SOCIO-ECONOMIC IMPACT OF SMALLHOLDER FREE RANGE LOCAL CHICKEN (FRLC) IMPROVED HUSBANDRY SYSTEM: A CASE STUDY OF RURAL MOROGORO

BY

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ABSTARCT

Ways and means to improve free range local chicken (FRLC) production have been studied in Tanzania, however the economic contribution of the improved FRLC production is still unknown. Hence, this study investigated on the impact of the free-range local chicken production improvement program on farmers' Socio-economy. Specifically, the study aimed at: (i) evaluating the socio-economic characteristics influencing the interventions, (ii) evaluating the impact of the interventions on the level of knowledge, attitude and practices that respondents acquired for enhancing FRLC productivity, and (iii) exploring the intervention effects on smallholders' FRLC productivity. The study used both primary and secondary data, and a random sample of project respondents were interviewed with a corresponding number of non-project respondents as a control group. Then both qualitative and quantitative analyses were performed. The study concludes that the interventions had no significant impact not only on the FRLC production but also on the farmer's socio-economy. However, the project participants had increased their total household income by 0.5% due to the increased production in FRLC and eggs. Also, the interventions had a statistical significant impact on; the practices towards disease control and breeding; the change of knowledge in Feeding, disease control and breeding; and on the change in FRLC management practices. Education, income, cropping pattern and FRLC farm-gate price were the characteristics, which affected the adoption of the interventions ($P<0.05$). While inputs on disease control were the most economical, inputs on other aspects showed a decrease in net-return. The study recommends that the farmer's socio-economic status should be considered before the implementation of an intervention. The implication of these findings is that intervention packages should be coupled with economic incentives such as credit facilitation, social-economic groups and market access.

DECLARATION

I, Roselyne Alphonce, do hereby declare to the Senate of Sokoine University of Agriculture that this work is my own original work and has neither been submitted nor being currently submitted for a degree award in any other University.

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DEDICATION

This work is dedicated to my beloved husband. You made it possible, thank-you. To my mother who has always been there for me.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
BPM	Bangladesh Poultry Model
Etc	Etcetera
FRLC	Free Range Local Chicken
GDP	Gross Domestic Product
GoB	Government of Bangladesh
IHEPRUCA	Improvement of Health and Productivity of Rural Chicken in Africa
Kg	Kilograms
Km	Kilometers
KVL	The Royal Agriculture and Veterinary University
LSD	Least Significant Difference
ND	Newcastle Disease
SNAL	Sokoine National Agricultural Library
SUA	Sokoine University of Agriculture
Tshs	Tanzanian shillings
USD	US Dollars

CHAPTER ONE

INTRODUCTION

1.1 Background information

Tanzania with a human population of 36.2 million in 2005 is endowed with 39.5 million hectares of arable land for agriculture (Economic survey, 2005). Agriculture is the backbone of the Tanzania's economy, the sector accounts for an average of 46.7% of the GDP, provides 75% of the export earnings and employs 84% of the total workforce, and that 93% of the smallholders live on land holdings of less than two hectares (Economic survey, 2005). Seventy percent of livestock GDP originates from cattle, and 30% from other livestock including poultry, which contribute about 16% (Boki, 2000; Melewas, 1989). In Tanzania, recent estimates show that there are approximately 30 million FRLC (Economic survey, 2005). About 2.5 million (72%) households, out of 3.7 million agriculture households, keep a total of 30 million chickens with an average of 23 chicken per household (Economic survey, 2005).

It is estimated that the poultry industry of Tanzania is worth Tshs 40.5 billion (USD 50.6 million) (Boki, 2000; Minga *et al.*, 2000; World Bank, 1994). The industry is divided into the traditional poultry production and the commercial poultry production. The traditional poultry sector is the largest as it contributes about 70% of the total flock (Boki, 2000; Minga *et al.*, 2000; World Bank, 1994). The traditional sector supplies 100 percent of poultry meat and eggs consumed in the rural areas and 20% consumed in the urban areas (Melewas, 1989).

This study was done under the auspices of a project called the improvement of Health and Productivity of the Rural Chicken in Africa (IHEPRUCA). The project aimed at increasing productivity of FRLC through health management interventions. The FRLC production improvement program involved the introduction of local Newcastle disease (ND) vaccines and *Aloe spp* for treating diseases and training smallholders in general disease and production management methods.

1.2 Problem statement

Rapid increase in population and urbanisation, and improvement in economic growth increase domestic demand for livestock products (Kristense *et al.*, 2004). Thus, these factors suggest an increase of opportunities for FRLC production in Tanzania. However, the traditional ways of keeping FRLC in Tanzania cannot sustain the livelihood of the household, because the off-take is very low. There is hardly any surplus due to FRLC low genetic potential and high mortality rate (Minga *et al.*, 2000). However, ways and means to improve FRLC production have been studied on aspects pertaining to housing (Minga *et al.*, 1989), feeding (Mwalusanya *et al.*, 2002), breed improvement (Katule, 1990) and disease control (Minga *et al.*, 1989). But to improve productivity one has to move from scavenging to semi-scavenging system, which requires financial capital and human capital investment through education and training (Udo *et al.*, 2001). It is important to involve technical, economic and institutional changes in improving FRLC productivity. But the economic contribution of the improved FRLC production system to smallholder farmers is unknown. Hence, it was the purpose of this study to do a cost-benefit analysis to find out the economic contribution of the improved FRLC production system, and to assess the sustainability of the FRLC production improvement programs.

1.3 Justification of the study

FRLC have faster multiplication capacity, can survive on leftovers, can eat grasses, seeds and insects, and can convert cheaply available crop materials to high quality protein which enable them to survive into different geographical locations (Melewas, 1989; Kabatange and Katule, 1989). FRLC is an ideal livestock for smallholders because of the small individual requirement for feed, water and other production inputs. FRLC has enormous socio-economic importance to the agricultural smallholder in terms of poultry products, income generations and in bartering chicken (initial investment or entry point) for other livestock. The experiences in Bangladesh and Malawi have shown that FRLC can benefit rural livelihoods, and especially women (Nielsen, 1996; Saleque and Mustafa, 1997; Huque *et al.*, 1999; Dolberg, 2001; Ahamed, 2002).

1.4 Objectives

1.4.1 General objective

The general objective of this study was to investigate the impact of the FRLC production improvement program on farmers' Socio-economy.

1.4.2 Specific objectives

i. To examine the of smallholders' characteristics that influence the interventions and FRLC productivity.

ii. To examine the effect of the interventions on the level of knowledge, attitude and practices that smallholders pose for enhancing the productivity of FRLC.

iii. To explore the intervention effects of ND vaccinations, treating with *Aloe spp*, and training in general, on disease and production management methods on smallholders' FRLC productivity.

1.5 Hypotheses

i. The characteristics of smallholders keeping FRLC have a significant influence on the FRLC production improvement program.

ii. The intervention program has a significant influence on change of knowledge, attitude and practices of smallholders for enhanced productivity of FRLC.

iii. The FRLC production improvement program has a significant effect on smallholders' FRLC production.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

Poultry production systems in developing countries are classified into three groups namely, scavenging (backyard), semi-scavenging (semi-intensive) and intensive (industrial) (Kitalyi, 1998). But the most dominant production systems are the scavenging (backyard) system and the semi-intensive system, which have developed recently with higher input and output (Kitalyi, 1998).

2.2 Characteristics of the free-range system of production

The free-range system is synonymous to scavenging, rural, traditional and backyard production system (Pandey, 1992). In this system, the farmer makes no attempt to control the flock's food or water intake, although he or she may occasionally throw food scraps or a handful of grain onto the flock (Kabatange and Katule, 1989; Gunaratne *et al.*, 1993; Dessie, 1996). Availability of feeds for free-range chicken depends mainly on scavenging household refuse, herbage, seeds and insects around the homestead. The farmer provides no sanitation and no disease control measures such as vaccinations (Minga *et al.*, 1989). Losses, especially of chicks due to diseases, predators and theft are high, hence the performance of these chicken is generally low (Pandey, 1992).

Studies show that well fed free-range chicken seldom suffer from nutritional deficiencies and diseases (Ologhobo, 1990), they also have a natural disease resistance potential (Msoffe *et al.*, 2003). Payne (1990) reported that a free range-system requires an area of

between five and eight meter square per chicken for good nutrition. However, the major advantage of this system is that, there is little or no inputs used as the birds acquire most of their diet from the surroundings (Kitalyi, 1997).

2.3 Feeding and nutrition of FRLC

Several researches done in Tanzania and other parts of the world have found that there is poor FRLC nutritional status for optimum growth and egg production. The study on the nutritional status of crop contents of local chicken in Tanzania revealed that the dietary status of local chicken varied according to season, age and zone (Mwalusanya *et al.*, 2002). It was found that the difference in nutritional status probably corresponds with the difference in the availability of feeds on the surroundings. The availability of feeds in the surroundings varies with season, climate of the area, and with whether it is a planting or harvesting season (Mwalusanya *et al.*, 2002). A study on the performance of growing and laying chicken in cafeteria and balanced feeding in Bangladesh under semi-scavenging conditions recommends that feeding levels should be adjusted to season, giving less supplementation during harvest, where scavenging feeds are readily available in the fields (Das, 2005).

The study by Minh *et al.* (2004) found out that feed (bran) given to chicken could not supplement the deficiencies observed especially with regard to calcium. The study recommended for the variation in nutritional status according to season and climate when planning to improve feeding standards for local chicken. In Northern Vietnam, a study on the effect of scavenging and protein supplement on the feed intake and performance of improved pullets and laying chicken, found that pullets and layers were getting about 28%

and 22% respectively of their nutrients requirement from scavenging feed sources, while a similar study done by (Gunaratne *et al.*, 1993) in Sri Lanka showed that village chicken were getting 72% of its daily nutritional requirement from scavenging feed sources.

However various authors have suggested that, through scavenging, chicken meet their requirement for vitamins and minerals and some of their protein requirements but not their requirement for energy (Hutchzermeyer, 1973; Roberts, 1999). In Zimbabwe, a study on free ranging hybrid chicken under smallholder conditions, showed an improved production on supplementation of some form. A production of 170 eggs per bird per year was observed when the free-range chicken were supplied with 75g of maize per chicken, together with better management and disease control (Hutchzermeyer, 1973).

2.4 Poultry disease

In a study about the poultry industry in Tanzania (Boki, 2000), it was reported that poultry diseases are a major constraint to the quick increase in chicken production. The study found out that, Newcastle disease (ND), fowl typhoid and infectious coryza, are the major poultry diseases in Tanzania. In a similar study on the disease trends and prospects of reducing losses in FRLC in Tanzania, (Muhairwa *et al.*, 2001) reported that fowl pox, infectious coryza, Newcastle disease (ND), Marek's disease, chicken infectious anemia and ectoparasites are the causes of mortalities; but chicken infectious anemia and Marek's disease were reported for the first time in FRLC. A study on poverty alleviation through free-range poultry improvement, which was done in Uganda, reported that the poor productivity of FRLC was caused by extremely high mortalities due to diseases and predators. Also on a survey on village chicken losses in Africa, farmers mentioned

Newcastle disease (ND) as the main source of chicken loss (Kusina *et al.*, 2001). And on the study on FRLC on the Accra plains of Ghana. 80% of the respondents mentioned Newcastle disease (ND) as the most important health issue (Aboe *et al.*, 2006). Other constraints pointed out in these studies include poor feeding, poor housing and marketing (Mukiibi-Muka *et al.*, 2000).

2.5 Disease treatments

There have been some evaluations on the efficiency of the crude extracts of *Aloe secundiflora* in chicken disease (Waiheya *et al.*, 2002a,b). An experiment done on this aspect revealed a reduced mortality rate and the severity of clinical signs during the acute phase of infection in *Aloe* treated chicken compared to the non-treated ones. However, there was no significant effect of the *Aloe* on the antibody levels that were attributed to the recovery of the surviving chicken (Waiheya *et al.*, 2002a). Another experiment, which investigated the efficiency of the crude extract of *Aloe secundiflora* on fowl typhoid in FRLC, indicated that the extract of *Aloe secundiflora* was useful in the control of fowl typhoid in chicken (Waiheya *et al.*, 2002b).

A study on the smallholder poultry production in Malawi (Kampeni, 2000) reported that Newcastle disease (ND) was controlled by the use of Lasota vaccine;, but its performance in the rural areas is not effective because its packed in large quantities (e.g. in a viral of 1000 doses) and it needs to be stored in refrigerators. Nyange (2000) did a similar study on the smallholder poultry production in Kenya and observed that although vaccines were produced in the country, farmers did not access the vaccines due to financial constraints, as the viral drugs were packed and sold in large quantities. Also Njue *et al*, (2001) on a

survey of the disease status of village chicken in Kenya, reported that rural poultry rears were ill equipped with the knowledge on advantages of vaccination, he reported that, in spite of the availability of vaccines, the village chicken farmers didn't fully use them due to lack of awareness, large quantities per viral which are not commensurate with the small flock size.

