EFFECT OF MANAGEMENT AND SOCIO-ECONOMIC FACTORS ON THE PERFORMANCE OF THE VHEMBE DISTRICT EGG PRODUCTION PROJECT

MASTER OF AGRICULTURAL MANAGEMENT (ANIMAL PRODUCTION)

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BY

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DECLARATIONS

I declare that the dissertation hereby submitted to the University of Limpopo for the Degree of Master of Agriculture (Animal production) has not been previously submitted by me for a degree at this or any other university, that it is my own work in design and execution, and that all material contained therein has been duly acknowledged.

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Nelwamondo Nditsheni Constance Date

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ABSTRACT

The objectives of the study were to evaluate the productivity of the Vhembe egg production project and determine the management and socio-economic factors affecting productivity. The data were collected from 2005 to 2007. Thirty-two farmers from four municipalities were randomly selected. Each household received a once-off unit consisting of a cage with eighteen point of lay chickens 4x50 bags of laying mesh, feeding and drinking troughs. Production records from sampled farmers were used in the analysis. Data included monthly egg production, eggs consumed, eggs sold, income from eggs, production costs, monthly feed utilization and mortality. Primary data on educational standards, socio-economic characteristics (age and gender of the household head, farming size, level of education and alternative income, were collected using a questionnaire. The study revealed that sex, age and educational level had impact on production as low production was associated with older farmers and low level of education. These factors should be considered when planning community projects. Chicken rearing and ownership is often shared among the family members, in this study, the management was predominantly by women (63%) and children (18%). This may be an indication that if assistance efforts are targeted towards women, village poverty could be significantly reduced. It is concluded that the low income accrued from the project explains the reason for high abandonment or neglect of the project. The income received from the project is smaller than the government grants and as such not attractive. It is not surprising that presently most farmers have abandoned the project. It is noted that if labour costs had been taken into consideration, the project would be running at a serious loss and the resultant output would discourage even the most enthusiastic farmers.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INNTRODUCTION

1.1 Background

Poultry production has been recognized as an important enterprise in national economies of developing countries. Its role in improving the nutritional status and incomes of many small farmers and landless communities has been recognized by various scholars and rural development agencies (FAO, 1982, 1987; Bembridge, 1988; Creevey, 1991; Mokotjo, 1990). Rural poultry population in Africa accounts for more than 60 % of the total national poultry population. It has been accorded an asset value of US $ 5,750 million (Kitalyi, 1998). Over 70% of the poultry products and 20% of animal protein intake in most African countries come from the rural poultry sector (Kitalyi, 1998).

African livestock population statistics indicate that poultry is the most numerous species of farm animals (Aganga *et al*., 2003). More than 80% of poultry are kept in rural areas and contribute substantially to annual egg and meat production (Sonaiya, 1997). Village chickens provide cheap, readily harvestable protein-enriched white meat and eggs with high quality digestible protein for immediate home consumption and sale for income generation (Dolberg and Petersen, 2000; Mapiye and Sibanda, 2005; Miao, 2005). Chickens are used as buffers or banks in cases where they are sold to pay school fees, medical costs, village taxes and etc. The extent to which chickens are used as buffers or banks depends on the socioeconomic status of each rural household (Julian, 1992; Muchadeyi *et al*., 2004).

Village chickens play a vital role through their contribution to cultural and social life of smallholder farmers (Dolberg and Petersen, 2000; Pedersen, 2002). In some cases farmers give birds and eggs as gifts to visitors and relatives, and as starting capital for youth and newly married women as well as token of appreciation for services rendered (Kusina and Kusina, 1999). Chickens are reserved for special guests or for ceremonial gatherings such as marriage feasts, weddings and funerals. Village chickens are used to strengthen relationships with

in-laws and to maintain family contacts by entrusting them to other family members. They are given as sacrificial offerings to appease avenging spirits and ancestors. Village chicken feathers are used to make special clothes (skirts and hats). They are also given to traditional healers for their day-to-day use and to spirit mediums to wear during traditional ceremonies. The chickens perform a valuable sanitary function by eating discarded food and controlling pests in gardens (Muchadeyi *et al*., 2004).

Indigenous chickens are an important reservoir of genomes that may be used in future to produce hybrid birds since most strains have superior genetic constitution that has not been fully exploited (Pedersen, 2002). Another important role of village chickens is the provision of manure. Manure from chickens is applied in vegetable gardens, and is regarded to be of a higher value for vegetables in comparison to goat or cattle manure (Maphosa, et al., 2004; Muchadeyi et al., 2004). Village chicken litter, offals and feathers can be used as ruminant feed to supplement protein, hence if treated to eliminate bacterial infection can be an attractive option for smallholder farmers.

Chicken production in South Africa, like in most developing countries, is two-dimensional; large-scale and smallholder. Large-scale production is characterised by intensive management, mechanization and specialization, and is dominated by a few large companies which are both breeders and producers (Pedersen, 2002). The smallholder sector predominantly includes small-scale commercial (semi-intensive) and communal (extensive) farmers. The semi-intensive production system is comprised of moderate management level, specialised breeds and is labour intensive. The extensive system is dominated by village chickens, which are not classified into specific breeds and scavenge for feed (Muchadeyi et al., 2004).

Though the contribution of poultry to rural livelihoods is significant, rural poultry production does not seem to rate highly in the mainstream national economies

because of the lack of measurable indicators of its contribution to macroeconomic indices such as gross domestic product (GDP). Economic evaluation of livestock at household and national levels is complicated by the multiple functions of livestock in the economy. Moreover, estimating the value of rural poultry is even more difficult than for other livestock because of the lack of reliable production data (Branckaert, 1997).

The monetary contribution of poultry production to household economy is viewed as low (Pedersen, 2002; Miao, 2005; Muchadeyi *et al*., 2005) though it is recognised as having the potential to improve the livehoods of rural communities. In realization of the importance of poultry production in provision of animal protein, the government of South Africa has been pursuing programs at national, provincial and community levels to boost the mass production of chicken eggs in order to alleviate hunger, poverty and malnutrition. One of such programs is the Vhembe Egg Production Project which targets the poor. Because of the problems of poverty and low protein in household diets, the Government of South Africa, through the provincial Department of Agriculture in Limpopo started a project of giving selected families point of lay pullets and feed. The aim was to tackle poverty and improve household income and animal protein consumption (Swatson *et al*., 2002). In Bangladesh one of the poorest countries in the world with over 40% of the population living below the poverty line, smallholder poultry as a tool for poverty alleviation has been developed and widely applied. A number of extensive survey-based assessment of different poultry projects in Bangladesh indicate that the project participants have benefited positively in terms of income, consumption, nutrition and empowerment of women (Fakhrul Islam and Jabbar 2005).

There has also been a recognition that in South Africa, especially in the Limpopo province, the production of edible table eggs has not increased at the rate that can meet the increasing population (Absa Bank, 1993). This apparent disparity between the rate of egg production and demand for eggs in the Limpopo

province has led to higher rates of increase in egg prices and an egg demand supply gap, thus leading to widening gap between domestic egg production and total requirement. The price increases have also meant that the rural poor cannot afford to purchase eggs, further exacerbating their poor diets which are generally characterized by low levels of animal protein, especially chicken egg protein.

1.2 Problem Statement

The Vhembe Egg Production Project as indicated above, was aimed at boosting the production of eggs in rural areas so that livelihoods are improved through availability of animal protein and the selling of surplus eggs for cash. The project started in 2003. However, just like most of the government development programs, most of the beneficiaries tend to abandon the projects a few years into the project. The reasons for this abandonment are not known because no extensive evaluation of the project has been done. Furthermore, the project does not seem to be doing well in terms of production levels (Swatson *et al*, 2002). This study is trying to determine factors (both socio-economic factors and management practices) that impact on production. The study also seeks to assess the profitability or viability of the project through a profitability analysis as this may determine and also indicate why many beneficiaries abandoned the project.

1.3 Motivation

The Limpopo province is considered one of the poorest provinces in South Africa with approximately 89 % of its population considered rural. The Limpopo province has a low human development index (HDI), relatively high illiteracy and unemployment rates, but has future growth potential in mining, agriculture, trade and tourism (Maliwichi *et al*., 2003; Nesamvuni *et a*l., 2003; Tshovhote, 2003). There is a general agreement amongst South Africans on the need to address the problems arising from poverty, income inequality, and disparities in access to

services amongst the population. National and provincial governments have intensified efforts to fight poverty by introducing different kinds of projects in poverty-stricken rural communities. Vhembe district is a beneficiary of the egg production project. Poor households were defined as those in which the total family income is less than two hundred rands per month (Swatson *et al*., 2002). This project was aimed at increasing income of households and providing protein to their diet. To achieve this aim, evaluation of productivity and factors affecting egg production has to be performed regularly. Results on factors affecting egg production and the assessment of the profitability will be generated. All this will be helpful to the government and farmers involved in the project.

1.4 Aims and Objectives

1.4.1 Aim

To evaluate productivity and determine the management and socio-economic factors affecting productivity of laying chickens in Vhembe Egg Production Project and to assess the potential profitability of the project.

1.4.2 Objectives

1 To estimate the average monthly egg production per household in municipalities within the district.
2 To determine management factors influencing production levels across different municipalities.
3 To determine socio-economic factors influencing production levels across different municipalities.
4 To evaluate the profitability of the project across different municipalities.

CHAPTER 2
LITERATURE REVIEW

2.1 Importance of Poultry

The importance of rural poultry in national economies of developing countries and its role in improving the nutritional status and incomes of many small farmers and landless communities is well recognised (FAO, 1982, 1987; Bembridge, 1988; Creevey, 1991; Mokotjo, 1990). The rural poultry population in Africa accounts for more than 60% of the total national poultry and over 20% of animal protein intake in most African countries come from rural poultry sector (Kitalyi, 1998). Apart from increasing household food security through provision of readily harvestable animal protein to rural households, rural poultry is also an important element in diversifying agricultural production.

Reports from a number of African countries show that the main function of village chickens from the farmer's perspective is the provision of meat and eggs for home consumption [Mali (Kuit, Traore and Wilson, 1986); Ghana (van Veluw, 1987); the United Republic of Tanzania (Kabatange and Katule, 1989); South Africa (Cairns and Lea, 1990); the Gambia (Andrews, 1990); the Niger (Abdou and Bell, 1992) and Côte d'Ivoire (Diambra, 1990)]. Apart from increased quantitative production of animal protein in rural households, chicken meat and eggs provide protein of a higher biological value than that of red meat (Norman, 1973). Chicken meat and eggs are reported to complement staple diets of rural Africa due to the higher nutrient concentration (Table 1) (FAO, 1997). Small poultry production units of 12 laying hens per unit have reported an increase in the consumption of animal protein and reduced incidence of malnutrition in resource-poor households of South Africa (MacGregor and Abrams, 1996).

