

**FACTORS INFLUENCING THE ADOPTION OF INDIGENOUS
MICROORGANISM TECHNOLOGY ON COMMERCIAL PIG FARMS: A CASE
STUDY OF MUKONO DISTRICT**

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DECLARATION

I CORNELIUS SSEMBUUSI declare that this thesis has not been submitted for a degree in any other University or Institution of higher learning. All the work contained herein is original. Where information was obtained from other works, such information has been properly referenced and acknowledged.

Signature.....



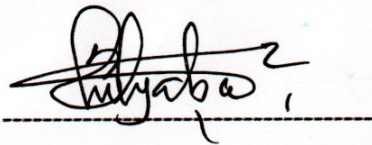
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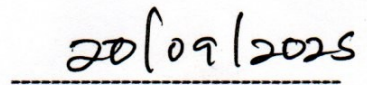
APPROVAL

I John Livingstone Mutyaba the supervisor hereby certify that this dissertation has met the accepted minimum research requirements and ethics and is ready for examination with my approval in partial fulfillment of the requirements for the award of **Master of Science in Agriculture and rural development at Uganda Christian University, Uganda.**

A handwritten signature in black ink, appearing to read 'Mutyaba', written over a horizontal dashed line.

Signature

John Livingstone Mutyaba PhD

A handwritten date '20/09/2025' written in black ink over a horizontal dashed line.

Date

DEDICATION

This thesis is dedicated to my dad, mum and my family at large. May you all live longer. Finally, to the Almighty God for the guidance, peace and gift of life I have had during my studies.

ACKNOWLEDGEMENT

I am very grateful to my supervisor Dr. John Livingstone Mutyaba for the guidance, patience and efforts provided during my study. Special thanks go to fellow course mates and colleagues who were always there full-time to attend to me. Through them, I gained confidence, competence, and determination to continue my endeavors in pursuing my course. Writing and completing this thesis has been a combination of many efforts, especially from other people like Moris Kabyanga.

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TABLE OF CONTENTS

DECLARATION.....	i
APPROVAL.....	ii
DEDICATION.....	iii
ACKNOWLEDGEMENT.....	iv
TABLE OF CONTENTS.....	v
LIST OF TABLES.....	vii
LIST OF FIGURES.....	viii
LIST OF ABBREVIATIONS.....	ix
CHAPTER ONE.....	1
INTRODUCTION.....	1
1.0 Background.....	1
1.1 Problem statement.....	3
1.2 Objectives of the study.....	4
1.2.1 Main objective.....	4
1.2.2 Specific objectives.....	4
1.3 Research questions.....	5
1.4 Justification.....	5
1.5 Significance.....	6
1.6 Scope of the study.....	7
1.7 Theoretical framework.....	8
CHAPTER TWO.....	11
LITERATURE REVIEW.....	11
2.1 Overview of indigenous micro-organisms practice.....	11
2.2 The requirements and process of making Indigenous Micro-Organisms.....	11
2.2.1 Application of IMO/ General use of IMO.....	12
2.2.3 Adoption of pig technologies among smallholder farmers.....	15
2.3 Farmers’ characteristics and technology adoption.....	16
2.3.1 Institutions and adoption.....	19
2.4 Knowledge gap in literature review.....	21
CHAPTER THREE.....	22
METHODOLOGY.....	22
3.1 Study area.....	22
3.2 Study design.....	22
3.3 Study population.....	22
3.4 Sample size estimation.....	22

3.5 Sampling procedure and techniques.....	23
3.6 Data collection procedure.....	23
3.7 Quality Control.....	24
3.8 Data analysis.....	24
3.9 Ethical considerations.....	24
CHAPTER FOUR.....	26
4.0 Socio economic characteristics of respondents.....	26
4.1 Institution factors associated with adoption of IMO technology.....	26
4.1.1 Access to credit.....	26
4.1.2 Access to Information.....	27
4.2 Test of association between independent variables.....	31
4.3 The Socio economic and institutional factors that influence adoption of IMO technology among the pig farmers.....	34
4.4 Discussion Of Results.....	37
4.4.1 Discussion.....	37
4.4.2 The socio-economic factors associated with use/adoption of IMO technology on commercial pig farms in Mukono District.....	37
4.4.3 The institutional factors associated with use/adoption of adoption of IMO technology on commercial pig farms in Mukono District.....	40
4.4.4 The influence of socio-economic and institutional factors on adoption of IMO technology among commercial pig farmers in Mukono District.....	41
CHAPTER FIVE.....	43
CONCLUSION AND RECOMMENDATIONS.....	43
5.2 Conclusion.....	43
5.3 Recommendations.....	43
References.....	44

LIST OF TABLES

Table 1: Descriptive statistics for continuous variables on social economic characteristics of respondents.....	26
Table 2: Descriptive statistics for continuous variables on social economic characteristics of respondents.....	26
Table 3: Descriptive statistics for categorical variables on access to credit for pig production	27
Table 4: Descriptive statistics for categorical variables on access to credit for pig production	29
Table 5: Training of farmers on IMO technology.....	28
Table 6: Results regarding access to Extension services.....	30
Table 7: Marketing of pigs.....	31
Table 8: Test of association between independent variables.....	32
Table 9: The relationship between categorical variables and IMO technology adoption.....	34
Table 10: Factor influencing the adoption of IMO technology among the pig farmers.....	36

LIST OF FIGURES

Figure 1: Awareness about the Indigenous Microorganisms Technology.....	28
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LIST OF ABBREVIATIONS

CGIAR	Consortium of International Agricultural Research Centers
ILRI	International Livestock Research Institute
IMO	Indigenous Micro Organisms
Kg	Kilogram
MAURIK	Makerere University Agricultural Research Institute Kabanyolo
ZARDI	Zonal Agriculture; Research Development Institute

ABSTRACT

Commercial pig production is increasingly contributing to availability of food of animal origin, incomes and livelihood of many households. Pig production is marred by the pervasive emission of foul odors arising from various sources including urine, anaerobic decomposition of feces, spilled feed, and decaying matter. The objective of this study was to investigate the factors influencing the adoption of Indigenous Micro Organism (IMO) technology in pig farming in Mukono district, Uganda. Cross-sectional study design was used to analyze socio-economic and institutional factors that influence the adoption of IMO technology on commercial pig farms. Questionnaires were used to capture data on socio-economic and institutional variables. The results revealed that 131 pig farmers were interviewed. Results indicate that 31% of farmers adopted IMO technology. Male farmers showed higher adoption rates (33%) compared to female farmers (27%), and university-educated farmers exhibited a higher adoption rate (63%) compared to those with no education (14%). Access to credit was limited, with 13% of respondents accessing credit, mainly from banks (100%) and friends/relatives (80%). Awareness about IMO technology was moderate, with 47% of respondents being aware, and 32% receiving training in making or using IMO. Access to extension services was very low at 28%. Despite universal access (100%), the majority (98%) had no supply contracts.