2.6 Housing and shelter for FRLC

Host (1990) emphasized on the importance of housing in protecting FRLC against disease, predators, adverse temperatures, radiation, rain, and chilling weather. He suggested that the construction of houses be in such a way that they are easy to clean, well-ventilated and cheap to construct. Most studies of FRLC production have indicated housing as a problem area for being in a rather poor state, the housing observed ranged from no housing at all, whereby chicken roost on trees or roof tops of houses, to simple shelters (Matthewman, 1977; Wilson *et al.*, 1987; Minga *et al.*, 1989; Gunaratne *et al.*, 1993; Minga *et al.*, 1996; Yongolo, 1996; Mwalusanya *et al.*, 2001). Poor quality shelter, which is mostly used at night, is made from local building materials such as tree poles and thatch grass. Such shelters are usually small with a door just enough for chicken to pass (Matthewman, 1977; Kuit *et al.*, 1986). Chicken are also kept in kitchens or human quarters at night or covered in woven baskets (Yongolo, 1996). Njue *et al.* (2001) suggested that the designing of village chicken housing would go a long way into controlling parasitic disease and losses associated with predation.

2.7 Breed selection

Studies conducted in different countries show that FRLC breeds share the following characteristics: slow growth rate, poor egg production, the habit of broodiness, good meat and egg quality, and resistance to some diseases (Kitalyi, 1998). In Bangladesh, the cross breed of Sonali (Rhode island x Fayoumi) showed the best performance, it had the highest egg production, lowest mortality and highest profit per hen among eight breed combination under rural conditions (Rahman *et al.*, 1997). However, feed supplementation was required to increase productivity, showing that nutrition had a grater effect on productivity than genetic factors (Bessei, 1989).

2.8 Factors influencing FRLC production system

The FRLC production system is very complex and is controlled by a number of factors namely: - Environment, farmer's management and decision making, market situation, and farmers characteristics.

2.8.1 Environment

Village chicken scavenge in the vicinity of the household to find their own feed. For good nutrition, health and growth, the chicken are very dependent on the amount and quality of feed available in the area.

Rahman *et al.* (1997), in a study on the effect of cropping patterns on egg production of hybrid hens in semi-scavenging conditions, observed that feed availability in the area depends on climatic conditions. The climatic conditions have an impact on the vegetations and insects available for feeding. The study also found that, the farming system, which

depends on the type of crops grown and the intensification level, has an effect on the edible grain spillage in the fields as well as the amount of vegetation cover. The number of chicken and species of other livestock in the farming system influence the level of competition for feeds and water, and the number of predators in the area affects chicken survival. However, sufficient feeding available for scavenging depends on the area's capacity, which is influenced by factors such as cropping patterns and the density of birds.

In Nicaragua, the peasants farming system comprised mainly crop production and the keeping of cattle or pigs. Also, most poultry peasants mainly kept scavenging chicken, which were fed additional sorghum grown on the farm. An on-farm study was done in Nicaragua on supplementing poultry diet with tree leaves or seeds of *Cresentia alata* by mixing with sorghum. The results of this study showed an increase in flock size in years of good harvest (Kyvsgaard and Urbina, 1996).

2.8.2 Farmer's management and decision

The level of chicken production is highly dependent on the farmer's management level, which includes supplementing chicken with feed and water, provision of shelter and the prevention or cure of diseases. However, in Pedersen and Kristensen's (2004) study on the dynamic modeling of traditional African chicken production system, farmer's management and the production level of chicken were associated with financial cost, where the farmers were always concerned with whether the increased production could cover the cost. Farmer's decision making covers the destiny of eggs and chickens, that is, whether the eggs are hatched, sold or consumed and, similarly, whether the chicken are sold, consumed, used as gifts or kept as replacement birds. Pedersen and Kristensen (2004) also

found out that farmers' wealth influences management practices and decisions. On a study on the Productivity and husbandry of FRLC on the Accra plains of Ghana, the variance in flock size is influenced by the sex of the respondent, the scavenging area, the number of family members and the number of other livestock (Aboe *et al.*, 2006).

2.8.3 Market situation

Farmers manage chicken flock not only according to the environment, but also according to the market demand for chicken. Higher demand lead to higher prices hence higher return. In many African countries, the traditional system gives low output thus the market is not a problem to the farmer. However, if larger production is considered, many questions related to marketing such as price, customers, input price and input availability will suddenly become important and will influence the farmer's strategy and decision making (Pedersen, 2002; Mlozi *et al.*, 2003; Kitalyi, 1998).

2.8.4 Household characteristics

Household characteristics include the farm size, household size, education level of household members, income level, experience in poultry production and the farming system. In a study on the status of smallholder poultry production in the Alfred District of Kwazulu-Natal South-Africa, numeric data were analysed with SAS using descriptive statistics. The means for different variables were then compared to establish whether household income and family size influence the number of chicken kept and the level of chicken consumed (Kilogram of protein intake/person/month). The results showed that there is generally a linear increase in the number of other livestock kept and the gross household income with an increase in the number of chicken kept per household (Swatson

et al., 2001). The study by Swatson also showed that, as the family income increases, and the family size decrease, the protein security increases.

The study on introducing socio-economic characteristics in a production analysis, (Feinerman and Finelshitain, 1996) revealed that wealthier, experienced farmers in poultry production and small family sizes were more willing to take risks in poultry production. Pedersen and Kristensen's (2004) study on the dynamic modeling of traditional African chicken production system, found out that wealth influences the management practices and decisions in FRLC production, and which in turn affects its (FRLC) output. Similarly, another study on the production function analysis of smallholder semi-subsistence and semi-commercial poultry production systems in three agro-ecological regions in Northern provinces of Vietnam found out that the level of farm poultry output a farmer produced varied with the farms and farmer's conditions (Tung and Rasmussen, 2005). Generally, a farmer with higher level of income and education invested more in poultry than a farmer with low income and education level. However, Tung and Rasmussen's study showed that the education level could have a negative impact on poultry production, which was due to the fact that highly educated farmers usually involved themselves in other social and economic activities, resulting in little attention to FRLC production. The experience in FRLC keeping was seen to be an important variable affecting productivity and management practices.

2.9 Impact of the interventions

Tung and Ramussen (2005) used a Cobb-Douglas production function in their study on the production function analysis of semi-subsistence and semi-commercial farmers in three

agro-ecological regions. They assumed that the poultry production output at farm level depended on the number of birds on the farm, the amount of various feed inputs provided by the farmer, the garden area where the birds could search for feed, the amount of labor, and capital and veterinary inputs. The results showed that the flock size, the feed amount per bird, the labor amount per bird, the household income level, and veterinary cost coefficients were highly significant in the two models (Semi-subsistence versus Semi-commercial). On the other hand, the garden size had only a significant influence among the poultry farmers in the midland regions. However, regardless of the region (Lowland, Mid-land, or high-land) and the production system (Semi-subsistence VS semi-commercial), the results indicate that the feed amount per bird coefficient was the most responsive variable in the farm poultry output. The influence however differed between the production systems and the regions.

In another study on the performance of Zimbabwean local chicken in a controlled environment, chicken from one communal farming area were studied. The results showed that chicken in a controlled improved management environment performed better than what was found on-farm (unimproved environment). But in comparing the economic performance between the traditional on-farm conditions and the improved on-farm conditions, the improved on-farm condition showed a negative pay back on feed cost and that the net profit could be more skewed if labour and housing costs were added (Pedersen, 2002). Low feed costs were reported to be crucial in increasing the economic benefits, this could be obtained through lowering of the slaughter age and through the use of home made feed or use of a different breed with higher feed efficiency (Pedersen, 2002).

In a study on the dynamic modeling of traditional African chicken production system, a dynamic stochastic model (Simflock) of the traditional African chicken production was developed as a supplement to on-farm and on-station trials. The study found that by collecting eggs for home consumption or sale, egg production could be doubled and growth of chicken could be improved considerably by raising them under improved conditions (Pedersen and Kristensen, 2004).

Udo *et al.* (2001) did a study on the evaluation of interventions (daytime housing, ND vaccination, supplementing feeding, crossbreeding and control of broodiness) in village poultry systems and found out that, over a simulated period of three years, crossbreeding had a highly negative effect on bird off-take, egg production, egg off-take and flock size. However housing showed the greatest increase in flock size; followed by ND vaccination, feed supplementation and control of broodiness. Udo *et al.* (2001) then did a cost-benefit analysis in determining the economic effect of the interventions. The results of the analysis showed that the ND vaccination and broodiness control were the most economical interventions, while feed supplementation, crossbreeding and daytime housing had a negative effect on the net-return.

Das (2005) carried out a study on the performance of growing and laying chicken in cafeteria (free-choice feeding) and balance feeding under semi-scavenging conditions. Three supplementary levels (40g, 60g and 80g) of two feeding systems (commercial balanced feeding, cafeteria feeding) were randomly allocated to 18 selected farmers (three farmers in each treatment). The effect of the feeding systems and supplementary levels on growth, production and profitability were determined. The profit on the basis of the

expenditure during the experiment period was calculated through an economic analysis, and the results showed clearly that cafeteria feeding was profitable than balanced feeding. The results also showed that, irrespective of the feeding system, 40g and 60g supplementation were more profitable than higher levels. In the study, it was recommended to farmers to reduce the feed cost by using local available conventional and non-conventional cheep feed ingredients.

The famous Bangladesh Poultry Model (BPM) used poultry as a tool for poverty eradication and as a promotion for gender equity (Fattah, 1999). The strategies of the Government of Bangladesh (GoB) in making village poultry rearing more profitable included the provision of improved breeds, motivation, group organization, training on poultry management and vaccination, supply of small credit, and regular supervision and advice. On evaluating the impact of the program, village poultry rearing activities generated varying amounts of income from USD 60 to USD 375 per annum (Fattah, 1999). From the survey results, the poultry mortality rate fell from 21.3 percent to 7.6 percent in the project areas; yearly consumption increased from 1.6 to 16.7 chicken and 43 to 186 eggs, and yearly income from sales of chicken and eggs raised from TK 400 to TK 2919 (USD 8-60) (Fattah, 1999). During the study the average per capita income in Bangladesh was USD 250-280, which was several times higher than before the model was introduced. This was due to the introduced poultry breeds and more time spent in chicken production activities (Fattah, 1999).

A study on the economy of different poultry production systems was done in Kenya. Thirty poultry farmers rearing chicken for income and household nutrition under different poultry

production systems were randomly selected (Njue, 2004). Information on flock production, disease control and marketing were collected by a semi-structured questionnaire. The study results showed all production systems were viable for the poultry project (return>1), the returns on investment were 1.52, 1.72, 1.09 and 1.63 for intensive layers, broilers, semi-scavenging and scavenging production systems respectively. However the cost-benefit analysis results showed that, the profit per bird was highest (USD 5.84) for the intensive egg production system followed by broilers (USD 1.33). The profit margin for the semi-scavenging system was almost half of that of the scavenging system (USD 0.57/bird/year) due to high feed costs (Njue, 2004).

2.10 Project sustainability

Kyvsgaard and Urbina (1996) on a study on the supplementation of poultry diets with tree leaves and seeds of *Crescentia alata* investigated the effect of the *Crescentia alata* seeds on the daily egg production, pauses between clutches, shell thickness and colour of the yolk. Also before the study was conducted training on the general poultry nutrition and disease was done to participants. Productivity before the intervention was used in comparing and evaluating the effect of the innovation. The participants reported to have a higher daily egg production, shorter pauses between clutches, increased shell thickness and improved colour of the yolk. In evaluating the technology acceptance, lack of grain was often mentioned as the reason as to why farmers stopped using the innovations, as the seeds and leaves of *Crescentia alata* were mixed with sorghum grains. In the first evaluation on the acceptance of the technology, seven out of fifteen families interviewed tried the new feed formulation and the practice stopped just before the sorghum was harvested. However, two years after the initial study, 300 families (25% of the farms) were

practicing one or more of the methods. The number had increased to 398 by the end of the other year. The range of supplementation was extended to include leaves of other tree species and legume seeds of *Crescentia alata*. Different methods of feed preparation were also developed by the farmers (Kyvsgaard and Urbina, 1996).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Overview

This chapter comprises three sections. The first section presents the description of the study area and the conceptual framework. The second section describes the sampling techniques and procedures used for data collection, while the third section presents the analytical techniques used.

3.2 Description of the study area

The study was conducted in the villages of Mlali, Kipera, Melela and Turiani in Mvomero district, in Morogoro region. The villages were chosen as a case representing project farmers. Morogoro region is located in the southeastern part of Tanzania between the central highlands and the coastal lowlands. Morogoro has a total population of 1,753,362 and a total area of 70,799 km^2 with a temperature between 18° C and 30° C, and the rainfall, which varies from 600 to 1200 mm (Mvomero District Planning Report, 2003). Morogoro rural district has three agro-ecological zones; the highland above 600m; the plateau, with an attitude of 300-600 m; and the lowland and the river valleys (Mvomero District Planning Report, 2003).

