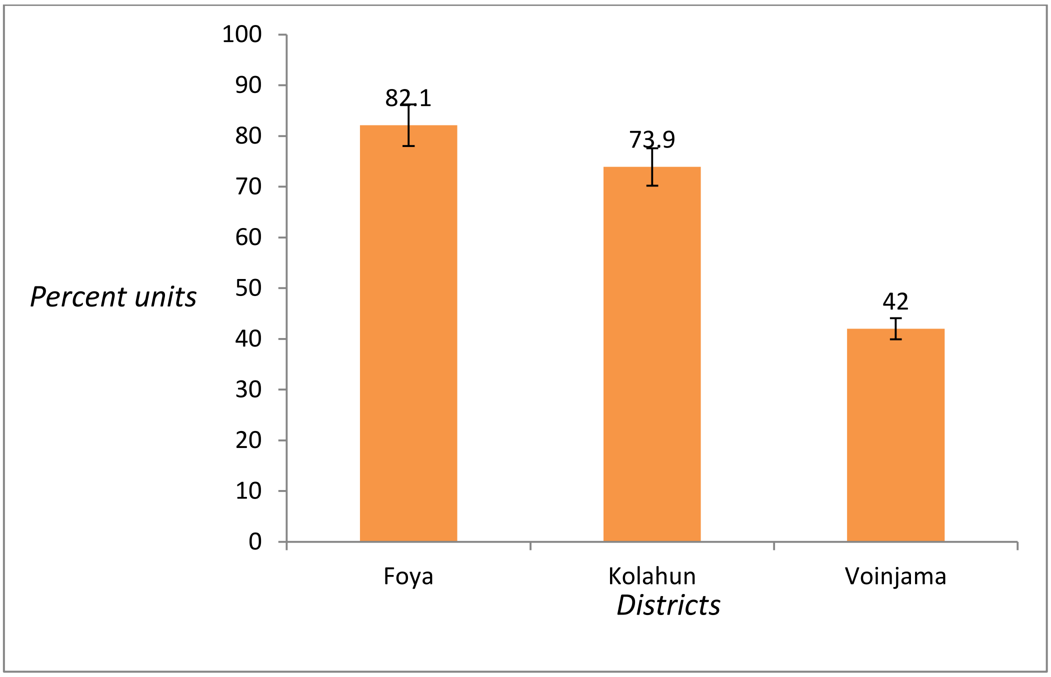

Figure 13: Experience major disease outbreaks in a year against small ruminants per district

Table 11 shows some prevalent diseases of small ruminants in respondents' communities such as diarrhoea and/or PPR, foaming from the mouth (clinical sign), skin infections, foot rot, dermatophilosis, discharge coming from the penis (paramphymosis**)** and prolapsed vagina. These diseases affect production negatively because some cause deaths to animals. More than 41% of them suffered of diarrhoea, 21.2% of foaming from the mouth, 38.1% skin infections, 23.1% of foot rot which mostly affects sheep. Others include vaginal and penile infections and running nostrils which is 11.9%. These diseases reduce growth rate and productivity significantly thereby reducing the income generation from sales of those animals. Hence, animal healthcare technicians are highly needed if this sector of the rural livelihoods should be improved or actualized.

Prevalent diseases of small ruminants in communities	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	frequency	%	frequency	%	frequency	%	frequency	%
Diarrhoea	75	17.1	53	12.1	53	12.1	181	41.4
Foaming from the mouth	28	6.4	28	6.4	37	8.4	93	21.2
Skin infection	61	13.9	21	4.8	85	19.2	167	38.1
Foot rot	40	9.1	60	13.7	1	0.2	101	23.1
Others	39	8.9	11	2.5	3	0.7	52	11.9

Table 11: Prevalent diseases of small ruminants in respondents' communities per district

The mode of treatment of disease varies from modern medicines to traditional methods. About 5.7% of the respondents vaccinated their animals, which means that they have access to animal health technicians while the few farmers who have little knowledge vaccinated their animals themselves. About 2.3% washed and put gas or fuel oil in the affected hooves of the animals to treat foot rot; 4.8% washed and applied oil palm to skin itches; while others 11.2% used crude methods of treatment on a trial and error basis (Appendix 2). Because of the lack of veterinary technicians, those modes of treatments do not make any significant contribution to saving the lives of their animals; thus, leading to massive losses in production. With appropriate training for farmers and the access of veterinary or animal health technicians to their localities, small ruminant production has the tendency to improve rural economies and living standards.

Figure 14: Pest des Petits Ruminants (PPR) in sheep in Fassawolo town, Kolahun District (Dead sheep with wet fur at the back leg and tail from diarrhoea)

Figure 15: Pest des Petits Ruminants (PPR) in sheep in Fassawolo town, Kolahun District (Sheep died of diarrhoea)

4.12 Training needs of small ruminants producers

Respondents on the training needs of small-scale rural farmers indicated these as being very crucial to the development and improvement needs of the rural society. If rural people should live better and improved lives, the government and its partners would need to support them with relevant trainings that can improve their productivities. Table 12 below outlines training needs of small ruminant producers.

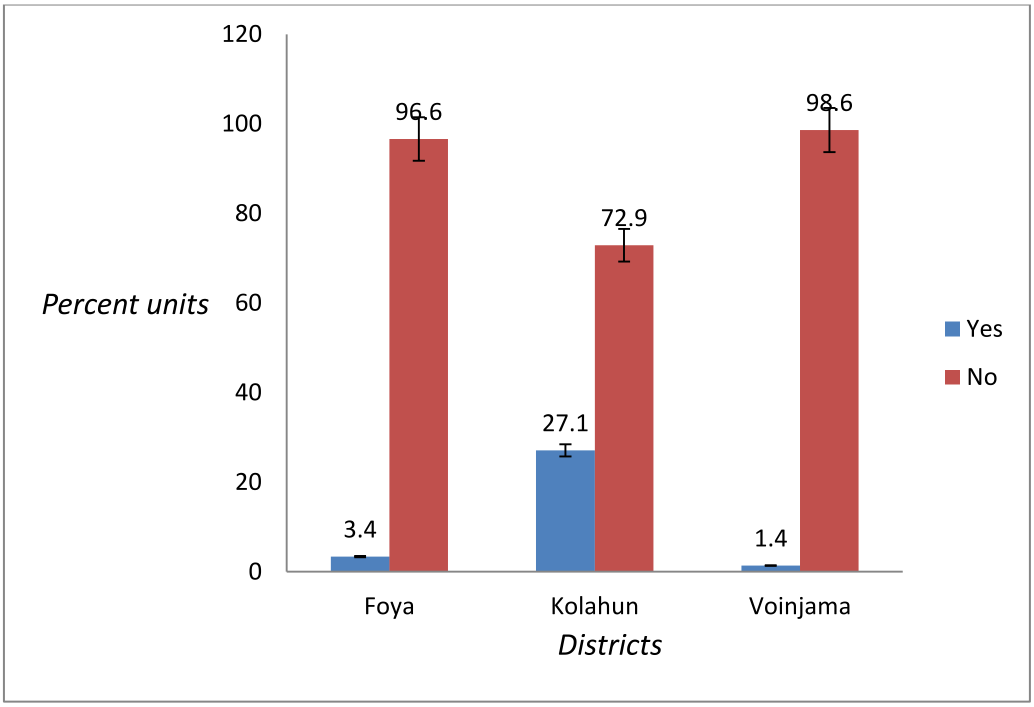

Figure 16: Received training in goat and sheep production per district

Some, 391 (89.5%) of respondents had not received any kind of training ever. This limits appreciation of global best practices in small ruminant production and subsequent low income generation from the husbandry practice, especially due to inability to control and treat the diseases such as foot rot, diarrhoea, mange and PPR.

If farmers were able to overcome these problems, small ruminant production would increase and with significant impact on income generation and farming interest. The farmers indicated desire to be trained, but there are no extensionists from the government to train them. Some 46 (10%) respondents had received some training by local or international NGOs. The Government of Liberia through the Ministry of Agriculture has not trained any farmers and does not even send extensionists to help the farmers combat common ruminants' diseases. Because of the lack of training, they lose lots of animals from improper care and common diseases. The organizations that trained the farmers on small ruminant production are ADRA-Liberia, Samaritan's Purse (SP), NRC and EU-Liberia. Individuals include friends and relatives who have previous trainings. These organizations have livestock components in which groups of farmers are trained and supplied with small ruminants to raise and improve their livelihoods. For example, SP and ADRA-Liberia trained and supplied farmers with goats and sheep in selected towns in the Foya and Kolahun District. If all the agricultural NGOs in Liberia can do same as the farmers said, their livelihoods will improve along with their living standards. Eighty percent (80.0%) of the respondent who had training were trained by SP. Most of those trainings have taken place right after the 14-year civil war in order to empower the rural farmers. It started in 2006 and continues up to now but on a slow pace. The reasons for the slow pace may be attributed to rapid corruption in the government and NGO sector in Liberia; because, after the war there were many NGOs implementing agricultural projects that were to empower rural farmers in all aspects of farming. Some of those NGOs implemented millions of dollars project on paper without any practical impact on the ground that they were implemented. If the

Government of Liberia can monitor all agricultural NGOs and hold them responsible for any irregularities, farmers will benefit from trainings. Most of the trainings were done by representation of a group of farmers. Only SP trained all of their farmers that they supplied animals to in order to teach them how to manage these animals individually. Therefore, all of their farmers are doing very well in caring for their small ruminants as two animals are supplied to each household. If the efforts of SP can be buttressed by the Ministry of Agriculture and other agricultural NGOs such as EU-Liberia, NRC, Concern Worldwide, it is possible that Liberia can become self-sufficient in meat production as a source of protein on the household basis and surplus can be sold to generate income to solve household problems; thus leading to improved livelihoods and standard of living.

