MAKERERE UNIVERSITY

COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF AGRIBUSINESS AND NATURAL RESOURCE ECONOMICS

ASSESSING RETURNS ON INVESTMENT IN THE INTENSIVE MANAGEMENT SYSTEM OF LAYER CHICKEN PRODUCTION AMONG FARMERS IN MUKONO DISTRICT

BY

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A SPECIAL PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF AGRIBUSINESS AND NATURAL RESOURCE ECONOMICS, SCHOOL OF AGRICULTURAL SCIENCES, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF BACHELOR OF AGRIBUSINESS MANAGEMENT OF MAKERERE UNIVERSITY

JULY, 2023

DECLARATION

I Nanfuma Sharifah, solemnly declare that this dissertation is based on my own original work. I assert the statements made and conclusions drawn are an outcome of my research work. I further certify that the work has not been submitted to any other institution for any other degree, diploma, or certificate.

Signature

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APPROVAL

This is to certify that this dissertation was written by Nanfuma Sharifah with REG NO: 20/U/14984/PS in partial fulfillment for the award of the Degree of Bachelor of Agribusiness Management.

Signature..... Date ..01.08.2023.....

Professor Johnny Mugisha

(SUPERVISOR)

DEDICATION

I dedicate this work to the Almighty Allah who is the author and finisher of my faith.

I dedicate this work to my sweet mother Mrs. Nabalamba Ruth Bwabye, my beloved father Mr. Bwabye sulaiman and my darling siblings for their financial and moral support.

I also dedicate this work to my supervisor, prof. Johnny Mugisha for his time, support and guidance towards achieving this information in the report and also to my sweet friends for their social support.

ACKNOWLEDGEMENT

It is my earnest intention to express my profound gratitude to the Almighty Allah for His enabling grace and to all that have contributed or offered help in one way or the other to the successful completion of my report.

I extend my gratitude to my supervisor, prof. Johnny Mugisha who not only encouraged and supported me in spite of his other pressing duties, but also guided me until the successful completion of my report.

I wish to express my joy to Mr. and Mrs. Bwabye and my big sisters Ms. Hadijah Nakamyuka and Ms. Namuswe Rehema for their moral and financial support in making my studies sweet. I remain indebted to my parents for their invaluable support throughout the period of carrying out this research work and my academic pursuit.

Finally, I thank the layer chicken farmers in Mukono district specifically those in Gulu and Namumira-Anthony parishes for being very good to me, and my dear friends Patricia, Shamira, Mary Blessing, Ibra, and Ngabo for their help, support and encouragement, may Allah reward you all abundantly for your good hearts, understanding, patience and love. Also, to my supervisor, I say thank you for impacting great knowledge into me.

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LIST OF ACRONYMS AND ABBREVIATIONS

FAO……..….. Food and Agricultural Organization

KSACMA……..….Kingdom of Saudi Arabic Capital Market Authority

MAAIF……...Ministry of Agriculture, Animal Industry and Fisheries

MFAT……..…Ministry of Foreign Affairs and Trade

MLHUD…….Ministry of Lands, Housing and urban Development

UBOS……..……Uganda Bureau of Statistics

ABSTRACT

Intensive management systems have been successfully employed in layer chicken production in other parts of the world, resulting in increased egg production and profitability and layer chicken production is a vital economic activity in Uganda. Therefore, an increasing number of farmers in Mukono district are adopting intensive management systems of layer poultry production. However, despite the adoption of intensive management systems in Uganda, there are concerns about the efficiency of these systems in terms of performance and profitability. The study aimed to assess the returns on investment in intensive management systems of layer chicken production among farmers in Mukono district, Uganda, specifically focusing on characterizing layer chicken farmers and determining returns on investment of deep litter and battery cage systems. By establishing the relationship between housing system and returns on investment as well as analyzing the impact of socioeconomic characteristics on birds in these housing systems. While adopting a cross-sectional approach, the study used a random sample of 80 poultry farmers, 40 deep litter farmers and 40 battery cage farmers selected across the entire district.

Data was collected using structured questionnaires. Return on investment was assessed using the return on investment model, and a t-test model. Through a comprehensive data collection process, findings revealed that deep litter system demonstrates a higher return on investments (0.66) compared to battery cage system (0.35). Furthermore, a statistically significant relationship between the housing system employed and the returns on investments such as labor ($P<0.1$), vaccination ($P<0.1$), electricity ($P<0.05$), feed ($P<0.05$), and additional costs ($P<0.1$) was identified. These results underline the importance of considering different housing option when planning for layer chicken farming, as it directly translates into financial gains or losses. A number of various socio economic characteristics were found to significantly impact the birds' performance in the housing system. These include type of feed given to birds ($P<0.1$), farmer's education level ($P<0.05$), farmer's experience ($P<0.01$), number of households ($P<0.1$), and annual income ($P<0.01$).

The study recommends farmers to seek professional advice, guidance and training, keep records on cots and revenue properly and regularly, monitor and evaluate performance regularly, prioritize bio security and vaccination protocols to minimize disease outbreaks and associated costs and implement efficient labor management in order to optimize returns on labor investment.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Empirical data of poultry production reveals that the first evidence of poultry farming was in the year 1800 in United States of America (USA). During the period ranging from 1800 to 1900 poultry production was done in small quantities by individual households. At that time it was essentially backyard farming. Farmers to notice that some birds were better suited for laying eggs while others were better producers of meat. They began to raise single purpose chickens used for either eggs or meat production, as opposed to dual purpose chickens that were used for both eggs and meat production, but just an average in performance (Victor & Merlin, 2021).

