An Assessment of the Profitability of Small Holder Commercial Egg Production in Zimbabwe. A Case Study of Goromonzi, UMP and Mutasa Districts.

By

GABAYI PRINCESS

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Department of Agricultural Economics and Extension

Faculty of Agriculture

University of Zimbabwe

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The undersigned certify that they read, and recommended to the department of Agricultural Economics and Extension for acceptance, the thesis entitled:

An Assessment of the Profitability of Small Holder Commercial Egg Production in Zimbabwe. A Case Study of Goromonzi, UMP and Mutasa Districts.

Submitted by PRINCESS GABAYI in Partial Fulfillment of the Requirements of the Degree of COLLABORATIVE MASTER OF SCIENCE IN AGRICULTURE AND APPLIED ECONOMICS

Approved by;

Supervisor……………………..........................Associate Supervisor...........................................

Dr S SIZIBA

Mr Odreck Mukorera

Chairperson……………………………………………………………………………………………………

Dr J MUTAMBARA

Date…………………………………………………………………………………………………………
Dedication

I dedicate this thesis to my wonderful sons (Nokutenda and Atidaishe) and my husband for providing the moral support.
Acknowledgements

I would like to gratefully acknowledge the contributions of individuals and institutions that made this thesis to be a success. Firstly I would like to express my sincere gratitude to my supervisor, Dr S Siziba for believing in me and for his professional and technical guidance in the compilation of this thesis and for sharpening my skills in regression analysis. I also acknowledge the input of Mr Mukorera in the completion of this thesis.

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Lastly I would like to thank The Almighty God, let your name be glorified in this work forever and ever.
Abstract

The past few years in Zimbabwe have seen a rise in the number of smallholder farmers taking up commercial poultry production. Past research has also shown that smallholder poultry production suffers from low profitability emanating from high mortality rates caused by disease outbreaks, low laying rates and increasing cost of feed among other things. This study aimed at investigating the profitability of smallholder commercial egg production in Zimbabwe given the constraints which farmers face. The study used descriptive statistics to provide a general description of 260 randomly sampled commercial egg producing households supported by Non Governmental Organisations for producing eggs under the cage and deep litter system. The study revealed that the average age of the heads of sampled households was 55 years and most of these heads were educated (96.1%). Hen performance under the cage system was relatively better when compared to that under the deep litter system, measured by parameters such as mortality rate, laying rate, cumulative hen housed eggs and feed conversion ratio. The K-S test for equality of distributions also revealed that both farmers operating under the cage and deep litter system were operating below optimal levels expected. The gross margin analysis was also applied and it revealed that feed costs were the major factor contributing to total production costs in percent terms 56.1, 56.29, 47.41 and 45.76 for the 6 birds caged, 12 birds caged, 18 birds caged and 20 birds in the deep litter system respectively. The returns per dollar invested were USD0.48, USD0.39, USD0.63 and a negative USD0.04 for the 6 birds caged, 12 birds caged, 18 birds caged and 20 birds in the deep litter system respectively. The coefficient of private profitability revealed that it is profitable to produce eggs under the cage system at all flock levels while on the other hand it is not profitable to produce under the deep litter system at the prevailing level of production and prices. A generalised linear model was also fitted to estimate the hypothesised determinants of profitability per 1000 eggs by applying the Ordinary Least Squares. The Ordinary Least Squares regression revealed that a 1kg increase in feed required to produce a dozen eggs will result in USD30.26 decline in profit per 1000 eggs. Holding other factors constant, farmers which faced difficulties in getting customers for their eggs experienced a USD 9.20 decline in profit per 1000 eggs. Farmers operating under the cage system earned USD27.33 more profit than those operating under the deep litter system. Being a member to a poultry producer association resulted in USD14.98 more profit than not being a member. Households which were headed by males had USD6.80 more profit than their female counterparts. The thematic analysis of data from focus group discussions revealed that egg producing households had weak linkages with input suppliers. The farmers perceived poor physical infrastructure to be fuelling costs of production in commercial eggs. The farmers also identified lack of access to credit as a bottle neck which was resulting in limited expansion of the egg enterprise. From the results of the study, it can be deduced that high feed costs, labour costs, veterinary costs, building costs and mortality rate are associated with lower profitability while on the other hand higher laying rate results in increased profit. Hen performance under the deep litter housing system performed poorly when compared to that under cages. Farmers are encouraged to produce home grown feed to minimise feed costs. Continued training with a change in approach was also recommended for improvement management of hens. Policy makers and investors willing to assist farmers can also channel resources towards the rehabilitation of the road network linking rural areas to major towns/cities for improved access to input and output markets. This study concluded by recommending that a study be commissioned to explore the use of home grown feeds for cost minimisation without compromising on productivity within the smallholder commercial egg enterprise.
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<th>Full Form</th>
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<tr>
<td>AGRIBANK</td>
<td>Agricultural Development Bank of Zimbabwe</td>
</tr>
<tr>
<td>AIDS</td>
<td>Acquired Immuno Deficiency Syndrome</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>CABS</td>
<td>Central African Building Society</td>
</tr>
<tr>
<td>CPP</td>
<td>Coefficient of private profitability</td>
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<tr>
<td>CSPRO</td>
<td>Census Survey Programme</td>
</tr>
<tr>
<td>DO</td>
<td>Day old</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>FNC</td>
<td>Food and Nutrition Council</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>GMB</td>
<td>Grain Marketing Board</td>
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<td>GMO</td>
<td>Genetically modified organisms</td>
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<td>GRM</td>
<td>General linear model</td>
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<tr>
<td>HIV</td>
<td>Human Immuno Deficiency Virus</td>
</tr>
<tr>
<td>DLPD</td>
<td>Division of Livestock Production and Development</td>
</tr>
<tr>
<td>MAMID</td>
<td>Ministry of Agriculture, Mechanization and Irrigation Development</td>
</tr>
<tr>
<td>NGOs</td>
<td>Non-Governmental Organizations</td>
</tr>
<tr>
<td>PASS</td>
<td>Poverty Assessment Study Survey</td>
</tr>
<tr>
<td>POL</td>
<td>Point of lay</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for Social Scientists</td>
</tr>
<tr>
<td>UMP</td>
<td>Uzumba Maramba Pfungwe</td>
</tr>
<tr>
<td>ZIMVAC</td>
<td>Zimbabwe Vulnerability Assessment Committee</td>
</tr>
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<td>ZPA</td>
<td>Zimbabwe Poultry Association</td>
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CHAPTER 1

1.1 Introduction

The Poverty Assessment Study Survey (PASS), 2003 reported that a higher proportion of households in rural areas are poor compared to households in urban areas. This situation may have deteriorated further due to the sharp economic decline between 2000 and 2008, which resulted in the gross domestic product (GDP) shrinking by 40% (Ministry of Finance, 2012). From a nutrition perspective, the Food and Nutrition Council (FNC) in the Zimbabwe National Nutrition Survey of 2010 reported that 33.8% of children between 6 to 59 months of age were stunted and this was reported to be high when compared to international standards. Millions of people worldwide, especially from low-income countries have been shown to consume less animal protein per head when compared to those in high-income countries (FAO, 1970). Within these low income countries literature has also shown that rich people consume higher animal protein than their poorer rural counterparts (The United Nations University Press, 1988).

Given that two thirds of Zimbabweans make a living from agriculture, finding innovative ways for unlocking the production potential in rural areas is important for poverty alleviation and nutrition security. There are potential development initiatives being implemented by FAO, with one of them involving the promotion of commercial egg production by rural farmers in some districts of Zimbabwe with the aim of raising incomes and protein supply in rural areas. Poultry production can easily supply the protein needs of a growing population through eggs and the poultry meat as well as generate extra cash incomes for rural households (Alders, 2004). Poultry production has the potential of making significant contributions to the livelihoods of smallholder farmers because they constitute a ready source of dietary protein (meat and eggs), are easily disposable, have quick recovery and small start up costs (Hilmi, et al 2011). Above all poultry raising skills are not overly complicated and can be easily integrated with other farming activities (Hilmi, et al 2011). Poultry is widely known as the livestock of the poor people and its production is part of most smallholder farming systems (Kryger, 2010).
Traditionally farmers in rural areas have been keeping village poultry with minimal input of resources as birds are left to scavenge for feed and rarely do they get supplementary feed, provision of shelter is also minimal resulting in losses due to predation and diseases (Kryger, 2010). Small stock production is hindered by low productivity, increased small stock morbidity and mortalities. The above mentioned characteristics of village poultry production usually results in low productivity, increased stock morbidity and mortalities hence resulting in low profitability of the rural poultry enterprise (Perdersen, 2002).

For rural farmers to successfully adopt commercial egg production, the enterprise must be viable as profit is a function of costs and revenue generated by an enterprise. Given that farmers are largely price takers in input and output markets, the leeway to improve their margins is restricted to reaching high productivity levels, and cost minimisation. Literature shows that profit margins are quite sensitive to management and productivity indicators in this enterprise where feed costs account for as much as 70% of all costs. Hence smallholder farmers have to maintain or adopt high management levels for them to achieve positive profits hence the successful adoption of commercial egg production by rural communities.

Currently in Zimbabwe data on commercial egg production is only available for the large scale sector only where it is regularly collected through the Zimbabwe Poultry Association members and the Government Department of Livestock. Information regarding production indices and profit margins under the smallholder sector is hard to come by as it is currently not being collected hence this study is going to provide an insight into the quantification of profits obtained by communal farmers engaging in commercial egg production and also an insight of their productivity performance measured by parameters such as mortality rates, laying rates, cumulative eggs per hen housed and feed conversion ratios.

1.2 Background

Agriculture is the backbone of Zimbabwe’s economy and contributes approximately 11-14% of GDP and provides employment for some 70 percent of the population (MAMID, 2012). Poultry are commonly found in rural areas, for example, ZIMVAC 2011 reported that 76% of the surveyed households in rural areas own poultry, indicating that farmers are already rear poultry though they rear them at low levels of investment and management. Poultry production in Zimbabwe like most developing countries can be grouped into two main
sectors: large-scale commercial and smallholder (Faranisi, 1995). The large scale commercial sector is mainly characterised by huge capital investments, intensive management, mechanisation and specialisation whilst on the other hand the small-scale sector can be intensive, semi-intensive and extensive (Perdersen, 2002). Intensive systems are mostly dominated by hybrid breeds whilst on the other hand extensive systems are dominated by indigenous breeds.

The market for poultry and poultry products is growing the world over as, Delgado *et al* 1999 projected that per capita consumption of livestock products will increase by about 50% from 1993 to 2020, with most of the increase attributed to developing countries as a result of population growth, urbanisation and rising incomes. The expected demand for livestock products presents expanding market opportunities for smallholder livestock producers. For the Zimbabwean situation the recent ban on poultry and poultry products imports from South Africa implemented in April 2011, following an outbreak of Avian Influenza in ostriches may also have resulted in increased number of farmers engaging in poultry production. This resulted in a decline of poultry imports, triggering escalation of beef prices in the wake of a decreased national herd (Ministry of Finance, 2012). The Zimbabwe Poultry Association (ZPA) in February 2012 reported that, 35% of chicks produced were slaughtered by large-scale abattoirs, suggesting that the remainder (65%) of the chicks entered the small-scale and informal sectors thus enabling a cash business to develop in this sector with very little capital. This shows that commercial poultry production among smallholder farmers is becoming increasingly important for the generation of cash income and improvement of nutrition.

With the increased contribution of the smallholder sector to poultry production it is important that information is collected/docuemented for the updating of agricultural statistics or for use in decision making for programming support to activities with a potential to alleviate poverty among small scale producers.

1.3 Problem statement

Official figures of the Poverty Assessment Survey of 2003, indicate that the proportion of households living below the food poverty line in Zimbabwe rose from 35% in 1995 to 63% by 2003 (Ministry of Public Services, Labour and Social Welfare, 2006). Rural households registered a higher poverty rate than urban households. Smallholder commercial egg
production has the potential to alleviate poverty as this arguably requires relatively small start up costs and is capable of producing good returns on investment at low production scale.

Commercial egg production is one of the most important income generating activities of the livestock sector resulting in rapid returns and reasonable profit if managed properly (Farooq, 2003). Commercial egg production suffers from low profitability or losses in many of developing countries all over the world (Altahat et al, 2012). Numerous factors such as size of operation, mortality, feeding regime, laying rate, management practises, price of inputs (pullets, feed, veterinary drugs) and price of eggs affect the cost of production and net returns to the enterprise. The experiences of farmers have shown that poultry production has been suffering from some setbacks caused by increasing cost of feed among others and this has resulted in reduced net returns for the business significantly (Aihonsu, 1999).

Family poultry production in many rural areas of Africa is an important source of food and income as well as a major source of protein; unfortunately there have traditionally been many constraints on production (Sonaiya et al, 2004). Village poultry production is a low input system with little investment on disease control and prevention, very little supplementary feeding or housing provided to birds thus resulting in low output from high losses and low production. The result is that both production and productivity remain well below potential and losses and wastage can be high (Sonaiya et al, 2004).

Given that most smallholder farmers are price takers because of the nature of the market which is more or less perfectly competitive, a more reasonable approach to increasing net returns to farmers is to reduce the costs of production (Aihansu, J, 1999). Because of the lack of control over prices, farmers need to seek means to reduce costs and risks, thus increasing the profitability of the poultry enterprise. Since profits are determined by costs of production, gross return and market prices, minimisation of costs and maximisation of gross return will result in higher profitability.
1.4 Overall objective

Given the importance of costs on potential profitability of the commercial egg enterprise this study seeks to explore productivity of commercial layers under smallholder management and quantify the profits obtained. This is done by addressing the following specific objectives;

1.4.1 Research Objectives

1. To quantify productivity parameters (flock size, mortality rate, laying percent, cumulative eggs per hen housed and feed conversion ratio) of smallholder commercial egg producers.
2. To determine the profitability of smallholder commercial egg production under the cage and deep litter housing system.
3. To identify the socio-economic and management factors which affect profitability of smallholder commercial egg production.
4. To elicit farmer’s perception and views on market accessibility.

1.4.2 Research questions;

1. What are the levels of productivity among the smallholder commercial egg producers in terms of flock size, mortality rate, laying percent, cumulative eggs per hen housed and feed conversion ratio vis a vis the optimal levels?
2. What are the production costs vis’ a vis’ the returns earned by smallholder commercial egg producing households?
3. What are the main socio economic and management factors which affect profitability of smallholder commercial egg production?
4. What are the views of the smallholder commercial egg farmers with regards to challenges they face in accessing markets?

1.4.3 Hypotheses;

1. The productivity indices for smallholder commercial egg producers are below the optimum levels.
2. Small-scale commercial egg production is profitable.
3. Profitability of smallholder commercial egg production is positively and significantly affected by the education level of household head and farmer’s management of layers.
1.5 Expected contribution and Justification of the study

In recognition of the increased role that smallholder informal poultry producers are playing in the poultry industry, this study was initiated with the objective of documenting information on the costs and returns of commercial egg production within the smallholder farming sector. As there is a serious lack of data on small holder egg production, undertaking this research will help in filling in the knowledge gap with regard to informal table egg production. Although pilot projects which supports rural farmers in commercial egg production have been initiated in several districts, very little information has been documented with regards to the profitability and hence sustainability of the enterprise under smallholder management.

An understanding of the costs and returns attained by smallholder farmers is essential in the design and implementation of commercial egg production development programs for adoption by the wider population. Information which will be generated will be relevant to policy makers, donors and investors for decision making with regard to the level of support which can be rendered to small-scale producers for sustainability of the sector, as commercial egg production require a minimum efficient scale of production for it to be worthwhile.
1.6 Organization of the Study

Chapter 1 introduces the research, provides background information on the smallholder egg production, and examines the research problem, justification, research questions, objectives and hypotheses of the study.

Chapter 2 reviews literature on poultry production with a bias towards smallholder egg production. It covers topics on the importance of poultry on livelihoods and factors affecting egg production. This chapter also reviews research done in the past for the examination of factors affecting the performance of laying hens and profitability in a bid to give guide and direct analysis in this present study.

Chapter 3 articulates the research methodology, providing the conceptual framework for analysing factors which affect profitability of an egg enterprise. This is followed by a section on data collection and data management techniques used in this study. The theoretical framework underpinning this study is also presented in this chapter and also highlights of the major limitations of the various analytical tools applied in this research.

Chapter 4 is the first analysis chapter which presents the general description of surveyed households in terms of their demographic characteristics and egg production parameters such as flock size, mortality rate, laying rate, cumulative hen housed and feed consumption disaggregated by housing system. This chapter seeks to answer the question; What are the levels of productivity among the smallholder commercial egg producers in terms of flock size, mortality rate, laying percent, cumulative eggs per hen housed and feed conversion ratio vis a vis the optimal levels?