Turiani village is about 200 km west of Dar es Salaam. The main activity of smallholder farmers is agriculture, with the cultivation of paddy, sugarcane and maize being the predominant occupation. Mlali, Kipera and Melela villages are located about 20 km south of Morogoro town. The main activity of smallholder farmers is agriculture with the

cultivation of tomato, sunflower and maize being the predominant occupation of the farmers.

3.3 Data collection

This study involved both secondary and primary data. The primary data were collected using a semi-structured questionnaire with both close and open-ended questions; and direct observations, which were made by the researcher. The researcher selected two enumerators in each town who were trained on how to conduct interviews and fill in questionnaires during each respondent's interview process.

3.3.1 Formal surveys

A formal survey was conducted using a cross-sectional design to collect the data. According to Casley and Kumar (1998), such design allows data to be collected at one point in time to represent some large population. A semi-structured questionnaire with close and open-ended questions was used. The questionnaire was designed, pre-tested and used to collect both qualitative and quantitative data from the respondents (Appendix I). The primary data was collected between November 2005 and January 2006. The respondents, who were either heads of the households or their spouses, were visited and interviewed individually in their homesteads. However, during the study, in most cases both the husband and wife helped in responding to the questions asked. Direct observations were also made on the studied aspects.

3.3.1.1 Measures of knowledge level

Respondents were asked several questions on feeding, housing, disease control, and breed selection. These questions were used to assess their level of knowledge. If a respondent did not know, she/he scored a zero and if she/he happened to know, then he/she scored one. The scores for each respondent were then added up to get the total score of knowledge in housing, feeding, disease control, and breeding. A total score acquired by a respondent presented the level of knowledge on FRLC management.

3.3.2 Secondary data

Secondary data on the agricultural sector, food security and FRLC were collected from reports, proceedings and other documents from Sokoine National Agricultural Library (SNAL), the IHEPRUCA project at Sokoine University of Agriculture in Morogoro, The Royal Agricultural and Veterinary University Library (KVL) in Denmark and from the family poultry website and other websites from the internet.

3.4 Sampling procedures

The population of the study consisted of smallholder farmers keeping FRLC in the villages where the project operations took place. Respondents in Melela and some in Turiani and Mlali villages were selected as a control group. The selection of the control group was based on their similarities with the project participants in their socio-economic characteristics such as their economic activities, farming systems, distance from market place, nature of the village (if urban, peri-urban or rural) and socio-cultural similarities. All the respondents from the study villages were randomly selected by using a simple random sampling method. A sample size of 120 smallholder farmers who keep FRLC were

selected and interviewed; 60 of these were project farmers and 60 were non-project farmers (control group). A list of all project farmers and non-project farmers in the selected villages were used as a sampling frame. The representative sample for the study from each village was based on Boyd's formula n/N*100=C, where C represents a figure greater or equal to 5% of the population. N is the total population and *n* is the sample size (Boyd *et al.*, 1981). The 60 non-project respondents used as a control group were selected irrespective of their village population size. The sample size of 60 was adopted in order to get a good comparison with the project respondents. The household was used as a sampling unit because it was the most appropriate unit of measure when assessing the socio-economic situation in a household (Blackwood and Lynch, 1994).

Table 1: Project households sampled for the study

Division	Number of project households (N)	Number of sampled household (n)	% of sampled household
Turiani	60	30	50
Kipera	30	15	50
Mlali	30	15	50
Total	**120**	**60**	**50**

3.5 Data analysis

The data collected from primary sources were coded, and analysed using the Statistical Package for Social Science (SPSS) computer programme, LIMDEP and Microsoft Excel. The data analysed included both qualitative and quantitative data. The descriptive analysis such as cross tabulations and chi-square test were done mainly to summarise the formal survey data in order to facilitate interpretation. The independent sample t-test, one-way analysis of variance (ANOVA) test, least significant difference (LSD) multiple comparison criterion test and chi-square test were used to test the hypotheses stated in Section 1.5.

3.5.1 Regression analysis

A Regression analysis was then used in testing the factors that influenced the adoption of the new technology among the project participants. A Logit model was used to test the model that: Logit (Π)= $\beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$

Where:- Π (0, 1), Π is between 0 and 1, where 1= adopted and 0=otherwise.

X1 = Education, 1= Informal education and 0 otherwise

X2 = Income/wealth

X3 = FRLC Farm-gate price

X4 = Occupation, 1=farming only and 0 otherwise

X5 = Cost of inputs, 1=high costs and 0 otherwise.

All tests of significance were tested at the 5% level of significance.

3.5.2 Economic analysis

A Cost-benefit analysis and a partial budget analysis are economic analysis used to measure the economic performance of different production systems and of the use of different inputs.

3.5.2.1 Cost-benefit analysis

A cost-benefit analysis was done whereby FRLC gross income of project participants were compared with the FRLC gross income of non-project participants. Also the increase in gross income was compared with the decrease in gross income when different interventions were used.

3.5.2.2 Partial budget analysis

A partial budget analysis was done to compare the costs of different interventions, that is, the costs of housing, feeding, disease control and the costs of all the FRLC inputs.

3.6 Conceptual framework on the impact of intervention and socio-economic factors influencing interventions

The intervention in poultry production aimed at increasing the FRLC production (increase the output per unit input) but there were factors, which were assumed to have influenced the interventions and, as a result, influenced the returns on FRLC production.

- The dependent variable was the FRLC production. The indicators for FRLC production were the gross income from FRLC production/farm/year and the market value of FRLC/farm/year (FRLC on farm, consumed, sold, and given away).
- The independent variables that were expected to have an influence on the dependent variables were as follows:

Characteristics of the respondent; this variable included the education level of the head of household, the age of the respondent, the total wealth or family income per year and expenditure was used as a proxy in determining the household income. The respondent's characteristics were assumed to influence the change of knowledge, attitude and practices of FRLC.

Farm characteristics; this variable included the cropping and livestock pattern, whether foodcrops, cash crops or both were farmed, and whether poultry only, poultry and small

ruminants or poultry and large ruminants were kept. The farming system was assumed to affect the scavenging area, attitude and practices towards FRLC production.

Input access; this variable included access to extension and veterinary services, poultry inputs such as, vaccines, poultry medicines and feed. Input access was assumed to influence the adoption of the interventions.

Markets; Market forces (supply and demand) influence the farm-gate price. The farm-gate price was assumed to influence the adoption of the interventions.

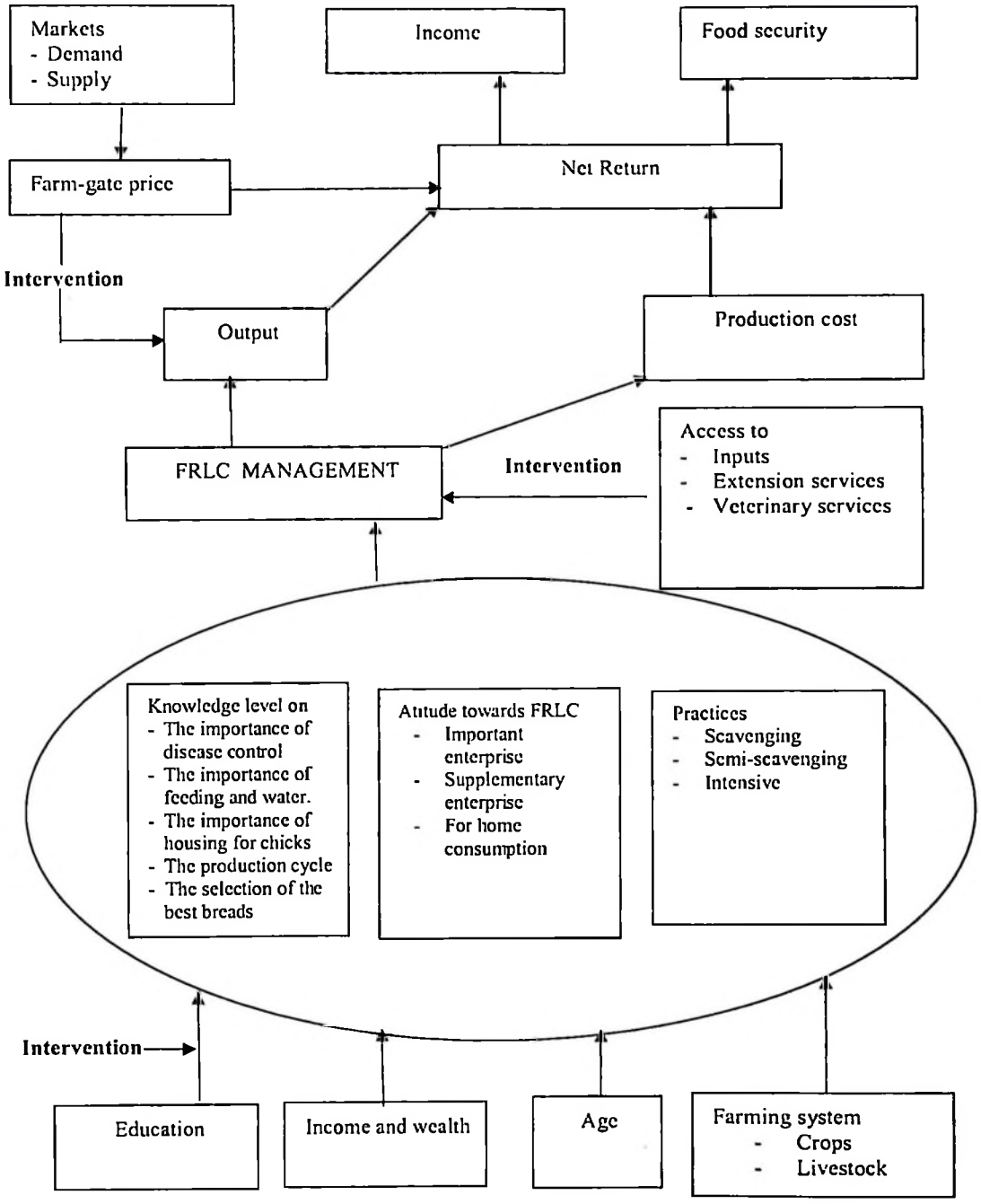

Figure 1 : Conceptual framework of the internal and external factors influencing the interventions in FRLC productivity.

Source: Modified from Tung and Rasmussen (2005), and Pedersen (2002)

3.7 Limitation of the case study

The project's baseline information was inadequate, especially for farmers in Mlali and Kipera. This deficiency arose from the fact that this type of information was not comprehensively collected at the start of the project. This forced the study to use the "with and without" criterion instead of the "before and after" criterion. The project in Turiani ended in 2004, so sustainability of the project could be easily measured. However, project activities in Kipera and Mlali were still continuing and most inputs were provided to smallholder farmers free of charge. Hence in Mlali and Kipera it was difficult to declare if the improvement system would be sustainable and whether the costs of inputs would be the same without the project.

Most of the data for this study were obtained mainly from interviewing smallholder farmers, whose replies were subject to error due to inadequate knowledge on certain issues or faulty memory or due to, sometimes, farmers' suspicion of the outsiders. The study was conducted during the 2005/06 season, and which was affected by rain shortage; hence most households had experienced low crop harvests. Consequently, the results from this study might not reflect the real situation in the areas due to the fact that most households were in a transit period of food insecurity.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Overview

This chapter presents the results and discussions of the findings from the survey. The chapter contains the following sub-sections: the general survey observations, project interventions, factors influencing the interventions and FRLC production, the effect of the interventions on the level of knowledge, attitude and practices, and the effect of the interventions on FRLC production. The results from both qualitative and quantitative analyses are presented and discussed.

4.2 General study observations

From the study, it was observed that both the husbands and the wives had interests in FRLC production. The wife and husband's knowledge on FRLC management were more or less similar. During the survey, it was observed that respondents who kept small and large ruminants kept other poultry like ducks and guinea fowls as well. While those who did not keep large and small ruminants kept only FRLC.

Respondents from Turiani were socio-economically better off compared to those in Kipera, Mlali and Melela, probably due to the prevalence of mixed ethnic groups in Turiani district. In addition, the presence of the sugar factory could be another contributory factor for making being better off socio-economically. However, there was also an observed difference between different villages within Turiani district. For example, respondents from Lungo were by far better off socio-economically than those from Kwamtonga.

During the survey the observed differences in production and management practices between the project and non-project participants were negligible; this was probably because there was a dissemination of knowledge on improved management practices through veterinary officers, agriculture extension officers or project participants. However knowledge on FRLC management was higher among project participants. Although there was a small difference in production and management practices between project and non-project participants, a larger difference could have been observed if the socio-economy, production and management practices of the project participants were compared before and after the interventions.