Poultry is one of the most popular business enterprises in East Africa. Uganda has about 47.6 million birds. Of this 41.7m are indigenous and 5.85m are exotic. Poultry population in Uganda grew by 9.6% with chicken being the predominant but turkeys, ducks, geese, pigeons, pigeons and ostriches are also kept (MAAIF, 2021). Mukono has the highest poultry population accounting for 18.5% (UBOS, 2018). Locally adopted chickens include Ugandan Black, Ugandan Red, Ugandan Brown, Nserere (naked neck), Nyoro, and Nganda. They are named according to the geographical regions they live in or physical appearances as adopted by Animal Genetic Resources of Uganda (Tainika & Duman, 2019). Exotic layer breeds are Issa Brown, Issex, Bovan Brown, Shaver, and Hubbard (MAAIF, 2021).

Intensive system is one of the three main poultry management systems. Intensive system is where birds especially exotics ranging from 500-5000 or more are kept under a modern house with controlled environments (Tainika & Duman, 2019). It is based on specialized breeds, constitutes less than 20% of the total poultry population in Uganda. This system is found mainly in urban areas where there are markets for eggs and chicken meat. Producers in this system aim at using the recommended standard practices such as breed of choice depending on production objectives, appropriate housing, feeding and health and disease control programs (Umut, 2017). Under this system birds are confined within a house and are fed. Laying hens are usually kept in 3 sub-systems of intensive system namely; 1) Deep litter- system where chicken is reared on floors made of concrete but covered with litter like saw dust or wood shavings to make birds feel comfortable. 2) Slatted floor system- similar to deep litter but no litter used. It has raised floor fitted with slats of

wood, strong mesh or plastic. The poultry manure passes through the slates to the ground (MAAIF, 2021). 3) Battery cage system- the birds are confined in cages and arranged in tiers provided with feed and water. The cages are divided into compartment containing a bird or 2 in a cage. It has a sloping floor for easy passage of eggs and laying nests as well (Wang, 2021). However two (2) subsystems i.e. deep litter and battery cage systems in this study are considered. These two (2) subsystems were selected for assessment because it was observed they are the major systems adopted by the layer farmers in the study area.

Chicken production plays a great a role in provision of employment for job seekers, business opportunities for entrepreneurship, and a major source of protein from meat and eggs which was considered to be one of the most nutritious food intakes and acceptable by major religions in the country and also generates quick economic return to the producer (Yero et al., 2020). Layer poultry is a source of foreign exchange through exportation of poultry products like eggs, dressed and live birds and its products have a rich local and international demand (Muhindo, 2018).

Due to increasing demand for chicken meat and eggs in Uganda, there has been a corresponding increase in the number of smallholders rearing poultry, particularly layer chickens. In order to meet the demand for chicken products and maximize profits, farmers have increasingly adopted intensive management systems (Sharma & scheer, 2014).

Mukono district, located in central Uganda is known for its high concentration of smallholder farmers rearing layer chickens. These farmers have embraced intensive management systems, but there is little information on the efficiency of these systems, particularly in terms of performance and profitability. Therefore, this research project aims to assess the efficiency of the intensive management system of layer chicken production in Mukono district.

1.2 Problem statement

Intensive management systems have been successfully employed in layer chicken production in other parts of the world, resulting in increased egg production and profitability (Mukasa-Mugerwa et al., 2003). Layer chicken production is a vital economic activity in Uganda (Munyeme, Muma & Munang'andu, 2016). In Mukono district, intensive management systems are used to maximize productivity and meet the demand for eggs. These systems involve the use of high quality feeds, automatic egg collection systems and appropriate biosecurity measures (FAO, 2007).

However, despite the adoption of intensive management systems in Uganda, there are concerns about the efficiency of these systems in terms of performance and profitability (FAO, 2014). There is a need to assess the returns on investment in intensive management systems of layer chicken production in Mukono district. Furthermore, there is limited research conducted on the effectiveness of these intensive management systems, making it difficult for farmers to make informed decisions regarding the adoption of such systems.

Therefore, assessing returns on investment in intensive management system of layer chicken production is very critical in agriculture sustainability in Mukono district. By evaluating the costs and benefits of this approach, this project aims to guide farmers in making informed decisions regarding the adoption of such systems, planning and resource allocation to improve production efficiency and profitability. It will also enable them improve their livelihoods and contribute to the growth of the local economy.

1.3 Objectives

The overall objective was to assess returns on investment in the intensive management system of layer chicken production among farmers in Mukono district.

The specific objectives are;

1. To characterize the layer chicken farmers practicing intensive management system in Mukono district.
2. To determine returns on investment in the deep litter and battery cage sub systems of intensive system of layer chicken production in Mukono district.

1.4 Hypotheses

1. There is no significant relationship between socio-economic characteristics of layer chicken farmers practicing intensive management system such as age, level of education, sex, experience, etc. and birds performance in the housing systems.
2. There is no significant difference between the housing system of layer chicken production and the returns on investment.

1.5 Significance of the study

To the researcher, the study will be a requirement for the award of bachelor's degree in agribusiness management.

The findings of this study will contribute to the understanding of the efficiency of the intensive management system of layer chicken production in Mukono and Uganda at large.

The study will provide valuable information to farmers, policymakers, and other stakeholders in the poultry industry on the performance and profitability of layer chicken production under intensive management systems.

By evaluating returns on investment, the study facilitates a cost benefit analysis of the intensive management system. It allows farmers to assess the costs involved in adopting this system against the potential benefits, thereby assisting them in determining the financial feasibility of implementing the system.

The study will provide data and evidence on economic viability of using this system which can guide stakeholders like farmers and investors in making informed decisions regarding their investments.