Chapter 5 is the second analysis chapter, which presents a gross margin analysis for the egg enterprise under smallholder communal farmers. This chapter in performing a profitability analysis of the egg enterprise answers the question that; What are the production costs vis’ a vis’ the returns earned by smallholder commercial egg producing households?

Chapter 6 is the third analysis chapter in which an econometric analysis of the hypothesised determinants of egg enterprise profitability which were estimated by fitting the generalised linear model to examine the direction and quantity of effect of each dependant variable on profit per 1000 eggs. This chapter provides answers to the question that; What are the main factors which affect profitability of smallholder commercial egg production?
Chapter 7 is the final analysis chapter which documents the views and perception of farmers with regards to the market accessibility challenges. This chapter provides answers to the following research question; What are the views and perceptions of the farmers with regards to market accessibility challenges they face?

Chapter 8 summaries the findings of the study and considers the broader policy and development implications of the study. This chapter will conclude with suggestions for possible areas of further research.
CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Advances in knowledge and technology over recent decades favour the growth and intensification of poultry production in developing countries where there are increasing human populations and economic constraints (Williams, 2009). Poultry meat and eggs provide affordable, quality food products that are consumed by most ethnic populations worldwide (Williams, 2009). Poultry are important for most rural households as they constitute an important fall back asset which can be readily disposed in the event of stress (Pedersen, 2002). The purpose of this literature review is to provide a summary of some of the important research findings reported by various authors and give a critical review of such findings.

2.1 The importance of poultry on livelihoods

Animal production in general and chickens in particular play important socioeconomic roles in developing countries (Alders, 2004). Approximately 85% of rural households in Sub Saharan Africa keep chickens or other type of poultry (Kryger, 2010). Provision of animal protein and generation of extra cash incomes are amongst the major reasons for keeping chickens by rural communities (Alders et al, 2009). Livestock contributes to the livelihoods of more than two thirds of the world’s rural poor (Holloway et al, 2002). Delgaldo et al, 1999 projected that per capita consumption of livestock products will increase by about 50% from 1993 to 2020, with most of the increase attributed to developing countries as a result of population growth, urbanisation and rising incomes.

The expected demand for livestock products presents expanding market opportunities for poor smallholder livestock producers. The importance of the poultry industry is that it provides employment not only to those engaged in production directly, but also for the hatchery operations, feed dealers, manufacturers of drugs, building materials, processors of eggs and poultry products and all dealers engaged in the marketing of egg and poultry from the time they leave the producer until they are in the hands of a consumer (Morly, 1982).
Poultry provides animal protein in the form of meat and eggs and are available for sale or barter in societies where cash is not abundant (Clarke, 2004). Poultry and poultry products can be sold and bartered to pay school fees or medical expenses or to buy oil or other items. Eating poultry meat is especially important for children and expectant mothers as it can make a significant contribution in areas where child malnutrition is common (Clarke, 2004). The Zimbabwe National Nutrition Survey of 2010 found out that 33.8% of children between 6 to 59 months of age to be stunted and that the rate of stunting in 24 districts was high according to global thresholds (FNC, 2010). Protein from livestock is said to be nutritionally superior to that of vegetable origin because it contains a complete range of amino acids that are essential for maintenance of health (Evbuomwan, 2005). Thus augmenting the production of eggs is an important objective in helping to meet the nutritional needs of the stunted children in Zimbabwe.

Poultry production is also important in rural livelihoods in that it can provide income to households as the layer chickens are prolific, easy to raise and their output can be generally expanded more rapidly and easily than that of other livestock (Altahat, et al 2012). The ZIMVAC survey of 2011 reported that 76% of communal farmers own village chickens with an average flock size of 10 birds. These birds provide food and nutrition security and family income for smallholder farmers (Van Fekeren, 2006).

Poultry are commonly found in and around the homestead and hence provide a good opportunity for women to actively participate in a business opportunity that is also easily accessible and does not command excessive labour requirements (Hilmi, et al 2011). The skills required for raising poultry are not overly complicated and such an enterprise can be easily integrated with other farm activities and in many instances complement other farm enterprises (Hilmi, et al 2011). In communities that are hard hit by HIV and AIDS, poultry can provide an easy enterprise to manage for elderly people and young children (Hilmi, et al 2011).
2.2 The poultry industry in Zimbabwe

The poultry industry in Zimbabwe is based on both indigenous and imported poultry strains (Faranisi, 1994). Poultry production in Zimbabwe is two-dimensional, the large-scale poultry production and the smallholder poultry production. Large-scale poultry production units are characterised by huge capital investments, intensive management, mechanisation and specialisation and is dominated by few large companies which are both breeders and producers (Pedersen, 2002). On the other hand the smallholder poultry production sector can be intensive, semi-intensive or extensive. Most intensive poultry units in the smallholder sector are dominated by hybrid broiler and layer breeds. The extensive system is dominated by village chickens, which are not classified into specific breeds and usually rely on scavenging and is often described as low input/low output production system (Clarke, 2004).

Figure 2.1 shows the trend in the production of day old sexed pullets and point of lay pullets from the commercial sector. The figure 2.1 shows a sharp increase in day old chicks produced from the period starting 2009 where production of day old chicks increased by four times in 2010. The production of point of lay (POL) pullets has remained stable over time.

![Figure 2.1 Trends in production of point of lay pullets and day old layers](source: ZPA, 2012)
The Zimbabwe Poultry Association in the February 2012 newsletter reported that 35% of chicks produced were slaughtered by large-scale abattoirs, suggesting that the remainder of the chicks entered the small-scale and informal sectors thus enabling a cash business to develop in this sector with very little capital. The ban placed on poultry produce and products from South Africa in April 2011 following an outbreak of Avian Influenza on ostrich farms may also explain the upsurge of poultry production under smallholder producers. Data overtime on village poultry is not readily available as well as the trend in production of eggs and broilers under the semi intensive system.

Figure 2.2 also shows a sharp increase in the number of dozens of eggs produced starting from year 2010 where egg production measured in dozens of eggs doubled from 8 million dozens in 2009 to 16 million dozens in 2010.

![Figure 2.2 Trend in egg production](image)

**Source:** ZPA, 2012
2.3 Factors affecting egg production

As eggs are the main outputs from commercial egg production contributing to the total income obtained by a farmer, it is important to review the factors which affect egg production. The sections which follow presents the egg production cycle, production costs and profits and the optimal laying rate, feed consumption and mortality rates of exotic breeds of layers widely used in Zimbabwe.

2.3.1 The egg production cycle

Laying in hens usually starts at around 5 months (20-21 weeks) of age and the laying period is on average 12 months (FAO, 2003). During the production cycle many factors influence egg production hence the cycle must be managed effectively and efficiently in order to provide maximum output and profitability (FAO, 2003). Factors such as breed type, mortality rate, age of birds, body weight, laying house, lighting schedule, feed quality and quantity, weather and management factors affect egg production.

Generally hens lay fewer eggs as they reach the moulting stage. A hen lays on average one egg per day, producing on average 250 to 300 eggs per year. For a typical egg production curve, egg production usually rises rapidly and then starts to decline after 31 weeks of age as depicted in figure 2.2 which follows (Brown Novogen, 2013). When the laying percentage decreases to less than 60% it may become uneconomical to retain the birds.

![Figure 2.3 Optimal laying rate in percentage by breed type](image)

2.3.2 Production costs and profits

Good management practices encourage record keeping which captures costs incurred during the operations and proceeds from the sale of eggs, spent layers, and manure. For the enterprise to be viable, costs must be covered by the sale of eggs and the difference between the proceeds from sales and costs incurred represents the profit (FAO, 2003). The major costs which are incurred by poultry farmers also include the costs of birds be they day old chicks or point of lay pullets (which are usually bought at 16-18 weeks of age). For the districts under this study, farmers were provided with point of lay pullets which were procured at a cost ranging between USD10 to USD13 per bird.

Generally feed costs are estimated to be about 60 to 75% of the production costs of eggs (Chiba, 2009). Farmers can opt to buy commercial feed which is usually more expensive as compared to use of home grown feed. Total amount of feed used during the egg production period should be considered when determining profits earned by the egg enterprise. The figure 2.3 below shows the expected feed consumption rates over time for the hyline and Novogen brown layers under optimum management using an energy adequate diet. Feed consumption rates measured by grams of feed required per bird per day will vary according to feed nutrient content (particularly caloric content), house temperature, rate of production, egg size and body weight (Hy-Line International, 2012).

![Figure 2.3 Feed consumption over time for hyline and Novogen brown layers](image)

**Figure 2.3 Optimal laying period feed consumption by breed type**

*Source: Hy-Line International, 2012 and Brown Novogen 2013*
Other expenses which should be considered when keeping laying hens is the cost of housing (cage system or deep litter system), equipment (such as drinkers, feeders), labour, vaccinations, mortality and other miscellaneous costs. Costs associated with housing include the initial capital investment for the construction of buildings to house the laying hens plus also the costs of maintenance and feeding and watering equipment. Labour costs are incurred during the management of laying hens.

The cost of mortality includes the losses incurred in terms of loss in egg production and value of the spent layer when a hen dies due to diseases or predation. Mortality rate may rise due to diseases, predation or high temperature (FAO, 2003).

![Figure 2.5 Optimal laying period mortality rate by breed type](image)

**Source:** Hy-Line International, 2012 and Brown Novogen 2013

Other costs to be considered include the costs of packaging (eggs trays or plastic bags) and lighting. Another factor that is likely to affect the development of smallholder poultry production is that of labour. Labour is a problem in the rural areas of Zimbabwe, it is either not available due to the rural urban migration or where it is available it is under-utilised (Hanyani-Mlambo, 2002). When calculating income for the laying cycle, the earning which should be taken into consideration is income from the sale of eggs, sale of cull birds after the production cycle and sale of manure.
2.3.3 Laying housing type

The characteristic of a good laying house are that it must protect laying birds from theft, predation, harsh climatic conditions and excessive dust (FAO, 2003). Housing in modern poultry is an important input, accounting for a major component of the initial capital investment (Kitalyi, 1995). In modern poultry enterprises, the structures are constructed and designed in consideration of bird welfare and efficiency of production (Weaver, 1996).

2.4 Review of studies conducted on factors affecting performance of laying hens and profitability

A lot of studies have been conducted to investigate the factors which affect the performance of layers and profitability of the enterprise and these will be discussed in the sections which follow. Farooq et al (2002) investigated egg production performance of commercial layers in Pakistan and analysed data using weighted mean procedures, general linear model procedures, production functions and regression procedures. Farooq et al (2002) using the multiple regression model investigated the effect of density of birds per square meter, hygienic condition of the farm, strain of chicken, flock size, cage versus floor rearing and system of housing on hen-day egg production. The study concluded that egg production was better for large than small sized flocks (Hisex strain of layer than Babcock, Nick-chick and Hyline), layers kept in cages than on floors and flocks maintained at optimal stock density coupled with better hygiene as compared to flocks maintained at higher stocking rate under poor hygiene.

In another study Farooq et al (2003), conducted by the same researcher on cost of production, gross return and net profit in commercial egg production, the effect of stocking rate, hygienic conditions on the farm, strain of chicken, flock size, housing and rearing system on the cost of production per layer was studied applying the general linear model procedure. The study concluded using cost and returns analysis that feed cost was the major component contributing 76.73% to the total cost of production and the average cost of labour, day old chicks, building rent, vaccination, therapy, miscellaneous, electricity, bedding material and transport contributed 5.05%, 5.01%, 4.13%, 3.25%, 2.77%, 1.1%, 0.8%, 0.67% and 0.48% of the total cost of production respectively.
Jacob et al (2011) also conducted a study to investigate factors affecting egg production in backyard chicken flocks and identified that age of hens (after two or three years many hens significantly decline productivity), improper nutrition (inadequate diet causes hens to stop laying), omission of feed ingredients such as salt, calcium, vitamin D or toxicoses which occurs when highly excessive amounts are fed to birds, inadequate day length, parasites and diseases and poor management practices can cause a drop in egg production.

Evbuomwan (2005) conducted an empirical analysis of costs and returns to commercial table egg production in Lagos, Nigeria and used basic statistics, trend analysis and a simple gross margin analysis to determine the profitability of table egg production. The study concluded that commercial egg production in Lagos was profitable and asserts that the demand for poultry products was expected to grow in view of the increase in per capita income, increased awareness of the health implications of inadequate intake of protein in human diet and the outbreak of avian influenza in Asia. Also Yusuf et al (2007) used the gross margin analysis to determine the profitability of poultry egg production in Ogun, Nigeria on the study measuring technical efficiency of poultry production. Yusuf et al (2007), also applied the straight line method formula for calculating depreciation and assumed that the salvage value of the fixed items in the enterprise were zero. The study revealed that large farm size had the lowest cost of production per bird and that feed constituted more than 70% of the costs for the different farm sizes studied. The study also revealed that large farms had the highest average gross margin per bird which they attributed to economies of scale.

Bamiro et al (2009) conducted a study to examine the economics of vertical integration in poultry industry in Ogun and Oyo states of Nigeria. The analysis techniques which were employed included descriptive statistics and farm budgetary analysis. The gross margin analysis revealed that the fully integrated poultry production systems have the highest gross margin while the non-integrated poultry farms have the lowest gross margin per 1000 birds. Bamiro et al (2009), asserts that the profitability indicators: value added sales ratio, rate of return on investment and rate of return on fixed cost, increase with the extent of vertical integration therefore confirming that vertical integration is profitable in the poultry industry. Bamiro et al (2009) in their study revealed that a larger percentage of poultry farmers in Nigeria were young and had formal education hence resulting in enhanced managerial skills.
In a survey conducted in Botswana on small scale layer production systems to gather baseline information on aspects of production systems and productivity, Badubi et al (2004) asserted that daily feed intake was 108.1 grams per hen and on average 1740 grams of feed was required to produce a dozen of eggs. The productivity of the birds under farmer’s management was well below standards indicated by the breeding companies.

In a study conducted by Altahat et al (2012) on ten main factors which affect the profitability of layer hen enterprise. The investigated factors included price of purchases pullets, feed price, cost of labour, cost of veterinary service and medicine, building and machinery depreciation, repairs and maintenance and length of the production cycle, feed conversion ratio, mortality rate, egg sale price and laying percentage. The study used a multiple regression profit model to estimate the effect of these factors on profit per kg egg produced. The study revealed that the feed price to be the factor with the highest negative impact on the profitability and the egg sale price with the highest positive impact on profitability of the egg enterprise.

A research review of village chicken production constraints and opportunities in Zimbabwe which was conducted by Mapiye et al (2007) concluded that chicken production is hampered by feed shortage, poor health and housing management. Mapiye et al (2007) also identified socio-economic constraints to production such as lack of markets, poor marketing arrangements, and poor infrastructural and institutional support as negatively affecting village poultry production.

Gausi et al (2004) conducted a study on the characterisation of the smallholder poultry marketing systems in rural Malawi and used descriptive statistics, gross margin analysis to explain the observed market performance and a logit model to determine the factors that influence occurrence or non-occurrence of chicken sales at household level. The study identified the major constraints in rural chicken marketing as low prices low marketable output and long distances to reliable markets. The study also showed that there are three main frequently used chicken marketing channels which are: direct producer to consumer selling; rural assembler sells to retailers for final selling to consumers and assembler-retailer where assembly and retailing functions were integrated. Transport costs constituted the major marketing cost item.
In a monitoring study conducted in Zimbabwe by Maphosa et al. (2004) to compare the production of village chickens between communal and small scale commercial farms which used descriptive statistics and the General Linear Models (GLM) procedures to detect differences between communal and small scale production parameters such as monthly flock sizes, clutch sizes and weights of chicks. The study concluded that the productivity of the birds under communal systems was low due to low management levels and also observed high levels of mortality during the brooding stage.

Perdersen (1998) conducted on farm research on village chicken production in Sanyati, Zimbabwe using the participatory rural appraisal technique and the study asserts that the most visible constraints to village poultry production were high mortality caused by diseases, pests, predators, weather fluctuations and lack of veterinary services. Inadequate management as well as limited feed supply, causing few eggs per clutch and few clutches per year and long brooding periods were suspected to be major reasons for the low production per hen.

In a study conducted in 11 African countries by Klos et al. (2005) making use of a standardised form of partial budget analysis to assess the feasibility and efficiency of interventions in family poultry operations, it was concluded that the economic benefit of certain interventions such as Newcastle vaccinations, feed supplementation and improved housing of chickens were all profitable and had a positive return on investment.

Assa (2012) in a study on poultry production and rural poverty among small-scale farmers in Mzimba district of Malawi made use of descriptive statistics for the description of the socio-economic characteristics of randomly sampled farmers and also applied the logistics regression model for measuring the effect of poultry production on poverty. The study revealed that backyard poultry production makes an important contribution to poverty alleviation/mitigation and recommended that it should be considered in any strategy aimed at improving rural livelihoods.