Logistic regression analysis revealed that training in IMO technology significantly ($p=0.000$) increased adoption likelihood ($OR=679.552$), with trained farmers being 680 times more likely to adopt. Farmers with herds of more than 30 pigs were significant ($p=0.030$) with high likelihood ($OR=21.718$) to adopt IMO technology. Further, access to extension services was 44.056 times more likely to adopt it for use evidenced by a high odd ratio ($OR=44.056$). Therefore, the research findings have underscored the importance of farmers access to training, extension services, and credit to promote IMO technology adoption. We recommend commercialization of the pig industry through targeted interventions to promote farmers' access to credit, training and extension services to promote adoption of IMO technology.

Key words: Indigenous Micro Organism Technology, adoption, Mukono district and Uganda

CHAPTER ONE

1.0 Introduction

This chapter presents background of the study, statement of the problem, purpose of the study, objectives, research questions, justification, significance and conceptual framework and the basic operational definitions in this research.

1.1 Background to the study

Globally, commercial pig production is increasingly contributing to availability of food of animal origin, incomes and livelihood of many households (USDA, 2021). The demand for animal protein by the growing world population is steadily increasing particularly in developing countries (OECD and Food and Agriculture Organization for United Nations, 2010; Ravindran, 2013). Per capita consumption of pork worldwide is estimated at 36% (USDA, 2021). To meet this increasing demand, pig production is steadily increasing worldwide. For instance, in Africa it has risen from 33.8 million in 2013 to 34.5 million in 2014 (Arnold, 2016). Equally in Uganda, there is a growing trend resulting into change in pig population from 0.19 to 3.2 million with more than 1.1 million families raising pigs using backyard farming methods in smallholder households in peri-urban and rural areas (ILRI,2012).

Furthermore, ILRI (2012) observed that pig production sector was ranking highest in growth, driven by increase in population, urbanization and wealth alongside improvements in animal health control and government projects promoting growth of the livestock sector. According to CGIAR (2011) findings, Uganda had the highest per-capita consumption of pork meat in sub-Saharan Africa (3.4kg/person/year). Though, Ugandan government has not prioritized the pig production sector under Third National Development Plan (NDPIII) 2020/21 – 2024/25 due to lack of evidence of the full scope and potential of the industry as well as

misconceptions about pigs as dirty animals. Pig production is increasingly being embraced at commercial level both in urban and peri-urban areas to respond to market demand for pork.

However, pig production is marred by a number of constraints like the pervasive emission of foul odors arising from various sources including urine, anaerobic decomposition of feces, spilled feed, and decaying matter (Le et al., 2008), feed wastage, diseases like African swine fever etc.

Presently, Indigenous microorganisms' technology is being used to solve the above-mentioned constraints in production (Kidega et al.,2020). The technology utilizes naturally occurring microbes to decompose waste, suppress odors, reduce disease incidence and improve animal welfare (Kidega et al., 2020). Introduced in Uganda in 2011 by Professor Hong Yo Lee at Makerere university Agricultural Research Institute, the technology has shown promise in improving pork quality and reducing labor inputs.

However, adoption of IMO technology remains low. A study conducted by Kasima et al. (2021) on pig production in Gulu and Omor districts in Northern Uganda revealed that none of the pig farmers interviewed was using Indigenous micro-organisms.

By 2019, only 20% of pig farmers in Mukono District had adopted IMO (DVO Report, 2019), and a survey conducted for this study in 2021 revealed an adoption rate of 31%. Adoption patterns varied across sub-counties: Nama (18%), Goma (24%), Kyampisi (34%), and Mukono Town (40%).

The persistence of low adoption, despite clear benefits, highlights the need to understand the factors influencing uptake among commercial pig farmers in Mukono District

This research therefore will investigate the factors influencing the low adoption of IMO technology on commercial pig farms in Mukono district, central region of Uganda.

1.2 Problem statement

IMO adoption remains limited, particularly among commercial pig farmers in Uganda, where the majority (90%) continue to rely on conventional rearing methods (Lagu et al., 2017).

A study conducted by Kasima et al., (2021) on pig production in Gulu and Omor districts in Northern Uganda revealed that none of the pig farmers interviewed was using the Indigenous micro-organisms. Further studies underscore the widespread non-adoption of IMO technology, with adoption rates as low as 20% in Mukono District (DVO report, 2019), and a staggering 0% adoption in Gulu and Omor districts in Northern Uganda (Kasima et al., 2021).

Commercial pig production farmers face major production constraints like; pervasive emission of foul odors arising from various sources including urine, anaerobic decomposition of feces etc. (Le et al., 2008), total loss due to death of animals caused by swine fever disease, feed wastage. etc.

Among the proposed alternatives, Indigenous Micro-organisms (IMO) technology stands out as a promising, cost-effective approach to solve the above constraints in pig production (Ndyomugenyi and Kyasimire, 2015)

Studies on IMO in Uganda mainly concentrated on its preparation, formulation and how it can be used by farmers for their best benefit. These studies did not tackle adoption of IMO or the factors that influence its adoption.

Despite the evident benefits of IMO technology in enhancing health, environmental sustainability, and productivity within pig farming, there is a notable gap in research focusing on factors impeding its adoption among commercial pig farmers in Uganda. While socio-economic and institutional factors have been identified as crucial determinants of technology adoption in various contexts (Birungi, 2017; Zanu et al., 2012), their specific influence on the

uptake of IMO technology among pig farmers in Uganda remains largely unexplored. Against this backdrop, this study aims to investigate the impact of socio-economic and institutional factors on the adoption of IMO technology among commercial pig farmers in Mukono District. By addressing this research gap, the study seeks to provide valuable insights that can inform strategies for promoting the wider adoption of IMO technology in pig farming practices, thereby enhancing sustainability and productivity in the sector.

1.2 Objectives of the study

1.2.1 Main objective

To explain the factors influencing the adoption of Indigenous Micro-Organism (IMO) technology among commercial pig farmers in Mukono District, Uganda

1.2.2 Specific objectives

1. To assess the socio-economic and institutional characteristics of pig farmers.
2. To evaluate the use/utilization of Indigenous Micro-Organism technology among pig farmers
3. To determine factors that influence adoption of IMO among commercial pig farmers

1.3 Research questions

- What are the socio-economic characteristics of commercial pig farmers in Mukono District that influence the adoption of Indigenous Micro-Organism technology.
- What institutional factors influence the adoption of Indigenous Micro-Organism technology among commercial pig farmers?
- How do socio-economic and institutional factors jointly affect the adoption of Indigenous Micro-Organism technology in commercial pig farming?
- What are the key constraints and opportunities that shape the adoption of Indigenous Micro-Organism technology in Mukono District?