The information generated from this research project will provide a basis for further research in the field of poultry production, particularly sub-Saharan Africa.

1.6 Scope of the study

The study was explanatory and cross sectional in nature and was conducted in two parishes of Mukono district, Ggulu ward and Namumira-Anthony. These parishes were selected because of individuals and farmers in groups supported by the government, and the development partners who have implemented considerable number of commercial poultry projects. The content of the study was limited to the investments made by farmers in intensive systems, resources, and returns on the costs in the intensive management system of layer chicken production in Mukono district. The study reflects a time scope of three months that is from May, 2023 up to July, 2023. The data was also collected from relevant secondary sources.

1.7 Problems encountered

Some of the layer farmers feared to fill their details of the household information due to fear of insecurity, others thought of being evicted by government authorities. I assured them that the questions are intended for a university research purpose and will take less 20 minutes.

Language barrier was another problem, the researcher encountered. A couple of respondents knew only their mother tongue. This is a big limitation because it may not elicit the most correct information from the respondents. Also biased responses from some farmers leading to invalid conclusions.

Time constraint. Time allocated for data collection was really so limited. This resulted into a small sample size hence leading to missing or incomplete information and also making it so hard to standardize.

High transaction costs involved in the research process. These included costs such as transportation costs to and from the field, supervisor's office, printing costs, etc. this limited the scope of the research.

Access to data. Access to primary data sources such as government databases was restricted and limited. Also literature on returns on investment in intensive management system of layer chicken production in Uganda was so limited hence a challenge.

Technical difficulties. The researcher faced technical challenges related to equipment, tool and software. These resulted into making data analysis and interpretation a hard task.

Lack of sufficient skills and support in data analysis while using the advanced statistical methods was also a challenge thus making data analysis and interpretation a very difficult task.

Other people expected some cash from the researcher; poor transport network and bad weather like rain and sometimes too much sunshine also weakened my progress.

CHAPTER TWO

LITERATURE REVIEW

2.1 Investments and returns in the intensive system of layer chicken production

Making investment is an essential part of running a business. Investment refers to commitment of current financial resources in order to achieve higher gains in the future. It deals with uncertainty domains (KSA-CMA, 2021). There are two (2) types of investment and these are; real investment and financial investment which refers to purchase of fixed assets and purchase of securities respectively (Hemalatha, 2020). Investment means every kind of assets that an investor (farmer) owns or controls directly or indirectly (MFAT, 2020). Investment assets or mechanisms usually used in investment are real and financial assets. Real assets are tangible assets used to produce goods or services such as building, land, machinery and equipment or cognitive assets that are utilized in the production of commodities or services and financial assets are claims on real assets or income produced by those assets e.g. securities (KSA-CMA, 2021). Investments may take various forms like an enterprise such as layer chicken production enterprise; licenses, authorization, permits and similar rights conferred pursuant to a party's domestic law; tangible , movable or immovable property and related property rights such as mortgages, liens, or pledges, etc. (MFAT, 2020). Returns refer to expected rate of return from an investment. It is an important characteristic of investment. The major objective of investment is to maximize returns and minimize risks. Return is a major factor that influences the pattern of investments that is made by the investors (farmers) who usually prefer high rate of returns from the investments (Hemalatha, 2020).

The majority of businesses like layer chicken production business in particular require land and buildings to keep their operations running (Smarter, 2020). Farms that employ deep litter and battery cage housing systems typically need to invest in both buildings and land since birds are confined in a modern house and controlled environment (Okerede et al., 2020). Farms that deal in layer chicken production business also need to invest in machinery, equipment and vehicles to supply their goods. In battery cage system, battery cages are the primary equipment used in the battery cage system for layer chicken production. These cages are made of galvanized wire mesh and come in different sizes and designs (Kumar, 2018). Feeder and drinker are used to provide feed and water respectively and can be placed outside or inside the cage, Egg collection belt which is used to collect eggs laid by the chickens. The belt can be made of rubber or plastic and is in-

stalled underneath the cages and manure removal system which is used to remove the manure produced by the chickens. The system can be manual or automatic and is installed underneath the cages (FAO, 2009). In deep Litter System, brooder is used to provide heat and light to the chickens in the initial stages after hatching. The brooder can be a heat lamp or a gas stove, feeders and drinkers: which are used to provide feed and water to the chickens. Different types of feeders and drinkers can be used in the deep litter system, perches which allow the chickens to roost and rest. The perches can be made of wood or metal, nest boxes which provide a comfortable and safe place for the chickens to lay eggs. The nest boxes can be made of wood or plastic, litter material such as straw, hay, or wood shavings provide a comfortable and healthy environment for the chickens (Jeyathilakan et al., 2014).

2.2 Comparison of resources in the subsystems of intensive system of chicken production

Chicken production is a vital segment of the global food industry. Consequently, farmers and researchers have devoted efforts to developing efficient and cost-effective production methods such as deep litter and battery cage systems (Santos et al., 2012). The deep litter system is characterized by allowing poultry birds to roam in a spacious area while farming chicken in a small area is the modus operandi of the battery cage system (Ganapathy et al., 2019). Each of which requires varying levels of investment from farmers. The resources used in these subsystems are feed, housing, water, electricity, labor, and veterinary services. According to Kirunda et al (2014), the feed is the most resource intensive component, followed by housing and water, while electricity and veterinary services are the least resource intensive. The resources used in deep litter and battery cage systems of layer chicken production in Mukono differ in terms of costs, labor, and environmental impact.