4.3 Project interventions

The IHEPRUCA project anticipated low productivity in FRLC. The project aimed at increasing FRLC production through health management. The project had selected active farmers with secondary education level. These farmers were used to disseminate the new technology to their fellow farmers. Seminars were conducted in the villages and a sample of these villagers was selected for the interventions. The IHEPRUCA FRLC production improvement program involved education of farmers on breed selection and culling, vaccinating FRLC against ND virus, use of *Aloe spp* for protection against diseases, identifying different bacterial and viral diseases, feed and water supplementation and construction of chicken houses. The level of chicken production is highly dependent on the farmer's management levels, which includes supplementing chicken with feed and water, provision of shelter and prevention of disease (Pedersen and Kristensen, 2004). The training that respondents from the different villages received is shown in Table 2 below. Respondents had received more than one training technique.

Table 2: Distribution of respondents reporting the intervention they received from the project (N=54)

Training/intervention offered	Mlali (n=9)	%	Kipera (n=15)	%	Turiani (n=30)	%
Disease control	4	44.0	12	80.0	28	93.0
Feed supplementation	1	11.1	10	66.7	26	86.7
Housing management	1	11.1	10	66.7	26	86.7
Breeding	3	33.0	9	60.0	24	80.0

Results from Table 2 show that the majority of respondents from Turiani villages have received the intervention, 28 respondents (93%) on disease control, 26 respondents (86.7%) on feed supplementation, 26 respondents (86.7%) on housing management and 24 respondents (80%) on breeding. While the majority of respondents from Mlali villages claimed that they had not received the interventions, only four (44%) of the respondents reported to have received interventions on disease control, one respondent (6.7%) on feed supplementation, one respondent (6.7%) on housing management and three (33%) on breeding. From Kipera 12 respondents (80%) claimed to have received interventions on disease control, 10 respondents (66.7%) on feed supplementation, 10 respondents (66.7%) on housing management and nine respondents (60%) on breeding.

The project however, claimed to have educated all its participants. But, the above results show a different picture. This was probably due to poor participation in the project activities by the project beneficiaries, or poor technology dissemination. In this regard, for example, Lugeye (1994) discovered that illiterate groups need special attention when information is being disseminated.

4.3.1 Disease control

Despite the above results, all of the project participants agreed to have their chicken vaccinated against the ND virus at one point in time. When asked how they knew about the vaccines, 50 respondents (83.3%) claimed to have known about the vaccines from the project, nine respondents (15%) from experience and from the project, and one respondent (1.7%) came to know about the vaccines from the village Veterinary officer. The respondents who claimed not to have received the interventions said that the project just advised them to vaccinate their chicken against the ND virus and they took the advise because they wanted a solution to the massive loss of their FRLC. Table 3 shows the respondents' sources of information on ND vaccination and other disease control (Project participants Vs Non- project participants).

Table 3: Respondents' source of information about ND vaccination and the control of other diseases (N=91)

Source of information	Project participants		Non- project participants (n=31)	
	n	%	n	%
The Project	50	83.3	2	6.4
People from the project	0	0.0	1	3.2
Fellow farmers	0	0.0	15	25.0
Experience + project	9	15.0	1	3.2
Village extension officers	0	0.0	12	39.0
Project+ village extension officer	1	1.7	0	0.0

The results from Table 3 shows that most of the project participants got information about ND vaccination from the project while non-project participants got information on ND vaccination from the village extension officers and from their fellow farmers. The results

show a significant difference in accessing information on vaccination and disease control between the project participants and non-project participants ($P<0.05$). Only 31 non-project participants (52%) had information on ND vaccination compared to 60 project participants (100%).

Table 4 shows other methods that respondents used for disease control; some of the methods include the use of ethno veterinary medicines such as *Aloe secundiflora*, conventional medicines, and the use of viral drugs. Further, the table shows that respondents used different practices on disease control. For example, while some respondents, who used *Aloe spp*, reported to have been cutting and mixing it with water, others reported to have been mixing *Aloe spp* milk sap with feeds, while yet, others reported to have been using its milk sap directly in treating FRLC wounds. Respondents who made frequent use of Aloe *spp*, reported that Aloe *spp* was effective in curing FRLC wounds and typhoid. *Aloe spp* also protect FRLC from ND virus and other disease infections.

The crude extract of *Aloe secundiflora* reduces the mortality rate and severity of clinical signs during the acute phase of ND infection, although it has been reported to have no significant effect on the antibody levels that are attributed to the recovery of the surviving chicken (Waiheya *et al.*, 2002a). Similarly, the extract of *Aloe secundiflora* has been reported to be useful in the control of fowl typhoid in chicken (Waiheya *et al.*, 2002b). Also, respondents used ethno veterinary treatments like hot pepper and Neem tree (*Azadirachta indica*). Antibiotics like tetracycline and ampicillin. Kerosene and cooking

oil were also used as conventional medicines in treating FRLC wounds. Table 4 shows the different methods used by the respondents in controlling FRLC diseases.

Table 4: Respondent's ways of disease control (N=120)

Practices on disease control	Project Participants (n=60)		Non-Project Participants (n=60)	
	n	%	n	%
Don't control disease	0	0.0	14	23.3
Ethno veterinary/conventional	2	3.3	20	33.3
Ethno veterinary +poor time of vaccination	16	26.7	17	28.3
Vaccination at recommended interval	23	38.3	5	8.3
Vaccination at recommended interval+ other disease control+ use of *Aloe secundiflora*	19	31.7	4	6.7

The null hypothesis that the intervention program has a significant influence on the change of practices on disease control for enhanced productivity of FRLC was significant at ($P<0.05$), implying that the project interventions have a significant influence on the change of practices on FRLC management.

4.3.2 Feed supplementation

Table 5 shows the different ways in which respondents supplemented their FRLC with feeds and water. Sixty respondents (50%) supplied their FRLC with feeds and water without considering the available nutrients in the scavenging area, the amount of food available around the scavenging area and the age category of the chicken. Forty six respondents (38.3%) considered the age category of chicken during feed supplementation and the amount of feed available in the scavenging area. For example, respondents

indicated that they give less feeds during harvesting time and they separate chicken according to their age categories during feed supplementation. Six respondents (5%) considered the age category, the amount of feed available in the area and the quality of feeds available in the scavenging area. For example, if there were plenty of carbohydrate feeds around the scavenging areas and no vegetables and protein, then the respondents would supply their FRLC with grass and sardines. Five respondents (4.2%) also considered the FRLC age category by supplying layers with calcium and protein. Sixteen respondents (13.3%) reported that they gave no feeds to their FRLC or sometimes they just supplied them with small amounts of maize bran when there was food deficit. Seventy six respondents (63.3%) reported that they frequently supplied their FRLC with water, 32 respondents (26.7%) twice a day, and 12 respondents (10%) occasionally. The study results show that the interventions has a significant impact on the improvement in feeding management practices ($P<0.05$).

Table 5: FRLC feeding (N=120)

Practices	Project participants (n=60)		Non-project participants (n=60)	
	n	%	n	%
No feed or water supplementation.	0	0.0	8	13.3
Supply FRLC with feed and water but neither considers the age category of FRLC nor the season.	28	46.7	32	53.3
Supply FRLC with feed and water and considers the FRLC age category and season.	29	48.3	17	28.3
Supply FRLC with feed and water, considers the age category of FRLC, available nutrients for scavenging and quality of scavenging feed.	3	5.0	3	5.0

The results from the study show that out of 60 project participants, only 37 participants (61.7%) received training on feeding management even though, all project participants

practiced feed supplementation. The type of supplementary feeding used was more or less the same in all the villages for both project and non-project participants. Maize bran was reported to be the main source of feed supplementation. The results of the study showed that 106 respondents, that is 94.6% of the respondents supplemented their FRLC with maize bran, while 39 respondents (34.8%) supplemented their FRLC with maize bran together with other feed supplements such as sardines, grass, *Cresentia alata*, rice husks, sunflower seed cake, maize and bones. Aboe *et al.* (2006) supported these study results when he reported that 80% of the respondents in the study on the productivity and husbandry of FRLC in the Accra plains of Ghana supplemented their chicken with Maize. The supply of maize bran together with other nutrients was considered to increase the FRLC production. The results showed no significant difference between the project and non-project participants in feeding their FRLC ($P>0.05$), implying that the project interventions had no significant influence on the improvement in feeding management practices.

The respondents reported that when calcium was mixed in layer's feeds, FRLC hatched more eggs, with bigger eggs and with yellow colour of the yolk. . Minh *et al.* (2004) reported that feeds (bran) given to FRLC cannot supplement the deficiencies of nutrients in chicken, especially with regard to calcium. One respondent reported to have supplied her chicken with tree leaves of *Crescentia alata* mixed with maize bran. She reported that by mixing FRLC feed with tree leaves of *Crescentia alata,* chicken increased egg production and the frequency of hatching eggs per year. These results were in agreement with the evidence reported by Kysgaard and Urbina (1996) who found out that the supplementation of poultry diet with tree leaves and seeds of *Crescentia alata* increased the daily egg

production, shortened pauses between clutches, increased the thickness of the shells and improved the yolk colour.

Table 6: Types of feed supplements that respondents fed their FRLC (N=112)

Feed type	Project participants (n=60)		Non-project participants (n=52)	
	n	%	n	%
Maize bran	35	58.3	32	61.5
Maize bran+ sunflower seed cake	8	13.0	1	1.9
Tomato + maize bran + house waste	5	8.3	4	7.7
Sardine + maize bran	6	40.0	5	9.6
Sorghum + maize bran+ sardine	0	0.0	1	1.9
Maize bran + sardine + tomato	1	1.7	3	5.8
Maize flour	0	0.0	2	3.8
Bones + maize bran + sardine	1	1.7	3	5.8
Ricehusk + sardine + limestone + maize bran	1	1.7	0	0.0
Rice husk + maize bran	1	1.7	1	1.9
Maize+ *Crescentia alata*	1	1.7	0	0.0
Sorghum + maize	1	1.7	0	0.0

Table 7 shows the respondents source of information on feed supplementation. The respondents reported to have received information about supplement feeding from the project, through experience, and from their fellow farmers. The results in Table 7 below show that there was a significant association between where respondents got information about feed supplementation and the status of the respondents ($P<0.05$). Project participants got information mainly through:- experience 46 respondents (76.7%), experience and project seven respondents (11.7%), through the project six respondents (10%) and fellow

farmers one respondent (1.7%); while non project participants got information through experience 49 respondents (94.2%), through experience and extension officers two respondents (3.8%), and through their fellow farmers one respondents (1.9%).

Table 7: Source of information on feed supplementation (N=112)

Source of Information	Project participants (n=60)		Non-project participants (n=52)	
	n	%	n	%
Project	6	10.0	0	0.0
Experience	46	76.7	49	94.2
Fellow farmers	1	1.7	1	1.9
Experience+ extension officer	0	0.0	2	3.8
Experience + project	7	11.7	0	0.0

4.3.3 Housing and shelter

The results from this study show that 37 project participants (61.7%) agreed that they had received training on housing management. The respondents who claimed not to have received the interventions from the project, either slept with their chicken at night and left their chicken to roam freely in the daytime or built houses but not at the recommended standards. During the survey, it was observed that the conditions of the FRLC houses that the respondents were using for FRLC were more or less the same in the four study villages. Respondents either kept their FRLC in their own homes or built a separate FRLC house made of mud, mud bricks, wire mesh; or houses made of wood for FRLC to roost and have the chicken shed divided into places for laying eggs, for chicks, and for feeding. The result in Table 8 show different housing management practices practiced by the respondents.

Respondents who did a weekly and monthly cleaning constructed their FRLC houses in such a manner that they could be able to collect manure for other uses (e.g. gardening and fish feeds). Housing helped protect FRLC against diseases and predators, adverse temperatures, radiation, rain and chilling weather. Njue *et al.* (2001), on a survey on the disease status of village chicken in Kenya, suggested that the designing of housing for the village chicken will go a long way into controlling parasitic disease and losses associated with predation. Table 9 shows the respondents' reasons for building houses for their FRLC.

Table 9: Reasons for building a FRLC house (N=51)

Reasons	Project participants (n=32)		Non-project participants (n=19)	
	n	%	n	%
Advised by the project	11	34.4	0	0.0
Hygiene (didn't like sleeping with them)	2	6.2	3	15.8
Advised by project members	0	0.0	1	5.3
Protection from hazards	2	6.3	2	10.5
Through experience from there fore-fathers	13	40.6	13	68.4
Through experience & project	4	13.0	0	0.0

The results in Table 9 above revealed a statistical significant association between the reasons for building a FRLC house and the status of the respondents ($P<0.05$). That is project participants had reported different reasons for building FRLC houses from non-project participants.

4.3.4 Breeding

The study results show that of the 60 project participants, only 36 respondents (60%) agreed to have been educated on FRLC breeding and consequently 50 respondents (83.4%) mentioned that they culled their FRLC and had knowledge on breeding and knew the importance of breeding management in increasing chicken production. However five respondents (4%) claimed that they observed no differences in FRLC production performance between those who practiced breeding management and those who did not. Eighty respondents (67%) thought that proper feeding made a grater difference than breeding in FRLC production performance. Nutrition has a greater effect on productivity than genetic factors (Bessei, 1989). Only ten respondents (8.3%) controlled chicken broodiness by early separation of hens from their chicks, which was mentioned to contribute to an increased FRLC production. Three respondents (2.5%) reported that they removed the first laid eggs for home consumption if they observed poor hatching from the layers. Five respondents (4%) reported that eggs laid by a hen with poor hatching were given to another hen with the ability to hatch many eggs. Forty four respondents (37%) described a good FRLC for breeding to be the one that laid and hatched many eggs and had a big body structure. Table 10 shows the respondents' knowledge and practice on breed selection and culling.