1.4 Justification

Pig production is marred by the pervasive emission of foul odors arising from various sources including urine, anaerobic decomposition of feces, spilled feed, and decaying matter (Le et al., 2008). This malodor not only dissuades smallholder farmers but also engenders tensions among pig farmers and their neighbors within the community (Phiri et al., 2003; Perry and Grace, 2009; Waiswa et al., 2009; Nissen et al., 2011). The Indigenous Micro-organisms (IMO) technology represents a transformative solution in pig farming, offering a host of benefits crucial for sustainable and profitable operations. Notably, IMO technology significantly reduces the incidence of African swine fever, a pervasive threat to pig populations globally (MAURIK, 2020). Moreover, it streamlines farming practices by decreasing labor intensity, thus enhancing operational efficiency.

Furthermore, IMO technology elevates the quality of pork by creating odorless, fly-free environments without the need for constant cleaning, thereby improving animal welfare and reducing operational burdens. Its unique ability to decompose organic compounds and catalyze essential soil processes fosters healthy ecosystems, promoting disease suppression and facilitating nutrient recycling (Reddy, 2011).

Despite these compelling advantages, the adoption of IMO technology among farmers remains disconcertingly low, posing significant challenges. Further studies underscore the widespread non-adoption of IMO technology, with adoption rates as low as 20% in Mukono District (DVO report, 2019), and a staggering 0% adoption in Gulu and Omor districts in Northern Uganda (Kasima et al., 2021). This can be due to socio-economic barriers and inadequate institutional support.

Inadequate adoption exposes farmers to heightened feed costs, compromising profitability and sustainability. Moreover, it jeopardizes animal health and immunity, increasing susceptibility to diseases such as African swine fever. Additionally, unaddressed technology needs contribute to increased instances of animal injuries, further impacting farm productivity and profitability.

Addressing the low adoption of IMO technology is imperative to mitigate these challenges and unlock its full potential in enhancing pig farming practices. Failure to do so not only undermines farm profitability but also compromises animal welfare and environmental sustainability. Hence, fostering wider adoption of IMO technology is essential for ensuring the resilience and viability of the pig farming sector.

This study, therefore, seeks to close the knowledge gap on what determines the adoption of IMO technology, providing evidence for policy, farmer support and improved extension services.

1.5 Significance

Informing Agricultural Practices: Understanding the factors influencing the adoption of IMO technology is crucial for guiding farmers and policymakers in implementing sustainable agricultural practices. By identifying barriers to adoption, this study can inform strategies to promote the uptake of IMO technology, thereby enhancing farm productivity, sustainability, and profitability.

Mitigating Disease Risks: IMO technology has the potential to reduce the incidence of diseases such as African swine fever, thereby safeguarding pig populations and mitigating economic losses for farmers. By elucidating the adoption dynamics of IMO technology, this study can contribute to the development of targeted interventions aimed at mitigating disease risks in pig farming.

Economic Implications: The adoption of IMO technology can have significant economic implications for pig farmers, including reduced feed costs, improved product quality, and enhanced market competitiveness. By quantifying the economic benefits associated with IMO adoption, this study can provide valuable information for farmers and policymakers to make informed decisions regarding investment in sustainable agricultural technologies.

Policy Development: The findings of this study can inform the development of policies and programs aimed at supporting the adoption of IMO technology in pig farming. By identifying key barriers to adoption and potential strategies for overcoming them, policymakers can design targeted interventions to incentivize farmers to adopt sustainable agricultural practices.

Contribution to Literature: This study contributes to the existing body of literature on technology adoption in agriculture, particularly in the context of pig farming in Uganda. By filling a gap in the literature, this study provides valuable insights for researchers and practitioners interested in understanding the factors influencing technology adoption and promoting sustainable agricultural development.

1.6 Scope of the study

Subject:

The study focused on investigating the adoption of Indigenous Micro-organisms (IMO) technology among commercial pig farmers in Mukono District, Uganda. Specifically, it examined the socio-economic and institutional factors influencing the adoption of IMO technology and its implications for pig farming practices, including disease management, labor intensity, and product quality.

Time:

The study was conducted over a specified time frame to capture the current adoption patterns and dynamics of IMO technology among pig farmers in Mukono District. The research encompassed data collection, analysis, and interpretation over a period of six months in 2021 and provided insights into the contemporary status of IMO technology adoption in the study area.

Geographical:

The geographical scope of the study was limited to Mukono District, located in central Uganda. Mukono District was selected as the study area due to its significant presence of commercial pig farming operations and the observed low adoption rates of IMO technology. By focusing on a specific geographical area, the study provided context-specific insights into the adoption dynamics of IMO technology within the local pig farming community.

1.7 Theoretical framework

The guiding theoretical under-pinning of this study is the Technology acceptance model (TAM)

The technology acceptance model is a theory that explains and predicts the likelihood of individuals and organizations adopting and using new technologies. It is a psychological model developed by Fred Davis in the 1980s that focuses on how people's perceptions of a technology influence their acceptance and usage.

Core concepts of TAM

- Perceived usefulness; The degree to which a user believes that using a particular technology will enhance their performance or achieve their goals.
- Perceived Ease of use; The degree to which a user believes that using a particular technology will be effortless and straight forward.
- Behavioral Intention; The user's intention to use or not use the technology.
- Actual Use; The user's actual behavior of using the technology.

How it works

The TAM suggests that a user's perceptions of usefulness and ease of use directly influence their attitude towards the technology, which in turn shapes their behavioural intention to use it. This intention, combined with other factors like social influence or facilitating conditions, ultimately leads to actual use of the technology.

Key features of this model

- Focus on Perceptions; The TAM emphasizes the importance of users' subjective perceptions, rather than the technology's objective features, in determining acceptance.
- Two-stage process; TAM proposes a two-stage process; first, the user's perceptions of usefulness and ease of use are formed, and then these perceptions influence their behavioral intention.
- Widely Applicable; TAM has been extensively used in various contexts, including information systems research, e-commerce and education to understand technology adoption.

While the core TAM focuses on perceived usefulness and ease of use, extensions of the model have been developed to incorporate additional factors, such as:

Social influence:

The impact of others' beliefs and behaviours on a user's decision to adopt a technology.

Facilitating conditions:

The availability of resources and support that can make it easier for a user to adopt and use a technology.

Hedonic Motivation:

The extent to which a user perceives using the technology as enjoyable or fun.

Computer Anxiety: The user's apprehension or fear when interacting with computers.

The Technology Acceptance Model therefore, is a valuable framework for understanding and predicting how users will respond to new technologies. By focusing on perceptions and behavioural intentions, it provides insights into the factors that drive technology acceptance and adoption.

Perceived Ease of Use of IMO Technology

Farmers' perception of how easy it is to prepare and apply IMO strongly affects adoption.

