PRODUCTIVITY AND TECHNICAL EFFICIENCY OF EGG PRODUCTION IN TANZANIA UNDER THE INTENSIVE SYSTEM: A CASE STUDY OF ILALA AND KIBAHA DISTRICTS

BY

OLEKE, JOFREY MASAHI

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ABSTRACT

This study examined the productivity and technical efficiency of egg production in Tanzania under the intensive system. The study also attempted to identify the factors constraining egg production. A multistage random sampling procedure was employed for the selection of 80 respondents from two districts; Kibaha and Ilala in the Coastal and Dar es Salaam region respectively. The study used a stochastic frontier production functions in which the technical inefficiency effects are assumed to be functions of some socio-economic characteristics and management practices of the farmer which influence the technical efficiency for eggs production. This study utilizes the most recent development in stochastic frontier modeling by a one-step process in Limdep software. Results show that egg production was in the rational stage of production (stage II) as depicted by the Returns to Scale (RTS) of about 1.3. The variables of interest were effectively allocated and used, as confirmed by each variable having estimated coefficient value between zero and unity. Empirical results indicated that the mean technical efficiency of egg production is 64 percent; however, this ranged from 4 to 90 percent. The family size, employment status, types of heating and lighting equipments, age of the farm attendant, and sex of the household head affect the technical efficiency. The study further found out that the farm technical efficiency is positively related to net profit. In general, the study revealed the existence of considerable economic efficiency in production. However, diseases, lack of credits, high input costs, and improper marketing arrangements are the major constraining factors in egg production. The findings of this study showed that there is the need for governmental and/or private institutions interventions to improve the production and marketing performance of poultry by providing the

necessary institutional support to the smallholder farmers in the study areas to improve their efficiency.

DECLARATION

I, Jofrey Masahi Oleke, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has not been or concurrently being submitted for a higher degree award at any other university.

12th 2008

Jofrey Masahi Oleke   Date

(MSc. Candidate)

The above declaration is confirmed

12th Nov 2008

Prof. Aida Isinika   Date

(Supervisor)

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LIST OF ABBREVIATIONS

APP	Average Physical Product
ASDS	Agricultural Sector Development Strategy
CES	Constant Elasticity of Substitution
DAEA	Data Envelope Analysis
ESRF	Economic and Social Research Foundation
FOC	First Order Condition
GDP	Gross Domestic Products
LFDCs	Low Income Food Deficit Countries
LIMDEP	Limited Dependent Variables
MS	Mycoplasma Synoviae
MAFC	Ministry of Agriculture, Food and Cooperatives
MALD	Ministry of Agriculture and Livestock Development
MLD	Ministry of Livestock Development
MDG	Millennium Development Goals
MFC	Marginal Factor Cost
MG	Mycoplasma Galliseption
MLE	Maximum Likelihood Estimates
MOA	Ministry of Agriculture
MPP	Marginal Physical product
MVC	Marginal Variable Cost
OLS	Ordinary Least Squares
SFA	Stochastic Frontier Approach

TE	Technical Efficiency
TFA	Thick frontier approach
TVC	Total Variable Cost
TVP	Total Value of Product
URT	United Republic of Tanzania
VMP	Value of Marginal Product

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The world human population is expected to increase from 5 282 million in 1990 to 7 286 million in the year 2015. This growth is expected will take place largely in low-income food-deficit countries (LIFDCs) of Africa, Asia, the Near East, Latin America, Europe and the South Pacific (http://www.fao.org). One of the strategies to cope with such increase in food insecurity is poultry production. Recent increasing food prices worldwide presents an incentive for producers and a pressure for policy makers to advocate poultry production as one of the alternatives. Over the last decade, the poultry population has grown significantly throughout the world. Poultry production has increased by 23 percent in developed and 76 percent in developing countries. This increase, due primarily to industrial or commercial production, has been most notable in South and East Asia where growth averaged 90 percent from 1990 to 2000. For example, in India, production has increased sixfold in ten years. However, according to Branckaert and Guèye (2000) most of the conditions required by the industrial poultry sub-sector are not met in LIFDCs, namely: the ability to purchase most inputs, such as improved birds, feeds, vaccines, drugs and equipment, the availability of a highly skilled manpower, the presence of a strict disease control, and the existence of national domestic markets able to absorb poultry products at attractive prices, which means having consumers with adequate purchasing power.

Poultry constitute an important component of the agricultural and household economy in LIFDCs, a contribution that goes beyond direct food production for the fast-growing human population as well as employment and income generation for resource-poor small farmers, especially women. Poultry also serves as a means of capital accumulation and as a barter product in societies where there is no circulation of currency (Katalyi, 1998).

In 2001, the total world's poultry meat production amounted to almost 70 million metric tons. The greatest part (more than 50%) was produced in Asia and North America. More than 56 million metric tons of eggs were produced worldwide where the greatest production came from Asia (Faostat, 2002). Poultry production is equally important in developing countries and it will remain important for many years to come because of the high population densities and the enormous numbers of small farms in developing countries (Ellis, 1992). In Africa the most reared poultry species are chicken, the domestic indigenous fowl *Gallus domesticus*. Production mostly uses traditional methods based on the free-range production systems, characterized by low inputs and low outputs (Rushton and Ngongy, 1998; Gueye, 2000). The share of family poultry to total poultry population in developing countries, especially in Africa is not well documented but is estimated to reach 70% to 80% of total poultry population (Gueye 1998; Sonaiya *et al.,* 1990). Chrystome *et al.,* (1995) estimated the share of free-range chickens in Benin to be 90% of the total poultry population. In Tanzania, the share of local chickens is about 90% (MLD, 2006)

Tanzania is one of the countries where agriculture remains the largest sector in the economy and hence its performance has significant effect on output and corresponding income and poverty levels. In 2004, the sector contributed approximately 51% of foreign exchange, 75% of total employment and 47% of the Gross Domestic Product (GDP). Smallholder farming dominates agricultural production, and a large proportion (90%) is for subsistence. Sale of agricultural products accounts for 70% of rural household income (ESRF, 2006). During the 1990s, agricultural growth was 6.3%, which was higher than in the 1970s and 1980s when annual growth averaged 2.9 and 2.1% respectively. National data show significant progress towards the objective of a sustained 5% GDP growth rate. There was an increase of the five year moving average agricultural GDP growth rate from about 3.3% between 1991and 2000 to 4.3% over the 1999-03 periods (MAFC, 2006 a).

In Tanzania agriculture largely comprises of crops and livestock production. The growth of agriculture depends on growth of crop and livestock sub-sectors. For example, in the period of 2001-05 the livestock sub-sector expanded with, the cattle herd growing at 2.2% annually, which is almost the same as the growth rate of the entire sector. Livestock products such as meat (beef) and milk are also expanding.

The poultry industry has also been increasing, particularly in the last five years. Rapid growth was recorded in eggs production, where production quadrupled from 450 million eggs in 2000 to 18 000 million eggs in 2005 (MAFC, 2006 a). Given the experience it appears that poultry production under intensive system has a lot of opportunities for private investment (MLD, 2006). Meanwhile, small and medium enterprises have managed to increase local chicken from 27 million in 2001 to 30 million in 2006 representing an annual growth rate of two percent during the same period. The commercial stock increased from 20 million to 25 million reflecting an annual growth of five percent for the same period (MLD, 2006). However, growth of the poultry sub-sector is limited by the low supply of old day chicks, meat and eggs which is still low.

In Tanzania most urbans and periurban areas also practise agriculture because it provides food and income, especially for low income families. Sawio (1996) argues that two third of Dar es Salaam inhabitants are involved in some agricultural activities. Although crop cultivation is more common, many urban dwellers keep one or more animals. The most common types of animals are dairy cattle and chickens raised for commercial purpose than for food self sufficiency as is the case for food crops (Mlozi *et al.*, 2003). About 94% of the total chicken population in Tanzania is kept in villages and in periurban areas under traditional free range system and in most cases owned by women (MOA, 2000). The traditional poultry system is the largest, supplying more than 90% of poultry meat and eggs consumed in rural areas, and 20% of the same are consumed in urban areas.

Under the Agricultural Sector Development Strategy (ASDS), support to poultry production sets the framework for achieving the sector objectives and targets (URT. 2006). Some of the targets for attaining broad based and sustainable growth include the growth rate of livestock sector from 5% in 2002/03 to 10% by 2010 in order to contribute to improving food availability, accessibility and reducing income poverty. Supporting poultry production is important because the majority of rural poor depend on poultry as an alternative source of income. Increasing the productivity of poultry through better technical services, will contribute to this goal. There has been more recognition that poultry can generate income for rural, urban and periurban dwellers as well. Despite the predominance of local chicken in Tanzania, Paul *et al*., (1990) argues that production of layers is comparatively a better source of earning cash, especially in urban and peri-urban areas. However, little is known about the efficiency of commercial poultry enterprises in Tanzania.

1.2 Problem Statement and Justification

Since the establishment of the commercial poultry industry in Tanzania in the 1980s, visible growth in the production of layers has been observed. The small and medium enterprises have managed to increase the numbers of local chicken from 27 million in 2001 to 30 million in 2001in 2006, while the commercial stock increased from 20 million to 25 million. On average 5.5 hatching eggs and one million Day Old Chicks are imported annually to produce a total of 25 million day old chicks for commercial purposes. This figure is low compared to the actual requirement of 60 million day old chicks per year. Egg production has increased from 790 million in 2002 to 1.8 billion in 2006. The increase is largely due to sensitization on good poultry husbandry practices and use of thermo stable New Castle Disease vaccine (MLD, 2006). The per capita consumption of eggs has increased from 23 eggs in 2002 to 50 eggs in 2006 per person per year. Although the production of eggs has grown rapidly, still there is a big gap between the demand and the supply in the country. Meanwhile the per capita consumption of eggs in Tanzania is quite low, compared with 106 eggs per person per year for Africa and 190 for high income countries (Gueye, 2004). The rising demand for eggs calls for more investments in the intensive poultry production and the poultry industry as whole. Although poultry is a relatively young industry in Africa, there are many studies which have been done to provide a better understanding of the emerging industry. A study by Mutizwa-Mangiza and Helmsing (1991) assessed the contribution of various components of the poultry farming system to household subsistence in Zimbabwe while Ojo (2003) studied the technical efficiency of egg production of the rural poultry industry in Nigeria. Meanwhile, in Mali (Wilson *et al.,* 1987) studied chicken mortality within the first three to four months after hatching. While Buza, and Mwamuhehe (2003) studied constraints to production of chicken at the village level in Tanzania, the study by Mlozi *et al.* (2003) focused on marketing of local chicken. Another study by Kusolwa (2002) concentrated on effects of substituting fishwaste for fishmeal in egg production in Tanzania whereas Millau (1990) looked at effects of leucaena leafmeal on egg production and egg quality in the production of layers. Many of these studies focused on production aspects, diseases and marketing of rural poultry. Only a few studies focused on production of eggs using commercial layers.

While these studies, focusing on specific aspects of poultry production are important for informing small, medium, and large scale producers who strive to maximize profit, it is also important to assess the technical efficiency of such farms especially now that the government's objective is to promote and support commercial oriented agricultural production. The technical efficiency becomes critical factor in decision making in management and production systems because the cost of production is closely related to the productivity and technical efficiency of the farm. Knowledge on technical efficiency or efficiency of a farm can help to identify productivity gaps, including those related to socio-economic characteristics and management practices, which can subsequently be improved. An assessment of technical efficiency of intensive egg production will also shed light to extension workers and other development practioniners on the best way of resource allocation.

The present study strives to assess productivity and measure the technical efficiency of egg production in selected urban and periurban areas of Tanzania. The study also determines the relationship between technical efficiency and the profit obtained by farmers.

1.3 Objectives

1.3.1 General objective

This study seeks to assess the productivity and measure technical efficiency of producing eggs under the intensive production systems in urban and periurban areas of Ilala district (Dar es Salaam region) and Kibaha district (Coast region) of Tanzania.

1.3.2 Specific Objectives

The study pursued four specific objectives as follows:

(i) To estimate the responsiveness of yield (value of egg produced per annum per unit variable input) to the main factors of production by estimating the production elasticity of the inputs.

(ii) To estimate the frontier production function and determine levels of technical efficiency for each egg producing farms.

(iii) To evaluate the relationship between technical efficiency and selected farm characteristics.

(iv) To establish the relationship between technical efficiency and the profit obtained by farms.

(v) To identify major constraints of egg production vis-à-vis technical efficiency of egg production.

1.4 Hypotheses

On the basis of the specific objectives, four hypotheses were tested as follows

(i) In relation to specific objective number one, the null hypothesis was;

Variation in the average yield of egg between different farms is not influenced by the main factors of production (Stock size, amount of feeds, cost of drugs, transport cost and operating cost)[1].

Mathematically;

$$H_0; \beta_1 = \beta_2 = \beta_3 \ldots \beta_i = 0 \ldots\ldots (1.1)$$

Where;

βi represents the elasticity of production for the ith factor of production

The alternative hypothesis states that variation in the yield of eggs between different farms is influenced by the main factors of production (Stock size, amount of feeds, cost of drugs, transport cost and operating cost).

Mathematically;

---

[1] $Liny_i = \ln \beta_o + \beta_1 \ln X_{1ij} + \beta_2 \ln X_{2ij} + \beta_3 \ln X_{3ij} + \beta_4 \ln X_{4ij} + \beta_5 \ln X_{5ij} + v_{ij} - u_{ji}.$

$Hi;\beta 1 \neq \beta 2 \neq \beta 3 \neq \ldots\ldots \beta i \neq 0$ ....(1.2)

Where;

βi is as previously defined in the equation (1.1) above

(ii) The second null hypothesis corresponding to specific objective number two specifies that each farm is not operating on the technical efficient frontier and that the symmetric and random technical efficiency effect is zero, Mathematically

$H_0;u_i = 0$ .... (1.3)

Where;

u_i represents inefficiency effect, contained in the error term presented in the production function for egg production.

The alternative hypothesis states that each farm is operating on the technical efficient frontier, and that the symmetric and random technical efficiency effect is significantly different from zero,

Mathematically;

$H_i;u_i \neq 0$ .... (1.4)

Where u_i used as previously defined.

(iii) The third null hypothesis which relate to specific objective number (iii) specifies that;

The selected farm characteristics have no significant effect on the technical efficiency of the i^{th} farm.

Mathematically;

$H_0;\rho_1 = \rho_2 = \rho_3 ... \rho_i = 0$ .... (1.5)

Where;

ρ_i represent parameter estimates with respect to variables Z_1, Z_2....Z_i of the selected farm characteristics.

The alternative hypothesis specifies that the selected farm characteristics have significant effects on technical efficiency of the farm

Mathematically

$H_1;\rho_1 \neq \rho_2 = \rho_3 \neq .... \rho_n \neq 0$ ....(1.6)

Where ρ_I is as previously defined in equation (v) above

(iv) The fourth null hypothesis corresponds to fourth specific objective. It specifies that the technical efficiency of a farm is not related to the average profit margin per year,

Mathematically;

$H_0;\alpha_i = 0$ .... (1.7)

Where;

α_i represents parameter estimates

The alternative hypothesis specifies that, farm technical efficiency is related to the profit margin.

$H_1;\alpha_i \neq 0$ .... (1.8)

The fifth objective does not call for a testable hypothesis. The farm operator's views were deduced based on observation and discussion to get a qualitative perspective of the problems facing them. Findings were summarized in tables, figure and in narrative form. In the next chapter different aspects of egg production are discussed.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

Research findings pertaining to commercial chicken production with special reference to egg type layers are reviewed and presented in this section. The purpose of this review is to provide a summary of some important research findings reported by different authors in different parts of the world and give a critical review of various findings in order to provide a solid background for the present investigation. Critical analysis of previous findings further identified avenues for making commercial egg operation more profitable. In order to assess the efficiency of egg production systems, it is also important to know key factors that contribute to such efficiency. These include; production systems, genetic composition, flock size, stocking rate, egg production, feeding, light and temperature, hygiene, nutrition and diseases; which are discussed in subsequent sections.

2.2 Poultry Production Systems

Poultry production in Tanzania and generally throughout the world is carried out under two systems of production. The first is the scratcher system, which is mainly based on the scavenging poultry in the rural and peri urban areas. The second is the semi-intensive and intensive systems, which is used to raise commercially improved poultry, often concentrated in urban or peri urban areas. According to MLD (2006) rural poultry constituted more than 90% of the total poultry in Tanzania. Thus, it is evident that the poultry industry in Tanzania is dominated by the scavenging poultry (mainly Chickens and ducks) in rural areas, where 83% of more than 40 million human populations live. Commercial poultry production currently has a total annual hatchery capacity of 1.8 billion eggs. They are mainly owned and run by three private companies (MLD, 2006).

In India Rushton and Ngonji (1998) and Sonaiya *et al.* (1990) classified poultry systems on the basis of management and the degree of commercialization. These are free system, semi-intensive and intensive systems. In Tanzania, a scavenging based system is characterizes by low inputs, with the birds being allowed to wander freely and scavenge for all or almost their food. The birds are provided with some feed, night time housing and occasionally water during the day. But, water is generally poor. Jensen (2000) defines semi-scavenging as a system in which poultry flocks are under partial controlled management. Poultry are provided with feed and water and they are kept in a fenced area that normally has some type of shelter.

In the intensive birds are fully confined either in houses or cages. The capital outlay is higher and the birds are totally dependent on their owners for all their requirements. The intensive system is often associated with high production cost (Bogart and Taylor, 1983). In Tanzania there are three types of intensive systems. The first is a deep litter system in which birds are fully confined, with floor space allowance of 3 to 4 birds/m^2 within a house, but the birds can move around freely. The floor is covered with litter, 5 to 10 cm layer of grain husks (maize, rice straw, wood shavings or a similarly absorbent but non-toxic material). The fully enclosed system protects the birds from thieves and predators. The deep litter system is suitable for specially selected commercial breeds of egg or meat-producing poultry (layers, breeder flocks and broilers).

The second intensive system is a slatted floor system. Wire or wooden slatted floors are used instead of deep litter, which allows stocking rates to be increased to five birds/m^2 of floor space. Here, birds have reduced contact with faeces and are allowed some freedom of movement. The third intensive system is a battery cage system, which is often used for laying birds that are kept in cages throughout their productive life with very limited movement. The system requires high initial capital investment, and the system is mostly confined to large-scale commercial egg layer operations (Kabatange and Katule, 1989). The deep litter system is the most common system among medium and small sized farmers in Tanzania, a situation that also prevails in the study area. While the management system influences production, the genetic production of the bird can be a limiting factor as discussed in the next section.

