ASSESSMENT OF TECHNOLOGY ADOPTION FOR FREE RANGE LOCAL CHICKEN IMPROVEMENT IN MZUMBE WARD MVOMERO DISTRICT MOROGORO

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULLFILMENT FOR THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN TROPICAL ANIMAL PRODUCTION OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

The assessment of technology adoption for free range local chicken improvement was carried out using a sample of one hundred and twenty (120) farmers, fifty trained farmers, fifty neighbouring farmers and twenty control farmers. A structured questionnaire was used. Other data were obtained by direct measurement of eggs and adult live birds. Multiple Range Test (MRT) was used to separate the means especially for the production data. Results indicated that adoption rate among the trained farmers were high, being 92%, 88%, 92% and 56% in use of supplementary feeds, disease control, chick management and improved housing respectively. As for neighbours the values were 60%, 68%, 54% and 50% respectively. Much lower adoption was observed in control group values ranging from 20-55%. Record keeping was lowly adopted by all groups. Availability` of extension services, education level and veterinary services influenced adoption rate significantly ($P<0.05$). Trained farmers group had significantly ($P<0.001$) higher values for eggs weight and ($P<0.05$) flock size than the other categories. Male and female adult bird weights were significantly ($P<0.001$) higher for trained farmers than untrained farmers. Mature laying hens in the flock increased from 16% to 40%. Eggs laid/hen/cycle increased from 8-15 to 15-25, chicks hatched/hen/cycle increased from 9-12 to 10-16, chick mortality was reduced from 65% to 30%, while grower mortality was reduced from 50% to 20%. It is concluded that, relatively simple interventions such as feed supplementation, disease control and housing, in small-scale free range local chicken production, may significantly improve their production within a relatively short period of about 1-2 years.

DECLARATION

I, Emmanuel Mbonea Masha, do hereby declare to the Senate of Sokoine University of Agriculture, that this dissertation is my original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

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DEDICATION

To the almighty God: ‘But you, O LORD, are a shield around me, my glory, and the one who lifts my head high. I cried out to the lord, and he answered me from his holy mountain’. PSALM 3:3-4.

To my parents: My father Mbonea Matayo Masha, my mother Wemaeli and my aunt the late Nterindwa Matayo Masha for they laid my academic foundation. May the Almighty God bless them.

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LIST OF ABBREVIATIONS

CDF	-	Cumulative Distribution Functions
CIMMYT	-	Centro International de Mejoramiento de maiz Tigo International Maize and Wheat Improvement Centre)
FAO	-	Food and Agriculture Organization
FRLC	-	Free Range Local Chicken
FSA RET	-	Farming Systems Approach to Research, Extension and Training
GDP	-	Gross Domestic Product
GLCRSP	-	Global Livestock Collaborative Research Support Programme
HRV4	-	Heat Resistant Vaccine
IPM	-	Integrated Pest Management
KARI	-	Kenya Agricultural Research Institute
LIFDC	-	Low Income, Food-Deficient Countries
LPM	-	Linear Probability Models
MLE	-	Maximum Likelihood Estimation
MOA	-	Ministry Of Agriculture
MRT	-	Multiple Range Test
NDAF	-	Newcastle Disease and Avian Flu
ND	-	Newcastle Disease
NGOs	-	Non Governmental Organizations
SFRB	-	Scavengable Feed Resource Base
SPFS	-	Special Programme for Food Security
SPSS	-	Statistical Package for Social Sciences
SUA	-	Sokoine University of Agriculture
UNDP	-	United Nations and Development Programme
US$	-	United States Dollar

CHAPTER ONE

1.0 INTRODUCTION

There are about 28.3 million poultry in Tanzania, and of these 26.6 million (94%) are the free range local chicken (FRLC), while 0.5 million (1.8%) are the commercial broilers and layers and the remaining 1.2 million (4.2%) are other poultry, mainly ducks (3.4%) (MOA, 1995). The big potential of the FRLC has not been realized and utilized in Tanzania because of a number of reasons. The major reasons are: Chicken losses through various causes, the low genetic potential, low plane of nutrition, and poor husbandry system which is a low or near zero input extensive type (Kitalyi, 1998). The low input, low output husbandry system is characterized by poor nutrition, poor or no housing facilities, unplanned breeding, no veterinary interventions and lack of provision for rearing chicks. In an earlier study by Minga *et al.* (1989), it was reported that the main loss among the FRLC occurs during chick hood and averages 50%. The other losses of growers and adult chickens are due to chicken diseases, predators and theft. Chicken loss during adulthood is mainly due to diseases, especially Newcastle disease (ND) and theft. Whereas commercial chickens are regularly vaccinated against ND, the FRLC are rarely vaccinated against the disease and even when vaccinated, the programmes are often not sustained.

In most African countries, (Tanzania inclusive) FRLC have no regular health control programme, may or may not have shelter, and scavenge for most of their nutritional needs. Supporting data in the literature have been provided for Burkina Faso (Bourzat and Saunders, 1990), Ghana (van Veluw, 1997), Mali (Kuit *et al.,* 1996), Togo (Aklobessi, 1990) and the United Republic of Tanzania (Yongolo, 2004). Therefore, several poultry scientists have recently suggested a specific scientific thrust for rural poultry, aimed at improving the understanding of the biological and socio-economic factors affecting the input-output relationships and the economic efficiency of the production systems. The main message is that FRLC have an important role in increasing household food security and income, as well as increasing gender equity. These free range local chickens remain predominant in African villages despite the introduction of exotic and crossbred types, because farmers have not been able to afford the high input requirement of introduced breeds (Safalaoh, 1997). FRLC in rural Africa are characteristically:

i. An indigenous and integral part of the farming system, with short life cycles and quick turnovers;
ii. Low-input production systems with outputs accessible at both interhousehold and intrahousehold levels;
iii. A means of converting low-quality feed into high-quality protein

Moreover, land - a critical production resource in rural Africa - is not a limiting factor in FRLC production systems. Consequently, disadvantaged groups in the community can be direct beneficiaries of FRLC improvement programmes. For example, FRLC production improved the status of landless women in Bangladesh through access to more food, income and labour, as well as increased social status in the rural community (Saleque and Mustafa, 1996). The Bangladesh project was based on a semi-scavenging model for rural poultry that combined technical improvements with institutional and organizational support (Jensen, 1996). Access to FRLC for women encourages involvement of women in rural development, particularly where technology transfer includes the participation of end users.

Conventional research into farmer adoption of new technology explains the adoption-decision and the timing (early or late) primarily in terms of the decision maker's perceptions and inherent characteristics, with "innovators" at one extreme and "laggards" at the other (Cramb, 2003). However, farmer's decision making is generally more complex. Farmers have multiple objectives including food security, adequate cash income, a secure asset or resource base and social security. Farmers select "livelihood strategies" to pursue these objectives with the resources available to them. Both the objectives and the available resources vary between farmers and change over the life cycle of the farm household. Thus, farmers in the same environment may have different objectives and livelihood strategies, so they respond differently to a given technology. Furthermore, within the farm household, the ability to make decisions regarding resource use and technology varies according to age, gender and other categories like education level and financial status. Actual decisions can depend on a complex bargaining process among household members (Cramb, 2003).

Cramb (2003) contend that differences between the environment in which the technology was developed and the environment of the "target “community will prompt farmers to adapt the technology in the process of adopting it. Differences within a given community in farmers' goals and circumstances, livelihood strategies, and the complexity of intra-household, group, and project interactions and decision-making will result in a variety of adoption-adaptation behaviours, which should be investigated on their own terms and not pre-judged by labelling them as "poor adoption" or "non-adoption”.

1.2 Problem Statement

The national economies of most third world countries are dependent on the agricultural sector. However, this sector is often unable to adequately meet the populations’ food and foreign exchange requirement. Agriculture in these countries is characterized by being a dual sector. “Firstly, there is a small modern sector using advanced technology and producing for the market. Secondly, there is a large subsistence sector often called ‘traditional’ using indigenous techniques and producing mostly for home consumption” (Achour, 1990).

In order to improve the traditional sector, agricultural productivity, social and economic conditions, governments and international agencies have tried development strategies based on the adoption of new production techniques. Many agricultural and rural development programs have been implemented in the Third world. Yet these programs have not alleviated hunger and poverty. On the contrary, these programmes have often disrupted the farmers social economic organizations, impoverished small farmers, increased inequality between large scale farmers and increased the rate of rejection of the proposed technologies and practices. Several studies show that small scale farmers tend to reject new technologies and practices than adopt them (Machumu, 1995).

The non-adoption of new ideas by small holder farmers in developing countries is a concern to international development agencies and governments in the Third world (Machumu, 1995).

The importance of improved agricultural technology in relation to agricultural development has been realized in Tanzania, it is believed that technological changes allow farmers to compare and assess input/output relationships (Mvena and Mattee, 1988).

Under prevailing economic conditions, the free range local Chicken (FRLC) therefore appears to be a better alternative to the commercial chicken because it requires minimal inputs in terms of finance, manpower and land resources and hence the final product can be made affordable (Kitalyi, 1998). However, the FRLC has been neglected and limited efforts have been made by government, non governmental organizations (NGOs) and farmers to improve their health and productivity (Saleque and Mustafa, 1996). If effective technologies are developed and fully adopted, they will lead to positive impact on farmers' income and nutrition (Mvena and Mattee, 1988).

By adopting improved technologies, at individual or community level, households could improve food security, raise income, and improve household health status while preserving land and natural resources (Saleque and Mustafa, 1996).

An understanding of the processes leading to the adoption of new technologies by smallholders has been important to the planning and implementation of successful research and extension programs. At one level, a number of farm-household factors are typically associated with adoption, such as:

i. age, education and personal characteristics of the household head
ii. size, location and tenure status of the farm
iii. availability of cash or credit for farm investment
iv. access to markets for farm produce.

However, at the village level and beyond, more interesting and significant issues often arise: Why is there widespread adoption in one village but not others in the same general location? Why does one project lead to apparently successful adoption, but another following the same procedures and promoting the same technologies, result in failure? Answers to these questions are likely to be useful in achieving widespread agricultural development.

1.3 Justification

A project known as 'Newcastle Disease and Avian Flu control' (NDAF) under the support of the GLCRSP was implemented in year 2007, in Mzumbe ward, Mvomero District, Morogoro. The aim of the project was to improve livelihood of people through keeping Free range local chicken. About 83 farmers, 64 males and 19 females were trained on chicken disease control, chick management, and feed supplementation to the free range local chicken, egg management, housing and record keeping. Since then there has been no assessment made on the adoption of those technologies delivered to farmers. The main objective for carrying out this study was to assess to what extent the technologies have been adopted and reasons for non-adoption. The identification of the constraining factors may aid the government and other agencies responsible for extension, planning and policy formulation to more appropriately promote the adoption of free range local chicken management technologies.

1.4 Objectives of the Study

1.4.1 General objective

To assess the use of technologies delivered to farmers for improving free range local chicken health, management and productivity.

1.4.2 Specific objectives

(i) To assess the extent of adoption of technologies among trained farmers and untrained farmers.

(ii) To assess the impact of technology adoption on chicken performance

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 General Consideration

This chapter presents the literature review on adoption of technologies, factors affecting adoption of agricultural technology and review on productivity of free range local chickens.

2.2 Adoption Defined

Adoption of technology is defined as a decision to apply technology and continue to use it, (Van de Ban and Hawkins, 1996). Some authors tend to modify the above conventional definition to include real adopters and potential adopters (Nellet *et al.,* 1999). The argument is that, had there been no limitation in accessing and using the technologies, the potential adopters would become adopters. Willingness to change and desire to try new ideas are the main cause of innovative behaviour. Adoption processes refer to a series of changes that take place within an individual with regard to the technology. These changes start from the moment that the farmer first becomes aware of that technology to the final decision to use it or not (Van de Ban and Hawkins, 1996).

2.3 Stages of Adoption

The adoption process involves various stages ,these are (a) Awareness stage in which the farmer or potential innovator hears about the technology for the first time (b) Interest building stage in which the farmer seeks more information about the technology (c) Evaluation in which the farmer weighs the advantage and disadvantage of using the technology (d) Trial stage in which the farmer tests the technology on small scale to avoid risk associated with using the technology (e) Adoption stage in which the farmer applies the technology on a large scale in preference to the old technologies. In this study a definition by (Van de Ban and Hawkins, 1996) will be adopted. The primary question in adoption is what constitutes adoption? What is the minimum proportion of farmer's practices to be called adopters? According to (CIMMYT, 1993) adoption can be measured by determining the rate of adoption (percentage of farmers practicing new technologies). It can also be measured by looking at the intensity (percentage aggregate of technologies adopted). Adoption can also be measured by percentage aggregate of output for the improved management.

2.4 Adoption and Diffusion of Technology

Adoption of the technology is distinguished from diffusion by time factor. According to CIMMYT (1993), adoption is measured at a point in time; whereas the diffusion of technology is the spread of the technology across the community over time.

2.5 Theories on Adoption of Technology

These are classified as sociological and economical theories (Semgalawe, 1998) under sociological theories there is (a) Decision theoretical model in which adoption is regarded as learning process (Van de Ban and Hawkins, 1996). (b) The adoption curve model in which adopters are divided into five categories namely innovators, early adopters, early majority, late majority and laggards. (c) Group dynamic model that takes into consideration the influence of community into adoption process. According to adoption curve model, adoption behaviour differs across socio-economic groups and over time. Because of this, some technologies have been adopted only by a small group of farmers (Feder *et al.,* 1985). Cumulative proportion of adoption follows an 'S' shape curve in most cases (Rogers, 1993). This implies slow initial growth in the use of technology, followed by a more rapid increase and then slowing down as the cumulative proportions of adoption approach maximum (CIMMYT, 1993).

Lionberg and Gwin, (1991) asserted that the curve has three parts. In part one, majority of people wants to see the technology tried locally by someone else first. In part two majorities of society adopt the technology as a result of interpersonal communication and finally in part three the adoption rate declines. This is a period when some farmers having tried the technology, decide to discontinue using the technology depending on how they perceive it. CIMMYT (1993) says that in such a situation, it is worth to get information on why farmers stop using it.

2.5.1 Sociological theories

According to Rogers (1993) there are five adopter categories under sociological theories. These are innovators, early adopters, early majority, late majority and laggards. Each of these categories is discussed as follows.

Innovators

Innovators are venturesome individuals in social systems, who are very eager to try new ideas, have substantial financial resources, and the ability to understand and apply complex technical knowledge. They are also able to cope with a high degree of uncertainty, and play an important role in launching a new idea in a social system by importing it. They are the gate keepers with regard to flow of new ideas in social system, and cosmopolitan in terms of social relations (Rogers, 1993).