One of the primary resources in poultry production is feed. Poultry feed accounts for approximately 60-70% of the total cost of poultry production (Ganapathy et al., 2019). In the deep litter system, birds are allowed to forage for food, which significantly reduces feed expenses. The deep litter system typically relies on a mix of natural and commercially available feeds (Onu and Orji, 2016). However, in battery cage systems, birds are mainly fed with processed feeds, which are expensive compared to natural feed resources. As such, the cost of managing the battery cage is relatively high compared to deep litter production (Santos et al., 2012). Another important resource

in poultry production is water. Water is essential for the survival and growth of birds, and its availability significantly impacts the growth rate and productivity of poultry (Ero et al., 2018). In the deep litter system, birds are given access to clean water sources, and the water usage is relatively low compared to battery cage systems. In contrast, battery cages require a constant supply of water due to inadequate ventilation and the small cage space, leading to high water usage (Onu and Orji, 2016).

Space is another critical resource in poultry production. In deep litter systems, birds are allowed to roam and have adequate space to move around freely. In contrast, in battery cages, space is limited, which can lead to stress and decreased bird productivity (Ganapathy et al., 2019). Additionally, the battery cage production system requires a lot of labor to maintain and clean regularly, leading to high labor costs. In battery cage system, birds are kept in small cages with wire mesh floors that allow their droppings to fall through to a collection system. The design is easier to clean and helps to reduce disease transmission but it requires a considerable initial investment, with costs ranging from $30-$50 per bird for housing and equipment (Mutayoba et al., 2016). In terms of labor, maintenance of the cages and equipment requires daily attention, and the collection and management of waste can be time consuming. The impact on the environment is also significant as the waste from battery cages can pollute the soil and water if not properly managed (Barrett et al., 2016).In contrast, the deep litter system involves raising the birds on floor covered in a thick layer of straw or other organic material like saw dust or wood shavings. This system requires less initial investment with costs ranging from $10-$20 per bird for housing and equipment (Mutayoba et al., 2016). Daily labor requirements are also lower as the birds are able to move freely on the litter and clean the floor with their pecking behavior. This system is also less harmful to the environment, as the litter can be used as a fertilizer for crops or as cover material for composting manure (Mutayoba et al., 2016).Therefore, while the initial investment required for a battery cage system maybe higher, the ongoing labor and environmental costs associated with the deep litter system may offset the difference over time. Ultimately, the choice of which system to adopt may depend on factors such as the size and the goal of the farm, as well as the availability of resources such as labor, bedding material and waste management technology, and cost requirements.

2.3 Returns on cost in chicken production and other various agribusiness enterprises

The returns on each cost incurred by farmers in the subsystems of intensive system vary with intensity. Returns on costs in intensive systems of layer chicken production are influenced by various factors, including the cost of feed, housing, labor, and equipment. The cost of feed, which accounts for the largest share of the total input costs, has a significant impact on the profitability of layer chicken production. According to a study by Aviagen, feed accounts for up to 70% of the total production costs in a modern layer operation (Aviagen, 2019). Therefore, producers need to carefully consider the cost and quality of feed inputs and management practices to optimize returns on investment. To Etalem et al (2018), the return on labor cost is the most influential cost factor on profitability of chicken production in Uganda. Higher levels of productivity would require increased levels of labor input that would increase production costs. The capital investment on day old chicks and feeding equipment, on the other hand, would significantly impact the cost of production since higher cost of capital would result in higher production costs. In addition, the costs of treatments would also affect overall costs and return on investment since it directly impacts the lifespan of each chicken and their eventual economic value. The intensive system of layer chicken production in Mukono district of Uganda is an expensive undertaking that requires a considerable investment by the farmers. The resources in the deep litter and battery cage systems of intensive system of layer chicken production i.e. feed, housing, water, electricity, labor, and veterinary services, each require varying levels of investment and have different returns on each cost.

In addition to intensive systems of layer chicken production, there are other various agribusiness enterprises that require significant investments. These include intensive dairy farming, fish farming, crop production, and livestock fattening, among others. Returns on investment in these enterprises are influenced by various factors, including market demand, input costs, and management practices. According to a study by the International Livestock Research Institute, returns on investment in intensive dairy farming in Kenya ranged from 17.2% to 28.3%, depending on the scale of production (Ekernas, 2018). In fish farming, the returns on investment are influenced by various factors, including the quality of water, the species of fish, and the cost of feeds and equipment. A study by Rathnayake et al (2019) found that the returns on investment in fish farming in Sri Lanka ranged from 32% to 118%, depending on the scale of production and management practices. In crop production, the availability of inputs, such as fertilizers, pesticides, and irrigation, significantly influences the returns on investment. A study by Ghebru and Holden (2014) found

that returns on investment in crop production in Ethiopia ranged from 10% to 125%, depending on the type of crop, scale of production, and inputs used.

Therefore investments in agribusiness enterprises, including intensive systems of layer chicken production, require careful consideration of input costs, management practices, and market demand. The returns on investment in these enterprises are influenced by various factors, and producers need to conduct thorough market research and analysis to optimize returns on investment.

2.4 Related studies on the investments, and returns on investments

There have been numerous studies conducted on investments and returns to investments over the years. Many scholars have published articles, books, and academic papers analyzing various aspects of investments and their returns. One study that analyzed the returns on various types of investments over an extended period is “The Arithmetic of Investment Expenses” by William F. Sharpe. In this study, Sharpe concludes that investment expenses have a significant impact on the returns to investments. He recommends that investors pay close attention to the fees charged by investment management firms and minimize these costs to maximize their returns. In addition to academic studies, many investment experts have published works on the subject. One such book is “The Intelligent Investor” by Benjamin Graham. Graham is widely regarded as one of the most influential investors of all time, and his book is a classic in the field. He argues that investors should focus on the intrinsic value of investments rather than market trends and should always aim to buy undervalued stocks. Other studies have looked at the impact of emotions on investment decisions. For example, “Behavioral Economics and Its Applications to Investment Decisions” by Meir Statman looks at the role of cognitive biases in investment decisions. He argues that investors need to be aware of their emotional responses when making investment decisions and should work to minimize these biases to maximize returns.