A review by Chale and Carloni (1982) on the attributes of chicken meat and eggs in rural areas show that egg dishes and chicken meat cook faster than pulses and red meat, and therefore use less fuelwood. In the same review, citing poultry projects in Asia and Africa, the authors highlighted the importance of chickens as a diversification component in rural farming systems, particularly for women.

Income occurred from the sale of eggs in a women's project in the Sudan was used to purchase household consumable goods, thus increasing household welfare. Gittinger, Leslie and Hoisington (1987), in a survey on food production by women and its impact on food security, found that rural households that had cropping as their only source of food production were more food insecure than households that had livestock, including poultry. Similarly, Bembridge (1988), assessing the impact of a maize extension programme based on a survey of farmers' needs. indicated that diversification including poultry would be beneficial to women.

Table 1 The amount of nutrients provided by 100 g (edible portion) of poultry meat, eggs and other selected staple foods of Africa.

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

The advantages of household poultry in improving household food security and increasing household welfare have been reported in other regions. In India, Desai (1996) reported successful rural poultry projects involving women, which led to increased production and empowering of women through provision of training and credit. Similar projects have been reported in Thailand and Honduras (FAO, 1994; Bradley, 1996), as well as Bangladesh (Saleque and Mustafa, 1996). The importance of organization and capacity building in enhancing increased rural women's poultry production featured highly in the

projects in Asia and Latin America (FOA, 1987). The recent developments in the importance of poultry in household food security, especially for the poorer members of the community, including increased distribution of resources through involvement of women, have been appreciated globally (FOA, 1987).

The participation of women in rural poultry improvement programmes contributes to human development both by increasing access for rural women to income and knowledge and by increasing production efficiency (Aboul-Ella, 1992; Bradley, 1992; Scola, 1992). Bradley (1996) suggested that increased contribution of poultry production in national economies through the involvement of women will be attained primarily through explicit incorporation of gender issues in such programmes, thus involving rural women directly in rural development. Similarly, Kitalyalim (1996) suggested that transformation of the village chicken production systems of Africa into economically viable enterprises would require better understanding of the socio-economic aspects of the production system.

Village chicken production systems have not been included in the mainstream agricultural and economic activities of most African countries. There is a paucity of quantitative data to support the importance of the village chicken production systems in household and national economies. There has been more development focused on introducing exotic high-yielding breeds than understanding the production potential of village chickens. Nevertheless, a new research focus on village chickens has developed in the last decade and, consequently, there have been changes in objectives and development strategies. Village chicken production systems are integrated in the rural farming systems and therefore, sustainable improvement programs need to adopt a systems perspective. Achievements made in single-discipline-oriented programs are not sustainable, as noted in the past (Kitalyalim, 1998).

There are various advantages which make village chickens attractive in the context of poverty alleviation and quality protein supply than cattle, sheep, goats

and pigs: village chickens in one form or another are kept in most areas and there are hardly any religious or social taboos associated with them (Pedersen, 2002). They have high reproduction rate per unit time and are efficient in transforming feed protein and energy into human food; they use very low capital, labour and space, which allows chicken production to be practiced even by landless individuals (Muchadeyi *et al*., 2004). Village chickens are easily liquidated, and eggs and meat represent consumable units that do not require specialised storage and preservation facilities (Mapiye and Sibanda, 2005). Village chicken production plays a complementary role to other crop-livestock activities and therefore, can be the most dynamic sub-sector within the livestock poly-systems (Muchenje and Sibanda, 1997).

2.2. Poultry Production in South Africa

The poultry industry is one of the fastest growing livestock industries in South Africa. It provides food, fuel, fertilizer, income and employment to sustain rural economy, thus contributing to poverty alleviation in South Africa (Sonaiya, 2001 and FAO, 1997). They reported that rural areas in South Africa are characterized by high levels of poverty and in most cases, households do not have enough finance to support their families, coupled with the fact that their diets are characterized by low level of animal protein. This scenario is also prevalent in Limpopo province, particularly in the Vhembe district where more than half of the households live below the poverty line (Van Rooyen, 1996).

Most of South Africa's population lives in rural areas where the indigenous chicken is best adapted to the harsh living conditions. It is speculated that with minimal technical and institutional support, the indigenous chicken could contribute significantly to the rural economy and could curtail the vicious cycle of unemployment and poor human nutrition. However, the indigenous chicken's potential has not been exploited in South Africa as much as it has been done in other African countries (Swatson *et al*. 2002). Some research aimed at increasing the contribution of village chicken production towards rural livelihoods

has been carried in South Africa but the impact has not been significant. There is a general recognition that most agricultural research efforts have been unable to make significant improvements in the small-holder farming sector. This is particularly the case in developing countries. The research approach has largely failed to recognise the intricacies of production in small-holder farming systems and thus the outputs of these research approaches are rarely appropriate or relevant to the needs of these farming communities. The outputs have therefore not been adopted by the farmers, resulting in stagnation of agricultural productivity. It should be noted that even in cases where some outputs (such as new crop varieties) have been adopted, there has been no significant improvement in productivity. This stems from the fact that rural livelihoods are complex and developmental efforts cannot be put in place without consideration of other factors that influence or impact rural livelihoods. In a nutshell, most research efforts are not geared towards development but solutions to predetermined research problems and this has resulted in failure to improve rural livelihoods (Branckaert, 1997).

There is a need to understand the perceptions of the farmers on the functions of village chickens and the value of their products under the existing production systems in order to improve village chicken productivity and sustainability in rural areas. Detailed studies targeting comprehensive description of use patterns of village chicken and its products and understanding the associated socio-economic conditions, roles and functions of local chickens are required (Mapiye *et al*., 2008). Furthermore, in order to identify constraints and opportunities for technological interventions into smallholder village chicken production, gender analysis should be carried out (Mapiye *et al*., 2008). This will assist in preventing frequent misdirecting of technologies and services to the wrong gender group. Gender analysis is a tool for understanding men and women's roles and the responsibilities in various activities, their use of resources, access and control of resources and benefits, participation in decision-making and contribution to household income and food security (Kusina *et al*., 2001). The involvement in

different types of agricultural work for men and women in most African communities depends mostly on social, cultural, local customs and religious influence (Dassie and Ogle, 1996; Tadelle and Ogle, 2001). The role of women in farming and village chicken production until recently, largely unrecognised. In Zimbabwe for instance, more than 90% of households keep chickens, which almost entirely belong to women (95% of the households) (Kusina and Kusina, 1999; Maphosa et al., 2004). Women dominate most of the activities in village chicken production (feeding, watering, cleaning, selling of chickens and eggs) (Kusina et al., 2001; Mapiye and Sibanda, 2005). The women look after the birds and earnings from the sales of eggs and chickens are often their main source of income (Muchadeyi et al., 2004). In addition to shelter construction, men are also dominating in the treatment and slaughtering of chickens. Women, even in those households headed by men, are responsible for most of the decision-making on chicken production (Kusina et al., 2001).

The Government of South Africa recognises the role livestock such as poultry may play in reducing poverty levels of the rural poor. Therefore, many livestock poverty alleviation projects and schemes have been established in most parts of the country. Sadly, most of these projects have failed to achieve their intended objectives largely because those implementing the schemes fails to take into consideration many of the issues mentioned above (Tshovhote, 2003).

2.3. Constraints to village chicken production.

Apart from the lack of insight into small-scale livestock production, there are several other constraints to village chicken production that largely relate to production management.

2.3.1. Management factors

Effective and efficient management techniques are necessary to increase the productivity of the birds and consequently increase income. This entails proper feeding, good treatment and vaccination of the birds. For instance, irregular feed

supply due to lack of resources to buy the feed or due to absence of people to feed the birds can contribute to poor productivity since about 65 % of the weight of the egg in water (Moreki *et al.,* 1997; Badubi and Ravindra, 2004). Similarly, lack of water for the hens for a long period of time may lead to a drop in egg laying since water is the largest constituency of the body and, in general, represents about 70 % of total body weight (NRC, 1994; Faroog *et al*., 2000). Ojo (2003) suggested that the reason for low productivity in rural household poultry farming could be attributed to poor technical efficiency and lack of health and extension services. Ojo (2003), in a study of productivity and technical efficiency of poultry egg production in Nigeria, found that households headed by uneducated and aged people were associated with low productivity. Therefore, educational standard and age of the poultry keeper are important when considering management factors. For instance, in some instances, feeding of the birds is done by aged uneducated female household heads. This sometimes results in irregular feeding of the birds, and as indicated by Moreki *et al.* (1997), Badubi and Ravindran (2004) and irregular feed supply due to absence of people to feed the birds contributes to low productivity. Management strategies in keeping chickens vary according to cultural systems of land use, labor division, sex and age group (Tadelle and Ogle, 2001). Factors such as age, sex and socio-economic group should therefore be considered since different categories of men and women have different interests, resources and possibilities regarding village chicken production. In general, all aspects of village chicken enterprise development from problem identification to implementation and dissemination have social implications. Therefore, development has to be focused on specific needs and interests of a specific group; man, woman, boy, girl and same social-cultural groups in order to improve both equity and efficiency.

2.3.2. Production constraints

Village chicken flock productivity is mainly determined by egg production, hatchability, chick survivability and growth rates (Tadelle and Ogle, 2001; Pedersen, 2002). Compared to performance reported on-station, village chicken

productivity in the smallholder system is inefficient, characterized by high reproductive wastage and low productive performance (Tadelle and Ogle, 2001; Pedersen, 2002). The reproductive performance is generally low; hens lay 30-80 small eggs/hen/year under smallholder conditions compared to commercial strains that produce up to 300 eggs. The number of eggs incubated per clutch varies from 8-14 and the average clutch size range from 2-3 clutches/hen/year (Kusina and Kusina, 1999; Pedersen, 2002). Smith (1990) estimated that under scavenging conditions the reproductive cycle consists of a 10-day laying phase, a 21 day incubation phase and finally a 56 day brooding period. Pedersen (2002) reported that at any given time only 40-50% of the hens were productive (laying, incubating or brooding). Village chickens reach point of lay at 26-30 weeks (Pedersen, 2002). This is fairly late compared to layer breeds that normally reach point of lay at 18-22 weeks old. The local average egg weight is 52 g (with a range of 35-60 g) (Muchenje and Sibanda, 1997; Mapiye and Sibanda, 2005), thus very low compared to commercial strains that have an average egg weight of 60-70 g. Hatchability and survivability levels vary from 20-70% (Pedersen, 2002; Muchadeyi *et al.*, 2005). Chick mortality represents a major loss in the studied village chicken production systems (Pedersen, 2002; Muchadeyi *et al*., 2004). Reports from other countries in Africa show that 50 - 70% of chicks die between hatching and the end of brooding (Kitalyi, 1998; Tadelle and Ogle, 2001). Various studies recorded hatching weight values that range from 30 to 40 g (Maphosa *et al*., 2004; Muchadeyi *et al*., 2004).