This research also revealed that very few farmers were trained in the following topics or subjects: animal production, feed production and management, disease prevention and control, marketing, and shelter construction for small ruminants. Those trainings were conducted by NGOs and friends and/or relatives. With the small percentage of farmers that have been trained, there has been little impact of those training on the rearing of small ruminants in terms of the above topics/subjects. However, Kolahun District had the highest trained farmers in all the topics (6.4%, 7.5%, 3.2%, 1.8% and 0.5%) respectively because of the presence of SP that was still training and supplying small ruminants to farmers.

Figure 17: Shelter for goats and sheep at Kiafata, in Kolahun District

(Taught by Samaritan's Purse – A Non Governmental Organization in Liberia)

Figure 18: Goats under the plum tree at Kiafata, in Kolahun District

(Supplied by Samaritan's Purse – A Non-Governmental Organization in Liberia)

Training is very important in any enterprise. One hundred percent (100%) of those who were trained in small ruminant production said that the training was beneficial to them. This means that if the Government of Liberia through the Ministry of Agriculture could supplement and/or replicate the efforts of the few NGOs, farmers would realize high productivities in order to sell the surpluses. Kolahun has the highest beneficiaries of those trainings due to the presence of the SP which supplied small ruminants as a livelihood project in the district.

Kinds of relevant training needed to improve production of small ruminants	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	frequency	%	frequency	%	frequency	%	frequency	%
production and management	122	27.9	117	26.7	138	31.5	377	86.1
animal healthcare	128	29.2	134	30.6	59	13.5	321	73.3
housing construction	23	5.3	14	3.2	1	0.2	38	8.7
feed production and management	55	12.6	58	13.2	8	1.8	121	27.6
small ruminants' marketing	25	5.7	37	8.4	1	0.2	63	14.4

Table 12: Relevant trainings needed to improve small ruminant production per district

Table 12 shows the various training needs of farmers. Even though only 10% of the farmers were trained, almost all the small ruminant farmers want to be trained in small ruminant production and management, healthcare, housing construction, feed production and management and marketing. It was revealed that 86.1% of the farmers want to be trained in small ruminant production management and 73.3% wants training in small ruminants’ healthcare. Farmers believe that if they are trained in production and management and healthcare of those animals, they can maintain their productivity with little intervention by veterinarians or animal health technicians. They will also need extension workers or veterinary services for major diseases or problems that they cannot control.

CHAPTER 5

DISCUSSION

5.1 Small Ruminant Population and Husbandry Systems

Kolahun had the least number of goats because half of the population in the study area is Muslim who use sheep for sacrificial purposes instead for cash; however it had 85 sheep, which was the highest number of sheep of the three districts. Wilson (1995) said that in all Muslim societies sheep are important to the Touareg and flock sizes are larger than those of goats, averaging 103 head.

Poaching is the illegal hunting of wild animals. It was revealed that if small-scale rural farmers' capacities are built leading to high animal production, poaching and fishing will be minimized. Although the number of small ruminants kept per present household had no relationship to poaching and fishing among rural farmers, the condition would improve if production and size of the herds increase compare to the present. This increase in number of small ruminants could subsequently influence hunting and fishing of wild animals and fishes, thus leading to the preservation of wildlife for research and tourism purposes. According to LISGIS (2008) household's livestock census, Lofa County has 2870 livestock (small ruminants), out which Foya has 359 (Waum Clan had 46, Tengia Clan had 118 and Luankollie Clan had 195 small ruminants respectively); Kolahun had 750 (Tahamba Clan had 370, Wolukoha Clan had 23, Wanwoma Clan had 106, Lukasu Clan had 36, Hembeh Clan has 12 and Hassala Clan had 203 small ruminants respectively); and Voinjama had 555 (Lower Workor Clan had 155, Upper Workor Clan had 335, and Bondi Clan had 65 respectively).

Small ruminant production contributes immensely to rural livelihoods especially in generating income for rural households. This livelihood sector of the rural people is not given much attention as it contributes; however, when it is given attention, it may serve as a leading financial sector for the rural farmers. Estimated number of goats sold per year per household varied from 1 to 5. It was mostly based on the farmer's need for money at a given time. Goats were usually sold by farmers when the need arises for money, since they serve as farmers' "bank savings." A number of different systems of goats or sheep production exist, including subsistence, extensive and intensive. The number of animals kept is often a helpful factor that indicates the type of system. Subsistence is where farmers keep small numbers of animals and manage to use whatever feed resources that are available at town and or village level. Under extensive production system, small ruminants graze and browse areas of land that are not used for agricultural purposes at the time; while intensive system of production are those where the goats are confined and so are not allowed to forage for themselves (Steele, 1996).

5.2 Education of Rural Inhabitants of Lofa County

The low level of education may be due to the 14-years civil conflict that ended in 2003. Rural people were displaced by rebel forces, schools and infrastructure were destroyed and where schools existed, there were no teachers because educated people were targets for the rebels.

However, Ministry of Education-Liberia (2005) attributed the low level of education to the 1984 census that revealed that women and girls in Liberia constitute over half of the nation's population and perform about 80% of all productive activities in rural agriculture and other sectors, but as yet they have not been given the basic equal rights and opportunities in human resource and educational development thereby making them the most vulnerable group of learners. If MOA can train or educate local farmers through farmer field schools-FFSs (informal education), productivity would increase thereby increasing rural livelihoods of the people. Young and Guenther (2008) believed that education is one of the most powerful instruments for reducing poverty and inequality, and lays a foundation for sustained economic growth.

In Australia, 42.5% of the aborigines are in the labour force including Community Development and Empowerment Projects (CDEP), and almost 12% have never attended school. The desert context presents several challenges to the provision of education and training services to the aboriginal people. Nevertheless, learning in a variety of forms does contribute positively to the livelihoods of desert dwellers and is a mixture of both formal and informal programs. Until recently, much of this learning occurred as part of CDEP, but the progressive changes to CDEP raise questions about the future of these programs (Young and Guenther, 2008).

Aboriginal peoples of Australia experience 'overwhelming' disadvantages across every indicator of social and economic well being when compared with non-aboriginal peoples. The rural people of Liberia like the aboriginal Australians lack education that could have helped them to develop socially and economically to improve their livelihoods. Access to primary and secondary education is the key to access and success in post school education and training. Contributing factors include poor access to local education facilities and the difficulties students experience with boarding options. Occasional vocation and technical education programs on remote communities are therefore the only post school (usually primary) education on offer and assume uneasily the role of secondary education substitution within their core business of mainstream work-oriented training. Access to education is necessary but not sufficient to improve health, well being or economic outcomes for poor and marginalised peoples. Evidence would suggest that improved attendance and years spent in education matter little if the quality of the education received is poor or if parents have little capacity to support achievement in education (Young and Guenther, 2008). If rural farmers can be empowered to increase productivity of small ruminants, they can be able to send their children to good schools and pay for good health services.

5.3 Extension and Training for Enhancing Rural Livelihoods

The broad goal of the MOA is to expand Liberia's agricultural output until maximum economic and social benefits are gained for the total population, consistent with judicious use and prudent conservation of resources. In general, over 70% of

Liberia's population and specifically, over 350,000 households are the beneficiaries of the MOA services. Key services include planning and development to ensure efficient resources use, packaging and transferring of technology in formation through the national extension network to increase farm productivity, providing high quality products (Budget Bureau-Liberia, 2007). Ironically, all of the above-mentioned goals of MOA are yet to be implemented or practicalized in the lives of the rural farmers of Liberia in all sectors of agriculture. There is no sign of extensionists in the rural areas of Liberia, especially the study area. Of course nothing will be developed if the Governemtn of Liberia is unable to develop the skills and knowledge of the rural people to sustain productivity. However, if farmers are encouraged in the small ruminants' sector by good veterinary services, and trainings, many are willing to make it their primary objective.

The Ministry of Agriculture founded May 1972, is charged with the responsibilities of achieving self-sufficiency in food production, increasing the country's ability to earn and conserve foreign exchange; to increase farmers' income and purchasing power and to bring them out of subsistence farming thereby enabling the country and people to prosper. One of the four pillars of the government of Liberia's interim Poverty Reduction Strategy (PRS) paper is the revitalization of the economy and one of its four broad nation policy choices or directions is ensuring food security. The ministry is the key institution for vitalization of the economy and ensuring food security as the entity charged with coordinating agricultural development activity in the country. Successful achievement of its goals will result in poverty reduction, food security and rural development through the generation of employment, income and foreign exchange, and the sustaining of natural resources (Budget Bureau-Liberia, 2007).

The Department of Regional Development and Extension of Liberia is to provide extension services through technological transfers via training and the dissemination of agricultural information to about 75% of the population who are mainly involved in subsistence farming in both urban and rural communities. The program is expected to increase agricultural production and provide income for farmers, thus meeting the government poverty reduction goal (Budget Bureau-Liberia, 2007). For government to achieve its goal in improving the lives of subsistence farmers, it needs to train extensionists and send them to train farmers in the hinterlands. Forse (1999) stated that most people who keep animals know a lot about them already. But even animal keepers who already know a lot about their animals need to learn how to recognise and treat a disease that is new to them. They also need to learn about new medicines and methods for treating animals and preventing disease. Forse further explained that good training gives people confidence. It helps them to realize how much they already know and to use their knowledge. One way to share knowledge is to organize training sessions. Therefore, MOA needs to embark on the training of small-scale small ruminant farmers to empower them with the necessary modern skills on treating their animals.

5.4 Small Ruminants and Other Sources of Rural Livelihoods

The total number of goats in the respondents' households was 594 out of which 262 (44.1%) were male and 332 (55.9%) were female. On the other hand, the total number of sheep was 259, in which 103 (39.8%) were male and 156 (60.2%) were female. In all, there were 853 small ruminants in the study area. Household small ruminant ratio was 438:853, an estimated ratio of 1:2, being two goats and/or sheep per household.

An average highest price for a goat was US$55.21 while lowest was US$29.41. Also, an average highest selling price for a sheep was US$71.60, and the lowest was US$44.18. Cumulative cost value of sheep and goats in the 3 districts was US$39,680.00, out of which US$26,739.00 was the estimated value of 594 goats (67.4%); while, US$12,950.00 was the total estimated cost for sheep (32.7%).