Early adopters

Early adopters are a more integrated part of the local system than the innovators, whereas innovators are cosmopolites, early adopters are localites. This adopter category has the greatest degree of opinion leadership in most social systems more than any other. Potential adopters look to early adopters for advice and information about the technology. The early adopter is considered by many people as “the individual to check with” before using a new idea. This adopter category is generally sought by change agents to be a local missionary for speeding the diffusion process (Rogers, 1993).

Early adopters serve as a role model for other members of a social system because they are not too far ahead of the average individual in innovativeness. This adopter category is respected by its peers, and is the embodiment of successful and discrete use of new ideas. They also know that to continue to earn the esteem of colleagues and to maintain a central position in the communication structure of the system, it is necessary to make judicious technology decisions. The role of the early adopters is to decrease uncertainty about a new idea by adopting it, and then convey a subjective evaluation of the technology to near-peers by means of interpersonal networks (Rogers, 1993).

Early majority

The early majority adopt new ideas just before the average member of the social system. The early majority interact frequently with their peers, but seldom hold leadership positions. The early majority’s unique position between the very early and the relatively late to adopt, makes them an important link in the diffusion process. They provide interconnectedness in the system’s networks. The early majority may deliberate for sometime before completely adopting a new idea. Their innovation- decision period is relatively longer than that of the innovator and the early adopter (Van Ban and Hawkins, 1996).

Late majority

Late majority are people in a social system, who adopts technologies relatively late, they do so only after the technologies have been adopted by majority of people in the society.

Rogers (1993) contends that late majority are sceptical, their adoption is in response to economic necessity and peer pressure.

Laggards

Laggards are the last people in a social system to adopt technologies. They possess almost no opinion leadership, they are the most localites in their out look of all adopter categories; many are near isolates in social networks. Decisions are often made in terms of what has been done in previous generations and these individuals interact primarily with others who also have relatively traditional values (Rogers, 1993).

2.5.2 Economic theories

Under economic theories there are four adoption models: (1) Utility maximization model that explains households' behaviour towards decision making on various choices confronting them (2) The profit maximization model that states that the rational behaviour of household is profit maximization (3) Technological change model that is based on technical efficiency (Semgalawe, 1998). It implies that the household's willingness to change and ability to make production investment is influenced by the output and profit levels associated with technology use (4) Risk and uncertainty model. According to this model, household risk aversion inhibits diffusion and adoption of innovations that could increase output and income of the household (Gravelle and Rees, 1992).

Both social and economic theories are used in adoption studies and are useful depending on the nature of study and the professionals involved. Adoption study by sociologist will tend to draw more from sociological models while economist tends to apply more of economic theories. Since farmers' decisions to adopt technologies are influenced by both sociological and economical factors, it is imperative to combine both theories.

2.6 Factors Influencing Adoption of Technologies

Adoption of a particular technology is influenced by a number of factors. These factors have been classified into four broad categories namely; Demographic, Institutional, Environmental and Farmers' subjective perception of new technology (Achour, 1990).

Examples of demographic factors are education level, gender, experience, age, religion, and marital status. Institutional factors include extension services, input and output marketing system, credit facilities, land tenure system, information and communication infrastructure. Environmental factors land quality and soil type are important factors influencing the acceptance of new technology, Farmers' perception which is associated with the characteristics of technology as perceived by them, e.g. palatability, cooking time colour and size. Some technologies may have a relative advantage, for example high yielding variety. Others may be easy and compatible to the existing farming system while others are complex and incompatible (Bisanda and Mwangi, 1996).

2.6.1 Institutional factors

It has been reported that Institutional factors particularly the credit component, overall market environment, frequency of extension visits, and proximity of farm to formal markets are important determinants of agricultural technology adoption (Bisanda and Mwangi, 1996; Mkenda, 1997; Msuya, 1998; Ntege –Naneenya *et al.*, 1997).

Credit

Credit is an important element in modernizing agriculture because it allows the use of other factors of production produced off the farm, for example industrial materials which are important in agriculture. The demand for credit has increased over time relative to the degree of specialization of farm activities and reliance on purchased inputs. The need for credit has been identified as an important factor in promotion of new necessary influence to promote new technologies if they are to be adopted quickly (Kashuliza *et al*., 1998).

Capital in the form of either accumulated savings or access to capital markets is required to finance many new agricultural technologies. Thus, differential access to capital is often cited as a factor in differential rates of adoption (Feder *et al.,* 1985). Banks and other formal lending institutions often pose problems to small farmers. In Africa, many of these institutions especially commercial banks are not keen to lend to the rural sector as the latter has a reputation for poor loan repayments. However some technologies require high costs of inputs, which are not affordable by small–scale farmers without credit facilities. In this regard farmers with access to credit have a higher probability of adopting capital intensive technologies (Bisanda and Mwangi, 1996).

Extension services

In the context of farming, extension is defined as an assistance to farmers to enable them identify and analyse their production problems and become aware of opportunities for improvement by changing their outlook towards their difficulties (Rogers, 1993). Tanzania being an agricultural oriented country requires farming techniques so as to assure high production (Minjas and Delobel, 1990). Agricultural extension as a link between research and peasants has an important role to play in enhancing this productivity. In most countries, the key person to give farm level training is the extension agent. A change agent is an individual who influences client' innovation decisions in a direction deemed desirable by a change agency (Rogers, 1993). The extension agent's aim is to explain characteristics of the technology to farmers and identify social implications of the innovation (Minjas and Delobel, 1990). Some constraints to the adoption of technology are of extension nature. The ineffective of extension system in respect to adoption of improved technologies and practices may be attributed to a number of reasons such as ineffective extension methodology, unaffordable technologies by farmers and poor supervision.

Others include poor coordination in the extension organization, lack of incentives and motivation of extension agents, and financial constraints that lead to poor transport facilities. In addition, poor infrastructure and low salaries for extension agents contribute to the ineffective extension system. Some of the indirect constraints to the transfer of technology by extension officers are that wealthier farmers in any area have a tendency to dominate the activities and time of extension officers at the expense of the less powerful and needy families (Kauzeni, 1988). Studies also reveal that failure of many extension programmes to reach the majority of smallholder farmers is due to neglect of extension services for women who contribute a major proportion of the family farm labour (Shayo, 1990; CIMMYT, 1993). Social status such as leadership position in rural set up has been reported to influence adoption of improved cassava production (Obinne and Jojo, 1991). Lack of market for certain varieties may be decisive factor to adopt or not adopt the technology in question. It is therefore worthy studying the existing market and market systems in relation to adoption of improved technologies (Minde and Mbiha, 1993).

Research

Agricultural Research establishment in any country is focused in agricultural technology development and adoption. The objective is to ensure that new agricultural technology is developed and used by farmers. Many developing countries lack adequate research infrastructure or even a coherent and logical research policy. Within the research system some of the problems include lack of understanding by researchers of the complexities of smallholder agriculture, and the lack of impact by newly developed technologies. Mvena and Mattee (1988) grouped such problems into four categories:

a) Lack of knowledge and understanding of the farming systems.

b) Insufficient feed back from the farmers to research programmes.

c) Insufficient understanding of the environment in which farmers work.

d) Lack of mechanisms for testing and adopting technology on farmers' fields.

This means that the process of technology development is fraught with problems which render it less effective. Agricultural research in developing countries is based on a technical perspective of agricultural problems and provides a product which is unfinished in terms of the needs of the small farmers it seeks to serve. More farmers may not have access to the resources required for the technology adoption. In Iringa Tanzania, for example, the extension and research institutions were found to be insignificant in promoting adoption of hybrid maize seed (Hella, 1992).

2.6.2 Demographic factors

Demographic characteristics such as household size, income, education level, and farming experiences have been reported to affect adoption of improved varieties and fertilizer (Bisanda and Mwangi, 1996).

Education

The majority of small scale farmers in the villages can neither read nor write, and therefore cannot benefit from written materials. The farmers' education background is an important factor in determining the readiness to accept and properly apply the technology (Swanson *et al.,* 1984). Education makes a farmer more receptive to advice from an extension worker or more able to deal with technical recommendations. The more complex the technology is the more likely it is that education will play a major role (CIMMYT, 1993).

Age

Rate of adoption of a new technology is higher among young age members than older ones. Young and energetic people have proved to be more venturesome, active and ready to try innovations (Nanai, 1993), and are called ‘innovators’ (Rogers, 1993). Older people have more experience but their receptivity to new ideas and technologies typically decreases with age (John, 1995). Age of respondents was one of the factors which influenced the adoption of hybrid maize seed in Iringa region, Tanzania (Hella, 1992). It was also found that the adoption of hybrid maize seed was high among farmers aged between 26-50 years than young age group. This suggests that if extension agents concentrate more on this group, the adoption of technology can be enhanced.

Income

Wealthier farmers may be the first to try a new technology, especially if it involves purchased inputs. This may be because wealthier farmers have better access to extension information or to credit, or they may be able to use their own cash resources to experiment with a new technique (CIMMYT, 1993). Many times, it is farmers with more resources in the form of land, labour or capital that are able to take advantage of new technologies and practices. A study on the assessment of transfer and utilization of selected technologies in Musoma distric, found that the extension system tends to favour certain categories of farmers (Wambura, 1993). He found that richer, younger and better educated farmers within the surveyed villages had higher levels of extension contact than poorer, older and less educated farmers. In some cases, farmers with a more commercial orientation who sell a large proportion of their harvest are the ones who adopt certain technologies and practices.

Gender

Females are estimated to be the head of one third of households worldwide (Gass and Bigs, 1993). Similarly, most of the food producers in the world are women and yet most technologies are considered gender neutral in them, but often become gender biased during their introduction and use by societies (Stephens, 1992). Furthermore, Jefremovas (1991) asserted that female farmers have restricted or no formal land rights in many countries.

In most rural societies the social status of women is inferior to that of men. Due to this, they become a disadvantaged group especially when it comes to the introduction of new technologies and practices in their areas (Shayo, 1990). The evidence from Tanzania shows that it is difficult for extension agents to hold meetings or address female farmers freely. Wambura (1993) observed that although rural women receive information on farm practices from various sources, the impact of these sources to womens' access to agricultural information is still low. The study results showed that women's sources of agricultural information were their husband and neighbours. However, in Kenya a case study by Ngugi *et al*. (2007) presents evidence on how the use of gender sensitive participatory approaches (PA) in agricultural research for development enhances research outcomes and impacts among the National Agricultural Research Systems. PA ensures that the relevant stakeholders, both men and women are involved in development initiatives. In Kenya Agricultural Research Institute (KARI), PA was introduced in 1991 when the Institute adopted Farming Systems Approach to Research, Extension and Training (FSA-RET). This was during its implementation of adaptive research programme. However, FSA-RET alone as were soon realized, did not achieve high levels of technology adoption among the targeted groups. The missing link was failure to consider gender differences in its research processes. In Kenya, though female farmers contribute 80% of the total labour in food production and 50% in cash-crop production, they were ignored in KARI's research activities. To redress the situation, KARI embarked on a gender-mainstreaming process in 1995. Various efforts were initiated to enable research management and scientists embrace gender concerns in the Institute’s research agenda. The expected output was that projects undertaken would incorporate gender concerns resulting in high technology adoption levels, increased yields and improved livelihoods among the farming communities. The indigenous poultry was selected as one of the most gender sensitive projects implemented in KARI. It confirms that incorporation of gender concerns in research does improve livelihoods (outcomes and impacts).

2.6.3 Farmers’ subjective perception factors

By using standard classification for describing the perceived attribute of innovations in universal terms, Rogers (1993) came up with five attributes:

Relative advantage

Relative advantage is the degree to which an innovation is perceived as better than what it is intended to replace, advantageous to the adopter relative to the old way of doing things. Relative advantage may include reduced labour costs, and reduction in demand for labour to do unpleasant tasks. The greater the perceived relative advantage of technologies the more rapid its rate of adoption. A technology which can show obvious and quick profit in combination with reduced risks can be readily accepted (John, 1995). Due to this, the new technology may be perceived as a threat to some of the farmers. It is likely that, when the price of the technology decreases dramatically during its diffusion process, a rapid rate of adoption is facilitated.

In the case of backyard poultry, due to the scavenging habits, feed costs are kept at a low level, which in cash terms often make small-scale production profitable. The long-term profitability is more secure when simple technologies, such as vaccination, anti-parasitic medication, housing and equipment and use of local feedstuffs are adapted locally. The effect of vaccination, anthelmintics, feed supplementation, housing and management has been studied at village level in a number of countries, notably Bangladesh (Network, 2002). The results are highly promising, showing a decrease in bird mortality caused by Newcastle Disease from 21% to7 % by using vaccination, a significant increase in growth and egg production by using anthelmintics, the highest net profit for the farmers using only 60 g feed supplementation per day for semi-scavenging birds (Network, 2002). Other simple management procedures such as decreasing the broody period have long been shown to increase in egg production drastically in indigenous birds (Roberts, 1999).

In terms of income generation, keeping small flocks of 5-50 birds under improved management may make a big difference for poor farmers in many countries. “Egg-money” is a well-known term in many countries, signifying the money that is foremost earned by a woman in a poor household, and which she may decide herself on how to be spent (Gueye, 2000). Normally egg-money will be spent on cost relating to the children, i.e. school fees, clothes or food for the children.

Compatibility

Compatibility is the degree to which the technology is consistent with existing values, past experiences, and needs of potential adopters. A technology that is clearly compatible, profitable and reliable with farmers’ farming systems will be adopted relatively faster and its diffusion rate will be higher. Farmers are likely to adopt technologies that are more visible and have positive attributes. An incompatible technology often requires prior adoption of a new value system (Rogers, 1993).

Complexity

Complexity is the degree to which the technology is perceived relatively difficult to understand and use. There are technologies which appear in simplified packages that farmers could easily adopt and there are those that are complex and cannot easily be understood and adopted. Technologies that are simpler to understand can be adopted more rapidly than technologies that require the adopter to develop new skills and understandings (CIMMYT, 1993).

Triability

Triability is the degree to which the technology may be experimented on a limited basis. New ideas that can be tried on small scale will generally be adopted more rapidly than the one that cannot be tried.

Observability

Observability is the degree to which the results of the technology are visible to others. The results of some ideas are easily observed and communicated to others, whereas some technologies are difficult to explain to others. The easier it is for individuals to see the results of the technology, the more likely they are to adopt.