Village chickens grow very slowly compared to exotic breeds (Pedersen, 2002). Results obtained on-farm showed that males on average had higher body weights (2.4 kg) than females (1.5 kg) (Maphosa *et al*., 2004) whilst on-station they had 2.714 kg and 1.756 kg, respectively (Pedersen, 2002). These results indicate that village chickens have a higher potential for growth than what was found on-farm. Maphosa *et al*. (2004) reported mean growth rates of 3.69 g/d and 4.44 g/d to eight weeks for females and males, respectively. Pedersen (2002) obtained daily growth rates of 6.8 g and 7.4 until week 20 for males and

females, respectively. The variation in growth rates might be due to differences in time of surveys, ages, genotypes and type of management practised by farmers. These results indicate that growth rates and mature weights are low, showing that village chickens are lightweight type of chickens and this might be an adaptation to local environment of poor feed resources and high ambient temperatures. Research is required to determine village chickens' point of inflexion on the growth curve.

Mortality is observed to be the major limitation to village chicken production (Kusina *et al*., 2001; Pedersen, 2002; Maphosa *et al*., 2004). Mortality claims more exits than other exits such as sales, consumption, gifts, exchanges or entrusted chickens (Muchadeyi *et al*., 2005). Village chicken mortality often exceeds 50% (Kusina *et al*., 2001; Pedersen, 2002) in communal areas and less than 20% on-station in Zimbabwe (Pedersen, 2002). Most chickens die during the hot-wet and hot-dry seasons (Maphosa *et al*., 2004; Muchadeyi *et al*., 2005). Mortality is due to a number of interacting factors such as diseases, parasites, predation, accidents and bad weather among many others (Kusina *et al*., 2001; Muchadeyi *et al*., 2005). There is no accurate measurement of the contribution of each of these factors to mortality.

Predation and diseases were recorded as the major causes of mortality in many communal areas (Kusina *et al*., 2001; Pedersen, 2002). Most common predators are dogs, cats, snakes, eagles, hawks and thieves. Predation can be reduced by close monitoring of village chickens during scavenging periods and keeping them in proper houses during the night. Hunting, trapping or poisoning of predators can also lessen predation levels. Chicks are the most vulnerable; with mortalities of up to 60 % (Pedersen, 2002; Muchadeyi *et al*., 2005).

2.3.3. Rearing Systems

There are basically two major systems of rearing layer chickens, namely, battery cage and deep litter systems. Studies on cage rearing of layer chickens found

that factors like cage depth, width and feeder space affect the productive performance of layers (Carey *et al*., 1995). Furthermore, there is evidence to show that cage rearing causes stress among the birds (Carey *et al*., 1995). However, Tolon and Yalcin (1997) observed that there are also some beneficial aspects associated with raising layer chickens in cages. These include elimination of litter, reduction in the use of medication, improvement feed conversion ratios, reduction in housing cost by increasing bird's density, control of disease problems, reduced labour, decreased incidence of bruising and reduction in the incidence of egg licking. Therefore, cage rearing of layer chickens requiring less management inputs can be an available option to poor rural households when considering the cost reduction. In contrast, the deep litter system is traditionally used for brooding and rearing chicks and broiler chickens. However, apart from the need for brooding, the deep litter can also be used for rearing layer chickens. Deep litter rearing helps to reduce stress in layer chickens (Tolon and Yalcin, 1997). However, it is important to note that the type of rearing system used appears to be unimportant, although the rearing system that will enhance maximum productivity at least cost is most desirable as reported by Tolon and Yalcin (1997).

2.3.4. Nutrition

Laying chickens require a completely balanced diet to sustain maximum egg production over time. Inadequate nutrition can cause hens to stop laying. Inadequate levels of energy, protein or calcium can cause a drop in egg production. It is important to provide laying hens with a constant supply of nutritionally balanced layer food. Poor supply of feeds is a major constraint to increased productivity in small-scale poultry production. Feeding whole grains, scratch feeds and table's scraps will cause the birds' diet to become imbalanced and inadequate. Imbalances can cause other problems like oviduct prolapses (Moreki *et al.,* 1997). Badubi and Ravindran (2004) in their survey of small scale layer production systems in Botswana found that poor quality feeds from

manufacturers or those formulated at home were responsible for low productivity. Similar results are reported by Rajendran and Mohanty (2003) in their study on egg production in India. These authors also concluded that the high costs of feeds led to low productivity, since farmers would tend to restrict their birds to avoid high production costs. When pullets begin laying, there is an increase in protein, vitamin and mineral requirements per day due to deposition in the egg. If dietary protein is too low or the amino acid requirements are not met, poor egg production and hatchability will occur. The nutritive demand for egg production in modern strains of chickens is tremendous. The eggs as produced by a pullet during the laying year weigh eight times as much as she weighs and she will increase her body size by 25% (Moreki *et al.,* 1997). To do this, she will have to eat nearly 20 times her body weight. Thus, the fact that hens do not lay at a constant rate throughout their egg production period also influences their dietary requirements. For instance, during low production phase of the laying cycle, as at the end of laying period, the nutritional requirements will be different from the requirements at the peak of egg production (NRC, 1994).

2.3.5. Diseases and parasites of laying chickens

Diseases can cause losses in egg production due to high mortality and reduced production thus affecting the net profit negatively. Increased mortality results in decreased net profit. Poultry suffer losses from important diseases recognized in virtually every country (Moreki *et al.,* 1997). Infection on its own leads to a decrease in the number of eggs laid or a stop in laying resulting in huge losses of revenue and food of households. Rajendran and Mohanty (2003) in their study on constraints to egg production under cage verses deep litter systems in India found that lack of disease control facilities leads to increased mortality rate. Major diseases which affect laying chickens include Newcastle disease, prolapse of the uterus, enteritis, marek`s disease, infectious bursal disease and infectious bronchitis. Some of the ectoparasites and endoparasites that cause reduces egg production and are lice and mites, and roundworms and tapeworms (Permin and Hansen, 1998).

Mareks disease

Mareks is one of the important diseases of the chicken. It is characterized by leg paralysis and lymphocyte infilteration of brachial and sciatic nerves (Nicholls, 1984), potentially causing 4.2-20.8% mortality in layers (Taylor *et al*., 1999). The disease could be more prevalent in layers lacking immunization and additionally, further risk exists with calcium deficiencies during the laying phase. Chickens are vaccinated against Mareks at the hatchery before they are transported to the farms. Losses due to this disease therefore are avoided through effective vaccination and elimination of calcium deficiency in the egg laying period. Calcium is vital for the eggshell formation and its insufficiency will not only result in poor-shelled eggs, but also could work as a predisposing factor for Mareks disease (Taylor *et al.,* 2000). In addition, the rearing of mixed age flocks increases the risk of Mareks disease (Heier and Jarp (2000). Nicholls (1984); Taylor *et al*. (1999); Taylor *et al.* (2000); Heier and Jarp (2000) also reported a higher risk of Mareks in laying birds reared on the floor than those maintained in cages, probably due to the condition of a soiled environment.

Infectious bursal disease (IBD)

Infectious Bursal Disease (IBD) also known as Gumboro has been reported to cause heavy losses in chickens. Sah *et al*. (1995) and Chowdhury *et al.* (1996) reported 10-75 % and 80-100 % loses respectively in chickens. The disease is characterized by lameness and severe morbidity and mortality in chickens. It is considered as Acquired Immune Deficiency Syndrome of the chicken, because it adversely affects the chicken's immune system. Amin *et al*., 1995 and Singh *et al*., 1994 reported that the Bursa Fabricus, one of the organs responsible for antibody production in the chicken was invaded by IBD virus and destroyed completely which in turn, resulted in higher losses in egg type layers. The higher incidence of IBD in egg type layers could probably be due to poor vaccination

and susceptibility of chickens to IBD (Anjum *et al.,* 1993; Farooq *et al*., 2000), filthy environment and predisposing factors like concurrent infections with E. coli, coccidiosis and other bacterial infections (Singh *et al.,* 1994). Anjum *et al.* (1993) and Kouwenhoven *et al*. (1994) reported that vaccination against IBD at the age of 14-21 days partially controlled the problem, but the atrophy of bursa could not be protected even if there was a mild infection of IBD (Sultan and El-Sawy, 1997). Therefore, care must be taken to administer vaccines at stipulated times and overcome predisposing factors working as conducive media for outbreak of IBD. Prevention of concurrent infections like *Escherichia coli* and *coccidiosis* and maintenance of standard hygiene will be helpful in reducing losses due to IBD in the chicken.

Newcastle disease (ND)

Newcastle disease is one of the destructive diseases of chickens; it is characterized by severe mortality, greenish diarrhea and thirst. The birds tend to drink more water and decrease their consumption of feed. Savic, (1999) reported that Newcastle disease caused 60% losses in egg type layers. However, lower losses of 12.58% had also been reported earlier by Srithar *et al.* (1997). The comparatively lower losses reported by some authors than others could probably be attributed to the implementation of effective measures for the prevention of diseases, such as vaccination against ND and maintenance of improved hygienic conditions. The higher losses due to ND could probably be due to the infectious nature of ND and its rapid spread from flock to flock within a shorter period of time. Thus, assurance of appropriate hygiene and effective and timely vaccination will be helpful in reducing losses.

Infectious coryza

Infectious coryza is also an important bacterial disease of chickens characterized by respiratory complications, swollen head syndrome, nasal discharge and

severe drop in egg production. The most common causal agent is *Haemophilus gallinarum*. Poor hygiene, chilly environment and adverse climate exposure are predisposing factors for the onset of this disease. Chickens of all type and age are susceptible to this infection and the disease causes 2-5 % mortality and 35 % drop in egg production (Sandoval *et al*., 1999; Reece *et al*., 1986). El-Houadfi and Vanmarcke (1991) also reported adverse effects of coryza on egg production. As the disease spread slowly, it could cause almost 100% morbidity (Bains, 1979). Protection of birds from extreme climatic conditions, maintenance of good hygiene and antibiotic therapy as well as administration of vitamin C or ascorbic acid could be helpful in preventing losses due to coryza.