Estimated value of small ruminant population in the three districts implied a per capita of US$90.59 per household in the communities. This amount is considered high in a low income country like Liberia for an average rural farmer in a post-war country. This study reveals that small ruminant production contributes 30.2% of the total estimated household income among the various household's sources of income, which include crop production 32.3%, other livestock 16.0%, non-agricultural activities 20.3% and remittances 1.2% respectively. Farmers in Lofa County and Liberia as a whole practice mixed farming systems in which crop production is mixed with livestock production; however, crop production is primary and livestock is secondary.

According to a research that was conducted in the mixed farming or livestock systems in the Latin American highlands, Wilson (1995) said that livestock may contribute up to 30% of the total income with cattle producing 60% of the cash from all livestock. Animals are not only integrated with crops but among livestock species, with pigs and poultry. There is generally good integration of agriculture and livestock production.

The reasons for keeping small ruminants are the sources of cash for rural farmers. They serve as reserve bank where money is withdrawn whenever there is need by selling one or more to solve household financial problems such as sickness, education and food shortages. They are also used for socio-cultural ceremonies such as sacrifices and other rituals like festivals and funerals. Money obtained from the sales of small ruminants was often used for school fees, hospital bills, food, clothes and other necessities. The reasons given by those farmers are school fees are seasonal expenditures and therefore they sell their animals when schools are about to open to pay their children tuitions; while, hospital bills are unforeseen expenditures that usually come when the family maybe penniless and sickness befalls the household. The incomes from small ruminants' sales are highly important to rural farmers' households. If farmers can be trained to maximize productivity, sales of the animals can generate more income to raise their livelihoods and living standards. They are highly significant sources of money or cash for rural farmers who do not have bank accounts to withdraw money when need arises. Very few sheep are sold above those prices mentioned above. This may be based on some urgency of the buyer of those animals at the time. So, sheep sales contribute greatly to rural economy and facilitate in education of rural children and achieving better health services.

Small ruminants keeping have been an age old hobby of rural dwellers in Liberia. However, it was not considered as farming activity that could generate income rather they kept sheep and goats only for ceremonial purposes like feasts, sacrifices or given them to friends or leaders as gifts. For this reason, Liberian rural inhabitants, extension workers and service providers must be educated on the economic value of raising sheep and goats. Poor rural dwellers, medium and large scale farmers, children, women and men can engage in goats and sheep farming as a way of increasing their income at the village level and enhance food security. Therefore, service providers must emphasize the following to the rural farmers in order to improve the productivities of these animals and generate income for the poor rural farmers (Samaritan's Purse - Liberia, 2005).

Crop and small ruminant production are the largest contributors to rural livelihoods. Non-agricultural activities, which included 'paid jobs' can increase contributions if government creates employment opportunities in the hinterlands to absorb the rural people especially unskilled population. Remittances which come by good will can only increase if people are employed to sustain themselves and give out 'handouts'.This means that if farmers can be trained to increase their production, sales of those animals can generate income to improve their livelihoods and living standards.

Goats and sheep can contribute significantly to household finances if only farmers are capable of managing and treating common animal diseases that are causing lots of losses to them thereby reducing their income generation to improve their livelihoods. Therefore, if farmers training in the production of those crops (rice, cassava, potatoes, peppers, okra, beans, cocoa, coffee, plantain, oranges), it is possible for their livelihoods to improve along with their living standards. The advantage of crop production in Liberia or Lofa County in particular is that the soil is very rich and shifting agriculture is used effectively so that the land needs either little or no artificial fertilizers to grow any crops. The staple food crop is rice, which is cultivated on uplands and lowlands (swamps) for both consumption and sales of the surplus to generate household income. Other cultivated food crops include cassava, yams, potatoes, beans, groundnuts, and so on. However, if education and employment increases and business improve in the cities, many households will receive remittances from their relatives and friends from the cities. Wilson (1995) also said that the dominant crop or crops vary with the region; for example, in the upland, as well as paddy, rice is important everywhere, while maize and root crops such as yams, cocoyams, taro, cassava and sweet potatoes are more or less significant components of the cropping system according to the region.

In Sri Lanka, many cultivate rice, which is a major smallholder crop for consumption, sales, and given for rent. Also in Gambia, the main cash income for most households is crop sales, while the income from livestock appears to be relatively small, nevertheless, make a major contribution to the rural economy.

5.5 Diseases and Veterinary Services in Rural Localities

This research revealed that 282 (66.4%) small ruminant farmers have experienced disease outbreaks in their herds. Diseases such as diarrhea, foot rot, foaming from the mouth (clinical sign), skin disease, and so on were very conspicuous in many localities. Other diseases discovered during the research were discharges coming from the penis (Paramphymosis) and prolapsed vagina which were very strange and unimaginable to local farmers. Access to veterinary services in the study area is an important aspect of sustainable small ruminant production for profitability. Although important, rural farmers in the 3 districts do not have any stable veterinary services or animal technician services. Since Liberia has very few veterinarians, the MOA should train and send animal health technicians to districts or clans to help local farmers treat their animals. For production to be maximized and achieve maximum profitability, MOA needs to train more people in the district or clan level in order to minimize this problem; or, train farmers in each town to take care of their animals with supervision from the district animal healthcare technicians.

Samaritan’s Purse (SP) being an INGO, provides the necessary facilities for their workers to make follow-up checks on farmers every week in order to assist when need arises. They also leave their telephone numbers with all farmers to call for any help when they are unable to control any situation in terms of sickness and treatment of their animals. The Government of Liberia (MOA) should follow-suit or emulate the examples of SP if farmers' productivity should improve sustainability of their livelihood source. New animals brought in from Guinea and Sierra Leone were sometimes infected with contagious diseases that easily spread to other healthy animals thereby killing them. This situation can be attributed to the lack of quarantine officers at the borders to examine animals brought into the country, and sometimes where they are available, may not have the necessary implements or skills to determine disease condition of the animals. To minimize this situation, trained quarantine officers should be assigned to all borders as done by customs officers to stop farmers from bring in sick or diseased animals.

Figure 19: Paramphymosis in a goat in Medicorma town, Foya District

Skin diseases have serious impact on productivity of small ruminants. Some common skin problems according to Forse (1999) and Coste and Smith (1996) are mange (mites), ticks, fleas, black flies, blowflies, bot flies, photosensitisation, stable flies, flystrike (myiasis), contagious pustular dermatitis(contagious ecthyma), and many others. Animals become sick 2-3 weeks after they are attacked by mites (3mm parasites). Mite infestation of skin can cause intense irritation and debilitation; sheep are particularly susceptible to *Psoroptes* cause of sheep scab; and, infected animals scratch and rub against objects because mites bite into the skin and cause a lot of irritation. Mange starts at the ears and neck, the skin become red and some animals lose hair or wool. This leads to less production of milk and meat and skin worth little when killed. Paramphymosis is a clinical condition that may be caused by trichomoniasis, a venereal protozoal infection of cattle caused by *Trichomonas foetus*. The clinical signs of *T.foetus* infection in cattle are restricted to the genital tract. Infected males suffer only mild inflammation of the surface of the penis and prepuce but remain permanently infected; while in female mild reddening of the vagina may occur shortly after the infecting coitus, but the main effects develop nearly two months later. It leads to abortion and infertility and return to heat after about four to five months. It is spread normally at the result from coitus and can be prevented only by using disease-free breeding animals. *Bovine campylobacteriosis*infects animals as does *T. Foetus* (Wilson, 1995). Diarrhoea is one of the major diseases that is causing low productivity in the small ruminants' sector. It may be caused by worms which rural farmers do not have the knowledge to treat. According to Natural Resources Institute (2002), an extensive system of goat management is practiced by goat keepers in Karnataka with hardly any attention paid to supplementary feed or deworming. The worm infested animals become weak due to less supply of nutrients required for survival and production. The farmers are either unaware of the ill effects of these parasites or have no access to an effective remedy. The cost of the treatment and the need for repeated use are additional constraints in regular deworming of these animals. There is thus a need to educate the goat keepers about the ill effects of worms in the animals and demonstrate effective deworming methods. As the farmers in Karnataka, animals dying of diarrhoea may have been infected by worms but there is no knowledge of combating the disease. These diseases can only be diagnosed and treated by trained animal health workers or veterinarians who are completely lacking in Lofa County and Liberia as a whole.

Figure 20: Foot rot in a sheep in Kornorsue town, Foya District

As seen in table 11, diarrhea and foot rot are the most prevalent diseases in the studied area; when they are taken care of, productivity may increase significantly. Extension officers need to go to all parts of Liberia and teach farmers simple methods of prevention and treatment of diarrhea and foot rot for small ruminants and other livestock since they are major causes of animal losses in the study area.

5.6 Reasons for Small Ruminant Production and Management

The MOA is to provide services to farmers, control the exploitation of natural resources including use of forest resources; to develop small business enterprises in the areas of fisheries, wildlife, poultry, livestock and timber, and to provide policies that leadership can use in assisting farmers and farm cooperatives to improve production capacity (Weh-Dorliae, 2004). Therefore, the Government of Liberia through MOA should train rural farmers in order to increase their productivities and improve their livelihoods. This means that if farmers' methods of production can be enhanced through training, production will increase immensely for sale in order to generate income and use the surplus for household daily consumption which may over time minimize poaching of wild animals for household consumption.