2.2.1 Genetics and Breeds

In the case of poultry, a breed is an established group of individual birds possessing similar characteristics and when mated they produce offsprings with those same characteristics. A breed may include a number of species of the same general weight, distinguished by different color plumage, or different types of combs, and color of dorking. In some cases breeds are distinguished by being bearded or not bearded (Crawford, 1990). Hybrid chicken lines are crosses that man has produced to give higher productivity or particular selected features such as docility which required for battery production (Kumar and Mahalati, 1998). Hybrids may be related to the standard breeds but each parent stock line has been specially selected for many years. Most hybrids are patented for their qualities to avoid reproduction using the same pure breeds by farmers. Many of the hybrids have been derived from the Rhode

Island Red species. In comparison, hybrids developed for free range production systems tend, in general, to be heavier and have fuller feathered bodies than those developed for deep litter systems Crawford (1990). The genetic breeds raised in Tanzania include Rhode Island Red, Light Sussex, White Leghorns, Brown Leghorn, and Black Australorps. These pure-breeds are used in programmes for up-grading local breeds (Bhoki 2000). Apart from genetics and breeds, there are other factors to be considered in egg production as discussed in the following section.

2.2.2 Flock Size and Stocking Rate

Without limitation of management, cost and flock size can be a significant determinant of the profitability of commercial egg production. In their study Ryan and Mickey (2004) found that when a flock (group of hens) first enters egg production, the rate of egg laying will be around 10% to 20%. The maximum rate of egg laying is around 80% to 90% attained before laying starts to decrease normally after 72 weeks. Increased flock size was reported to improve feed efficiency in layers (Sharm and Singh, 1994) and reduced the cost of production (Farooq *et al.*, 2001). Hatter (1983) associated a reduction of 1.26% in building cost and 3.45% in labour wages with increased flock size. The authors attributed such better performance to the distribution of overhead expenses over a large number of birds, higher number of egg production and efficient utilization of the available resources. Kumar and Mahalati (1998) also reported smaller cost of production, higher returns for larger layer flocks. Conversely, Park (1993) reported higher egg production (296.6 eggs/bird/year) in flocks comprising of 15196 layers under Cooperative Farmers Association relative to flocks of 17389 birds on individual farms where only (263.9

eggs/bird/year) were obtained. This implies an excellent opportunity for policy makers to organize farmers into groups and capitalize on their combined capacities furthering their opportunity to increase their farm income through a cooperative system.

Under each production system as discussed above there is an optimum flock size which offers the best returns. A study in India showed that flocks with more than 20000 birds yielded higher returns/bird as compared to small flocks (Nair and Ghadoliya, 2000). The author also reported a lower cost benefit ratio for large than small sized flocks. Viney and Sharma (1994) reported that flock owners maintaining a flock size of 10000 layers were able to recover the fixed invested capital from the sale of eggs in about two years. A further increase in flock size and input leads to overcrowding, increased feed consumption and higher incidence of cracked eggs (Carey *et al.,* 1995). The authors reported that increased cost of production per bird would narrow gross margin resulting into poor economic returns. On the other hand increased stock size beyond the optimal might reduce production and returns from layers (Derbetin, 1986).

According to the law of diminishing returns, increased input will increase marginal returns up to a certain limit above which a diminishing effect will be observed. The author suggested an indicative break-even point to show an optimum level below or above which production efficiency is affected. In Bangladesh, Ascard *et al.* (1995) reported an optimal stock size of 12,000 layers for better profitability in deep litter system. While flock size is an important parameter in eggs production, it is also important to consider the stocking rate (birds/m^2) in relation to eggs production

North (1984) reported that optimum bird density resulted in higher egg production at lower cost. The author established that egg production, egg size and egg quality deteriorate when the birds are given less than the required cage or floor space. Optimum space per bird in multi-deck cages could also result in poor performance due to poor ventilation. Adams and Craig (1985) reported that a reduction of 16.6 egg/hen-house, increase in mortality by 4.8% while increasing in feed intake by 68g per dozen eggs. Carey *et al.* (1995) also observed higher feed intake and increased incidence of cracked eggs at higher density of birds. Asghar *et al.* (2002) and Zahir-ud-Din *et al.* (2001) similarly reported poor production performance of chicken in overcrowded houses. Besides flocking size and stocking rates, there are several other factors which affect egg production as discussed below.

2.2.3 Egg Production Performance

Egg production is a variable phenomenon and could adversely be affected by unfavorable conditions such as a filthy environment, disease and management conditions. North (1984) reported house temperature of 65^{0}F to 75^{o}F for optimum egg production. An increase in house temperature up to 80^{o}F did not cause a decline in egg production but egg size was reduced above 75^{o}F. A drop in egg production of 10-15% has been reported by Mousa *et al.* (1999) in flocks having Fatty Liver Syndrome disease. According to Mohammad et al. (1987) fewer eggs were produced by flocks infected with Mycoplasma Galliseptions (MG) and Mycophasma Synoviae

(MS). The authors reported a loss of 127 million eggs causing an annual loss of $ 7 million globally. Meanwhile Mathivanan *et al.* (2000) reported better egg production when the birds received water from deep wells through boring compared to those getting water from shallow open wells. Koelkebeck *et al.* (1999) also reported poor egg production performance on water supplied from farm well than birds receiving water from the public supply system. Light exposure has been reported to play a significant role in egg production as well (Alton *et al.,* 2000). Egg production often depends on the type and amount of feeds available to the laying chicken. In the subsequent section we discuss the issues related to feeds in Tanzania

Layers are generally reared on full feed (*ad libitum*) provision. In Tanzania where most farmers keep layers under deep litter system, feeds are offered via simple feeders that are purchased or made locally. Feedstuffs production is estimated at 500 000 tons per annum while the potential demand stands at 650 tons (MLD, 2006). There are more than 60 Animal Feed Industries in the country with varying capacities. Most of these industries are located in Dar es Salaam as well as in the Coast, Arusha and Mwanza regions. Due to inconsistent supply and the perceived high cost of commercial feeds, most livestock producers use home compounded feeds, which are often not well balanced. Most farmers are not able to get all the necessary ingredients and are limited in their capacity to observe the recommended feed requirements. The most commonly used ingredients in both homemade and feed formulation by companies are grains and cereals, cereal by products, oilseed and oilseed by products, animal and fish by products. These are purchased locally. Other ingredients such as concentrates are mostly imported from Mauritius, Kenya and Holland (MLD, 2006).

The local feed industries also produce feed additives. These are not nutrients, but their presence in the diets increase the nourishing value of the ration, which could result in higher rate of growth as well as increased efficiency of feed utilization. Presently the use of feed additives in Tanzania is growing, especially for intensive livestock production systems in dairy, poultry and pig production. Feed additives commonly used to improve growth rate and/or feed efficiency are enzymes preparations, hormonal preparations and antioxidants. In some cases antibiotics are added to the ration to control and treat diseases. For instance, it has been observed that antibiotics added in small quantities in chicken diets increased their rate of growth, feed intake, and efficiency of feed conversion (MLD, 2006). Feed additives used in this country are mainly imported from Kenya, South Africa, Singapore, European Union and other countries and they differ greatly in the nature and purpose (MLD, 2006). The next section discusses the effects of temperature in egg production.

Ryan (2004) argues that lighting and temperature conditions are important aspects in laying hens. Increase in light exposure triggers hens to begin laying eggs. If the laying hen has not reached proper body weight (usually 2 kg.) by the 18^{th} week egg production will cease very quickly, following the onset of the laying period. Hence, it is important for the young laying hen (pullet) to attain the proper body weight that will support egg production.

Scott (1991) reported that the temperature is particularly important in relation to nutrient requirements and the intake and retention or digestibility of dietary nutrients. In a cold temperature the retention of energy is more than in high temperature. The nutrient standards for poultry are expressed in quantity per energy unit, because the feed intake of the birds is largely regulated via the energy content Chwalibog (2001). According to Rose (1997), energy is required in varying amounts to maintain different body metabolic processes. So, a deficiency of energy affects most aspects of productive performance of poultry. If the available energy concentration of the diet is changed then poultry maintain a constant energy intake by changing their feed intake.

A study by Daghir (1995) reported that the heavier breeds such as Rhode Island Reds, Barred Plymouth Rocks, White Plymouth Rocks and Australops don't have much tolerance to high temperatures. He observed that when the hens are in a cold temperature, heat escapes thus hens need high energy from their bodies. Kampeni (2000) reported that during food intake, heat production of laying hens increases temporarily due to increased physical activity, and the heat increment depends on the amount of food intake, but is also affected by the ambient temperature. On the other hand, heat production increases with decreasing ambient temperature. The rate of increase depends on factors such as body size, the feather covering, whether housed singly or in a group, and the wind speed. At very low ambient temperature egg production cannot be maintained unless stored energy is used. Indeed hens subjected to low temperatures lose weight in contrast to cocks. According to Daghir (1995), White Leghorn chickens have been shown to have a greater tolerancc to high temperature than heavy breeds. The dominant gene for naked neck and the recessive gene for dwarfism are associated with tolerance to temperature. In addition to these natural and environmental factors, preventing and managing diseases is also important in poultry production.

In Tanzania, the poultry industry suffers from low production due to rampant diseases such as; Newcaste disease, fowl typhoid, chronic respiratory disease, fowl pox, gumboro disease, coryza syndrome that cause high mortalities (Mella *et al.*, 1978; Magwisha 1997). Yongolo (1996) in Tanzania have shown that 80% to 90% of chicken die within the first year after hatching, mostly due to diseases and nutrition.

Similar studies conducted in Mali by Wilson *et al.*(1987) also reported 10% of eggs laid produced an adult bird with low growth rate due to diseases. Another study (Kuit *et al.*, 1986), reported mortality of 57% of hatched chicks in the first four weeks of life. In Indonesia, Roberts (1997) observed mortality of 85% during the first six weeks while Muhusamy and Viswanathan (1998) in India reported 70% mortality up to six weeks of age.

Often, economic losses caused by nutrition deficiencies, internal and external parasites are insidious and always masked by economic losses due to viral, bacterial, and protozoa diseases (Mella *et al.*, 1978; Ojok, 1993). Infectious diseases, parasites, and low nutrition play a major role in low poultry production (Pandey and Demey, 1992). Famers are usually not keen to have their chicken vaccinated before the outbreak of diseases. They often lack knowledge about the required poultry drugs and vaccines. Often such treatment is also unaffordable. Furthermore, nutritional deficiencies, helminthoses and enclement (i.e chilling) are not considered as economically important parameters, but they may exacerbate the death toll during outbreak of killer diseases (Mella *et al.,* 19978; Magwisha, 1997). Kabatange and Katule (1990) noted that poultry keepers are usually left with very few chicken after major disease outbreak. Hence disease control is likely to increase layers productivity through increased survival rate (Kabatangate and Katule, 1990).

Marek's is one of the diseases which cause higher mortality rates in the study area. Marek's is not caused by bacteria or virus. It is characterized by leg paralysis and lymphocyte infiltration of brachial and sciatic nerves (Nicholls, 1984), potentially causing 42-20.8% mortality in layers (Taylor *et al.,* 1999). The disease is prevalent in layers lacking immunization. Losses due to this disease can be avoided through effective vaccination and eliminating calcium deficiency in the egg laying period. Further risk exists where there is calcium deficiencies during the laying phase. Under good management chickens are vaccinated against Marek's at the hatchery before they are transported to the farms. Calcium is vital for the egg shell and its deficiency will not only result in poor eggs shell, but it could work as a predisposing factor for Marek's disease (Taylor *et al.*, 2000). In addition, the rearing of mixed age flocks increase risks of Marek's disease (Heier and Jarp; 2000). The authors also reported a higher mortality rates caused by Marek disease in laying birds reared on the floor than those maintained in cages, probably due to the condition of a soiled environment. Apart from diseases, egg prolapes and Cannibalism cause higher mortality rates in laying hens

Prolapse is a condition where the hen's oviduct protrudes through the vent. If not discovered quickly, the hen will die from the other chicken's pecking at this moist, protruding area. Egg prolapes has become one of the major issues in egg type layers during the past few-years. Egg prolapes could cause higher mortality and in turn, would result in huge economic losses (Tablante *et al.,* 1984). These authors reported 9.4% egg prolapse cases in egg type layers in Quebec whereas in Ethiopia, Larsen (2002) reported cannibalism as the picking habit of chicken, causing 4.2% mortality. Cannibalism may be due to deficiency of fibre in feed and management faults North (1984). Cannibalism could be effectively controlled through appropriate beak trimming. In India, a study by Damme (1999) reported a lower incidence of cannibalism (0.3%) in beak-trimmed than non-trimmed birds (7.5%) hence lower mortality rates.

Mortality plays a major role in determining profitability of egg type layers, as it is a function of culled and dead birds. Farooq *et al.*(2001) reported a significant and negative association mortality and net profit. Higher mortality and culling have often caused severe outbreaks of infections and non-infectious diseases, accidental deaths, substandard management practices, poor quality of chicks and feed. A higher proportion of culls in turn is a function of poor quality chicks, feed and inappropriate management or care of the flock. Similarly, higher death rates in layers could be due to severe outbreak of disease, substandard health measures and management practices, poor quality of chicks or feed and accidental deaths. Thus, due attention should be given to infections, health care management practices and predisposing factors to avoid risks of mortality.

In Bangladesh, diseases caused overall mortality in layers of around 12% (Petek, 1999, and Amin *et al.* 1995) while Singh et al (1995) reported a little higher mortality (14.2%) in layers. Much higher mortality was reported by Ghodasara *et al.,* (1992) in layers during brooding (26.2%) growing (24.6%) and laying periods (49.2%). In Australia, these losses were higher than the normal level of mortality (8-10%) reported by North (1984). In breeding commercial chickens, more emphasis has now been placed upon the breed's genetic potentials for higher production, rather than their acclimatization to odd environments or their ability to resist diseases. Thus, improved poultry they are to be reared in a healthy environment to avoid increased risks of mortality.

It has been further observed that assurance of clean drinking water, appropriate and timely vaccination, antibiotic therapy, and cleaning of water tanks reduced the incidence of mortality in India (Mukherjee and Khamapurkar, 1994). Reducing flock mortality requires; (i) maintenance of a healthy environment inside and outside the poultry shed (ii) protecting of birds from extreme climatic conditions (iii) restricting visitors and wild animals (iv) proper clearing and disinfection of houses (v) using appropriate equipment, workers, appropriate floor and house construction. This means besides addressing issues related to diseases for poultry production, proper housing for layers will reduce the incidences of diseases thus increased productivity as discussed in the next section.

2.2.4 Housing for Layers

The housing and management of layer hens can be carried out using one of two methods, caged layer production or floor production. Use of either method can keep the hens in production throughout the year if proper environmental and nutritional needs are met.

Poultry houses are normally located away from other farm structures to minimize risks of disease incidences and tension. The house should have plenty of open wall space to allow for ventilation and sunlight. Place one-inch, poultry wire netting over all openings to separate the hens from other birds and animals, both wild and domestic (Smith, 2000).

The caged layer production method consists of placing the hens in wire cages with feed and water being provided to each cage. The birds are housed at a capacity of two to three hens in each cage, which measures approximately 12"x16"x18". The cages are arranged in rows, which are placed on leg supports or suspended from the ceiling so the floors of the cages are about 2½ to three feet above the ground.


Semi-intensive Poultry Management System


Deep Litter System


Battery Cage

Water is supplied by individual cup waterers or a long trough outside the cages that extends the length of the row of cages. The feed trough is also located outside the cages and runs parallel to the water trough on the opposite side of each cage. The cages are designed so the eggs will roll out of the cage to a holding area by means of a slanted wire floor. This method of housing is used primarily with layers kept for infertile egg production (Smith, 2000).

The floor production method is designed for either layers or broiler kept for fertile or infertile eggs. In commercial flocks this method is used when fertile eggs for hatching are needed. The birds are maintained in the house on a litter covered floor, giving the term floor production. The birds are provided with enough light to stimulate egg production as discussed earlier. Reducing the cost of production is equally important to increase the profit of poultry enterprise as discussed in the next section.

2.3 Cost of Production and Returns

In case of poultry production, fixed costs include capital invested on buildings, the purchase of equipments plus other accessories like furniture plus the salaries of permanent employees. Proper utilization of fixed capital will ensure better returns. The contribution of fixed cost to the total cost of production is added as a small fraction of the cost in terms of depreciated cost per period (e.g. year) as remuneration for permanent staff. For layers, Petek (1999) reported average fixed cost to be 7.3% of the total cost of production over 72 weeks of growth and production period.

Variable cost includes capital spent in buying stock, drugs, feed, transport and day to day operations, varying widely depending on the time, place and management. In Bangladesh wide variability in variable cost was reported by Asghar *et al.* (2000) and Zahir-ud-Din *et al.* (2001) in commercial chicken production. In India, Petek (1999) reported 7.3% fixed and 92.7% variable cost in commercial egg production with higher variability being observed in variable cost components. The author attributed wider variability to variable flock sizes and management conditions. Viney and Sharma (1994) in Punjab reported that farms maintaining a flock size of 10,000 layers were able to recover the fixed capital from layers in about two years. In India, Kumar and Mahalati (1998) reported smaller cost of production, higher returns and net profit for large as compared small size flocks. Ames and Ngemba (1986) in Zaire also observed a decreasing trend in cost of production per bird when flock size was increased beyond 500 birds. In addition, a decrease in cost of production by about 16% was reported when the birds were housed in cages than on deep pit or deep litter housing system (Haartsen and Elson, 1989) in Ghana. In Senegal, Home-Van and Van-Horne (1996) reported a reduction of 8.2% in cost of production for layers kept in cages as compared to those reared on floor.

Among the variable cost components, feed cost was the most important contributing 60-80% to total cost of production in India (Mian, 1994). The authors reported that feed cost could efficiently be reduced through minimal feed wastage and optimal house temperature. Other cost components could be effectively controlled through proper planning and management. In Mali, Hatter (1984) associated a reduction of 1.26% in building cost and 3.45% in labor charges with increased flock size in commercial layers. The author attributed the reduction in such cost components to efficient utilization of available resources; thus increased net returns.

Returns from egg laying birds are obtained from selling eggs, spent layers, empty feedbags and manure. In Bangladesh, Farooq *et al.* (2001) reported 85% contribution of eggs to total return. The author also established that as the flock mortality decreases total returns increase. In India a study by Verma and Singh (1997) reported 10.9%, 0.8%, 0.8% and 87.3% contribution of spent hens, manure, empty bags and eggs, respectively to total returns. Meanwhile, Kumar and Mahalati (1998) reported that returns in commercial egg operation could be increased significantly through decreased cost of production, larger flock size and smaller rate of mortality. For producers to benefit, proper marketing functions must be ensured. The next section discusses the importance of marketing in egg production.