- **Simple preparation process:** Farmers noted that IMO can be prepared using locally available inputs (e.g., rice bran, molasses, forest soil), reducing reliance on external inputs.
- **Ease of integration:** Application involves mixing IMO solution with pig waste or feed, which farmers described as straightforward once trained.
- **Training effect:** Farmers who received training reported that IMO preparation and use became routine and less time-consuming compared to traditional waste management methods.
- **Barrier:** Some untrained farmers perceived IMO preparation as complicated, which discouraged adoption.

This reflects TAM's perceived ease of use construct—training reduces complexity, making farmers more confident to adopt.

Perceived Benefits (Usefulness) of IMO Technology

Adopters consistently highlighted multiple benefits that motivated adoption:

- **Odor reduction:** IMO suppresses foul smells in pigsties, improving farm and household hygiene.
- **Disease control:** Farmers observed fewer cases of diarrhea and respiratory infections after using IMO, reducing veterinary costs.
- **Feed efficiency:** Some adopters noted improved feed utilization, as IMO helps ferment feed materials.
- **Manure quality:** IMO-treated waste decomposes faster, producing high-quality organic fertilizer for crop fields.
- **Environmental benefits:** Reduced waste pollution and better waste recycling.
- **Economic gains:** Improved pig growth rates and lower costs for disinfectants/medicines translated into higher profits.

These align with TAM's perceived usefulness construct—farmers adopt IMO because it directly improves productivity, health, and income.

The theory of Planned Behavior; This is a psychological model that explains how intentions, which are the primary drivers of behavior, are influenced by three key factors: Attitude towards the behavior; this refers to an individual's positive or negative evaluation of a specific behavior.

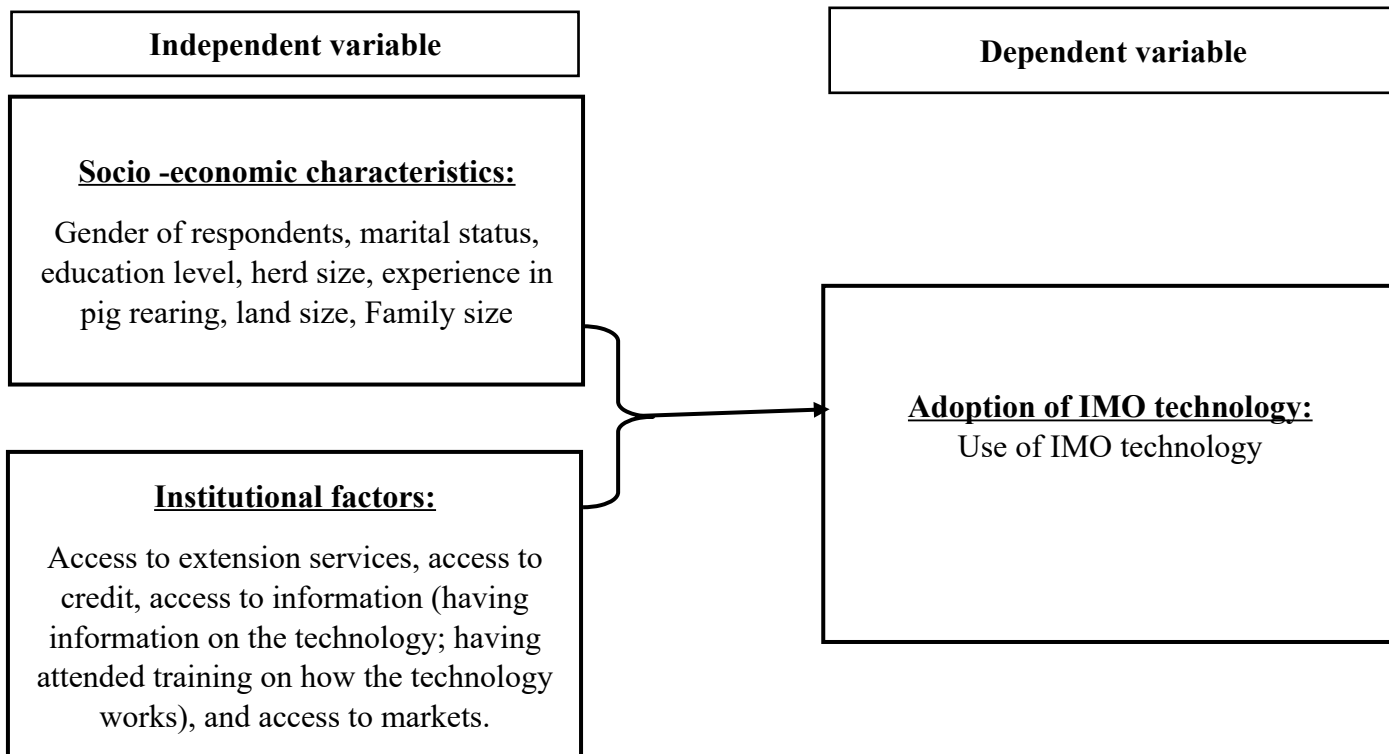
Subjective norms; This reflects an individual's perception of social pressure to perform or not perform a certain behavior.

Perceived Behavioral control; This refers to an individual's belief about their ability to control the behavior.

In other words, the theory of Planned Behavior suggests that if an individual has a positive attitude towards a behavior, feels a social pressure to perform it, and believes they have the ability to do so, they are more likely to intend to and actually perform that behavior.

Together, TAM and TPB provide a strong foundation for analyzing adoption behavior, particularly how perceptions, access, and social norms shape the use of IMO technology.

1.8 Conceptual framework



The conceptual framework is underpinned by: **Technology Acceptance Model (TAM)** – by Fred Davis. This model explains how users come to accept and use a technology. It includes:

Perceived Usefulness – The degree to which a farmer believes that using IMO will improve production outcomes (e.g., reduced smell, Labor, and disease).

Perceived Ease of Use – The degree to which a farmer finds IMO technology easy to understand and apply.

Behavioral Intention – The willingness or plan of a farmer to adopt IMO.

Actual Use – Whether the farmer actually applies the technology.

These elements shape how socio-economic and institutional factors affect attitudes and decisions regarding IMO adoption.

Theory of Planned Behaviour (TPB) – by Ajzen

This adds the following:

Attitude Toward the Behaviour – Farmer’s overall evaluation of using IMO.