2.6.4 Environmental factors

Land quality and soil type may be important factors influencing the acceptance of a new technology. Not only do management practices differ by the type of soil but also other conditions such as slope or moisture retention capacity are often important. On the other hand, climatic factors play an obvious role in the management of farming systems. The possibility of drought or flooding makes farmers worry about investing in some technologies and practices. Climate, soils and other physical factors have a major influence on the levels of technology that are used by farmers for tillage, water application and conservation, type of crops planted and animals raised (Kebede *et al.*, 1990)

Sometimes the characteristics of the research package may not be appealing for farmers to adopt; such technologies need to be refined to conform to the farmers' criteria. Evidence from a maize study in the northern zone of Tanzania revealed that farmer' perception of technology characteristics example profitability, riskiness of use, compatibility with other practices, technical soundness, relevance to farmers needs and complexity of the technology are key elements in adoption (Nkonya *et al*., 1998). In that study, demand for hybrid maize was higher than composite maize although the latter can be recycled (Mkenda, 1997) reported a number of attributes influencing the probability of adopting SUA 90, a bean variety in Morogoro region. These include technology characteristics namely palatability, yield, cooking time, seed colour, and seed size.

2.7 Free range Local Chicken

2.7.1 Free range Chicken Performance

The productivity indices are relatively low among the FRLC. In a study made at Sokoine University of Agriculture (Minga and Nkini, 1996*)* it was reported that the average adult body weight was 1538 g (range 800–2450 g) and 1864 g (1650–3800 g) for hens and cocks respectively. The average egg weight was 41.8 g with a range of 25 to 56 g.

The growth rate under a free range system varied from 0.9 g to 30.2 g per day for chicks and growers, but the rate differed depending on age and initial weight. Mwalusanya (1998) reported that the average growth rate from day-old to 10 weeks of age was 4.6 g and 5.4 g per day for female and male chicks respectively. Hens laid an average of 40 eggs per year in three clutches. The average clutch size was 11.8 eggs, and hatchability ranged from 62%

to 89%, with an average of 83.6%. Msoffe *et al.* (2002) reported that FRLC are small in size, lay few and small eggs. Body weight vary within and between sex, live weight of hens ranges from 1.47 to 2.3 kg while cocks weight is between 2.3kg to 3.5kg and the shank length is between 7-15 cm long.

Apart from laying few eggs (22 to 26 eggs per clutch) with 3 laying cycles per annum, the number of eggs produced per chicken per year is very low. The size of the egg and of the adult Chicken is small under scavenging, in good management production is considered to be high (Katule, 1990).

The constraints experienced by the FRLC sector must be solved in order to increase their productivity. Once those constraints have been tackled, the chicken population will increase, off-take rate will increase, which could then be translated into better income and nutrition of rural people (Katule, 1990). A moderate increase of off-take would easily be accommodated by the current level of the economy and will force prices down. The experience in Tanzania shows that FRLC meat is preferred to that of commercial chicken meat on account of their perceived better taste there is thus a good market for the FRLC in urban areas in Tanzania (Minga and Nkini, 1996).

Egg production and chick survival are the key parameters used to study village chicken flock characteristics. The egg production data obtained through hen history in the study made by Kitalyi (1998) are within the ranges found in the literature (Table 1). However, the chick mortality rates observed in the Gambia are much lower than those reported from other systems (Table 1). Although the clutch size parameter is highly influenced by management, it could also be an indication of the potential for genetic improvement through selection. The study made by (Rushton, 1996) showed different annual egg production levels between the Gambia (23 eggs per hen per year) and Ethiopia (143 eggs per hen per year). The higher egg production levels in Ethiopia reported by (Rushton, 1996) were attributed to manipulation of the hen laying cycle, i.e. discouraging brooding. This management practice in Ethiopia could be attributed to a higher return from marketing eggs during the festival period. This practice is unique to Ethiopia compared with the other case study countries.

Egg production and chick survival data are probably the main determinant of the flock productivity. Chick mortality accounts for high losses in most village chicken production systems. Therefore, management factors that would have a positive impact on chick survival and egg production can be used to increase output from the village chicken flocks.

Hatchability is another important parameter in the production characteristics of a village chicken flock. The data obtained in the study made by (Kitalyi, 1998) which ranged from 71 to 78 percent, fall within the range reported in the literature (Table 1). The natural hatching characteristics of village chickens are an attribute that can be used in improving flock productivity. In the Bangladesh semi-scavenging model, local chickens were used to hatch eggs from improved stock as a means of introducing new genetic material (Jensen, 1996). Programs aimed at improving the health and productivity of the FRLC ought to be sustainable in order to have lasting impact on the income nutrition and health of target rural human population (Kitalyi, 1998). Kitalyi recommended a step-wise improvement of the FRLC production system;

Step 1: Improve hygiene, shelter, preferential treatment of chicks and control of devastating diseases and hence end up with healthy FRLC.

Step 2: Improve management of FRLC through supplementary feeding, better housing and disease control program and formation of farmers group.

Step 3: Improve FRLC productivity through selective breeding, for high yielding traits and for disease resistance. Improve feeding, marketing and formation of producer-consumer associations. Encourage vigorous promotion of the consumption of chicken meat, eggs and chicken products in urban and rural areas. Increased consumption would then create increased demand and thus sustain and promote improved chickens and increase FRLC production. Increase FRLC production in turn would add to food security, increased income, better nutrition and health for the resource-poor rural populations.

Step 4: Commercial village chicken production system: Multiplication and distribution of high-yielding FRLC types, promotion of improved and competitive marketing strategies.

Table 1: Production coefficients of FRLC in developing countries

Country	Clutch Per year	Eggs per Clutch	Egg wt	Hatchability %	Mature wt kg		Mortality		Source
					Cock	Hen	Chick	Mature	
Ethiopia	-	-	44-49	39-42	-	-	-	1.1-1.7	Shanaway and Banerjee(1991)
Burkina Faso	2.7-3.0	12-18	30-40	60-90	-	-	-	-	Bourzat and Sanders(1990)
United Republic of Tanzania	-	6-20	41	50-100	2.2	1.2	>80	-	Minga *et al*. (1989)
Ghana	2.5	10	-	72	-	-	50	50	Van Veluw(1997)
Mali	2.1	8.8	34.4	69.1	1.6	1.02	56	-	Wilson *et al.* (1987)
Sudan	4.5	10.87	40.6	2.1	1.31	-	-		Wilson (1989)

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2.7.2 Free range local chicken management

The production is described as a low-input-low-output system where hens lay only 30-40 eggs per year and where it might take up to one year to produce a sizable bird for slaughter. The birds are kept in the house with the owners or they are kept in simple housing systems. Feed is rarely given and neither is vaccines given to protect the animals from outbreaks of especially viral diseases. As a consequence mortality goes up to 90 % within the first year after hatching (Kitalyi, 1998).

Feeding: In rural areas FRLC feeding is not given high consideration, they are left to feed themselves. A study made by Msoffe *et al*. (2002) revealed that FRLC can attain reasonable body and egg weights under zero input free ranging mode of nutrition. But still this mode of nutrition does not make full exploitation of FRLC. If free range local chicken receives supplementation their performance will be enhanced (Msoffe *et al.*, 2002).

The availability of feeds for the FRLC is often irregular and varying in quantity and quality by season and within season. During the rainy season, there is an abundance of green vegetation, wild grass seeds and insects. Towards the end of the rainy season and beginning of the dry season when grains are harvested, there is abundant supply of grains and kitchen leftovers. During the dry season, however, grain supplies dwindle and insect populations decline. Rarely are the FRLC fed on whole grains but rather spoilt grains and the brans which are left over after milling the grains. Such erratic feed supply cannot be expected to sustain high chicken productivity levels (Mwalusanya, 1998). It has been estimated that the FRLC feed consumption provides to the chicken only 11 kcal metabolisable energy and 11 g of protein per day, and that amount of feed is inadequate for optimal productivity and below what is needed for maintenance (Kitalyi, 1998).

Mwalusanya (1998) reported that the main components of crop contents of FRLC were cereal grains bran, green forages, insects and worms. The chemical composition of the crop contents were: 43% dry matter, 10% crude protein, 5.8% crude fibre, 12.5% ash, 0.66% calcium and 0.4% phosphorous. Flock size can rapidly increase to the point where the feed requirement exceeds the available Scavengable Feed Resource Base (SFRB) in the area around the dwelling.

Housing: FRLC housing in rural area is at a rudimentary stage, and field surveys have shown cases where no housing or shelter is provided (Kuit, *et al.*, 1986; Atunbi and Sonaiya, 1994; Yongolo, 2004).

Table 2 shows the sites visited in the four countries and a description of the main features of the village chicken production systems. In Ethiopia, all the households visited had no separate housing for the chickens. However, within the family house there was an area marked for the chickens. In central United Republic of Tanzania, keeping chickens in the family house was common, but in Morogoro and Dar-es-Salaam, separate housing for chickens was common. In the Gambia and Zimbabwe, the use of separate houses for the chickens was more common than keeping the chickens in the family house.

Table 2: Free range local chicken: main features of flocks

Country	Province/regions visited	Number of households interviewed	Flock size range	Housing	Feeding
Ethiopia	Ada'a Woreda, Eastern Shoa	12	6–15	Same as household members	Scavenging and hand feeding of grains (wheat and barley)
Gambia	Western Division, West Bank Division, North Bank and Central River Division	15	8–45	Separate housing	Scavenging and homemade ration
United Republic of Tanzania	Dar-es-Salaam, Dodoma and Morogoro	24	6–130	Same and separate	Scavenging, hand feeding of grains plus homemade ration (household ingredients and commercial feed)
Zimbabwe	Mashonaland East and Masvingo	17	2–38	Separate	Scavenging and hand feeding

Source: Kitalyi (1998)

The housing structures in the Gambia, the United Republic of Tanzania and Zimbabwe were similar. They were small and low and had very small outlets. However, the small, low structures, also found in Zimbabwe and the United Republic of Tanzania, were associated with protection from theft. In Zimbabwe, the fowl run, which includes a fenced area for scavenging, was a common element of village chicken housing. However, not all village chicken structures in Zimbabwe had a fowl run (Kitalyi, 1998).

Scavenging was the major feeding system in all case study countries. However, occasionally the chickens' food was supplemented with household refuse and grains.

Preferential treatment, where chicks were fed separately, was reported in the case study countries, although the practice was not regular and the amount fed was not quantified. In the Gambia, farmers have been trained to improve feeding of the chickens using readily available ingredients, including oyster shells and fish bones. Use of termites was also mentioned by farmers in the Gambia. However, none of the households interviewed had such supplementary feeds at the time of the field visit (Kitalyi, 1998).

Disease control: New-castle disease (ND) constitutes the most serious epizootic poultry disease in the world, particularly in developing countries (Minga *et al.,* 1989). New-castle disease is probably the only disease identified by farmers in rural areas on the basis of clinical signs. Use of rapid tests in identifying poultry diseases at farm level has been suggested by various workers as one of the strategies to enhance disease control in rural poultry (Verma, 1996). In an earlier study by Minga *et al*. (1989), it was reported that the main cause of chicken loss among the FRLC occurs during chickhood and averages 50%. The other losses of growers and adult chickens are due to chicken diseases, predators and theft. Chicken loss during adulthood is mainly due to diseases, especially ND.

Loss due to disease outbreaks can be substantial. In Tanzania, ND has been singled out as the most devastating disease, whereby whole village populations may be decimated. The greatest loss due to ND occurs during the hot and dry season starting from July up to the start of the short rains in October to November. However, sporadic outbreaks do occur in between (Yongolo, 2004). Larger flock sizes can easily be realised once mortality is reduced through vaccination and improved husbandry.

It is very difficult to organize vaccination campaigns covering free-range birds. The main constraints are:

i. The difficulty of grouping together an adequately large number of birds in order to obtain an efficient vaccination rate;

ii. The possibility of disease cross-contamination arising from birds of various ages being raised together; and

iii. The difficulty of maintaining an efficient cold chain for proper vaccine quality preservation (Branckaert *et al.*, 2000).

Table 3: Reported Free range bird mortality caused by New castle disease

Country	% mortality	Source
Togo	50	Aklobessi (1990)
Sudan	50	Elzubeir (1990)
Nigeria	70	Nwosu (1990)
Comoros	80	Mohammed (1990)
Ethiopia	80	Alamargot (1997)
Morocco	100	Houadfi (1990)

Sonaiya (1990), after summarising the reports from six African countries, reported that the mortality caused by Newcastle disease ranges from 50-100% per annum and that severity is higher in the dry season (Table 3).

Genetic improvement: Free range local chicken have low genetic potential; but they have advantage of tolerating tropical environment, Katule (1990) considered tolerance of harsh environmental conditions as the most important attribute of these birds. He also pointed out the possibility for genetic improvement by selection among indigenous breeds population and within cross breeding of indigenous and improved temperate breeds. The phenotypic and genetic heterogeneity and the indication of disease resistance emphasises the biodiversity of FRLC and hence FRLC are a rich source of genes ideal for selection, breeding and multiplication of the most suitable ecotype which would be most adapted to the local condition (Minga and Nkini, 1996). The same was pointed out by Horst (1991) who stated that the genetic resource base of the indigenous chicken in the tropics is rich and should form the basis for genetic improvement and diversification to produce a breed adapted to the tropics.

There is high genetic relatedness within indigenous chicken ecotype than between ecotypes. This offers a basic step towards rational decision-making on the modalities of selective breeding without compromising the existence of each unique genetic resource **(**Msoffe *et al.*, 2005). Currently there is a major global thrust on genetic preservation and biodiversity which is reflected in efforts on development of genome and data banks, (Crawford and Gavora, 1993). These initiatives have come at an opportune time, because continued cross-breeding programmes in rural poultry, which do not consider gene preservation aspects, would lead to erosion of the indigenous germplasm (Bessei, 1989).

2.7.3 FRLC products consumption and marketing

Product utilization and marketing is the other key area requiring support. Various chicken product preparation methods, either from traditional dishes or introduced dishes, or use of eggs in producing snack foods could be included in training sessions, particularly where women groups are involved. Marketing is another aspect that requires institutional and organizational support. Institutional and organizational support in marketing village chickens would include assistance with feeding, housing and disease control between the different marketing points (Kitalyi, 1998).

Despite being disregarded through limited provision of shelter, feeds limited protection against predators and above all against infectious and parasitic diseases which cause high mortalities, free range chickens have invaluable characteristics that are not found in the exotic strains, Msami and Kapaga (2001) cited by Emuron *et al.* (2010). These characteristics are appropriate to the traditional low input/low out put farming systems (Kyarisiima *et al.,* 2004). To the urban folk, there is general preference for local chickens over their exotic counterparts because of the belief that they are tastier and have no drug residues.