2.5 Marketing for Layers Production

Marketing is the performance of all business activities involved in the flow of food products and service from the point of initial agricultural production until they are in the hands of consumers (Kohls & Uhl, 1990). Marketing is a societal process which discerns consumers' wants, focusing on a product or service to fulfil those wants, attempting to move the consumers toward the products or services offered (Gill, 2006). According to Abbott (1987), the marketing is necessary for economic development. The efficiency of a marketing system is measured in terms of the level and/or costs of inputs, to achieve a given level and/or quality of output. In agriculture, such inputs are generally in the form of land, finance, time, manpower and materials. Efficient marketing optimizes the ratio between inputs and outputs

(Rushton and Ngonji 1998). The authors reported that the market will need to be assessed for their accessibility, size and seasonality. It is important to know the current price of the products, the difference between markets for indigenous and exotic eggs and meat, distance to markets and barriers faced by market participants, taboos associated with egg and meat consumption and how increase in output will affect consumption patterns. The relative price of products also influences demand. Alternatively high price may be a reflection of high demand. Branckaert & Gueye (1999) described that poultry products in most developing countries are still expensive compared to developed countries due to high production cost.

Having discussed at length the issues related to egg production, it is also important to review aspects that relate to technical efficiency in egg production. Technical efficiency is an important factor for decision making in management of layers enterprise because the cost of production is closely related to the productivity and technical efficiency of the farm.

2.6 Approaches to Technical Efficiency

The level of technical efficiency of a particular farmer is characterized by the relationship between observed production and some ideal or potential production (Greene, 1993). The measurement of firm specific technical efficiency is based upon deviations of observed output from the best production or efficient production frontier. If a farmer's actual production point lies on the frontier it is perfectly efficient.

Farrell's (1957) definition of technical efficiency led to the development of methods for estimating the relative technical efficiency of farmers. The common feature of these estimation techniques is that information is obtained on extreme observations (on the upper end) from a body of data to determine the best practice production frontier (Lewin and Lovell, 1990). From this the relative measure of technical efficiency for the individual farmer can be derived. Despite this similarity the approaches for estimating technical efficiency can be generally categorized under the distinctly opposing techniques of parametric and non-parametric methods (Seiford and Thrall, 1990). Parametric approaches meet all the three assumptions of normality; equal variance and independence while non-parametric do not rely on normality assumptions. While parametric correlation is powerful and uses information about mean and deviation from the mean, non-parametric correlation uses only the ordinal position of pair of scores. These two widely used methods of measuring the efficiency of a decision making unit include: the non-parametric Data Envelopment Analysis (DEA) and the parametric Stochastic Frontier Analysis (SFA).

Given a stochastic production frontier production function, several approaches can be used to analyze the determinants of technical efficiency. The first follows a two- step procedure in which the frontier production function is first estimated to determine technical efficiency indicators, and then the indicators thus obtained are regressed against a set of explanatory variables, which are usually firm specific characteristics (Greene, 1993; Ogundele, 2003). The stochastic frontier approach has the advantage that it deals with the stochastic noise and permits statistical tests of hypotheses pertaining to the structure and the degree of inefficiency. In the first stochastic frontier model, the error term (the inefficiency effects) are assumed to be identically independently distributed and the technical efficiency indicators obtained are assumed to depend on a number of factors specific to the firm, which implies that the inefficiency effects are not identically distributed (Jondrow *et al.*, 1982). The major drawback is the assumption of an explicit functional form for the distribution of the inefficiency terms (Kumbhakar *et al.*, 1996).Thus stochastic frontier approach violates assumption about error term that the mean of the error terms given the independent variables is zero ($E[u_i]=0$).

This drawback led to the development of more consistent approach which modeled inefficiency effects as an explicit function of certain factors specific to the firm, and all the parameters are estimated in one step using maximum likelihood procedure (Ajibefun and Daramola (2003) as also applied in the present study. Green (1993) asserts that the maximum likelihood procedure is a consistent and asymptotically efficient estimator and allows for random error estimation as opposed to ordinary least square (OLS).

In chapter three, the analytical framework of production economic theory using the case of layers for egg production, econometric approaches to efficiency measurement and data collection process are outlined.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

This chapter presents the methodology which was used to conduct the study. The chapter begins with describing the study area followed by the analytical framework and description of the stochastic frontier production function and the empirical model. This is followed by a description of the sampling procedure, questionnaire design and administration of the research instrument. The last section presents the statistical analysis of the data.

3.2 Location of the Study Area

This study was conducted in two districts namely Ilala and Kibaha in Dar es Salaam and the Coast regions respectively. The two districts were considered ideal for the study because there are more farmers engaged in rearing layers under the intensive production system than in other districts in the two regions. The suburbs of Dar es Salalm region and Coast region are close to Dar es Salaam city, which is the main market for almost all agricultural products in the country including poultry products.

Ilala District is one of three districts in Dar es Salaam region, the others being Temeke to the South and Kinondoni to the North. The 2002 National Tanzania Census indicates the population of Ilala was projected to be 635 924 people residing in 273 km^2, with a population density of 242 people per km^2 by 2007. Ilala District is subdivided administratively into 3 divisions and 22 wards. Kibaha district is one of the six districts in the Coast region. The district is bordered by Bagamoyo district to the north, Dar-es-Salaam region to the east, Kisarawe District to the south and Morogoro Region to the west. The district covers 1 812 sq km of dry land or 5.4% of the total land area of the Coast region. Kibaha district is located about 40 km west of Dar es Salaam city, and the highway to Morogoro runs through the district center. According to the 2002 Tanzania National Census, the population of the Kibaha District was projected to be 134 045 people with a population density of 80 people per km^2 by 2007.

In the next section, the fundamental conditions for profit maximization as applied to layers for egg production are described. The primary objective of a framer who keeps layers for egg production is to maximize profit. Kabede (2001) asserts that profit maximization conditions can be met if resources are allocated efficiently. This review of economic theory will provide background on the theoretical aspects for the present investigation.

3.3 Analytical Framework

Specific objective number one of this study was to determine the elasticities of production to gauge the responsiveness of yield to changes in inputs. The production elasticities for each of the inputs were calculated from a Cobb-Douglas production function. According to microeconomic theory a production function is a model that is used to formalize the relationship between inputs and outputs as specified in the general form below.

$Y_i = f(x_i)$ (2.1)

Where;

Y_i represents the output

x_i represents the vector of variable factor

Equation (2.1) may also be written as shown in equation (2.2) below

$Y_i = f\{S, F, C...\}$ (2.2)

Where;

S represents the stock of chicken,

F represents quantity of feed used in production of *Q* while

C represents the cost of other inputs applied.

The objective of the producer is to maximize profit either by increasing the quantity of Y_i produced or by reducing the cost of producing Y_i. The production function can be expressed using specific functional forms such as Cobb-Douglas, translog and the constant elasticity of supply (CES) which are used to estimate the parameters within the function. Farrell (1957; Bylee1991) disaggregated economic efficiency into technical efficiency and price or allocative efficiency. Allocative efficiency occurs if the marginal physical product is equal to the ratio of the corresponding product prices. In a perfectly competitive market, allocative inefficiency is the failure for a farm to meet the conditions for profit maximization. Technical efficiency is defined as the ratio of the observed output to the corresponding frontier and as estimated from the composed error term. A production frontier is the highest production achieved from a given level of inputs (resources) in a population of farmers In estimating the frontier production function (where the conditions for profit maximization can be evaluated), effects of the socio-economic characteristics of the household on the variation of the dependent variable Y_i are often lumped together in the error term[2]. Before considering the stochastic frontier, let's examine condition for profit maximization.

Given the output price (P_y), the value marginal product (VMP) of y_i can be computed as shown in the equation (2.3) below;

$$VMP=MPP*P_y \tag{2.3}$$

Where;

MPP represents marginal physical product

VMP represents value marginal product

From the production function, a profit function (π) can be generated as shown in the equation (2.4) below

$$\pi = TVP-TVC \tag{2.4}$$

Where;

Π represents profit

TVP represents total value of product

TVC represents total variable cost

Applying the first order condition (FOC) to equation (2.4) we get equation (2.5).

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[2] Error term means the component of variation y_i due to random, unsystematic, unexplainable noise.

$\partial \pi / \partial x_i$ =MVP-MFC=0 (2.5)

Where;

MVP represents marginal value of product

MFC represent marginal factor cost.

All other variables as previously defined

Therefore, at the point profit where is maximized, the VMP must be equal to the MFC as shown in equation (2.6). The point at which profit is maximized represents the optimum use of inputs.

VMP (MPP*Py) =MVC=P_x (2.6)

Having discussed the conditions for profit maximization, in section 3.4 we discuss the stochastic frontier model using a Cobb-Douglas production function. The stochastic frontier model described below was be used to estimate parameters and evaluate the conditions for profit maximization.

3.4 Stochastic Frontier Production Function

Different forms of functions can be used to estimate the general production function given in equation (2.1). Among the most commonly used are the Cobb-Douglas and the translog production functions since both functions depict the three stages of production and have variable production elasticities. The Cobb-Douglas production function has been widely used in agricultural studies because of its simplicity and ease of estimation from agricultural data (Derbetin, 1992). In this study we used the Cobb-Douglas production function presented in equation (1.7).

$$y_i = \beta_i \Pi \quad x_{ij}^{\beta_j} . e_i^{\varepsilon_i} \qquad (2.7)$$

Where;

y_i = output for i=1,2.........,n

x_{ij} =i^{th} input, for the j^{th} respondent for i=1,2...,n and j=1,2....,m

β_0 = constant

e=natural logarithm

β_i = a vector of parameter; for i = 0, 1, 2,...,N,

Π =a steady multiplicative symbol

ε_i= the error term

The loglinear transformation of equation (2.7) gives equation (2.8) which can be used for parameter estimation using regression analysis (Kumbhakar *et al.*, 1991).

$$Y_i = \beta_0 + \sum_{j=1}^{k} \beta_i X_{ij} + \varepsilon_i \qquad (2.8)$$

Where;

$Y_{ij} = \ln(y_i)$,

$X_{ij} = \ln(x_{il})$,

The error term (ε_i) has two components u_i and v_i such that $\varepsilon_i = v_i - u_i$;

Where;

v_i represents a random error associated with random factors, that the farmer does not have control over. It has a zero mean and variance equal to $\delta^2{}_v$ such that its distribution is given as N $(0,\delta^2{}_v)$.

u_i represents the inefficiency component of the error term. It is a non-negative half normal random variable truncated at zero, with a distribution given as , N $(0,\delta^2_u)$. However, u_i can also have other distributions such as gamma and exponential. It is associated with farm-specific factors. The mean values of u_i are determined by equation (8).

$$u_i = \rho_i Z_i \quad (2.9)$$

Where;

Z_i represents inefficiency variable for; i=1,2...,n

ρ_i= parameter estimates; for i=1,2...,n

δ^2_v and δ^2_u are the variances of v_i and u_i respectively

The inefficiency variables are represented by farm characteristics such as age, marital status, employment status, education of a farmer, family size, gender, location of the farm, access to credit and management. Equation (2.8) was estimated using the maximum likelihood method as discussed in the next section.

3.5 Estimation of Stochastic Frontier using Maximum Likelihood Method (MLE)

Green (1993) asserts that MLE is a consistent and asymptotically efficient estimator and allows for random error estimation as opposed to ordinary least square (OLS) which is inefficient in estimation. While equations (2.7) and (2.8) represent the production frontier, equation (2.9) describes how the mean (u_i) inefficiency is measured, representing the deviation of output (y_i) by each respondent from the maximum possible output. The maximum likelihood estimation of equation three (2.8) yields parameter estimates; β_i and λ. Where β_i is as previously defined and λ is the ratio of variances. The technical efficiency of a production function can be obtained from the conditional expectation of u_i given ε_i shown by (Zaibet and Dharmapala, 1999) and represented in equation (2.10).

$$E[-ui \;|\varepsilon_i] = \frac{\delta_u \delta_v}{\delta}\left[\frac{f^*(\lambda\varepsilon_i/\delta)}{1 - F^*(\lambda\varepsilon_i/\delta)} - \frac{\varepsilon_i\lambda}{\delta}\right] \qquad (2.10)$$

Where;

f* represents value of a standard normal density

F* represents value of a distribution functions

$\lambda = \delta_u / \delta_v$

$\delta^2 = \delta_v^2 + \delta_u^2$.

$E[-ui \;|\varepsilon_i]$ = the conditional mean of u_i given ε_i.

All other variable are as previously defined.

The individual farmer's level of technical inefficiency can then be calculated from the expected value of equation (2.10) as re-written in equation (2.11). Thereafter TE can be compared with the corresponding net return of the individual farm.

$$TE_i = \exp(E[-u_i \;|\varepsilon_i]) \qquad (2.11)$$

Such that $0 \leq TE \leq 1$.

The next section presents the empirical models which were used for estimation in order to test the hypotheses as given in chapter one.

3.6 Empirical Models

The model in equation four (2.8) representing stochastic frontier was estimated in a two step process. First the value of eggs produced per farmer over 24 months of production (Y_i) was regressed against the independent variables, including the cost of drugs, transport cost, amount of feeds, flock size and operating cost. Twenty four months is the normal lifespan for a stock of layers. The loglinear production function is represented by equation (2.12)

$$Liny_i = \ln\beta_o + \beta_1 \ln X_{1ij} + \beta_2 \ln X_{2ij} + \beta_3 \ln X_{3ij} + \beta_4 \ln X_{4ij} + \beta_5 \ln X_{5ij} + v_{ij} - u_{ji} \qquad (2.12)$$

Where;

$Y = (\ln y_i)$ =Value of egg produced over 24 months period (Tsh),

X_1 = Cost of drugs (Tsh),

X_2 = Transport cost (Ths)

X_3 = Feed intake (Kg)

X_4 = Sock of bird (Number),

X_5 = Operating cost (Tsh),

v_i = Random errors ,

u_i = Technical inefficiency effects,

Once the production function had been estimated, the determinants of technical efficiency were also determined by regressing key or selected socio-economic variables against the error term (u_i) in order to assess their influence on deviation of observed output (Y_o) from the potential output level (Y_p). Such deviation Yp-Yo represents technical inefficiency. Then in the second step of the analysis, the error term (u_i) was regressed against selected socioeconomic characteristics of the farm as shown in equation (2.13).

$$u_i = \rho_0 + \rho_1 Z_1 + \rho_2 Z_2 + \rho_3 Z_3 + \rho_4 Z_4 + \rho_5 Z_5 + \rho_6 Z_6 + \rho_7 Z_7 + \rho_8 Z_8 + \rho_9 Z_9 + \rho_{10} Z_{10} + \rho_{11} Z_{11} + \rho_{12} Z_{12} + \rho_{13} Z_{13} + \rho_{14} Z_{14} \qquad (2.13)$$

Where;

Z_1= experience of a farmer squared (squared term)

Z_2= Experience of the farm attendant (years)

Z_3=Location of the farm (Urban=1, Periurban=0)

Z_4=level management (lighting and temperature) which is dummy variable (Electricity=1, charcoal/Kerosene=0)

Z_5 = Housing type (Iron roofed and concrete walls=1, Iron roofed and mud walls)

Z_6= Family size (Number of people)

Z_7 = Employment (formal employment or not expressed as dummy variable)

Z_8=Education level of farm attendant (years)

Z_9= Marital status (Married=1, Otherwise=0)

Z_{10}=Age of the farm attendant (years)

Z_{11}=Sex of the household head (Male=1, Female=0)

Z_{12}=Use of credit (use of credit=1, no use of credit=0)

Z_{13}=Age of a farmer (years)

Z_{14}=Education level of a farmer (years)

$\rho_0, \rho_1, \rho_2, ... \rho_{14}$ = parameter estimates.

The model in equation (2.13) was estimated using regression analysis. Once the technical efficiency of individual farms was calculated, it was then regressed against profit as shown in equation (2.14).

4.7 Technical Efficiency and Net Return

The fourth objective required that we determine the relationship between technical efficiency and profit (Net return) per farmer. Equation (13) shows below expresses the relationship between technical efficiency of individual against the corresponding profit (Net return)

$$T.E_i = \alpha_0 + \alpha_i \pi_i \qquad (2.14)$$

Where;

T.E_i = technical efficiency of i^{th} farm as computed from equation (2.11)

α_0-α_1=parameter estimates

π_i= profit of the i^{th} farm

The next section deals with the technique used in data collection.

3.8 Sampling Technique

Primary data for this study were collected from 80 eggs producers selected from the two districts (Kibaha and Ilala) in two regions of Coast and Dar es Salaam respectively. The second stage involved a multistage sampling procedure in which two divisions were selected from each district, and two wards from each division. At this stage a list farmers who keep layers was drawn in each of the selected ward. They constituted a sampling frame, from which 80 farms (40 from each district) were randomly selected.

3.9 Questionnaire Design and Administration

Primary data collection took place in October-November 2007 using a structured questionnaire (Appendix 4). The information collected included data on output, and key economic and socio-economic variables as shown on the empirical models. The farms were classified by the number of birds. Boki (2000) classified poultry farmer keeping 100-2000 birds as small scale, those keeping 2001-4999 as a medium scale while farmers having 5000 or more birds as large scale. Data on the value of output were obtained by adding cash receipts from the sale of eggs produced, culled birds poultry manure and value of eggs consumed by the farmers during the 24 months period.

Secondary data on various aspects; including egg production trends and organization of the poultry industry in Tanzania were obtained from reports and other documentary materials from relevant institutions and organizations such the Ministry of Livestock Development, Ministry of Agriculture, Food and Cooperatives, Agricultural and Livestock research stations, Kibaha Education Centre and Sokoine National Agricultural Library. The pre-testing of questionnaire was done by interviewing four poultry keepers in Morogoro municipality during September 2007. Necessary corrections were made to the questionnaire before data collection.