Infectious bronchitis (IB)

Infectious bronchitis is a highly infectious viral disease characterized by respiratory symptoms, increased mortality and decreased egg production (Butcher *et al*., 1990). The disease could occur at any stage of the chicken's life and during any season of the year. However, it is more prevalent (35.7 %) from seven days to five weeks of age. Incidence of the disease is higher (66.6 %) in the winter season (Javed *et al*., 1991). The higher incidence in young chickens is attributable to poor immunity development during the first few weeks of life. Similarly, winter conditions also favor the incidence of IB because of stressful conditions and chilly environment. Thus, protection of birds from extremely cold conditions and the maintenance of a healthy environment would further reduce the incidence of this disease.

Avian influenza

Avian influenza is an important poultry disease that has emerged with higher mortality in the recent decades. This disease causes 90% morbidity and 80% mortality in 30-week old chickens (Morgan and Kelly (1990). Pathogenisity of avian influenza is more in egg laying birds than in broilers (Swayne *et al.,* 1994).

The higher incidence of avian influenza in layers could probably be due to the incidence of avian influenza at later stages of life as layers are retained in a flock for a longer duration than broilers.

Mycoplasmosis

Mycoplasmosis is a series of bacterial infections caused by bacterium mycoplasm of various types in egg type layers. Mycoplasmosis results in severe economic losses in egg type layers in terms of reduced egg production and higher mortality. Eggs with pimpled shells are also associated with Mycoplasma infections (Branton *et al*., 1995). Flocks infected with *Mycoplasma gallisepticum* (MG) and Mycoplasma synoviae (MS) produce fewer eggs (Mohammad *et al.,* 1987). The authors reported a loss of 127 million eggs and $7 million due to MG only. North (1984) reported 20-30% drop in egg production due to MS. These losses are very high and would narrow the margins between cost of production and net profit from commercial egg laying birds. Efforts should always be made to reduce losses thereby increasing egg production. This could however, be possible through better health management and the application of improved husbandry skills. For effective control of MG, a vaccine has now been prepared and is administered in drinking water when the layers are 12 weeks old. However, the disease is mostly transmitted through eggs from the infected or carrier birds to the newborn chickens. Thus, it is imperative for the breeders to have a regular blood test program and eliminate infected or carrier birds from the flocks.

Salmonellosis

Salmonellae, some of the bacterial species, are abundantly found in most of areas where chances of contamination are greater; primarily poultry sheds and feed reservoirs. Salmonella has also been isolated from drinking and feeding tanks. These organisms usually contaminate feed and drinking water thereby,

resulting in poor economic gains and higher mortality. Salmonellae cause pullorum, typhoid, paratyphoid and other related infections in chicken resulting in 50% losses (North, 1984). Salmonellae are vertically transmitted to the new born chicks, therefore regular blood testing of the parent flock and elimination of infected and carrier birds would be helpful in reducing its vertical transmission. In addition, preventing entry of rodents, vermin or other wild animals and the assurance of improved hygienic conditions would be helpful in reducing the incidence of salmonellosis.

Coccidiosis

Coccidiosis, a protozoan disease, is one of the major problems of the chicken industry. It is characterized by blood tinged feces, ruffled feathers, loss of appetite, poor growth and reduced egg production. The most prevalent causative agents of coccidiosis among the coccidia species are sporolated oocysts of the genus *emeria* that primarily invade the small intestine and caecal pouches, leading to enteritis and thickening of the intestinal walls (Hofstad *et al.,* 1978). Oocysts are usually passed through feces by infected chickens and undergo the process of sporolation when conditions are favorable. Unclean environment, wet bedding material and house temperature in the range of 20-28 ˚C favor sporolation of oocysts (Hofstad *et al.,* 1978). Coccidia are the most resistant type of protozoa, remaining viable for several months in poultry sheds (Stayer *et al*., 1995).

Coccidiosis can occur at any stage of the chicken's life and during any season of the year. However, it is more prevalent in the summer season (Boado *et al*., 1991), probably when higher summer temperatures and wet bedding favor rapid sporolation of oocysts. Bushell *et al.* (1989) reported affective use of live attenuated coccidiosis vaccine in controlling the problem. Assurance of a healthy environment and the elimination of moisture and increased heat conditions within the house are reported to reduce chances of a coccidiosis outbreak (Stayer *et*

al., 1995). Addition of coccidiostats to the ration has been one of the best options for the control of coccidiosis; however, egg laying birds are given coccidiostate-free ration during the egg laying period and an outbreak of coccidiosis at that stage will not only result in massive death casualties, but it could lower egg production. The pullet should therefore, have complete immunity against coccidiosis before initiation of egg lay (North, 1984). Thus, management would be a key to avoid sporolation of oocysts when the layers are to be reared on the floor. With the introduction of cage systems, the coccidiosis problem has now been solved to a greater extent. However, elimination of coccidiosis before the shifting of birds to cages should be ensured.

Yolk sac infection

Yolk sac infection is one of the most common bacterial infections of chicken observed during the first few weeks of a chicken's life. Drowsiness, minimal mobility, vent pasting and the lack of interest in feeding in the chicken characterize yolk sac infection. There may be several predisposing factors such as poor hygiene and stressful conditions leading to this anomaly because it is a general bacterial infection. Isolates of *Staphylococci* and *Escherichia coli* are found to be the most common causes of yolk sac infection (Bains, 1979). Yolk (a reservoir of food for the embryo and chicken in the first few days after hatching as well) can easily become infected with the presence of any bacterium. The intact bacteria enter the inner content of the egg during the incubation process and cause infection of the navel area of chicken. Conversely, if the yolk is not effectively utilized after hatching, it could be easily infected and easily become rancid. The yolk usually becomes infected prior to hatching and during the first 48 hours after hatching. Yolk sac infection was found to cause 31.45% mortality in the early few days of a chicken's life (Ghodasara *et al.,* 1992). North (1984) and Reece *et al.* (1986) however, reported smaller losses due to yolk sac infection in chicken than those reported by Ghodasara *et al.* (1992). As the infection is mostly transmitted through dirty shell eggs, frequent collection of eggs and

keeping the conditions more favorable to obtain clean eggs will be helpful in the reduction of yolk sac infection. In addition, better management of the chicks during brooding; avoiding overcrowding and other stressful conditions will further reduce the incidence of yolk sac infection.

Escherichia coli (E. coli)

E. coli is one of the major problems in chicken production contributing to heavier losses and severe drop in egg production. About 5.5% mortality and 10-20% drop in eggs was observed by Qu *et al*., (1997) with E. coli infections in egg type layers reared in cages. Zanella et al. (2000) also reported 5-10% mortality due to E. coli infections with no pronounced signs, suggesting that the infection may be there but couldn't be easily detected until regular tests are performed for its proper diagnosis. The situation leading to mortality with no pronounced clinical signs will be more critical as it would result in heavier losses of reduced egg production prior to the investigations. *Escherichia coli* will not only cause in reduced egg production and mortality, but also be a predisposing factor for other complications like IBD as has been stated by Singh *et al*. (1994). Thus, it is important to control E. coli infections in chickens, thereby preventing losses due to this disease and other associated infections.

Egg prolapse

Egg prolapses has become one of the major issues in egg type layers during the past few years. Egg prolapses could cause higher mortality and in turn, would result in huge economic losses (Tablante *et al.,* 1994). These authors reported 9.4% egg prolapse in egg type layers.

Cannibalism

Abrahamsson and Tauson (1998) reported cannibalism as the picking habit of chicken, causing 4-20% mortality. North (1984) reported deficiency of fiber in feed and management faults as the major factors contributing to higher incidence of cannibalism. Damme (1999) reported that cannibalism could be effectively controlled through appropriate beak trimming. The author reported a smaller incidence of cannibalism (0.3 %) in beak-trimmed birds than non-trimmed (7.5 %).

Aflatoxicosis

Presently, aflatoxicosis is one of the major issues in chicken production. The common cause of aflatoxicosis is contaminated feed. It results in higher mortality and severe drop in egg production. Prathapkumar *et al*. (1997) reported 10 % mortality and 20 % drop in egg production due to aflatoxin B1 in the diet. The drop in egg production can be as higher as at about 26-55 % with increased level of aflatoxin B1 (Prathapkumar *et al*., 1997)). To avoid such losses it is important to regularly monitor feed quality. In case of aflatoxicosis, change of feed will be a better option.

2.3.6. Seasonal Variations and Lighting Strain

Production of eggs is affected by seasonal variations and lighting strain. It is important to keep layers in a proper house which is capable of providing an optimum laying environment. The house must further be capable of protecting the birds from climatic variations encountered during normal day to day changes in temperature since egg production falters when the chickens are subjected to temperatures above or below the thermal neutral zone. Laying chickens will be able to lay optimally in temperatures between 21 and 26 °C. Increased ambient temperatures will decrease and will affect egg quality and production. Layers will lay fewer and the quality of the shell will be poor. Proper ventilation is therefore important for the maintenance of optimal temperature in summer (North, 1984).

Cold weather also affects egg production. When the outside temperature become very low, it may become impossible for the bird to generate enough heat to maintain its body temperature. Feed intake increases as the birds try to keep the body warm. This becomes a problem where restricted feeding system is used since birds will firstly have to meet their body requirements before using feed for production. A housing type which can conserve heat in winter is recommended to reduce drop in egg production (North, 1984).

Lighting on the other hand plays an important role in egg production because egg production is stimulated by day length. Therefore, as the days grow longer production increases. In open houses found commonly in the tropics, artificial lighting may be used to increase the laying period. When darkness falls artificial lighting can be introduced for some hours, which may increase egg production by 20 to 30 percent. In closed houses, where layers are not exposed to natural light, the length of the artificial day should be increased either in one step or in a number of steps until the artificial day reaches 16 to 17 hours, which will ensure constantly maximized egg production. Effective day length should never decrease during the laying period. At the start of production, few eggs will be laid and there will be an increase thereafter. In the meantime layers will still be growing and this result in increased feed intake. If additional light is given at the onset of egg production, but feed allotment is increased in the absence of additional light, the pullet will gain weight too rapidly because fewer eggs are being produced, and consequently production will be negatively affected (North, 1984).