- Subjective Norms – Influence from peers, community norms, or expectations that affect the farmer’s decision.
- Perceived Behavioural Control – The farmer’s belief in their capacity (resources, skills, support) to use IMO

The conceptual framework links the **determinants** (independent variables) to the **adoption of IMO** (dependent variable). These are grouped as:

Socio-economic Factors:

- Age
- Education level
- Gender
- Household size
- Farming experience
- Herd size
- Access to markets

These influence:

- Perceived usefulness and ease of use
- Individual capacity to adopt technology

Institutional Factors:

- Access to extension services
- Training on IMO
- Access to credit
- Belonging to farmer groups or cooperatives

These influence:

- Behavioural intention
- Perceived behavioural control
- Social norms

The interaction of these socio-economic and institutional factors influences whether a pig farmer:

- Is aware of IMO,
- Willing to try it,
- Able to access resources/support, and
- Ultimately adopts and uses the technology

In Summary, the conceptual framework proposes that:

“Socio-economic and institutional characteristics influence the perception, intention, and ability of commercial pig farmers to adopt Indigenous Micro-Organism (IMO) technology through constructs drawn from TAM and TPB theories.”

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents the overview and practice of IMO technology together with its associated benefits and constraints of the traditional methods of pig rearing.

2.1 Overview of indigenous micro-organisms practice

Commercial pig production and productivity best husbandry practices including proper feeding, animal welfare and health care using new innovations and technologies among others have been promoted (Kasima et al.,2021).

In Uganda, IMO technology is a newly introduced approach to improved pig management particularly for the commercial pig farmers.

The innovation involves use of indigenous micro-organisms (IMO) that are simple micro-organisms which occur naturally in the environment made by culturing. They can be a virus, bacteria or fungi or any other organism. Its composition can be made and cultured in the laboratory depending on the type (MAURIK, 2013). The innovation was introduced in Uganda by South Korean professor Hong Yo Lee 2011 at Makerere university research institute Kabanyolo under the theme, "Mindset change in Uganda". Professor Hong Yo Lee gave students a project of organic piggery which they have tested and proved efficient. (MAURIK, 2011)

The Indigenous Micro-organisms (IMO) technology involves use of micro-organisms to decompose waste, and this greatly reduces the incidences of African swine fever, reduces labor intensity and improves on the quality of pork among other benefits (Kidega et al.,2020)

Under this technology, a farmer can keep many animals in a small piece of land or unit. A 3.8 meters construction can accommodate 25 pigs of up to 8 months hence saving land and space. Compared to other methods, it is easier for farmers to make microorganisms themselves. The

technology reduces feeding costs in piggery by 30%, eliminating smell and flies in the piggery unit, and generates manure for fertilizing crops. Labor costs are also greatly reduced as one needs to come once, to turn the saw dust, sprinkle the IMO or add feed stuff.

However, recent studies emphasize that farmers consider a range of characteristics such as household (education, age and family size), farm characteristics, technology characteristics, wealth (economic status), contact with extension agents, farmers knowledge of specific technologies, price, access to credit and position of the farmer in farmers organization to determine the adoption of new technologies (Legesse, 1992; Teresa, 1997; Walda, 1999, Caswell et al., 2001, Kinyangi, 2014) Oladele (2005) and Giger et al., (1999) mentioned a range of factors including: profitability , economic, social, physical and technical aspects of farming that influence the adoption of agricultural production technologies.

Further, the farmer's attitude towards change, land, sources of information, membership of farmer's organizations, education level, farm income, farmers' exposure, are the important socio-economic factors influencing adoption of farm innovations (Rousan, 2007).

Other factors that trigger adoption of new technologies comprise of young and educated male farmers, higher income level, risk orientation and decision -making ability of farmers (Feder and Slade, 1984). Factors limiting adoption of technology includes conservative old men, illiteracy, weak belief on ensuring high yield of the new technology among others. So, it is evident that farmers' use of technologies can be influenced by various socio-economic factors (Birungi, 2017; Zanu et al., 2012)

2.2 Application of IMO/General use

The Indigenous micro-organisms (IMO) are sprinkled over the animal fecal matter and saw dust. The saw dust is a source of carbohydrates locked in saw dust called cellulose and no enzyme in mono-gastric animals can break it down. The micro-organisms break down the

cellulose locked up in the saw dust and avail nutrients to the animals as they feed on the saw dust.

The fecal matter of the animals is a rich source of protein not digested by the animals and micro-organisms go ahead and break down the protein locked in the fecal matter and the animals go back to feed on it. This cycled feeding caters for 30% and the farmer provides 70% of the feed.

During the fermentation or breakdown of the saw dust and fecal matter into nutrients, a lot of heat is produced raising the temperature of the litter to about 60 degrees Celsius. This temperature is good enough to kill disease causing organisms and during this fermentation the smell is minimized or eliminated and therefore no flies will be attracted to the place. IMO technology reduces noise as the animal is kept busy and comfortable in the same place. What happens is that the animal is not disturbed, it feeds all the time in a convenient sty. As such, a farmer can keep pigs without the notice of the immediate neighbor because they never make noise.

2.3 Role of knowledge, attitude and practice on technology adoption

Farmers can have knowledge about the existence of a new technology, how to apply it, and what the outcomes are in terms of products, yield, potential environmental benefits, risks and costs. The information an individual has about a new technology then forms the basis of the perceptions and attitudes this individual develops towards the technology (Seline et al., 2015). The perceptions farmers have about innovation are very closely related to the knowledge they have about it. Whereas knowledge refers to factual information and understanding of how the new technology works and what it can achieve, perceptions relate to the views farmers hold about it based on their felt needs and prior experiences (Roling and

Jiggins, 1998); and these do not necessarily align with reality. The knowledge and perceptions about an innovation then together determine the attitude towards it. In accordance with the theory of planned behavior, the attitude component comprises not only the attitude towards the behavior, but also the attitudes with regard to the subjective norms and perceived behavioral control (Fishbein, 1975). In this case, we expect that a positive attitude towards an agricultural innovation such as Indigenous Microorganism will increase the likelihood of adoption and a negative attitude to reduce the probability of adoption.

The individual attitudes and values determine a person's motivation to adopt a particular behavior, and motivation ultimately determines whether a behavior is adopted by a person (Sun *et al.*, 2021). When performance expectancy is at a high level, users have a positive attitude towards using the system. For agriculture, studies found the importance of performance expectancy on the intentions of farmers to adopt mobile-based technologies for agricultural information (Chai, 2020).

2.4 Adoption of technologies among smallholder farmers

The decision of a farmer to adopt technology depends on the characteristics of an innovation (Kinnucan *et al.*, 1990). These characteristics do not consider whether the proposed technology is better than the one it intends to replace. What matters is whether farmers see the new technology to have an advantage over the one it is replacing and to what extent do they stand to benefit from the new technology.

There are several factors that determine whether a farmer will or will not adopt a certain technology. Studies have shown that farmers' decisions to adopt or not to depends on their needs, costs incurred and benefits accruing from the adoption of the technology (Karki, 2004).

Farmers consider a range of characteristics such as household (education, age, and family size), to determine the adoption of new technologies (Legesse, 1992; Teressa, 1997; Walday, 1999). Oladele (2005) also mentioned a range of economic, social, physical, and technical aspects of farming that influences the adoption of agricultural production technologies.