Based on the literature which has been reviewed this study seeks to determine the profitability of commercial egg production by smallholder farmers in Zimbabwe given the conditions which prevail and challenges being currently faced by these farmers using the gross margin analysis. A profit function model to estimate the hypothesized determinants of
the profitability of the poultry enterprise will be fitted to show the effect of various factors on profit.

2.5 Conclusion

Based on the literature reviewed it was shown that poultry production especially through the use of indigenous breeds is widespread among smallholder farmers in developing countries with approximately 85% of the households reported to keep chickens or other type of poultry. Indigenous poultry birds are kept by smallholder farmers mainly for the provision of food and nutrition security and for the generation of family income. Poultry production in most rural areas is usually described as a low input and low output system in that there is usually low investment in disease control, birds scavenge for feed with very little supplementary feeding resulting in low output from high losses and low productivity. On the other hand literature has shown that in countries where smallholder farmers have taken up the rearing of commercial breeds with an improvement in management have reported positive profits. The main factors identified in literature to significantly affect profitability of the smallholder commercial egg enterprise includes price of purchased point of lay pullets, feed costs, veterinary drugs, cost of building and equipment, mortality rate, feed conversion ratio, laying percentage and egg sales price. The farm budget technique of applying the gross margin analysis for the determination of profit levels was used by several researchers and generalised linear model was applied to isolate the effect of each factor on profitability.
CHAPTER 3:

MATERIALS AND METHODS

3.1 Introduction

This chapter describes the methodology that was employed in order to achieve the objectives of the study. This chapter starts by describing the conceptual framework that was used to guide both data collection and analysis. The chapter also presents the data collection methods used for the survey and the way data was processed. The chapter also presents the analysis techniques which were employed.

3.2 Conceptual Framework on factors affecting profitability of an egg enterprise

Households raise chickens all around the world under varying circumstances but their main objective is generally the same; maximum production for minimum costs and minimum risks (Van Fekeren, 2006). Calculations for the laying cycle (52 weeks) are more accurate and enable the determination of whether the egg enterprise is running at a profit or loss (FAO, 2003). Variable costs which a farmer incurs when he/she operates an egg enterprise include the cost of feed, vet drugs and cost of point of lay pullets.

Feed has been identified as the major limiting factor militating against the poultry industry because it hampers production, not only on the basis of high cost but also due to the low quality of feeds supplied by the millers which negatively impacts productivity as well as rendering the birds susceptible to diseases. Mortality which is define in this study as a loss of laying birds due to diseases or predation increases the cost of production and negatively affects the gross returns. High disease incidences will result in higher mortalities and below optimum feeding regimes will also adversely affect egg production. When birds die costs are incurred when a farmer buys replacement stock or loss of the value of the cull birds at the end of the laying cycle and also loss on egg production. For the households under study, point of lay pullets (hens that are typically 21 weeks of age), egg trays, egg layer concentrates to mix with grain, water troughs and essential drugs were supplied to the farmers through NGOs. Figure 3.1 shows the various factors which affect the profitability of an egg enterprise adopted from an FAO training handbook.
The fixed costs which a farmer incurs are the housing costs, labour and equipment such as feeding and watering troughs. Housing and equipment costs can be considered as once off as these are incurred at the start of the business. Housing in modern poultry is an important input accounting for a major component of the initial capital investment (Weaver, 1996). Farmers in most rural areas of Zimbabwe use water from the boreholes or wells and access
this freely. Although it is known that egg production is closely related to changes in day length to which the pullets are exposed and that egg numbers, size and total profitability can be favourably influenced by a proper lighting program, farmers under study were also using natural light and therefore not incurring costs on lighting. Farmers in Goromonzi district were supplied with cages for housing of their birds whereas those in UMP and Mutasa used the deep litter system.

Eggs are the major outputs in commercial egg production and higher egg production implies higher profit for the enterprise. Egg production is influenced by several factors which include breed type, mortality rate, age of birds, housing conditions, feed type, lighting schedule and management factors. The breed of the laying birds influence egg production however management and feeding practises are the key determining features for egg production (FAO, 2003). Households under study were supported with the Hyline brown and Novogen brown point of lay pullets to kick start commercial egg production. Birds start to produce eggs in their twentieth or twenty first week and continue to lay for over a period of 12 months (FAO, 2003). Peak egg production is normally reached at 31 weeks in lay and thereafter production will begin to fall until the end of the egg production cycle (FAO, 2003).

Effective and efficient management techniques are necessary to increase the productivity of the birds and consequently increase income. Management includes vaccination and disease control, frequent collection of eggs to prevent hens from brooding and production planning for egg production to be constant so as to meet market demand (FAO, 2003). Effective management can also result of eggs of good quality that fetches higher grades and hence a higher price on the market resulting in improved profitability. Losses that occur when eggs are damaged or cracked or soiled can be minimised with effective management. The weight of the carcass of the culled birds can influence the price that is charged, where the heavier the bird the more the price it fetches on the market.
3.3 Data collection and management

3.3.1 Study Site and Sample

The study was carried out in Goromonzi, Mutasa and UMP districts. These districts were selected because these are the areas where communal farmers had been supported with inputs for commercialised egg production and had completed a 12 month production cycle. The farmers supported in these districts also had production records which captured feed quantity mortalities and egg production over the production cycle. Goromonzi district is located 32km southeast of the capital city of Harare (Betterworld books, 2013). Goromonzi district lies in natural region 11B and receives on average 750mm to 1000mm of rainfall per year. Mutasa district is located 30km from the provincial capital city, Mutare. Figure 3.2 shows the districts which were covered in the study. At the time of conducting the study Goromonzi had 186 farmers who had been supported for commercial egg production under the cage housing system through an FAO funded program while on the other hand Mutasa and UMP had 90 farmers supported in each district under the deep litter housing system.

![Figure 3.2 Sampled Districts](image-url)
Data was collected from a total of 260 households of which 165 households were interviewed in Goromonzi while in Mutasa and UMP had 46 and 49 households interviewed respectively. Goromonzi had the largest number of households interviewed as it had various models which ranged from 6 birds caged to a maximum of 24 birds in cages. On the other hand each farmer in Mutasa and UMP was supported with 20 birds under the deep litter housing system.

3.3.2 Primary data collection

A household questionnaire designed to capture primary data on household’s demographic characteristics, flock size, production characteristics, marketing channels and economic aspects of production was designed and pre tested before being administered. Focus group discussions were also carried out to solicit information on egg marketing channels and issues to do with sustainability of the enterprise and training received.

The enumerators who assisted in the administration of the household questionnaire were trained over a period of 2 days and had a chance to conduct a field practise of the questionnaire to ensure internalisation of the household questionnaire and interview techniques. The enumerators were drawn from a pool of local extension officers based in the wards. A systematic random sampling technique was employed to select households for the selection of households to be interviewed from a population list of table egg producers.

3.3.3 Limitations of primary data collection

Some of the farmers who had been selected on the initial list of farmers had no production records hence had to be excluded from the analysis. Finding replacements for farmers without records proved to be costly as it meant more days for data collection of which the enumerators were being paid allowances using a daily rate, the household survey data collection period had to be extended by 2 more days coming up to 7 days. Also the farmers were not keeping weekly records on the weight of the birds and also the weight of eggs produced hence these will be excluded from the analysis.
3.3.3 Secondary data

Secondary data was also collected to guide this study in analysis and interpretation of results. Grey literature was also consulted in this study. The major problem encountered is that literature with regards to commercial egg production under smallholder farmers in Zimbabwe is relatively scant and most of the research work which has been conducted focused on indigenous or village poultry hence most referenced work has been from other third world countries which are comparable to Zimbabwe.

3.3.2 Data management

Data was entered using CSPRO and exported to SPSS 21.0 for analysis. Microsoft excel and GIS Arc View 3.2 was also used for the presentation of the survey results. Descriptive statistics were used to give a general description of interviewed households in terms of their socio-economic characteristics. A budgetary technique (gross margin analysis) was employed to determine the profitability of engagement in small scale table egg production and multiple regression analysis was performed to determine factors which affect the profitability of the egg enterprise. Secondary data review was done to assist in the interpretation of results coming out of the study.

3.4 Theoretical and analytical framework

The main theory underpinning this study is the neoclassical theory of profit maximisation which assumes that profit maximisation is the main objective of any business and that farmers want to maximise net returns or profit from variable inputs. Many proponents of theory have argued that the theory of profit maximisation has its advantages in that it is based on profits and that profits are a must for survival of any business. They have also argued that profits are a true measurement of viability of a business model and without profits, the business loses its primary objective and therefore has a direct risk on its survival (EFinance Management, 2013). The profit maximisation objective indirectly caters to social welfare, in a business, as profits rove efficient utilization and allocation of resources. Resource allocation and payments for labour, capital and organization takes care of social and economic welfare.
There are limitations to using the profit maximisation theory as maximum profits will not be obtained all the time and these include (EFinance Management, 2013);

i. The pursuit of multiple objectives of which profit earning may be only one of them – farmers in communal areas may engage in an enterprise just to please the extension worker or for prestige or motivated by food security and food self sufficiency in their decision to engage in a certain enterprise;

ii. Uncertainty and lack of information required to make rational decisions – farmers usually adapt to experiences from previous year rather than future expectations;

iii. Restraint imposed on the single-minded pursuit of profit maximisation by such other considerations as the prevention of potential entry of new firms as competitors, the long-term survival of the firm and self-preservation of the top management of the firm, which short-run profit maximization alone, would not guarantee.

Given the real-life uncertainty, inadequate information and other constraints, the issue of profit maximization is therefore about achieving a minimum satisfactory profit since firms can survive without maximizing profit if there are adequate barriers to entry of new firms. The profit maximisation theory was also used to guide this current study as it simplifies reality and allows the study to be undertaken within the set time frame and also takes into consideration that most farmers have a strong interest in making money from farming and try to do the best they can under their circumstances.

3.5 Analytical techniques

Table 3.1 presents a summary of the research objectives, hypothesis and data requirements, sources and analytical tools used to test the hypothesis in this study.
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<td>What are the levels of productivity among the smallholder commercial egg producers in terms of flock size, mortality rate, laying percent, cumulative eggs per hen housed and feed conversion ratio vis a vis the optimal levels?</td>
<td>To quantify productivity parameters (flock size, mortality rate, laying percent, cumulative eggs per hen housed and feed conversion ratio) of smallholder commercial egg producers.</td>
<td>The productivity indices for smallholder commercial egg are below the optimum levels.</td>
<td>Household demographics, production parameters (week by eggs produced, week by week cumulative mortality, week by week cumulative eggs per hen housed, optimum standard performance parameters of breeding companies)</td>
<td>Descriptive statistics and production graphs K-S Test for equality of distributions</td>
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<td>What are the production costs vis’ a vis’ the returns earned by small-scale commercial egg producing households?</td>
<td>To determine the profitability of small scale commercial egg production.</td>
<td>Small-scale commercial egg production is profitable.</td>
<td>Total Variable Costs Total Fixed Costs Total Revenue</td>
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<td>What are the main socio-economic and management factors which affect profitability of smallholder commercial egg production.</td>
<td>To identify the socio-economic and management factors which affect the profitability of the smallholder commercial egg production.</td>
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<td>Data on linkages with input and output markets.</td>
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Table 3.1: Summary of Research Objectives, Hypothesis, Analytical Methods and Data

References
3.5.1 Descriptive statistics
The descriptive statistics were used mainly in this study for the reader to have a general feel of the study population in terms of their demographic characteristics, production characteristics (mortality rates, laying percentages, feed consumption and hen-day percentages) and also access to extension. The production parameters under the current smallholder farmers will be compared with the breeder’s optimum production parameters to evaluate the performance of smallholder farmers. Descriptive statistics were used to build up the analysis for hypothesis one in this study. After the general description of the study population was given gross margin analysis was performed to estimate profitability of the egg enterprise.

3.5.2 Kolmogorov-Smirnov (KS-test) Equality of Distribution Test
The Kolmogorov-Smirnov test was also performed in this study to determine if there are any significant differences in the distribution of mortality rates, laying percent, feed consumption and cumulative eggs per hen housed under the deep litter system, cage system and the optimal conditions. The KS-test tries to determine if the distribution of two datasets differ significantly. The KS-test uses the maximum vertical deviation between the two curves as the statistic D (SEMATECH, 2012).

3.5.3 Gross margin analysis
The gross margin is a measure of enterprise viability (FAAB, 2011) and is the difference between gross income and total variable costs. Gross income is the total value of production from an enterprise and it includes sales, value of produce consumed at home and value of retained produce. The income items which were considered in this study were income from sale of eggs, sale of cull birds and sale of manure.

The variables costs are the production costs which can be directly allocated to a particular enterprise and they can change with size and scale of production. The cost items considered in this study were the cost of; housing, equipment, feed, labour, vaccinations and miscellaneous costs. Labour costs are incurred during the management of laying hens and this study collected data on labour hours per day devoted to layer management. This study will represent the labour cost using the cattle herders wage rates. This may reflect a reasonable opportunity cost of labour in rural areas. Also health care costs in this study include the costs
of medicines only and exclude veterinary visit charges as the farmers interviewed in the selected districts indicated that they were not paying for the veterinary visits. The gross margin analysis method was also used by Evbuomwan, 2005 in the study conducted in Nigeria on the empirical analysis of costs and returns to commercial egg production. The gross margin of an enterprise is expressed as follows;

\[ \text{GM} = \sum p_i q_i - \sum r_j y_i \]

Where:
- \( \text{GM} \) = Gross margin in USD/flock of laying birds
- \( p_i \) = Farm gate price of eggs in USD/dozen, price of cull birds, price of manure
- \( q_i \) = total eggs produced per laying flock, total number of cull birds, total number of bags of manure sold
- \( r_j \) = unit cost of variable inputs (feed, housing, equipment, labour, vaccinations)
- \( y_i \) = total quantity of inputs utilised by the laying flock

The limitations of using the gross margin analysis are that it assumes a linear relationship between inputs and outputs which in the real world is not always the case, they assume that enterprises are independent of each other yet in practical farming this is not completely true since enterprises do affect each other and that gross margin budgets tend to result in short term solutions as the budgets usually look at what happens to a business over a period of one season. The decision to use the gross margin budget in this study was influenced by the fact that most of the farmers interviewed were not keeping records of other farm operations which were not being supported by NGOs as they considered these to be traditional with limited focus on commercialisation hence making it impossible to perform a whole farm budget analysis.

### 3.5.3.2 Depreciation

Depreciation was for poultry buildings and equipment was calculated using the simple straight line method as shown below;

\[ \text{Depreciation} = \frac{\text{cost price} - \text{salvage value}}{\text{Life span}} \]

The salvage value for the buildings and equipment is assumed to be zero in this study.
3.5.4 Generalized Linear Model

The gross margin analysis paves way for the performance of the generalized linear regression to estimate the direction and strength of relationship between profit per 1000 eggs and variables affecting profit. Prior to performing the regression analysis this study explored the relationship between the dependent variable and each explanatory variable through the use of scatter plots to check for the feasibility of a linear relationship. The selection of the generalized linear model was based on the fact that the dependent variable approximates a normal distribution. The model is also simple to apply and can be used to include only those variables which are most relevant to policy. General linear regression models were used as these allowed the dependent variable which is continuous, $Y_i$, to be regressed against two or more explanatory variables (Gujarati, 2004).

The general linear model was fitted to test hypothesis 3 and the dependent variable was assumed to be a linear function of more than one independent variable and an error term introduced to account for all other factors. The following linear model was used in the study to estimate the determinants of profitability of smallholder egg production.