2.4 Nutritional Requirements for Egg Production

2.4.1 Energy requirements for egg production

The daily energy requirements of the laying bird are highly variable. Reasons for this, are variability in body weight of the pullet, environmental temperature

changes, amount of bird activity, differences in egg production, prevalence of stress, age of bird and amount of feather cover (North, 1984). Several authors have constructed different equations for the exact determination of daily energy requirements for laying birds (Leeson, 1996;Carey *et al.,* 1995; Hurwitz *et al*., 1978). However, in analyzing the structure of these equations, it appears that all the equations seem not to be absolutely complete as they exclude one or two of the factors affecting energy requirements in laying birds (Hurwitz *et al*., 1978). Thus, the only compensating fact in overcoming the above variation is that each bird is able to govern her feed intake according to her energy needs although the efficiency of this governing mechanism remains to be determined (North, 1984).

2.4.2 Protein requirements for egg production

Empirical determination of protein requirements of laying hens have shown highly variable results due to differences in live weight, egg weight, laying rate and food consumption which are caused by breed differences, age, feed, etc (Hurwitz*et al*., 1978). Several authors have worked out methods for predicting protein requirements (Leeson, 1996; Carey *et al.,* 1995; Hurwitz*et al*., 1978). While investigating the factors affecting protein requirements of layers, Carey *et al.* (1995) found that management and environmental factors apparently have no effect on protein use and that requirements are proportnal to output. However, it is interesting to note that efficiency of protein use increases with energy intake and decreases with increasing age in the first laying year. For instance, just prior to peak egg production the requirement may be as high as 17 to 19% while at the end of the production cycle it may drop to as low as 14%. However, under these conditions, requirements are not only in proportion to output. Protein requirements per hen/day therefore decline, with age and also depend on egg output. This phenomenon is in agreement with the concept that, at different phases of productivity, nutritive needs of the laying hens are different (Hurwitz*et al.,* 1978).

2.4.3 Amino acid requirements for egg production

Amino acid requirements vary considerably according to the physiological state of the bird, that is, the rate of growth or egg production. Other factors contributing to variations in amino acid requirements of the laying birds include age, body size, and breed. Amino acid requirements decrease with age. the ideal balance of amino acids changes gradually to reflect those of maintenance (Zubair and Leeson, 1996). For instance, the percentage of amino acid required in the diet is highest for young pullets and declines gradually to maturity when only enough amino acid to maintain body tissue is required (Pond *et al*., 1995). The balance of amino acids needed for maintenance is not proportional to the balance of amino acids in a bird's tissues, but rather reflects the relative rate of obligatory loss of each individual amino acid (Gous and Morris, 1985). For this reason, the balance needed for maintenance is considerably different from that needed for growth and egg production (Nemavhola, 2001). Dietary amino acid levels slightly below maintenance can sustain life, but muscle mass and functions are impaired (Leeson, 1996). Matching the amino acid profile of the diet with animal requirements is crucial for maximizing animal performance. For instance, young pullets have high amino acid requirements to meet the needs for onset of egg production. Because the contributions of maintenance and growth to total amino acid requirement change with body size, and the ideal amino acid profiles for maintenance and growth are different, the composition of the ideal amino acid pattern will change continuously during the growth period (Mack *et al*., 1999).Several authors have established the requirements of laying hens for amino acids using linear regression analysis of empirical data or by deriving partition equations which assume linear relationships between inputs and outputs (Hurwitz *et al.,*1978). Thus, stating dietary requirements for amino acids for the laying birds is an appropriate way to ensure that all amino acids needed physiologically are provided.

The laying bird's amino acid requirements are given in Table 2.

Table 2 Amino acid requirements of layers (NRC, (1994))

Amino Acid	Amount in the Diet (%)
Arginine	0.8
Lysine	0.5
Methionine	0.53 or 0.28
Cystine	0.2
Tryptophan	0.11

CHAPTER 3
MATERIALS AND METHODS

3.1 Study Area

This study was conducted in four municipalities (Musina, Mutale, Thulamela and Makhado) of the Vhembe district of the Limpopo Province. Vhembe is one of the six districts of Limpopo province of South Africa. The Vhembe District is located at the Northwestern tip of South Africa in the Limpopo Province. It is bordered by Zimbabwe to the North and Botswana to the North east. The Limpopo river valley forms the border between the District and its International neighbors. Through the Kruger National Park the Vhembe District also Boarders Mozambique on its Eastern border. Within South Africa the Kruger National Park to the east, the Mopani District to the Southeast, and the Capricorn District to the Southwest boarder the Vhembe District.

Figure 1: Map showing The Municipalities of the Vhembe District.
Source: Municipal Demarcation Board (2006)

3.2 Data sampling and collection

Data was collected from 2005 to 2007. Eight farmers from each of the four municipalities were randomly selected, hence a total of 32 households were sampled. Each household received a once-off unit consisting of a cage with eighteen point of lay chickens, four 50kg bags of layer mash, and feeding and drinking troughs. Production records from the sampled farmers were used in the

analyses. The data included monthly egg production, eggs consumed, eggs sold, income from the sale of eggs, production costs, monthly feed utilization and mortality. Primary data on educational standards, socio-economic characteristics (age and gender of the household head, family size, level of education, and alternative income) were collected using a questionnaire.

All beneficiaries used the standard chicken diets. The composition of chicken diets is shown in Table 3.

Table 3 Diet composition of laying mash fed to chickens

Feed	Level (%)
Maize	45.69
Wheat	15
Lucern meal	5.8
Soyabean meal	16.84
Fish meal (2-8% fat)	5
Maize gluten meal	1.47
Full fat	3.19
Soya oil	4
Di sodium phosphate	0.11
Calcium carbonate	0.86
Salt	0.18
Di calcium phosphate	1.47
DL-Methionine	0.20
L-Lysine	0.20
Calculated Nutrients	
Crude protein	15%
Metabolisable energy	14.06 MJ/Kg DM
Vitamin E	13.33 mg/kg DM

3.3 Data editing

In preparation for analysis data were edited as follows:

1. Creation of environmental class variables

Housing was evaluated using classes 1 and 2 (1=proper housing and 2= Adopted housing). diseases were evaluated using classes 1 and 2 (1=no diseases 2= diseases prevalence).

2. Creation of socio-economic class variables

Gender of household head was evaluated using classes 1 and 2 (1=male 2=female). Family size was evaluated using two classes (1= 1-5 members and 2= 6 members and above). Age was evaluated using 4 classes (1=30-40 years, 2= 41 -50 years, 3= 51 – 60 and 4 = 61 and above). Education level was classified into 3 (1= no formal education, 2=up to grade 7 and 3 = grade 8-12). Alternative household income was evaluated using seven classes (1= R1-R2000, 2= R2001 – R4000, 3= R4001 – R5000 and 4= R5001 and above).

3.4 Statistical Analysis

Proc means of Statistical Analysis System (SAS, 2008) was used to estimate average monthly production, average estimated gross margin and average mortality in municipalities within the district. Proc GLM of SAS was used to determine socio-economic and environmental factors that affect monthly production, laying percentage, mortality and estimated gross margin. Chi-Square test of association (Proc Freq) of SAS was used to find the correlation between socio-economic factors and production.

3.5 Economic analysis

Gross Margin analysis

Gross margin is the difference between the sales and the production costs excluding overhead payments. Gross margin can be defined as the amount of contribution to the business enterprise, after paying for direct-variable unit costs required to cover overheads (fixed cost) and provide a buffer for unknown items. It expresses the relationship between gross profit and sales revenue. i.e. the Gross Margin for an item is the sales revenue obtained from the item sold, minus the direct costs of producing the item and selling the item. The direct costs are the variable costs that go up or down based upon the number of units sold.

Model specification

(GM) Gross margin equation is given by:

GM=TR-TVC

Where

GM=Gross margin

TR=total revenue

TVC=Total variable cost

The Profitability ratios are:

Benefit cost ratio BCR=TR/TC

Expense structure ratio ESR=FC/VC

Rate of return ratio ROR=NR/TC

Gross ratio GR=TC/TR

Where TC = total cost

FC = Fixed Cost

NR=Net Ratio

VC=Variable Cost

CHAPTER 4
RESULTS

4.1 Influence of management factors on production

Egg production and chicken mortality are influenced by local municipality and are shown in Table 4. The least production was observed in Mutale while the highest production was realized in Thulamela and Makhado localities.

Table 4 Egg production and chicken mortality per municipality

Municipality	Egg Production	Mortality
Makhado	468[a] (30)	0.83[a] (0.4)
Thulamela	464[a] (35)	0.69[a] (0.3)
Musina	407[b] (40)	0.36[b] (0.3)
Mutale	367[c] (33)	0.17[b](0.3)

a, b, c : Means with different superscripts within a row are significantly different (P<0.05)

Egg production and mortality as affected by month is shown on Table 5. Low production was observed during the months of April, May, June, November and December. Mortality was high during the months of November and December, followed by August and September whilst the other months had the least mortality rates.

Table 5 Effect of month on egg production and chicken mortality

Month	Egg Production	Bird Mortality
January	464[a]	0.13[c]
February	459[a]	0.16[c]
March	450[a]	0.13[c]
April	395[b]	0.25[c]
May	377[b]	0.28[c]
June	384[b]	0.16[c]
July	457[a]	0.28[c]
August	462[a]	0.47[bc]
September	459[a]	0.61[bc]
October	430[ab]	1.00[ab]
November	394[b]	1.25[a]
December	390[b]	1.44[a]
SE	35	0.25

a, b, c : Means with different superscripts within a row are significantly different (P<0.05)

Type of housing significantly influenced egg production; with higher means for egg production observed under improved housing conditions (Table 6).

Table 6 Effect of housing on egg production

Housing Type	Egg Production
Improved	430[a] (25)
Traditional	399[b] (23)

a, b : Means with different superscripts within a row are significantly different (P<0.05)

4.2 Project Challenges

The farmers indicated a number of challenges (Table 7) and these included high feed price, low egg selling price, poor management expertise, climatic conditions etc.