Experience in Tanzania shows that FRLC meat is preferred to the commercial chicken meat on account of their perceived better and superior taste (Horst, 1990). There is thus a good market for the FRLC in urban areas in Tanzania. Preliminary results of a market survey in Morogoro, indicate that there is a big market for FRLC in urban areas (Mlozi *et al.,* 2000). According to Emuron *et al.* (2010), Chicken traders asserted that, there were fluctuations in free range local chicken trade across the months of the year. The highest demand for free range local chickens coincided with the major social and religious festivals of the year. These are the Christmas and New Year (December- January) and Easter (April). On the other hand the pre-Easter fasting period which lasts about two months (February to March) was reported to have the lowest demand for free range local chickens. Similarly Aklilu *et al.* (2007) reported high sales of local chickens in periods like Easter and Christmas in Ethiopia. In Thailand, the months in which large numbers of chickens were consumed corresponded to annual and occasional ceremonies in which all villagers participated (Masuno, 2008). The differences in the demand of local chickens in times of the year can be attributed to functional needs during festivals.

2.7 Free range Chickens in Household and National Economies

The importance of rural poultry in national economies of developing countries and its role in improving the nutritional status and incomes of many small farmers and landless communities has been recognized by various scholars and rural development agencies in the last two decades (Creevey, 1991). However, rural poultry does not rate highly in the mainstream national economies because of the lack of measurable indicators of its contribution to macroeconomic indices such as gross domestic product (GDP). Economic evaluation of livestock at household and national levels is complicated by the multiple functions of livestock in the economy. Moreover, estimating the value of rural poultry is even more difficult than for other livestock because of the lack of reliable production data (Mutizwa-Mangiza and Helmsing, 1991). For example, in the Gambia, a national agricultural survey had to omit the poultry component owing to lack of measurable indicators for this sector.

The rural poultry population in most African countries accounts for more than 60 percent of the total national poultry population, which has been accorded an asset value of US$5 750 million (Sonaiya, 1990). In Burkina Faso, Ouandaogo (1990) reported that the 25 million rural poultry produce 15 000 tonnes of meat, out of which 5000 tonnes are exported at a value of US$19.5 million, mainly to Cote d'lvoire. Forssido (1996), cited by Kitalyi, (1998) estimated that village chickens provide 12 kg of poultry meat per inhabitant per year, whereas cattle provide 5.3 kg per inhabitant. Village chickens are more widely distributed in rural Africa than the other livestock species. In the United Republic of Tanzania, a survey of 600 households in 20 villages showed that chickens were the only form of livestock found in most households (Collier *et al.*, 1996). Similar observations have been reported in Ghana (van Veluw, 1997) and in Mali (Kuit *et al.*, 1996). Surveys in some African countries have reported that the main function of village chickens from the farmer's perspective is the provision of meat and eggs for home consumption [Mali (Kuit *et al.*, 1996); Ghana (van Veluw, 1997); the United Republic of Tanzania Katule, (1990); South Africa (Cairns and Lea, 1990); the Gambia (Andrews, 1990) and Côte d'Ivoire (Diambra, 1990)]. Apart from increased quantitative production of animal protein in rural households, chicken meat and eggs provide protein of a higher biological value than that of red meat (Norman, 1993). Chicken meat and eggs are reported to complement staple diets of rural Africa due to the high nutrient concentration (Table 4). It has been shown that small poultry production units of 12 laying hens per unit have led to an increase in the consumption of animal protein and reduced incidence of malnutrition in resource-poor households of South Africa (MacGregor andAbrams, 1996).

Table 4: Amount of nutrients provided by 100g (edible portion)

Food item	Energy *(kcal)*	Protein *(g)*	Calcium *(mg)*	Iron *(mg)*	Vitamin A *(µg)*
Egg (fresh)	158	12.1	56	2.1	156
Poultry meat	139	19.0	15	1.5	0
Maize flour, whole	353	9.3	10	2.5	0
Rice, polished	361	6.5	4	0.5	0
Cassava flour	344	1.6	66	3.6	0
Sorghum	345	10.7	26	4.5	0
Plantain	135	1.2	8	1.3	390

Source: Kitalyi (1998)

FRLC is also an important element in diversifying agricultural production and increasing household food security. The village chickens provide readily harvestable animal protein to rural households, and in some parts of Africa are raised to meet the obligation of hospitality to honoured guests. Chale and Carloni (1992) reviewed the attributes of chicken meat and eggs in rural areas. Egg dishes and chicken meat cook faster than pulses and red meat, and therefore use less fuel wood. In the same review, citing poultry projects in Asia and Africa, the authors highlighted the importance of chickens as a diversification component in rural farming systems, particularly for women. Income accrued from the sale of eggs in a women's project in the Sudan was used to purchase household consumable goods, thus increasing household welfare. Gittinger *et al.* (1997), in a survey on food production by women and its impact on food security, found that rural households that had cropping as their only source of food production were more food insecure than households that had livestock, including poultry. The advantages of household poultry in improving household food security and increasing household welfare have been reported in other regions. In India, Desai (1996) reported successful rural poultry projects involving women, which led to increased production and empowering of women through provision of training and credit. Similar projects have been reported in Bangladesh (Saleque and Mustafa, 1996).

The importance of organizational structure and capacity building in enhancing increased rural women's poultry production featured highly in the projects in Asia and Latin America. The recent developments in the importance of poultry in household food security, especially for the poorer members of the community, including increased distribution of resources through involvement of women, have been appreciated globally. Household poultry has been included in the FAO Special Programme for Food Security (SPFS) (Dessie and Ogle, 2001), and was endorsed in the Rome Declaration and World Food Summit Plan of Action in November 1996 (Kitalyi, 1998). For smallholder farmers in developing countries (especially in low income, food-deficient countries [LIFDC]), family poultry represents one of the few opportunities for saving, investment and security against risk. However, comparatively little research and development work has been carried out on village chickens despite the fact that they are usually more numerous (Table 5) than commercial chickens in most developing countries and they have been marginalized by planners and decision makers (Cumming, 1992).

Table 5: Percentage contribution of free range of free range chicken

Country	% Contribution	References
Sri Lanka	28	Fonseka (1992)
Zimbabwe	30	Kulube (1990)

Cameroon	65	Agbede et al.(1990)
Cote d Ivoire	75	Diambra (1990)
Kenya	80	Mbugua (1990)
Gambia	90	Andrews (1990)
Malawi	90	Upindi (1990)
Nigeria	91	Adene (1990)
Ethiopia	99	Alamargot (1997)
Bangladesh	99	UNDP/FAO (1993)

Source: Dessie and Ogle (2001)

2.8 Methodologies Employed in Adoption Studies

Both probability and purposive sample surveys are used in adoption studies. Large samples are normally used especially when rigorous econometric analyses are involved. Formally multivariate linear regression analysis was the common analytical tool for determinants of adoption but currently the linear probability models (LPM) and cumulative distribution function (CDF) are becoming popular (Kaliba and Marsh, 1999; Feder, *et al*., 1985; Ntege-Naneenya *et al*., 1997).

CDF models take into consideration of non-linear characteristic, which is typical in adoption data. Also in the non-linear models, parameters are estimated using the Maximum Likelihood Estimation (MLE) approach in order to yield parameters that are asymptotically efficient and consistent. Although LPM is the simplest, it has limitations. Estimated probabilities for LPM may fall outside the 0-1 bounds. It also suffers non-normality and heteroscedasticity problems (Gujarati, 1995).

CDFs include Probit and Logit probability models as suggested by Gujarati (1995). Probit and Logit models measure the relationship between the strength of stimulus and the proportion of cases exhibiting a certain response to the stimulus. These models are appropriate tools in situation where there is a dichotomous output that is thought to be influenced by levels of some independent variable(s). These models are useful in estimating the strength of stimulus required to induce a certain proportion of responses, such as the probability of adoption resulting from farming experiences. The models are quite appropriate in analysing cross sectional data with binary dependent variable. In some cases they have been used to analyse time –series-cross-sectional data (Nathaniel and Jonathan, 1997). The difference between the two models is that Logistic curve has flatter tails than probit curve. Probit curve approach the axes quickly than logistic curve. A logistic estimate of parameter multiplied by 0.625 gives a fairly good estimate of probit model (Gujarati, 1995). Choice between the two models is that of mathematical convenience and ready availability of computer software.

Nkonya *et al*. (1998), in their study, used probit model and applied a two stage Heckman's procedure to analyse factors affecting adoption of improved maize in Northern Tanzania. The result from the probit model showed that farming experience influences adoption. In central Tanzania, Kaliba *et al*. (1998) used probit model to analyse factors affecting adoption of improved maize and realised that household wealth, education level, Agro-ecological zone and variety type significantly influenced adoption.

Logit model has been widely used in wheat and maize studies. For instance, in Southern highlands of Tanzania, a logistic regression model was used to analyse factors affecting adoption of improved wheat (Mwanga *et al*., 1999). They found that household size; farm size and extension contact had significant influence on adoption of improved wheat varieties. The same model was used in maize study in Uganda and wheat study in Ethiopia by Ntege-Nanyeenya, *et al*. (1997) and Regessa *et al*. (1998) respectively. Using the model, Ntege-Nanyeenya *et al*. (1997) found that education, farmers' group and land tenure had statistically significant effect on adoption of improved maize. The logistic model is also applicable in analysis of land conservation technologies. For example, Logit regression model was used to analyse the factors influencing adoption of soil conservation in Tanzania (Kalineza *et al.*, 1999). It was also used in Tennessee by Roberts *et al.* (2002) to determine factors affecting the location of precision farming technology.

The third model is the Tobit model. This model is also known as censored regression model because some of observations on regressand are known. This model has been used by several scientists in analysis of farmer's perception of a given technology (Kaliba and Marsh, 1999). Advantage of Tobit model over the rest is that it can further be dis-aggregated to determine the effect of change in the i^{th} variable on change of probability of adopting modern technology. Unfortunately this model is not easily accessible since it is not embodied in popular software like SPSS. In southern highlands maize study, (Bisanda and Mwangi, 1996) used Tobit model to analyse factors affecting proportion of land allocated to improve maize and discovered that extension contact, agro- ecological zone and livestock units were significantly associated with adoption of improved maize varieties.

CHAPTER THREE

3.0 METHODOLOGY

Data for this study were obtained by using a cross-sectional study design. In cross-sectional design data is collected at a single point in time (Babbie, 1990; Creswell, 1994). This design is considered favourable when challenged with limited time for collecting data.

3.1 Study Area

This study was conducted in Mzumbe ward in Mlali division, Mvomero district Morogoro Region. The ward is located at 6^0-33^0 S 37^0 - 6^0 E and a distance of about 30km from Morogoro town along Morogoro - Iringa high way. The area receives long and short rains; short rains are from September to November and long rains from February to May. Samples of respondents were drawn from the following villages; Tangeni, Sangasanga, Changarawe, Vikenge, Lubungo and Mafuru. Farmers from two villages in Mlali ward, i.e. Mlali and Peko where the training was not done were selected as control.

3.2 Sampling Procedures

The study population were farmers who received the technologies through training and those who were not trained. Among the 83 trained farmers, 19 females and 64 males, 50 farmers including all 19 females were purposevely selected and interviewed. Also, 50 neighbouring farmers were randomly selected from Sangasanga, Changarawe, Vikenge, Lubungo, and Mafuru, to assess extent of adoption of technologies by non-trained farmers in those villages. Ten farmers from each of the control villages were randomly selected for interviewing; this made a total of 120 farmers who were interviewed. Neighbouring farmers refer to farmers who were not trained but within the same village where training was carried out; while control farmers were chosen from different ward but within the same division.

The selected villages were within a radius of about 7-10 kilometres from the trained group villages.

3.3 Data Collection

Primary data were collected from respondents using a structured questionnaire. Two sets of questionnaires were used, one for trained farmers and the other for untrained farmers (neighbour farmers and control farmers), (Appendix 1 and 2). Data collection involved visiting individual farmers in their homestead and direct observations. The type of data collected included: type of technology adopted, reasons for non-adoption, factors influencing adoption and production data. Quantitative data included measurements of eggs and adult birds, weight. Such data provided comparison between farmers adopting technologies and farmers who did not adopt the technologies. A total of 150 eggs, were randomly picked and weighed, 50 from trained farmers, 50 from neighbour farmers and 50 from control farmers. As for adult bird weights, 40, 40, and 30 birds were weighed from trained, neighbours and control farmers respectively. Weights were separated by sex.

3.4 Data Analysis

In order to draw conclusions, qualitative data collected from individual households were coded and analyzed using the statistical package for social sciences (SPSS) computer program. From the analysis, descriptive statistics analysis including frequency distribution, percentages and means were computed. Regression analysis was employed to establish effect-cause relationship among the variables. Cumulative Distribution Functions (CDF) specifically logit model was used to determine the influence of a number of pre-indicated variables on adoption of technologies. The choice of this model was based to the fact that logit model corresponds to a logistic distribution function, while the probit model assumes an underlying normal distribution relation between the probability of adoption and various explanatory variables. Choice of independent variables was based on literature review and social-economic theories governing the adoption of innovations. In this study regression analysis was used to examine the relationship between a set of independent variables and adoption as the dependent variable. The following farmers' characteristics and institutional factors were included as explanatory variables in the model: the age of farmer (AG), gender (GE), education level (ED), extension services (ES), leadership (LE), and veterinary services (VS) and the model is specified as follows:

$Y = B_O + B_1AG + B_2GE + B_3ED + B_4ES + B_5LE + B_6VS + e$

Where:

Y= Technology adoption

B_O = Constant

AG = Age of respondents (years)

GE = Gender (1= female; 2 = male)

ED = Education level attained

ES = Extension services

LE = Leadership

VS = Veterinary services

e = Error term

For quantitative data (body weights) the means and variance were computed and compared between respondent categories and sex for live birds to satisfy the model.

(1) $Yij = \mu + Si + Gj + eij$.

Where:

Si = sex of adult birds (i=1 cocks, 2 hens)

Gj = groups of farmers (j=1 trained, 2 neighbour, 3 control)

Eij = random error

For egg weights, the means and variance were computed and compared between respondent categories to satisfy the model (2) $Y_{ij}= \mu + G_j + e_{ij}$

Where:

G_j = groups of farmers (j= 1 trained, 2 neighbour, 3 control)

E_{ij} = random error

Comparison was employed in order to summarize the data to facilitate scientific interpretation. Then Multiple Range Test (MRT) was used to separate the means especially for the production data.