The adoption of the technologies promoted could also be determined by the profitability from the agro-pastoralists' point of view (Giger et al., 1999). This goes to suggest that farmers abandon or discontinue the use of a technology if they feel that it is not beneficial either in the short or long run. The irony lies in the fact that the economic impact of the adoption of a technology cannot be known in advance with certainty (Karki, 2004).

Studies from India (Rahman, 2007) and Ghana (Zanu et al., 2012) affirm that education, land ownership, social participation, training, and access to extension services all significantly affect adoption rates.

2.5 Farmers' characteristics and technology adoption

This is by far the most common factor which affects the rate of adoption of technologies in Africa. These are the farmers' attributes that either increase or reduce their likelihood of adopting new agricultural technologies. Factors in this group include the physical and social capital holdings of individual farmers and their educational achievements and demographic groups. In technology adoption, the smallholder's income level is important (Cramb, 2000; Shelton et al., 2005; Mapiye et al., 2007; Gillah et al., 2012).

Most small-scale pig farmers in Africa are poor and do not have the resources to use to adopt new technologies

The level of education of most pig farmers influences the rate at which they take up newly introduced feeding methods for their livestock. Literacy enhances the level to which farmers can interpret and appreciate new methods and increases the likelihood of them adopting useful strategies (Njarui et al., 2012). Unfortunately, most pig farmers in Africa have low educational backgrounds, which often limit their capacity to appreciate and take up complex technologies (Ndambi et al., 2007). However, Abdulai and Huffman (2006) insist that the part played by education fades with time and improved overall literacy levels.

Information on newly introduced technologies also plays a vital role in their adoption (Mwakaje, 2012; Kassie et al., 2013).

Social capital is all the formal or informal human networks that could support farmer's decisions and serve as insurance (informal) for their actions (Kassie et al., 2013). There are several ways in which social capital can influence a farmer's decision to take up (or not take up) an Indigenous microorganism technology. One of them takes the form of strong farmers' associations (Abdulai and Huffman, 2006). Membership to such networks could easily increase individual farmers' bargaining power and reduce their transaction costs, thus making room for excesses that could be used to introduce improved technologies (Kassie et al., 2013).

The mere concentration of many pig farmers in one area increases the probability of their uptake of improved technologies (Abdulai and Huffman, 2006). This happens because of competition among neighboring farmers which can spur on the need for innovative practices among them as well as the possibility for more informed farmers to share their knowledge with less informed ones.

Furthermore, the size of a family matters as it provides a ready and cheap workforce.

Shelton *et al.* (2005) found age to be one of the factors that affected the adoption of technologies all over the world. They argued that older farmers generally lack interest in innovation and are reluctant to abandon their past experiences to pursue new ideas on the best practices in pig farming. They are generally more risk averse and less likely to take up new technologies than their younger counterparts (Mwakaje, 2012; Kassie *et al.*, 2013).

Researchers were almost unanimous in the view that female dairy farmers in SSA were less likely to adopt forage technologies than their male counterparts. The first reason for this disparity is that female farmers in Africa often dispose of fewer critical farm resources (i.e. land, labor, and capital) than male ones (Kassie *et al.*, 2013). Women in many parts of SSA have less managerial power than men. The male head of the household is generally the main decision maker (Kavana *et al.*, 2005) and controls most piggery-related activities and decisions (Pham *et al.*, 2015). In Tanzania, women equally own less managerial powers than their male counterparts (Lukuyu *et al.*, 2009) and despite being responsible for animal husbandry and feeding, they are not in charge of decision making (ILRI, 2014), which puts female Ugandan pig farmers at a disadvantage.

A study by Rahman (2007) on Adoption of improved technologies by the pig farmers in India revealed that adoption of improved technologies was associated with age, education, operational land holding, farm size, income from piggery, social participation, extension contact, farming experience, farm education exposure, scientific orientation, knowledge level, training and financial help received. Similarly, a study conducted in Ghana by Zanu *et al.* (2012) indicated that adoption of improved technologies was associated with age, education, operational land holding, farm size, income from piggery, social participation, extension contact, farming experience, farm education exposure, scientific orientation, knowledge level, training and financial help received.

2.5.1 Institutions and adoption

For pig farming to take the right form and produce the expected results in Africa, institutions must be present to offer support and guide pig farmers in their uptake of the best available practices (Ndambiet *al.*, 2007). This indicates that institutions have specific roles to play in the adoption process. The following section examines the various institutions concerned and how they affect smallholder farmers' decisions to take up new indigenous Micro-organism techniques.

Institutions—both formal and informal—shape farmers' access to innovations. Government and NGO-provided **extension services** to help farmers gain skills, access inputs, and understand new technologies. However, the decline of formal extension services in many African countries has reduced farmer outreach (Franze & Wambugu, 2007).

Other critical institutional factors include:

- **Access to credit**, which facilitates investment in new technologies
- **Training programs**, which build confidence and competence
- **Market access**, which improves the incentive to invest in productivity-enhancing methods
- **Farmer groups or cooperatives**, which enable collective learning and bargaining

Governments could indirectly influence the rate of adoption of technologies through the use of extension services (Kalibaet *al.*, 1997). Unfortunately, formal extension systems are reported to be in general decline throughout Africa (Franze and Wambugu, 2007). The negative influence of absent extension services on adoption rates has been highlighted in

several studies (Elbasha *et al.*, 1999; Shelton *et al.*, 2005). However, bad governance has marred the positive influence of government extension workers in Africa (Kassie *et al.*, 2013).

Ready access to credit would be greatly beneficial in the adoption of improved forage technologies. Unfortunately, individual farmers in these poor regions lack the surety required to obtain loans from formal institutions (Kurwijila *et al.*, 2012; Mwakaje, 2012). In most of SSA, credit procedures are complex, and banks are reluctant to lend money to individual farmers.

The interplay between poverty, high costs of forage inputs, and the difficulties that smallholders encounter in the quest for credit, is a discouraging factor in the adoption of technologies in SSA. However, this factor can be overcome through the formation of organized dairy farmer groups and associations (Kassie *et al.*, 2013). This would improve the credibility of individual farmers and ease their access to credit.

2.6 Knowledge gap in literature review

While some studies in Uganda have explored the formulation, preparation, and application of Indigenous Micro-Organisms (e.g., MAURIK, 2013; Kidega et al., 2020), few have examined the socio-economic and institutional determinants of adoption. Existing research often lacks empirical analysis on what drives or hinders uptake among farmers, especially in relation to extension access, training, and credit availability.

This gap limits the ability of stakeholders to design targeted policies and programs to increase adoption rates. Understanding these factors is crucial for scaling IMO technology in pig farming, especially in districts like Mukono where adoption remains low despite high potential benefits.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents the methodology used in the study on adoption of IMO technology among smallholder pig farmers. It covers the research design, area of the study, population of the study, sample size and sampling techniques, methods that were used by the researcher while collecting data, scope of the study, research procedure, and ethical considerations that were followed while in the field. It also highlights how data was processed and analyzed.