Table 7 Major challenges faced by farmers

Makhado	Thulamela	Musina	Mutale
High feed price	High feed price	High feed price	High feed price
Low egg selling price	Low egg selling price	Low egg selling price	Poor disease knowledge
Poor disease knowledge	Poor disease knowledge	Poor disease knowledge	Lack of training
Poor management expertise	Poor management expertise	Lack of management skills	No support from extension officers
Poor chicken housing	Poor chicken housing	Poor chicken housing	Poor chicken housing
High transport costs	High transport costs	High transport costs	High transport costs
	Poor marketing strategies	Extreme hot conditions	Extreme hot conditions

4.3 Major Diseases and Control Measures

The main diseases reported (Table 8) were Newcastle, Coccidiosis and Gumboro. It should be mentioned that most farmers indicated that they were not knowledgeable about diseases and therefore could not accurately determine the diseases which caused chicken deaths. Diarrhea and cannibalism were reported by some beneficiaries but they could not determine what caused these conditions. Farmers in Musina pointed out that the high temperature in their locality contributed to increased mortality.

Table 8 Major diseases reported

Makhado	Thulamela	Musina	Mutale
Newcastle	Gumboro	Coccidiosis	Coccidiosis
Coccidiosis	Newcastle	Gumboro	Gumboro
		Newcastle	

A large percentage of farmers used conventional medicine to control diseases Table 9). None of the farmers used traditional medication for disease control.

Table 9 Disease Control

Disease Control	Makhado	Thulamela	Musina	Mutale
Conventional medicinal use	62.5%	75%	75%	87.5%
No medicinal use	37.5%	25%	25%	12.5%
Traditional medicinal use	0%	0%	0%	0%

4.4 Egg Marketing

All farmers across the different localities sold their produce in their local communities (Table 10).

Table 10: Marketing Channels

Market	Makhado	Thulamela	Musina	Mutale
Local Community	100%	100%	100%	100%
Hospital	-	-	-	-
Schools	-	-	-	-
Nearest Town	-	-	-	-

4.5 Project Success Indicators

Some farmers pointed out increased income and ability to adequately provide food for their families as indicators of what they would regard as a successful poultry project (Table 11).

Table 11 Indicators of Success

Success Indicators
Increased Income
Provision of food for families

4.6 Factors that Influence Sustainability of Project

The farmers indicated a number of issues that they believed would sustain and improve the viability of the project (Table 12).

Table 12 Sustainability Factors

Sustainability Factors
Increased provision of layers
Improved chicken housing
Formation of a cooperative
Training in poultry management

4.7 Influence of Socio-Economic Factors on Production

The association between socio-economic variables and egg production is shown in Table 13. Gender, age and education level of the farmers influenced egg production while amount of additional income had no effect on the production level. Females were more successful in terms of production than males. Farmers aged 51 and above achieved lower production. Farmers with Grade 7 and above attained higher production with the least production observed in farmers with no formal education.

Table 13 Correlation between socio-economic variables and egg production

Socio-economic variable	(Chi-Square, X^2)	P-value
Sex	244.11	<0.0001
Male		
Female		
Age	517.01	< 0.0001
30 – 40		
41 – 50		
51 – 60		
Education Level	317.22	0.01
No formal education		
Up to Grade 7		
Grade 8 to Grade 12		
Alternative Income	209.77	0.09
R1 – R2000		
R2001 – R4000		
R4001 – R 5000		
R5000 and above		

4.8 Economic Analysis

Table 14 indicates the projects' performance in terms of revenue and the cost. The total cost of production incurred were categorized into fixed and variable cost. Highest revenue was obtained in Macao locality with the least revenue obtained in Mutale.

Table 14 Revenue and production cost of the Vhembe Egg production Project (Rand)

	Makhado	Thulamela	Musina	Mutale	Average
Sales/Revenue	298.00	250.00	245.88	215.32	252.30
Production cost	194.60	168.04	175.51	163.44	175.39
Fixed cost	23.72	31.04	27.19	34.48	29.11
Variable cost	170.88	137.00	148.32	128.96	146.29
Transport	23.88	28.00	21.97	18.69	23.14
Feed cost	115.00	87.00	100.00	75.00	94.25
Other(vaccination, sanitising)	32.00	22.00	26.35	35.27	28.91

Note: Selling egg price: R1.00 per egg. Production Cost = Fixed Cost + Variable Cost. Variable Cost = Transport Cost + Feed Cost + Other Costs.

Feed cost, on average, accounted for 54% of the total cost of production. Transport cost and other cost for the municipalities averaged R23.14 and R28.91 respectively.

4.8.1 Gross Margin Analysis

Table 15: shows gross margin analysis of the Vhembe Egg production project.

Table15 Gross margin analysis for the Project (Rand)

Municipality	TR	TR *	TVC	GM	GM*	FC	NR	TC
Makhado	298.00	332.33	170.88	127.12	161.45	23.70	103.42	194.58
Thulamela	250.00	265.41	137.00	113.00	128.41	31.00	82.00	168.00
Musina	245.88	272.38	148.32	97.56	124.06	27.19	70.37	175.51
Mutale	215.32	244.14	128.96	86.36	115.18	34.48	51.88	163.44
AVERAGE TOTAL	252.30	278.57	146.29	106.01	132.28	29.09	76.92	175.38

Note: TR* =TR including potential revenue from consumed eggs

GM*=GM including potential revenue from consumed eggs.

The average total revenue per monthly production for all four municipalities was R252.30, while the average total cost of production was R175.38.The average gross margin was R106.01.On average, beneficiaries within the Makhado and Thulamela municipalities had the highest gross margins, at R127.12 and R113.00 respectively, meaning they were able to keep their total variable cost minimum, accompanied with a low fixed cost. Mutale municipality had the lowest gross margin at R86.36 and the highest fixed cost at R34.48.

The average Total Variable Cost was R146.29 per monthly production, which accounted for 83% of total cost of production.

The Net Ratio: the amount left of the gross margin after covering the fixed expenses was an average of R76.92, meaning that after all costs had been covered, a farmer would have a profit of R76.92 to spend on other things. Generally the profits were still low even if consumed eggs were costed and accounted for in the total revenue and gross margin calculations. As illustrated by Figure 2, The NR* value is the remainder of the gross margin after fixed cost has been covered, which is the profit gained when the benefits from consumed eggs is been accounted for in the gross margin. When compared to the initial value of NR, the NR* would have only contributed a total of R26.26 to the profits had the beneficiaries not consumed the eggs and sold everything. The overall average profit from the project would still be under R100.

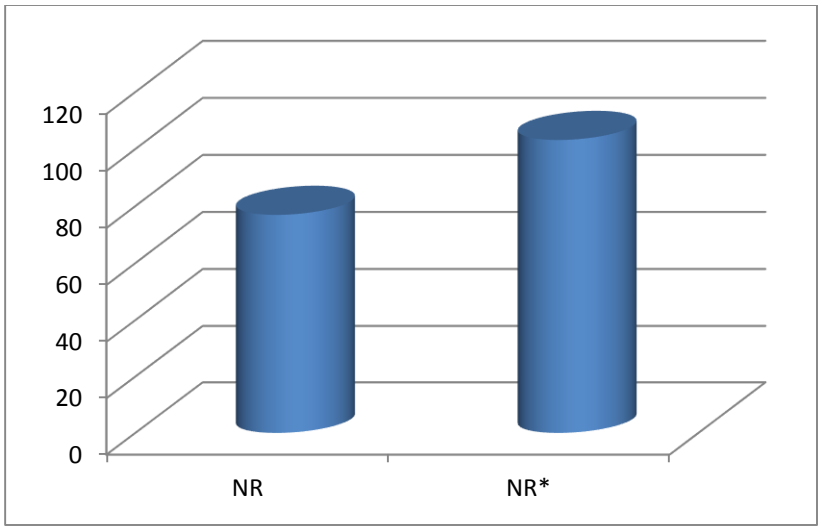

Figure 2 Comparison of the net ratios (profits)

4.8.2 Profitability Analysis

Table 16 shows the profitability estimates across different localities. The BCR or cost benefit technique was adopted to determine the feasibility of the egg production project by quantifying its costs and benefits. Olagunju *et al*., (2007) stated that, BCR equal to one, will break even, and would mean the beneficiaries are selling their eggs at a price that covers their cost of production, but not necessarily generating profits. Any price charged below this point of breakeven point will mean the producers will be producing at a loss and their BCR would be less than one. With BCR greater than one, the beneficiaries would be producing in a way that they were able to cover their cost of production and realise profits.

Table 16 Profitability estimates for the four municipalities (Rand)

Profitability estimates	Makhado	Thulamela	Musina	Mutale	average of all municipalities
BCR	1.53	1.49	1.40	1.32	1.43
ESR	0.14	0.23	0.18	0.27	0.20
GR	0.65	0.67	0.71	0.76	0.70
ROR	0.53	0.49	0.40	0.32	0.43

In Table 16, the average BCR (benefit cost ratio) for the four municipalities was found to be at 1.43. Since this value is greater than one, it indicates that the beneficiaries were making profits (though miniscule) from the project and that the project was a ‘profitable’ business.

The expense structure ratio (ESR) i.e. ratio indicating the expense structure of the egg production projects beneficiaries is at 0.20, meaning about 20% of the projects expenses total cost are made out of fixed cost, whilst 80% of the total cost are variable cost.

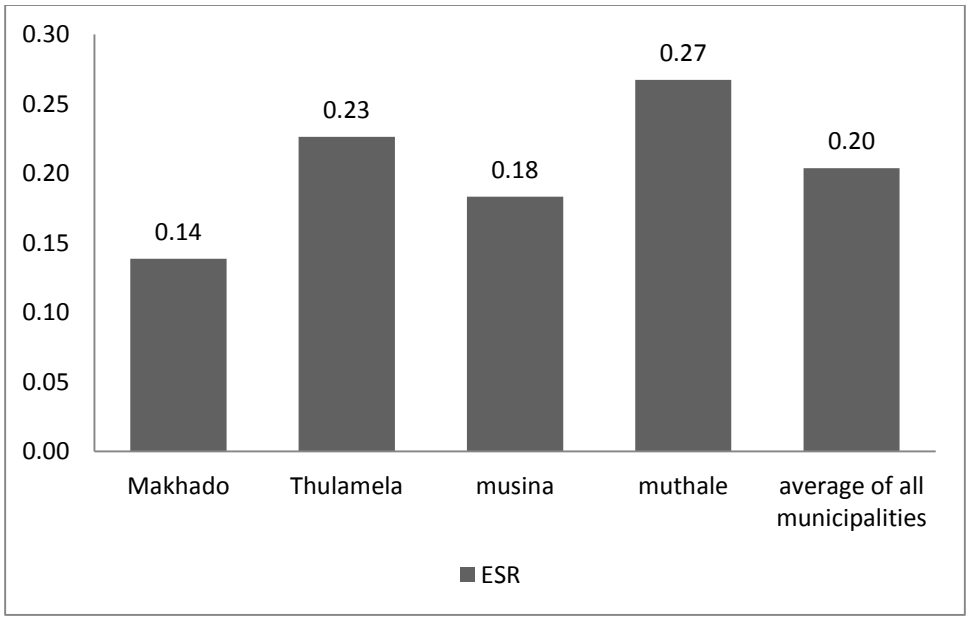

Figure 3 Expense Structure Ratio graph

Considering Table 15, Muthale had the highest fixed cost at R34.48, which resulted in them having the highest ESR at 27 % (Figure 3). Mutale’s high ESR coupled with its low Gross Margin resulted in the municipality having the lowest profit share. Thulamela municipality had ESR at 0.23, followed by Musina municipality at 18 % and Makhado municipality with the lowest at 14 %.