The regression model used in this present study is expressed as follows;

$$ Y = \beta_0 + \beta_1 \text{AGEHHH} + \beta_2 \text{SEXHHH} + \beta_3 \text{EDUCHHH} + \beta_4 \text{EXTEN} + \beta_5 \text{FCR} + \beta_6 \text{MORT} + \beta_7 \text{LAYPER} + \beta_8 \text{HOUSING} + \beta_9 \text{MARKDIFF} + \beta_{10} \text{MEMBER} + u_i $$

Where:

$Y$: profit (USD per 1000 eggs)

$\beta_1$: age of household head

$\beta_2$: sex of household head (1=male 0=female)

$\beta_3$: education level of household head (0= no education 1= educated)

$\beta_4$: access to extension services (0= no 1= yes)

$\beta_5$: feed conversion ratio (kg of feed consumed per dozen eggs produced)

$\beta_6$: mortality rate (%)

$\beta_7$: laying percentage (%)

$\beta_8$: housing type (1=cages 0=deep litter)

$\beta_9$: marketing difficulties (0= No 1=Yes)

$\beta_{10}$: Membership to producer association (0=No 1=Yes)

$u_i$: error term
\( \beta_1 \) is the intercept term and it gives the mean or average effect on \( Y \) of all variables excluded from the model (Gujarati, 2004). \( \beta_2, \ldots, \beta_{10} \) are regression coefficients and \( \mu_i \) is the error term. The random variable \( \mu_i \) has the following assumptions:

1. The variable \( \mu_i \) is a real random variable which is normally distributed with a mean of zero and a constant variance for all levels of each explanatory variable
2. The values of the random \( \mu_i \) are temporarily independent.
3. The disturbance term is not correlated with explanatory variables
4. The explanatory variables are measured without error
5. There is no multicollinearity among independent explanatory variables

Ordinary Least Squares method was used to find the parameter estimates and this method is subject to the following assumptions:

1. Parameter estimates obtained from ordinary least squares have some optimal properties such as unbiasness and efficiency advantages
2. Computational procedure for OLS is fairly simple and data requirements are not excessive
3. Mechanics of OLS are simple to understand and OLS is an essential component of most other econometric techniques

**Limitations of the Generalised Linear Regression Model**

The most common limitation of the linear regression model is that violation of the assumptions of the econometric model will result in unreliable estimates and standard errors. The other limitation is that one can identify relationships but can never be so sure of the causal mechanisms.
Table 3.2 presents the variables included in the model and their expected direction of influence on the profit obtained from an egg enterprise.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Variable Description</th>
<th>Relationship with Dependent Variable, ( Y ) Profit per 1000 eggs</th>
<th>Expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGEHHH</td>
<td>age of household head</td>
<td>Older household heads have more experience in rearing poultry hence better management techniques which improve profitability than younger heads</td>
<td>Positive</td>
</tr>
<tr>
<td>SEXHHH (dummy)</td>
<td>sex of household head 1 = male 0 = female</td>
<td>Chickens are mainly regarded as livestock for females hence females headed households are expected to manage better the poultry enterprise as compared to male headed households.</td>
<td>Positive</td>
</tr>
<tr>
<td>EDUCHHHH (dummy)</td>
<td>education level of household head 1 = with formal 0 = no formal</td>
<td>With enhanced entrepreneurial and management skills often acquired through education, the expected direction of the relationship with profitability is positive</td>
<td>Positive</td>
</tr>
<tr>
<td>EXTEN (dummy)</td>
<td>access to extension services (1 = yes 0 = no)</td>
<td>Access to extension may imply improved access to knowledge and services on animal husbandry hence improved management and profitability</td>
<td>Positive</td>
</tr>
<tr>
<td>FCR</td>
<td>Feed conversion ratio</td>
<td>The less the feed required to produce a dozen eggs, the more profit the egg enterprise generates</td>
<td>Positive</td>
</tr>
<tr>
<td>MORT</td>
<td>Mortality rate</td>
<td>The higher the mortality rate the less profit the egg enterprise generates</td>
<td>Negative</td>
</tr>
<tr>
<td>LAYERPER</td>
<td>Laying rate</td>
<td>A higher laying rate implies more eggs being produced and more profit being generated</td>
<td>Positive</td>
</tr>
<tr>
<td>HOUSING (dummy)</td>
<td>Housing type 1 = cages 0 = deep litter</td>
<td>Higher disease incidences are found within the deep litter system as birds come into contact with faecal material hence lower profitability</td>
<td>Negative</td>
</tr>
<tr>
<td>MARKDIFF (dummy)</td>
<td>Difficulties in getting markets for eggs (1 = Yes 0 = No)</td>
<td>Eggs are perishable products hence inability to find markets results in losses due to rotting under poor storage conditions thus reducing profits</td>
<td>Negative</td>
</tr>
<tr>
<td>MEMBER (member)</td>
<td>Membership to producer association (1 = Yes 0 = No)</td>
<td>Being a member might imply improved access to input and output markets hence lowering of costs and increase in profit</td>
<td>Positive</td>
</tr>
</tbody>
</table>

Table 3.2 Variables used in the multiple regression model

3.5.5 Thematic analysis

Data collected through focus group discussions was organized into themes which are presented in the last analysis chapter. The themes were constructed along lines to do with evaluation of extension methods used during the course of the project, evaluation of training received, input and output market contracts and formation of egg commodity associations and their utility to farmers.
3.6 Summary of the research methodology

This chapter presented the conceptual framework that was used to give direction to analysis for assessing the profitability of commercial egg production under smallholder farmers. The chapter also outlined the methods used for data collection and the major source was primary data collected through the administration of household surveys.

The theoretical and analytical approaches used for testing the hypothesis proposed in this study were also presented together with the limitations and strengths of using such approaches. The first hypothesis was tested using descriptive statistics to give a general description of surveyed households. The gross margin analysis was used to assess the profitability of commercial egg production under smallholder farmers and was used to test the second hypothesis. Picking from the gross margin analysis, the generalized linear model was fitted to estimate the direction and strength of the relationship between profit per 1000 eggs and the hypothesized determinants of profit. The thematic analysis was used to conclude the analysis chapter where data from focus group discussions was organized into certain themes.
CHAPTER 4:
CHARACTERIZATION OF SMALLHOLDER COMMERCIAL EGG PRODUCING HOUSEHOLDS

4.1 Introduction

This chapter presents the results on the characteristics of smallholder egg producing households. The sample consisted of households producing under the deep litter and cage housing system. This chapter starts by looking first at the demographic characteristics of commercial egg producing households and later on presents the production characteristics of these households in terms of mortality rates, laying rates, feed consumption and cumulative eggs per hen housed. The chapter finally looks at the access to veterinary and extension services by the smallholder farmers as this is important for the impartation of knowledge and support services required for successful commercialization of eggs. This chapter tests the hypothesis that households which engage in small-scale commercial egg production are older households, headed by females, educated and married whose production parameters under small scale farmers management practises are relatively poorer than under optimum conditions.

4.2.1 Household demographics

The survey collected information from 260 households of which 160 households were producing eggs under the cage housing system while on the other hand 95 households were producing eggs under the deep litter system. The overall picture shows that the majority of the interviewed households were headed by males (61%) while on the other hand 39% were headed by females. The average age for the households was 55 years, with the youngest reported as 24 years old and the oldest as 87 years. Most of the households interviewed are married (73, 6%) whilst on the other hand widowed households constituted 20, 5% of the sample households. These findings are generally consistent with other national surveys such as the ZIMVAC, 2012 and the national census.
<table>
<thead>
<tr>
<th></th>
<th>Percentage of households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male headed</td>
<td>60.9</td>
</tr>
<tr>
<td>Female headed</td>
<td>39.1</td>
</tr>
<tr>
<td>Married</td>
<td>73.6</td>
</tr>
<tr>
<td>Widowed</td>
<td>20.5</td>
</tr>
<tr>
<td>Divorced/separated</td>
<td>4.7</td>
</tr>
<tr>
<td>Single/never married</td>
<td>1.2</td>
</tr>
<tr>
<td>Age of household head</td>
<td>55 years</td>
</tr>
<tr>
<td>Average household size</td>
<td>5.5 members</td>
</tr>
</tbody>
</table>

Table 4.1 Demographic characteristics of sampled households

The level of education attained by the household head seems to be higher as only 3.9% were reported to not have attained any form of education and this is consistent with the setup in Zimbabwe where through government’s efforts to deliver free primary school education has resulted in increased literacy rates. Higher literacy rates may also imply the ease with which households may be able to adopt new technologies and ability to record and interpret production records on the farm if proper training is delivered to them. Figure 4.1 shows the distribution of households by education level of the household head.

Figure 4.1 Education level of household head

Source: Survey data
4.2.2 Presence of orphans, chronically ill persons and physically or mentally challenged persons

The survey also looked at vulnerability characteristics such as presence of orphans, chronically ill persons and physically or mentally challenged family members as these are considered when targeting households for support in humanitarian projects. In this survey chronic illness was defined as being ill for three or more months within a year and unable to work. Orphans were defined as children who are aged 17 and below.

As the data in table 4.2 shows, 26.9% of the interviewed households had the presence of at least one orphan, whilst on the other hand 4.6% and 5.4 % of the interviewed households reported the presence of at least one chronically ill and one physically or mentally challenged member respectively. Households with the highest load of orphans, chronically ill persons and mentally challenged persons are usually burdened as they have to allocate productive labour for the caring of these family members.

<table>
<thead>
<tr>
<th>Percent of households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orphans</td>
</tr>
<tr>
<td>Chronic illness</td>
</tr>
<tr>
<td>Physical or mental challenges</td>
</tr>
</tbody>
</table>

Table 4.2 Vulnerability characteristics of sampled households

Source: Survey data

4.3 Maize yields trend for selected districts

Since most of the farmers who were producing eggs within the sampled districts were buying concentrate feed which they had to mix with home grown maize it is also important to understand the maize production trends for these districts. Data extracted from the Ministry of Agriculture, Mechanization and Irrigation Development assessment reports was plotted to show the trend over time in maize production for the selected districts as shown in figure 4.2. Generally across all the districts survey maize yields have been on an upward trend.

The maize yields for Mutasa district are higher over time as compared to the two other districts. Mutasa attained an average maize yield level of 0.8 tonnes per hectare during the
2010/11 agricultural season compared to 0.74 and 0.4 tonnes per hectare which were obtained by farmers in Goromonzi and UMP respectively. The implication of these maize yields is that there is better access to maize for farmers in Mutasa and Goromonzi at relatively low prices when compared to UMP.

![Figure 4.2 Communal area maize yields over time](image)

Source: AGRITEX Reports

4.4 Commercial egg production characteristics under smallholder farmers

As alluded to earlier in this analysis chapter farmers were supported to produce eggs under the deep litter and cage rearing system and the next sections will present the results of the production parameters under these rearing system being compared to the optimal production levels which were established by the layers producing companies. Information collected from the farmers records regarding mortality rates, number of hens housed, age at peak of lay, peak percent lay and hen- housed egg production are presented in the sections which follow.
4.4.1 Flock size

Sampled households rearing birds under the cage system (see figure 4.3) were supported with packages which included some households receiving 6 point of lay pullets, some receiving 12 and others 18 birds. All farmers that were rearing birds under the deep litter system (see figure 4.3) received a support pack which had 20 point of lay pullets. For the sections which follow analysis of production parameters will be disaggregated by the rearing system.

Figure 4.3 Cage and deep litter housing system

The figure 4.3 above shows pictures of the cage housing system taken in Goromonzi for a farmer rearing 6 birds on the left hand side and on the right hand side the picture of the deep litter housing system in Mutasa.

4.4.2 Mortality rate

Mortality was defined as the number of birds that died or were culled during the egg production period (North, 1984). This was expressed as a percentage and calculated by dividing the number of birds which had died over time by the total number of the birds remaining multiplied by hundred. For this survey weekly mortality was recorded and the figure 4.4 presents the cumulative mortality rates which were recorded under deep litter and
cage rearing system. Figure 4.4 shows that mortality rates reported under the cage system were relatively lower when compared to that under the deep litter system.

![Diagram showing cumulative mortality by housing system](image)

**Figure 4.4 Cumulative mortality by housing system**

**Source: Survey data**

The K-S test was first performed to test if the distribution between the mortalities within the cage system is significantly different from that within the deep litter system and the results revealed that the maximum difference between the cumulative distributions, D, is 0.6875 with a corresponding P of 0.000. This implies that the distribution of mortality rates for the cages is significantly lower than that for the deep litter system. After having established this, the K-S test was also performed to ascertain if the distribution of mortality is different for the cage system and the optimal. The D value of 0.2344 was found with a corresponding P of 0.05 implying that the mortality rate under the optimal conditions is lower than that under both the cage system and the deep litter system.
It was observed that generally the cage system was cleaner when compared to the deep litter system as birds did not come into contact with fecal material within the cage system. At 52 weeks of age, the deep litter system had accumulated mortality rate of above 7% while on the other hand the cage system had reported 5% mortality.

Discussions with the Veterinary services and department of livestock staff operating in these districts yielded that most of the deaths reported were linked to poor hygiene and were due to respiratory infections. Observations in the field showed that feed under the deep litter system was sometimes contaminated with fecal matter when compared to that under the cages hence explaining the higher mortality rate for the deep litter system.

### 4.4.3 Laying rate

The percent lay on a weekly basis which was calculated using the formula whereby the total number of eggs produced on a weekly basis was divided by the number of birds available in the flock within that week multiplied by hundred is presented in figure 4.5 (North, 1984).

![Figure 4.5 Percent lay by housing system](image)

**Source:** Survey data
The figure 4.5 shows that generally the deep litter system had a low laying rate when compared to the cage systems. Peak lay percent for birds kept under the deep litter system was reported at 62% during week 22 and week 23, dropping off sharply after the birds had reached week 32 of age. On the other hand birds within the cage system reached a maximum laying rate of 80% in weeks 22, 23, 32 and 33 which was significantly higher when compared to the deep litter system. The laying rates recorded by the smallholders were below the optimal levels for the birds which were housed where it is expected that under good management the birds have a potential of reaching a maximum laying rate of 94 to 95% within the first 4 weeks of in lay. The K-S test showed that the maximum difference between the cage and deep litter laying rate cumulative distributions, \( D \), is 0.6719 with a corresponding \( P \) of 0.000 implying that the laying rate for the cage system is higher than that under the deep litter system. When the cage system laying rate is compared to the optimal laying rate the \( D \) value is 0.6875 with a corresponding \( P \) of 0.000 implying that both the cage and the deep litter system laying rates fall below the optimal.

Farmers keeping the birds under the deep litter system continued to raise the birds even if production had fallen below 50% implying that there is likelihood that they were incurring losses during this period as it is recommended that culling should start as soon as production drops to below 50%. Farmers interviewed attributed the drop in egg production to the onset of the rainy season which they reported to have been characterized by sudden rises in temperature in areas such as UMP. Low laying rate can also be attributed to feed especially maize that was of poor quality given to birds as farmers who had run out of grain had to access the GMB D-grade maize whose condition had deteriorated whilst in storage.

4.4.4 **Cumulative egg production per hen-housed by housing system**

Hen-housed production on a weekly basis was calculated using the formula whereby the total number of eggs produced by the flock within a week was divided by the number of hens which were housed during that week (North, 1984). The figure 4.6 shows that birds which were reared under the deep litter attained a maximum of 158 eggs per hen housed while on the other hand more eggs per hen housed were obtained under the cage system which produced on average 298 eggs during the production cycle.
The number of eggs obtained per hen housed under both rearing systems is significantly lower than the optimal. It is expected that a hen will reach a maximum of 350 to 360 eggs per bird within the laying cycle under optimal conditions. The K-S test showed that the eggs produced by a bird under the cage system were significantly more when compared to the deep litter system. When the cage system is compared to the optimal, the maximum difference between the cumulative distributions D is 0.1875 with a corresponding P of 0.188 implying that the cumulative distribution of eggs under the cage system and the optimal is not significantly different.

### 4.4.5 Feed consumption by housing system

Literature identified feed costs to be the single largest contributor towards total costs of production. Laying chickens require a completely balance diet to sustain maximum egg
production over time. Farmers in the study areas were buying concentrate feed and mixing it with home grown maize for feeding of their birds. The results of the study (figure 4.7) revealed that birds which were reared under the deep litter system were fed on average 143 grams per bird per day while on the other hand those which were reared under the cage system 115 grams per bird per day. The farmers rearing birds under the deep litter system attributed the higher amount of feed given per bird to have resulted from spillages which occurred whilst these were observed to be low on the cage system. Generally it is recommended that a bird should received 113 to 117 grams of feed per day implying that studied households rearing layers under the deep litter system were giving feed over and above of what is required hence incurring more costs in feed.

Figure 4.7 Feed consumption by housing system

Source: Survey Data

The K-S test for equality of distributions confirmed that farmers within the deep litter system were giving significantly more feed to their layers when compared to those operating under the cage system. Though the cage system appears to be following closely to the optimal feeding rate, there are significant differences in the amount of feed which was given to layers as reflected by a D of 0.5156 with a corresponding P of 0.000. Generally all farmers in
surveyed districts were giving more feed to their birds as compared to that recommended under optimal conditions.

In addition to a constant supply of nutritionally balanced layer food, fresh and clean water should always be provided, as a layer can consume up to one–quarter of a litre a day (FAO, 2003). The study assessed the various sources of water which was being given to the layers and the results are presented in table 4.3. A multiple response analysis was performed since households indicated that they drew water from more than one source depending on the season for watering their birds and the results shows that most of the households which reared layers under the deep litter system watered the birds using borehole water which is considered to be safe and clean whilst on the other hand households rearing layers in cages were using mostly water drawn from a deep well whose cleanliness and safety is subject to debate.

<table>
<thead>
<tr>
<th>Source</th>
<th>Deep litter (Percent of cases)</th>
<th>Cages (Percent of cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borehole</td>
<td>94.6%</td>
<td>23.5%</td>
</tr>
<tr>
<td>Deep well</td>
<td>62.0%</td>
<td>93.4%</td>
</tr>
<tr>
<td>Tapped</td>
<td>6.5%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Dam/river/stream</td>
<td>2.2%</td>
<td>5.90%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>165.2%</strong></td>
<td><strong>125.0%</strong></td>
</tr>
</tbody>
</table>

Table 4.3 Water sources used by farmers for layers

Source: Survey data

4.5 Access to training and extension and veterinary services

Regular training of farmers in layer husbandry and marketing of eggs is essential as it helps producers to understand the demands of the market and modify their production and marketing accordingly. Linkages to veterinary and extension services officers provide a valuable link between technical research workers and market intermediaries and the producers. Households interviewed were asked whether they had received training and extension services for poultry production especially layers and it is quite encouraging that
99% of all households interviewed indicated that they had received training and extension support from various institutions as presented in figure 4.8.