3.10 Empirical Analyses

Responses from the interview were coded and summarized using excel. The descriptive analyses involved computation of statistical means, standard deviations, graphs and frequency distribution. In order to test for technical efficiency, a Stochastic Frontier production function was estimated using a Cobb-Douglas production function. Then a one step process was used to estimate the determinants of TE using the maximum Likelihood method in LIMDEP[3] (Green, 2002) based on equations (2.12) and (2.14) and as they are rewritten in equation (2.15) and (2.16) while the variables are as previously defined.

$$Liny_i = \ln\beta_i + \beta_1 \ln X_{1ij} + \beta_2 \ln X_{2ij} + \beta_3 \ln X_{3ij} + \beta_4 \ln X_{4ij} + \beta_5 \ln X_{5ij} + v_{ij} - u_{ji} \quad (2.15)$$

$$u_i = \rho_i + \rho_1 Z_1 + \rho_2 Z_2 + \rho_3 Z_3 + \rho_4 Z_4 + \rho_5 Z_5 + \rho_6 Z_6 + \rho_7 Z_7 + \rho_8 Z_8 + \rho_9 Z_9 + \rho_{10} Z_{10} + \rho_{11} Z_{11} + \rho_{12} Z_{12} + \rho_{13} Z_{13} + \rho_{14} Z_{14} \quad (2.16)$$

A simple regression (OLS) was done using equation (2.16) to assess the effects of socio-economic variable on the inefficiency model (u_i). Meanwhile, individual farm

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[3] Thanks to Professor William H. Green for his guidance in TE computation using econometric software LIMDEP (2002)

technical efficiency was computed from conditional expectation of random variable (u_i). The relationship between technical efficiency of the farm and the corresponding profit (net returns) was done through OLS regression analysis.

Finally, the farm operator's views on technical efficiency of their layers enterprise were deduced based on their observation and discussion to get a qualitative perspective of the problems facing them. Findings from these analyses are reported in chapter four.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

Descriptive statistics of the variables used in 80 farms are discussed under farmers' characteristics. The chapter also presents the estimates of the stochastic the frontier production function described in chapter three, input elasticities, marginal value product, and individual farm level technical efficiency. Finally results on the relationship between technical efficiency of the farm and the corresponding profit (net returns) and qualitative perspective of the problems facing are presented and discussed in the subsequent sections.

4.2 Farmers Characteristics

The characteristics that were examined in the study included gender, age of farmers and farm attendants, marital status of farmer, education level of both farmer and farm attendant, family size, experience in poultry keeping, use of credit, type of house used in keeping layers and type of heating and lighting facilities used in keeping layers. The importance of these characteristics to determine their influence in egg production is discussed in the following sections.

4.2.1 Sex of Respondents

Results in Table one represent the distribution of sampled farmers by sex. Out of 36 farmers in Kibaha district majority (66%) were females while males were only 34 percent of the respondents. Women carry most of the farm activities. This might be attributed to the fact that most men are employed or they engage in other activities.

On the other hand, in Ilala district production of eggs is done by both men and women. About 52.5% of the respondents in Ilala districts are men while women constituted 47.5% of the respondents. For the sample as whole the proportion, men and women was about 38.5 % and 61.4% respectively. In Ilala district egg producers are almost one ethnic group (Kurya) who migrated from Tarime district to Dar es Salaam city to engage in egg production, being enticed by their relatives who came before them. Most of these farmers are not employed in the formal sector and egg production is their main source of livelihood.

Table 1. Distribution of Respondents by Sex

Sex	Kibaha		Ilala		Whole Sample	
	Frequency	%	Frequency	%	Frequency	%
Male	12	34	21	52.5	33	38.5
Female	24	66	19	47.5	43	61.5
Total	36	100	40	100	76	100

4.2.2 Age of Farmer and Farm Attendants

The age of a farmer is one of the factors that explain the level of technical efficiency reported by Basnayake and Guraratne (2002). Age is related to experience, wealth and decision making. All of which affect individual's ability to manage an enterprise of layers which in turn influence the productivity. In this study most farmers are in the productive age. The mean age of farmers in Kibaha district is 45.7 years with a standard deviation of 9.7 with a range from 23 years to 61 years with majority being females (Table 2 and 3). Meanwhile the mean age of farmers in Ilala district is 37.3 with a standard deviation of 9.5 and range from 24-57 years. Farmers in Kibaha district are older than their counterparts in Ilala district. The mean age of the sample as a whole is 41.3 years with standard deviation of 10.6, indicating that most farmers are in the productive age.

Table 2. Respondents Age by District

Standard measure of the Sample	Kibaha		Ilala		Whole Sample	
	Farmer	Att*	Farmer	Att*	Farmer	Att*
Number of respondents	36	22	40	32	76	54
Mean	45.7	21.4	37.3	35.4	41.3	22.4
Mode	58.0	20.0	35.0	45.0	35.0	20.0
Std. Deviation	9.7	3.7	9.6	10.6	10.6	5.2
Minimum	23.0	17.0	24.0	20.0	23.0	18.3
Maximum	61.0	30.0	57.0	48.0	61.0	48.0

Att* Means the age of farm attendants

Furthermore as shown in Table 2, the mean age of farm attendants in Kibaha district is 21.4 years with a standard deviation of 3.7, varying from 17 to 30 years. The older was 20 years and the younger was 48 years old. The mean age of farm attendants in Ilala district is 37.3 with a standard deviation of 10.6. These results show that farm attendants in Kibaha district are younger than their counterparts in Ilala district. The mean age of the farm attendants for the whole sample is 22 years with standard deviation of 5.2. The farm attendants in the sample are relatively young with mean age of about 22 years and standard deviation of 5.2.

Table 3.Respondents Age by Sex

Age Category	Kibaha		Ilala		Whole Sample	
	Female (N)	Male (N)	Female (N)	Male (N)	Female (N)	Male (N)
20-30	5	0	8	4	13	4
31-40	4	0	7	8	11	8
41-50	10	4	4	4	14	8
51-60	6	6	2	3	10	9
61-70	0	1	0	0	1	1
Total	25	11	21	19	46	30

4.2.3 Marital Status

Married couples are likely to be more productive than single farmers due to labor reinforcement in accomplishing both farm and no-farm activities. In addition a stable family provides a conducive environment to foster collaborative and efficiency in production. Results in table 4 show that out of 35 farmers who were interviewed in Kibaha district, 85% were married and 15% were either divorced or not married. About 95% of respondents in Ilala district were married and only 5% were single. As it can be seen in Table 5, out of 75 respondents 7 were not married (females).

Table 4.Marital Status by District

Marital Status	Kibaha		Ilala		Whole Sample	
	Frequency	%	Frequency	%	Frequency	%
Married	30	85	38	95	68	91
Single	5	15	2	5	7	9
Total	**35**	**100**	**40**	**100**	**75**	**100**

Table 5. Respondents Marital Status by Sex

Marital Status	Kibaha		Ilala		Whole Sample	
	Female (N)	Male (N)	Female (N)	Male (N)	Female (N)	Male (N)
Married	19	11	17	21	36	32
Single	5	0	2	0	7	0
Total	24	11	19	21	43	33

4.2.4 Education Level of Farmers and Farm Attendants

Tables 6 and 7 represent the education level of farmers. As expected in Kibaha farmers are more educated with a mean of 11.4 years in school compared to 7.6 years for Ilala districts and 9.6 for the sample as whole. This means on average poultry farmers have only primary education as reflected by the mode (7) for both districts and the whole sample. The lowest level of education is 7 years and the highest is 13 years. Education is very important for the farmers' ability to efficiently utilize the advice and information offered by extension services. It would therefore be expected that the technical efficiency of the farmers in Kibaha would be higher than the farmers in Ilala.

Table 6. Education Level of Farmer (Years)

Standard Measure of the Sample	Kibaha Farmer	Kibaha Att*	Ilala Farmer	Ilala Att*	Whole Sample Farmer	Whole Sample Att*
Number of respondents	40	37	37	23	77	60
Mean	11.4	7.1	7.6	6.7	9.6	7.3
Mode	7	7	7	7	7	7
Standard Deviation	3.5	2.2	1.6	1.6	3.3	1.6
Minimum	7	0	7	0	7	0
Maximum	17	12	13	11	17	12

Att* Means the age of farm attendants

Table 7. Education Level by Sex

Level of Education	Ilala		Kibaha		Whole Sample	
	Female (N)	Male (N)	Female (N)	Male (N)	Female (N)	Male (N)
Primary	17	9	9	2	26	11
Secondry	3	4	10	5	13	9
Post Secondary	0	5	9	4	9	9
Total	20	20	28	11	48	29

As it can be seen in Table 6, the mean level of education of farm attendants is almost equal in both districts. The mean and mode of attendant's educational level is close to seven, indicating having only up to primary education. Some of the attendants have no formal education while the highest level is secondary education represented by 12 years, which is probably enough to manage poultry farms.

4.2.5 Experience

Data on this variable were collected on the premise that experienced farmers can perform better in management of poultry. Table 8 shows that farmers in Kibaha district are more experienced with a mean of 7.8 years and standard deviation of 6.6 while farmers in Ilala district have a mean of 7.4 years and standard deviation of 3.5.

However, there is no significant difference in terms of experience in running poultry enterprise among the two districts.

Table 8. Respondent's Experience in Running Poultry Enterprise (years)

Standard Measure of the Sample	Kibaha		Ilala		Sample
	F	M	F	M	
Number of respondents	24	12	19	21	76
Mean	7.5	7.8	7.5	7.4	7.6
Mode	6	5	7	8	8
Standard Deviation	6.4	6.6	3.6	3.5	5.2
Minimum	1	2	1	1	1
Maximum	12	30	10	14	30

4.2.6 Employment

This variable (employment) was used to assess its effect on technical efficiency of egg production. The employment status of an individual affects his/her income and thus directly or indirectly his/her productivity. Table 6 shows that out of 35 farmers interviewed in Kibaha 54.3 percent are employed while 47.5 percent are not employed. In Ilala district, out of 40 respondents interviewed, only 7.3 percent are employed while 92.5 percent are not formally employed. Their main economic activity is egg production.

Table 9.Formal Employment

Employment Status	Kibaha				Ilala				Whole Sample			
	Males		Female		Males		Females		Males		Females	
	(N)	%	(N)	%	(N)	%	(N)	%	(N)	%	(N)	%
Employed	12	66	6	37	1	4	2	11	13	33	8	23
Not employed	6	33	10	63	20	96	17	89	26	66	27	77
Total	**18**	**100**	**16**	**100**	**21**	**100**	**19**	**100**	**39**	**100**	**35**	**100**

4.2.7 Family Size

Table 10 summarizes the average number of people in the households. The mean family size in both districts is eight people with standard deviation of 0.4. The minimum number of people in the household is 2 while the maximum household size is 13 people. This indicates that there is sufficient labor to carry out egg production activities.

Table 10.Family Size (number of people)

Standard Measure of the Sample	Kibaha		Ilala		Sample
	(F)	(M)	(F)	(M)	
Number of respondents	24	12	19	21	76
Mean	6.3	7.9	7.4	7.7	7.8
Mode	7	6	6	7	6
Standard Deviation	2.6	2.7	2.8	2.7	2.7
Minimum	3	3	4	2	2
Maximum	12	13	11	13	13

4.2.8 Type of Housing

Housing and management of layer have direct impact on egg production. Proper housing and management for layers will improve productivity. The poultry houses normally have plenty of open wall space to allow for ventilation and sunlight, free from tension, concrete walls and floor. Table 11 shows the distribution by type of houses used by poultry farmers in both district. The results show that most of houses in Kibaha district are (97.5%) iron roofed with concrete walls and floor. This is because farmers in Kibaha tend to have higher income. Apart from most of the farmer in Kibaha being employed, they use credits more often than their fellows in Ilala district. This difference in income can be reflected in terms of poultry houses farmers use. Farmers in Ilala have more houses made of iron roof and mud walls (85%).

Table 11. Housing Type by District

Housing type	Kibaha		Ilala		Whole Sample	
	(%F)	(%M)	(%F)	(%M)	(%F)	(%M)
Iron roofed and concrete walled	53	44.5	12	5.5	31.5	26
Iron roofed and mud wall	1	1.5	37	45.5	32	13.5
Total	54	46	49	51	63.5	39.5

4.2.9 Credit

The availability of credit will reduce the constraint of production facilitating to get the inputs on a timely basis and hence is supposed to increase the efficiency of the farmers. In Kibaha district, 32.5 percent of farmers interviewed used credit to purchase necessary inputs for egg production while only 5 percent in Ilala district were reported to use credit (Table 12). This can be explained by two main factors; employment and education.

Table 12. Respondent's Use of Credit

Use of credit	Kibaha		Ilala		Whole Sample	
	(%F)	(%M)	(%F)	(%M)	(%F)	(%M)
Use of credit	24	8.5	5.0	0	29	8.5
No credit	43.5	24	42	43	42.7	33.5
Total	67.5	32.5	47	43	35.8	21

Egg production performance is influenced by characteristic of respondents described in the preceding sections. It can therefore be concluded that for better performance these characteristics must be assessed. In section 4.3 we present the descriptive statistics of the variable used in the stochastic frontier model.

4.3 Variables in the Stochastic Model

The subsequent sections presents findings on variables that were used in the stochastic frontier model as they were discussed in chapter Two and Three. These variables include flock size, drug cost, operating cost, transport cost and amount of feeds. The section presents the descriptive statistics of these variables in relation to technical efficiency.

4.3.1 Flock Size

Boki, (2000), classified small scale poultry farm as having up to 2000 birds, medium scale farm could have between 2 001 to 4 999 birds and large scale farm, have above 5000 birds. In this study on average, farms are larger in Kibaha compared to Ilala. The results in Table 13 indicate that the mean stock size in Ilala district is 518.7 birds with a standard deviation of 354.9 birds while the mean stock size is 1 624.9 birds in Kibaha district with a standard deviation 1578.2 birds. The flock size varied from

200 to1600 birds in Ilala compared to 200-6000 birds in Kibaha. The mode was 300 and 2000 for Ilala and Kibaha districts respectively. However for the sample as whole the smaller sized firms dominated given the sample mode of 300 birds (Table 14).

Table 13. Flock Size

Standard Measure of the Sample	Kibaha	Ilala	Whole Sample
Number of respondents	40	40	80
Mean	1624.9	518.7	1071.8
Mode	2000	300	300
Standard Deviation	1578.2	354.9	1265.5
Minimum	200	200	200
Maximum	6000	1600	6000

Table 14. Flock Size by Sex

Category	Kibaha		Ilala		Whole Sample	
	Female (N)	Male (N)	Female (N)	Male (N)	Female (N)	Male (N)
100-2000	23	9	20	20	9	9
2001-4099	3	1	0	0	1	1
5000 and above	2	2	0	0	2	2
Total	28	12	20	20	28	12

4.3.2 Categorization of Farm Size by District

About 85% and 10% of the poultry farmers interviewed were small and medium-scale ventures respectively. As shown in Table 15, large farms (5%) and medium (20%) were found only in Kibaha district. This is consistent with the findings reported in the previous section that most farms are small, especially in Ilala.

Table 15. Categorization of Farm Size by District

Category	Kibaha		Ilala		Whole Sample	
	(N)	(%)	(N)	(%)	(N)	(%)
100-2000	28	70	40	100	68	85
2001-4099	8	20	0	0	8	10
5000 and above	4	10	0	0	4	5
Total	40	100	40	100	80	100

4.3.3 Cost of Drugs

As shown in Table 16, the mean cost of drugs in Kibaha was 640 605 shillings with standard deviation of 444 409 while the mean cost drug in Ilala is 487 247 shillings with standard deviation of 376 675. Thus in Kibaha where farmers have large flock sizes incur more cost on drugs. For example highest cost is 1 592 000 shillings in Kibaha compared to 1 345 670 shillings in Ilala. For the whole sample, drug cost is 563 927 shillings on average with standard deviation of 416 530 shillings.

Table 16. Cost of Drugs

Standard Measure of the Sample	Kibaha	Ilala	Whole Sample
Number of respondents	40.0	40.0	80.0
Mean	640 604.5	487 246.7	563 925.6
Mode	644 800.0	374 000.0	713 750.0
Standard Deviation	444 408.8	376 674.5	416 530.3
Minimum	36 500.0	33 600.0	33 600.0
Maximum	1 592 000.0	1 345 670.0	1 592 000.0

4.3.4 Operating Cost

As it can be seen in Table 17, the mean operating cost in Kibaha district is 5 033 045 shillings with standard deviation of 5 213 947 while the mean operating cost Ilala is higher at 1 645 233 shillings with standard deviation of 1 115 591. Farmers in Kibaha incur higher transport cost than Ilala indicated by mean cost of 22 650 500 and 4 134 633 shillings respectively. Furthermore, for the sample as whole the mean operating cost is 3 339 139 shillings with standard deviation of 4 115 895 shillings in the entire life of stock.

Table 17. Operating Cost

Standard Measure of the Sample	Kibaha	Ilala	Sample
Number of respondents	40	40	80
Mean	5 033 045	1 645 233	3 339 139
Mode	7 626 000	870 600	7 626 000
Standard Deviation	5 213 947	1 115 591	4 115 895
Minimum	355 800	442 750	355 800
Maximum	22 650 500	4 134 633	22 650 500

4.3.5 Transport Cost

Results in Table 18 show that the mean cost of transport in Kibaha district is 750 346.9 shillings with standard deviation of 2 944 970 while the mean transport cost is 130 636.8 shillings with standard deviation of 109 177.4. The difference in mean transport cost is because farmers in Kibaha keep bigger flock sizes than farmers in Ilala district. The mean sample transport cost is 440 499 shillings with standard deviation of 2 093 954 shillings in the entire life of stock.

Table 18. Transport Cost

Standard Measure of the Sample	Kibaha	Ilala	Whole Sample
Number of respondents	40.0	40.0	80.0
Mean	750 346.9	130 636.8	440 491.8
Mode	120 000.0	30 000.0	120 000.0
Standard Deviation	2 944 970.0	109 177.4	2 093 954.0
Minimum	0.0	8 000.0	0.0
Maximum	18 602 575.0	478 000.0	18 602 575.0

4.3.6 Feed Cost

The mean cost of feeds in Kibaha district is much higher at 16 339 554 shillings with standard deviation of 21 402 525 compared to only 5 423 141 shillings in Ilala with standard deviation of 4 332 058. This difference is statistically significant with t-value of -3.6. The difference in mean feed cost reflects the larger farms in Kibaha. Feed consumption constituted the major components of poultry production cost in both study areas. It represented about 70% of production cost. This is represented by the mean cost of 10 881 347 shillings with standard deviation of 16 296 275 shillings for the sample a whole as shown in Table 19.