3.1 Study area

The study was conducted among the pig farmers selected from households in Mukono district. This is because Mukono district is one of the best three pig producing districts in Uganda after Masaka and Kamuli districts respectively. Mukono district is in the central region of Uganda with longitude and latitude bearing coordinates as 00°28'50"N, 32°46'14"E.). The main economic activity in addition to agriculture is trading and services provisions to the population (World Bank, 2017).

3.2 Study design

A cross-sectional study was carried out using quantitative and qualitative techniques that is questionnaire and focused group discussion respectively.

3.3 Study population

The study population included pig farmers and agricultural service providers. Focused group discussions were also carried out.

As per the UBOS (2017) statistics the national population census put the population of Mukono at 596,804. A total household of 56,680 rear pigs with close representing 15.2% households rearing dairy, exotic or cross breed (UBOS,2009).

3.4 Sample size estimation

The sample size was determined using the method advanced by Kothari (2004):

$$n = \frac{z^2 p(1 - p)}{e^2}$$

Where, n is the sample size, p is the proportion of pig farmers in the 4 selected sub counties (Nama, Mukono town, Goma and Kyampisi) out of the total number of households in the 4 selected sub counties, z is the Z value corresponding to 95% confidence interval (Z=1.96), and e is the precision or acceptable error set at 5%. Using the formula above the sample size selected was 168 households that is without prior information of their status as adopters and non-adopters of IMO technology.

3.5 Sampling procedure and techniques

The study adopted a multi-stage random sampling strategy to select pig farmers without categorizing them based on their usage of Indigenous Micro-Organism (IMO) technology beforehand. In the first stage, random selection was used to choose four sub-counties of Goma, Nama, Kyampisi and Mukono town from a diverse set to ensure representativeness. From each of the four sub-counties, two villages were randomly selected from two parishes. In the final stage, ten individual pig farmers were randomly chosen from each village using lists provided by local council administrations in the selected villages, with each farmer having an equal chance of being selected. After sampling, the farmers' usage of IMO technology was determined through a survey or interview process. Adjustments to the sample size were made to achieve balanced representation between IMO users and non-users if necessary. This approach aimed to prevent bias and ensure a more accurate representation of pig farmers in the study.

3.6 Data collection procedure

Structured Questionnaire: Data was collected through face-to-face interviews using a structured questionnaire. The questions were in English and then translated to Luganda and then back translated to English by different persons to check for consistency. Data was collected by the researcher using pre-tested tools. Data collection was after obtaining participant's written consent. Research questions from the questionnaire were read to the participants individually and their responses recorded. For qualitative, in-depth interviews were carried out involving key informants, where responses were written down and recorded upon obtaining consent.

3.7 Quality Control

Data was collected by the researcher with the help of well-trained research assistants who were properly trained in how to administer the questionnaire. The Researcher ensured proper supervision and observation of filling of questionnaires to ensure competence and address unfamiliar terms, questions or complaints of respondents to ensure accuracy in collection of data. Questionnaires were checked for typing errors and corrected before final administration to respondents.

3.8 Data analysis

Data was cleaned and coded before analysis was undertaken. The analysis was done using STATA and SPSS software packages. The qualitative data was coded and analyzed in themes. Three levels of analysis were employed. At level one, descriptive statistics were generated to understand the characteristics of the farmers. With descriptive statistics a set of numerical measures aided to describe the central tendency, variability, and distribution of the dataset. At the second level bivariate analysis of relationship between farmer characteristics

and IMO technology adoption was explored. At the multivariate analysis level logistic regression model was used to test the factors associated with adoption of IMO technology among the pig farmers. Correlation analysis examines pairwise relationships between variables, with high correlation coefficients indicating potential collinearity.

3.8.1 Objective No.1: Social economic and institutional Characteristics of pig farmers.

The categorical chi-square test of association was used to determine whether production systems (IMO users and non- users) were associated with the categorical farmers' characteristics (level of education, gender, extension services, group membership, credit access, market access, marital status and access to extension services). The one-way ANOVA test was performed to compare continuous or numerical farmers' characteristics (Age in years, experience in years, and household size) by production system (IMO users and non- users). Farmers that used IMO at least once per month were considered users while those that never applied IMO were considered non -users.

3.8.2 Objective 2: Use of Indigenous Micro-Organism technology among pig farmers.

The categorical chi-square test of association was used to determine whether production systems (IMO users and non- users) were associated with the categorical farmers' characteristics (, production systems and IMO training service,). The one-way ANOVA test was performed to compare continuous or numerical farmers' characteristics (herd size, Imo application cost in UGX,) by production system (IMO users and non- users).

3.8.3 Objective No.3: Factors that influence the decision of pig farmers to adopt IMO technology

The selection of independent variables for the logistic regression model was guided by both

empirical literature and expert consultation with extension officers in Mukono District. Each variable reflects a socio-economic or institutional factor identified in past studies as critical to agricultural technology adoption: -

Schooling (years): Education enhances farmers' ability to process and apply new knowledge (Njarui et al., 2012).

Household size: Larger households provide labour resources that can support adoption (Shelton et al., 2005).

Experience in pig farming: More experienced farmers may have better knowledge and confidence to adopt new practices (Rahman, 2007).

Herd size: Larger herds indicate greater resource endowment and market orientation, which increase the incentive to adopt productivity-enhancing technologies (Rahman, 2007). -

Training on IMO: Training builds knowledge and skills, reducing uncertainty about the technology (Zanu et al., 2012).

Access to credit: Credit enables investment in new technologies (Kassie et al., 2013).

Access to extension services: Provides farmers with technical knowledge and confidence to adopt (Ndambi et al., 2007).

Market access: Farmers connected to markets have more incentive to invest in production technologies (Giger et al., 1999).

Age of farmer: Younger farmers are more likely to innovate compared to older, risk-averse farmers (Mwakaje, 2012). These variables were therefore selected based on their theoretical relevance and practical importance to adoption behaviour.

There is a dearth of tools in economics and social research for identifying factors that explain outcomes of one factor on another. The commonly used model is the linear regression. Regression models are used to predict one variable from one or more other variables. Regression models provide powerful tools, allowing predictions about past, present, or future events to be made with information about past or present events. Economists employ these models either because it is less expensive in terms of time and/or money to collect the information to make the predictions than to collect the information about the event itself, or, more likely, because the event to be predicted will occur in some future time. The most familiar model is the linear regression model estimated via the method of ordinary least squares (OLS). The linear regression model requires no assumptions regarding the measurement of the independent variables. Independent variables can be dichotomous, nominal, ordinal, or continuous. In contrast, the linear regression model requires that the dependent variable be continuous. The values of the dependent variable are assumed to: (1)

range from minus infinity to plus infinity, (2) be any real number, and (3) represent constant units of measurement. Moreover, it is assumed that the dependent variable has been measured for all cases in the sample (Batesse, 1992).