There have been also reports which are inconclusive on the relative investments and returns to the investments in both deep litter and battery cage systems for management of laying birds. Dim and Nwaogu (2019) conducted a comparative analysis of egg production performance and costs between the deep litter and battery cage systems in commercial layer poultry farming in Nigeria and reported that the battery cage system had higher egg production and lower costs compared to the deep litter system, indicating that the battery cage system was more profitable. Bhandari, Gurung, & Khatiwada (2018) analyzed the economics of poultry egg production for deep litter and battery

cage systems in Nepal and showed that the battery cage system had higher total revenue and net income compared to the deep litter system, indicating that the battery cage system was more profitable and Nweke, Oluwole & Adeogun (2016) reported that the deep-litter system had a higher return on investment compared to the battery cage system. This is in accordance with report Oyeleke, Oluyo & Oluyemi (2020) that the deep-litter system was more profitable than the battery cage system.

CHAPTER THREE

METHODOLOGY

3.1 Study area

The study was carried out across Mukono district in Mukono division in Ggulu and Namumira-anthony parishes and in six villages; Ngandu, Kigombya, Kitete, Namumira, Dandira and Anthony where individuals and farmers in groups supported by the government, and the development partners had implemented considerable number of commercial poultry projects. The interviewed respondents lived in the above-mentioned villages in Mukono division within Mukono district. Mukono was purposively selected because layer poultry production is a priority enterprise given the high population density, which calls for intensive approaches to strengthen household economic livelihoods.

Mukono district is located in central Uganda, bordered by Kayunga district to the north, Jinja district to the east, Buikwe district to the south, and Wakiso district to the west. The district lies approximately 22 kilometers east of Kampala, the capital city of Uganda. According to the Uganda bureau of statistics, the geographical coordinates of Mukono district are latitude 0°19’N and longitude 32°46’E. The district covers of approximately 2,725 square kilometers, with an estimated population of 711,846 people as of 2020 (MLHUD, 2021).

3.2 Research Design

The research design of this study was a descriptive cross – sectional and explanatory in nature due to the limited time of the study. It was based on qualitative research aimed at gathering a rich in depth understanding of returns on investment in the intensive management system of layer chicken production among farmers in Mukono district. The data was collected from farmers who utilize deep litter and battery cage systems for layer chicken production. The case study would lead insight into potentially significant information (findings) as presented in the chapter four of this dissertation.

3.3 Sampling and sample size

The sampling of this study was done using a multi stage sampling procedure where the first stage involved a purposive selection of the sub county, Mukono division in Mukono district. This selection was due to the sub county being known for commercial poultry farming using the intensive

management systems. The second stage was purposive selection of two parishes Ggulu ward and Namumira-Anthony in Mukono district on the basis of the predominance of chicken egg farmers in the area. In the third stage, three villages were selected using simple random sampling technique from each of the two parishes giving a total of six villages. Lastly, the final stage was random sampling, it continued until a total of 80 layer farmers are obtained comprising of 40 battery cage and 40 deep litter housing systems users.

3.4 Data collection

Data collection helped the researcher collect the required data qualitatively from the respondents to address the study objectives. Questionnaires were prepared and administered to layer chicken farmers within the study area. These were used to collect data on characteristics of layer chicken farmers, costs invested in both deep litter and battery cage housing systems, the outputs generated and their prices. Multiple choice questions were also used for layer chicken farmer (respondent) to choose either one or more options to allow both quantitative and qualitative data collection by the researcher. Interviews and observation were also conducted to gather data on socio-economic and demographic characteristics.

3.5 Data analysis

Socio- economic characteristics including level of age, education, marital status, sex, farming experience, etc. were analyzed using descriptive statistics like percentages, means and standard deviation.

Returns on investments in layer chicken production in deep litter and battery cage systems were analyzed using return on investment model to compare the returns on investment in deep litter and battery cage systems. The investments that were considered included labor, feeding, housing, treatment, electricity, day old chicks, electricity and miscellaneous costs. The returns per each investment were valued in both quantity and monetary terms.

Therefore, Returns on Investment in monetary terms and quantity terms was;

ROI = TR/TC and ROI = TR/QTY respectively

Where;

ROI= Return On Investment

TR=Total Revenue

TC= Total cost of input

QTY= Quantity of input

Then a two-sample T-test was used to determine which subsystem (deep litter and battery cage systems) was more profitable in terms of costs/inputs like labor, feeding, housing, treatment, electricity, day old chicks and miscellaneous costs.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 characterization of layer chicken farmers

Socio economic and demographic characteristics like age, gender, education level, household size experience, among others were characterized using descriptive statistics like mean, standard deviation, frequencies, and percentages as seen in tables 1 and 2.