According to Coste and Smith (1998), smallholder farmers depend on the natural conditions, the economic setting, the infrastructure, and the resources and opportunities available to the household for survival. Besides producing food (milk, meat) and raw materials (wool, skins) and generating a cash income, other possible functions of livestock keeping are: (1) to provide manure to use as fertilizer, fuel, or building material; (2) to provide draft power and transport; (3) to provide a means of savings and capital formation; and (4) to fulfil social obligations such as dowry. Wilson (1995) said that the major reasons for owning small ruminants smallholder farmers in the Gambia are for use in religious ceremonies and as a repository of wealth. Sheep and goats are readily exchangeable for cash; however, most farmers only dispose of animals when they are really in need of money. The best grown male sheep are slaughtered for the major Islamic festival of Id-el-Kabir, celebrated by 90% of the Gambian people. He also said that in the livestock sub-sector in North Africa's agricultural sector, small ruminant contribute a greater share to numbers and to total output than they do elsewhere in the world. In this region, almost 30% of meat produced is from small ruminants, compared with a world average of less than 6 percent; in Algeria, Morocco and Tunisia the proportion exceeds 50%.

Coste and Smith (1998) explained that smallholders often keep animals as a means of low-input capital formation. The animals make use of crop by-products and food wastes, but the farmers do not make large investments to maintain or increase the capital. For this purpose, an extensive form of livestock husbandry is usually more advantageous than semi-intensive or intensive forms, because it makes relatively few demands on scarce production factors such as cash or labor. While it has less cost involved, there is more injury and loss of animals (theft, predators, ingestion of plastics and an easy spread of contagious diseases) in an extensive system. Therefore, except for the SP Livelihood Project beneficiaries that practiced semi-intensive in the study areas, all the small-scale farmers practiced extensive systems of keeping their animals since it does involve meagre or no cost and labor.

Weaver (2005) said that farmers should provide pastured animals with a high-quality, free-choice, granulated sheep mineral mix. She further explained that a scant handful of corn, pellets, or sweet feed per head keeps them happy to see you and happy sheep are a whole lot easier to handle.

Figure 21: Foot rot infected ewe with its lambs given forage in Kornorsue Town, Waum, Foya District

Figure 22: Forage given to goats as supplement in Kornorsue Town Waum, Foya District

Figure 23: A farmer giving wheat as supplement to sheep in Kamatahun Town, Hassala, Kolahun District

While it is true that rural farmers in Liberia do not have the knowledge and finance to give their animals such supplements as mentioned by Weaver (2005), traditionally, small ruminant farmers give their animals leftover rice, dried corn, oranges, banana, wheat, cut and carry forages and so on; foods that they can afford to keep the animals happy and keep them coming to their owners every morning or evening. Wilson (1995) explained that green fodder, supplementary to grazing, is provided by 49% of Gambian owners, 33% growing forage for this purpose with 16 % cutting natural grasses or weeds. He further said that agricultural by-product animals by 72% of owners; and, the type and amount of by-product varies seasonally, but 48% of owners feed banana leaves, 25% feed sweet potato vines and peelings, 7% feed haricot beans and the remainder a variety of other products. This behavior aids the farmers to keep eyes on their animals and avoid conflict of ownerships. With the plentiful natural supply of forages, if small-holder rural farmers are trained in the management and production of small ruminants, they can quickly multiply them and realize a great turnover rate through income generation and supply of food (animal protein sources) for the households.

In Liberia, besides the farmers who were trained by SP and ADRA-Liberia, almost all the farmers do not fix special meal like oilseed meals, fish or meat meals, groundnut meals, and so on to give to animals for consumption, they only give them when there is surplus of what they are eating before the animals can receive the residuals.

Gatenby (1991) also elaborated that many of the concentrate foods are ones which can also be eaten directly by man. High-quality concentrates which are grown especially for livestock may use land and resources such as water and fertilizer that could be used for the production of crops for human consumption. For this reason, this type of food is not as available to tropical animals as it is in many temperate lands. Despite this, there are times when a surplus of, say poor-quality grain, can be profitably used for animal production when a shortage of storage or transport facilities prevents its being used directly by people. This is no exception to rural farmers in Liberia as well. This increase in production will minimize the poaching and fishing rates leading to an ecosystem health and conservation of wildlife.

Concentrates have high energy density and low fibre content. They are foods that are readily broken down in the rumen and have high value for metabolisable energy greater than about 10 mega joules (MJ) per kilograms (kg) of dried food. They are called concentrates because they concentrate the nutrients that the animal needs in such a small amount of food that livestock can be guaranteed to eat all of their daily requirements. Rice bran, maize, sorghum, wheat, barley, oats and so on are examples of foods with high levels of sugar or starch. If cereals are fed to small ruminants as an energy supplement, it is not necessary for them to be ground, except for cattle that cannot digest whole grains. Roughages have a low energy density and high fiber content. Straw in maize husks are examples of roughages. Roughages are usually cheap. Most of the foods eaten by sheep are roughages with low levels of both metabolisable energy and crude protein. Supplements of energy (energy concentrates or molasses) and protein (protein concentrates or non-protein nitrogen) therefore increase productivity (Coste and Smith, 1998 and Gatenby, 1991).

5.7 Management and Production Constraints

The major production constraints or problems of small ruminants in the study area as in Bhilwara range from inadequate feed, disease, lack of veterinary services, lack of training and lack of shelter to others. As high as 75.1% of the farmers have constraints or problems of lack of veterinary services to the communities, and 71.5% lack of training or knowledge on small ruminant production. This lack of veterinary services and training or knowledge of farmers is the major constraints that led to death of sheep and goats, thus a decrease in production. These two constraints are followed by disease constraints 41.3% and inadequate feed constraints 25.3%, and shelter constraint is 8.9%. Others include reproduction constraints and lack of fence for animals was 4.6%. When these constraints or problems are taken care of by MOA, especially assigning veterinary technicians to each community and training farmers to manage their animals, production may be increased, thus leading to increment in household income and sources of meat. Wilson (1995) detailed that animal productivity in particular is well below optimum owning to poor extension services, inadequate veterinary support and a lack of market information. If these services could be provided and coupled with the use of anti-erosion terraces for the growing of forage grasses and tree legumes such as *Leucaena leucocephala* to improve animal nutrition, then livestock output could be very considerably improved.

5.8 Discussions with County Agriculture Officials and Agricultural NGOs' Officials

Although the research focus was to determine the contribution of small ruminant production to rural livelihoods, some key informants in the agricultural sectors of Lofa County were also interviewed to ascertain the root causes of the farmers' plights. Such focus persons were the County agriculture Coordinator (CAC), Mr. John Dovee, District Agriculture Coordinators (DAC) and Agricultural NGOs Officers in the county. The CAC said that the major farming activities in the county ranked in importance are: rice production, cash or tree crops (cocoa and coffee) production, groundnuts and cowpea bean production, and livestock production as the least. Rice as a staple food is produced to sustain the family and cash crops, groundnuts, cowpea beans, and livestock are produced mainly for income generation, even though little percentage is consumed by the households.

According to the CAC, his staffs have been unable to reach farmers in the various districts and clans because of lack of manpower (sufficient workers) in all agricultural sectors including livestock. Among his staff, there are no specialists to handle special cases; example, veterinary doctors, entomologists, plant breeders, and so on. In the entire county there is only one livestock technician, who is based in Voinjama City and never had any mobility (motorcycle or car) to go out to check on animals until April, 2011. Upon receipt of the motorcycle, the only animal technician started his tour to monitor, vaccinate and treat animals in Foya, Kolahun, Vahun, and Voinjama Districts yet with two clan technicians to assist him. However, according to him, some communities refused their animals to be vaccinated because ACF Livestock Officer sometimes ago vaccinated some over 100 animals and they all died. Besides ACF, other NGOs livestock officers did same. This created mistrust among farmers thereby denying the County Livestock Technician to vaccinate their animals. Another incident that caused many animals' deaths in the Voinjama District was the consumption of plastics that are indigestible. Farmers do not fence their animals; therefore when there is any disease outbreak, it spread to all the animals in that community. Lofa County has long border line with Republic of Guinea and Sierra Leone that need quarantine officers to monitor any livestock brought into the county for diseases, but lack of manpower cannot permit them to deploy staff to do such. They observed that many diseases are brought in towns or villages by imported new animals. This problem of insufficient staffs makes disease monitoring, control and treatment difficult leading to the deaths of many animals that could have been sold to improve the livelihoods of rural farmers through income generation and consumption of surplus.

He recommended that in order to improve the livestock sector in Lofa County and Liberia as a whole, firstly MOA must establish cattle ranges or bands because animals will easily be quarantined and treated when there is disease outbreak. To encourage such system of raising livestock, farmers or livestock owners have to found cooperatives, associations or farmers' unions to enable them bring their animals together in bands for easy monitoring, control and prevention of diseases. It is only Foya District that presently has a cattle range with 68 cattle heads owned by a cooperative. With this, farmers can be able to generate more income to improve their livelihoods and living standards through small ruminant production. Secondly MOA must establish cold storage for the storage of leftover slaughtered animals in each district to be preserved. Thirdly, MOA must increase the gas supply of district agriculture officers from 3 or 5 gallons to amount that may carry them for a month to enable them reach the farmers and help treat and prevent diseases. This can be done through seminars. Fourthly, MOA must work alongside Ministry of Public Works to rehabilitate feeder roads to enable agricultural staffs to reach the farmers. Feeder roads make agricultural produce to reach the market on time without spoiling or damaging. This improves rural livelihoods.

The CAC also elaborated on the various NGOs that are operating in the county in agricultural sector to improve the livelihoods of farmers. Those NGOs, their functions and locations are:

1. GIZ (formerly known as GTZ), located in the Foya District is rehabilitating swamps and building dams to supply water from those swamps during dry seasons for continuous rice production. Swamps that have built dams to preserve water throughout the year are used to produce rice 3 times a year. GIZ is also rehabilitating cocoa and coffee plantations, which serve as the one of the largest contributors to rural finances. Rice is grown to sustain their families while cocoa and coffee are grown for income generation.

2. ADRA-Liberia, located in Foya was also in livestock (small ruminants) restocking to farmers in the district, and now onto swamps rehabilitation to increase swamp rice production. Appendix 3 shows the percentage of farmers that ADRA supplied and trained in small ruminant management, healthcare and treatment of diseases.

3. ACDI/VOCA-Liberia, located in all the districts of Lofa County conducts farmer field school on cocoa production from planting to post-harvest

handling of the products. It also links cocoa farmers to markets or buyers and disseminates current cocoa price information to farmers (Dovee, 2011).