Table 10: Respondents knowledge and practices on breeding (N=120)

Knowledge	Project participants (n=60)		Non-Project participants (n=60)	
	n	%	n	%
No knowledge	6	10.0	18	30.0
Know about chicken culling	20	33.3	27	45.0
Know about chicken culling and breeding	34	56.7	15	25.0
Practice				
Don't practice	10	16.7	26	43.3
Cull chicken	28	46.6	24	40.0
Breed and cull chicken	22	36.7	10	16.7

The results showed that, the interventions had a significant impact on the accrued knowledge and breeding practices ($P<0.05$).

4.4 Partial budget analysis

The partial budget analysis is an economic analysis which was used in comparing costs and benefits so as to decide whether a particular project intervention should be implemented or not. In this analysis, the situation with change in technology was compared to that of without change. The partial budget analysis comprised; the use of zero inputs, the use of inputs on disease control, the use of inputs on housing management, the use of inputs on feeding, and the use of all inputs on FRLC management. Table 11 presents a summary of the partial budget analysis.

4.4.1 Partial budget analysis with no inputs

The respondents who reported to have incurred no cost in FRLC production were considered. This included those who supplemented their FRLC with poultry inputs but at zero cost, for example, supplementing them occasionally with household waste or free maize bran. These respondents did not incur any costs in housing, feeding, breeding and disease control. In the analysis, the respondents had a FRLC market value of between Tshs 24 000 and Tshs 385 000; gross income of between Tshs 8000 and Tshs 267 500; and costs due to FRLC mortalities were between a market value of Tshs 10 000 and Tshs 112 000.

4.4.2 Partial budget analysis considering inputs for disease control

The costs for disease control include the costs for diagnosis, medication and ND viral drugs. The costs for ND viral drugs varied depending on whether the viral drugs were

subsidized or not. The average cost per vaccination for subsidized viral drugs was Tshs 200, while that for unsubsidized viral drugs was Tshs 1677. The cost for subsidized vaccination was Tshs 800 per farm/year, while that for unsubsidized vaccination ranged from Tshs 0 to 10 000 per farm/year. The respondents reported to buy the viral drugs in groups so as to reduce the costs. Three respondents reported to take the initiative of buying the viral drugs and give or sell the remaining dose to their fellow farmers.

The survey results showed that 21 respondents (24%) had no cases of FRLC mortalities, therefore the FRLC mortality costs ranged from the value of Tshs 0 to 192 500. The total cost for disease control ranged from Tshs 200 to 10 000. The study results show that the FRLC market value per farm per year ranged from the value of Tshs 600 to 1 070 500 and the gross income ranged from the loss of Tshs 800 to Tshs 570 000. The loss could probably be due to higher costs than benefits accrued from using inputs on disease control. Some respondents reported to observe eruption of unknown diseases after vaccination, leading to a massive loss of FRLC. If mortalities were controlled the benefits the respondents could have received ranged from Tshs 16 700 to 630 000.

4.4.3 Partial budget analysis considering housing inputs

Housing management practices ranged from no housing to houses built by bricks. Housing was especially important in controlling FRLC mortalities (control against predators, adverse temperatures, radiation, rain, chill weather), but only four respondents (3.3%) had a FRLC house because they wanted to protect their FRLC against disasters (Table 9). In calculating the housing cost per year, the total cost for housing facilities was divided by the house expected lifetime. Housing costs ranged from Tshs 0 to 20 000, the cost for FRLC

mortalities ranged from Tshs 0 to 192 500, the current FRLC market value ranged from Tshs 5000 to 1 070 500, the gross income ranged from a loss of Tshs 1500 to 570 000 and the benefits the respondents would have received if mortalities were controlled ranged from Tshs 13 500 to 640 000.

4.4.4 Partial budget analysis on inputs for feeding

FRLC feeding include no feed supplementation (scavenging on their own), supplementary feeding (supply with feed and scavenging) and intensive feeding (did not scavenge, depended on feed supplied by owners). Table 29 shows that eight respondents (6.7%) kept their FRLC on free-range basis, 109 respondents (90.8%) kept their FRLC on supplementary basis, and three respondents (2.5%) kept their FRLC intensively. The results show that feed costs ranged between Tshs 5000 and 1 070 500. Twelve respondents (10%) either did not supply their FRLC with feeds or supplied them with feeds when they got them for free. The costs for FRLC mortalities ranged between Tshs 0 and 192 500. Twenty two respondents (18%) did not experience FRLC mortalities. The gross income ranged from a loss of Tshs 100 000 to 480 000 and the benefits the respondents would have acquired if mortalities were controlled were between Tshs 0 and 640 000. From the results of the study survey, respondents reported not to have incurred any costs in breeding as they simply selected a good breed out of their own stock or just borrowed a breeding cock from their neighbours.

4.4.5 Partial budget analysis considering total input costs

The respondents who used inputs for disease control, feeding, housing and breeding were included in this analysis. Other costs such as costs for purchase of chicken were also

included. Out of 120 respondents, only 40 respondents (33%) incurred costs in housing, feeding and disease control. When the results were analysed, the total FRLC market value ranged between Tshs 6000 and 1 070 500; the FRLC mortalities costs ranged between Tshs 0 and 100 000, and 21 respondents (17.5%) did not experience FRLC mortality. The total cost for FRLC production ranged between Tshs 5400 and 163 000, the FRLC income ranged between Tshs 0 and 580 000 and the gross income ranged from a loss of Tshs 113 000 to 460 000.

Table 11: Summary of the partial budget analysis (N=120)

Inputs	Total cost	Mortality costs	Benefits	Gross income	Benefits with no mortalities	FRLC market value	FRLC market value with no mortalities	B/C
Zero input	0	36 808	81 450	81 450	118 258	148 404	185 212	~
Disease control	1989	35000	85 403	83 414	125 910	174 611	209611	42.9
Housing	3257	35 529	83 181	79 924	118 709	169 101	204 629	25.5
Feeding	20 654	35 529	83 181	62 527	118 710	169 101	204 630	4.0

Note: Projects were viable when the B/C ratio was > 1

4.4.6 Impact of the interventions on FRLC production

Each intervention performance was compared against the base situation. The respondents who used housing facilities reduced mortality by 3.5% (1279) and increased FRLC market value by 14% (20 697). The respondents who supplemented their FRLC with feeds also reduced mortality by 3.5% (1279) and increased FRLC market value by 14% (20 697). The respondents who intervened in disease control reduced mortality rate by 4.91% (1808) and increased FRLC market value by 18% (26, 207). And the respondents who fully adopted

the introduced technology (use of all FRLC inputs) reduced mortality by 6.7% (2481) and increased FRLC production by 34.6% (51 376). However, Udo *et al.* (2001) reported that housing had the greatest increase in flock size, followed by ND vaccination, feed supplementation and control of broodiness. Figure 2 below presents the impact of the interventions on FRLC production.

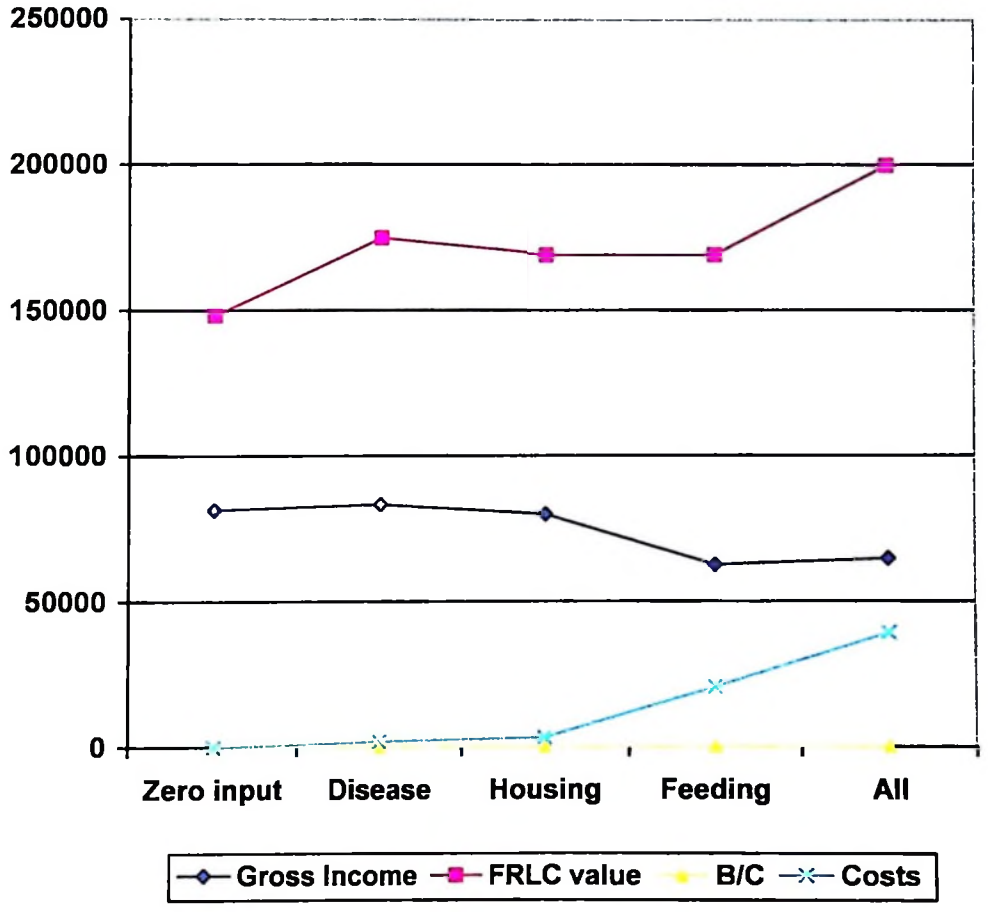

Figure 1 : Evaluating the impact of using different FRLC inputs

4.4.7 Cost-benefit analysis

When the benefit-cost analysis for different interventions were compared to the base situation (zero input), the results showed that the intervention on disease control was the

most economical, there was an increase of Tshs 1964 (2.4%) in net-return compared to the base situation. On the other hand; housing management, feeding management and total management of all inputs resulted into a negative effect on net-return. There was a decrease of 2% (Tshs -1526) for housing management, 23% (Tshs -18 923) for feeding management, and of 21% (Tshs -16 760) for total management. The results of this analysis are supported by Udo *et al.* (2001).

4.5 Adoption of technology

As seen in the above results, not all the respondents agreed to have received education on FRLC management. The study results show that only 41 respondents (68.3%) indicated to have adopted the interventions. One third of the respondents who had poorly adopted the technology either did not vaccinate their FRLC on time, or had poor housing, or fed their FRLC maize bran only and only when it was available, or never used ethno-veterinary medicines to protect their FRLC against diseases, or did not select and cull their FRLC. Poor adoption of the interventions were caused by constraints such as;- the delay of viral drugs from the project, reported by seven respondents (5.8%), viral drugs packed in large volumes and the need for refrigeration, reported by 30 respondents (25%), and high costs of poultry inputs, reported by 60 respondents (50%). The packing of viral drugs and the need for refrigeration render good performance of ND vaccines in rural areas (Kampeni, 2000; Nyange, 2000).

4.5.1 Socio-economic factors that influenced the adoption of the FRLC interventions

The farmer's socio-economic characteristics are important attributes of any society as they reflect ones behaviour in decision making and ones probable expected responses to many

stimuli exposed to them (Akyoo, 2004). The socio-economic characteristics assumed to influence the interventions in this study included age, education level, family income or wealth, the type of crops grown, the type of livestock kept, FRLC farm-gate prices and access to poultry inputs.

The FRLC market value was measured by the total value of chicken produced in a household per year (that is the Value of FRLC at time t + FRLC income/year + the value of consumed FRLC+ the value of given away FRLC)-(the value of purchased FRLC+ opening FRLC stock at the beginning of the year). The total market value of FRLC was measured by the total number of FRLC multiplied by the current market price.

The value for FRLC deaths per year was not included because the death of FRLC was mentioned in the literature to be one of the biggest reasons that accounts for low FRLC production (Boki, 2000). The total number of FRLC/farm/year indicator was not used because FRLC with different age categories had different values and in this study all the age categories of FRLC were included. From the survey, some of the respondents had a big number of growers and chicks than adults. The production of eggs was neglected because most of the respondents neither sold their eggs nor consumed them. Observation showed that respondents left their eggs to hatch; however some of the respondents consumed eggs when either the hen was not able to hatch all of its eggs or that few eggs were needed in the household. Most FRLC keepers thought that selling and eating eggs would reduce the FRLC market value.