![Figure 4.8 Training and extension services providers](image)

**Source:** Survey Data

From the multiple response analysis of training and extension services providers it is noted that NGOs were collaborating with government departments in the provision of services as 49.6% of the interviewed households reported to have received training jointly supported from NGOs, AGRITEX, DLPD and Veterinary Services departments. What can be worrying is the 42.2% of the households which received training and extension services support from NGOs only as this is not sustainable in the long run as the tenure of the NGO officers is dependent upon the availability of donor funds.

Other sources of extension as identified by farmers included churches and other farmers and 3.5% of the households indicated to have received training and extension services from these. On the frequency of farmer to extension worker, the majority (73.3%) of the interviewed households indicated that they were meeting with the extension worker once per month whilst 18%, 8.2% and 0.4% indicated that they had contact 8 times per month, 4 times per month and once in every three months respectively with the extension services providers. It is
expected that the higher the frequency on farmer to extension worker contact the more the information is transmitted to farmers that could help in execution of management decisions.

4.6 Access to markets and marketing information
Households interviewed were also asked questions on who sets the selling price of eggs, how the price was set, which markets they sold their eggs, whether they had entered into any contract for poultry production and if they were members of any poultry producers association. The results shows that farmers producing eggs are mostly price followers with very little control on the egg prices set as 56.4%, 11.3% and 0.4% indicated that they followed market prices, prices set by the NGOs and buyers respectively. Approximately 26.8% and 4.3% indicated that prices for eggs were set by themselves and the producer association respectively.

In terms of membership to a producer association only one district, Goromonzi, was found to have constituted an egg producer association (Chinamhora Egg Producer Association) which organized farmers for group supply of eggs to shops in Harare and also group procurement of feeds. Organization of farmers into groups is important as costs can be reduced through discount sales when they buy feed in bulk and also pooling of eggs for penetration of distant markets can also be made possible. Farmers in Goromonzi were also contributing USD0.50 per bird per month towards the procurement of replacement stock whereas in other districts (Mutasa and UMP) this was not happening hence posing questions on the sustainability of their approaches.

In terms of markets for the eggs, the majority (77.1%) of the households interviewed indicated that they were selling their eggs at the farm gate as shown in figure 4.9. The implications for this are that minimal costs are incurred when selling in terms of transport and packaging as it was observed that packaging was provided to customers who only bought a crate of eggs and anything less than that the customer had to bring his/her own packaging. The producers commented that the demand for eggs was outstripping supply and most of the eggs were being bought by the local community and all eggs regardless of size were being sold at USD1.00 for 6 eggs. As the grading of eggs was not being done farmers were losing potential income they could get if the grading system is implemented and pricing of eggs is done according to grades.
4.7 Summary of findings and insights drawn from the analysis

The survey found out that most of the households interviewed were headed by males (61%) whose average age was reported to be 55 years with the youngest being 24 years and the oldest being 87 years old. Most of the household heads were also found to have received formal education indicating high literacy levels which makes it easier for the dissemination of information through both electronic and print media. The average maize yields in the surveyed districts have been generally on an upward trend which is a positive for farmers growing layers in these districts as it may imply low prices for maize grain which is mixed with concentrate feed for the birds. Flock size for the cage system ranged from 6 to 18 birds and all farmers rearing birds under the deep litter system had 20 birds each.

Laying rate and cumulative hen-housed egg production was found to be significantly higher under the cage system when compared to the deep litter system. Also the mortality rate under the deep litter system was found to be significantly higher when compared to the cage system. Feed given to the birds under the deep litter system was significantly more when
compared to that given under the cage system. The production parameters are generally favoring the cage system against the deep litter system and this may imply that promotion of the cage system is more appropriate within the rural setting as it has the potential to improve profits obtainable. When the production parameters of the communal farmers are compared to those under optimal conditions, the study revealed that the communal farmers were operating below par hence this is likely to negatively affect profitability.

The effect of mortality rates, laying rate and cumulative hen-housed egg production attained by surveyed households on profitability is discussed in the following chapters. In terms of access to training and extension, most households indicated to have received these during the production period from various sources which included NGOs, AGRITEM, LPD, Veterinary Services Department, dealers of inputs, lead farmers and other sources such as churches. There are 42.2% of the households which indicated to have received training from NGOs only and this is a worrying situation as it can be classified as an unsustainable means of supporting farmers as NGO staff leave the area when donor funds get exhausted.
CHAPTER 5

PROFITABILITY ANALYSIS OF COMMERCIAL EGG PRODUCTION UNDER SMALLHOLDER COMMUNAL FARMERS

5.0 Introduction

Keeping other factors constant, cost of production, gross return and net profit are the major financial concerns of commercial egg operations (Farooq, M et al, 2003). Profit is a function of cost of production, gross return and prevalent market price, thereby minimizing cost of production and maximizing gross return would result in higher profit. Having assessed the various production parameters such as mortality rate, laying rate, cumulative hen-housed egg production, feed consumption and price setting mechanisms in the preceding chapter, this chapter being guided by the neoclassical theory of profit maximisation which assumes that profit maximisation is the main objective of any business and that farmers want to maximise net returns or profit from variable inputs uses the gross margin to assess profitability of commercial egg production. The gross margin analysis was used to test the hypothesis that commercial egg production by smallholder farmers is profitable.

5.1 Capital expenditures and start costs

The findings in relation to the costs of production, gross income and net income are presented in table 5.1. This section will offer a discussion of the findings on capital expenditure and start up costs. These include costs of building and equipment depreciation and cost of point of lay pullets. These are presented in sections which follow in relation to their contribution to total costs of production and disaggregated by flock size and housing type.

5.1.1 Building and equipment depreciation costs by housing type, flock size and their contribution to total costs

Farmers who were supported with layers for commercial egg production constructed the deep litter poultry houses using locally available materials. The cost of building and equipment depreciation was USD6.27, USD6.04, USD10.02 and USD5.28 per bird in a flock size of 6 birds in cages, 12 birds caged, 18 birds caged and 20 birds under the deep litter system respectively. The building and equipment depreciation costs are relatively higher for the 18 birds caged (23.33%) when compared to the 20 birds deep litter system (13.87%). A possible
explanation for this is that additional charges are incurred with improved housing like cages where equipment for watering and feeding may be costly given that most of the cages which are used are currently being imported from China.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cost/Returns per bird in USD</th>
<th>Percent contribution</th>
<th>Cost/Returns per bird in USD</th>
<th>Percent contribution</th>
<th>Cost/Returns per bird in USD</th>
<th>Percent contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building and equipment</td>
<td>6.27</td>
<td>13.0</td>
<td>6.04</td>
<td>13.56</td>
<td>10.02</td>
<td>23.34</td>
</tr>
<tr>
<td>Variable Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of point of lay pullets</td>
<td>10.00</td>
<td>20.8</td>
<td>10.00</td>
<td>22.44</td>
<td>10.00</td>
<td>23.29</td>
</tr>
<tr>
<td>Cost of concentrates (A)</td>
<td>14.00</td>
<td>14.00</td>
<td>11.67</td>
<td>10.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of maize grain (B)</td>
<td>12.98</td>
<td>11.08</td>
<td>8.69</td>
<td>7.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total feed cost (A+B)</td>
<td>26.98</td>
<td>56.1</td>
<td>25.08</td>
<td>56.29</td>
<td>20.36</td>
<td>47.41</td>
</tr>
<tr>
<td>Labour cost</td>
<td>4.32</td>
<td>9.0</td>
<td>3.12</td>
<td>6.45</td>
<td>2.23</td>
<td>5.19</td>
</tr>
<tr>
<td>Health care costs</td>
<td>0.49</td>
<td>1.0</td>
<td>0.25</td>
<td>0.56</td>
<td>0.31</td>
<td>0.72</td>
</tr>
<tr>
<td>Packaging</td>
<td>0.05</td>
<td>0.1</td>
<td>0.07</td>
<td>0.15</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td>Variable costs subtotal</td>
<td>41.84</td>
<td>38.52</td>
<td>32.92</td>
<td>32.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cost of production</td>
<td>48.11</td>
<td>100.0</td>
<td>44.55</td>
<td>100.00</td>
<td>42.94</td>
<td>100.00</td>
</tr>
<tr>
<td>Revenue</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income from marketable eggs</td>
<td>56.75</td>
<td>91.90</td>
<td>48.54</td>
<td>90.66</td>
<td>48.78</td>
<td>90.70</td>
</tr>
<tr>
<td>Income from spent birds</td>
<td>5.00</td>
<td>8.10</td>
<td>5.00</td>
<td>9.34</td>
<td>5.00</td>
<td>9.30</td>
</tr>
<tr>
<td>Income from manure</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Gross income</td>
<td>61.75</td>
<td>100.00</td>
<td>53.54</td>
<td>100.00</td>
<td>53.78</td>
<td>100.00</td>
</tr>
<tr>
<td>Gross margin</td>
<td>19.92</td>
<td>15.02</td>
<td>20.86</td>
<td>-1.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net profit</td>
<td>13.65</td>
<td>8.98</td>
<td>10.84</td>
<td>-6.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Returns per dollar invested</td>
<td>0.48</td>
<td>0.39</td>
<td>0.63</td>
<td>-0.04</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.1 Gross margin analysis per bird as affected by stocking rate and housing type

Source: Survey Data

In terms of percent contribution of building and equipment depreciation towards the overall cost of production across all stocking levels and housing system the 18 birds caged system reported a significantly higher percent contribution of 23.34% whereas the percent contribution of the 6 birds cages and the 12 birds cages were comparable to those of the 20 birds deep litter system.
5.1.2 Cost of point of lay pullets and its contribution to total costs

Farmers who were rearing layers under the cage system procured their birds at a relatively cheaper price of USD10 per bird as compared to those under the deep litter system who procured their birds at a price of USD12.50 per bird. The percent contribution of pullets to total cost was found to be significantly higher for the deep litter system (32.87%) when compared to the cages where the percent contribution to total costs was 20.79%, 22.44% and 23.29% for the 6 birds caged, 12 birds caged, and 18 birds caged respectively. Finding point of lay pullets ready on the market is proving to be difficult in Zimbabwe as most farmers interviewed indicated that pullet producers would only supply 2 months after an order has been placed. Layers day old chicks are available but require specialized labor for their upkeep until they reach the age of laying as they need specialized vaccinations and treatments from 1 week to the point of lay, a skill which the farmers interviewed indicated to lack in.

5.2 Operating costs/expenses

These are incurred during the day to day running of the egg production enterprise and are derived from feed costs, labour costs and health care costs. The following section presents the operating costs in relation to their contribution to total costs of production disaggregated by housing type and flock size.

5.2.1 Feed costs by housing type, flock size and their contribution to total costs

As shown in table 5.1 the average feed costs per bird were USD26.98, USD25.08, USD20.36 and USD17.40 at flock levels of 6 birds caged, 12 birds caged, 18 birds caged and 20 birds under deep litter system respectively. The study revealed that feed cost was the major component contributing 56.09%, 56.29, 47.41% and 45.76% of the total production costs for the 6 birds caged, 12 birds caged, 18 birds caged and 20 birds under deep litter system respectively. These results are generally consistent with the other findings of previous studies which have shown that feed costs are a major component of the total production costs. The results surprisingly shows relatively lower percent contribution when compared to Farooq et al, 2002 findings where feed cost contributed 76.73% to the total cost of production. It is against the expectation that the cost of producing feed is relatively higher when compared to other countries in the region as it is comparatively costly to produce maize and soya beans is Zimbabwe when compared to other countries which produce these using high yielding GMO
A possible explanation to the significantly lower contribution of feed cost (45.76%) to total cost of production under the deep litter system is that farmers in these districts accessed D Grade maize from GMB which they used for mixing with concentrate feed when compared to farmers in the cage system who could not access this seed and hence had to use grain normally reserved for household consumption. Using B grade maize significantly reduces the cost of feed but the question which remains is whether this maize is of good quality nutrition for feeding layers and its effect on egg production.

5.2.2 Labour costs by housing type, flock size and their contribution to total costs

The cattle wage rate was used as a proxy to the wage rate that one would receive when tending to chickens in this study. The average cost of labour per bird was found to be USD4.32, USD 3.12, USD 2.23 and USD 2.25 for the flock size of 6 birds caged, 12 birds caged, 18 birds caged and 20 birds deep litter system respectively (table 5.1). The contribution of labor cost to total production cost was significantly higher for smaller flock sizes such as the 6 birds (8.98%) and 12 birds (6.43%) and this can reflect that farmers with larger flock sizes have better management of time and can benefit more from economies of scale.

5.2.3 Health care costs by housing type, flock size and their contribution to total costs

The average costs of health care cost per bird were found to be USD0.49, USD0.25, USD 0.31 and USD0.45 for the flock size of 6 birds caged, 12 birds caged, 18 birds caged and 20 birds under the deep litter system respectively. The deep litter system (1.18%) reported a higher percent contribution of health care costs towards total costs of production when compared to the cage system. The higher health care costs under the deep litter system are indicative of poor hygienic conditions for bird reared on the floor in comparison to those reared in cages. Birds reared on floors usually come into contact with fecal material when bedding is not regularly changed and also when food and water are contaminated by bird droppings. A comparison of the percent contribution of health care costs under the cages under different flock levels reveals that the smaller the flock size, the higher the percentage contribution of health care to total cost of production. Medication is lost when dilutions are indicated for a number of birds more than the stock level hence farmers lose out when they
under stock. This also implies that farmers can benefit from economies of scale if they stock at appropriate levels and make efficient utilization of medication.

5.3 Overall costs of production by housing type and flock size

The overall costs of production per bird are significantly lower for the 20 birds reared under the deep litter system at USD38.03 as compared to the 18 birds caged, 12 birds caged and 6 birds caged which reported USD42.94, USD44.55 and USD48.11 respectively. Evidently the use of low cost maize grain by farmers under the deep litter system resulted in substantive reduction in total costs when compared to farmers under the cage system. Maize production in Zimbabwe is relatively costly when compared to other countries such as South Africa which use high yielding GMO seed. The high cost of production of major ingredients into stock feed such as maize and soya beans in Zimbabwe also result in high costs of production for farmers engaging in poultry production and also due to the fact that most companies which produce stock feeds are still operating below capacity as they are still recovering from a hyperinflationary period hence shortages of stock feed on the market also imply high costs to the farmers when they procure the stock feed.

Looking only at the birds which are kept under the cages, flock size is shown to have a significant impact on the cost of production as a low flock size is associated with a higher cost of production. This implies that with large flock size there is an efficient utilization of available resources. Also the cost of pullets for farmers under the deep litter system was relatively higher when compared to the price paid by farmers using the cage system hence it is important that farmers have access to market information which can result in savings on costs when they procure birds cheaply. Alternatively training and extension can also be targeted at keeping of layers from day old chicks to point of lay if the option proves to be cheaper than buying point of lay pullets.

5.4 Discussion of income from sales of eggs and spent layers

The income from the selling of eggs per bird were USD56.75, USD48.54, USD 48.78 and USD26.35 for a flock size of 6 birds caged, 12 birds caged, 18 birds caged and 20 birds under deep litter over a one year production cycle respectively. Eggs were the main products contributing to 91.90%, 90.66%, 90.70% and 84.05% of the total income for the flock sizes of 6 birds caged, 12 birds caged, 18 birds caged and 20 birds under deep litter respectively.
These results are consistent with findings from other studies conducted which showed eggs to be the main produce contributing to the overall income obtained in commercial egg production. Rarely would you find farmers selling manure in the study sites as most indicated to have used it in their gardens or fields for fertilization given that currently in the country the prices for fertilizer are relatively high due to shortages being experienced and are also beyond the reach of many communal farmers who are facing liquidity challenges following the introduction of the multi-currency use in 2009. All spent layers were being sold at a price of USD5 per bird in the areas surveyed.

5.5 Discussion of the gross income and net profit per bird under smallholder farmers

The gross income per bird was reported to be the highest for a stock level of 6 birds reared in cages (USD61.75) followed by 18 birds caged (USD53.78) and 12 birds caged (USD53.54) and reported to be the lowest for a flock size of 20 birds reared under the deep litter system (USD31.35). Though farmers operating the deep litter system had managed to reduce the costs of production, low egg production worked counter to the gain from feed cost cutting and resulted in low income being generated for the deep litter system when compared to the cage system which reported high gains from egg sales.