Table 1: Descriptive results for categorical variables

Variable	Deep litter farmers		Battery cage farmers		Overall sample		T P-value
	Freq	%	Freq	%	Freq	%	
Male	25	62.50	21	52.50	46	57.50	0.16
Female	15	37.50	19	47.50	34	42.50	
Primary	1	2.50	3	7.50	4	5.00	0.03
O level	14	35.00	12	30.00	26	32.50	
A level	11	27.50	13	32.50	24	30.00	
Tertiary	1	2.50	0	0.00	1	1.25	
Diploma	3	7.50	1	2.50	4	5.00	
Degree	10	25.00	11	27.50	21	26.25	
Family labor	15	37.50	4	10.00	19	23.75	0.26
Hired labor	25	62.50	36	90.00	61	76.25	
Mash	37	92.50	38	95.00	75	93.75	0.07
Concentrate	1	2.50	2	5.00	3	3.75	
Maize bran	2	5.00	0	0.00	2	2.50	

he results show that the overall sample percentage of males was greater than the females implying that male farmers were the most people to carry out layer chicken farming using both deep litter and battery cage systems compared to females. The level of education among the respondents was

high in O level, A level and degree and least in tertiary level implying that farmers attained formal education. The most type of labor used by the farmers was hired labor in both systems. This is due to the fact that large scale layer production requires significant amount of labor especially during peak seasons. Birds were mostly fed with mash. This is because it is an easy way of them with a nutritionally balanced diet. This is in line with the study of Adesivan, (2014). He found out that layer poultry enterprises are mostly operated by men, attendants having attained formal education (which is critical in adoption of better innovations). Adedeji et al., (2018) reported that mas feed was the most frequently feed type used by farmers. Abebaw et al., (2018) revealed that the majority of layer farmers approximately 72% employed hired labor while 28% utilized family labor. However, education and feed type had a significant effect on birds in deep litter and battery cage systems. Gender and labor type had no significant impact on birds in deep litter and battery cage systems.

Table 2: Descriptive results for Continuous variables

Variable	Deep litter farmers		Battery cage farmers		Overall sample		T P-value
	Mean	SD	Mean	SD	Mean	SD	
Farmer's age(years)	35.9	8.24	41.1	11.29	38.5	10.16	0.16
Farmer's experience (years)	5.3	3.09	5.8	3.75	5.6	3.42	0.00
Flock size	573 475.68		1439 1008.68		1006	896.66	0.50
Egg number per day	499 408.78		1289 942.56		894	824.10	0.89
Average household Number	5	2.08	4	2.16	4	2.13	0.09
Average annual income (Ugx)	11.9	7.9	17.7	12.8	14.8	11.0	0.00

he overall sample mean age of these farmers was 38 years, implying most farmers involved in layer chicken production were of middle age, who were still energetic, productive, and rational

decision makers. Farmers had a mean experience of at least 5.6 years implying that farmers had extensive knowledge and expertise in all aspects of layer production like disease management, feeding, and production management. Battery cage farmers kept more birds (1439) than deep litter farmers (573 birds) on average. This is due to the fact that battery cages allow for higher stocking densities. Deep litter farms produced a lower number of eggs (499) per day than battery cage farms (1289) eggs. This is due to the ability of battery cages to accommodate more birds than deep litter houses. The households were relatively large with an average of 4 members per household, which can be attributed to the fact that layer poultry is labor intensive, and a sizeable family is required. On average battery cage farmers had a higher annual income than deep litter farmers. These findings in this study were similar to those of other studies for example Otunaiya et al. (2015) reported that most farmers had been in operation for at least five years. Similar results were revealed by Folorunso, and Dawang, (2016) found out that most farmers (72%) were of middle age (25-50), and with a sizeable household of at least 5 members. Akinwumi et al., (2013) found out that battery cage systems can accommodate more birds per unit area compared to deep litter systems and Appleby et al. (1995) found that .birds in deep litter had a slightly lower egg production compared to those in cages. However there was a statistically significant relationship between farmer's experience, average annual income, average household number, and housing system of birds. There was no significant relationship between farmer's age, flock size, egg number produced per day and housing system.

4.2 Returns on investment in deep litter and battery cage systems

Total costs of production both variable and fixed costs, total revenue and overall returns on investments like housing, feed, labor, vaccination electricity, day old chicks and additional costs in both systems were analyzed and summarized as seen in table 3

Table 3: Overall returns on investment in deep litter and battery cage systems

Cost of production(Ugx)	Deep litter farmers		Battery cage farmers	
	Mean	Freq	Mean	Freq
Total variable costs				
Labor costs	235,500	2.9	539,250	1.2
Vaccination costs	154,500	1.9	232,000	0.7
Feed costs	3,808,218.8	46.1	22,770,300	52.4
Day old chicks costs	2,202,837.5	26.7	10,604,483	23.4
Electricity costs	15,625	0.2	41,179.49	0.09
Additional costs	144,375	1.7	543,750	1.2
Total fixed costs				
Housing costs	1,700,000	20.6	9,557,500	21.1
Total cost of production	8,261,056.3	100	45,379,462.48	100
Revenue				
Egg sales	5,469,787.5		15,896,025	
Total revenue	5,469,787.5		15,896,025	
Overall ROI	0.66		0.35	

Variable costs were the major cost of layer chicken production in both systems, deep litter and battery cage and constituted 79.4% and 78.9% of the total costs respectively. Feed cost was the major variable cost in systems which constituted 46.1% and 52.4% of the total costs in deep litter and battery cage systems of layer chicken production respectively. The findings agreed with the studies Owuor et al. (2017), Nwandu et al. (2015) and Gangwar (2013). The revenue was from

sale of eggs. Overall return on investment was 0.66 and 0.35 in deep litter and battery cage systems respectively implying deep litter system was more profitable than battery cage system in the study area as indicated by return on investment value, the higher return on investment value, the higher the profitability level of the system. This is in line with the study of. Mamun et al. (2018), Adetunji et al. (2016) and Eja et al. (2015).