Table 19. Feed Cost

Standard Measure of the Sample	Kibaha	Ilala	Sample
Number of respondents	40	40.0	80
Mean	16 339 554	5 423 140.5	10 881 347
Mode	9 211 840	7 118 500.0	7 118 500
Standard Deviation	21 402 525	4 332 057.6	16 296 275
Minimum	634 000	766 880.0	634 000
Maximum	102 543 899	19 860 660.0	12 7342 569

4.3.7 Amount of Feeds

Table 20 shows the amount of feed (kg) used over the 24 months which is the lifespan of the stock. More feed is used in Kibaha district as indicated by the mean of 55 864.7 kilograms with a standard deviation of 50 877. In Ilala the mean is 22 013 kilograms of feed, again reflecting the difference in the number of birds kept. The overall mean sample indicates that the amount of feeds used is about 38 939 kg and standard deviation of 40 667 kg.

Table 20. Amount of Feed Used

Standard Measure of the Sample	Kibaha	Ilala	Sample
Number of respondents	40.0	40.0	80.0
Mean	55 864.7	22 013.2	38 938.9
Mode	28 787.0	39 810.0	39 810
Standard Deviation	50 876.8	13 187.5	40 667.1
Minimum	6 353.0	7 948.0	6 353.0
Maximum	268 000.0	66 156.0	268 000.0

4.3.8 Total Cost

Total cost of production was obtained by adding variable cost and fixed cost. From table 21 the mean total cost in Kibaha is 2 3297 084 shillings with a standard deviation of 2 607 6845. Meanwhile, the mean total cost in Ilala district is 7 876 683 shillings with standard deviation of 542 784 which reflects a higher level of variation. For the sample as whole the mean total cost ranges from 1 832 590 to 119628928 shillings. However, the mean total cost for Kibaha is higher than the sample mean total costs, which are 23297084 and 15 586 883 shillings for Kibaha and the sample respectively.

Table 21. Total Cost by District

Standard Measure of the Sample	Kibaha	Ilala	Sample
Number of respondents	40	40	80
Mean	2 329 7084	7 876 683	15 586 883
Standard Deviation	26 076 845	5 452 784	20 262 652
Minimum	1 832 590	2 200 827	1 832 590
	119 628 928	24 659 264	119 628 928
Maximum			

4.3.9 Value of Output (yield) per Farm

The value of output per farm over a period of 24 months was obtained by adding cash receipts from the sale of eggs produced, value of eggs consumed by the farmers' households and value of manure. The summary of results in Table 22 shows that farmers in kibaha district have higher value of output with mean of 97 805 224 shillings with standard deviation of 139 287 208 than farmers in Ilala district with mean value of output of 15 397 355 shillings and standard deviation of 8258691. The mean value of egg produced was 56 601 290 shllings per farmer which when compared with a mean total cost of 15 586 883 shillings in table 16 showed that egg production was very profitable in the study area. This was further confirmed by net returns of 38 696 shillings per bird.

Table 22. Value of Output

Standard Measure of the Sample	Kibaha	Ilala	Sample
Number of respondents	40	40	80
Mean	97 805 224	15 397 355	56 601 289
Mode	34 195 000	N/A	30 960 000
Standard Deviation	139 287 208	8 258 691	106 445 285
Minimum	2 314 500	2 821 500	2 314 500
Maximum	753 857 260	33 918 000	753 857 260

.N/A means not available

4.3.10 Net Returns

The net returns per farm were computed as shown in Table 23. Results in Table 23 show that farmers in Kibaha district have higher net returns with mean of 74508140 shillings and standard deviation of 13 189 324 than farmers in Ilala district with mean of 7 520 672 shillings with standard deviation of 5 594 942 shillings. The difference in net returns between the two districts is statistically significant with t-value of -3.15012. Some farmers incur losses reflected by the minimum net income of up to 11 160 in Ilala and 3 317 in Kibaha. The losses are higher in Ilala probably due to frequent outbreak diseases such as Marrek which usually cause higher mortality rates in layers. Other causes of losses include poor feed quality and rapid increase in prices of drugs. The lower level education of farmers in Ilala could also farmers in kibaha district have higher value of output with mean of 97 805 224 shillings with standard deviation of 139 287 208 than farmers in Ilala district with mean value of output of 15 397 355 shillings and standard deviation of 8258691. The mean value of egg produced was 56 601 290 shllings per farmer which when compared with a mean total cost of 15 586 883 shillings in table 16 showed that egg production was very profitable in the study area. This was further confirmed by net returns of 38 696 shillings per bird.

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Table 23. Net Returns

Standard Measure of the Sample	Kibaha	Ilala	Whole Sample
Number of respondents	40	40.0	80
Mean	74 508 140	7 520 672.1	41 011 407
Standard Deviation	13 189 324	5 594 942.0	98 075 629
Minimum	-3 317	-11160.0	-33 171
Maximum	73 623 478	22 458 912.3	73 624 678

Based on these findings, most farms are in small category especially in Ilala district while feed and drug cost constitute a major portion of the production cost. However, poultry production is still profitable in the study area. Section 4.4 reports the estimation of stochastic frontier model using variables described in section 4.3.

4.4 Estimation of Stochastic Frontier Model

In analysing the data for the stochastic frontier model, check for multicollearity, autocorrelation and heteroskedasticity are important. In order to test for multicollinearity, a correlation matrix was developed followed by a stepwise regression to select variables that did not exhibit multicolinearity among them. Model in equation (2.12) was then tested for autocorrelation using the Dubin Watson test whose value was found to be 1.56.This value lies between the acceptable limits of 1.1-1.92, at α=0.05. It is therefore safe to conclude that the model does not suffer from autocorrelation. The White Test was also conducted to test for heteroscedasticity. For White test, the product of R-squared (0.65) and the sample size follows a Chi-square distribution. $(N-P)^* R^2 \sim \chi^2 P$, where P is the number of dependent variables in the regression. The computed chi-square value is 52.56 at a 5 percent level of confidence. Since the computed chi-distribution is less than critical value of 79.33, it was safe to conclude that the model was free of heteroscedasticity. Thus the model that was estimated using maximum-likelihood was rewritten as equation (3.1) below where all other variable areas previously defined in section 3.6. Results of estimation are presented in section 4.4.1 (Table 24)

$$LinY = \ln\beta_o + \beta_1 \ln X_{1ij} + \beta_2 \ln X_{2ij} + \beta_3 \ln X_{3ij} + \beta_4 \ln X_{4ij} + \beta_5 \ln X_{5ij} + v_{ij} - u_{ji} \quad (3.1)$$

4.4.1 Maximum-likelihood Estimates of the Production Model

Table 24 presents results of the stochastic frontier production function results estimated using the maximum-likelihood method. The estimator in the LIMDEP version 8.0 econometric software by Green (2002) computes parameter estimates for numerous single equation variant of stochastic frontier model. Determination of elasticities is necessary for the estimation of responsiveness of production to changes in inputs. As it can be seen in Table 24 elasticities of the explanatory variables indicate that, stock size, drug costs, transport costs, amount of feed consumed and operating costs were positive, indicating that the variables allocation and use were in the second stage of the production function. A one percent additional shilling in the quantity of drug bought increases the value of egg by 2.4% ceteris paribus. Meanwhile, a one percent additional shilling in transport increased value of egg by 6.04 percent. However, such increases are not significantly different from zero. On the other hand, a one percent increase in quantity of feed consumed will probably increase the value of egg by 36.7%. The study has shows that the value of egg has the highest responsiveness to stock of bird evaluated at 54.38%, for one unit increase in the stock size (one bird). This means farmers could increase their profit by adding more birds into their stocks. The coefficient operating cost is 0.262, implying that where operating cost increase by one percent the value of output would increase/decrease by 36.23%. This variable is significantly different from zero at $\alpha=0.1$.

The results show that there is still a chance of doing well in the business through increasing stock size. This argument is consistent with the finding of Nair and Ghadoliya, (2000) who reported that flocks with sizes (>20000 birds) yielded higher returns/bird as compared to smaller flocks. The findings also conform to similar findings by Viney and sharma (1994), who reported that farmers who maintained a flock size of 10000 layers were able to recover the fixed invested capital from egg type layer in about two years compared to those who keep smaller flock sizes.

Summation of all the partial elasticity of production in equation (3.1) with respect to every input is 1.26, gives the value which represents the return to scale also called the function coefficient or total output elasticity. If all factors are varied by the same proportion, the function coefficient indicates the percentage by which output will be increased. In this case, it means if all of the variables were to be increased by 1%, output would increase by 1.26% representing increasing return to scale. Therefore, an increase in all inputs by one percent increases the value of egg by more than one percent.

Table 24. Maximum-likelihood Estimates for Parameters of the Stochastic Frontier Production Model

Variable	Proxy variable	Coefficients	Standard Error	t-Value
Stochastic Frontier				
Constant	β_o	7.18**	2.05	2.80
Drug cost	β_1	0.02	0.12	0.67
Transport cost	β_2	0.06	0.10	0.09
Amount of Feeds	β_3	0.37**	0.23	1.21
Stock size	β_4	0.54***	0.15	3.25
Operating cost	β_5	0.26*	0.16	1.75
Variance Parameters				
Lambda (δ_u/δ_v)	λ	17.65*	996.397	
Sigma	δ	10.18*	573.892	
Sigma Squared (u)	δ_u	103.30		
Sigma Squared (v)	δ_v	0.33**		
Ln(likelihood)		-91.18		
Gamma $\delta^2_u/\delta^2_u+\delta^2_v$	Υ	0.99		
Mean Technical Efficiency		64%		

Where

*** =α= 0.1 significance level

**=α=0.05 significance level

*=α=0.001significance level

In estimating the efficiency effects it is evident from Table 24 that the estimates of λ is (17.6511) and δ is (10.1802) are large and significantly different from zero, indicating a good fit and correct specification of the model. Lambda (λ) is the ratio of the variance of u (δ_u) over the variance of v (δ_v) and is an indication that the one sided error term (u) dominates the symmetric error (v). Lambda (λ) is significantly different from zero then the variation in actual output comes from differences in farmer's practice rather than from random variability. Gamma (Υ), which is equal to $\delta^2_u/\delta^2_u+\delta^2_v$ is also a measure of level of the inefficiency in the variance parameter. In this study Gamma (Υ) is computed as 0.99, implying that 99% of the random variation in egg production is explained by inefficiency in resource utilization. Further more, a higher value of Ln-likelihood function (-91.18); which is always negative means that observed results were more likely to occur. The subsequent section we evaluate the condition for producer's profit maximization.

4.4.2 Marginal Value Product

In order to assess the condition of a producer's profit level a number of variables such as marginal physical product (MPP)[4], marginal value product (MVP)[5] and input prices were also estimated (detail of calculations is shown in appendix 6). Data for variables were evaluated from their mean values over 24 months period.

Table 25 shows the MPP, MVP and factor prices for inputs. The stock of bird had the highest MPP. This suggests that an increase in stock of bird by one chicken is estimated to increase value of eggs by 0.544 units in a period of 24 months. An increase in amount of feed by an additional kilogram is estimated to increase the value of eggs by 0.370 units per annum. The average price of egg is 150 Tanzanian shillings while average price of feed is 260 shillings per kilogram and average price of chicken is 1200 shillings.

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[4] MPP=APP*Input Elasticity

[5] MVP=MPP*output price

Table 25. Factor Price and Marginal Value Product

Variable	APP[6]	Elasticity of Production	MPP	MVP	Factor Cost (Tsh)
Cost of Drugs	196.9	0.024	4.72	708	526.1
Transport Cost	252.1	0.060	15.10	2 265	410.9
Amount of Feeds	2 851.7	0.370	1 055.10	158 265	260.0
Stock Size	103 606.4	0.544	56 361.80	8 454 270	1000.0
Operating Cost	33.3	0.260	8.60	1 290	3 115.0

Profit maximizing conditions require that the MVP=Px. This necessary condition is not satisfied for amount of feed, stock size, transport cost and cost of drugs. For all cases the VMP are greater than the corresponding prices of the input, an indication that egg production is not at the optimum use of inputs, and could benefit by increasing the quantity of variable inputs especially feeds and stock size. Meanwhile, the MVP for operating cost is less than the factor cost which also does not satisfy the profit maximizing condition. The next section deals with determination of technical efficiency of egg production.

4.6 Determination of Technical Efficiency of Egg Production

Based on the discussion in chapter three, technical efficiency is calculated using the conditional expectation of the error term (u_i) as it is rewritten in equation (2.11) below.

[6] APP means average physical product

$$TE_i = \exp\left(E\left[-u_i \ |\varepsilon_i\right]\right) \qquad (3.2)$$

It is expressed in percentage representing how close the performance of the farmers in that district is to the highest possible level of output using the technology at home. Technical efficiency is conditioned on the composed error ($e_i=v_i-u_i$), and evaluated using equation (3.2) and the estimated parameters as presented in Table 24. Technical efficiency was computed for each individual farm using the Limdep Software. Table 26 shows the predicted technical efficiency values. The minimum estimated technical efficiency is 4% found in Ilala district, while the maximum in the same district 69.78% and mean of 59.80% with a standard deviation of 11.35 percent. In Kibaha district the minimum estimated technical efficiency is 30% with a maximum of 90% and mean of 69.78 percent having a standard deviation of 17.9% with most of women having technical efficiency equal to or above above 50 % (Table 27).

Table 26.Technical Efficiency

Standard Measure of the Sample	Kibaha	Ilala	Whole Sample
Number of respondents	40.0	40.0	80.0
Mean	69.8	59.8	64.8
Standard Deviation	11.4	15.7	15.7
Minimum	30.0	3.9	3.9
Maximum	90.0	80.0	90.0
%Scope[7]	30.2	40.0	35.2

As it can be seen from the Table 27, when evaluated at the sample level, the maximum technical efficiency is technical 90 percent; minimum is 4.0 percent and mean of 64.79 percent with standard deviation of 15.76 percent. This is interpreted as

[7] Scope for increasing egg production

follows: in the short run, there is a scope for increasing egg production by 35.21 percent if farmers adopt technologies and techniques that use best practice in egg production. This suggests that, on average; about 35.21 percent of value of eggs is lost because of inefficiency. The scope for improvement is higher in Ilala district (40%) than in Kibaha district (30.2%). The detailed analysis of TE is given in appendix 4.

Table 27. Technical Efficiency Category by Sex

%TE Category	Kibaha		Ilala		Whole Sample	
	Female (N)	Male (N)	Female (N)	Male (N)	Female (N)	Male (N)
<30	0	0	3	2	3	2
30-39	1	0	0	1	2	1
40-49	2	2	1	4	3	6
50-59	10	3	11	8	21	11
60-69	8	5	5	3	13	8
70-79	7	2	0	2	7	4
Total	28	12	12	20	49	32

4.6.1 Range of Frequency Distribution of T.E. of Egg Producers

As shown in table 28, 9 (23%) farmers in Kibaha and 5 (13%) farmers in Ilala district, have a mean TE below 50 percent, and thus, are considered technically inefficient. However, analysis of TE of the whole sample indicates that only 8 (10%) farmers have technical efficiency equal to or above 80%. Further analysis reveals that Kibaha district has the highest number of farms with higher technical efficiency; where 35 (85.5%) of farmers have the mean technical efficiency equal to above 50%. Meanwhile in Ilala district, 31 (77%) farmers have the mean technical efficiency equal to or above 50%. Most egg producers are operating above the average level of technical efficiency of 50%.

Table 28. Percentage Technical Efficiency

Category of Technical Efficiency %	District				Sample	
	Ilala		Kibaha		(N)	%
	(N)	%	(N)	%		
<30	2	5	0	0	2	2.5
30-39	2	5	2	5	4	5
40-49	5	12.5	3	7.5	8	10
50-59	6	15	4	10	10	12.5
60-69	16	40	11	12.5	27	33.75
70-79	8	20	13	32.5	21	26.25
≥80	1	2.5	7	17.5	8	10
Total	40	100	40	100	80	100

4.6.2 Technical Efficiency and Farm Size

Other studies have shown that the size of the stock of bird influence technical efficiency (Ojo, 2003). The results in this study similarly show that the bigger the flock size, the higher the TE, which is consistent with previous findings that profit, could be increased by adding more birds in the stock both in Kibaha and Ilala. As shown in the Table 29 all farms in the medium category (2001-4999 birds) are more efficient than smaller farms. This is confirmed by all 4 larger farms, having their TE ranging from 70-79 percent followed by the next level (2001-4999 birds) where 6 farmers have technical efficiency above 60%. Meanwhile, all 17 farms with less than 60% TE fall in the lower farm size (100-2000 birds). The larger farms are more technically efficient due to economies of scale.

Table 29. Technical Efficiency and Farm Size

% Technical Efficiency	Farm size						Total	
	100-2000		2001-4999		≥5000			
	(N)	%	(N)	%	(N)	%	(N)	%
<30	5	8.33	0	0	0	0	5	6.25
30-39	2	2.99	0	0	0	0	2	2.50
40-49	1	1.4	0	0	0	0	1	1.25
50-59	9	13.2	0	0	0	0	9	11.25
60-69	30	44.11	2	25	0	0	32	40.00
70-79	20	29.41	4	50	4	100	30	37.50
≥80	4	5.88	2	25	0	0	6	7.50
Total	68	100	8	100	4	100	80	100

The analysis of technical efficiency has shown that women are more technically efficient than men, while bigger flock sizes are associated with higher technical efficiency. The larger farms are more technically efficient due to economies of scale as it was evidenced by higher TE in Kibaha district. In the next section, results of estimation from a linear regression of inefficiency model are discussed.

4.7 Socio-economic Characteristics and Technical Efficiency

This section reports on sources of inefficiency when the error term (u_i) was regressed against a set of social economic factors using equation (2.13) which is repeated here as equation (3.3). All other variables are as previously defined.

$$u_i = \rho_0 + \rho_1 Z_1 + \rho_2 Z_2 + \rho_3 Z_3 + \rho_4 Z_4 + \rho_5 Z_5 + \rho_6 Z_6 + \rho_7 Z_7 + \rho_8 Z_8 + \rho_9 Z_9 + \rho_{10} Z_{10} + \rho_{11} Z_{11} + \rho_{12} Z_{12} + \rho_{13} Z_{13} + \rho_{14} Z_{14} \quad (3.3)$$

For estimation of parameters, the model was tested for multicollinearity. autocorrelation and heteroscedasticity. After performing multicollinearity and autocorrelation tests, the results showed values of Condition Number and Durbin

Watson of 12.78 and 1.72 respectively which are acceptable. The White-Test for heteroscedasticity was performed by squaring the error term e_i^2 and dividing each squared error term by the mean error term to obtain v_i^2. Then v_i^2 was regressed against all dependent variables to obtain R^2. The product of R-squared (0.781) and the sample size follows Chi-square distribution. The chi-statistic is 52 at 95% (α=0.05) level of confidence. Since the computed chi-statistic is less than the critical value of 79.33, then we conclude the absence of heteroscedasticity in the model. Thus, the model is good for estimation of parameters. The parameter estimates of the model in equation (3.3) are given in Table 30. Results in Table 32 show the parameter estimates of the model shown in equation (3.3) using the sample as whole while the results of the model using data disaggregated by district are shown in the appendix 1 and 2. A negative sign on an efficiency parameter means that the variable increases technical efficiency, while a positive sign reduces technical efficiency. It is important to note that these coefficients should not be directly interpreted as signs read (Battese and Coelli, 1993).