CHAPTER FOUR

4.0 RESULTS

4.1 Background Information of Respondents

Knowledge about background information of respondents is important in assessing the capacity of respondents in the process of adopting and utilizing crop and livestock technologies. This section describes the demographic variables in the study population.

Table 6: Sex and Age Groups of Respondents

	Trained Farmers		Neighbours		Control	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Sex of respondent						
Female	19	38.0	25	50.0	10	50.0
Male	31	62.0	25	50.0	10	50.0
Total	**50**	**100.0**	**50**	**100.0**	**20**	**100.0**
Age of respondent in years						
18 - 24	2	4.0	4	8.0	0	0.0
25 - 30	9	18.0	13	26.0	1	5.0
31 - 37	5	10.0	12	24.0	6	30.0
38 - 44	7	14.0	4	8.0	4	20.0
45 - 50	7	14.0	4	8.0	7	35.0
Above 50	20	40.0	13	26.0	2	10.0
Total	**50**	**100.0**	**50**	**100.0**	**20**	**100.0**

In terms of age 40% of trained farmers were above 50 years of age while for neighbour farmers and control farmers the result revealed 26% and 10% of the respondents were above 50 years respectively.

Nearly 50% of neighbouring respondent were aged between 25 and 30 years, while among the control farmers, more than 60% were above 31 years of age. The difference could be explained by the fact that sampling was not based on age but rather on whether a respondent kept chicken or not. Number of male and female respondents did not differ between neighbour and control group since the number were fixed at the start of the interview. The distribution of sex among the trained farmers was skewed towards males, meaning that more males received training than females (Table 6).

Table 7: Marital status, Educational level and Household Family size

	Trained farmers		Neighbour farmers		Control farmers	
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequenc y**	**Percent**
Marital status						
Married	44	88.0	42	84.0	14	70.0
Single	4	8.0	5	10.0	2	10.0
Divorced	1	2.0	0	0.0	3	15.0
Widowed	1	2.0	3	6.0	1	5.0
Total	**50**	**100. 0**	**50**	**100.0**	**20**	**100. 0**
Education level						
No education	4	8.0	3	6.0	2	10.0
Primary education	40	80.0	41	82.0	17	85.0
Secondary education	6	12.0	6	12.0	1	5.0
Total	**50**	**100. 0**	**50**	**100.0**	**20**	**100. 0**
Number of people in the household						
1-3	10	20.0	8	16.0	4	20.0
4-6	30	60.0	31	62.0	15	75.0
7-9	9	18.0	11	22.0	1	5.0
10-12	1	2.0	0	0.0	0	0.0
Total	**50**	**100. 0**	**50**	**100.0**	**20**	**100. 0**

In Table 7 results show that in all the three groups the majority of the respondents were married. With regards to educational levels, again for the three groups, most of the respondents acquired at least primary school educational level. With respect to family size for all three locations the majority of the households had within 4 to 6 people.

4.2 Leadership and Availability of Veterinary Services

Results in Table 8 show that 56%, 54% and 35%, of the trained farmers, neighbour farmers and control farmers respectively have been leaders or committee members within their villages. As for veterinary services, 64%, 40%, and 10%, for trained farmers, neighbour farmers and control farmers respectively reported to have access to veterinary services.

Table 8: Leadership and veterinary services

	Trained farmers		Neighbour farmers		Control farmers	
	Frequency	%	Frequency	%	Frequency	%
Leaders/c. members	28	56.0	27	54.0	7	35.0
Veterinary Services	32	64.0	20	40.0	2	10.0

4.3 Factors Influencing the Adoption of Technologies

One way of assessing adoption is to look at those factors that influence the adoption rate of the introduced technologies. In this study regression analysis was used to examine the relationship between a set of independent variables and adoption as the dependent variable. Factors identified and investigated were; the age of the farmer, gender, educational level, extension services, leadership and veterinary services. Results in Table 9 show that, extension services, educational level, and veterinary services influenced adoption of feed supplementation, chick management, disease control, housing, and egg management technologies significantly ($p<0.05$). Results further show that age, sex, and leadership variables, did not influence adoption of technologies significantly ($p>0.05$).

Table 9: Factors influencing adoption for the three categories

Independent variables	Standardized coefficients	Un standardized coefficients	Sig. t
Age	0.0162	0.0820 (0.539)	0.855 8

Gender	0.0081	0.1083 (1.154)	0.9255	
Education level	0.1893	0.1330 (0.656)	0.045	*
Extension services	-0.236	0.8335 (0.366)	0.0246	*
Leadership	0.0448	0.0145 (0.03)	0.6357	
Veterinary services	0.0659	0.0779	0.0129	*
R=.79130				
Adj. R-square = .62615				
F-statistics F12,121 (for R) = .0083				
Constant		4.695 (3.584)	0.1927	

* = Significant at .05 level
In parentheses are standard errors.

4.4 Technologies Adoption

During data collection it was aimed to know whether the trained farmers have adopted the full package (all target technologies disseminated) or part of the package (few among those disseminated technologies), and to what extent. Results from the study show that supplementation Of FRLC, chick management, egg management, disease control and housing were the most adopted technologies by the trained farmers. Supplementary feeding and chick management technologies were adopted by 92%, while housing and disease control technologies were adopted by 56% and 88% respectively. However, record keeping was poorly adopted; only 4 farmers (8%) were keeping records out of 50 farmers interviewed in this category. Of the different technologies adopted by neighbouring farmers, disease control, supplementary feeding, and chick management were adopted by 68%, 60%, and 54% respectively. About 36% and 30% adopted housing and egg management, while none of the respondent kept records.

The results further show that the technologies are poorly adopted by the control group; however disease control and housing to some extent were accepted by 55% and 50% of respondents respectively. The least adopted technologies involve chick management 30% and supplementary feeding 20%, again no respondent in this category adopted egg management and records keeping. The assessment of technology adoption among control farmers was carried out in order to assess the spread of technologies beyond target villages and also to serve as control (Table 10).

Table 10: The Extent of Technology adoption

	Trained farmers		**Neighbour farmers**		**Control farmers**	
Technology	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
Feed suppl. of FRC	46	92.0	30	60.0	4	20.0
Housing	28	56.0	18	36.0	10	50.0
Chick management	46	92.0	27	54.0	6	30.0
Egg management	30	60.0	15	30.0	0	0.0
Records keeping	4	8.0	0	0.0	0	0.0
Diseases control	44	88.0	34	68.0	11	55.0

4.5 Trained Farmer’s Opinion about the Technologies in Chicken and Eggs Production

The results revealed that the majority of farmers reported an increase in chicken productivity due to adoption of the technologies. About farmer’s opinions, all trained farmers acknowledged that the technologies were very important, over one third (62%) of respondents reported production of chicken and eggs to have doubled as a result of adopting the technologies, where as one third (32%) reported production to have tripled (Table 11).

Table 11: Trained farmer’s opinion on impact of technologies

Direction of growth	Frequency	Percent
Increased productivity	50	100.0
Decreased productivity	0	0.0
No change in productivity	0	0.0
Total	**50**	**100.0**
Estimation of increment		
Doubled	31	62.0
Tripled	16	32.0
No change	3	6.0
Total	**50**	**100.0**
Opinions about the technologies		
They are very important	50	100.0
They are not important	0	0.0
Nothing to recommend	0	0.0
They are expensive	0	0.0
Total	**50**	**100.0**

4.6 Activity profile and decision making in undertaking chicken enterprise

Among the trained farmers results show that men are responsible in the construction of shelter while women played role in feeding and provision of water, women made decisions in selling eggs and chicken as well as eggs and chicken consumption at home (Table 12 and 13). The results further show that men were also responsible for treatments done in the flock and decision making in purchase of drugs. About cleaning the chicken house the results revealed it as family responsibility.

Table 12: Activity profile (Trained farmers N=50)

	Responsible person	Frequency	%
Shelter construction	Women	4	8.0
	Men	37	74.0
	Children	4	8.0
	Family	5	10.0
	Total	**50**	**100.0**
Cleaning chicken house	Women	15	30.0
	Men	7	14.0
	Children	2	4.0
	Family	26	52.0
	Total	**50**	**100.0**

Supplementary feeding	Women	20	40.0
	Men	10	20.0
	Children	1	2.0
	Family	19	38.0
	Total	**50**	**100.0**
Providing water	Women	22	44.0
	Men	8	16.0
	Children	2	4.0
	Family	18	36.0
	Total	**50**	**100.0**
Selling chicken	Women	16	32.0
	Men	10	20.0
	Children	1	2.0
	Family	23	46.0
	Total	**50**	**100.0**
Selling eggs	Women	28	56.0
	Men	9	18.0
	Children	1	2.0
	Family	12	24.0
	Total	**50**	**100.0**
Treatment	Women	12	24.0
	Men	34	68.0
	Family	4	8.0
	Total	**50**	**100.0**

Table 13: Decision making (N=50)

	Responsible person	**Frequency**	**%**
Decision to sell eggs	Women	26	52.0
	Men	9	18.0
	Children	0	0.0
	Family	15	30.0
	Total	**50**	**100.0**
Decision to sell chickens	Women	21	42.0
	Men	9	18.0
	Children	0	0.0
	Family	20	40.0
	Total	**50**	**100.0**

Decision on egg consumption	Women	22	44.0
	Men	9	18.0
	Children	0	0.0
	Family	19	38.0
	Total	**50**	**100.0**
Decision on chicken consumption	Women	17	34.0
	Men	9	18.0
	Children	0	0.0
	Family	24	48.0
	Total	**50**	**100.0**
Decision on drug purchase	Women	14	28.0
	Men	30	60.0
	Children	0	0.0
	Family	6	12.0
	Total	**50**	**100.0**

4.7 Reasons for Not Adopting or Adopting Part of Technological Package

Results show that 3 farmers (6%) among the trained farmers did not adopt any component of the package. The main reason for failing to adopt the technologies was outbreak of New-castle disease that wiped the whole flock; only 1 farmer (2%) said that the technologies were expensive. On the other hand the reasons differ for the neighbour farmers and control farmers, 10 farmers (20%), 9 farmers (45%) for neighbour and control groups respectively reported that they were not aware of the technologies, while 4 farmers (8%) in neighbour farmers group reported that they are in a preparation stage for adoption. Results further revealed that neighbour farmers received the information about technologies soon after training has been conducted; this was through interpersonal communication, while control farmers received the technologies through routine visits by extension stuff. However untrained farmers (control farmers in this case) do have some indigenous knowledge about feed supplementation, housing, chick management, and disease control.

Farmers were requested to give reasons why they decided to adopt the technologies selectively and not the full package. Results show that 64%, 48%, 30% of the respondents for trained, neighbours and control farmers respectively reported that the adopted components are important than others. 14%, 22%, and 15% of respondents for the trained, neighbours and control farmers reported that the adopted components are simple compared to others, few respondents 8%, 2% and 10% respectively said that they have no reason for adopting only part of the package. With regards to problems which have been experienced on the process of adoption, 82%, 34% and 25% of the respondents for trained, neighbours and control farmers respectively were not experiencing any problem, while 8%, 26% and 10% of the respondents respectively reported high price of materials. On the other hand 4%, 12%, and 20% for trained, neighbours and control farmers respectively reported lack of funds to influence adoption. Only 1 farmer (2%) under trained farmers reported market problem (Table 14).

Table 14: Farmer's reasons and challenges

	Trained Farmers		**Neighbour farmers**		**Control farmers**	
Reasons for not adopting	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Technologies are expensive	1	2	0	0	0	0
ND wiped the whole flock	2	4	0	0	0	0
Not aware of the technology	0	0	10	20	9	45
Making preparation to adopt	0	0	4	8	0	0
Total	**3**	**6**	**14**	**28**	**9**	**45**

Reasons for partly adopting						
The adopted parts are simple	7	14	11	22	3	15
The adopted parts are important	32	64	24	48	6	30
No reason	4	8	1	2	2	10
Total	**43**	**86**	**36**	**72**	**11**	**55**
Problems on the process of adoption						
Lack of funds	2	4	6	12	4	20
High price of materials	4	8	13	26	2	10
market problem	1	2	0	0	0	0
No problem	41	82	17	34	5	25
Total	**48**	**96**	**36**	**72**	**11**	**55**

4.8 Contribution of Free range Local Chicken to the Household Income

Farmers reported the contribution of local chicken in different areas of the family needs including paying school fees 22%, 24% and 5% of the respondents for trained, neighbours and control farmers respectively. Hospital charges 52%, 78% and 90% of the respondents for trained, neighbours and control farmers respectively. The results further show other expenses covered such as buying clothes 46%, 52% and 60% respectively, buying school materials 60%, 48% and 30% respectively. While household consumption of chicken eggs and meat 84%, 78% and 85% of the respondents for trained, neighbours and control farmers respectively. Here it should be clear that one respondent may respond positively in all variables (Table 15). The eggs, the chicken and the incomes from the sales of both are contributing not only to the household's nutritional/food security, but also cover other expenses. The results revealed that household expenditure and consumption ranked the first followed by purchasing of school materials and hospital charges for the trained farmers. While the neighbour farmers ranked high household expenditure and consumption followed by purchasing of clothes, hospital charges were ranked the first by the control farmers followed by household expenditure and buying clothes. This implies that FRLC play a significant role through their contribution to the social economic life of rural people, apart from other income sources like crop farming and beekeeping.

Table 15: Free range chicken contribution to household expenditures

Expenditure	Trained farmers		Neighbour farmers		Control farmers	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**
Pay school fees	11	22	12	24	1	5
Hospital charges	26	52	39	78	18	90
Buy clothes	23	46	26	52	12	60
Buy school materials	30	60	24	48	6	30
Home expenditure and consumption	42	84	39	78	17	85

4.9 Sources of Information for the Untrained Farmers

With regard to sources of information, the neighbour farmers were asked to tell their sources of information about technologies, results show that 52% of respondents cited neighbouring household as the main source of information about technologies, while 30%, 18% and 16% of the respondents reported extension services, agricultural show, and neighbouring village respectively, as the source of information. For the control farmers, they were also asked about the awareness of the technologies and their sources of information. 55% of respondents reported extension services as their main source of information on the technologies to improve free range local chicken. Very few farmers (15%) reported neighbours, radio and television (5%) as well as agricultural show as their source of information (Table 16).