4.5.1.1 Age of respondents

The average age of the respondents was 43 years with a minimum of 19 years and a maximum of 86 years. In this study, 29 respondents (24.2%) were in the young age (less than 35 years), 80 respondents (66.7%) were in the adult age (between 35-65 years old) and only 11 respondents (9.2%) were elders (greater than 65 years old). Table 12 presents the age distribution of the respondents by status.

Table 12: Distribution of the respondents' age by status (N=120)

Age Category	Project participants (n=60)		Non-project participants (n=60)	
	n	%	n	%
19-34	13	21.7	16	26.7
35-65	43	71.7	37	61.7
66-86	4	6.7	7	11.7

Age distribution was thought to be one of the factors affecting the interventions in this study. Table 13 presents an ANOVA table testing the effect of age on the FRLC production improvement program. The results showed that the age of the respondents had no significant influence on the production improvement program. Hence, age was not a factor in influencing the adoption of the FRLC interventions.

Table 13: The effect of age on FRLC production improvement program (N=60).

Source of Variation	Sum of Squares	df	Mean Square	F	Significant level
Between groups	1.27E+10	2	6339691644	0.260	0.772^{ns}
Within groups	1.39E+12	57	2.434E+10		
Total	1.40E+12	59			

Note: E+nn or E-nn means multiply by 10 to + or -nn power; ns = Not significant.

4.5.1.2 Education level of respondents

Education level refers to the formal education attained by the respondents in the study areas. All respondents who had been at school were regarded to have attained formal primary education. Education tends to broaden the horizons beyond given habits and traditions of individuals and encourage participation of an individual in developmental issues (Lugeye, 1994). In this study, 26 respondents (21.7%) had informal education, 87 respondents (72.5%) had attained primary education and only seven respondents (5.8%) had attained secondary education and above. Table 14 presents the distribution of respondents' education levels.

Table 14: Distribution of respondents' education level (N=120)

Level of education	Project participants (n=60)		Non-project participants (n=60)		Total	
	n	%	n	%	n	%
Informal	12	20.0	14	23.3	26	21.7
Primary	44	73.3	43	71.7	87	72.5
Secondary and above	4	6.7	3	5.0	7	5.8

The respondents' education level was the factor, which was assumed to affect the adoption of the interventions. The study results show that the respondent's education level had a significant impact on the adoption of the interventions. Implying that the education level of the respondents influenced the adoption of the interventions and hence improved FRLC production. Table 15 presents an ANOVA table showing the effects of the respondents' level of education on the adoption of the interventions.

Table 15: The effect of respondents' education level on the interventions (N=60)

Source of Variation	Sum of Square	df	Mean Square	F	Significant level
Between groups	3.82E+11	3	1.273E+11	7.0	0.0001*
Within groups	1.02E+12	56	1.818E+10		
Total	1.40E+12	59			

Note: E+nn or E-nn means multiply by 10 to + or -nn power. * was significant at p=0.05

4.5.1.3 Income

The total family income per year is sometimes used as a proxy for wealth. In this study, consumption expenditure was used as a proxy in determining the total households' income per year. The consumption expenditure provides a measure of how much was spent by a household per adult equivalent (Deaton and Zaidi, 2002).

The total consumption expenditure in this study therefore, presents the total family income per year and the standard of living of the respondents. The study results show an income of between Tshs 143 800 and Tshs 11 700 000. The consumption expenditure was divided in three categories: consumption expenditure of less than Tshs 350 000, consumption expenditure of between Tshs 350 000 and Tshs 1 000 000 and consumption expenditure grater than Tshs 1 000 000. Table 16 presents the distribution of the respondent's income per year.

Table 16: Distribution of the respondents' total family income per year (N=120)

Level of income (Tshs)	Project participants (n=60)		Non-project participants (n=60)		Total	
	n	%	n	%	n	%
> 350,000	16	26.7	23	38.3	39	32.5
350,000-1,000,000	27	45.0	23	38.3	50	41.7
<1,000,000	17	28.3	14	23.3	31	25.8

An ANOVA test was run to test the significant effect of the respondent's income on the adoption of the interventions. The results showed that the income level of the respondents had a statistical significant effect on the adoption of the interventions. Meaning that, the adoption of the intervention increases as the level of family income increases. Hence, FRLC production increases as the family income increases. Swatson *et al.* (2001) also found out that, as the family income increases and family size decreases the protein security increases.

Table 17: Effect of income on the adoption of the interventions (N=60)

Source of Variation	Sum of Square	df	Mean Square	F	Significant level
Between groups	1.69E+11	2	8.473E+10	3.95	0.025*
Within groups	1.23E+12	57	2.159E+10		
Total	1.40E+12	59			

Note: E+nn or E-nn means multiply by 10 to + or -nn power. * Was significant at p=0.05

A multiple comparison criterion was then done using the Lest Significant Difference test (LSD). The LSD test results showed that there was a significant difference in FRLC production between respondents earning income less than Tshs 350 000 and those with income above one million Tshs ($P<0.05$) (Appendix II).

4.5.1.4 Respondents' occupation

Table 18 shows the respondent's main source of income. Farming was the major activity carried out by respondents in the study areas, 109 respondents (90.8%) indicated farming as their main activity in the survey. Other respondents' occupations included formal employment indicated by eight respondents (6.7%) and business indicated by three respondents (2.5%). Although most of the respondents were farmers they also had other sources of income from non-farm activities. For example, 31 farmers (28.4%) reported to have other sources of income from; small businesses like selling local brews to remittances and retirement benefits.

Table 18: Respondents main sources of income (N=120)

Occupation	Project participants (n=60)		Non-project participants (n=60)		Total	
	n	%	n	%	n	%
Farmer	55	91.7	54	90.0	109	90.8
Employed (profession)	4	7.6	4	6.7	8	6.7
Business	1	1.7	2	3.3	3	2.5

The respondents who got income from farming and other sources of income were compared to respondents who got income from farming only. The study results show that the respondents with other sources of income had a more significant impact on the interventions than respondents with only income from farming. Implying that the respondents' occupation influenced the adoption of the improved FRLC production system. Table 19 presents the effect of the respondents' sources of income on the interventions.

Table 19: Effect of the respondents source of income on FRLC market value (N=60)

Occupation	Mean FRLC market value (Tshs)	n	Std deviation (Tshs)	t-test	Significant level
Farming only	156 278	38	97 437	-2.217	0.031*
Farming &other sources	244 881	22	211 493		

* Significant at p=0.05

4.5.1.5 Farming systems

In this study, farming systems were divided into two systems; crop and livestock production. Crop production was further sub-divided into cash crop and food crop production. Livestock production was divided into three types: large ruminants and FRLC production, small ruminants and FRLC production, and FRLC and other poultry production. Table 20 shows that 58 respondents (48.3%) cultivated food crops only, while 62 respondents (51.7%) cultivated both food and cash crops. Seventy four respondents (61.7%) kept poultry only, of which 40 poultry keepers (54.2%) kept FRLC only. However 19 respondents (15.8%) kept FRLC and small ruminants like goats, while 27 respondents (22.5%) kept FRLC and large ruminants like cattle.

Table 20: Distribution of respondents' farming system (N=120)

Type of production	Project participants (n=60)		Non-project participants (n=60)		Total	
	n	%	n	%	n	%
Cropping system						
Food crop	25	41.7	33	55.0	58	48.3
Food crop &cash-crop	35	58.3	27	45.0	62	51.7
Livestock system						
Poultry	31	51.7	43	71.7	74	61.7
Poultry& small ruminants	14	23.3	5	8.3	19	15.8
Poultry& large ruminants	15	25.0	12	20.0	27	22.5

Table 21 shows that 58 respondents (48.3%) practicing subsistence agriculture (food crops) have an average FRLC market value of Tshs 132 210 while 62 respondents (51.7%) practicing commercial farming (cash and food crops) have an average FRLC market value of Tshs 229 163. The study results revealed that there was a statistical significant difference in the adoption of the improvement program between respondents practicing different cropping patterns. Hence, the cropping pattern had a significant effect in influencing the use the interventions, which in turn influence the FRLC production. The respondents who practiced commercial farming, were probably wealthier, and more educated, hence were risk takers. Also, the respondents who practiced commercial production (food and cash crops) probably had more feed around for FRLC to scavenge. Tung and Rasmussen (2005) reported that the level of farm poultry output varied with the farms and farmer's conditions, farming systems affect FRLC productivity, since farming system depends on the type of crops grown and the intensification level. Aboe *et al.* (2006) also reported that the variance in FRLC flock size was caused by the sex of the respondent, the scavenging area, the number of family members and the number of other livestock.

Table 21: Effect of the cropping systems on FRLC market value (N=60)

Cropping system	Mean FRLC value	n	Std deviation	t-ratio	Significant level
Food crop	132 210	25	94 384	2.509	0.015*
Cash and food crops	229 164	35	175 658		

Note: * Significant at p=0.05

The respondents who keep only poultry have an average FRLC market value of Tshs 185 435, the respondents who keep poultry and small ruminants have an average FRLC market value of Tshs 185 121 and those keeping poultry and large ruminants have an average FRLC market value of Tshs 199 053. The ANOVA test was conducted and the statistical

results showed that the livestock systems had no significant effect on the adoption of the interventions. The improved FRLC management practices were not influenced by the livestock systems. However, other livestock and number of FRLC could have influenced the availability of scavenging feeds. The number of chicken and species of other livestock in the farming system influence the level of competition for feeds and water, and the number of predators in the area affects chicken survival (Nielsen, 1996). Table 22 presents the statistical results on the effect of the livestock systems on the interventions.

Table 22: Effect of the livestock systems on the interventions (N=60)

Source of Variation	Sum of Square	df	Mean Square	F	Significant level
Between groups	2.12E+09	2	1058714015	0.043	0.958^{ns}
Within groups	1.40E+12	57	2.452E+10		
Total	1.40E+12	59			

Note: E+nn or E-nn means multiply by 10 to + or -nn power. ns= Not significant

4.5.1.6 Access to poultry inputs

In this study, poultry inputs included; feeds, medicines for FRLC, viral drugs and extension or veterinary services. Poor access to poultry inputs was considered as the unavailability of inputs or available inputs but at unaffordable prices (high cost). High feed cost was mentioned as one of the biggest constraints in FRLC production, 60 respondents (50%) reported it as a constraint to improvement in FRLC production. When respondents were asked whether they had access to extension and veterinary services, 84 respondents (70%) agreed and when asked if they had access to other poultry inputs, 90 respondents (75%) agreed. 18 respondents mentioned feeds as unavailable inputs (15%), 11 respondents (9.2%) viral drugs (ND), and two respondents (1.7%) other poultry medicines.

Table 23 shows that project participants who had access to veterinary and extension services had an average FRLC market value of Tshs 151 797 while those who had poor access to veterinary and extension services had an average FRLC market value of Tshs 147 225. The independent sample t-test results revealed that access to extension and veterinary services had no significant impact on the influence of using the interventions to eventually improve FRLC production. These results can be attributed to the fact that all project respondents had received interventions on FRLC management, and hence they did not need a lot of assistance from the extension and veterinary officers. During the study survey, it was observed that most of the respondents visited the extension and veterinary officers by themselves and did so by visiting veterinary pharmacies. Some respondents were comfortable with the visit of the project representatives and regarded them as their extension and veterinary officers. Table 23 presents the effect of the accessibility to extension and veterinary services on the interventions.

Table 23: Impact of the access to extension/veterinary services on the interventions (N=60)

Access to extension/veterinary services.	Mean FRLC market value	n	Std deviation	t-ratio	Significant level
Poor access	151 797	29	108 865.3	0.156	0.88^{ns}
Access	147 226	31	116 860.3		

Note: ns=Not significant

High costs of feeds during planting seasons were reported as a constraint to the increase in FRLC production. Eighteen respondents (15%) mentioned feed (maize bran) to be unavailable especially during the planting season, hence influencing the rise in prices. During the planting period, the cost for 20 Kg of maize bran go up to Tshs 1200, while

during the harvesting period the cost of 20 Kg of maize bran go down to Tshs 300. The results in Table 23 shows that the respondents who complained about the cost of feeds had an average FRLC market value of Tshs 182 003 while those who did not complain about the costs of feeds had an average FRLC market value of Tshs 195 529. However, there was no statistical significant difference in the FRLC market value between respondents who complained of the feed costs and those who did not complain. In other words, poor access to feeds and high feed costs had no significant influence in the use of the interventions and eventually improving the FRLC production. This was probably because the respondents who complained of high feed costs, reduced feeding their FRLC with maize bran but still fed them with small amount of maize bran and house waste. Table 24 presents the effect of feed costs on the interventions.