Table 30. Determinants of Technical Inefficiency

Variable	Proxy variable	Coefficients	Standard Error	t-Value
Inefficiency Model				
Constant	ρ_0	-1.0222*	0.0323	34.2141
Location	ρ_1	0.5023***	0.3043	1.6678
Marital Status	ρ_2	-0.9813***	0.4314	22.223
Education of farmer	ρ_3	- 0.5117**	0.0244	0.7431
Farmers Years in business Squared	ρ_4	0.6220**	0.2778	2.2734
Credit	ρ_5	-0.3308*	0.1803	1.842
Family Size	ρ_6	-0.0014*	0.0016	-1.820
Attendants Years in business	ρ_7	0.0480	. 974	0.1154
Lighting	ρ_8	-0.1656	0.5689	-0.28 01
Housing type	ρ_9	0.3243	0.1512	1.3545
Employment	ρ_{10}	-0.0003	0.0156	-0.900
Education of farm Attendant	ρ_{11}	0.0001	0.0043	0.561
Age attendant	ρ_{12}	-0.0002	0.0019	-0.761
Sex of farmer	ρ_{13}	-0.0702	0.3066	-0.613
Age of farmer	ρ_{14}	0.0001	0.0052	0.191

Where

*** =α= 0.1 significance level
**=α=0.05 significance level
*=α=0.001significance level
df =73
R^2=78.1%
Durbin Watson=1.72
CN=12.78

The coefficient of location of the poultry farm is the positive sign showing that farms that are close to urban centers tend to be more technically inefficient as in Ilala district where the population is large and land is scarce making it difficult to keep large flock sizes. The larger stock sizes are normally associated with higher TE due to economies of scale. Thus, the study observed that the further the poultry farm is from the Dar-es-Salaam city center the higher the TE. However, the priori expectation was that distant farms are less efficient than the farms closer to urban centers. These findings are contrary to findings by Ojo (2003) in Nigeria which concluded that the farms close to urban centers exhibit higher TE.

The negative and significant coefficient of the marital status variable indicates that married farmers engaged in poultry business tend to exhibit higher levels of efficiency. The expected sign of this variable was negative. This means couples are supported by their partners in business. They share and discuss adoption of new technologies and gathering technical information that is essential for enhancing production efficiency. Other researchers had similar findings including Ajifemi (1996) on his investigation of factors influencing technical efficiency of smallholder cropper in Nigeria; Awudu et al, (2001) on technical efficiency of economic reform in Nicaragua; Liu and Zhung (2000) on determinants of technical efficiency in post collective Chinese agriculture.

The coefficients for experience of farmers (squared term) years of school and age were positive, indicating that these factors led to reduction in technical efficiency of poultry egg production in the study areas. The priori expectation was that TE should increase with experience. It was expected that the more experienced farmers are to adoption improved technologies and techniques of production, the higher the TE (Ojo and Ajibefun, 2000). These results (where age and education of a farmer reduce technical efficiency) may be due to the fact that the more aged and educated farmers are, have less time for efficient supervision of their farms because of their involvement in other work related to societal activities. For this category of farmers the poultry enterprise may also be a less important source of income (a side activity).

These results are contrary to expectations where negative sign was expected for the variable on age and farmer level education.

The negative sign on the years of school variable (education) of a farmer shows that an increase in the number of school years increases TE; this relationship is significant at the 5 percent level. This implies that farmers with high education have more knowledge to use resources efficiently for farming especially in relation to mix and use medicine. This finding is consistent with similar results from other studies (for example, Awudu, *et al.*, (2001a) in their study on technical efficiency during economic reform in Nicaragua found that education increases production efficiency). Another study by Seyoum, *et al.*, (2000) on technical efficiency and productivity of maize producers in Eastern Ethiopia concluded that farmers with more education respond more readily to new technology and produces closer to the frontier output. Finding of this study are also consistent with results on structural adjustment and economic efficiency of rice farmers in Northern Ghana by Awudu nd Huffman (2000). A negative sign on the dummy variable for family size (as expected) indicates that big families tend to improve technical efficiency. This variable is statistically significant at (α=0.01).

Furthermore family size and age of farm attendant variables have a negative sign, and therefore increase technical efficiency, which conforms to expectation. The coefficient for use of credit is negative and significant at one percent level of significance suggesting that farmers who use credit tend to be more efficient than their counterparts who face credit constraints. Awudu and Huffman (2000) made a similar conclusion on the efficiency of rice farmers in Northern Ghana. Likewise, Wambui (2005) made a similar conclusion on the technical efficiency of maize production in Kenya. As expected the signs on the coefficients of farmer's employment, type of lighting, sex of a farmer and age of farm attendant were negatives implying that these variables increase technical efficiency. However, the parameter estimates of all these variables are not significantly different from zero.

Finally, the coefficient of education of the farm attendant is positive but statistically not significantly from zero. This suggests that the education level of the farm attendant reduces technical efficiency thus increasing technical inefficiency. This is probably why most farm owners employ farm attendants who have only up to primary education as shown in Table 6 In section 4.8, relationship between technical efficiency and net return is discussed.

4.8 Technical Efficiency and Net Return

This study further investigated the relations between technical efficiency and profit (net return). The objective of a producer is often to maximize profit either by increasing the quantity produced or reducing the cost of production. Efficient resources allocation increases profits. In this section we determined the relationship between technical efficiency of a farm and the corresponding net return. A liner model as represented by equation (2.14) and repeated here as equation (3.4) was estimated by regressing individual farm technical efficiency and the corresponding net returns (net profit as give in appendix 3).

$$T.E_i = \alpha_t + \alpha_i \pi_t \qquad (3.4)$$

The ordinary least square (OLS) estimates of the parameter, which show the average performance of the sample farm, are presented in Table 31.

Table 31. OLS Estimates of Relationship between Technical Efficiency and Profit

Variable	Parameter	Coefficient	t-ratio	P-value
Intercept	α_0	0.624	2.39	0.019
Net Return	α_1	0.005	3.42	0.000

N=80
F-value =11.72
P-value= 0.000
Adjusted R^2=45%
Durbin Watson=1.99
Condition Index =8.395

The adjusted R^2 value of the model is 45%with a corresponding F-value of 11.72 which is significant at α=0.01. This means that 45 percent of the variations in the technical efficiency among farmers in the sample was explained by difference in net returns. The coefficient of profit is 0.005, being statistically significant and has the expected positive sign. If net return increases by one percent, technical efficiency would increase by five percent. This means that improving technical efficiency among poultry farmers will increase the corresponding net returns. In order to be technically efficient, several aspects relating layers enterprise must be addressed. These aspects include cost of production, prices of inputs, and change in profitability, marketing and problems related to egg production. The farmers' views on these aspects are presented in the following sections.

4.9 Operators Views Regarding the Technical Efficiency of their Poultry Enterprise

This section assesses the farmers' views as they perceive the challenges and constraints in the poultry business, capturing the farmers' opinions on the cost of producing eggs, changes of the price of inputs from time to time, changes in the profit margins and key factors that constraint egg production.

4.9.1 Farmers' Opinion on the Input prices and Production Cost

Results in Table 32 shows that 74.75% of the total respondents feel that the cost of producing eggs was high while 25.25% of the respondents said the cost of production was affordable because they had high level of egg production. High cost of production has been caused by the high prices of most inputs. For example, most farmers reported that in early 2007, one bag of layers marsh was sold between 7000-12000 Tsh, but by the mid year the same amount of feed was sold between 16000-18000 Tsh which was equivalent to 13000 Tsh in real terms compared to 2007 prices, an increase ranging from 50% to 128% of the nominal price for the highest and lowest price respectively in early 2007.

In the case of poultry drugs such as Vitalyte, Amprolium, Egg Boost, OTC plus and Gumboro Vaccine in early 2007 they were sold between 1000-1500 Tsh. The same quantity was sold at the price between 3500-4000 Tsh by the mid of the year 2007 representing a 167% to 250% increase for the lowest and highest price respectively. As a result of this shift in price, some farmers abandoned keeping layers.

Table 32. Farmers Opinion on the Cost of Producing Eggs

Opinion	Ilala N=40		Kibaha N=40		Whole Sample N=80
	Male	Female	Male	Femal	
High	50	12	17.5	70	74.7
Low	0	0	0	0	0
Affordable	17.5	2.5	12.5	18	25.2

Out of 80 farmers interviewed 90% reported that prices of inputs have gone up since the business started (table27). However 10% of the responded reported insignificance in price changes while no respondent said prices have gone down. As noted earlier, a rapid increase in the prices of inputs is not directly proportional to the increase in the prices of the output (eggs). The prices of output are always fluctuating, depending on the demand. The price of eggs falls significantly when eggs are imported from other countries such as Kenya and South Africa. For example in 2007, the price of egg fluctuated between 2500-4000 Tsh per tray depending on the demand and supply of eggs. When there is big supply of eggs, the local farmers lower the price of eggs in order to avoid losses. A similar situation occurs when there is high production of eggs among the local farmers.

Table33. Farmers View on the Changes of the Prices of Inputs Since the Business Started

View	Ilala N=40		Kibaha N=40		overall % N=80
	Male	Female	Male	Female	
No significant change	0	0	8	12	10
Prices have gone up	54.5	43.5	30	60	90
Prices have gone down	0	0	0	0	0

4.9.2. Change of Profitability and Technical Efficiency

Kumar and Mahalati (1998) established that returns in commercial egg operation could significantly be increased by decreasing the cost of production, having larger flock size and reducing mortality rates. In Table 33 results show that 24 (30%) respondents, with technical efficiency ranging from 40-49 percent, reported that returns from layers production were low. Only nine respondents (11.3%) with TE of 60-79 said returns were the same and 6.2 percent (TE between 60-69 percent) said the returns were better. Lower profits were due to the increased cost of production from higher inputs prices in the past few years. As discussed in section 4.4.2, farmers with higher flock sizes are technically efficient due to economies of scale; thus farmers can reduce cost of production by increasing their flock sizes. The qualities of feeds and drugs normally supplied have also been reported to decrease over time and hence reducing productivity and corresponding net returns.

Table 34. Technical Efficiency and Change in Profitability

% Technical Efficiency	Farmers view Same (N)		Better (N)		Low (N)		Whole Sample	
	(M)	(F)	(M)	(F)	(M)	(F)	(N)	(%)
<30	0	0	0	0	0	0	0	0
30-39	0	0	0	0	0	0	0	0
40-49	0	0	0	0	10	14	24	30
50-59	0	0	0	0	8	4	12	15
60-69	4	5	0	5	13	9	36	45
70-79	0	3	0	0	4	0	7	8
≥80	0	2	0	0	0	0	2	2
Total	7(8.8%),	6(7.5%)	0	5(6.2%)	44%,	34%	80	100

*M and F stand for number of males and females respectively

4.9.3. Marketing Eggs

The efficiency of a marketing system is measured in terms of the level and the costs of inputs, to achieve a given level of output. Such inputs are generally in the form of land, finance, time, manpower and materials. Efficient marketing optimizes the ratio between inputs and outputs. Rushton & Ngonji (1998) established that markets have to be assessed for their accessibility, size and seasonality. In the study areas the marketing system for eggs is generally informal and poorly developed as reported by 62.5% of the respondents with majority having technical efficiency between 30-69% (Table 35). Another 31.2% of the respondents felt lack of credit was the most overriding problem while 6.3 said transport cost was the most important.

Table35. Technical Efficiency and Marketing Problems

% Technical Efficiency	Reasons						Whole Sample
	Marketing problems (N)		Lack of credit facilities (N)		Transport cost (N)		
	(M)	(F)	(M)	(F)	(M)	(F)	
<30	1	3	0	0	0	1	5
30-39	8	6	0	0	2	3	17
40-49	0	5	0	0	1	3	9
50-59	4	6	7	5	4	8	34
60-69	6	4	0	5	0	4	19
70-79	2	3	0	0	0	0	5
≥80	0	1	0	0	0	0	1
Total	21(26%), 9(36%)		8(9%),10(13%)		7(8%), 9(24%)		80(100%)

*M and F stand for number of males and females respectively

4.9.4 Farmer's Views on Factors Affecting Egg Production

Results in Table 36 show that more than half of the respondents (51.3%) reported diseases is an important factor that affects egg production. In Tanzania, the poultry industry suffers from low production due to rampant diseases such as; Newcaste disease, fowl typhoid, chronic respiratory disease, fowl pox, gumboro disease, coryza syndrome that cause high mortalities (Mella *et al.*, 1978; Magwisha, 1997). However, economic losses caused by nutrition deficiencies, internal and external parasites are insidious and always masked by economic losses when viral, bacterial, and protozoa diseases occurrence. The most important disease is Marek's, potentially causing 42-21% mortality in layers (Taylor *et al.*, 1999). The disease is more prevalent in layers lacking immunization. Further risk exists with calcium deficiencies during the laying phase. This problem occurs when farmers buy unvaccinated stocks of chicks from the hatcheries or suppliers, which cause big loses to farmers. This was followed by the lack of capital for inputs (16.2%), shortage of labour (12.5%) and expensive hired labour (8.7%). Apart from space, lack of capital to buy inputs was also reported to be one of the factors constraining the growth of the poultry industry in Tanzania. The problem is more prevalent in Ilala district reflected in the mean lower stock size of 518.8 layers. Most of these farmers keep small flock sizes due to insufficient capital to invest in the business. Small flock sizes yield smaller returns.

Table 36. Factors Hindering Egg Production

	Ilala		Kibaha		Whole
Factors	%Males (N=12)	%Females (N=24)	%Males (N=21)	%Females (N=19)	Sample %
Household labor shortage	1	2	1	5	12.5
Labor too expensive to hire	2	1	1.7	4	8.7
Lack of knowledge in poultry keeping	0	0	3	2	5
Inadequate extension services	1.3	3	2	0	6.2
Lack of capital to buy inputs	6	5	3	2.3	16.2
Diseases	20	18	12.3	11	51.3

In general these results show that women dominate layers enterprise. Most farms are in small category especially in Ilala district while feed and drug cost constitute a major portion of the production cost. However, poultry production is still profitable in the study area with most farmers operating above 50% technical efficiency. The analysis of technical efficiency has shown that women are more technically efficient than men, while bigger flock sizes are associated with higher technical efficiency. The larger farms are more technically efficient due to economies of scale as it was evidenced by higher TE in Kibaha district. Technical efficiency of individual farm is positively related to net returns. Finally, higher cost of production, diseases and poor marketing arrangements are the major factors constraining egg production.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study aimed at estimating the technical efficiency of egg production in Ilala and Kibaha district in Dar es Salaam and Coast regions of Tanzania and to explain variations in technical efficiency among farms as affected by managerial and socio-economic characteristics. Farm specific technical efficiency was computed using sample survey data collected in 2007. A stochastic frontier model was used to generate technical efficiency estimates. In addition the farm operator's views were deduced based on the observation and discussion to get a qualitative perspective of the problems facing them.

Results revealed that bigger flock sizes are associated with higher TE and the corresponding net return due to economies of scales. The overall mean technical efficiency is estimated at 64.8% implying that, there is a 35.2% scope for increasing egg production by using the present technology. Technical efficiency ranges 3.96% to 89.9% among the egg producers (Table 26). A significant variation is observed in the mean level of technical efficiency in the two districts. Kibaha district achieved the highest TE of 90%, while the maximum for Ilala was 80% implying that farmers in Kibaha district are more efficient than their fellow counterparts in Ilala Districts. The difference in technical efficiency is because farmers in Kibaha have more education on average, they also operate larger farms (flock sizes) which provide for economies of scale.

Household characteristics have been evaluated to identify their effects on technical efficiency of egg production. Results show that variables such location of a farm (urban or periurban),the lighting and heating equipments used, family size, whether one has a formal employment or not, age of the farm attendant and the sex of the household head are associated with a higher technical efficiency. Observations made in the study area indicated that females are carrying most of the farm activities. The sign of the coefficient of variable sex is negative indicating that sex of a farmer increases technical efficiency. Credit has also been associated with higher technical efficiency implying that the availability of credit will loose the production constraint, by facilitating to get inputs on the timely basis and hence increasing the technical efficiency. This study has concludes that increasing flock size and improving household's characteristics such as education, acquisition of credits, housing type and type of heating and lighting materials may give good results to the yield across and within the two districts.

5.2 Recommendations

In this study high cost of production has been shown to reduce the competitiveness of poultry farmers. One of the most important avenues for reducing production cost is to increase output by increasing technical efficiency. Given the empirical findings, the proposed recommendations are:

(1) There is still a room for making layer enterprises in Ilala and Kibaha more profitable through increasing flock sizes. The study recommends that farmers can

increase the flock sizes which in turn will lower the total cost of production due to economies of scale.

(2) Credit is necessary to encourage technical innovations and timely availability of necessary inputs. The government should influence borrowing rates on credit and loans so as to spur agricultural development.

(3) The coefficient on farmer's education had a significant positive effect on improving technical efficiency. Hence effort to emphasize secondary schooling will have a positive impact on the TE in egg production. Recently, the government has supported free primary education and more effort in secondary education. If this education policy is sustained, future egg producers could reap benefits of education in the form of increased egg production. Since the benefits of education are not immediate, non-formal agricultural education, often provided by both public and private extension services should target poultry as well as farm families.

(4) For the poultry industry to be successful, organizational support is required at various levels. Support can be in terms of motivation and moral support within households and the community at large. At another level, institutional support can also include provision of credit, development and supply of genetically improved stock, supply and distribution of inputs (feed, vaccines, other drugs, etc.), disease control, training and capacity building including production and dissemination of relevant information and all the way to marketing of products. Services like vaccinations, supply of drugs, and compounding or trading of locally based feeds for

poultry, can be carried out by people living in the community. This will promote both entrepreneurship and employment creation in the communities.

(5) As it was shown in the previous chapter, diseases caused by buying unvaccinated stocks of chicks from the hatcheries or suppliers, lead to big loses to farmers. This study recommends that besides enforcing hatchery regulations, the government should increase the provision animal health extension services and monitoring of disease outbreaks.