The rate of return (ROR) i.e. the ratio of profit to total cost of production was at 0.43. This ratio indicates what is earned by the farmer per capital outlay. From

figure 4, an average Rate of Return of 43 % means that for each R1.00 the respondent invested in the project, 43 % of the Rand was gained by the respondent. This indicates that, the beneficiaries from all municipalities were gaining from the investments they were making in the project, even though the gains were small.

Musina and Mutale Municipalities had the lowest rate of returns at 0.4 and 0.32, indicating that these municipalities were spending or investing more that they were gaining, as they were only able to gain 32-40% of what they were investing into the project.

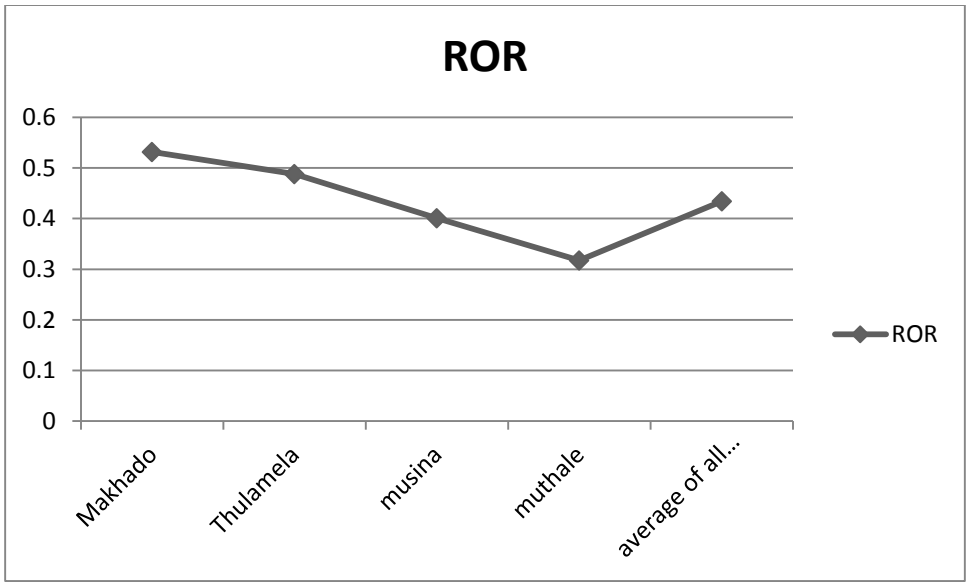

Figure 4 The rate of return ratio graph.

Makhado municipality realised the highest rate of return 0.53 which was significantly low as compared to the findings of Elson (1992), which stated that, businesses experiencing the highest profit should be accompanied by rate of returns of at least 60 % or more.

Gross ratio for the egg production project was 0.69. This means for every R1.00 returns from the project, 69 % of the Rand is been spent.

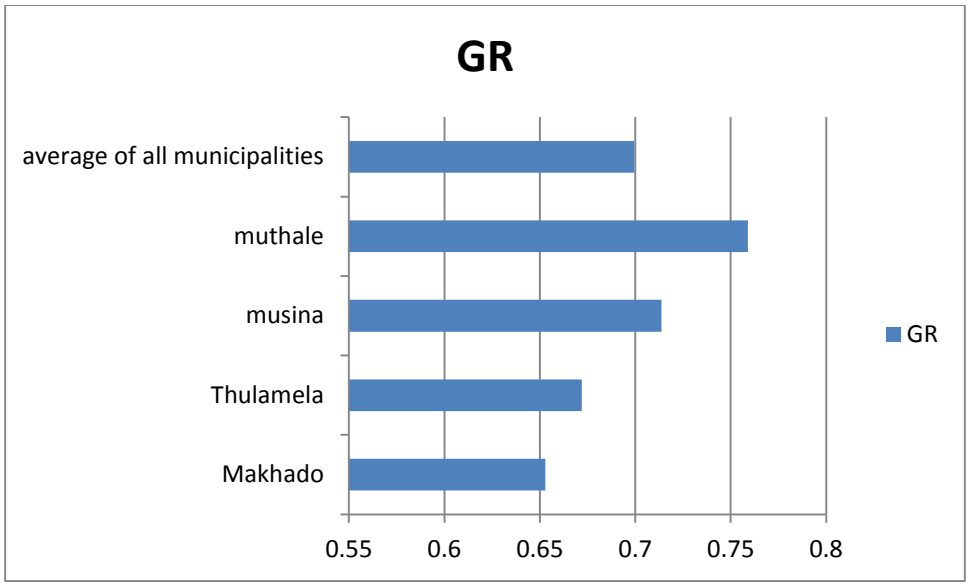

Figure 5 The gross ratio graph for the municipalities

From figure 5, Mutale Municipality had the highest gross ratio in terms of the amount been spent per each rand of returns (0.76) followed by Musina at 0.71, Makhado and Thulamela at 0.62 and 0.61 respectively. On average, the gross ratio for the project is too high, indicating that the beneficiaries have to spend or reinvest more of their profits back into the project. Taking Mutale Municipality as an example, a gross ratio average of 71 % will mean, out of every Rand gained as profit, they spend 71 % of it. This is not a good indicator for a sustainable income from their profits.

Table 17 illustrates the income levels of the beneficiaries before and after they embarked on the egg production project.

Table 17 Contribution of project to household income (Rand)

Municipality	Average Monthly Income (Other sources)	Average Monthly Income from Project	Total Income
Makhado	550.03	103.42	653.45
Thulamela	537.2	82.00	619.20
Musina	522.36	70.37	592.73
Mutale	520.15	51.88	572.03
Average	532.44	76.92	609.36

The beneficiaries from all the municipalities were unemployed and relied on government grants for their livelihoods. Their monthly income ranged between R520-R550 as shown on Table 17. From Figure 4, the contribution of project income to the total household income was on average only 12%, which indicates a low contribution of the project to the household income.

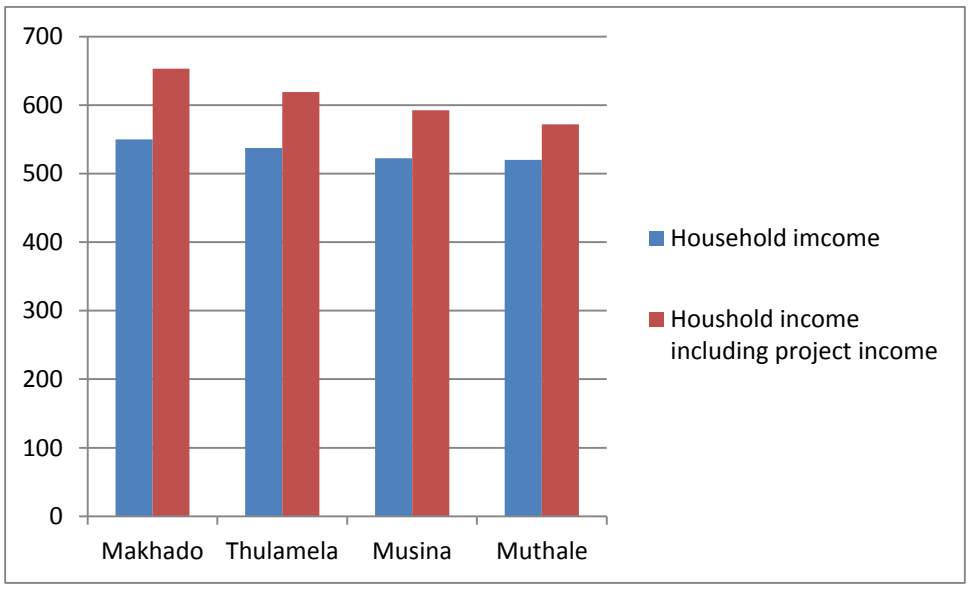

Figure 6 Graph comparing incomes, before and after the project.

Though the project seemed profitable and more revenue was generated than the cost, the profits values were too low to sustain these families over a period of time. The average profit after production only gave back about 14 % of the beneficiaries' average total income. If these farmers solely relied on this project for income, they will not be able to sustain their livelihood as the income generated from the project was very low.

CHAPTER 5
DISCUSSION

5.1 Introduction

Poverty still remains at unacceptably high level, and income levels are low particularly in rural South Africa. It is important therefore to recognise and improve the contribution of livestock to the incomes and welfare of the rural poor. Amongst the livestock based enterprises, poultry production occupies the pivotal position because of its enormous potential to bring about rapid economic growth particularly benefiting the weak sections of the society (Nesamvuni *et al*., 2003). Backyard poultry can make an important contribution to poverty alleviation/mitigation as the product (chicken) and its by products (eggs and the chicken meat) can be sold to generate additional income, and also be consumed to address some of the rural food security issues faced by households. The government of South Africa recognizes the potential role poultry production can play in alleviating poverty among the rural poor and has thus come up with projects such as the one investigated in this study.

5.2 Production Levels Across Different Municipalities

Higher egg production was attained in Makhado and Thulamela localities while low production was observed in Musina and Mutale municipalities. The possible reasons for this disparity in production include access to extension services, environmental conditions and age of farmers. Most farmers in the municipalities that realized low production expressed dissatisfaction with extension services. The farmers in these areas indicated limited interaction with extension officials. This was not the case with the farmers in municipalities that achieved higher production. The extreme heat conditions in Musina and Mutale seem also to have impacted negatively on production. These areas are generally hotter than other areas in the Vhembe District. It is also worth noting that most farmers in the Musina and Mutale regions were of older age than those in Makhado and Thulamela regions. The study revealed a correlation between advanced age and lower egg production. Older people would likely not have the energy to optimally

manage their farming enterprises and would not easily learn new farming skills especially if the farming enterprise is different from what they've traditionally been involved in. In most cases, rural farmers keep indigenous chickens for meat production and rarely raise improved egg laying chicken genotypes which require advanced management skills.