This NGO organizes farmers into farmer's associations or cooperative and trains them to improve their production through farmer field school (FFS) in 6 months. In this school, they learn financial management; bulk selling of their products to realize profit; and crop diversification (for examples, producing vegetables and swamp rice when cocoa production season is finished). After all the trainings, this NGO supplies 1,000 improved seedlings to each farmer to plant and extend their plantations, constantly inform those cooperatives or associations on the prices of cocoa to avoid the exploitation of farmers by middlemen and help farmers have direct contact of farmers to exporters and buyers of cocoa. For example, in Bomi County, cocoa was US$0.21 in 2008 and have increased to US$1.71 presently through the instrumentality of ACDI/VOCA. The objective of this Livelihoods Improvement for Farming Enterprises (LIFE) Project of ACDI/VOCA is to improve rural livelihoods through cocoa production since it is one of the major sources of rural finances in Liberia just as coffee (Tabolo, 2011).

4. Samaritan's Purse (SP), located presently in Foya, Kolahun and Voinjama Districts is restocking livestock (cattle, sheep and goats) and constructing fish ponds to build the rural livelihoods, the CAC explained. As seen in Appendix 3, 80% of the training of small ruminant farmers is conducted by SP. It trains farmers on production management of small ruminants and supplies a pair to each household in selected towns. Over the last seven years 2005-2010,

Samaritan's Purse Liberia has implemented projects addressing water, sanitation, and hygiene (WASH); health and nutrition; livelihoods, agriculture, livestock, and food; child protection and orphans and vulnerable children; infrastructure; education; and ministry (Carlson, 2010).

According to Vannie (2011), the objective of SP livestock project is to restock animals of rural inhabitants who lost their animals during the war; to empower farmers through livestock production; to increase income generation of rural farmers through the sale of animals; to minimize the killing of wildlife (poaching); to enlighten farmers on livestock farming as a business. He elaborated that during the 14-year civil war, the fighters killed and ate all the domestic animals in Liberia including the seldomly eaten animals, the domestic cats. It was based on this absence of domestic animals that farmers turn to consume wild animals and triggers the restocking program especially small ruminants, rabbits, and fish. The restocking by SP is done as follows:

> "conducted survey of previous livestock owners; selection of 25 farmers in each town and its villages; train selected farmers in basic animal production such as shelter construction, management, physical care of animals, semi-intensive system of animal keeping; mineral lick preparation (made from oyster shells, salts, cement or termite hills); the mineral licks are placed into to the shelters to encourage the animals going into the shelter by themselves; go to the Republic of Guinea and buy 6-7 month old animals for 25 farmers (5

> person in each group) in each town; give each farmer 2 female animals of choice between goats or sheep (55 animals total) but 1 male goat or sheep is given to each group head to service the 10 females of the group. Those 5 male animals are not for the community but for SP. Each farmer is to pay back 3 female animals to SP within 3 years. Those animals are then taken to another community and given to other group of farmers using the same protocol. After the distribution of the animals, 2 literate farmers are taken in each community and trained as animal health axillaries in oral drugs and muscular and intravenous drugs administration to treat those animals. SP animal specialists vaccinate the animals. It also creates a mini-pharmacy in each community to enable farmers buy drugs and treat their animals. The farmers put money together to buy drugs in their communities."

SP distributes West African Dwarf goats and sheep because they are adapted to the environment and are resistant to tropical diseases. According to him, other breeds that brought into the county from East and South Africa do not highly survive in the forest region and die of diseases such as trypanosomiasis from testes flies' bites, which are many in the forest regions like Liberia.

To further discourage rural farmers from poaching and fishing of wild fish, which is destroying our biodiversity, SP also built 6 fishponds through the church as a group in each selected community. The fishponds, which have 400 square meters areas each, are stocked with 1,200 fingerlings each. One fishpond is harvested each month until all the 6 are harvested in 6 months then the circle starts again. With this, the communities have fish throughout the year without destroying the wild fishes of Liberia (Vannie, 2011).

5. International Committee Red Crescent (ICRC), located in Kolahun, Voinjama, and QuarduBoundi Districts, is doing cocoa and coffee farms rehabilitation and supplies farmers with improved-and-high-yielding cocoa, coffee oil palm seedlings. This is to increase their productivity and subsequently to increase income generation capacity of rural farmers.

6. Vision in Action (VIA), located in Voinjama and Quandu Bondi Districts is in swamp rice production through giving technical services or advice (Dovee, 2011). VIA is realistically in swamp rehabilitation through the construction of spill ways and mini-dams as ADRA-Liberia to enable farmers produce swamp rice 3 times a year, especially 3 months rice variety. It also trains farmers and gives them improved rice seeds. These actions are to eradicate hunger and improve rural livelihoods of Liberians (Banks, 2011).

However, most of those NGOs sometimes implementing agricultural projects in the county do not sit with the CAC to identify districts or clans of needs and what are need for the people in the project areas. So, sometimes it becomes difficult to trace what each NGO is doing and where they are doing it (Dovee, 2011)

The key informant interview continued with the County Livestock Officer (CLO), after the County Agriculture Coordinator (CAC). The CLO started with disclosing the numerous problems that the livestock sector faces in the county. He said that the first most challenge is the inadequate staff to work in the entire county and clans in each district as district livestock technicians and clan livestock technicians. A county that had 6 livestock technicians prior to the 14-year civil conflict now has only 1 technician. Besides the lack of manpower, since he took office in 2006, it was only April 2011 that he was given a motorcycle to visit farmers and vaccinate animals. This lack of manpower, mobility and drugs served as impediments to the animal sector of the county. Presently, he has a motorcycle and 2 community animal health workers to visit communities that have disease outbreaks for treatment and unaffected communities for vaccination. According to him, some of the common diseases found in the visited communities are Peste des Petits Ruminants (PPR), foaming from the mouth (clinical sign of unknown disease to farmers), diarrhea, mange (skin disease) and foot rot. For the vaccination is ongoing in Foya, Kolahun, Quardu Bondi and Voinjama Districts one after another; however, Vahun District farmers refused their animals to be vaccinated because some NGOs' animal specialists vaccinated their animals in the past and they all died in 2007, 2009 and 2010 sequentially. Farmers need to be talked to before they accept their animals to be vaccinated. He gave the small ruminants population of Lofa as 10,000 estimated based on 2010 survey. According to his records, livestock come from the Republic of Guinea almost every day. In July 2011, 152 cattle, 64 goats and 38 sheep entered Lofa County from Guinea. This means that thousands of animals are brought into

Liberia from the neighboring countries because of the lack of animals for consumption and ceremonial purposes in the urban and rural areas. He finally emphasized that farmers in Lofa County depend on cocoa and coffee for income generation or livelihoods (Gbanue, 2011). Livestock provided farmers with sustainable source of protein and cash income. The bulk of the livestock products consumed in Liberia are imported either alive or frozen carcasses. Table 13 below shows the number of goats, sheep and cattle imported for the purpose of slaughtering from 1997-2000 in Liberia (Fannoh, 2001).

	Number of Animals			
year	**Cattle**	**Goats**	**Sheep**	**Total**
1997	1,541	250	200	1,991
1998	1,350	220	215	1,785
1999	1,546	480	2,280	4,306
2000	1,720	690	1,055	3,465
Total	6,157	1,640	3,750	20,153

Table 13: Livestock imported into Liberia: 1997-2000 (Source: Fannoh, 2001)

The Welt Hunger hilfe-Liberia also has an urban and peri-urban restocking program of livestock especially small ruminants, chickens, rabbits and Guinea pigs in Bomi County in which 2 females are given to each farmer in the selected communities. The purpose of this restocking program is to multiply them for farmers to consume domesticated animals as source of protein, sell the surplus to make generate income for the households, and to discourage poaching and fishing of wild fishes. Presently, many species of animals are now endangered; therefore they need to be preserved. They are training farmers to practise mixed farming in which crop production is mixed with animal production for sustenance. They also train farmers on the management of those animals and train one person in each group on diagnosis and treatment of common diseases. They supply the drugs while for SP the community buys the drugs. As SP, German Agro-Liberia buys from the Republic of Guinea and supplies the same breeds, the West African Dwarf goats and sheep, which are resistant to forest diseases. Even though the purpose is for farmers to consume and sell the surplus of those animals, Muslim population usually use small ruminants for ceremonial or sacrificial purposes. Therefore they must be talked to look at them as sources of protein and income (Stelder, 2011).

CHAPTER 6

CONCLUSION

The research was conducted with the objectives to determine the background characteristics of small-scale small ruminant farmers, small ruminants' contribution to household finances, management and marketing procedures and training needs of farmers. Based upon the analysis of the data, the hypotheses were either accepted or rejected. The first hypothesis that small ruminant production has no relationship with rural farmers income generation was rejected while alternative was accepted that small ruminant production had a significant relationship ($P<0.01$) with rural farmers' income generation. This means that small ruminant production contributes to rural household finances. Also, the second null hypothesis was rejected that small ruminant production does not significantly serve as sources of meat for rural farmers ($P<0.01$). Even though the percentage of production was low, small ruminants contributed to the rural farmers' households sources of meat because during all ceremonies (festivals, funerals, ritual sacrifices and so on), a goat or sheep was slaughtered for household consumption as source of meat. This rescued the farmers from spending extra money to buy beef for consumption during those occasions for the households. Although small ruminants were not used for daily household consumption, but, since they were used for all the occasions which occurred continuously, they served as one of the sources of meat for the rural farmers' households. Third hypothesis was also accepted that small ruminant production does not influence poaching significantly among rural farmers ($P<0.05$). The reasons can be attributed to low production, ceremonial uses and their sales for income generation, therefore cannot supply the entire household meat needs. This leads to poaching in order to meet up with the required household's meat needs. However, these conditions can be improved through training of farmers to increase their productivities and change their attitudes of consuming small ruminants as a daily source of meat for households' consumption.