Returns on each cost investment in monetary terms in both systems, deep litter and battery cage systems were computed and summarized as in table 4 in order to know how much the farmer gained per Ugx invested.

Table 4: Returns on each investment in monetary terms in deep litter and battery cage systems

Investment	System	Returns on investment(Ugx)	t-statistic	P-value
Labor	Deep litter	23.2	9.38	0.07
	Battery cage	29.5		
Vaccination	Deep litter	35.4	6.38	0.09
	Battery cage	49.2		
Electricity	Deep litter	350.1	21.01	0.03
	Battery cage	386.0		
Feed	Deep litter	1.4	5.73	0.04
	Battery cage	0.7		
Day old chicks	Deep litter	2.5	0.5	0.70
	Battery cage	1.5		
Additional costs	Deep litter	37.9	6.61	0.09
	Battery cage	29.2		
Housing	Deep litter	3.2	0.76	0.59
	Battery cage	1.7		

Return on labor investment was higher in battery cage (29.5) than in deep litter system (23.2). Battery cage farmers generated a revenue of 29.5 Ugx per 1 Ugx invested. This is in line with study of Singh et al. (2015). They found out that battery cage system yielded higher returns on labor investment compared to deep litter system. Battery cage farmers generated a revenue of 49.2 Ugx per 1 Ugx invested on vaccination implying that return on vaccination investment was higher in battery cage system than deep litter system (35.4). Return on electricity investment was higher in battery cage system than in deep litter system (350.1). The farmers utilizing battery cage system generated a revenue of 386.0 Ugx per 1 Ugx invested on electricity. A 1.4 Ugx revenue was generated by deep litter farmers per I Ugx invested on feed and return on feed investment was higher in deep litter system compared to that in battery cage system (0.7). deep litter farmers generated a revenue of 2.5 Ugx per 1 Ugx invested on day old chicks indicating that return on day old chicks was higher in deep litter system than in batter cage system(1.5). Returns on additional costs and housing investments was higher in deep litter system than battery cage system. Farmers generated a higher revenue of 37.9 and 3.2 Ugx per 1 Ugx invested on additional costs and housing respectively than in battery cage system.

However a statistically significant relationship was I identified between the housing system and return on labor investment, return on vaccination investment, return on electricity investment, return on feed investment, and return on additional costs investment. There was no significant relationship between housing system and returns on housing investment and day old chick investments.

The quantitative inputs such as labor and feed that were employed in layer production in both systems; deep litter and battery cage systems were also analyzed and results were summarized as seen in the table 5

Table 5: Quantitative inputs in deep litter and battery cage systems

Inputs	Deep litter system		Battery cage systems	
	Mean	Freq	Mean	Freq

Feed (kg)	63.93	40	149.49	40
Labor	2	40	3	40
Total revenue (Ugx)	5,469,787.5	80	15,896,025	80

The mean feed intake in kilograms by the flock per day in battery cage system was higher than that in deep litter system and battery cage farmers employed relatively a high numbers of workers to take care of the birds compared to deep litter farmers on average. This was attributed to the fact that battery cages accommodate a bigger flock size than deep litter system.

Returns on investments in quantity terms in both systems deep litter and battery cage systems were computed and summarized as seen in table 6

Table 6: Returns on investment in quantity terms in deep litter and battery cage systems

Inputs	System	Returns on each input(Ugx)	t-statistic	P-value
Feed (kg)	Deep litter	85,559.01	9.24	0.06
	Battery cage	106,335.04		
Labor	Deep litter	2,734,893.75	6.26	0.09
	Battery cage	5,298,675		

Return on feed investment was higher in battery cage system than in deep litter system. One kilogram of feed given to the birds could generate a revenue of 106,335.04 Ugx in battery cage system and 85,559.01 Ugx in deep litter system. Return on labor was also found higher in battery cage than in deep litter systems. One battery cage worker could make a revenue of 5,298,675 Ugx while a deep litter worker could generate 2,734,893.75 Ugx.

However, a statistically significant relationship between housing system and returns on feed and labor was identified.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

The study indicated that male farmers were the most people to carry out layer chicken farming and constituted for 57.5% of the total number of farmers, Layer mash was the major feed given to the birds in both systems and accounted for 93.75% in both systems. The battery cage farmers collected the higher number of eggs per day than deep litter farmers. On average, battery cage farmers had a higher annual income than deep litter farmers. On average.

The research revealed a significant relationship between housing system and education, feed type, experience, number of households, and annual income. Education and experience in poultry farming played a crucial role in determining the profitability of the farming venture. Farmers with higher experience, and education levels tended to have better financial management skills which positively influenced their returns on investments. However it also revealed that there was no a significant relationship between housing system and sex, labor type, age, flock size and egg number produced by farm per day.

This study revealed that total costs of production comprised of both variable and fixed costs, variable costs were the major costs of production Feed costs were the major variable cost in both systems and constituted 46.1% and 52.4% of the total costs of production in deep litter and battery cage systems respectively. Battery cage farmers earned a higher revenue than deep litter farmers

Deep litter system was found to be more profitable system of layer chicken production compared to Battery cage system. The analysis of return on investments indicated that farmers using deep litter system achieved higher return on investment due to low initial investment and maintenance costs. Additionally the deep litter system provided better conditions for the chickens like space for exercise.

There was a significant relationship between the housing system of layer chicken production and return on investments like labor, Vaccination, Electricity, Feed and additional costs. There was no a significant relationship between housing system and returns on investments such as day old chicks and housing.