5.3. Suggestion for Further Research

This study focused on the productivity and technical efficiency using commercial layer only under intensive system. A comprehensive study could be undertaken to determine the productivity, costs and returns of different types of layers, poultry farms under different management practices. In addition, the study can also be designed to evaluate the effect of different feed types in a laying hen.

REFERENCES

Abbott, J.C. (1987). *Agriculture Marketing Enterprise for the Developing World. 2nd edition.* Cambridge University Press,. Cambridge. 217pp.

Adam, A.W. and Craig, J.V. (1985). Effects of crowding and cage shape on productivity and profitability of caged layers; A survey. *Poultry Science* 64(2): 238-242.

Ajibefun, I.A. and Abdulkadri, O.A. (2003).An investigation of technical efficiency of farmers under the national directorate of employment in Ondo State, Nigeria. *Applied Economics Letter* 6: 111- 114.

Alton, O.S O. A. Attan, Akbas, Y. Ahyan, V. and Ozkan, K. (2000). Effects of short term fasting and midnight lightening on eggs production traits of laying hens during summer seasons. *Ege-Universitei-Ziraat-Fakultesi-Dergisi* 35:25-32.

Ames, G.C.W., and. Ngemba, L.M. (1986). Poultry Production in Zaire. World *Economic and Rural Sociology Abs*tract 28(9):5189-5123.

Amin, S.K.A. Shafique, M. Arshard and Rahman, S.U. (1995). Epidemiology studies on infectious bursal disease in poultry. In: *Proceedings of the National Seminar on Epidemiology of Livestock and Poultry Diseases.*(Edited by Amin, S.K.A. *et al)* January 19-20, College of Vet. Sci. Lahore, Pakistan. 37-44pp.

Ascard, K. and Von. Wachenfelt, E, (1995). *Laying Hens on the Floor: Inventory and Review of Experience.* Specialmeddelande-InstitutionenJordbrukets-biosystem-och-echnologiSverges-Lantbruk sununiveritet. 84pp.

Asghar, A., Farooq, M., Mian, M. A. and Khurshid, A. (2000). Economic of broiler production in Mardan Division. *Journal of Rural Development and Admnistration* 23(3): 56-64.

Awudu, Abdulai and Richard Eberlin. (2001). Technical efficiency during economic reform in Nicaragua. Evidence from Farm Household Survey Data. *Economic Systems* 25: 113-125.

Basnayanke, B.M.J.K and Gumarate L.H.P. (2002). Estimation of technical efficiency and its determinants in the tea small holding sector in the mid country of West-zone of Sri-Lanka, *Sri-Lanka Journal of Agriculture Economics* 4:137-150.

Battese, G.E and Coelli, T.J. (1995). A model for technical inefficiency effect in stochastic frontier production function for panel data. *Empirical Economics* 20:325-332.

Battese, G.E and Coelli, T.J. (1993). Stochastic frontier production function incorporating model for technical efficiency effects. *Working Paper in Econnometrics and Applied Statistics* 6:32-45.

Bogart, R. and Taylor, R.E. (1983). *Poultry Management.* Scientific farm annual production. Mammalian Publishing Company, Canada. 2 Edition. 310pp.

Boki, K.J. (2000). *Poultry Industry in Tanzania with Emphasis on Small Scale Poultry.* Proceedings of a workshop, Morogoro, Tanzania, 22-25 May 2000. 62 pp.

Branckaert, R.D.S. and Gueye, E.F. (2000). FAO's Programme for Support to Family Poultry Production. Poultry as a Tool in Poverty Eradication and

Promotion of Gender Equality. In: *Proc. Workshop organized by The Danish Agricultural and Rural Development Advisor's Forum*. (Edited by Gueye, E.F. *et al*) Mar. 22-26, 1999. Tune Landboskole, Denmark, 244-256 pp.

Buza, J.J. and Mwamuhehe, H.A. (2003). Country Report:Tanzania. In: *SADC Planing Workshop on Newcastle Disease Control in Village Chickens* (Edited by Alders, R.G. and Spradbrow, P.B.),7-12 May 3003, Proceedings No. 103, ACIAR, Canberra, Australia. 38-42 pp.

Bylee, M. (1991). The Measurement of productive efficiency. *Journal of the Royal Statistical Society* 120:253-281.

Carey, J. B., Kuo, F. L. and Anderson, K. E. (1995). Effects of cage population on the productive performance of layers. *Journal of Poultry Science* 74(4): 633-637.

Chrysostome, C.A.A.M., Bell, J.G., Demey, F. and Verhulst, A. (1995). Seroprevalences to three diseases in village chickens in Benin. *Journal of Preventative Veterinary Medecine* 22(4): 257-261.

Chwalibog, A. (2001). *Nutritive Value and Nutrient Requirements of Animals. Department of Animal Science and Animal Health*. The Royal Veterinary and Agricultural University, Copenhagen. 147pp.

Daghir, N.J. (1995). Poultry Production in Hot Climates. Ed: Daguir. Faculty of Agriculture. Sciences United Arab Emirates University Al-Ain, UEA. 1995. 303pp.

Damme, K. (1999). Effect of beak-trimming and strain on performance, feather loss and nesting behavior of different commercial white layer hybrids in floor pens. *Journal of Preventative Veterinary Medecine* 22(4): 257-262.

Debertin, D.L. (1986). *The Law of Beak-Trimming and Strain on Performance, Feather Loss and Nesting Behaviour of Different Commercial White Layer Hybrids in Floor Pens.* University of Kentuky. pp 182-194.

Debertin, D.L. (1992). *Agricultural Production Economics*; Unpublished; Second Edition, University of Kentucky. 160 pp.

ESRF (Economic and Social Research Foundation) (2006). MKUKUTA Based MDGs Costing for The Agriculture Sector, Final Report.145pp.

Ellis, P.R. (1992). The epidemiological and economic assessment of poultry diseases. In: *Proceedings of International Seminar on Prevention and control of poultry Diseases.* (Edited by Andrew, J. *et al*) September 7-13, 1992, Bangkok, Thailand, pp 9-30.

, FAO (2004), Statistical Database, Food and Agriculture Organization of United Nations.Rome, Italy.[http;//www.fao.org] site visited on 12/2/2008.

Faostat, H. (2002). Faostat Agricultural Data Online Database-Livestock Primary (28 May 2002). FAO, Rome, Italy, Press Release 00/60. [http://apps. Fao.org/ page/ collections subject, agriculture] site visited on 28/5/2008.

Farell, M.J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society* 120:253-281.

Farooq, M., Durrani, F.R. Fisal, S. Asghar, A. and Khurshid, A. (2000). Incidence of infectious bursal disease among birds submitted to a diagnostic laboratory in NWFP, *Pakistan. Pakistan Veterinary Journal* 20(2): 77-80.

Farooq, M., Shoukat, K., Asrar, M., Mussawar, S., Durrani, F.R., Asghar, A., and Faisal, S. (2001). Impact of female livestock extension workers on rural household chicken production. livestock research for rural development 12(4).[http://www.cipav.org.co/lrrd/lrrd12/4/faro124.htm] site visited on 17/3/2008.Ghodasara, D. J., Joshi, B. P. Jani, P. B. Gangopadhyay, R. M. and Prajapati, K. S. (1992). Pattern of mortality in chicken. *Indian Veterinary Journal* 69(10): 888-890.

Gill, V. (2006). *Next big thing, Marketing Magazine*, New York. 71pp.

Green, W.H. (2002). *Limdep Version 8.0: Econometric Modeling Guide.* Econometric Software, Inc, Plainview, New York. 201pp.

Greene, W.H. (1993). Maximum Likelihood Estimation of Ecometrics Frontier Functions. *Journal of Econometrics* 13:27-56.

Gueye,E.F.(2000). The role of family poultry in poverty alleviation, food security and the promotion of gender equality in rural Africa. *Outlook on Agriculture* 29(2): 129-136.

Haartsen, P.I., and Elson, H. A. (1989). Economics of alternative housing systems. *Poultry Abstract* 016 :(02310)143-150.

Hatter, M. H., (1984). Cost and Income Analysis of Layers on Commercial Poultry Farms. Dissertation for Award M.Sc. Degree at Agriculture Economics Unit. Fisalabad, Pakistan, 134 pp.

Heir, B.T. and Jarp, J. (2000). Risk factors for marek's disease and mortality in White Leghorns in Norway. *Journal of Preventive Veterinary Medicine* 44(3-4): 153-165.

Horne-Van, P.L.M., Van-Horne, P.L.M. (1996). Production and economic results of commercial flocks with white layers in aviary systems and battery cages. *British Poultry Science* 37(2):255-261.

Jensen, H. A. (2002). Semi- scavenging poultry flock. The Bangladesh model and other experiences in family poultry development. International network of family poultry development (INFPD) FAO Electronic Conference on FamilyPoultry.[http://www.fao.org/AG/againfo/subjects/en/infpd/econf_scope.html] site visited on 13/4/2008.

Jondrow, J. Lovell, C.A., Materov, I. and Schmidt, P. (1982) .On the estimation of technical inefficiency in the stochastic frontier production function model. *Journal of Econometric*19: 233-238.

Kabatange, M. A and Katule, A. M. (1989). Rural poultry production systems in Tanzania. In: *Preceeding of an international workshop on rural poultry in Africa.* (Edited by Sonaiya, E.B). 13-16 November 1989, Obafemi, Nigeria. 176 pp.

Kabede.A.T. (2001). Farm household technical efficiency; a stochastic frontier analysis. Dissertation for award of MSc. Degree at Agricultural University of Norway, Norway, 39 pp.

Kampeni F. (2000). Smallholder poultry production in Malawi. *In Proceedings of the Workshop on possibility for smallholder poultry projects in Eastern and Southern Africa. Morogoro. Tanzania*, 22-25 May 2000. 41-42pp.

Kitalyi, A.J. (1998). *Village Chicken Production Systems in Rural Africa.* Household Food Security and Gender Issues. FAO Animal Production and Health paper. 1998. Vol. 142. Rome, Italy. 81pp.

Koelbebeck, K. W. J. S. Mckeen, P. C. Harrisoson, C. M. and Zimmerman, R. A. (1999). Performance of laying bens provided water form two sources. *Journal of Applied Poultry Research* 8 (3): 374-379.

Kohls, R.L. and Uhl, J.N. (1990). *Marketing of Agricultural Products.* Seventh Edition, Macmillan Publishing Company, New York. 545pp.

Kuit, H.G; Traore, A and Wilson, R.T (1986) Livestock production in Central Mali;Ownership, Management and productivity in traditional sector. *Tropical Animal Health Production* 18:222-231.

Kumar, V. P., and Mahalati, S. (1998). Costs analysis of layer farm in South-West Madhya Pradesh. *Indian J. Poult. Sci.* 33 (1): 110-112.

Kumbhakar, S. C., S. Ghosh and Mc Guckin (1996). A generalized production frontier approach for estimating determinants of inefficiency in US. Dairy Farms. *Journal of Business and Economic Statistics* 9:279-286.

Kusolwa, P.M.K (2002). Effects of substituting fishwaste for fishmeal in egg production and quality in lying chicken, Dissertation for award of MSc. Degree at Sokoine University of Agriculture, Morogoro, Tanzania.1-3pp.

Larsen, C.E.S. (2002). Adoption of crossbred cows used in dairy-draught technology in Ethiopia. Ph.D. Thesis. Department of Animal Science and Animal Health, The Royal Veterinary and Agriculture University, Denmark.137pp.

Lewin, A.Y and Lovell, C.A.K. (1990). Editors Introduction, *Journal of Econometrics* 46:3-5.

Liu Zinan and Zhuang Juzhong. (2000). Determinants of technical efficiency in post-collective Chinese Agriculture: Evidence from Farm-Level Data. *Journal of Comparative Economics* 28: 545-564.

MAFC (2006 a). Ministry of Agriculture Food and Cooperatives, Agricultural Sector Review; Performance Issues and Options, Main Report, Volume II. 51pp.

MAFC (2006 b), Ministry of Agriculture Food and Cooperatives, Agricultural Sector Development Programme (ASDP); *Support through Basket Fund*, Government Programme Document. 23 pp.

Magwisha, H.B (1997). Prevalence of helminthoses and effect of deworming and supplementary feeding on live weight gains of free range chicken. Dissertation for award of MVM Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 110pp.

Mathivanan, R. Sundaresan, K. and Mani, K. (2000). Influence of drinking water soruces on egg production performance in commercial White Lehborn. *Indian Journal of Poultry Science* 35 (1): 115-117.

McAinsh, C.V., Kusina, J. Madsen. J and Nyoni, O. (2004). Traditional chicken production in Zimbabwe, Regional Report. *Worlds Poultry Science Journal* 60: 233-24.

Mian, M. A. (1994). Poultry Production In: *Animal Husbandry.* National Book Foundation, Islaunabd. 294 pp.

Millau,N.N. (1990).The effect of leucaena leafmeal on egg production and egg quality . Dissertation for award of MSc. Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 35pp.

MLD (2006). Investment Opportunities in Livestock Industry in Tanzania, Dar es Salaam, Tanzania, 412 pp.

Mlozi, Kakengi, Minga, Mtambo and Olsen. (2003). Marketing of free range local chickens in Morogoro and Kilosa urban markets. Tanzania. Livestock Research for Rural Development. [http://www.cipav.org.co/lrrd/lrrd15/2/mloz152.htm] site visited on 12/5/2008.

MOA. (2000). *National Sample Census of Agriculture*. Ministry of Agriculture Report Volume II.54pp

Mousa, S. M. H. Abd-El-Wahab, and a. M. Abd-El-Aziz-AM, (1999). Fatty liver syndrome in laying hens in Upper Egypt. *Assiut Vet. Medical J.* 42 (83): 379-393.

Muhusamy, P. and Viswanathan, K. (1998). Effect of rearing systems on performance of commercial layers. *Indian Journal of Poultry Science* 33 (3): 264-267.

Mukherjee, S. R. and. Khanapurkar, S. R. (1994). Occurrence of escherichia coli, newcastle disease virus and infectious bursal disease virus in broilers *Indian Journal of Vet Science*. 71 (6): 533-538.

Mutizwa-Mangiza, N.T. and Helmsing, A.H.J. (1991). *Rural development and Planning in Zimbabwe*. Aldershot, UK, Avebury. 123pp.

Nair, B. C. and Ghadoliya, M. K. (2000). Economic viability of layer farming in the State of Goa. *Indian Journal of Poultry Science* 35 (1): 73-76.

National Research Council. (1994). *Nutrient Requirements of Poultry. 9th Edition.* Subcommittee on Poultry Nutrition, National Research Council. 176 pp.

Nicholls, T. J. (1984). Marek's disease in sixty week-old laying chickens. *Australian Veterinary Journal* 61 (7):243-278.

North, M. O. (1984.) *Breeder Management.* In Commercial Chicken Produciton Manual. The Avi. Publishing Company. Inc. Westport, Commecticut. 240-243, 298-321pp.

Ogundele, O.O. (2003) .Technology Differentials and Resource- use Efficiency in Rice Production in Kaduna State, Nigeria.Unpublished Ph.D Thesis. Department of agricultural Economics, University of Ibadan, Nigeria. 67 pp.

Ojo, S.O. (2003). Technical efficiency of poultry egg production in Nigeria *International Journal of Poultry Science* 2 (6):4-5.

Ojok, L. (1993). Krankheiten und ihre Bedeutung anf expandierende Grefubhaltung in Uganda (Diseases an Important Factor Affecting Increased Poultry Production in Uganda. Der Trpenlandwirt, Zeitschrift fur die Landwirtschaft in dentopen und subtropen. 36-44pp.

Park M. (1993) An outbreak of infectious bursal disease in poultry in Bhutan Buhtan *Journal Animal Husbandry* 14: 29-32.

Paul, D.C,Beg, Chowdhury, E.R, and Podder, C.K. (1990). Family chicken and its importance in Bangladesh,International *Journal of Poultry Science* 4(5):6-7.

Peterk, M., (1999). Production traits and economic efficiencies of different genotypes of layers reared by enterprises in bursa province and its near vicinity. *Veteriner Fakultesi Dergisi Uludag Universitesi.* 18 (1-2): 65-77.

Population and Housing Census Report. (2002).Vol IV.56pp.

Roberts .J. A (1997). *Assessing the Scavenging Feed Resource Base for Sustainable Smallholder Poultry Development.* Published by the African Network for Rural Poultry Development. Ile-Ife, Nigeria. 152 pp.

Rose, S.P. (1997). *Principles of Poultry Science.* Cab International, New York, USA. 135pp.

Rushton, J. and Ngongyi, S.N. (1998). *Poultry, Women, and Development: Old Ideas, New Applications and the Need for More Research.* World Animal Review. 43-48pp.

Ryan. A.M, Mickey, A.L. (2004). *Commercial Egg Production and Processing,* Purde University. 47pp.

Sawio H. (1996). Research and development option for family poultry. Introductory paper to the first INFPD/FAO. In: *Electronic Conference on the Scope and Effect of Free-range Chick Survivability in Improved Condition and The Effect of Three Medicinal Plants on Eimeria tenella.*pp34.

Scott, T.A. (1991). Influence of temperature, dietary energy, nutrient concentration and self-selection feeding on the retention of dietary energy, protein and calcium by sexually maturing egg-laying pullets. *British Poultry Science* 32:1005-1016.

Seiford, L.M. and Thrall, R.M. (1990). *Recent Development in DEA*: The mathematical approach to technical efficiency in U.K. 45pp.

Seyoum, E.T., Battese, G.E.and Fleming, E.M. (2001). Technical efficiency and productivity of maize producers in Eastern Ethiopia: A study of farmers within and outside the Sawakawa–Global 2000 Project." *Journal Agricultural Economics* (19):341-348.

Singh, K. C. Verma, P. S. K. and Prasad, C. B. (1995). Occurrence of infectious bursal disease in chickens, isolation and clinico-pathology. *Indian Journal of Virol* 10 (2): 83-89.

Smith,M.(2000). *Available Amino Acid Content of Fish Meals.* poultry science and extension, Mississipi State University.345 pp.

Sonaiya, E., Branckaert, R and Gueye, E. (1990). The scope and effect of family poultry research and development. International Network for Family Poultry Development (INFPD). FAO Electronic Conference on Family Poultry.[http//www.fao.org/AG/againfo/subjects/en/infpd/econf_scope.html] site visited on 23/4/2008.

Tablante, N. Vailancourt, J. P. and Julian, R. J. (1994). Mortality in a Flock of Layer Hens during The First Half of the Production Periods. *Madecin Veterinaire du Quebe* 24 (2): 82-85.