Table 16: Sources of information about technologies

Sources	Neighbour farmers		Control farmers	
	Frequency	**%**	**Frequency**	**%**
Radio and TV	0	0	1	5
Extension	15	30	11	55

Neighbour Household	26	52	3	15
Neighbour village	8	16	0	0
Leaders speech	0	0	0	0
Agriculture show	9	18	1	5

4.10 Disease Problems on Adoption of the Technologies

Farmers were asked if they had experienced any disease problem. Results show that untrained farmers had an indigenous knowledge of disease diagnosis and also through the help of extension stuffs, enabled them to isolate different disease conditions. New-castle disease (ND) was mentioned in all groups of farmers as the leading local chicken killer. 30%, 38% and 35% of the respondents for trained, neighbours and control farmers respectively reported New- castle disease alone. 52%, 40% and 45% of the respondents respectively reported New- castle disease and infectious coryza. Few cases of other diseases were reported. However, the results show that farmers were vaccinating their birds mainly using the heat tolerant vaccine I-2, given by eye drops. The proportions were 64%, 60% and 55% for neighbour, trained and control farmers respectively. While 45%, 32%, and 16% of the respondents for control farmers, neighbour farmers and trained farmers respectively were not vaccinating their birds. Few respondents were using both heat tolerant vaccine I-2, and heat labile vaccine in vaccinating their birds (Table 17).

Table 17: Diseases mentioned by farmers and Vaccination Vs ND

Disease problems	**Trained farmers**		**Neighbour farmers**		**Control farmers**	
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Newcastle disease alone	15	30	19	38	7	35
ND and infectious coryza	26	52	20	40	9	45
ND and coccidiosis	1	2	1	2	3	15
ND and chicken pox	2	4	7	14	1	5
Infectious coryza alone	4	8	3	6	0	0
Total	**50**	**100**	**50**	**100**	**20**	**100**
Vaccination Vs ND						
I-2 given by eye drops	30	60	32	64	11	55
Heat labile and I-2	5	10	0	0	0	0
Heat labile vaccine only	3	6	2	4	0	0
Use of Aloevera	4	8	0	0	0	0
Not vaccinating	8	16	16	32	9	45

Total	**50**	**100**	**50**	**100**	**20**	**100**

4.11 Assessment of the Impact of Adopted Technologies on Chicken Performance

The impact of technologies adoption on chicken performance was assessed by looking at differences in weights of male chicken, female chicken and eggs between the trained farmers, neighbour farmers and control farmers. Analysis of variance models (1 and 2) were used to compare chicken and eggs weights in the three locations. Multiple Range Test was used to separate the means (Table 18). Performance assessment was also done purposely to check the impact of technology adoption after two years since when the training was conducted. It was done by looking the laying capacity, number of brooding hens, eggs brooded, chicks hatched, and surviving chicks. The egg-laying capacity has risen from 5-13 per hen per laying cycle before adoption of technologies to a mean of 17.5. Most of the farmers used 4 hens for brooding, with a hatching rate of 8-18 chicks per hen per cycle (Table 19).

Table 18: Flock size, Body and egg weights

	Trained	**Neighbour**	**Control**	**F value**	
Groups	**Mean**	**Mean**	**Mean**		
Flock size	3.85 ± 1.97^{a}	3.12 ± 2.47^{ab}	2.48 ± 1.29^{b}	0.0500000	**
Male (kg)	2.17 ± 0.35^{a}	1.87 ± 0.34^{b}	1.68 ± 0.33^{b}	0.0003641	***
Female(kg)	1.66 ± 0.39^{a}	1.48 ± 0.32^{a}	1.13 ± 0.22^{b}	0.0000594	***
Egg (gm)	42.58 ± 2.63^{a}	40.25 ± 3.49^{b}	$38.65 \pm 3.46_{c}$	0.0000001	***

a,b,c Least squares means bearing different superscripts along the rows with a specific factor are significantly different (p<0.05). Levels of significance: ***=p<0.001 **= (0.05).

The influence of technologies adoption on eggs weights showed that trained farmers group had significantly (P<0.001) higher values for egg weight and (P<0.05) flock size than the other categories. Males and females adult bird weights were significantly (P<0.001) higher for trained farmers than neighbour farmers and control farmers (Table 18).

The result in Table 19 reveals significant improvement in chicken performance. The status before training on chicken performance has increased almost twice when compared with the current status. The increased performance is obvious in all performance indicators. Eggs production increased and eventually other indicators increased also. Consequently the proportion of mature hens in lay increased to 40%, mortality of chicks was reduced to 30% and grower mortality was also reduced to 20%.

Table 19: Other production characteristics for trained farmers

Performance Indicator	Status before adoption	Current status
Eggs laid/hen/cycle	8-15	15-25
Number of brooding hens	1-2	3-6
Eggs brooded/hen/cycle	6-14	10-18
Chicks hatched /hen/cycle	9-12	10-16
Surviving chicks /hen/cycle	4-6	6-14
Mature laying hens	16.0	40.0
Chick mortality	65.0	30.0
Grower mortality	50.0	20.0

CHAPTER FIVE

5.0 DISCUSSION

This chapter discusses the results under ten sections as follows 1) farmer's characteristics 2) leadership and veterinary services 3) the extent of technologies adoption 4) trained farmers' opinion about the technologies in chicken and egg production 5)activity profile and decision making in undertaking chicken enterprise 6) farmer's reasons for not adopting or adopting only part of the package 7) contribution of FRLC to the household expenditure 8)sources of information about technologies for the untrained farmers 9) disease problems on the process of technologies adoption 10) assessment of the impact of adopted technologies on chicken performance.

5.1 Farmer's Characteristics

Among the more important farmers' characteristics dealt with in this study were: farmers' age, gender, educational level and household family sizes.

5.1.1 Age

The distribution of respondents involved in the technology adoption by age is presented in Table 6. The results show that the majority of farmers had age ranges between 30 years to above 50 years; about 96% of the respondents for all three categories of farmers were within this range. However, the majority of trained and neighbours were above 50 years, although age was not used as the criteria to choose the trainee in the process of technology dissemination in this study, the only criteria used was based on the fact that; for a farmer to be chosen he or she must have been keeping FRLC.

This is contrary to the finds by (Nanai, 1993) who reported that the rate of adoption of a new technology is higher among young age members than older ones. It was stated that young and energetic people have proved to be more venturesome, active and ready to try technologies and are called innovators (Rogers, 1993). Older people have more experience but their receptivity to new ideas and technologies typically decreases with age (John, 1995).

While young farmers are said to have greater likelihood in accepting new ideas and in dealing with risks, it is not clear what upward bounds can be set on this age level. One reason is that in subsistence agriculture children are exposed to farming at a very early age and often assume decision-making roles early in life (Polson and Spencer, 1991). This was so among the neighbours, where the proportions were near equal to those aged above 50 years.

Similar observation has been reported for determinants of adoption of poultry technology in Ethiopia (Teklewold, *et al.*, 2006) where by the study indicated that farmer's age may negatively influence both the decision to adopt and extent of adoption of improved poultry breeds. It may be that older farmers are more risk averse and less likely to be flexible than younger farmers and thus have a lesser likelihood of adopting new technologies. However, it could also be that older farmers have more experience in farming and are better able to assess the characteristics of modern technology than younger farmers, and hence a higher probability of adopting the practice. Adesina and Forson (1995) indicated that the expected result of age is an empirical question. There is no agreement in the adoption literature on this as the direction of the effect is generally, location or technology specific. For this study, age did not affect adoption significantly (Table 9).

5.1.2 Gender

Because women play a greater role in agricultural systems, it is important that adoption studies consider the degree to which a new technology reaches women farmers (CIMMYT, 1993). In this study the results in Table 6 shows that the distribution of sex among the trained farmers was skewed towards males, meaning that more males received training than females. The results further show that the number of male and female respondents did not differ between neighbour and control group since the numbers were fixed at the start of the interview. However, Table 9 shows that gender in this case did not influence adoption.

Mullin (1995) reported that women provided 46 percent of agricultural labour, produced approximately 70 percent of its food and did at least half of the tasks involved in raising animals. Ross (1991), cited by Okitoi *et al.* (2007) reported that women contributed 80% of labour to food production and received 7% of extension information. Chavangi and Hanssen (1983) estimated that women performed 70-80% of the daily work and yet have been disregarded by extension agents.

In Kenya (KARI, 1996), has recognized that clients /stakeholders have always not been taken into account sufficiently in technology development process. It is for this reason that, it is felt that in order for rural poultry improvement programmes to have a positive impact on household economies and gender equity, women have to be involved in the programmes as a gender variable. This requires a more explicit understanding of gender issues in rural poultry production system. Gender specific roles and responsibilities are often conditioned by household structure and access to resources. Okitoi *et al*. (2007) reported that there is a growing recognition of the contribution of women to agricultural production and that, gender component in any project is essential in order to identify factors of production and access to benefits accrued for technology transfer.

5.1.3 Educational level

In this study, results in Table 7 show that for the three groups, most of the respondents had at least primary school education. The results revealed that for trained, neighbour and control farmers, respondents who attained primary education were 80%, 82% and 85% respectively. Similar observation has been reported for a study of factors affecting the Adoption of hybrid maize in Mwanga District (Msuya, 1998). Further, better educated farmers have more contact than other farmers with information sources and change agents (Nowak, 1987; Rogers, 1993). Table 9 shows that education level affected significantly the adoption rate. The positive regression coefficient for education implies that farmers with medium to high education are likely to adopt innovations than farmers with low or without education.

The results concur with findings of (Ervin and Ervin, 1992), who asserted that education plays a key role in the uptake of information, as better educated farmers are better informed, not only about technologies, but also about the detrimental effects of unsustainable practices.

Education augments one's ability to receive, decode and understand information relevant to making innovative decisions (Wozniak, 1984). This creates an incentive to acquire more information. Farmers with more education should be aware of more sources of information, and be more efficient in evaluating and interpreting information about technologies than those with less education. Thus it is hypothesized that producers with more education are more likely to be adopters than farmers with less education.

5.2 Leadership, Veterinary and Extension Services

It was expected that farmers who had been leaders and also farmers who have access to veterinary/extension services may accept new ideas promptly and transfer technologies to neighbours. In this study, the results in Table 8 show that 56%, 54% and 35%, of trained farmers, neighbour farmers and control farmers respectively have been leaders or committee members within their villages. However, leadership did not affect adoption significantly in this study (Table 9) this is contrary to the finds by Obine and Jojo (1991) they reported that social status such as leadership position in rural set up, has influenced adoption of cassava production. As for veterinary services, 64%, 40%, and 10%, for trained farmers, neighbour farmers and control farmers respectively reported to have access to veterinary services and the access significantly influenced adoption of technologies.

Results in Table 9 show that the regression coefficient was significant ($P < 0.01$) and the six independent variables account for 63% (adjusted R^2 .62615) of the variation in adoption. The results also show that three of the six independent variables included in the analysis have significant ($P < 0.05$) regression coefficients. Extension services were the highest predictor of adoption of the technologies (beta of .23602), ($P < 0.05$). The positive regression coefficient implies that extension services and adoption of technologies are positively related. A high score on extension contacts lead to high level of adoption of technologies. Similar observation has been reported by (Alson and Reading, 1998) they found that frequency of extension visits has positive influence on technology adoption. But on the other hand it does not relate to what was reported by Msuya (1998) who used the chi-square test on this variable and found that it was not statistically significant ($p>0.05$) of presence of extension services and adoption of technologies.

5.3 The extent of Technologies Adoption

In the present study, results in Table 10 show that feed supplementation of scavenging chicken, chick management, egg management, disease control and housing were the most adopted technologies by the trained farmers. Supplementary feeding and chick management technologies were adopted by 92.0%, while housing and disease control technologies were adopted by 56.0% and 88.0% of the farmers respectively.

This implies that technologies disseminated by the project to farmers were important when compared to the extent of technologies adopted by neighbour and control farmers. Of the different technologies adopted by neighbouring farmers, disease control, supplementary feeding, chick management and housing were adopted by 68.0%, 60.0%, 54.0% and 36.0% respectively. The results further show that the technologies are poorly adopted by the control group when compared with trained and neighbour farmers, this is due to the distance from villages which received training, as a result they have no specific source of information about the technologies. Farmers in the control group who were aware of the technologies through various sources of information, adopted disease control, supplementary feeding, chick management and housing by less than 50%. However, control farmers have some indigenous knowledge on these variables and it should be kept in mind of trainers when conducting farmers training.

The results for the trained farmers in this study agree with the findings of Ngugi *et al*. (2007), with slight difference in housing and disease control where their respondents adopted slightly higher compared to findings of this study. They reported that the brooding management technology was adopted by most (99.0%) of the farmers followed by disease control (95.0%), supplementary feeding (92.0%) and housing (70.0%). The results of this study indicate that the NDAF project achieved fairly high adoption rates for the technologies disseminated to the farmers that resulted in a shift from free-range production systems with little or no supplementary feeding, disease control and planned breeding, to a fairly well-managed indigenous poultry production system. These results are also in a range with findings by Okitoi *et al.* (2007) and Riise *et al.* (2005).

5.4 Trained Farmers' Opinion about the Technologies in Chicken and Egg Production

The results in Table 11 present the information given by farmers about an increase of chicken productivity due to adoption of the technologies mainly feed supplementation, disease control, chick management and housing. All trained farmers acknowledged that the technologies were very important, over one third (62%) of respondents reported chicken productivity to have doubled as a result of adopting the technologies, while one third (32%) reported productivity to have tripled.

A similar observation has been reported by the Kenya Agricultural Research Institute Project on Indigenous Poultry in Western Kenya (Ngugi *et al*., 2007). The authors indicated the increase that was almost the same as the farmers in this study.

5.5 Activity Profile and Decision Making in Undertaking Chicken Enterprise

Results in Table 7 have shown that for all three locations, the majority of the households had between 4 to 6 people. Family size, a proxy to labour availability, may influence the adoption of poultry technology positively as its availability reduces the labour constraints faced in FRLC production.

Division of labour among family members in free range local chicken management was as shown in Table 12; the study showed that all family members provided labour to local chicken. Men did mainly construction of poultry sheds and all matters pertaining management like treatment and purchase of drugs. Women mainly did cleaning, feeding and provision of water to chicken. The results in this study are consistent with the findings by Teklewold *et al.* (2006), who were also reported that family labour input into the free range local chicken production system is a plurality; all family members provided labour to a FRLC enterprise.

Table 13 shows the participation of household members in decision making during sales, slaughter of chicken and purchase of drugs as indicated by the percentage of respondents. The decision-making in FRLC management reflects that there is more time and labour demand from women than from men and the entire family except for the purchase of drugs. Participation in selling eggs was predominantly for women. In almost all cases the greatest decision maker was the women. The reason behind here is that most men tend to rank low to the FRLC enterprise as a source of income, thus it deserve to be handled by women when compared to other enterprises.