5.2 Recommendations

In order to ensure increased returns on investment in layer chicken production, farmers should seek professional advice and training; farmers should consult with agricultural experts, nutritionists, or extension services to seek guidance on improving feed utilization, reducing costs and implementing sustainable practices. They should also attend training sessions or workshops that focus on efficient feeding management techniques to stay updated with the latest advancements in the field.

Farmers should monitor and evaluate their performance regularly, enabling them to identify areas for improvement and make necessary adjustments. They should also keep thorough records of production data, costs, and revenue to aid in decision making.

Farmers should implement efficient labor management in order to optimize returns on labor by adopting effective management practices such as proper training and allocating tasks efficiently. This will minimize labor costs and maximize returns.

Farmers should prioritize biosecurity and vaccination protocols to minimize disease outbreaks and associated costs, regularly monitor the health of the flock and consult with the veterinarians for appropriate vaccination strategies.

The farmers should also properly handle the feeds, control rodents in poultry house, and grow their own feeds in order to cut costs associated with feeding. They should also implement proper feeding management techniques such as rationing feed according to specific needs of birds at different growth stages in order to ensure that the birds consume only the necessary amount of feed to promote optimal growth and productivity.

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APPENDIX

Appendix 1: Research questionnaire

MAKERERE UNIVERSITY

COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF AGRIBUSINESS AND NATURAL RESOURCE ECONOMICS

I am NANFUMA SHARIFAH, a student pursuing a Bachelor's Degree of Agribusiness Management at Makerere University, I am in my final year of study currently carrying out research on the topic **assessing returns on investment in the intensive management system of layer chicken production among farmers in Mukono district.** The findings of this study shall only be used for academic purposes and all the information obtained shall be given utmost confidentiality.
Do you agree to take part in this interview?

Yes= 1

If no dismiss the interview.

Kindly fill in the following

SECTION A: LOCATION OF THE RESPONDENT

1. Name of respondent……..…….

2. Sub-county……..……
3. Ward……
4. Name of the village…….
5. Gender……

SECTION B: DEMOGRAPHIC CHARACTERISTICS

6. What is your age? .....years
7. What is your highest level of education completed? ……...….....
8. Number of household members…….……
9. Household annual income……..…Ugx

SECTION C: FARM PROFILE

10. How many years have you been involved in layer chicken production?
    ……..…… (Years)

11. How are the layer chickens housed?
    a) Deep litter
    b) Battery cage
    c) Both

12. What is your current flock size?

System	Flock size
Deep litter	
Battery cage	

SECTION D: INTENSIVE MANAGEMENT PRACTICES

13. What specific management techniques do you follow for health and well-being of layer chickens?

System	Specific management techniques

Deep litter	
Battery cage	

14. How do you prioritize biosecurity measures to prevent disease outbreaks on your farm?

System	**Biosecurity measures**
Deep litter	
Battery cage	

15. What type of feeds do you give to your layer chickens?

System	**Feeds given to layers**
Deep litter	
Battery cage	

16. Do you provide any additional supplements or additives to enhance egg production or quality?
    a. Yes
    b. No

SECTION E: INVESTMENT COSTS

17. How much was invested in establishing the deep litter or Battery cage systems?

System	**Cost (Ugx)**
Deep litter	
Battery cage	

18. What are the recurring costs associated with the maintenance and operation of the intensive management system?

System	Recurring costs
Deep litter	
Battery cage	

19. Are there any additional costs incurred specifically for deep litter or battery cage systems?
    a. Yes
    b. No

20. If yes, what are these costs and how much do you spend on them per month?

    A. For Deep litter system;

Additional costs	Amount spent on them per month (Ugx)

    B. For battery cage system;

Additional costs	Money spent on tem per month (Ugx)

21. How much do birds consume per day?

System	Feed consumption in kgs per day
Deep litter	
Battery cage	

22. How much is one (1) kg of feed?

……(Ugx)

23. How often do you purchase new chicks?

a. Once a year
b. Twice a year
c. Quarterly
d. Monthly

24. How much does each day old chick cost?

……..…. (Ugx)

25. What type of labor do you use on your farm?

a. Family labor
b. Hired labor

26. How many workers do you employ on your farm?

System	**Number of workers**
Deep litter	
Battery cage	

27. What is labor cost per day?

System	**Labor cost per day in Ugx**
Deep litter	
Battery cage	

28. Do you use electricity on your farm?

a. Yes
b. No

29. If yes, what is the monthly cost of electricity?

System	**Electricity cost per month in Ugx**
Deep litter	

Battery cage	

30. How much do you spend on flock treatment per month?

System	Flock treatment cost per month in Ugx
Deep litter	
Battery cage	

SECTION F: EGG PRODUCTION AND RETURNS

31. How many eggs per day does your farm currently produce?

System	Total eggs per day
Deep litter	
Battery cage	

32. What is the current price of each egg in your market?

……. (Ugx).

SECTION G: BIRD MORTALITY, LOSSES AND CHALLENGES

33. How many birds die per batch per month?

System	Number of birds lost.
Deep litter	
Battery cage	

34. What is the cost of birds lost per month?

System	Cost of birds lost (Ugx)
Deep litter	
Battery cage	

35. On average, how many eggs do break per day?

System	Number of eggs broken per day
Deep litter	
Battery cage	

36. How many “too small” eggs do you collect per day that are not sold?

System	Number of “too small” eggs
Deep litter	
Batter cage	

37. Have you encountered any challenges or difficulties in implementing and managing the intensive system?
    a. Yes
    b. No

38. If yes, please describe the major challenges faced and how have you addressed them

Challenges faced	Solutions to them

Thank you for participating in this survey! Your inputs are highly appreciated and will contribute to valuable insights for this research