The returns per dollar invested were found to be the highest per bird for the flock size of 18 birds caged (USD0.63) followed by 6 birds caged (USD0.48) and 12 birds caged (USD0.39) and lastly negative for the 20 birds under the deep litter system (-USD0.04). The results shows that relatively larger flock sizes tend to earn more income per dollar invested under the cage system. This could be so as the cage system has shown higher income earned from egg production. Low income from sell of eggs from the deep litter system can be attributed to use of poor quality maize grain in comparison to that used in the cage system which could have resulted in poor performance of the birds.

<table>
<thead>
<tr>
<th>Flock size and housing type</th>
<th>Total Costs USD/bird</th>
<th>Total Income USD/bird</th>
<th>CPP (TI/TC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 birds caged</td>
<td>48.11</td>
<td>61.75</td>
<td>1.28</td>
</tr>
<tr>
<td>12 birds caged</td>
<td>44.55</td>
<td>53.54</td>
<td>1.20</td>
</tr>
<tr>
<td>18 birds caged</td>
<td>42.94</td>
<td>53.78</td>
<td>1.25</td>
</tr>
<tr>
<td>20 birds deep litter</td>
<td>38.03</td>
<td>48.92</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Table 5.2 Coefficient of private profitability in egg producing farms
The profitability of commercial egg production under small holder farmers was measured using the coefficient of private profitability (CPP) whereby total income per bird was divided by the total costs per bird. If the CPP is less than 1, then it is not profitable to produce commercial eggs under smallholder management at the present productivity level. The coefficient of private profitability is greater than unity according to the results presented in table 5.2 for the flock size of 6 birds under cages, 12 birds caged and 18 birds caged which implies that at all flock sizes and housing type, egg production was profitable at the production level and price level prevailing at the time of conducting this study.

The flock size of 20 birds under deep litter system had a coefficient of private profitability which was less than one implying that egg production under the deep litter system was not profitable at the prevailing productivity level. Ranking of these results shows that profit was higher for farmers with a flock size of 18 birds being reared under the cage system followed by 20 birds under the deep litter system, 6 birds caged and lastly 12 birds caged.

5.6 Summary of findings and insights drawn from the analysis

Feed costs fuelled the total production costs across all flock sizes and housing systems followed by the cost of point of lay pullets. Eggs were the major produce contributing towards income obtained by farmers engaged in commercial egg production. Layers under the cage system yielded higher net profit per bird when compared to those reared under the deep litter system which yielded negative returns.

Generally profit was increasing with flock size implying that large flocks size results in more efficient utilization of available resources when compared to smaller flock sizes. This also implies that farmers stand a chance to benefit from economies of scale when flock size is increased as they would be able to buy inputs in bulk at discounted prices. Overall, egg production under smallholder communal farmers for all flock sizes reared under the cage system was found to be profitable given the prevailing production levels and price levels whilst on the other hand it was not profitable to produce eggs under the deep litter system. To better isolate the effect of factors affecting profitability of smallholder commercial egg production, the next chapter builds on the analysis and in cooperates the multiple regression analysis.
CHAPTER 6

ESTIMATION OF THE HYPOTHESIZED DETERMINANTS OF PROFIT IN SMALLHOLDER COMMERCIAL EGG PRODUCTION

6.1 Introduction

In seeking to better understand the factors which affect profitability of commercial egg producing among smallholder farmers; this thesis fitted the generalised linear model for the estimation of hypothesized determinants of profit per 1000 eggs. Primary data is analysed being guided by the neoclassical economics theory which contends that main objective of any business is to maximise profits. The first step involved performing a correlation matrix of the independent variables to test for multicollinearity and this was followed by performance of a probability distribution of the dependent variable to explore if profit per 1000 eggs is normally distributed. The results of the models are presented in the sections which follow.

The OLS technique was applied to estimate factors which affect profitability of smallholder commercial egg production using SPSS 21.0 to statistically test the significance of the hypothesized determinants of smallholder commercial egg production. The results of the statistical analyses performed are presented in the sections which follow.

6.2 Testing for the independence of independent variables

The problem with multicollinearity is that if 2 or more explanatory variables are highly correlated then it becomes difficult for one to separate out the individual effects of the variables on the dependent variable. Coefficients greater than 0.65 tends to suggest a problem of multicollinearity. The assumption of independence of the independent variables was tested and it holds for the coefficients in correlation matrix as all coefficients fall below 0.65 (see appendix 2). According to the result obtained from the analysis there is no strong multicollinearity and degree of association between the continuous and dummy variables respectively.

6.3 Exploration of the cumulative probability plot of profit per 1000 eggs

The cumulative probability plot of profit per 1000 eggs is also presented below to plot the risk of engaging in smallholder commercial egg production. In the plot shown in figure 6.1,
there is a 17.6% chance for households which engage in smallholder commercial egg production to get a profit of zero or negative per 1000 eggs. There is a 50% chance that farmers who engage in smallholder commercial egg production get a profit of approximately USD58 per 1000 eggs sold.

Figure 6.1 Cumulative probability plot for profit per 1000 eggs (USD)

Source: Survey Data

The table 6.1 below also shows the distribution of households according to the ranges of profit per 1000 eggs. The majority of the households (78.2%) posted a profit of between USD0.23 to USD100 per 1000 eggs produced and sold. On the other hand, quite a substantial proportion of households (17.6%) posted negative profits.

<table>
<thead>
<tr>
<th>Profit range (USD per 1000 eggs)</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 100 to 0</td>
<td>41.0</td>
<td>17.6</td>
</tr>
<tr>
<td>0.23 to 100</td>
<td>178</td>
<td>78.2</td>
</tr>
<tr>
<td>101 to 150</td>
<td>10</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Table 6.1 Proportion of households by range of profit per 1000 eggs
6.4 Study Hypotheses
The study hypotheses on the determinants of profitability were developed in consideration of the primary data collected through household surveys and with reference to literature. The hypotheses are summarized in the table 6.1 which follows;

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Variable Description</th>
<th>Relationship with Dependent Variable , Y Profit per 1000 eggs</th>
<th>Expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGEHHH</td>
<td>age of household head</td>
<td>Older household heads have more experience in rearing poultry hence better management techniques which improve profitability than younger heads</td>
<td>Positive</td>
</tr>
<tr>
<td>SEXHHH</td>
<td>sex of household head</td>
<td>Chickens are mainly regarded as livestock for females hence females headed households are expected to manage better the poultry enterprise as compared to male headed households.</td>
<td>Positive</td>
</tr>
<tr>
<td>EDUHHH</td>
<td>education level of household head</td>
<td>With enhanced entrepreneurial and management skills often acquired through education, the expected direction of the relationship with profitability is positive</td>
<td>Positive</td>
</tr>
<tr>
<td>EXTHHH</td>
<td>access to extension services</td>
<td>Access to extension may imply improved access to knowledge and services on animal husbandry hence improved management and profitability</td>
<td>Positive</td>
</tr>
<tr>
<td>FCR</td>
<td>Feed conversion ratio</td>
<td>The less the feed required to produce a dozen eggs, the more profit the egg enterprise generates</td>
<td>Positive</td>
</tr>
<tr>
<td>MORT</td>
<td>Mortality rate</td>
<td>The higher the mortality rate the less profit the egg enterprise generates</td>
<td>Negative</td>
</tr>
<tr>
<td>LAYPER</td>
<td>Laying rate</td>
<td>A higher laying rate implies more eggs being produced and more profit being generated</td>
<td>Positive</td>
</tr>
<tr>
<td>HOUSING</td>
<td>Housing type</td>
<td>Higher disease incidences are found within the deep litter system as birds come into contact with faecal material hence lower profitability</td>
<td>Negative</td>
</tr>
<tr>
<td>MARKDIFF</td>
<td>Difficulties in getting markets for eggs</td>
<td>Eggs are perishable products hence inability to find markets results in losses due to rotting under poor storage conditions thus reducing profits</td>
<td>Negative</td>
</tr>
<tr>
<td>MEMBER</td>
<td>Membership to producer association</td>
<td>Being a member might imply improved access to input and output markets hence lowering of costs and increase in profit</td>
<td>Positive</td>
</tr>
</tbody>
</table>

Table 6.2 Description of Hypothesized Determinants of Smallholder Commercial Egg Profitability

6.5 The Generalized Linear Model
The following linear model was used by the study for the estimation of the determinants of profit per 1000 eggs. OLS was applied to estimate the direction and quantity of the
relationship between profit per 1000 eggs and the variables which affect profit. The model is presented as follows;

\[ Y = \beta_0 + \beta_1 \text{AGEHHH} + \beta_2 \text{SEXHHH} + \beta_3 \text{EDUCHHH} + \beta_4 \text{EX TEN} + \beta_5 \text{FCR} + \beta_6 \text{MORT} + \beta_7 \text{LAYPER} + \beta_8 \text{HOUSING} + \beta_9 \text{MARKDIFF} + \beta_{10} \text{MEMBER} + u_i \]

Where:

Y: profit (USD per 1000 eggs)
\( \beta_1 \): age of household head
\( \beta_2 \): sex of household head (1=male 0=female)
\( \beta_3 \): education level of household head (1= educated 0= no education)
\( \beta_4 \): access to extension services (1= yes 0= no)
\( \beta_5 \): feed conversion ratio (kg of feed consumed per dozen eggs produced)
\( \beta_6 \): mortality rate (%)
\( \beta_7 \): laying percentage (%)
\( \beta_8 \): housing type (1=cages 0= deep litter)
\( \beta_9 \): marketing difficulties (1=Yes 0= No)
\( \beta_{10} \): Membership to producer association (1=Yes 0=No)
\( u_i \): error term

<table>
<thead>
<tr>
<th></th>
<th>( \beta )</th>
<th>Std. Error</th>
<th>T-statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>109.083***</td>
<td>33.922</td>
<td>3.216</td>
</tr>
<tr>
<td>AGEHHH</td>
<td>-0.091</td>
<td>0.166</td>
<td>-0.548</td>
</tr>
<tr>
<td>SEXHHH</td>
<td>6.800*</td>
<td>3.989</td>
<td>1.705</td>
</tr>
<tr>
<td>EDUCHHH</td>
<td>-12.199</td>
<td>12.196</td>
<td>-1.000</td>
</tr>
<tr>
<td>EX TEN</td>
<td>-6.479</td>
<td>6.260</td>
<td>-1.035</td>
</tr>
<tr>
<td>HOUSING</td>
<td>27.332**</td>
<td>13.407</td>
<td>2.039</td>
</tr>
<tr>
<td>MARKDIFF</td>
<td>-9.203***</td>
<td>4.729</td>
<td>1.946</td>
</tr>
<tr>
<td>MEMBER</td>
<td>14.978***</td>
<td>5.312</td>
<td>2.820</td>
</tr>
<tr>
<td>FCR</td>
<td>-30.260***</td>
<td>7.793</td>
<td>-3.883</td>
</tr>
<tr>
<td>LAYPER</td>
<td>0.002</td>
<td>0.168</td>
<td>-0.011</td>
</tr>
<tr>
<td>MORT</td>
<td>0.624</td>
<td>1.327</td>
<td>0.470</td>
</tr>
<tr>
<td>R- squared</td>
<td></td>
<td></td>
<td>0.758</td>
</tr>
<tr>
<td>Adjusted R squared</td>
<td></td>
<td></td>
<td>0.741</td>
</tr>
<tr>
<td>F value (P-value)</td>
<td></td>
<td></td>
<td>43.968 (0.000)</td>
</tr>
</tbody>
</table>

*** significance at 1%, ** Significance at 5%, * Significance at 10%

Table 6.3 Linear Regression coefficient estimates for Determinants of Profitability of Smallholder Egg Enterprise
The model for estimating the determinants of commercial egg profitability among smallholder farmers is significant with an F value of 43.97 and the independent variables in the model explain 74.1% of the variability in profitability. From the model, five variables namely sex of household head, housing type, membership to a poultry producers association, difficulties in getting buyers and feed conversion ratio were significant in explaining variability in profit. Male headed households were shown significantly to earn more profit per 1000 eggs than female headed households which is contrary to the prior expectation. The possible explanation for this is that most of the male headed households were married (95.2%) hence those labelled to be male headed households have the input of females. Households which are headed by males will have a USD6.80 increase in profit per 1000 eggs holding other factors constant.

Rearing of layers under the cage system was also shown to significantly increase profit per 1000 eggs by USD27.33 holding other factors constant. The results confirm the hypothesis that birds within the cage system earn more profit as compared to those reared under the deep litter system at 5% significance level. Farmers which face difficulties in getting buyers of their eggs will incur a loss of USD9.20 per 1000 eggs holding other factors constant. These results confirm the set hypothesis. Failure by farmers to get buyers will result in losses due to rotting and/or selling of eggs at discounted prices to avert the problem hence resulting in low profitability. If farmers have to travel long distances to sell their eggs, the number of breakages may increase depending on the type of transport used and also marketing costs will increase thus eroding the marginal profits.

The feed conversion ratio which is more of a management issue was shown to negatively affect profitability whereby a one kilogram increase in kilograms of feed required to produce a dozen eggs will result in a USD30.26 decline in profitability per 1000 eggs. This observation confirms the set hypothesis. Overfeeding the birds imply more costs on feed being incurred hence a reduction in profitability implying that farmers who want to maximise profits need to properly manage the birds feeding regime according to the breed’s optimal requirements.

Being a member to a poultry producer association was shown to positively affect profitability thus confirming the set hypothesis. Farmers who are members of a poultry producers association earn USD14.98 more profit per 1000 eggs as compared to those who are not members holding other factors constant and this is significant at 1%. Membership to a farmer
group as got its advantages in that bulk purchases of inputs for egg production can be done at discounted prices and also bulk deliveries of eggs to large customers can also be done at more favourable prices. The equation for profitability of smallholder commercial egg production is written as follows:

\[ Y = 109.083 - 0.091 \text{AGEHHH} + 6.80\text{SEXHHHMALE} - 12.199\text{EDUCHHH} - 6.470\text{EXTEN} - 30.260\text{FCR} + 0.624\text{MORT} + 0.002\text{LAYPER} + 27.332\text{HOUSING} - 9.203\text{MARKDIFF} + 14.978\text{MEMBER} \]

### 6.7 Summary of findings

In this chapter, the OLS model of hypothesized determinants of profit per 1000 eggs was estimated by fitting a generalised linear model to assess factors which affect profitability among smallholder communal farmers. Based on this model, the following variables were found to be significant in determining profitability of commercial egg production namely; sex of household head, housing system, difficulties in getting buyers (dummy variable 1=yes), membership to poultry producers association and the feed conversion ratio. The feed conversion ratio and facing difficulties in getting buyers of eggs had a negative and significant effect on profitability of the commercial egg enterprise.

Rearing birds under the cage system had a positive and significant effect on profitability as compared to rearing birds under the deep litter system. Male headed households were shown to earn positive and significant profits per 1000 eggs when compared to female headed households. Membership to a producer association also had positive and significant impact on profitability.
CHAPTER 7

DOCUMENTATION OF THE VIEWS OF FARMERS WITH REGARDS TO MARKET ACCESSIBILITY ISSUES

7.1 Introduction

This chapter, which is the last analysis chapter, serves to document the views and perceptions of smallholder commercial egg producers with regards to market accessibility issues. The chapter analyses data mainly from the focus group discussions conducted and household surveys and captures mainly the perception of farmers with regards to the constraints which they face. Success of a poultry enterprise is measured by the quantity and quality of products sold and consequently the amount of profit generated (Mapiye et al 2008). Chicken production in the rural areas of Zimbabwe using local breeds is generally characterized by poor reproductive performance, poor growth rates, diseases, parasitism, and lack of organized markets (Muchenje, et al 1997). Having reviewed the production characteristics of commercial egg producing housing in the previous chapters, this chapter will concentrate mainly on the socio economic constraints which smallholder farmers face.

This chapter will first present an analysis of the existing linkages between the surveyed households and input markets, followed by access to credit and a review of infrastructural constraints and knowledge gaps.

7.2 Linkages with input suppliers

Since farmers in the sampled districts had received their point of lay pullets through direct distribution from NGO programs to kick start commercial egg production, this survey asked a question to evaluate whether these farmers had been linked to suppliers of point of lay pullets for future procurement of replacement stock. The results of the survey shows that generally a greater proportion of the interviewed households had not been linked to the suppliers of point of lay pullets as 76.8% of the interviewed indicated that they would get the point of lay pullets from the NGO and some did not know where to get them from. This can indicate a clear indication of lack of market information which needs to be addressed or a donor dependency syndrome which raises concern on the sustainability of commercial egg
production. It would be interesting to conduct a survey a few years after the departure of NGOs in these areas to see which farmers would continue commercial egg production without external assistance. On a positive note 20.7% of the households indicated that they would get replacement from the dealer of birds they had been linked.