The activity profile showed that women and children were involved in local chicken management throughout the day. Men were mostly involved occasionally. This has a bearing on scheduling of other activities such as meetings, farm visits etc. Since local chicken enterprise is an integral part of the farming system and that the poultry calendars of activities interact with other farming activities, labour saving skills in other farming activities would allow more time to care for chicks and reduce chick losses.

Division of labour among family members in FRLC management as far as construction of sheds, cleaning of chicken houses, feeding and treatment of sick chickens showed that all family members provided labour, although women and children dominated the activity profile. Similar labour utilization profiles have been reported in Zambia, Ethiopia and Kenya (Kitalyi, 1998; Okitoi *et al.,* 2007). It was observed that men tend to be involved in rural poultry production if they see that it has the potential for generating income. As the enterprise tended towards commercialization, men appeared to participate more in its management.

5.6 Farmer's Reasons for Not Adopting or Adopting Only Part of the Package

Of the 50 respondents in the trained farmers group only 3 farmers (6%) revealed that they had not adopted any part of the technological package because of the outbreak of Newcastle disease that wiped the whole flock. It is obvious that adoption of technologies by farmers normally is a result of technologies disseminated to farmers through various ways, in this regard 10 farmers (20%), 9 farmers (45%) for neighbour and control groups respectively reported that they were not aware of the technologies.

The results in Table 14 further shows farmer's response as to why they decided to adopt only parts of the package. The majority of farmers 64%, 48%, 30% for trained, neighbours and control farmers respectively reported that the adopted components are relatively more important than others. Also the second major reason of adopting only parts of the package, is that the adopted components are simple when compared to others and this reason was supported by 14%, 22%, and 15% of respondents for the trained, neighbours and control farmers respectively. According to CIMMYT (1993), technologies that are simpler to understand can be adopted more rapidly than technology that requires the adopter to develop new skills and understandings. Few farmers in the trained group adopted most of the introduced technologies. Few farmers in all categories did not give reasons for not adopting some or all of the technologies.

Given the simplicity of technologies, majority of farmers (82%) in the trained group did not experience any problem in the process of adopting. Nevertheless, several respondents for all categories 4%, 12%, and 20% for trained, neighbours and control farmers respectively reported lack of funds to have influenced adoption, (Table 14). The findings in the neighbour and control farmers are within the range as reported for the case of Western Kenya, (Ngugi *et al*., 2007).

5.7 Contribution of FRLC to the Household Income

In this study the contributions of FRLC to the household expenditure are presented in Table 15. The results show that majority of farmers used cash from sale of chicken to pay for hospital charges, the number being higher among the control group. There were variations in response among the three groups in terms of the contribution of FRLC to other household expenses.

Although FRLC require low resource inputs and generally considered secondary to other agricultural activities by smallholder farmers, this type of production has an important contribution in supplying local populations with additional income and high quality protein as it has been shown in this study.

The results in this study are consistent with the findings by Branckaert *et al*. (2000); Tike and Ronny, (2005); and Ngugi *et al*. (2007), who reported that FRLC contributes to the household income, financially, nutritionally, socially and religiously.

The contribution of FRLC to paying of school fees was low as reported by 24%, 22%, and 5% for neighbour farmers, trained farmers and control farmers respectively. The same range of findings have been reported by Riise and McAinsh (2005), they found that small producers depend on the FRLC for a number of reasons including payment of school fees and gifts. A study on income generation in transmigrant farming systems in East Kalimantan, Indonesia showed that family poultry accounted for about 53 percent of the total income, and was used for food, school fees and unexpected expenses such as medicines (Ramm *et al.,* 1984). Surveys in some African countries have reported that the main function of village chickens from the farmer's perspective is the provision of meat and eggs for home consumption Kitalyi, (1998). Similarly Kperegbeyi *et al.* (2009) reported that the scope for utilizing local chicken as a source of poultry meat is high because consumers prefer its hard meat. Kugonza *et al.* (2008) observed that local consumption included eating chicken products within the home, food for visitors, gifts to friends and the church offerings. According to Kugonza *et al.* (2008) chickens also are exchanged for labour and other livestock such as goats. In the study bone by Dessie and Ogle (2001) also showed that chicken owner farmers in central highlands of Ethiopia, in some cases, gave live birds (8.6%) and eggs (5.4%) as a gift to visitors and relatives, as starting capital for youths and newly married women. However, Sonaiya *et al.* (2004) reported that giving of live birds as sacrificial offerings in traditional worship was not practiced anymore in many chicken producers of developing countries, he stated that sale of live birds for income generation was the primary goal of keeping family chicken in developing countries. Based on the findings of this study, FRLC contribution was high on household consumption, hospital charges and buying clothes, showing that it is an important enterprise which needs to be in the priority list for rural communities.

5.8 Sources of Information about Technologies for the Untrained Farmers

The results show that extension services and neighbour household were the main sources of information about technologies to the control farmers and neighbour farmers by 55%, 52% respectively. Very few farmers reported to be aware of the technologies through agricultural shows by 18% and 5% for the neighbour farmers and control farmers respectively. Few farmers in the control group 5% received technologies from the mass media i.e. radio and television, results which are contrary to the findings reported by Choudhuri *et al.* (2010) who found that the respondents got the information mostly from the radio followed by television among the mass media group. Another contrary results were reported by Pipy (2006) who found that poultry farmers obtain information from a variety of sources with television been the most prominent (68%) in Nigeria. Justin *et al.* (2007), in the case study of small-scale poultry farmers in Ghana found that more than 70% of the respondents indicated that Farmers' association was their main source of information.

Experience from around the world has shown that with relatively simple technical measures, smallholders' production of meat and egg from indigenous or improved breeds can be improved, however, adoption of new technologies is a slow process for most small-scale farmers (Larsen, 2002) cited by Riise *et al.* (2005). The right approach for technology transfer needs to be developed and tested with and by small farmers (Dilts, 2001). The extension argents are responsible to use the right approach, since the majority of small-scale producers around the world including Tanzania are still today depending on national extension systems (Hooton, *et al*., 2003).

This calls for a participatory approach, whereby farmers may themselves develop the necessary "enabling environment" for them to demand the necessary inputs, in particular in terms of veterinary services and training. Such a demand-driven process will often have a slow start, as it requires training of farmers in more than techniques. Training relating to organisational skills and general empowerment often becomes more important in the initial phase. The Farmer Field School approach encompasses this as farmers are trained in organizational and technical skills in a combined process (Dilts, 2001). In this study the approach used was training.

5.9 Disease Problems on the Adoption of the Technologies

In this study, the mentioned disease problems are presented in Table 17. Newcastle disease was reported to be the most important killer disease of FRLC; as a result it became a major obstacle in the adoption of the technologies. Farmers in the neighbour group, control and trained reported ND alone as their main disease problem by 38%, 35% and 30% of respondents respectively. ND together with other diseases especially infectious coryza were reported as the problem on the adoption of technologies by 52%, 45% and 40% of the respondents for trained, control and neighbour farmers respectively.

These findings generally agree with those of Foster *et al.* (1997) on FRLC in Tanzania who observed that the extremely high mortalities due to Newcastle disease in Tanzania was a major factor that discourages peasants from investing much of their time and scarce resources in expanding flock sizes. Several recent surveys in Africa showed high rates of ND seropositivity in the absence of vaccination (Kitalyi, 1998). In this survey Kitalyi was reported that, the problem of diseases in free range chickens is compounded by the interactions of different entities that are of significant importance to disease epidemiology. At the village level, contacts between flocks of different households, the exchange of birds as gifts or entrusting, sales and purchases are the main sources of infection transmission. Similarly, other domestic fowls and wild birds form another source of infection, because the chickens roam freely in the villages. Similar observation has been reported by Branckaert *et al.* (2000) who observed that, in developing countries, ND occurs every year and kills an average of 70 to 80 percent of the unvaccinated FRLC. However, this problem is likely to be reduced in the study area since the majority of the respondents in this study especially for the trained farmers were vaccinating their birds using the heat resistant I-2 vaccines.

5.10 Assessment of the Impact of Adopted Technologies on Chicken Performance

Results in Table 18 show the impact of adopted technologies on chicken performance. The influence of technologies adoption on eggs weights and flock size was significant ($P<0.001$) and ($P<0.05$) respectively, and was higher among trained farmers than other categories. The results further revealed that live bird weights were also significantly ($P<0.001$) higher for trained farmers than neighbour farmers and control farmers. The mean number of birds was 3.85kg for trained farmers, 3.12kg for neighbour farmers and 2.48kg for control farmers. On the other hand the mean weight of birds and eggs for trained farmers was 2.17kg for cocks, 1.66kg for hens and 42.58g for eggs. Among the interviewed neighbours the mean weight of birds and eggs was 1.87kg for cocks, 1.48kg for hens and 40.25g for eggs. These minor differences between trained farmers and neighbour farmers could positively be influenced by sharing of information among the two groups of farmers, while egg size may be a result of previous introduction of improved cocks in some of the households under TASAF project. For the control farmers the performance is low in terms of the mean weight of birds and eggs being 1.68kg, 1.13kg, 38.65g for cocks, hens and eggs respectively.

The NDAF project has had notable positive impact on the local chicken performance in that the population of birds, their quality and egg laying capacity has increased. Farmers are using more hens and eggs for brooding leading to more chicks. Disease control, housing of chicks and supplementary feeding has increased the survival rates of the birds. Table 19 show the production status before and after adoption of the technologies, trained farmers were able to answer the prepared questions in order to come up with an estimated data which shows that egg laying capacity has been increased from 8-15eggs before technology adoption to 15-25eggs currently. Number of brooding hens also increased from 1-2 before to 3-6 currently, as a result the number of hatched chicks also increased from 9-12 before to 10-16. Surviving chicks increased from 4-6 before to 6-14. Also the results in Table 19 revealed that mature laying hens increased from 16%, to 40%, chick mortality decreased from 65% to 30% and growers mortality decreased from 50 % to 20% because of improved management. Similar trend has been reported for the case of Kenya Agricultural Research Institute Project on free range local chicken in Western Kenya Ngugi *et al*. (2007), and Kitalyi (1998) for various production systems in Africa.

The technologies availed provided surplus eggs through increased flock sizes and egg production for home consumption. Since flock numbers had increased and the supplemented chickens were growing faster and thus reaching sale weight earlier, the off take per year was obvious that it has been increased also. Income acquired from the sales of chickens provided the households with extra cash to buy other food commodities and meet their domestic needs. A combination of all these factors suggests that household nutrition and welfare in general is likely to have been improved. The findings here reported, therefore, reflect that technologies have been well adopted by the beneficiaries and that the increased weights of adult chicken and eggs was mainly due to feed supplementation and disease control measures. Studies on improvement of free range local chicken in western Kenya revealed that vaccination against ND could reduce mortality by 45.5% and that improved management alone could increase flock sizes by 12.5% (Okitoi, *et al.*, 2007). Also the results of Dessie and Ogle, (2001) show that supplementation of energy and protein in addition to other management changes can increase egg production by more than 100%.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

i. This study aimed at assessing the extent of adoption of technologies among the trained farmers and untrained farmers, also the impact of technologies adoption on chicken performance.

ii. The results of this study showed that training influenced positively the adoption of technologies such as feed supplementation, chick management, disease control, egg management and housing.

iii. Adoption of technologies led to significant increase in flock size, and egg number among the trained farmers compared to untrained group.

iv. Adoption rates were significantly influenced by education levels and presence of extension /veterinary services. However age, sex and leadership experiences among the respondents did not have a bearing on adoption rates.

6.2 Recommendations

The positive impact of the training carried out by the NDAF project on technologies to improve FRLC enterprise is an indication that farmers perceived these efforts as advantageous; hence lesson learnt must further be intensified to reach more farmers i.e. upscalling within and beyond the target villages, therefore the government and non governmental organizations should put more emphasis on technologies dissemination to farmers through various ways such as agricultural shows, mass media communication, farmer field schools and training and visit approach. Although the intervention was for short period, there is a need to have a monitoring mechanism in place to ensure sustainability of the introduced technologies.

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APPENDICES

Appendix 1:Trained farmers questionnaire

Date...

Respondent’s number……….. Village……………… Sub village..........................

A.GENERAL INFORMATION (Tick where appropriate)

1. Gender: Female........... Male.............

2. Age of the respondent

How old are you?

1) 18-24 years 2) 25-30 years 3) 31-37 years

4) 38-44 years 5) 45-50 years 6) Above 50 years

3. Marital status

1) Married…………. 2) Single…………

3) Divorced…………. 4) Widowed………

4) How many people live in the household?

1) 1-3 (2) 4-6 (3) 7-9 (4) 10-12 (5) Above 12

5) What is your highest level of education attained?

1) No education 2) Adult education 3) Primary education 4) Secondary education

6) The household members level of education (number)

1) Illiterate………… 2) Read and write

3) Primary education…………… 4) Secondary education……..

7) Have you ever been in the leadership or committee member of any group? Yes/No

8) If yes in question 7 what kind of that group

1) Agricultural organization leader………… 2) Social organization leader…

3) Agricultural organization member…….. 4) Social organization member.

5) Village/ Sub village leader………. 6) Village/Sub village committee member

9) What is the major source of income for your family?

1) Salary/wages 2) Farming 3) Income generating activity

4) Others (specify)……….

10) If farming, in which activity are you engaged?

1) Livestock farming 2) Poultry keeping 3) Crop farming

4) Fishing 5) Bee keeping 6) others (specify)

11) If income generating activity, what type of activity?

1) Shop owner 2) Brewing 3) Pottery 4) Masonry/carpentry

5) Tailoring/sewing 6) Brick making 7) other (specify)……..

B. Information about local chicken (farmers who were targeted)

12) Are you keeping local chickens? Yes /No

13) If yes, what is your flock size? Tick the flock size where appropriate

1) 5-10 2) 10-15 3) 15-20 4) 20-25 5) 25-30

6) 30-35 7) 35-40 8) 40-45 9) 45-50 10) Above 50

14. Who is responsible for the following duties/activities (tick where appropriate)

	Women	Men	Children	Family
Ownership				
Labour profile				
Shelter construction				
Cleaning chicken house				
Supplementary feeding				
Providing water				
Selling chicken				
Selling eggs				
Treatment				
Decision making				
Selling eggs				
Selling chicken				
Home consumption of eggs				
Home consumption of chicken				
Purchase of drugs				

15. After attending training on local chicken improvement technologies did you adopt the full package? Yes/No/Not full

16. If you have adopted the full package of the technologies, what changes do you think that they were brought by those technologies?