The Liberian Government has a Poverty Reduction Strategy (PRS) plan that it uses to alleviate poverty. According to (Africa Community Publishing and Development Trust, 1996), poverty is the inability to afford a defined basket of consumption items (food and non-food) which are necessary to sustain life. Since 49.1% of the respondents lacks education or have 'no formal education' and 89.5% have not received training, the PRS becomes difficult to achieve its goal especially for the rural farmers can only receive education through trainings to enable them afford a defined basket of consumption items. Small ruminant production has the potential to improve rural livelihoods only if farmers have the requisite education and materials available for this sector. Land being abundant for rearing animals with plentiful forage throughout the year gives this rural enterprise the edge over competingother enterprises. With regular training sessions organize to upgrade rural farmers on their productivities, improved or better lives can be assured. Finally, small ruminants have the ability to convert forages into protein efficiently without any other supplement; therefore, if small-holder farmers can invest into them, they can realize more profit since they are not giving extra labor in rearing them.

CHAPTER 7

RECOMMENDATION

Based upon the findings of this research, the researcher wishes to recommend that the Government of Liberia through the MOA organize training for all rural farmers for all livelihood sectors: small ruminant production, crop production and other livestock production. Besides training, MOA should also assign animal health extension workers in various clans to assist farmers in rearing their animals. Since many farmers have undertaken most of the livelihood projects by themselves, they should be buttressed by the government by availing those things (veterinary services, new technologies or techniques of production) that they lack to get better returns from their farming operations. With increased productions, surplus food crops or animals can be sold to generate income that will improve their livelihoods and living standards. Finally, government and its partners must create rural employment opportunities to augment the people's strife for better living. These employment opportunities may also lead to minimization of rural-urban migration thereby decongesting the country's urban centers.

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APPENDIX I

QUESTIONNAIRE

A. FARMER CHARACTERISATION

	1. Date of visit:______________________		2. Respondent's #:___________	
	3. District:__________________________		4.Town:____________________	
	5.Clan:_____________________________		6. Contact number:___________	
	7. Status of respondent in the household: …………………………….....................		8. Age of respondent:	
	9. Sex of head of household: Male ☐ Female ☐		10.Level of education of respondent: No formal education ☐ 1 Elementary ☐ 2 Junior High ☐ 3 Senior High ☐ 4 Vocational ☐ 5 Tertiary ☐ 6	
	11. How many people stay in this household? ……………………………		12 What is the most important farming activity: Crop farming ☐ 1 Small ruminant production ☐ 2 Other livestock ☐ 3	
	13. What is your main source of income Small ruminants ☐ 1 Crop production ☐ 2 Other livestock ☐ 3		14. Any other household income sources: Salary and wages ☐ 1 Pension ☐ 2 Vending ☐ 3 remittances ☐ 4 Business ☐ 5 Other means ☐ 6	

B. LIVESTOCK CHARACTERISATION

15. Species			Total
	Male	Female	
Goats			
Sheep			

C. SMALL RUMINANTS MANAGEMENT

16.	Who owns the sheep and goats? Father ☐ 1 Mother ☐ 2 The family ☐ 3

17.	Who feeds the sheep and goats? Father ☐ 1 Mother ☐ 2 Sons ☐ 3 Daughters ☐ 4 Others (specify) ☐ 5......................................

18.	What kind of system do you use to keep your animals? Intensive ☐ 1 Extensive ☐ 2 Semi-intensive ☐ 3

19.	If it is intensive, what kind of housing do you use? Exotic (concrete blocks, cements, zinc, etc.) ☐ 1 Local (thatch/straw house ☐ 2 Others (specify): --

20.	What do you feed your animals with? Specify combinations Imported feed (concentrates) ☐ 1 Graze by themselves (forages/fodders)☐ 2 Concentrates (local) ☐ 3 Others (specify) ☐ 4……………………………

21.	Do you sometimes experience feed shortage? Yes ☐ 1 No ☐ 2

22.	What do you use to supplement if there is a feed shortage? Concentrates ☐ 1 Forages ☐ 2 Others (Specify) ☐ 3... Nothing ☐ 4

23.	What happens when there is feed shortage and no supplement? Animals die ☐ 1 Animals lose weights ☐ 2 Cull animals for sale ☐ 3 Slaughter for home consumption ☐ 4

24.	What are the contributing factors to sheep and goats losses? Disease ☐ 1 Inadequate feed ☐ 2 Thefts ☐ 3 Others (specify) ☐ 4...

25.	What are the major production constraints/problems? Inadequate feed ☐ 1 Reproduction ☐ 2 Breed type ☐ 3 Disease ☐ 4 Lack of technical support e.g. veterinary services ☐ 5 Insufficient knowledge on small ruminant production/training ☐ 6 Others (specify) ☐ 7

26.	Suggest what type of assistance you require to improve on your current production levels. ....

D. ECONOMIC SIGNIFICANCE OF KEEPING GOATS AND SHEEP

27.	Reasons for keeping goats and sheep (**Select all that applied**) Source of cash ☐ 1 Source of meat/protein ☐ 2 Ceremonial/socio-cultural ☐ 3 Other reasons (specify) ☐ 4

28.	What are your household sources of meat in order of importance Wild animals/hunting ☐ Fishing ☐ Purchase at market ☐ Goat and sheep produced ☐ Others (specify) ☐ • **Use numbers: 1, 2, 3, 4 & 5**

29.	If your capacity is built, thus leading to high animal production, will you still hunt wild animals or fishing Yes ☐ 1 No ☐ 2 Other (specify) ☐ 3..

30.	Cash obtained from sale of sheep and goats was used for (**Select all that applied**) School fees ☐ 1 Hospital bills ☐ 2 Food ☐ 3 Clothes ☐ 4 Others (specify) ☐ 5...

E. MARKETING

31.Where do you sell your livestock and type of sale?

Species	**Open market**	**Private sales**	**Abattoirs (slaughterhouse)**	**Other (specify)**
Goats				
Sheep				

32.	How frequently do you sell your sheep and goats in a year Once ☐ 1 Twice ☐ 2 Thrice ☐ 3 Other (specify) ☐ 4

33. Please give an estimate of the prices charged for each of the species

Species	Lowest price $	Highest prices $	Number of sale/year	Estimated income/year
Goats				
Sheep				

34.	What problems do you face during the purchase of small ruminants? High cost of animal ☐ 1 Long distance to market ☐ 2 Unavailability of transportation to market ☐ 3 High cost of transportation ☐ 4 Other (specify) ☐ 5...................................

35.	What problems do you face during the sale of small ruminants? Low prices ☐ 1 Long distance to market ☐ 2 No transportation ☐ 3 High cost of transportation ☐ 4 Other (specify) ☐ 5.................................

36.	How much do you derived from the following sources of income each year? Income from other livestock (L$)... Incomes from crop production (L$).. Income from non-agricultural activities (L$)... Remittances from friends and relatives (L$).. Other sources (specify)..

37.	How much do sales of sheep and goats contribute to household finances Less than 50% (Negligible/little) ☐ 1 50% (Significantly) ☐ 2 Above 50% (Highly significant) ☐ 3

F. VETERINARY SERVICES

38.	Do you have access to veterinary services in your community? Yes ☐ 1 No ☐ 2

39.	If yes, how often does he/she visit your household? Once a week ☐ 1 Once a month ☐ 2 Four times a year ☐ 3

40.	Do you pay for the services of the veterinary technician? Yes ☐ 1 No ☐ 2

41.	If yes, how much do you pay per year? Specify amount LD$............ US$.........

42.	Do you think the services of a veterinary technician are important? Yes ☐ 1 No ☐ 2

43.	Do you vaccinate your small ruminants? Yes ☐ 1 No ☐ 2

44.	Have you experience major disease outbreaks in the year against small ruminants? Yes ☐ 1 No ☐ 2

45.	Which kinds of diseases are prevalent in your community for small ruminants? 1... 2... 3... 4... 5...

46.	How do you treat these diseases? 1... 2... 3... 4... 5. ....

G. TRAINING IN SMALL RUMINANTS PRODUCTION

47.	Have you received any training in goat and sheep production Yes ☐ 1 No ☐ 2

48.	If yes, who trained you? Ministry of Agriculture ☐ 1 Local NGO ☐ 2 Specify........................ International NGO ☐ 3 Specify......................... Farmers' Union ☐ 4 Specify......................... Others (specify) ☐ 5.....................................

49.	When were you trained? Specify year and location Year .... Location ....

50.	What were you trained on? (**Select all applicable ones**.) Animal production ☐ . 1 Feed production & management ☐ 2 Disease prevention and control ☐ 3 Marketing ☐ 4 Other subjects specify ☐ 5............................