![Figure 7.1 Proportion of households by perceived source of replacement stock (pullets)](image)

**Source:** Survey Data

**7.3 Evaluation of the of the input supply system from the farmers perspective**

Households were also asked questions that would evaluate the input supply system in terms of availability of critical inputs such as concentrate feed, maize grain, replacement stock and veterinary services. What was referred as the nearest markets by the households for concentrate feed were not markets within their districts but the nearest town for example farmers in Goromonzi were buying their concentrate feed from Harare while on the other farmers in UMP and Mutasa were buying from Murewa and Mutare respectively. There was limited availability of concentrate feed within shops in the most of the districts surveyed except for Goromonzi. Farmers in Goromonzi indicated that they would pay USD1.00 per 50kg bag of stock feed for transportation from Harare to their respective areas whereas those
in Mutasa indicated that they were paying USD2.00 in transport costs for the same bag for transportation from Mutare and Murewa.

<table>
<thead>
<tr>
<th>Availability of concentrates on nearest market</th>
<th>Not available</th>
<th>Fairly available</th>
<th>Readily available</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.4</td>
<td>3.4</td>
<td>92.2</td>
</tr>
<tr>
<td>Availability of maize grain on local market</td>
<td>1.0</td>
<td>7.7</td>
<td>91.3</td>
</tr>
<tr>
<td>Availability of replacement stock</td>
<td>14.4</td>
<td>10.9</td>
<td>74.8</td>
</tr>
<tr>
<td>Availability of veterinary services</td>
<td>4.8</td>
<td>14.0</td>
<td>81.2</td>
</tr>
</tbody>
</table>

Table 7.1 Proportion of households by response to availability of inputs for egg production

Source: Survey Data

Table 7.1 shows that farmers could readily access concentrate feed and maize grain on markets they considered to be nearer to them. The availability of veterinary services also was not an issue in the surveyed districts as 81.2% of the surveyed households indicated that these were readily available.

Having considered the availability of inputs on the markets, the study also asked farmers questions to evaluate the prices attaining at these markets and results are presented in table 7.2. The analysis shows that the prices of concentrate feed and veterinary drugs were considered to be ranging fair and high across all study sites. Increased costs of concentrate feed can act negatively against the profitability of the egg enterprise hence there is a need for the promotion of growing of soya beans and maize grain which the farmers will fortify with essential minerals for home based feeds to reduce feed costs.
<table>
<thead>
<tr>
<th>Input prices for concentrate feed</th>
<th>Low</th>
<th>Fair</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.4</td>
<td>53.9</td>
<td>25.7</td>
</tr>
<tr>
<td>Input prices for veterinary drugs</td>
<td>19.9</td>
<td>51.9</td>
<td>28.2</td>
</tr>
</tbody>
</table>

Table 7.2 Evaluation of prices for stock feed and veterinary drugs

Source: Survey Data

7.6 Poor physical infrastructure

All surveyed districts are linked to the major towns and cities but observations of the condition of the roads shows that they have been deteriorating overtime. The deterioration of the road network was blamed by surveyed households for resulting in high transport costs as transport operators hike fees to cover up costs of maintaining vehicles and this has the effect of increasing costs of accessing inputs and thus profitability of the egg enterprise. Agro dealers operating in these areas also indicated that large companies which produce stock feed were also not willing to deliver stock feed to rural agro dealers as transport costs are high given that orders placed will be low hence the agro dealers outsource delivery services from private players whose charges are exorbitant in their view. The costs of transport incurred by agro dealers in transmitted to the farmers in the form of hiked price of feed.

This shows that there is need for the policy makers to channel funds towards the improvement of road networks linking rural areas to urban areas for improved movement of stock feed and also eggs as they are transported to lucrative markets. The rural agro dealers interviewed also indicated that the large stock feed making companies and animal drug producers were shunning away from the providing them with stock feed and drugs on a credit basis as they did not have collateral to insure against goods delivered. There is a need to get information with regards to the views of the input supplying companies on this issue.
7.4 Linkages with output markets

Most farmers interviewed indicated that most of their eggs were being bought at farm gate and had not entered into contracts with external markets (3.6% had contracts). Those farmers who had contract were found in Goromonzi where farmers organized into an egg producer association had entered into formal contracts with retail shops in Harare such as SPAR, OK and Bon Marche for supplying 100 crates of eggs on a weekly basis. Not all farmers in Goromonzi were willing to supply their eggs to these shops as they realized that they could get more by selling at farm gate price as these retail shops charged 10% for packaging for the price agreed per crate. External markets are important for the absorption of excess produce in future in cases where there will be a market glut caused by an increased number of producers as new farmers come on board. Group formations can also be important for bulk purchasing of inputs at discounted prices and also for bulk transportation and pooled sales to external markets which can greatly improve profitability of egg production under smallholder farmers.

Currently the farmers in the surveyed districts are not aware of the local demand for their eggs and their production decisions are mainly being based on the present events. Some farmers in UMP indicated that they were facing challenges in getting markets for their eggs and this can be contributed by the fact that the district is relatively far away from the nearest town which is Murewa which could help in absorbing their eggs. It is important that market linked production be promoted especially when perishable products such as eggs are produced rather than starting to promote production and then look for a market.

7.5 Access to credit

Credit that is reasonably priced is essential for the expansion of the egg production business as farmers have been shown to benefit from economies of scale. Farmers in the surveyed districts just like any other communal farmer in Zimbabwe have limited access to credit stemming mainly from the lack of collateral required for borrowing. All farmers interviewed in the surveyed districts indicated to have not accessed credit from financial services providers even though group accounts had been opened with CABS in UMP and AGRIBANK in Goromonzi. Interest rates which were being charged by lending institutions ranged from 16-35% for short term loans and this is considered to be high when compared to other countries in Southern Africa. Farmers in UMP had organized themselves into groups of
8 members where each member contributed USD10.00 which was given to one member on a rotational basis per week. This approach resulted in each farmer getting approximately USD80.00 during the week of their turn of receiving. This also highlights the importance of group formations in the case of UMP district which in resulted farmers accessing working capital at zero percent interest.

7.7 Access to training and extension

Although analysis of the proportion of farmers that had received extension support shows that 99% of the interviewed households had received training from various services providers, an evaluation of the production parameters such as mortality rates, laying percentages and feed management as obtained by the survey of farmers still shows that there is room for improvement in the management of birds. This improvement can be brought through training of farmers and provision of information that will assist them in making informed decisions. The farmers interviewed indicated that before they received the point of lay pullets they went through training for a period of about 6 months and this was done in a classroom style of learning with farmers taking notes in the books. This approach may be criticized in that the farmers did not have the birds to do the training with hence abstracting from the realities they faced when they had birds. The suggestion here is that methods of disseminating information can be improved to ensure a complete internalization of the information and that should a similar project be implemented elsewhere, training should include hands on practice.

7.7 Summary of findings

Farmers operating egg production enterprises in the rural areas face problems when they engage the input and output markets. For example most farmers interviewed (76.8%) did not know where they would get replacement stock from once their hens had finished off the laying circle implying that there was no direct link of the suppliers of birds to the farmers which will result in unsustainable commercial egg production as unscrupulous middleman may identify this information gap and start supplying birds at very high prices. The nearest markets for stock feeds preferred by farmers were in large towns and cities not within their district of operation. With farmers having to access stock feeds from the large towns and cities they faced the challenge of high transport costs as each 50kg bag of stock feed was being charged at USD1.00 and USD2.00 by transport operators in Goromonzi, and UMP and Mutasa district respectively. All egg producing farmers interviewed in the surveyed districts
indicated to not have been able to access loans from the banks even if they had opened accounts and deposited money in these banks. The farmers cited lack of collateral as the major bottle neck preventing them from accessing loans. Training gaps are still evident amongst egg producing households as indicated by the high mortality rates, low laying percentage and poor feed management.
CHAPTER 8

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

8.1 Introduction

This study was conducted primarily to examine the profitability of commercial egg production under smallholder communal farmers. An upsurge in the number of smallholder farmers taking up poultry production has been widely noted in the country yet the performance of these had not been documented hence it was necessary that this study be conducted generate information which can be used by decision makers and investors with regards to support to smallholder communal farmers engaged in commercial egg production. Descriptive statistics were used in this study for the characterisation of egg producing households in terms of their demographic characteristics and egg production characteristics. This was mainly done so as to also get a feel of what is happening in the data as a first step in analysis. Analysis was done disaggregated by the housing type as it was noted in the study that performance was linked to the type of housing.

The second step involved the use of the gross margin analysis technique to determine the level of profit for households producing eggs under both the deep litter and cage housing system. To better isolate the direction and quantity of the relationship between each factor independent variable on profitability of commercial egg production under smallholder communal farming, a generalized linear model was fitted to identify factors which affect profitability per 1000 eggs produced by a communal farmer. Besides looking at the production and technical constraints to smallholder commercial egg production, this study in a bid to include the voice of the farmer, presented a thematic analysis of issues coming out of focus group discussions which were designed to capture the perception of farmers with regards to the socio-economic constraints which they face when they engage the input and output markets.

The purpose of this chapter is to provide a summary of key findings of the study and in the process provide conclusions and policy recommendations. A brief overview of the findings from empirical analysis is first presented and this is followed by policy insights, implications of findings and recommendations on the areas for further study.
8.2 Summary of findings

The first hypothesis to be tested was;

*The productivity indices for smallholder commercial egg producers are below the optimum levels.*

Descriptive statistics presented in tables and graphs were used in this study for the description of surveyed households in terms of their demographic and commercial egg production characteristics followed by the performance of the K-S test to ascertain if there are significant differences in the cumulative distributions of mortality, eggs per hen housed, feed consumption and laying rate disaggregated by housing system and compared to the optimal rates. Survey findings revealed that the average age of household head for commercial egg producing households is 55 years with the youngest household head being aged 24 and the oldest 87 years. Most of the households interviewed were headed by males (61%) an observation which is consistent with most findings in rural areas of Zimbabwe. Since chickens are mainly regarded as women’s livestock while large animals are considered to be men’s livestock in most African countries it was expected that households engaging in commercial egg production will be headed mostly by females. The implications of these findings are that promotion of poultry production should be holistic and target all members regardless of gender orientation. A further assessment of who does what disaggregated by gender on commercial egg production can have the potential of revealing this if conducted. Membership to an egg producing association was reported in only one district (Goromonzi) where structures for the association had been put in place and was not evident in other districts surveyed.

The level of education for household heads among the interviewed households was very high as 96.1% of the interviewed households indicated that the head had attained formal education being split as follows; primary education (44%) followed by secondary education (45.9%) and tertiary education (6.2%). The implications of these results are that training and dissemination of information becomes easier through the use of print and electronic media which in turn may result in ready uptake of technology for improving the profitability of commercial egg production.

Production characteristics as defined by parameters such as mortality rate, laying rate, cumulative hen housed egg production feed management though below the optimum levels
shows that generally farmers operating under the cage system performed better than those operating under the deep litter housing system when the K-S test was performed. The K-S test revealed that farmers operating under both the cage system and the deep litter system were operating below the optimal rates. An analysis of the markets to which the eggs were being sold revealed that most households (77.1%) were selling their eggs at the farm gate. In the future with increased competition due to entry of new players, selling of eggs can become a challenge to these farmers hence they should be encouraged to forge linkages to other external markets.

The second hypothesis to be tested was:

*Small-scale commercial egg production is profitable.*

For this hypothesis, the gross margin analysis technique was used to determine profitability of smallholder commercial egg production under the cage and deep litter system and also disaggregated by the flock size. For all housing systems, feed costs were the major contributors to total costs contributing 56.1%, 56.29%, 47.41% and 45.76% of the total costs for the 6 birds caged, 12 birds caged, 18 birds caged and the 20 birds deep litter system. Feed costs were followed by the cost of point of lay pullets which contributed approximately 20.8%, 22.44%, 23.29% and 32.87% towards total costs for the 6 birds caged, 12 birds caged, 18 birds caged and the 20 birds deep litter system. The major contributor to income obtained by the commercial egg producers was eggs which contributed on average 91.9%, 90.66%, 93.6% and 84.05% of the total income obtainable in commercial egg production for the 6 birds caged, 12 birds caged, 18 birds caged and the 20 birds deep litter system.

The gross margin analysis found production under the cage system to be profitable when compared to production under the deep litter housing system which obtained a net loss of USD6.67. Households under the cage system obtained a net profit of USD13.95, USD8.98 and USD35.23 for stock levels of 6 birds, 12 birds and 18 birds respectively. The returns per dollar invested was found to be USD0.48, USD0.39, USD0.60 and a negative USD0.04 for the 6 birds caged, 12 birds caged, 18 birds caged and the 20 birds deep litter system respectively. The coefficient of private profitability also showed that for the cage system it was profitable to produce commercial eggs at all stock levels as the coefficient was greater
than unity. On the other hand the coefficient of private profitability for the deep litter system was 0.82 implying that it was not profitable to produce eggs under this system at prevailing production and price levels.

The third hypothesis to be tested was;

*Profitability of smallholder commercial egg production is positively and significantly affected by the education level of household head and farmer’s management of layers.*

OLS regression model was fitted to identify the key factors which affect the profitability of smallholder commercial egg production. The results of the cumulative probability plot of profit per 1000 eggs shows that there is a 17.6% chance of posting a loss when smallholder farmers engage commercial egg production. Sex of household head, housing type, facing difficulties in getting customers for eggs, membership to producer association and feed conversion rate were factors which were found to significantly affect profitability per 1000 eggs. Households which were headed by males earned USD6.80 more profit per 1000 eggs as compared to those headed by females. It is also important to note that most of these male headed households were married. Farmers rearing the layers under the cage system earned USD27.33 more profit per 1000 eggs as compared to those that reared under the deep litter system holding other factors constant. Also being a member to poultry producer association positively affected profitability, with members earning USD14.98 more profit than those who were not members. Farmers who faced difficulties in getting customers for their eggs report a USD9.20 loss in profitability as compared to those who do not face these challenges holding other factors constant. A one kilogram increase in the quantity of feed required to produce a dozen eggs will negatively affect profitability resulting in a loss of USD30.26 holding other factors constant. The level of education of household head was found to have no significant effect on profitability of the egg enterprise.

The final analysis chapter documented the views and perceptions of farmers with regards to market accessibility challenges they face. This chapter is mainly relied on the thematic analysis of findings from the focus group discussions conducted to document the perception of smallholder commercial egg producers with regards to the constraints they face in input and output markets. The study revealed that there were limited linkages that existed between
egg producers and suppliers of inputs such as the point of lay pullet producers and stock feed manufacturing companies. This conclusion is based on the fact that 20.7% of the interviewed households responded that they would get replacement stock of pullets directly from suppliers whilst 64.5% indicated they would get from NGOs and 12.3% had no idea of where they would get them from. Stock feeds which were being used by the surveyed households had been procured from areas outside their districts which had cost implications as they had to meet the costs of transportation. Most farmers indicated that the feed and drugs were readily available in these distant markets. The deterioration of the condition of the road network was also cited by farmers as resulting in hiked prices of inputs for commercial egg production if sold by local agro dealers within the districts.

Only farmers in Goromonzi had signed contracts with external buyers such as OK retail shop, SPAR and Bon Marche but most of the eggs were being sold at farm gate as the farmers indicated that they would make more from local sells. The retail shops were deducting 10% of packaging from the agreed price hence the reluctance of some farmers to channel their eggs through these shops. External markets are important in the future when there in increased competition which will result in a local market glut. All farmers even though they had opened group accounts with banks in their districts could not access credit as they did not have collateral.

8.3 Policy Insights and Implications of Findings
The first objective of this study was to characterize small-scale egg producing households and evaluate egg production parameters such as cumulative mortality, laying percentages, cumulative eggs per hen housed, feed consumption and flock size. Demographic statistics showed that most of the households engaging into commercial egg production had households heads who were literate hence for information dissemination it is important that print media in the form of pamphlets be made available as reference material for poultry production advise. The performance of birds being kept under the cage system was better than that under the deep litter system by such parameters as mortality rate, laying percent, cumulative egg production per hen housed and feed management. A change in the approach in which farmers are trained should be effected to include more focus on the practical lessons on handling of birds to ensure complete internalization of information.
The second objective of the study was to determine the profitability of commercial egg production under smallholder farmer management. The study revealed that it is profitable to produce eggs under the cage system as compared to the deep litter system which yielded a loss. Policy makers can assist in the promotion of local steel manufacturing industries which produce steel cages for egg production to ensure that these are available locally and at reasonable price which is affordable to communal farmers. Feed was identified as the largest contributor to total costs of production among farmers hence promotion of the production of soya beans and maize grain should be done among communal farmers so that they would be able to formulate home based feeds which can reduce the costs of feed. The reduction of import duty on inputs for commercial egg production can also be done so that farmers can access stock feed at lower prices from other countries which are producing it cheaply. Following the assessment of the local market demand for eggs in Zimbabwe, the government can also regulate the importation of eggs to protect the growing farmers from global competition.