5.3 Mortality Rates, Diseases and Disease Control

The highest mortality was observed in Makhado while the lowest mortality was observed in Mutale. This finding corresponds with the extent of medicinal use in the two localities. A large percentage (88 %) of farmers in Mutale use conventional medicine to control diseases while in Makhado, only 62 % of farmers used medication to control diseases. This may explain the disparity in mortality between the two municipalities. Of interest is the non-usage of traditional medicine by farmers. Most studies have revealed that resource poor small-scale farmers largely use non-conventional or traditional herbal medications to control diseases. Swatson *et al* (2002) indicated the wide use of traditional herbal remedies in indigenous free-ranging poultry production systems in the Vhembe District of Limpopo Province – the same district in which the present study was conducted. Wide use of ethno-veterinary medicine by rural poultry farmers has been reported in other developing countries (Muchadeyi *et al*., 2004). The possible explanation for the non-usage of traditional herbal remedies in this project is that farmers were keeping an improved chicken breed and may have had the inclination to use conventional medicines rather than traditional remedies. Additionally, the extension officers who were tasked to assist the farmers involved in the project may have impressed upon the farmers to use conventional medicine. It is rare for traditional chicken farmers to receive technical advice on keeping indigenous chickens and thus the farmers would usually practice traditional management protocol.

The major diseases reported were Newcastle, Gumboro and Coccidiosis. Newcastle disease problem in the area has also been reported by Swatson et al (2002). Savic (1999) reported that Newcastle disease can cause up to 60% losses in egg type laying birds. The mortality rates in the project were not very high indicating that though some Newcastle disease cases were observed, the disease was not severe. Cases of low mortality and production has also been reported by Sridhar et al (1997). The high mortality observed during the summer months (October, November and December) could have been due to the incidence of coccidiosis infection or extreme heat. According to Boado et al (1991), coccidiosis is a major problem during the hot and wet season. Many other common diseases that affect egg laying birds such as Mareks disease, IBD and IB were not reported. This does not mean the diseases were non-existant as most of the farmers expressed lack of knowledge of disease symptoms.

5.4 Housing

Housing type had an influence on egg production. Higher production was observed under improved housing conditions. The wide use of extensive systems that are characterized by poor housing is due to low cost in terms of labour and material costs (Ovwigho *et al.*, 2009). However, poor housing exposes birds to predators and unfavourable weather conditions that negatively impact on production. The project only provided chickens and no assistance in terms of improved housing was given. This contributed to the observed low egg production. The exotic egg laying chickens are more susceptible to adverse climatic conditions than the indigenous poultry breeds and will thus likely perform below their normal production capacity when the management conditions are sub-optimal. It would have been proper for the government to comprehensively assist the farmers by providing proper housing instead of distributing chickens under less than ideal conditions.

5.5 Challenges Experienced by Farmers

The farmers mentioned a number of challenges in the project and these included high feed price, low egg selling price, poor disease knowledge, poor management expertise, poor chicken housing, high transport costs and poor marketing strategies. Challenges such as poor disease knowledge, poor management expertise and poor housing have also been reported in various other studies (Maphosa *et al.*, 2004; Pederson, 2002; Tadelle and Ogle, 2001). One of the weaknesses of developmental efforts are 'half-baked' interventions. Lack of proper training of beneficiaries was bound to lead to the poor performance of the project. Traditionally, most farmers keep free range chickens that require minimal management interventions. The type of birds provided to farmers requires semi-intensive to intensive management system which requires requisite skills. These skills were not imparted to the farmers. According to the beneficiaries, there was no mentoring provided by the extension services. The lack of training and mentoring are likely to have also contributed in the less than ideal production levels.

5.6 Marketing Channels

One of the problems that limit farmers from producing optimally is the market condition in an area (Holloway and Ehui, 2002). Though poultry products are highly marketable and poultry rearing as a business has a high turnover rate (Gebregziabher, 2010), efficient marketing system is one of the major component of a profitable poultry production enterprise. Farmers will not attempt to increase production if there are market limitations (Akilihu, 2007). According to the beneficiaries, they did not receive any information on the marketing channels for their produce. This is evident by from responses on the question of where they sell their produce. All the farmers sold the eggs within their communities largely to their neighbours. Though there were clinics and schools within the communities no attempts were made to sell to these institutions. Interaction with

the officials of these institutions and shops found in these communities revealed that had the farmers approached them they still would not have bought from them as individual farmers unless they formed farming groups and sold in bulk consistently. Farmers do realise that if they sell as individuals they would not be able to attract big clients such as schools and shops due to low egg volumes and fluctuations in supply. This assertion is proven by the farmers' response to what they perceive as the factors that may sustain their production. The farmers indicated that they need to form cooperatives to sustain their operations. It is worth noting that attempts at forming cooperatives have not been made by the farmers due to their lack of knowledge in developing such formations. Though the farmers expressed a desire to form cooperatives, they feel reluctant to do so due to the failure of other cooperatives within their communities. The farmers however indicated that they've approached agricultural officials to assist them in forming cooperatives but nothing has happened.

5.7 Sustainability Factors

Farmers mentioned the following as factors that will sustain their enterprises: Increased number of layers, improved chicken housing, formation of a cooperative and training in poultry management. The economic analysis reveals minimal profits. However, the basic economics of scale reveal that had the beneficiaries received a larger number of birds, more eggs would have been produced resulting in higher income. The farmers recognize this and have expressed desire to receive more birds from government. Provision of proper housing has also been mentioned. Laying hens are raised mainly in environmentally controlled poultry houses in cage systems. This is not the case in this project. This seems to have adversely affected production as mentioned earlier. Egg laying hens require more intensive management than broilers and thus farmers need more specialized skills than in broiler production. Access to training is perceived by farmers as very critical to sustainability of the project. Several studies such as the study by Adebisi-Adelani *et al*., 2010 reveal that

capacity building through training of beneficiaries on new farming practices is critical to success. Though the government could be commended for making efforts towards alleviating poverty, it is apparent that some projects aimed at improving livelihoods are not well thought through before implementation.

5.8 Impact of Socio-Economic Factors on Productivity

Several studies have shown that socio-economic factors need to be considered when planning community projects. These factors have been shown (Mpawenimana, 2005) to have influence on production. Some of these factors include age, gender, social attitude, standard of living, family structure and occupation etc. The study revealed that gender, age and educational level had impact on production. Females were better farmers compared to males. Low production was associated with older and poorly educated farmers. This association between socio-economic factors and production has been observed in other studies (Adebisi-Adelani *et al*., 2010; Muchadeyi *et al.*, 2004; Adisa and Adekunle, 2010). It is therefore important that these factors be considered when planning community projects. The study also revealed that in choosing beneficiaries, these factors should be considered. According to Okitoi *et al*., (2006), gender has an effect on ownership of rural poultry. Chickens rearing and ownership is often shared among the family members but is predominantly by women (63 %) and children (18 %). Therefore, if efforts are targeted towards women in poultry production, village poverty can be significantly alleviated.

5.9. Project Profitability/Viability

Village/smallholder poultry can provide income for family activities such as education, health and clothing. Village poultry have constantly commanded a premium price over commercial birds and there is a wide market demand for village poultry products (Maliwichi and Chauke, 2003). According to the economic analysis, this particular project is not sustainable largely because of

the reasons mentioned above but most importantly the economic analysis shows that the biggest threat to the project is the small number of laying hens per farmer. The Benefit Cost ratio (BCR) is on average greater than 1 across all municipalities. This indicates that the beneficiaries are not making a loss. This also indicates that had the farmers received a larger number of birds, greater profitability would be attained leading to sustainability.

The low gross margins were largely due to large variable cost (high feed cost and transport). The high feed and transport costs would be reduced if the farmers buy as a collective. If the farmers bought feed as a group they could benefit from discounts. This could also reduce transport costs as common transport could be used instead of individuals driving or hiring transport for long distances to buy one or two bags of feed.

The low income that accrued from the project explains the reason for high abandonment or neglect of the project. The income received from the project is smaller than government grants and as such not attractive. It is therefore not surprising that presently most farmers have abandoned the project. If the labour costs had been taken into consideration,

it is likely that the projects would be running at a loss. The labour that goes into the project and the resultant output is bound to discourage even the most enthusiastic farmer.

CHAPTER 6
CONCLUSION AND RECOMMENDATIONS

It is important to recognize and improve the contribution of livestock to the incomes and welfare of the rural poor. The study reveal that Backyard poultry can make an important contribution to poverty alleviation/mitigation as the product (chicken) and its by-products (eggs and the chicken meat) can be sold to generate additional income, and also be consumed to address some of the rural food security issues faced by households. The government of South Africa recognize poultry production in alleviating poverty among the rural poor.

Several studies have shown that socio-economic factors need to be considered when planning community projects. These factors have been shown to have influence on production. Some of these factors include age, sex, social attitude, standard of living, family structure and occupation etc. The study revealed that sex, age and educational level had impact on production. Females were better farmers compared to men. Low production was associated with older farmers and low level of education. The results of the current study revealed that when planning the community project these factors should be considered. According to the economic analysis, this project is not sustainable largely because of the reasons mentioned above but most importantly the economic analysis shows that the biggest threat to the project is the small number of laying hens per farmer.

The low gross margins were largely due to large variable cost (high feed cost and transport). The high feed and transport costs would be reduced if the farmers buy as a group. If the farmers bought feed as a group they could benefit from discounts. This could also reduce transport costs as common transport could be used instead of individuals driving or hiring transport on long distances to buy one or two bags of feed). Efficient marketing system is one of the major component of a profitable poultry production enterprise. Farmers will not attempt to increase production if there are market limitations. Increased number of layers, improved chicken housing, formation of a cooperatives and training in poultry

management are factors that can contribute to the sustainability of the project. It is also worth noting that most farmers in the Musina and Mutale regions were older than those in Makhado and Thulamela regions. The study revealed a negative correlation between age and egg production. Older people would likely not have the energy to optimally manage their farming enterprises and would not easily learn new farming skills especially if the farming enterprise is different from what they've traditionally been involved in. In most cases, rural farmers keep indigenous chickens for meat production and rarely raise improved egg laying chicken genotypes which require advanced management skills.

Housing type had an influence on egg production. Higher production was observed under improved housing conditions. The government should comprehensively assist the farmers by providing proper housing instead of distributing chickens under less than ideal conditions .

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