51.	Was the training beneficial? Yes ☐ 1 No ☐ 2

52.	What training do you think is relevant to your needs? ....

APPENDIX II

REFERENCE TABLES

Town of respondent	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
Porluma	24	16.1	0	0.0	0	0.0	24	100.0
Kornorsue	25	16.8	0	0.0	0	0.0	25	100.0
Solumba	25	16.8	0	0.0	0	0.0	25	100.0
Medicorma	25	16.8	0	0.0	0	0.0	25	100.0
Kwendemba	25	16.8	0	0.0	0	0.0	25	100.0
Worsongar	25	16.8	0	0.0	0	0.0	25	100.0
Kambolahun	0	0.0	25	17.3	0	0.0	25	100.0
Fassawolo	0	0.0	19	13.2	0	0.0	19	100.0
Korworhun	0	0.0	25	17.3	0	0.0	25	100.0
Popalahun	0	0.0	25	17.3	0	0.0	25	100.0
Kamatahun	0	0.0	25	17.3	0	0.0	25	100.0
Kiantahun	0	0.0	25	17.3	0	0.0	25	100.0
Kugbemai	0	0.0	0	0.0	25	17.2	25	100.0
Tobogizizu	0	0.0	0	0.0	25	17.2	25	100.0
Bazagizia	0	0.0	0	0.0	25	17.2	25	100.0
Kpademai	0	0.0	0	0.0	25	17.2	25	100.0
Balakpalasu	0	00	0	0.0	25	17.2	25	100.0
Gbegbeta	0	0.0	0	0.0	20	13.8	20	100.0
Total	149	100.0	144	100.0	145	100.0	438	100.0

Towns of respondents per district

Clan of respondent	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
Waum	74	49.7	0	0.0	0	0.0	74	16.9
Tengia	75	50.3	0	0.0	0	0.0	75	17.1
Tahamba	0	0.0	69	47.9	0	0.0	69	15.8
Hassala	0	0.0	75	52.1	0	0.0	75	17.1
Upper Workor	0	0.0	0	0.0	75	51.7	75	17.1
Bondi	0	0.0	0	0.0	70	48.3	70	16.0
Total	149	100.0	144	100.0	145	100.0	438	100.0

Clans of respondent per district

Sex	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	F	%	f	%	f	%
Male	110	77.8	111	77.1	114	78.6	335	76.5
Female	39	26.2	33	22.9	31	21.4	103	23.5
Total	149	100.0	144	100.0	145	100.0	438	100.0

Head of household's sex per district

Household size	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
1-3	2	1.3	6	4.2	13	9.0	21	4.8
4-6	44	29.5	44	30.6	47	32.4	135	30.8
7-9	55	36.9	47	32.6	54	37.2	156	35.6
10-12	28	18.8	28	19.4	20	13.8	76	17.4
13-15	11	7.4	11	7.6	7	4.8	29	6.6
16-18	1	0.7	2	1.4	2	1.4	5	1.1
19-21	3	2.0	2	1.4	1	0.7	6	1.4
25-27	1	0.7	3	2.1	1	0.7	5	1.1
28-30	2	1.3	0	0.0	0	0.0	2	0.5
>30	2	1.3	1	0.7	0	0.0	3	0.7
Total	149	100.0	144	100.0	145	100.0	438	100.0

Household size for the respondents per District

Respondent's level of education	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
No formal education	95	21.6	58	13.2	62	14.2	215	49.1
Elementary	14	3.2	18	4.1	29	6.6	61	13.9
Junior High	17	3.9	11	2.5	28	6.4	56	12.8
Senior High	13	2.9	23	5.3	16	3.7	52	11.9
Vocational	7	1.6	23	5.3	7	1.6	37	8.4
Tertiary	1	0.2	5	1.1	2	0.5	8	1.8

Respondent's level of education per district

The most important farming activity	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
Crop farming	143	32.6.0	130	29.7	141	32.2	414	94.5
Small ruminant production	6	1.4	9	2.1	2	0.5	17	3.9
Other livestock	0	0.0	4	0.9	0	0.0	4	0.9
Total	149	34.0	143	32.6	143	32.6	435	100.0

Most important farming activity of respondent per district

Ownership of goat and sheep	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	F	%
Father	41	27.7	57	39.9	55	37.9	153	35.1
Mother	14	9.5	13	9.1	19	13.1	46	10.6
Family	88	59.5	66	46.2	68	46.9	222	50.9
Son	3	2.0	6	4.2	2	1.4	11	2.5
Daughter	1	.7	0	0.0	1	.7	2	0.5%
The town	1	.7	1	.7	0	0.0	2	0.5
Total	148	100.0	143	100.0	145	100.0	436	100.0

Ownership of goat and sheep per district

Number of goats	District of respondent							
	Foya		Kolahun		Voinjama		Total	
	frequency	%	frequency	%	frequency	%	frequency	%
1.00	92	15.5	50	8.4	58	9.8	200	33.7
2.00	61	10.3	57	9.6	81	13.6	199	33.5
3.00	36	6.1	11	1.8	47	7.9	94	15.8
4.00	15	2.5	6	1.0	32	5.4	53	8.9
5.00	4	0.7	1	0.2	11	1.9	16	2.7
6.00	3	0.5	0	0.0	12	2.0	15	2.5
7.00	1	0.2	1	0.2	3	0.5	5	0.8
8.00	1	0.2	2	0.3	2	0.3	5	0.8
10.00	1	0.2	1	0.2	1	0.2	3	0.5
12.00	1	0.2	0	0.0	0	0.0	1	0.2
13.00	1	0.2	0	0.0	0	0.0	1	0.2
18.00	1	0.2	0	0.0	0	0.0	1	0.2
20.00	1	0.2	0	0.0	0	0.0	1	0.2
Total	218	37.0	129	21.7	247	41.6	594	100.0

Number of goats per district

Number of sheep	District of respondent							
	Foya		**Kolahun**		**Voinjama**		**Total**	
	Frequency	%	frequency	%	frequency	%	frequency	%
1.00	36	13.9	52	20.1	26	10.0	114	44.0
2.00	17	6.6	35	13.5	17	6.6	69	26.7
3.00	10	3.9	21	8.1	10	3.9	41	16.0
4.00	3	1.2	9	3.5	6	2.3	18	7.0
5.00	2	0.8	3	1.2	0	0.0	5	2.0
6.00	2	0.8	1	0.4	1	0.4	4	1.6
7.00	0	0.0	1	0.4	0	0.0	1	0.4
8.00	0	0.0	1	0.4	0	0.0	1	0.4
9.00	0	0.0	1	0.4	0	0.0	1	0.4
12.00	1	0.4	0	0.0	0	0.0	1	0.4
13.00	0	0.0	0	0.0	1	0.4	1	0.4
15.00	0	0.0	1	0.4	0	0.0	1	0.4
20.00	0	0.0	1	0.4	0	0.0	1	0.4
24.00	1	0.4	0	0.0	0	0.0	1	0.4
Total	72	28.0	126	48.8	61	23.6	259	100.0

Number of sheep per district

Number of small ruminants	District of respondent							
	Foya		Kolahun		Voinjama		Total	
	frequency	%	frequency	%	frequency	%	frequency	%
1.00	128	15.0	102	11.9	84	9.8	314	36.8
2.00	78	9.1	92	10.8	98	11.5	268	31.4
3.00	46	5.4	32	3.8	57	6.7	135	15.8
4.00	18	2.1	15	1.8	38	4.5	71	8.3
5.00	6	0.7	4	0.5	11	1.3	21	2.5
6.00	5	0.6	1	0.1	13	1.5	19	2.2
7.00	1	0.1	2	0.2	3	0.4	6	0.7
8.00	1	0.1	3	0.4	2	0.2	6	0.7
9.00	0	0.0	1	0.1	0	0.0	1	0.1
10.00	1	0.1	1	0.1	1	0.1	3	0.3
12.00	2	0.2	0	0.0	0	0.0	2	0.2
13.00	1	0.1	0	0.0	1	0.1	2	0.2
15.00	0	0.0	1	0.1	0	0.0	1	0.1
18.00	1	0.1	0	0.0	0	0.0	1	0.1
20.00	1	0.1	1	0.1	0	0.0	2	0.2
24.00	1	0.1	0	0.0	0	0.0	1	0.1
Total	290	33.8	255	30.0	308	36.1	853	100.0

Total Number of small ruminants per district

Other sources of household income	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	F	%
Business	73	34.9	39	18.7	60	28.7	172	82.3
Black smith	0	0.0	3	1.4	3	1.4	6	2.9
Tailor	0	0.0	3	1.4	5	2.4	8	3.8
Carpenter	0	0.0	5	2.4	8	3.8	13	6.2
Manson	0	0.0	1	0.5	9	4.3	10	4.8
Total	73	34.9	51	24.4	85	40.6	209	100.0

Other sources of household income of respondents per district

Contribution of goats and sheep to household finances	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
< 50% (negligible/little	79	53.4	71	51.4	101	70.1	251	58.4
50% (significantly)	51	34.5	55	39.4	40	27.8	164	34.0
> 50% (highly significant)	18	12.2	12	8.7	3	2.1	33	7.7
Total	148	100.0	138	100.0	144	100.0	430	100.0

Contribution of goats and sheep sales to household finances per district

Supplements used during feed shortage	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
Concentrates	22	9.8	17	3.9	18	4.1	57	17.1
Forages	45	10.3	63	14.4	33	7.5	141	32.2
Others	20	4.6	6	1.4	0	0.0	26	5.9

Uses of cash obtained from the sales of goat and sheep by respondents per district

Uses of cash obtained from the sales of goat and sheep	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
School fees	139	31.7	132	30.4	140	31.9	411	93.8
Hospital bills	104	23.7	106	24.2	105	23.9	315	71.9
Food	23	5.3	39	8.9	80	18.3	142	32.4
Clothes	33	7.5	22	5.0	96	21.9	151	34.5
Others	16	3.7	30	6.8	4	0.9	14	3.2

Supplements used during feed shortage by farmers in each District

% Contributions	Small ruminants		Crop production		Other Livestock		Non-agric. activities	
	f	%	f	%	f	%	f	%
>10	83	20.8	59	15.1	188	68.4	324	76.8
10-19	21	5.3	34	8.7	46	16.7	17	4.0
20-29	48	12.0	58	14.9	20	7.3	21	5.0
30-39	54	13.5	48	12.3	9	3.3	20	4.7
40-49	52	13.0	45	11.5	5	1.8	12	2.8
50-59	41	10.3	44	11.3	2	0.7	7	1.7
60-69	32	8.0	34	8.7	1	0.4	7	1.7
70-79	20	5.0	19	4.9	4	1.5	5	1.2
80-89	24	6.0	15	3.8	0	0.0	5	1.2
>89	25	6.3	34	8.7	0	0.0	4	0.9
Total	400	100.0	390	100.0	275	100.0	422	100.0

Contribution of small ruminants, crops, other livestock and non-agricultural activities to household income