Table 24: The effect of feed costs on the interventions (N=60)

Feed cost	Mean FRLC market value	n	Std deviation	t-ratio	Significant level
Low feed costs	195 529	30	199941.5	0.338	0.737 ^{ns}
High feed costs	182 003	30	90577.3		

Note: ns=Not significant

4.5.1.7 FRLC farm-gate price

Respondents sold their FRLC to middlemen, *mamalishe*, the village market and their neighbours. Also, the FRLC prices varied according to the location, season and market channel. The average FRLC price was Tshs 2964. Respondents from Mlali, Kipera, Turiani and Melela reported an average price of Tshs 3009, 2864, 2600 and 3083 respectively. Table 25 presents the FRLC prices by location.

Table 25: FRLC prices by location

Location	Mean price (Tshs)	Minimum price (Tshs)	Maximum price(Tshs)
Mlali	3009	2000	4000
Kipera	2864	1200	6000
Turiani	2600	1200	4500
Melela	3083	2000	4000
Average	2964	1200	6000

Table 26 shows the impact of farm-gate prices on the interventions. The farm-gate prices showed a statistical significant influence on the interventions, hence influenced the FRLC production. When a LSD multiple comparison test was done, it was found out that there was a significant difference in FRLC production between respondents selling their chicken at farm gate prices greater than Tshs 5000 and those selling their chicken at prices between Tshs 2500 and 3500 ($P<0.05$) (Appendix III).

Table 26: Effect of FRLC farm-gate price on the interventions (N=60)

Source of Variation	Sum of Square	df	Mean Square	F-ratio	Significant level
Between Groups	1.76E+10	2	8.802E+10	3.848	0.028*
Within Groups	1.19E+12	52	2.287E+10		
Total	1.37E+12	54			

Note: * significant at p=0.05

4.5.2 Quantitative evidence on socio-economic factors affecting the adoption

This section provides further quantitative evidence with respect to socio-economic factors affecting the adoption of the interventions. Table 27 reports the regression results on the socio-economic characteristics affecting the adoption of the interventions. The results clearly show that the education level of the respondents, income levels, the cropping patterns, and the FRLC farm-gate prices have a significant impact on the adoption of the

interventions (P<0.05). The results from the regression analysis further indicated that the explanatory variables accounted for 69.21% of the variation on the adoption of the interventions. The model chi-square was significant at (P<0.05) implying that independent variables significantly explained the variation in terms of the adoption of the interventions. The model correctly predicted the actual 1s and 0s by 91.667%.

Education had a negative significant influence on the adoption of the interventions. The results further implied that, the respondents with informal education poorly adopted the technology, meaning that the education level of the respondents influenced the adoption of the interventions and eventually FRLC production. This was supported by Nanai (1993), who reported that people's level of education had a positive relationship with the level of participation in development projects. Similarly, Tung and Rasmussen (2005) supported these results when they reported that poultry output varied with farms and farmer's condition, in that farmers with high levels of education invested more in poultry than farmers with low levels of education.

The FRLC farm-gate price also had a negative significant influence on the adoption of the interventions implying that respondents adopted more interventions when the FRLC farm-gate price was lower. In other words, respondents who sold their FRLC at high prices poorly adopted the interventions. This contradicts the assumptions that FRLC farm-gate price influence the adoption of the interventions, but as it can be observed from Table 25, high FRLC farm-gate prices were found in Kipera and Mlali (at an average of Tshs 3000) where the interventions were poorly adopted, whereas in Turiani where the interventions were well adopted, the average FRLC farm-gate prices were lower (at an average of Tshs

2600). It can be concluded that the significant negative impact could have been due to the difference in geographical locations.

Further, Table 27 shows that the respondents cropping patterns had a negative significant influence on the adoption of the intervention, implying that the respondents who cultivated food crops only, poorly adopted the interventions; while those who cultivated food and cash crops well adopted the interventions. Nielsen (1996) reported that sufficient feeds available for scavenging depended on the area's capacity, which is influenced by factors such as cropping patterns and the density of birds. Nielsen reported further that the income and education levels of the respondents could also influence the cropping patterns.

Income had a positive significant impact on the adoption of the interventions, that is, the technology was well adopted by respondents with higher income levels. The respondents with higher income tended to take more risks than those with low income, and thus, the former invested more in FRLC production. Feinerman and Finelshitain (1996) collaborate similar findings that wealthier and experienced farmers were less susceptible to risks in poultry production, hence were more willing to try new technologies and increased FRLC production. Tung and Rasmussen (2005) also supported these findings when they observed that farmers with higher levels of income invested more in poultry than farmers with low income.

Further, Table 27 shows that the respondents' occupation and feed costs had no significant impact on the adoption of the interventions. These results contradict the Chi-square results in Table 19, where the occupation of the respondents had a significant impact on the

adoption of the interventions. Table 27 presents the regression results on the socio-economic factors influencing the adoption of the interventions.

Table 27: Socio-economic factors influencing the adoption of the interventions (N=60)

Explanatory variable on the adoption of the interventions	Coefficient	Standard Error	Z- value	P [|Z |>z]
Education level of the respondents	-3.4496	1.6907	-2.04	0.04*
Income/wealth	0.2398	0.9009 E-05	2.662	0.008*
Crop type	-7.9884	3.3896	-2.357	0.018*
FRLC farm-gate price	-0.2021	0.8063 E-03	-2.506	0.012*
Occupation of the respondent	1.0172	1.2785	0.796	0.426 ^{ns}
Feed cost	-2.1773	1.4986	-1.453	0.1463 ^{ns}

Note: E+nn or E-nn means multiply by 10 to + or -nn power. * Significant at p=0.05 and ns= Not significant. Model chi-square 51.855; Pseudo R-square 69.2% and the model correctly predicted the actual 1s and 0s by 91.667%.

4.6 Assessment of farmers' knowledge, attitude and practices

This section comprises the assessment of the respondents' knowledge, attitude and practices on FRLC production. The section presents the effect of the interventions on; the knowledge towards FRLC management, the respondents' attitude towards FRLC production, and the respondent's FRLC management practices.

4.6.1 Impact of the interventions on the respondent's knowledge on FRLC production

The study results show no significant association between the level of knowledge on housing management and the interventions. That is the level of knowledge on housing

management was more or less the same between the project and the non-project participants. However, the results in Table 28 show that the higher the knowledge score, the higher the percentage of the project participants and the lower the knowledge score, the higher the percentage of the non-project participants.

In comparing the knowledge score on feeding management, the results showed a significant association between the level of knowledge on feeding management and the interventions. That is the interventions had a significant effect on the acquired knowledge on feeding management. The results in Table 28 also show that the higher the knowledge score, the higher the percentage of project participants and the lower the knowledge score, the higher the percentage of non-project participants.

The interventions had also a significant effect on the acquired knowledge on breeding management; however, both the project and the non-project participants did not have good knowledge on breeding management. When respondents were assessed on their level of knowledge on disease control, their results also showed that the interventions had a significant impact on the acquired knowledge. The results showed that as the level of knowledge increased, the percentage of project participants increased; whereas the percentage of non-project participants decreased as the level of knowledge increased. And when the total score on FRLC management was assessed, the interventions showed to have a significant impact on the acquired knowledge on FRLC management

Table 28: Respondent's knowledge level on FRLC management (N=120)

Knowledge score on		Project participants (n=60)					Non project participants (n=60)					P	χ^2
Scores		0	1	2	3	4	0	1	2	3	4		
Housing	n	0	28	16	8	8	2	39	13	4	2		
	%	0	47	27	13	13	3	65	22	7	3	0.06 ns	9.05
Feeding	n	0	28	29	3	0	8	32	17	3	0		
	%	0	47	48	5	0	13	53	28	5	0	0.01*	11.4
Disease	n	0	0	32	13	15	14	17	22	4	3		
control	%	0	0	53	22	25	23	28	37	7	5	0.000*	45.6
Breeding	n	6	20	34	0	0	18	27	15	0	0	0.001*	14.4
	%	10	33	57	0	0	30	45	25	0	0		

* Significant at p=0.05 and ns= Not significant

4.6.2 Effect of the interventions on the respondent's attitude towards FRLC production

The respondents' attitude towards FRLC production was assumed to influence the FRLC management and eventually its production. The respondents' attitude towards FRLC production was either to produce for home consumption, for petty cash, or for commercial purposes. The study results show that the different attitudes that the respondents had towards FRLC production were not influenced by the interventions (P>0.05). The results also show that most of the respondents, that is 105 respondents (87.5%) considered the FRLC enterprise as a supplementary enterprise. Table 29 presents the respondents' attitude towards FRLC production.

Table 29: The respondent's attitude towards FRLC production (N=120)

Status of respondents	Home consumption		Supplementary enterprise		Commercial purpose	
	n	%	n	%	n	%
Project participants (n=60)	4	3.33	54	45.00	2	1.66
Non-project participants (n=60)	7	5.83	51	42.50	2	1.66
Total	11	9.1	105	87.5	4	3.32

4.6.3 Effect of the interventions on respondents' FRLC management practices

This study assumed that the project interventions influenced the FRLC management practices. During the study survey it was observed that the respondents either practiced the scavenging system (zero input, low output), the semi-scavenging system or the intensive system. Most of the respondents, that is 109 respondents (90.8%), practiced the semi-scavenging system and none of the project participants practiced the scavenging system. This showed that the project interventions had helped smallholder farmers to shift from the scavenging to the semi-scavenging system. The statistical results show that the interventions had a significant influence on the practiced FRLC production systems ($P<0.05$), implying that the interventions influenced the management practices. A study by Kitalyi (1998) reported that the most dominant production system was the scavenging (backyard) system; and that the semi-intensive system had developed recently with higher input and output, Kitalyi's results collaborates with the results of this study that the interventions influenced the management practices, that is smallholder farmers shifted from the scavenging to the semi-scavenging production system.

Table 30: The respondent's FRLC management practices. (N=120)

Status of respondents	Scavenging		Semi-scavenging		Intensive	
	n	%	n	%	n	%
Project participants (n=60)	0	0.0	58	48.3	2	1.7
Non-project participants (n=60)	8	10.8	51	42.5	1	0.8
Total	8	10.8	109	90.8	3	2.5

4.7 The effect of the interventions on FRLC production

In measuring the effect of the interventions on FRLC production, the FRLC market value/farm/year between the project and non-project participants was compared. Table 31

shows that the project participants had a higher average FRLC market value/farm/year (Tshs 188 766) than non-project participants (Tshs 149 435). The project participant's FRLC market value was higher than that of the non-project participants by 26%. However, the interventions had no significant effect on FRLC production.

Table 31: Effect of the interventions on FRLC market value (N=120)

Status	Mean FRLC market value	n	Std deviation	t-ratio	Significant level
Project	188 766	60	154041	1.599	0.112 ^{ns}
Non-project	149 435	60	112133		

Note: ns= Not significant

When the gross income/farm/year from FRLC was calculated, and the income compared between the project and non-project participants, the study results showed no statistical significant difference in FRLC income between the two groups. The project participants had an average income of Tshs 66 915, while non-project participants had an average income of Tshs 61 874. When compared with the non-project participants, the project participants showed an increase in income by 5041 (8.1%). Hence, project interventions increased the total household income by 0.5% due to increased income from FRLC. Seventy four respondents (62%) reported to be using the income they get from FRLC to buy other foods; 74 respondents (62%) used their income to invest in health services; 34 respondents (28%) used their income to buy inputs for farming; 30 respondents (25%) used their income to invest in education; and 16 respondents (13%), used their income to buy cloth for the family. Further, ten respondents (8%) used their income to invest in capital goods; and eight respondents (7%) used their income for emergencies purposes. Table 32 presents the effect of the interventions on FRLC gross income.

Table 32: Effect of the interventions on FRLC gross income (N=120)

Status	Mean income	n	Std deviation	t-ratio	Significant level
Project	66, 915	60	84298	0.347	0.730**
Non-project	61, 874	60	74758		

Note: ** was not significant at p=0.05

The respondents who used FRLC income to buy other food items increased food security. The respondents who reported to invest the money they got from FRLC to buy farming inputs also increased food security in the household as they increased the production of other agricultural products. This also improved the household welfare as enough food was supplied for the household (Food security) and surplus food generated income for the family. Others used FRLC manure as feeds, e.g. for feeding fish, which indirectly increased fish production, hence increased income and food security.

4.8 Summary of the results

This study aimed at evaluating the impact of the improvement program (interventions) on FRLC production, hence farmer's socio-economic benefits. Thus from the results of this study, it can be concluded that the interventions had no statistical significant impact on FRLC production. However the interventions had a statistical significant impact on the practices towards disease control and breeding, and a non-significant impact on the practices towards feeding management and housing management.

Also the intervention program had a significant influence on the change of knowledge in feeding management, disease control and breeding but had an insignificant impact on the change of knowledge in housing management. The intervention program had no significant

impact on the change of attitude towards FRLC production but a significant impact on the change in FRLC management practices.

The study results revealed that, the interventions on disease control were the most economical while the interventions on housing management, feeding management and total management of all inputs had a negative effect on net-return. The socio-economic characteristics, which had a statistical significant influence on the interventions, were Education, income, cropping system and the FRLC farm-gate price.