Taylor, R. D. Jones, G. P. D. and Murison, R. D. (1999). Influence of the method of calcium provision on marek's disease losses in compound and choice fed layers. *British Poultry Science* 41 (2): 219-233.

URT. (2006). *Agricultural Sector Development Programme.* Government Programme Document. Kiuta, Dar es salaam, Tanzania. 110pp.

Verma L. C., and Singh, K. S. (1997). Cost and return structure in layer farming. *Indian Journal of Poultry Science 32* (2): 152-158.

Viney, Sharma, and Sharma, V. (1994). Break even analysis of egg production in Punja. *Poult Adviser* 27 (5): 17-20.

Wambui, Betty (2005). Stochastic frontier approach to Kenyan Maize. Dissertattion for award of MSc. Degree at Kolorado State University. Kolorado, USA. 156pp.

Wilson, Paul, Dave Hadley, Stephen Ramsden, and Loannis Kaltsas. (1998). Measuring and explaining technical efficiency in UK potato production. *Journal of Agricultural Economics* 48 (3): 294-305.

Wilson, R.T., A., Kiut, H.G., and Slingerland, M. (1987). Livestock production in Central Mali: Reproduction, growth, and mortality of domestic fowl under traditional management. *Tropical Animal Health and Production Journal* 4:44-45.

Yongolo, M.G.S. (1996). Concurrent diseases. In Epidemiology Newcastle Disease in Tanzania. Dissertation for award of MVM Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 230pp.

Zahir-ud-Din, M. Farooq, F.R Durrain, N. Chand, and Ahmed, J. (2001). Status of Broiler Produced in Swat, Pakistan. Livestock Research for Rural Development.[http//www.cipav.orgoco/irrd 13/3/zail33.htm]site visited on 23/5/2008.

Zaibet, L. and Dharmapala, P. S. (1999). Efficiency of government-supported horticulture. The Case of Oman. *Agricultural Systems*, 62: 159-168.

APPENDICES

Appendix 1. Determinants of Technical Efficiency (Ilala)

Variable	Proxy Variable	Coefficient	Std. Error	t-value	Sig.
Constant	ρ_0	-0.150	0.875	-0.171	0.86
Location	ρ_1	0.066	0.096	0.682	0.00
Marital Status	ρ_2	-0.001	0.006	-0.139	0.02
Education of farmer	ρ_3	-0.007	0.021	-0.338	0.74
Farmers Experience	ρ_4	-0.023	0.192	-0.121	0.07
Credit	ρ_5	-0.051	0.030	-1.706	0.12
Family Size	ρ_6	0.102	0.119	0.854	0.00
Attendant Experience	ρ_7	0.095	0.270	0.351	0.73
Lighting	ρ_8	0.005	0.029	0.173	0.86
Housing type	ρ_9	0.037	0.038	0.952	0.36
Employment	ρ_{10}	-0.005	0.249	-0.020	0.09
Attendant Education	ρ_{11}	0.040	0.206	0.193	0.05
Age attendant	ρ_{12}	0.041	0.438	0.094	0.92
Sex of farmer	ρ_{13}	0.121	0.051	2.37	0.11
Age of farmer	ρ_{14}	0.031	0.321	0.96	0.45
R-squared	R^2	69.8			
Condition Number	CN	20			

Appendix 2. Determinants of Technical Efficiency (Kibaha)

Variable	Proxy Variable	Coefficient	Std. Error	t-value	Sig.
Constant	ρ_0	0.795	0.307	2.589	0.231
Location	ρ_1	-0.062	0.079	-0.246	0.154
Marital Status	ρ_2	-0.021	0.076	-0.072	0.002
Education of farmer	ρ_3	-0.005	0.006	-0.334	0.091
Farmer Experience	ρ_4	-0.006	0.011	-0.180	0.011
Credit	ρ_5	0.004	0.013	0.105	0.284
Family Size	ρ_6	-0.025	0.020	-0.321	0.250
Att. Experience	ρ_7	-0.011	0.093	-0.044	0.022
Lighting	ρ_8	0.003	0.017	0.058	0.172
Housing type	ρ_9	-0.007	0.014	-0.123	0.475
Employment	ρ_{10}	-0.034	0.183	-0.051	0.086
Attendant Education	ρ_{11}	0.23	0.681	0.337	0.941
Age attendant	ρ_{12}	0.014	0.012	1.166	0.123
Sex of farmer	ρ_{13}	0.024	0.034	0.705	0.000
Age of a farmer	ρ_{14}	0.054	0.045	1.20	0.013
R-squared	R^2	62			
Condition Number	CN	20			

Appendix 3. Output, Net Return and Sex of Farmer

S/N	Sex		Value of Output (Tsh)		Net Return per Farmer (Tsh)	
	Kibaha	**Ilala**	**Kibaha**	**Ilala**	**Kibaha**	**Ilala**
1	Female	Female	123835400	23826000	50662780.7	4061422.11
2	Female	Male	109088000	9359000	88149686.29	5194956
3	Male	Male	43274100	15882800	23236414.86	6940012.3
4	Female	Female	6514400	10400000	348859.71	7281064
5	Female	Male	16285500	16080000	11098748	7461028
6	Male	Male	2314500	23480000	-3317.29	11239095.92
7	Male	Female	13402000	5756000	4040692	2983184
8	Male	Female	59045000	6804000	37128714.29	1635479.14
9	Male	Female	31835000	12294000	13956629.29	7989210.57
10	NA	Male	25449000	29365000	7618532	20974498
11	Female	Male	244129000	5005200	211883558.3	1964381.14
12	Female	Male	15284000	11852900	8263138	4273948
13	Female	Female	28095000	29184000	20945317.14	10996129.71
14	Female	Female	34195000	5574000	24229767.43	347981.14
15	Female	Female	34195000	16917500	-856704	9426486.29
16	Male	Female	28389000	27783000	10513756	3123736
17	Female	Male	24484000	8523800	7924703.43	5653536
18	Male	Female	286512500	18151200	265272891.4	11664472
19	Male	Female	99295000	24817200	68239747.4	1855256.14
20	Male	Female	148550000	12985500	132161040	4326672
21	Male	Male	28418000	2821500	16427296	620672.57
22	Male	Male	32435000	31650000	14223382.29	17572596
23	Female	Male	123255000	6922600	89076192	3824003
24	Male	Female	225720000	15726000	126709380	10712322
25	Female	Male	217637200	12214000	98008272	8727518.57
26	Female	Male	140160000	4508400	136656221.7	-11160.43
27	Male	Male	293777500	8945600	234188250.1	3592682
28	Male	Male	21841500	14066000	17138591.4	8745800.71
29	Female	Male	297665000	20345400	226843814	16086595.14
30	NA	Male	203971000	15119000	191051398	10276764.57
31	Female	Male	36518200	10755000	17788792	5234344.7
32	Female	Female	15882800	12551400	6859698	5957063.71
33	Female	Female	28002500	17017200	15922060.29	11801745.43
34	Female	Male	753857260	12774400	736108848	7477175.43
35	Male	Male	38745400	9376400	20517177.7	2996609.71
36	Male	Female	5982000	17049000	-59328	9649126.57
37	Male	Male	6620200	10628800	4787609.57	5501095.14
38	Female	Male	6925000	30960000	5002173	18324384.7
39	Male	Male	29664000	33918000	22577498	22458912.29
40	Female	Male	30960000	14504400	18997179.43	2991022

Appendix 4. Technical Efficiency Outputs per Farm

S/N	Ilala	Kibaha
1	0.566886	0.81849
2	0.719516	0.79912
3	0.654667	0.724782
4	0.730061	0.521142
5	0.630049	0.665277
6	0.655398	0.661501
7	0.790154	0.688101
8	0.710695	0.758281
9	0.676265	0.670259
10	0.748765	0.588912
11	0.743319	0.81924
12	0.623977	0.709133
13	0.636542	0.696256
14	0.514299	0.737038
15	0.621652	0.498809
16	0.660994	0.612382
17	0.676376	0.580186
18	0.687976	0.842917
19	0.505372	0.75817
20	0.556109	0.806492
21	0.27934	0.710245
22	0.639672	0.64122
23	0.627653	0.779513
24	0.708324	0.73508
25	0.702099	0.710401
26	0.383188	0.898865
27	0.141784	0.772115
28	0.683813	0.563871
29	0.798343	0.722288
30	0.262722	0.789975
31	0.677115	0.627167
32	0.192913	0.646162
33	0.747364	0.708862
34	0.699149	0.876835
35	0.693032	0.655697
36	0.679841	0.303668
37	0.54648	0.791162
38	0.039656	0.794306
39	0.648536	0.627248
40	0.659741	0.602819

Appendix 5.Calcualation of Marginal Value Product

The marginal value product was calculated from estimation using equation (3.1) as rewritten below as equation (4.1)

$$Liny_i = \ln\beta_i + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \beta_3 \ln x_3 + \beta_4 \ln x_4 + \beta_5 \ln x_5 + v_{ij} - u_{ji} \quad \text{.........(4.1)}$$

Where;

x_1 represents cost of drugs

x_2 represents transport cost

x_3 represents amount of feeds

x_4 represents stock size

x_5 represents operating cost

And all other variables are as previously defined

The estimated linear form of equation (4.1) gives the value of total product (Y) represented by equation (4.2).

$$y = e^{7.18} * x_1^{0.024} * x_2^{0.06} * x_3^{0.37} * x_4^{0.54} * x_5^{0.26} \quad \text{.........(4.2)}$$

$$y = e^{7.18}(563925.6)^{0.024} * (440491.8)^{0.06} * (38938.9)^{0.37} * (1071.8)^{0.54} * (333919)^{0.26}$$

y= 111,045,379

Thus we can calculate the marginal physical product (MPP) related to each input as shown in appendix 6.

Appendix 6. APP and MPP

Variable	**Mean** $(\bar{x})$	**Average Physical Product (APP)**	**Marginal Physical Product (MPP)**
Cost of Drugs	563925.6	196.9	4.72
Transport Cost	440491.8	252.1	15.1
Amount of Feeds	38938.9	2851.7	1055.1
Stock Size	1071.8	103606.4	56361.8
Operating Cost	3339139	33.3	8.6

Appendix 7: Questionnaire for Farmers

Productivity and Technical Efficiency of Egg Production in Tanzania under the Intensive System; A Case Study of Ilala and Kibaha Districts

Questionnaire No……………..Date of interview……………………

Division……………………….Ward……………………………………………..

Interviewer……………………………………………………………………….

A. Farm Characteristics

A1	District	1=Kibaha 2=Ilala
A2	Name of the household head……….	
A3	Name of the farmer	
A4	Respondent?	1=Farm manager, 2= Farmer,3=Farm attendant, 4=Others, 5=Do not know
A5	Sex of the farmer	1=Male, 2=Female, 999=missing
A6	Sex of farm manger	1=Male, 2=Female 999=missing
A7	Age of the farmer……….years	Don't know missing= 999
A8	Age of the farm manager……………..years	Don't know missing= 999
A9	Age of the farm attendant……… years	Don't know missing= 999
A9	Experience of a farm attendant………..(years)	Don't know missing= 999
A10	Marital status	1=Married, 2=Single, 3=Divorced, 4=Widowed, 5=Others (Specify)
A12	Education level of a farmer…………..years	1=Primary, 2=Secondary, 3=None,4=Others (Specify)
A13	Education level of a farm manager…………..years	1=Primary, 2=Secondary, 3=None,4=Others (Specify)
A14	Education level of a farm attendant……………years	1=Primary, 2=Secondary, 3=None,4=Others (Specify)
A15	Employment	1= Self employed, 2=Government employee, 3=Farmer, 4=Business
A16	Household	

	size....................members (number)	
A17	For how long have you been keeping poultry.............years	
A18	Location of the farm	1=Urban, 2=periurban
A19	What is the housing for layers made of?	1=Grass thatched and wall mudded 2=Iron roofed and concrete walled 3=iron roofed and wooden wlled.
A20	Systems used	1= deep litter system 2= slatted floor system 3= battery cage system
A21	Type of lighting and heating and used?	1=None 2=Kerosene lamp 3=Electrical bulbs 4=charcoal burner

B. Inputs used

B1. What are the inputs necessary for layers production?
1=Labour, 2=Machinery/implements, 3=Drugs, 4=Feeds, 5=All of them. 6=Specify

B2. Labour cost in egg production

	Activity	Family Labour (Man day)	Hired Labour		
			Man days	Wage rate	
				In kind	Cash
B21	Feeding	B211	B212	B213	B214
B22	Watering	B221	B222	B223	B224
B23	Cleaning	B231	B232	B233	B234
B24	Mixing Feeds	B241	B242	B243	B244
B25	Brooding	B251	B252	B253	B254
B26	Pens preparation	B261	B262	B263	B264
B27	Vaccination and debeaking	B271	B272	B273	B274
B28	Others (Specify)	B281	B282	B283	B284

Man-day =No of labourers*hrs/day*No. days worked

B3. Machinery and implements

	Machinery/Implement	No owned	Initial cost per unit owned	Life span (Years)
B31	Buildings	B311	B312	B3133
B32	Feeders	B321	B322	B323
B33	Drinkers	B331	B332	B333
B34	Spades	B341	B342	B343
B35	Automatic drinkers	B351	B352	B353
B36	Wheelbarrows	B361	B362	B363
B37	Buckets	B371	B372	B373
B38	Automated feeders	B381	B382	B383
B39	Shovels	B391	B392	B393
B310	Brooms	B3101	B3102	B3103
B311	Others (Specify)	B3111	B3112	B3113
		B31112	B31122	B31132
		B31113	B31123	B31133
		B31114	B31124	B31134
		B31115	B31125	B31135
B312	Total	B3121	B3122	B3123

B4. Cost of drugs

	Type	Amount used	Price per unit	Total Cost (Tsh)
B41	Vitalyte	B411	B412	B413
B42	OTC-plus	B421	B422	B423
B43	Amprolium	B4311	B432	B433
B44	Piperazine citrate	B441	B442	B443
B45	Newcastle vaccine	B451	B452	B453
B46	Gumboro vaccine	B461	B462	B463
B47	Others (Specify)	B4711	B4712	B4713
		B4721	B4722	B4723
		B4731	B4732	B4733
		B4741	B4742	B4743
B48	Total	B481	B482	B483

B5 Feeds used

	Type	Amount used (Kg)	Price per unit	Total cost
B51	Maize bran	B512	B513	B514
B52	Cotton seed cake	B522	B523	B524
B53	Sunflower cake	B532	B534	B534
B54	Fish meal	B542	B544	B544
B55	Vitamin/Mineral premix	B552	B554	B554
B56	Bone meal/Limestone	B562	B564	B564
B57	Salt	B572	B574	B574
B58	Others (Specify)	B581	B582	B583
		B5811	B5821	B5831
		B5812	B5822	B5832
		B5813	B5823	B5834
		B5814	B5824	B5835
B59	Total	B591	B592	B593

C. Transport

C1. What is the means of transport do you use

1= Bicycle,2= Motor cycle, 3=Car, 4= Others (Specify)

C2. The cost of transport

	Type	Amount	Cost (Tsh)
C21	Feeds	C211	C212
C22	Eggs	C221	C222
C23	Drugs	C231	C232
C24	Chicken	C241	C243
C25	Equipments	C251	C254
C26	Other (Specify)	C261	C265
		C2611	C2651
		C2612	C2652
		C2613	C2653
C27	Total	C271	C276

D. Other costs

D1	On average how much money do you spend in electricity charges.....................(Tshs)	Electricity charges per month Don't know missing 999
D2	How much of the average electricity charges are used in poultry..........(Tshs)	Electricity charges per month Don't know missing 999
D3	On average how much money do you spend in water charges.....................(Tshs)	Water charges per month Don't know missing 999
D4	How much of the average water charges are used in poultry..........(Tshs)	Water charges per month Don't know missing 999

D. Use of credit

A1	Did you take the credit in starting the business?	1=Yes, 2=No
A2	What was the source credit that you received?	1=Bank, 2=Traders,3=Cooperative society, 4=Other farmers. 5=Others (Specify)
A3	Amount you got as credit.........Tsh	

E. Enterprise Size (Last stock size before the most recent one)

E1	What was the number of chickens bought in last 24 months.................(number)	Number of eggs Don't know missing 999
E2	Date of in which the chicken started laying eggs	Don't know missing 999
E3	Date of egg collection................	Don't know missing 999
E4	Number of eggs collected in the first the life span of a stock...........(number)	Number of eggs Don't know missing 999
	Number of eggs collected in last 12 months of the life span of a stock...........(number)	Number of eggs Don't know missing 999
D5	Number of eggs sold...........	Number of eggs Don't know missing 999
E6	Number of eggs consumed......	Number of eggs Don't know missing 999
E7	Number of eggs damaged.......	Number of eggs Don't know missing 999
E8	Price of egg in the first 12 months of the life span of the stock..................	Price per egg Don't know missing 999
E9	Price of egg in the last 12 months of the life span of the stock..................(Tshs)	Price per egg Don't know missing 999
E10	Date of curling..............	Don't know missing 999
	Total umber of chicken sold at curling stage............	Number of chickens Don't know missing 999
D11	Price per chicken at curling stage...............(Tshs)	Price per curled chiken Don't know missing 999
D12	Number of chicken consumed.........	Number of chickens Don't know missing 999
D13	Value of litter if sold...........	Amount of money (Tshs) Don't know missing 999
D14	Value of litter if used in own garden...........	Amount of money (Tshs) Don't know missing 999

F. Operators views regarding the technical efficiency of their poultry enterprises

E1	What is your opinion on the costs of producing eggs? gh ɔw ffordable due high output 4. Unaffordable due to low output 5.Others (Specify)	
F2	In your view, how has the price of inputs change since you started the business	1=No significant change, 2.=prices have gone up, 3= prices have gone down, 999=don't know, missing
F3	In your view how has the profitability changed since you started the business	1=same, 2.=better now 3= worse now 999=don't know, missing
F4	ıat are the main problems you usually face selling eggs? Rank in their order of importance;	If no constraint experienced, write '0' 1. Marketing problems ck of credit facilities gh transportation cost ıreliable market outlet 5. Others (Specify) *Indicate the most important of the mentioned related factors* Most important constraining factors
F5	ıich of the following household factors constraint the present production of eggs? 1.Household labour shortage 2.labour too expensive to hire Lack of knowledge in poultry keeping Inadequate extension services 5. Lack of capital to buy inputs seases ***Indicate the most important of the mentioned household related factors*** **Most important constraining factors**	If no constraint experienced, write '0'
F6	ıich of the two groups of factors, market or household conditions, is the most constraining one in your case?	1=Market related factors, 2=Household factors 999=Don't know, missing