Income from other livestock (US$)	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
<20	48	61.5	54	74.0	70	56.5	172	62.5
20-39	12	15.4	11	15.1	31	25.0	54	19.6
40-59	6	7.7	4	5.5	15	12.1	25	9.1
60-79	3	3.8	0	0.0	2	1.6	5	1.8
80-99	3	3.8	0	0.0	3	2.4	6	2.2
100-119	2	2.6	4	5.5	0	0.0	6	2.2
120-139	1	1.3	0	0.0	0	0.0	1	0.4
140-159	1	1.3	0	0.0	0	0.0	1	0.4
>150	2	2.6	0	0.0	3	2.4	5	1.8
Total	78	100.0	73	100.0	124	100.0	275	100.0

Income from other livestock per district

Income from crop production (US$)	District of respondent						Total	
	Foya		**Kolahun**		**Voinjama**			
	f	%	f	%	f	%	f	%
< 20	28	20.9	18	14.6	8	5.8	54	13.6
20-39	20	14.9	15	12.2	5	3.6	40	10.1
40-59	17	12.7	21	17.1	12	8.6	50	12.6
60-79	14	10.4	11	8.9	8	5.8	33	8.3
80-99	7	5.2	5	4.1	19	13.7	31	7.8
100-119	12	9.0	4	3.3	39	28.1	55	13.9
120-139	4	3.0	4	3.3	1	0.7	9	2.3
140-159	13	9.7	16	13.0	25	18.0	54	13.6
>150	19	14.2	29	23.6	22	15.8	70	17.7
Total	134	100.0	123	100.0	139	100.0	396	100.0

Income from crop production per district

Income from non-agricultural activities	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
<20	3	17.6	6	13.6	18	23.7	27	19.7
20-39	1	5.9	3	6.8	11	14.5	15	10.9
40-59	4	23.5	6	13.6	8	10.5	18	13.1
60-79	1	5.9	3	6.8	3	3.9	7	5.1
80-99	2	11.8	2	4.5	3	3.9	7	5.1
100-119	1	5.9	6	13.6	2	2.6	9	6.6
140-159	0	0.0	3	6.8	10	13.2	13	9.5
>150	5	29.4	15	34.1	21	27.6	41	29.9
Total	17	100.0	44	100.0	76	100.0	137	100.0

Income from non-agricultural activities per district

Income from remittances	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
< 20	1	100.0	0	0.0	52	72.2	53	71.6
20-39	0	0.0	0	0.0	13	18.1	13	17.6
40-59	0	0.0	0	0.0	3	4.2	3	4.1
80-99	0	0.0	0	0.0	1	1.4	1	1.4
100-119	0	0.0	0	0.0	1	1.4	1	1.4
>150	0	0.0	1	100.0	2	2.8	3	4.1
Total	1	100.0	1	100.0	72	100.0	74	100.0

Income from remittances from friends and relatives per district

Contributing factors sheep and goat losses	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
Disease	112	25.6	73	16.7	24	5.5	209	47.7
Inadequate feed	17	3.9	42	9.6	4	0.9	63	14.4
Thefts	24	5.5	24	5.5	111	25.3	159	36.3
Snakes bite/swallow them	19	4.3	3	0.7	1	0.2	23	5.3
Wild animals eat them	3	0.7	1	0.2	13	2.9	17	3.9
Car accidents kill them	0	0.0	6	1.4	14	3.2	20	4.6
Others	1	0.2	10	2.3	0	0.0	11	2.5

Contributing factors sheep and goat losses per district

Mode of treatment	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
Vaccinated animals	8	1.8	16	3.7	1	0.2	25	5.7
Washed & put gas/ fuel oil in affected hooves	2	0.5	20	4.6	1	0.2	23	5.3
Washed and applied oil palm to itch	5	1.1	7	1.6	9	2.1	21	4.8
Others	16	3.7	32	7.3	1	0.2	49	11.2

Mode of treatment of diseases per district

Importance of veterinary technician services	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
No	14	9.5	14	9.9	8	5.6	36	8.4
Yes	133	90.5	127	90.1	135	94.4	395	91.6
Total	147	100.0	141	100.0	143	100.0	431	100.0

Importance of the services of veterinary technician important per district

	District of respondent						Total	
	Foya		Kolahun		Voinjama			
training beneficial	f	%	f	%	f	%	f	%
Yes	4	100.0	34	100.0	2	100.0	40	100.0
Total	4	100.0	34	100.0	2	100.0	40	100.0

Benefit of training per district

Year of training	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
2006	2	50.0	1	2.7	0	0.0	3	7.0
2008	2	50.0	1	2.7	0	0.0	3	7.0
2010	0	0.0	20	54.1	0	0.0	20	46.5
2011	0	0.0	15	40.5	0	0.0	15	34.9
2007	0	0.0	0	0.0	1	50.0	1	2.3
1976	0	0.0	0	.0	1	50.0	1	2.3
Total	4	100.0	37	100.0	2	100.0	43	100.0

Time (year) of training per district (arrange the rows according to the years)

Trainers of small ruminants farmers	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
Local NGO	0	0.0	0	0.0	1	50.0	1	2.4
International NGO	4	100.0	34	94.4	1	50.0	39	92.9
Relative or friend	0	0.0	2	5.6	0	0.0	2	4.8
Total	4	100.0	36	100.0	2	100.0	42	100.0

Trainers of small ruminants' farmers per district

Location of training Sites	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	f	%	f	%	f	%
Kornorsue Town	2	66.7	0	0.0	0	0.0	2	4.8
Korworhun Town	0	0.0	18	48.6	0	0.0	18	42.9
Kiantahun	0	0.0	6	16.2	0	0.0	6	14.3
Foya City	1	33.3	0	0.0	1	50.0	2	4.8
Bapulo Town	0	0.0	1	2.7	0	0.0	1	2.4
Vahun	0	0.0	1	2.7	0	0.0	1	2.4
Bolahun	0	0.0	1	2.7	0	0.0	1	2.4
Kiafata	0	0.0	7	18.9	0	0.0	7	16.7
Gokorhun	0	0.0	1	2.7	0	0.0	1	2.4
Kamatahun Town	0	.0	2	5.4	0	0.0	2	4.8
Voinjama	0	0.0	0	0.0	1	50.0	1	2.4
Total	3	100.0	37	100.0	2	100.0	42	100.0

Location of training per district

Frequency of veterinarian visit to household	District of respondent						Total	
	Foya		Kolahun		Voinjama			
	f	%	F	%	f	%	f	%
Once a week	0	0.0	3	7.9	0	0.0	3	6.3
Once a month	0	0.0	2	5.3	2	66.7	4	8.3
Twice a month	2	28.6	5	13.2	0	0.0	7	14.6
Thrice a year	0	0.0	6	15.8	0	0.0	6	12.5
four times a year	0	0.0	2	5.3	0	.0	2	4.2
Available every time	1	14.3	5	13.2	0	0.0	6	12.5
Once a year	4	57.1	10	26.3	1	33.3	15	31.3
Twice a year	0	0.0	5	13.2	0	0.0	5	10.4
Total	7	14.6	38	79.2	3	6.2	48	100.0

Frequency of visit of veterinary technician to household per district

	District of respondent						Total	
	Foya		Kolahun		Voinjama			
Subjects/topics trained on	f	%	f	%	f	%	f	%
Animal production	1	0.2	28	6.4	1	0.2	30	6.8
Feed production & management	1	0.2	33	7.5	1	0.2	35	7.9
Disease prevention & control	3	0.7	14	3.2	1	0.2	18	4.1
Marketing	0	0.0	8	1.8	0	0.0	8	1.8
Shelter construction	1	0.2	2	0.5	0	0.0	3	0.7

Subjects/topics trained on per district

APPENDIX III

Budget and Logistics

The tables below show the summary and detailed budgetary costs for the project.

Items	**Quantity**	**Unit Price US Dollars**	**Total US Dollars**
Research assistants	2 persons	$5.00/day for 14 days	$140.00
Motorcycle	1 (TADCO) Motorcycle	690.00	690.00
Operating cost for one motorcycle	13 gal. fuel, 3 liter of oil, & maintenance	$79.85	$79.85
Three-in-one photocopier and sheets	1 Copier & 5 reams of sheets	$420.00	$420.00
Printing 6 copies of 150 pages	6 copies	$65.375/copy X 6	$392.25
Binding 6 copies of 150 pages	6 copies	43.75/copy X 6	$262.50
Hp Laptop	1 piece	$571.42/laptop	$571.42
Compact 103 Camera	1 Camera	$135.71 X 1	$135.71
Lodging, food and transportation	3 persons	$200.00	$200.00
Total			**2,891.73**
Miscellaneous **5%** of total			$144.58
Grand Total			**$3,036.31**

Summary budget

Items	**quantity**	**Unit price USD**	**Cost price USD**	**Total Cost USD**
Research Assistant	1person	$5.00/day	$5.00/day X 14 days	$70.00
Motorcycle Rider and repairer/ research assistant	1 person	$5.00/day	$5.00/day X14 days	$70.00
Subtotal				**$140.00**
Motorcycle	1(TADCO) Motorcycle	$690.00	$690.00	690.00
Gas Cost for Motorcycle	Monrovia to Voinjama, Kolahun and Foya clans and back 13 gallons	$4.14/ gallons	$4.14 X 13 gallons	$64.85
Lubricating oil	3 liters	$5/liter	$ 5 X 3	$15.00
Subtotal				**769.85**
Three-in-one photocopier	1 piece	$400.00 for one	$400.00 X1	$400.00
Hp Laptop	1 Piece	$571.42/laptop	$571.42 X 1	$571.42
Compact 103 Camera	1 Camera	1 Camera	$135.71 X 1	$135.71
Reams of sheet	1 Cartoon	$20.00/cartoon	$20.00 X 1	$20.00
Printing	6 copies	$65.375/copy	$65.375 X 6	$392.25
Binding	6 copies	$43.75/copy	43.75 X 6	262.50
Subtotal				**1,781.88**
Lodging and food	3 persons		200.00	$200.00
Transportation	2 trips	$20.00	$20.00	$20.00
Subtotal				**$220.00**
Total				2,891.73
Miscellaneous **5%** of total				$144.58
Grand Total				**3,036.31**

Detailed Budget