From the study results, it was seen that the interventions had a statistical significant impact on the practices towards disease control and breeding but an insignificant impact on the practices towards feeding and housing. Therefore, the decrease in net-return from FRLC production when housing, feeding and all inputs were used could have been attributed to the poor interventions practices. And the economical benefits from disease control could have been attributed to the adoption of the interventions on disease control.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Overview

The major objective of this study was to evaluate the impact of the interventions on smallholders' socio-economy in Morogoro rural. Specifically, the study aimed at: (i) evaluating the socio-economic characteristics influencing the interventions, (ii) evaluating the impact of the interventions on, the level of knowledge on FRLC management, the attitude towards FRLC production, and the practices in FRLC management, (iii) exploring the intervention effects on FRLC production. This chapter presents conclusions and recommendations emanating from the major findings of the study.

5.2 Conclusion

This section comprises the conclusions from the study results; the conclusions include the farmers' socio-economic characteristics influencing the intervention on FRLC management; the impact of the interventions on, the level of knowledge on FRLC management, the change of attitude towards FRLC production, and the change in FRLC management practices. Also the conclusion includes the impact of the interventions on FRLC production.

5.2.1 Socio-economic characteristics influencing the interventions

In evaluating the socioeconomic characteristics influencing the adoption of the interventions, it was hypothesised that the characteristics of smallholder farmers had a significant impact on the FRLC production improvement program. The education level of

the respondents, income or wealth, the cropping systems and the FRLC farm-gate prices were the socio-economic factors found to have a significant influence on the adoption of the interventions.

5.2.2 Impact of the interventions on the level of knowledge on FRLC production, on the change of attitude and practices towards FRLC production

The study found out that the FRLC production improvement program had a significant impact on the acquired level of knowledge on FRLC management; however the interventions only had a significant impact in improving the level of knowledge on feeding management, disease control and breeding. The interventions did not improve the level of knowledge on housing management. Most respondent's attitude towards FRLC production was to keep their chicken as a supplementary enterprise and the interventions did not change their attitude. However the interventions did influence their change in practices towards FRLC production; the respondents moved from the scavenging to the semi-scavenging and intensive system.

5.2.3 Impact of the interventions on FRLC production

The null hypothesis that the production improvement program had a significant impact on FRLC production was rejected because it was found out that the production in FRLC was not significantly different between the project and the non-project representatives. In spite of the intervention's insignificant impact, the project representatives' income from FRLC and FRLC production (FRLC market value) was higher that of non non-project representatives by 8.1% and 0.26% respectively. Further, the total household income for project representatives increased by 0.5%. Although the FRLC production improvement

program had a non-significant impact on FRLC production, the effect of the use of inputs on disease control showed an economical effect in FRLC production. However there was a decrease in net-return from housing and feeding management. The interventions had a significant impact on the practices towards disease control and breeding and an insignificant impact on the practices towards feeding and housing. The significance of the practices towards disease control makes it the most economical input.

5.2.4 Socio-economic impact of the interventions

From the tested hypothesis, the interventions had no significant impact on the FRLC production. However, the interventions gave a higher income and the FRLC market value. The average household income increased by 0.5%, implying an improvement in the smallholder farmers' socio-economy. Other indirect benefits due to the interventions were also observed. For example, the use of FRLC manure as feeds for fish and as manure in the gardens, improved production in other agricultural activities leading to improvement in family income and food-security. Other indirect benefits obtained were, the use of the income they obtained from FRLC to buy other food items and agricultural inputs, hence increased production in other agricultural activities and subsequently improving the farmer's welfare. The improvement in FRLC production also improved the food security of the family, as chicken and eggs consumption increased.

5.3 Recommendations

Based on the findings of this study, the following recommendations are suggested for improving the implementation of project activities.

5.3.1 Socio-economic characteristics

Socio-economic characteristics like education, income/wealth, cropping systems and FRLC farm-gate price were characteristics that influenced the adoption of the interventions. Therefore, it is recommended that in educating farmers on new technology, their socio-economic situations should be considered. For example, respondents with no education should be treated differently from respondents with primary or secondary education.

5.3.2 Selection of target farmers

During the study survey it was observed that most project recipients were active respondents; and in selecting a sample for the study, the project representative or the extension officers would choose the most active respondents. Therefore, it is recommended that in selecting respondents as project representatives, projects should not just select upfront and well off families in order to get good results, but should consider the less privileged as well. For example, when dealing with FRLC families, project participants should be selected at random and asked if they are willing to participate in the project activities and a follow up of their participation should be made. If the project evaluation gets positive results because of dealing with the inspired families only, then the results would be biased, as the population sample doesn't present the actual population or situation and in the long run, giving wrong suggestions and solutions, which would not solve problems in the society.

5.3.3 Project sustainability

The survey showed signs of sustainability due to the higher benefits than the cost obtained from adopting the improvement program, and project viability from the benefit/cost ratio. However, respondents reported poor access to vaccines due to the fact that drugs were sold in large quantities per viral. The quantities and even the high prices are not commensurate with the small sized flock. Therefore, in ensuring project sustainability, the new technologies should be made available even after the project has ended. Also, the costs of new technologies should always be lower as compared to the benefits. Project participants should be advised and encouraged to disseminate the introduced technology to their fellow farmers. For example, the project can advise the farmers on the importance of educating their fellow farmers on vaccinating their FRLC against ND in order to prevent the disease outbreak in their villages.

5.3.4 Economic incentives

The study results show that the FRLC production improvement program had no significant impact on the FRLC production. The level of insignificance could have been due to the farmer's failure to put the acquired knowledge into practice because of poor resource base. Hence, it is recommended that the intervention packages should be coupled with economic incentives such as credit facilitation; social groups - to create capital and technical know how; and market access. Therefore, it is recommended that further research be carried out on evaluating the impact of interventions when coupled with economic incentives such as credit facilitation, social capital groups and market access.

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APPENDICES

Appendix 1 : A semi-structured questionnaire for a study on the Socio-Economic impact of smallholder free range local chicken (FRLC) improved husbandry system: A case of rural Morogoro.

Section A: Data on the Socio-economic situation of the farmer

	Enumerator
	Date
1.	Status of farmer Intervention/non intervention
2.	District
3.	Village / zone
4	Name of respondent involved in chicken production
5	Position in household 0=Wife 1=Head of household 2=Child 3=Others
6	Age of respondent
7	Marital status 0=married 1= single 2= widow 3= Divorced 4=polygamy
8	Occupation 0= farmer 1=Employed (state) 2=Business(state) 3=Others .....
9	Do you have another occupation other than being a farmer or other source of income Eg Remittances
10	Number of people leaving in the household
11	Sex of headed household 0=female 1=male
12	Education level of headed household 0= no formal education 1=primary education 2= secondary education 3= advanced education (high school, cert, diploma, university) 4= others.....
13	Livestock kept 1.chicken 2.goat 3.cattle 4. pigs 5. others.....
14	Total income from livestock..... Chicken..... Goat..... Cattle..... Pig..... Others.....

15	Crops grown 1. Tomatoes 2.Sugarcane 3. Paddy 4. Maize 5. Sunflower 6. Others.....
16	Total income from crop production..... Tomatoes..... Paddy..... Sugarcane..... Maize..... Sunflower..... Others.....
17	Aim of cultivating crops 0= Food crops 1= Food and Cash crops
18	Total family income per year.....
19	How do you use your income from poultry? 0=health 1=education 3= purchase other food 4=others.....
20	How much do you spend per year on food? Low season High season Oil..... ..... Salt..... ..... Meat..... ..... Onions..... ..... Tomatoes..... ..... Others..... .....
21	How much per year do you spend on assets?
22	How much per year do you spend in education?
23	How much per year do you spend in health?.....
24	How much per year do you spend on luxury (luxurious goods)? Alcohol..... Ceremonies..... Others.....

25	How much per year do you spend in clothing?
26	How much per year do you put on servings?
27	How much per year (Production expenditure) do you spend on inputs?.....
28	How much per year do you spend on other activities?.....
29	What is your total expenditure per year?.....
30	Do you have access to extension and veterinary services? 0=no 1= yes
31	Is the cost for Veterinary/ Extension services a constrain to your FRLC production? 0=No 1=yes
32	Do you have access to other poultry inputs? 0=No 1=Yes
33	If no, mention the unavailable ones.....
34	Do you find the feed cost a constrain to your production?0=No 1=yes
35	Do you find the cost of other poultry inputs a constrain to your production?
36	How do you sell your chicken? 0= farm-gate (neigbour) 1= farm-gate (Middleman) 2= Market place (rural) 3=Market place (urban) 4= Others.....
37	What is your aim of keeping Chicken? 0= for home consumption 1=Petty cash, home consumption and social functions (supplementary enterprise) 2=Traditional background 3=Commercial purpose 4=Others.....

Productivity:

Meet Production

38. What was the FRLC Farm-gate price this year?

Low Season			**High Season**	
Number of FRLC sold		**Price**	**Number of FRLC sold**	**Price**
Cock				
Hen				
Growers				
Chicks				

39. How many chicken do you have?

Cock.....

Hen.....

Growers.....

Chicks.....

40. How many have you consumed this year?

Cock.....

Hen.....

Growers.....

Total.....

41. How many have you given away as presents/ rituals?.....

42. How many have you purchased this year?.....

43. How many have died this year

Cock.....

Hen.....

Growers.....

Chick.....

Total.....

44. What was the source of death?

0= Unknown

1= ND (Mdondo,Kideri)

2= Influenza (mafua ya kuku)

3= Others.....

Cost of production and impact of the intervention

45. Have you received education on how to build a FRLC house and its importance?

0=No 1=yes

46. What type of chicken house do you have?

0= No house

1= Part of house

2= Made of local available materials

3= Bricks

4= others.....

47. What is the estimated cost incurred.....

48. Estimated lifetime.....

49. Who/what inspired you to build a FRLC house?

0= Hygiene 1= Advised by fellow farmers in the project 2= To protect them from Hazards 3= Through experience Others.....

50. Analysis of respondents knowledge score

Type of Knowledge	No (0 score)	Yes (1 Score)
Housing		
Daily cleaning/weekly if well constructed can allow litter to pass though		
Separate Layers from growers and chicks		
Built at recommended level with tree structure for birds to fly		
Leave chicks confined inside in the early days, to protect them from predators		
Feeding		
Supply with water		
Supply with feeds		
Supply feeds separately to chicks, growers and layers		
Give additional quality feeds to layers eg. Calcium and protein		
Supply feeds according to season, Age and available feeds for scavenging		

Disease		
Use conventional medicines		
Use ethno veterinary medicines		
Use *Aloe secundiflora*		
Use ND vaccine		
Use ND vaccine at recommended time		
Know vaccines to used against ND		
Control other diseases		
Know symptoms of ND virus		
Know symptoms of other disease (two or more)		
Selection and Breeding		
Cull old chicken		
Cull poor breed.		
Cross breed and select the best breed culling the weak.		
Brooding (remove chicks from layers at early days)		

51. How much cost do you incur in?

	Cost per chicken	Total cost on vaccination/medicine/service	Total cost per year
Every vaccination ND(Subsidised) (Unsubsidised) Others.....			
Cost for other medicines			
Cost for diagnosis			
Cost on ethno-Veterinary treatment			
Cost of chicken death			
Cost of housing			
Cost of feeds			
Cost of labor			
Opportunity cost of labor in chicken			
Total cost			

Project Sustainability

52. Will you continue/have you continued with the improved system of production?

0. No

1=Yes [ ]

Thank-you very much

Appendix 2:Multiple Comparisons

Dependent Variable: the total value of chicken per year

LSD

					95% Confidence Interval	
					Lower Bound	Upper Bound
	Medium(between 350,000-1,000,000)	-64594.52	47446.530	.179	-159604.56	30415.52
	high(greater than 1,000,000)	-133821.36(*)	47936.425	.007	-229812.39	-37830.32
Medium(between 350,000-1,000,000)	Low (less than 350,000)	64594.52	47446.530	.179	-30415.52	159604.56
	high(greater than 1,000,000)	-69226.84	44825.092	.128	-158987.54	20533.86
high(greater than 1,000,000)	Low (less than 350,000)	133821.36(*)	47936.425	.007	37830.32	229812.39
	Medium(between 350,000-1,000,000)	69226.84	44825.092	.128	-20533.86	158987.54

* The mean difference is significant at the .05 level.

Appendix 3: Multiple Comparisons

Dependent variable the value of FRLC per year

LSD

(I) price grade	(J) price grade	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
less than 2500	2500-3500	36264.55	44003.244	.414	-52034.42	124563.52
	Greater than5000	-141686.90(*)	66004.865	.037	-274135.36	-9238.45
2500-3500	Less than 2500	-36264.55	44003.244	.414	-124563.52	52034.42
	Greater than5000	-177951.46(*)	64145.199	.008	-306668.21	-49234.70
greater than5000	Less than 2500	141686.90(*)	66004.865	.037	9238.45	274135.36
	2500-3500	177951.46(*)	64145.199	.008	49234.70	306668.21