1) The flock size has been increased from………..to……….

2) Egg number per clutch has been increased from……….to………

3) Family egg consumption has been increased from……..to ………per month

4) Family chicken meat consumption has been increased from………to ……..per month

5) Death caused by diseases has been decreased from…………………to…………..per year

6) Loss caused by predators has been decreased from ……………….to…………per year

7) Sales of live birds and eggs has been also increased from…………to……….live birds per year and from…………to………..eggs per year

17. If you have not adopted all the technologies, give reasons (Tick where appropriate)

1) The technologies are expensive

2) The technologies are not compatible with the existing situation

3) No market for selling local chicken products

4) No extension services 5) the technologies are complex

6) Others (specify)...

18. If you have adopted only part of the package, which technologies have you adopted among the following? (Tick where appropriate)

1) Supplementation to the scavenging chicken

2) Housing 3) Chick management

4) Egg management 5) Record keeping

6) Disease control

19. Why have you adopted the technologies mentioned above and not others? Give reasons

....

20. On the process of adopting technologies have you experienced problems? Mention them ....

21. From your opinion what can you recommend about these technologies?

1) They are very important 3. Nothing to recommend

2) They are not important

22. What is your opinion concerning these technologies on egg production and chicken flock size?

1) Increased 2) Decreased 3) No changes

23. If egg production and flock size were increased how, do you estimate the increment?

1) Doubled 2) Tripled 3) Others (specify)

24. If egg production and flock size were decreased or no changes what do you think are the problems? ....

HOUSING

25. Where do the chickens rest at night?

a. Do not know b. Kitchen/store c. In the main house d. Perch on trees

e. Woven basket f. Other (specify)

26. Who constructed the chicken house/shelter?

a. Adult male b. Adult female c. Young boys d. Young girls

27. Do you clean the chicken house? Yes/No

28. If yes, how frequently do you clean the chicken house?

a. Daily b. Weekly C. Monthly d. Less than once per month

29. Who cleans the house?

a. Adult male (>18 years) b. Adult female (>18 years)

c. Boys (<18 years) d. Girls (<18 years) e. Hired labour

SUPPLEMENTARY FEEDING (OTHER THAN SCAVENGED FEED)

30. Do you supplement your chicken? Yes/No

31. If yes in question 30 describe the supplement in the following chart.

Type of supplement	**Source (household harvest, purchase, donation)**	**If purchased, unit price**	**Quantity and time of feeding per day**	**Person who feeds the chickens**

32. Do you provide water to the chicken? Yes/No

33. If yes, in question 32 fill in the following table.

Source of water(tap, river, bore hole, well)	**Type of drinkers**	**How frequently do you provide water?**	**How far is the source of water from the homestead?**	**What is the walking distance to the water source?**

34. Do you generally have a ready market for the local chicken products? Yes/No

35. If yes, what kind of market?

a. Neighbours b. In town c. In the market d. Others (specify)......................

36. If no in question 34 what did you do with the products

a. Used for family consumption only

b. Used as gifts to friends c. Others (specify)

37. At what price do you sell your products?

Eggs......................... Adult cocks............................ Cockerels.................... Adult hens..................

38. Have you experienced any problem regarding markets of local chicken products? Yes/No

39. If yes mention them..

ANIMAL HEALTH

40. Have you experienced any disease problems in your flock Yes/No If yes, indicate the symptoms/disease and control measures taken using the Table below. Rank the problems in order of importance.

Type of disease/ symptoms	**Control measure**	**Cost incurred to control**	**Last occurrence in the flock**	**Age group affected**	**Rank according to importance**
Swollen head					
Swollen joints					
Coughing					
Diarrhoea (bloody/greenish)					
Twisted neck					
Paralysed legs/wings					
Fowl pox/warts					
Newcastle disease					
Mites/ticks					
Fleas					

41. Do you have access to veterinary services? Yes/No

42. If yes, please fill in the Table below.

Source/name of centre	**Type of service (advice, diagnosis, drugs)**	**Cost incurred, if any**	**Frequency of visits by veterinary assistants**

43. In which season do you lose most of your chickens?

a. Rainy season b. Dry season c. Both seasons d. Not aware

44. Have you heard of Newcastle disease? Yes/No

45. If yes, where and when? ....

46. Has there been any occurrence of Newcastle disease in your flock? Yes/No

47. If yes, can you describe the symptoms? ....

48. When did Newcastle disease last occur in your flock? ....

49. How did it affect your flock?

a. Wiped out the whole flock b. Destroyed more than half of the flock

c. Destroyed less than half the flock d. No mortality

50. What was the source of infection?

a. Own flock b. Incoming chicken c. Neighbouring household

d. Neighbouring village e. Unknown

51. What do you think is the best control strategy for Newcastle disease?

a. Vaccination b. Observing disease control measures

c. Destroying the whole flock during the out break

d. Others (specify)..

52. Can you explain the situation before and after adopting technologies on chick and grower mortality? Yes/No

53. Give the information on the following performance indicators

Performance indicators	**Status before adoption/% or number**	**Current status**
Eggs laid/hen/cycle		
Number of brooding hens		
Eggs brooded/hen/cycle		
Chicks hatched/hen/cycle		
Surviving chicks/hen/cycle		
Mature laying hens		
Chick mortality		
Grower mortality		

54. Do you keep records? Yes/No

55. If yes, what type of records do you keep?

a. Flock size records b. Production records

c. Feeding records d. Flock health records

56. Do you practice chick management? Yes/No

57. If yes, explain..

58. Do you practice egg management? Yes/No

59. If yes, explain (Tick the correct answer)

a. Use of trays and keep them in clean and dry area

b. Use of boxes and keep them in clean and dry area

c. Eggs are left in laying nests d. Others (specify)

60. Do you think that local chicken contribute to your family income? Yes/No

61. If yes, which area do you think they contributed?

a) To pay school fees b) to pay hospital charges

c) To buy clothes d) to buy exercise books

e) Others (specify)...

THANKYOU

Appendix 2: Untrained farmers questionnaire

Date..

Respondent's number……….. Village……………… Sub village..........................

A.GENERAL INFORMATION (Tick where appropriate)

1. Gender: Female........... Male..............

2. Age of the respondent, how old are you?

2) 18-24 years 2) 25-30 years 3) 31-37 years

5) 38-44 years 5) 45-50 years 6) Above 50 years

3. Marital status

2) Married…………. 2) Single…………

3) Divorced…………. 4) Widowed………

4) How many people live in the household?

1) 1-3 2) 4-6 3) 7-9 4) 10-12 5) Above 12

5) What is your highest level of education attained?

1) 1) No education 2) Adult education 3) Primary education 4) Secondary education

6) The household members level of education (number)

1) Illiterate………… 2) Read and write

3) Primary education…………… 4) Secondary education……..

7) Have you ever been in the leadership or committee member of any group?

1) Yes…….. 2) No………

8) If yes in question 7 what kind of that group

1) Agricultural organization leader………… 2) Social organization leader…

3) Agricultural organization member……..4) Social organization member……..

5) Village/ Sub village leader………. 6) Village/Sub village committee member…

9) What is the major source of income for your family?

1) Salary/wages 2) Farming 3) Income generating activity

4) Others (specify)………..

10) If farming, in which activity are you engaged?

1) Livestock farming b. Poultry keeping d. Crop farming

4) Fishing 5) fishing 6) Bee keeping 7) others (specify)

11) If income generating activity, what type of activity?

1) Shop owner 2) Brewing 3) Pottery 4) Masonry/carpentry

5) Tailoring/sewing 6) Brick making 7) other (specify)……...................

B. INFORMATION ABOUT LOCAL CHICKEN

12. Do you keep scavenging local chicken? Yes/No

13. If yes, what is your flock size? (Tick where appropriate)

a. 5-10 b. 10-15 c. 15-20 d. 20-25 e. 25-30 f. 30-35

14. Are you aware of the technologies to improve scavenging local chicken? Yes/No

15. If yes, from where/ whom have you received the information? (Tick where appropriate)

a. Radio and television b. Extension officer

c. Neighbour's household d. Neighbour's village

e. From leader's speech f. Others (specify)

16. Have you adopted the full package? Yes/No/Not full

17. If yes, what changes have you observed in relation with the technologies? Mention them...............

18. In your opinion what can you say about these technologies?

a) They are useful b) They are not useful

c) They are expensive

19. If no in question 16 above give reasons for not adopting............................

20. If not full package, which technology have you adopted among the following?

a. Supplementation to the scavenging local chicken

b. Disease control c. Housing d. Egg management

e. Chick management f. Record keeping

21. Where do you sell, eggs and live birds?

a. To the neighbours b. In the village market c. In town

d. In the nearest shopping centre e. Other (specify).............

22. What expenses do you think that local chicken contributes to cover?

a.To pay school fees b. To buy exercise books c. To buy school uniform

d. Others (specify)

23. Have you experienced market problems about where to sell the local chicken products?

Yes/No

24. If yes, suggest ways to solve the

problem...

25. Do you have a poultry house? Yes/No

26. If yes, what type of the materials used to build poultry house?

a. Locally available materials

b. Mud bricks thatched with grasses

c. Mud bricks, roofing with iron sheet

d. Others (specify)

27. If no in question 25, where do the chickens rest at night?

a. Do not know b. Kitchen/store c. In the main house

d. Perch on trees e. woven basket f. Other (specify)

28. Do you supplement your scavenging chicken? Yes/No

29. If yes, what type of feed materials and their source?

Feed materials Source

....

30. According to your experience can you explain the difference in production before and after supplementation? Yes/No

31. If yes give the difference in the following space

Before After

....

32. If no in question 30 give reasons...

33. If no, in question 28 do you know that supplementation is important to increase chicken productivity? Yes/No

34. How do you manage your chicks to avoid loss by predators and other hazards?

....

35. How do you store eggs before selling them?

36. Have you experienced disease problems in your flock Yes/No

37. If yes, what type of diseases? Mention..

38. What strategies do you use to control and treat diseases?

....

39. In which year do you remember was the last incidence of disease out break in your flock? ……………………………………………………………………………

40. What kind of the disease and what was the out come?

....

41. Do you have access to veterinary services? Yes/No

42. If yes what is the frequency of visits by veterinary assistants?

43. Which methods were used by extension worker to advise you on agricultural practices?

1) Face to face 2) at meeting 3) demonstrations

4) Others (specify)

44. What is your opinion on the extension method used by your extension staff?

1) Good 2) Satisfactory 3) Poor 4) Very poor

THANKYOU

Appendix 3: Statistical tables

8.3.1 Factors influencing technology adoption

Dependent variable: Technology adoption

Independent variables	Standardized coefficients	Un standardized coefficients	Sig. t	
Age	0.0162	.0820 (.539)	0.8558	
Gender	0.0081	.1083 (1.154)	0.9255	
Education level	0.1893	.1330 (.6564	0.045	*
Extension services	-0.236	.8335 (.3661)	0.0246	*
Leadership	0.0448	.0145 (.0306)	0.6357	
Veterinary services	0.0659	0.0779	0.0129	*
R^2 =.79130				
Adj. R-square = .62615				
F-statistics F12,121 (for R) = .0083 **				
Constant		**4.695 (3.584)**	**0.1927**	

8.3.2 Male and Female adult birds Weight (kg)

Treatment	**Statistics**	Bird Weight **Male**	**Female**	Egg Weight
Trained	N	20	20	50
	Mean	2.17	1.66	42.58
	Minimum	1.50	1.00	37.30
	Maximum	2.80	2.30	47.70
	Std. Deviation	0.35	0.39	2.63
Neighbours	N	20	20	50
	Mean	1.87	1.48	40.25
	Minimum	1.50	1.00	32.00
	Maximum	2.50	2.00	45.60
	Std. Deviation	0.34	0.32	3.49
Control	N	15	15	50
	Mean	1.68	1.13	38.65
	Minimum	1.25	0.75	32.60
	Maximum	2.50	1.50	46.40
	Std. Deviation	0.33	0.22	3.46
Overall	N	55	55	150
	Mean	1.92	1.45	40.49
	Minimum	1.25	0.75	32.00
	Maximum	2.80	2.30	47.70
	Std. Deviation	0.39	0.38	3.58

8.3.3 Mean comparison for flock size, male adult birds, female adult birds and eggs

Groups	Trained **Mean**	Neighbour **Mean**	Control **Mean**	F value	
Flock size	3.85 ± 1.97[a]	3.12 ± 2.47[ab]	2.48 ± 1.29[b]	0.0500000	**
Male	2.17 ± 0.35[a]	1.87 ± 0.34[b]	1.68 ± 0.33[b]	0.0003641	***
Female	1.66 ± 0.39[a]	1.48 ± 0.32[a]	1.13 ± 0.22[b]	0.0000594	***
Egg Weight	42.58 ± 2.63[a]	40.25 ±3.49[b]	38.65 ± 3.46$_c$	0.0000001	***

8.3.4 Analysis of variance Table

K Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Prob
1 Sub/vill.	15	1.586	0.106	0.9581	
2 Sex	1	4.550	4.550	41.2256	0.0000
4 Groups	2	3.928	1.964	17.7958	0.0000
6 AB	2	0.074	0.037	0.3343	
-7 Error	75	8.278	0.110		

Total 95 18.416

Duncan's Multiple Range Test

LSD value = 0.3568

s_ = 0.05863 at alpha = 0.050

x

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Original Order			Ranked Order
Mean 1 =	42.762	A	Mean 1 = 42.762 A
Mean 2 =	40.409		AB Mean 2 = 40.409 AB
Mean 3 =	38.963		B Mean 3 = 38.963 B

8.3.5 Table of means

1	2	3	4	Total
1	*	*	1.808	10.850
2	*	*	1.683	10.100
3	*	*	1.608	9.650
4	*	*	1.592	9.550
5	*	*	1.750	10.500
6	*	*	1.742	10.450
7	*	*	1.533	9.200
8	*	*	1.725	10.350
9	*	*	1.733	10.400
10	*	*	1.417	8.500
11	*	*	1.783	10.700
12	*	*	1.508	9.050
13	*	*	1.725	10.350
14	*	*	1.633	9.800
15	*	*	1.525	9.150
16	*	*	1.933	11.600
*	1	*	1.886	90.550
*	2	*	1.451	69.650
*	*	1	1.920	61.450
*	*	2	1.661	53.150
*	*	3	1.425	45.600
*	1	1	2.125	34.000
*	1	2	1.853	29.650
*	1	3	1.681	26.900
*	2	1	1.716	27.450
*	2	2	1.469	23.500
*	2	3	1.169	18.700