The third objective of this study was to identify the socio-economic and management factors which affect profitability of smallholder commercial egg production. The study revealed that five variables namely sex of household head, housing type, membership to a poultry producers association, difficulties in getting buyers and feed conversion ratio were significant in explaining variability in profit. Households which are headed by males have a USD6.80 increase in profit per 1000 eggs holding other factors constant as compared to those headed by females. Rearing of layers under the cage system was also shown to significantly increase profit per 1000 eggs by USD27.33 holding other factors constant as compared to rearing birds under the deep litter system. Management of birds to minimise losses due to ill health or death of birds is still critical for farmers who are operating the deep litter system hence government training and extension should continuously train farmers in better management of layers. Farmers which face difficulties in getting buyers of their eggs will incur a loss of USD9.20 per 1000 eggs holding other factors constant. Entrepreneurship skills development is critical for these farmers so that they can easily identify markets for their eggs. Being a member to a poultry producer association was shown to positively affect profitability thus confirming the set hypothesis. Farmers who are members of a poultry producers association earn USD14.98 more profit per 1000 eggs as compared to those who are not members holding other factors constant and this is significant at 1%. The feed conversion ratio which is more of a management issue was shown to negatively affect profitability whereby a one unit
increase in kilograms of feed required to produce a dozen eggs will result in a USD30.26 decline in profitability per 1000 eggs. Management of the feeding regime of layers according to breed recommendation is critical in cost reduction thus calling for training of farmers on feed management.

The forth objective of this study was to elicit farmer’s perception and views on market accessibility. The study revealed that according to the interviewed egg producers still had limited linkages with the point of lay pullet suppliers. The feasibility of raising layers from day old up to the egg production stage by smallholder farmers can also be looked into. Access to credit by communal farmers is still limited due to lack of collateral. Training and capacity building of agro dealers in decentralised areas in the districts is recommended so that farmers can be able to access inputs cheaply within their locality. Investments in the road network can also result in the reduction of transport costs as the rural areas become easily accessible.

8.4 Areas of further study

The study alluded to the need for the assessment of local market demand for eggs in each of the surveyed districts so that farmers and project implementers can make informed decisions. It would be good to know the market demand in each area to prevent on oversubscription of producers within an area should prospects for up scaling arise. Given that this present study has examined the factors which affect profitability of smallholder commercial egg production and revealed that the feed conversion rate was an important factor in explaining variation in profitability. It is also important that a study be commissioned to explore home grown feeds which farmers can use for cost minimisation in the egg enterprise without compromising on productivity. Another area to explore is from a gender perspective whereby who is doing what and who controls use of proceeds from commercial egg production within a household in relation to commercial egg production.
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# APPENDIX 1: GROSS MARGIN ANALYSIS

<table>
<thead>
<tr>
<th>Variables</th>
<th>6 birds caged</th>
<th></th>
<th>12 birds caged</th>
<th></th>
<th>18 birds caged</th>
<th></th>
<th>20 birds deep litter</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Cost/Returns per bird in USD</td>
<td>Percent contribution</td>
<td>Cost/Returns per bird in USD</td>
<td>Percent contribution</td>
<td>Cost/Returns per bird in USD</td>
<td>Percent contribution</td>
<td>Cost/Returns per bird in USD</td>
<td>Percent contribution</td>
</tr>
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<td><strong>Fixed costs</strong></td>
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<td></td>
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<td>Building and equipment depreciation</td>
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<td>6.04</td>
<td>13.56</td>
<td>10.02</td>
<td>23.34</td>
<td>5.28</td>
<td>13.87</td>
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<td><strong>Variable Costs</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of point of lay pullets</td>
<td>10.00</td>
<td>20.8</td>
<td>10.00</td>
<td>22.44</td>
<td>10.00</td>
<td>23.29</td>
<td>12.50</td>
<td>32.87</td>
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<td>Cost of concentrates (A)</td>
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<td></td>
<td>14.00</td>
<td></td>
<td>11.67</td>
<td></td>
<td>10.20</td>
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<tr>
<td>Concentrate feed used (kg)</td>
<td>120kg</td>
<td></td>
<td>240kg</td>
<td></td>
<td>297kg</td>
<td></td>
<td>300kg</td>
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<td>Cost of maize grain (B)</td>
<td>12.98</td>
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<td>Maize grain used (kg)</td>
<td>192kg</td>
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<td>408kg</td>
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<td>462kg</td>
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<td>540kg</td>
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<td>Total feed cost (A+B)</td>
<td>26.98</td>
<td>56.1</td>
<td>25.08</td>
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<td>20.36</td>
<td>47.41</td>
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<td>Labour cost</td>
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<td>5.19</td>
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<td>5.92</td>
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<td>0.72</td>
<td>0.45</td>
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<td><strong>Variable costs subtotal</strong></td>
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<td>38.52</td>
<td></td>
<td>32.92</td>
<td></td>
<td>32.75</td>
<td></td>
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<tr>
<td><strong>Total cost of production</strong></td>
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<td>100.0</td>
<td>44.55</td>
<td>100.00</td>
<td>42.94</td>
<td>100.00</td>
<td>38.03</td>
<td>100.00</td>
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<tr>
<td><strong>Revenue</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Income from marketable eggs</td>
<td>56.75</td>
<td>91.90</td>
<td>48.54</td>
<td>90.66</td>
<td>48.78</td>
<td>90.70</td>
<td>26.35</td>
<td>84.05</td>
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<td>Income from spent birds</td>
<td>5.00</td>
<td>8.10</td>
<td>5.00</td>
<td>9.34</td>
<td>5.00</td>
<td>9.30</td>
<td>5.00</td>
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<td>Income from manure</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td><strong>Gross income</strong></td>
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<td>53.54</td>
<td>100.00</td>
<td>53.78</td>
<td>100.00</td>
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<td><strong>Gross margin</strong></td>
<td>19.92</td>
<td>15.02</td>
<td>20.86</td>
<td></td>
<td>-1.40</td>
<td></td>
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</tr>
<tr>
<td><strong>Net profit</strong></td>
<td>13.65</td>
<td></td>
<td>8.98</td>
<td></td>
<td>10.84</td>
<td></td>
<td>-6.67</td>
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</tr>
<tr>
<td><strong>Returns per dollar invested</strong></td>
<td>0.48</td>
<td>0.39</td>
<td>0.63</td>
<td></td>
<td>-0.04</td>
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</table>
## APPENDIX 2: CORRELATION MATRIX

<table>
<thead>
<tr>
<th></th>
<th>age of HHH</th>
<th>SEX OF HHH</th>
<th>new level of education</th>
<th>Did you get extension services for poultry production during project implementation</th>
<th>kgs of feed per dozen eggs</th>
<th>total mortality</th>
<th>new laying rate</th>
<th>housing type</th>
<th>do you face any difficulty in getting your eggs</th>
<th>Is any member of household a poultry producer association member</th>
</tr>
</thead>
<tbody>
<tr>
<td>age of HHH</td>
<td>Pearson Correlation</td>
<td>1</td>
<td>.039</td>
<td>.124</td>
<td>.059</td>
<td>.059</td>
<td>-.187**</td>
<td>.041</td>
<td>.076</td>
<td>.067</td>
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<td>Sig. (2-tailed)</td>
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<td>-.053</td>
<td>-.160*</td>
<td>.068</td>
<td>-.073</td>
<td>-.166**</td>
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<td>.043</td>
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<td>.059</td>
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<td>.181**</td>
<td>-.013</td>
<td>-.131**</td>
<td>.239*</td>
<td>-.105**</td>
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<tr>
<td>kgs of feed per dozen eggs</td>
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<td>-.053</td>
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<td>.181**</td>
<td>-.013</td>
<td>.174**</td>
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<td>-.186**</td>
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<td>-.073</td>
<td>.068</td>
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<td>.221**</td>
<td>-.726**</td>
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<td>.106</td>
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<td>do you face any difficulty in getting your eggs</td>
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<td>-.105</td>
<td>.102</td>
<td>.264**</td>
<td>-.186*</td>
<td>.106</td>
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<td>239</td>
<td>239</td>
<td>239</td>
<td>205</td>
<td>157</td>
</tr>
<tr>
<td>Is any member of household a poultry producer association member</td>
<td>Pearson Correlation</td>
<td>-.228**</td>
<td>-.080</td>
<td>-.033</td>
<td>-.207**</td>
<td>.159**</td>
<td>.212**</td>
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<td>157</td>
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</tbody>
</table>

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

*. Correlation is significant at the 0.05 level (2-tailed).
APPENDIX 3: DISTRIBUTION OF PROFIT PER 1000 EGGS

Mean = 40.64
Std. Dev. = 42.454
N = 239
APPENDIX 4 HOUSEHOLD QUESTIONNAIRE

EGG MODELS EVALUATION HOUSEHOLD QUESTIONNAIRE

<table>
<thead>
<tr>
<th>1. Province</th>
<th>2. District</th>
<th>3. Enumarator’s Name</th>
<th>4. Date (dd/mm/yyyy)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Respondent’s Name</th>
<th>6. Village Name</th>
<th>7. Ward Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8. Beneficiary status</th>
<th>1= Non Beneficiary</th>
<th>2= Beneficiary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.1 If beneficiary household, what is the type of egg production model that the HH benefited from?
1= 6 birds caged  2= 12 birds caged  3= 40 birds on ground  4= 70 birds
5= 100 birds on ground  6= 50 birds caged  7= 18 birds caged  8= other specify

<table>
<thead>
<tr>
<th>9. Sex of Household Head</th>
<th>1 = Male</th>
<th>2 = Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. Level of education of HHH
1= no formal education  2= primary education
3= secondary education  4= tertiary education

11. DOB of household head year of birth only
1= Single/never married  2= Married  3= Divorced/Separated  4= Widowed

12. Marital Status of HH Head
1= Single/never married  2= Married  3= Divorced/Separated  4= Widowed

13. Number of people in the HH

(Complete the table by Sex and Age Group)

<table>
<thead>
<tr>
<th>Please write '0' if there are none</th>
<th>Members aged under 5 years</th>
<th>Members aged 5-17 years</th>
<th># of Members aged 18-59</th>
<th># of Members aged 60+</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 a. Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 b. Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 c. Orphans (one or both parents dead)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>14 d. Chronically ill (ill for 3 or more months and unable to work)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 e. # physically/mentally challenged</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Poultry Ownership (section not for project layers)

<table>
<thead>
<tr>
<th>Poultry type</th>
<th>15a. Current Flock size</th>
<th>15b. Type of housing (multiple response)</th>
<th>15c. Feed type</th>
<th>15d. Main Water source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broilers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guinea fowl</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ducks</td>
<td>Turkeys</td>
<td>Indigeno us chickens</td>
<td></td>
<td></td>
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<tr>
<td>-------</td>
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<td></td>
</tr>
</tbody>
</table>

**Type of Housing**
1 = deep litter  
2 = battery cage  
3 = no housing  
4 = other specify

**Permanent water source**
1 = dam  
2 = river/stream  
3 = deep well  
4 = borehole  
5 = tapped

**Feeding type**
1 = commercial  
2 = Home based  
3 = free range  
4 = other specify

---

18. Cost and Revenue Structure of layers production (for beneficiaries this section is for project layers only – costs and revenue to be captured for one month only except for fixed costs)

<table>
<thead>
<tr>
<th>Cost/Revenue</th>
<th>Units</th>
<th>Total Number</th>
<th>Unit Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Direct Costs</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Feed costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- concentrates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- maize grain/crush</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Oil or paraffin lamp, candles or electricity</td>
<td></td>
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<tr>
<td>Water cost</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Health Care costs (medicines, vaccination, disinfection) ESB3, Terramycin, Stress Pack, Disinfectants</td>
<td></td>
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</tr>
<tr>
<td>Litter costs (floor material)</td>
<td></td>
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</tr>
<tr>
<td>Nest material</td>
<td></td>
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</tr>
<tr>
<td>Packaging</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Transportation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous(Producer Association Levy, maintenance and repairs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B. Fixed Costs</strong></td>
<td>Useful life in yrs</td>
<td>Units</td>
<td>Total Number</td>
<td>Unit Cost</td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Bricks</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>- Cement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Corrugated Iron (roofing)</td>
<td></td>
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<tr>
<td>- Asbestos(roofing)</td>
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<td></td>
</tr>
<tr>
<td>- Thatch</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>- Timber</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>- Wire mesh</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Labour</td>
<td>Labour hrs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeding equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Drinkers</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>- Feeders</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
87

- Nest boxes

- Perches

Labour (cleaning troughs, bed changing, watering, feeding, egg picking, guard)  
Labour hrs per day

C. Secondary Products

D.

<table>
<thead>
<tr>
<th>Units</th>
<th>Total Number</th>
<th>Unit Price</th>
<th>Total Revenue</th>
</tr>
</thead>
</table>

19. Regarding the money earned from the sale of eggs, who decides on how to spend it? (only circle one/ let the HH decide which fits best)

1=Head of HH  2=spouse of head  3= both head and spouse  4= child  5= other specify

Evaluation of the Input Supply System

20. Availability of concentrates for layers on nearest markets

3 = readily available  2 = fairly available  1 = not available

21. Availability of maize grain on nearest markets

3 = readily available  2 = fairly available  1 = not available

22. Availability of replacement stock

3 = readily available  2 = fairly available  1 = not available

23. Affordability of replacement stock

3 = affordable  2 = fairly affordable  1 = not affordable

24. Input prices (vet drugs, feeds)

3 = high  2 = fair  1 = low

25. Availability of veterinary services

3 = readily available  2 = fairly available  1 = not available

26. Inputs not provided timely

3 = prevalent  2 = fair  1 = low

27. Inconsistent input supply

3 = prevalent  2 = fair  1 = low  0 = N/A

Farmer’s Access to Marketing and Marketing Information

28. Who set the selling price of eggs?

1=Buyers  2= Sellers/producers  3= Producer Association  4= NGO  5= market  6=Other

29. How was the selling price of eggs set?

1= Demand and supply  2= Negotiations  3= other specify

30. Where do you sell most of your eggs? (Circle one)

1= farm gate  2= business centre (in the ward)  3= business centre (outside the ward)  4= neighboring town/city  5= road side  6= NGO  7= other specify

31. Do you face any difficulty in getting buyers for your eggs?

1=No  2= Yes
### Continuity in Egg Production

#### 32. If yes, state the reason for difficulty.

1= inaccessibility of markets  
2 = lack of information  
3= not able to market meet requirements  
4= buyers facing liquidity challenges  
5= unscrupulous middle men  
6= other specify

#### 33. Are you going to procure replacement stock of your layers?  
1= No  
2= Yes

#### 34. If yes, where are you going to get your supply of the next batch of layers?

1= dealer of inputs/birds  
2= friends / relatives  
3= don’t know  
4= NGO  
5= Producer Association  
6= other specify

#### 35. What will be the mode of purchase of layers?  
1= cash  
2= credit  
3= free

#### 36. Have you entered into any contract for layer production since the inception of the project in your area?  
1= no  
2= yes

#### 37. If household entered into a contract, whom did you enter into contracts with?

1= banks or similar institutions  
2= dealers of inputs/birds  
3= relatives/friends  
4= unregistered micro finance lenders  
5= supermarkets in large towns/cities  
6= other specify

#### 38. If household has entered into a contract then, what services are/were being provided under the contract? (multiple response)

1= supply of inputs (birds/food/vet drugs) on cash  
2= supply of inputs (birds/food/vet drugs) on credit  
3= buying of eggs  
4= buying of off layers  
5= veterinary extension services  
6= credit for purchase of inputs for layers production  
6= other specify

#### 39. Is any member of your household a member of a poultry producer’s association?  
1= No  
2= Yes

#### Extension Services Coverage on Egg Production and Marketing

#### 40. Did you get extension services for poultry production during project implementation?  
1= no  
2= yes

#### 41. Who provided the extension service?  
1= NGO  
2= Agritex/LPD/VET  
3= NGO & Agritex/LPD/VET  
4= Egg marketing association  
7= dealers of inputs/birds  
8= lead/contact farmer  
9= other specify

#### 42. How often do you contact the extension services provider?  
1= monthly  
2= twice a week  
3= once a week

#### 43. What was the extension advice on? (multiple response)

1= production (e.g management, animal health)  
2= Credit facilitation  
3= Market facilitation  
4= poultry farming as a business  
5= other specify

#### 44. In your view, were extension services provided on production and marketing relevant?  
1= relevant  
2= neutral  
4
<table>
<thead>
<tr>
<th>District Name</th>
<th>Ward Number</th>
<th>Farmer's Name</th>
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</table>

<table>
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<tr>
<th>BREED TYPE</th>
<th>Number Birds Housed</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date when started laying</th>
<th>EGG PRODUCTION</th>
<th>EGGS</th>
<th>EGGS</th>
<th>EGGS</th>
<th>FEED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Birds</td>
<td>MORTALITY</td>
<td>TOTAL</td>
<td>Consumed</td>
<td>Sold</td>
</tr>
</tbody>
</table>