Although the linear regression models are popular and commonly used, in practice the measurement of many outcome variables does not meet the assumptions of the linear regression model. Two general categories of outcomes—discrete and limited—exist that pose problems for linear regression. Nonlinear regression models were developed to overcome several problems encountered when linear (OLS) regression is used to analyze non-continuous dependent variables. Although the exact set of problems may differ across the various types of outcome variables, the following four problems are common: (1) nonsensical predicted values i.e. predicted values falling outside the possible range of the outcome, (2) biased regression coefficients, (3) non normally distributed error terms, and (4) heteroscedasticity (Greene, 2005). The first two problems undermine one's ability to trust predicted values and the direction and size of estimated relations. The last two problems undermine one's ability to produce unbiased outcomes.

3.8.4.1 Logistic regression theory

Probit and logistic regressions methods are used for the construction of adoption model when the dependent variable is of a binary type (Raquel, 1985). In adoption studies, the use of probability models is conceptually preferable to conventional linear regression models because parameter estimates from the former overcome most weaknesses of linear models, namely, they provide parameter estimates, which are asymptotically consistent and efficient. Like in linear probability model, the predicted probabilities of both logistic and probit regression model always approach 0 and 1 and yield similar results (Hair *et al.*, 1998). This study employed the logit model. The logit model was preferred to the probit because of its simplicity (Amemiya, 1981). The logistic regression is a better statistical tool to determine the influence of independent variables on dependant variables, when the dependant variable has only two groups such as adopters and non-adopters (Neupaine, 2000). The analysis has straightforward statistical test, with high capacity to incorporate non-linear effects and wide range of diagnostic power (Hair *et al.*, 1998).

To pursue the logistic regression analysis, the dependent variable, adoption of IMO technology was hypothesized to be influenced by a number of independent variables such as, Schooling (years), Household size (No.), Experience pig farming (Yrs.), Herd size (No.),

Access training in pig management IMO (1=yes 0 = no), Training on IMO (1=yes 0 = no), Access credit (1=yes 0 = no), Market Access (1=user 0 = non), Age of farmer (years). These variables were largely derived from literature.

Model assumptions

1. The dependent variable is binary.
2. Independent variables are not highly correlated (multicollinearity was checked through correlation analysis; cutoff = 0.5).
3. Sufficient sample size is available (131 respondents) for maximum likelihood estimation.
4. The logit link function appropriately models the binary outcome.

These assumptions were satisfied in this study, ensuring the validity of the regression results.

3.8.4.2 Model specification

To construct the logistic regression model, the dependant variable, adoption of IMO technology was converted into a dichotomous binary variable representing adopters and non-adopters. Value 1 was assigned to adopters and 0 to non-adopters. Then the variable was analysed in association with other independent variables using logistic regression method.

A positive coefficient increases the probability of occurrence whereas the negative value decreases the predicted probability. The coefficients in the model are estimated in an interactive manner through the maximum likelihood procedures.

The logistic regression model used conforms to the functional forms described by Gujarati (2003) and is mathematically expressed as follows:

$$\ln \frac{P_i}{1-P_i} = \beta_0 + \sum_{j=1}^k \beta_j \chi_{ij}$$

were.

P_i = Probability of the event occurring

β_0 = Constant term

β_j = Coefficients

x = Independent variables

The coefficients demonstrate the effect of each explanatory variable on log of odds as follows:

$$\ln \frac{P_i}{1-P_i} = \text{log-odds ratio}$$

Binary logistic regression applies the maximum likelihood estimation after transforming the dependent into a logit variable. The mathematical equation for estimations is formulated as follows:

$$P_i = \text{prob}(Y_i = 1) = \frac{1}{1 + e^{-(\beta_o + \beta_1 X_{1i} + \dots + \beta_k X_{ki})}} = \frac{e^{(\beta_o + \beta_1 X_{1i} + \dots + \beta_k X_{ki})}}{1 + e^{(\beta_o + \beta_1 X_{1i} + \dots + \beta_k X_{ki})}}$$

For ease of exposition, we write it as above

$$P_i = \frac{1}{1 + e^{-z}} = \frac{e^z}{1 + e^z}$$

were $Z_i = \beta_o + \beta_1 X_{1i} + \dots + \beta_k X_{ki}$

Similarly,

$$\text{prob}(Y_i = 0) = 1 - \text{prob}(Y_i = 1) = 1 / (1 + e^z)$$

Divide (6.4) by (6.5) we get:

$$\text{prob}(Y_i = 1) / \text{prob}(Y_i = 0) = \frac{P_i}{1 - P_i} = \frac{1 + e^{z_i}}{1 + e^{-z_i}} = e^{z_i}$$

Where P_i is the probability that Y_i takes the value 1 and then $(1 - P_i)$ is the probability that Y_i is 0 and e is the exponential constant. By taking the natural logarithms of (6.5) we obtain a very interesting result, namely,

$$L_i = L_n \left(\frac{P_i}{1 - P_i} \right) = \beta_o + \beta_1 X_{1i} + \dots + \beta_k X_{ki}$$

Notice these features of the logit model are that (1) it is easy to verify that as Z_i ranges from $-\infty$ to $+\infty$, P_i ranges between 0 and 1 and that P_i is nonlinearly related to Z_i , thus satisfying the two requirements considered earlier. (2) as P goes from 0 to 1, the logit L goes from $-\infty$ to $+\infty$. That is, although the probabilities lie between 0 and 1, the logits are not so bounded. (3) if L , the logit, is positive, it means that when the value of the regressor increases, the odds that the regress are equal to 1 increase. If L is negative, the odds that the regress are equal to 1 decrease as the value of X increases.

The observed dummy variables are whether or not the family applied IMO technology on the farm. Choices are represented by a binary variable that takes the value 1 if a family adopted IMO technology or the value 0 otherwise.

Before determining the independent variables in the model, all the socio-economic data of the households and the farmers' perceptions were tested by correlations through examination of the relationship between the decision to apply IMO technology and the predictive variables. Appendix I indicate results of testing for collinearity between independent variables before inclusion in the model. This was deemed necessary to rule out the existence of multicollinearity. A cut off point of 0.5 was adopted for the test and all the variables shown had a relationship of less than 0.5 were considered plausible for inclusion in the model. The result of the analysis indicates that the possible predictors (Schooling (years), Household size

(No.), Experience pig farming (Yrs.), Herd size (No.), Access training in pig management IMO (1=yes 0 = no), Training on IMO (1=yes 0 = no), Access credit (1=yes 0 = no), Market Access (1=user 0 = non), Age of farmer (years).

The decision to adopt IMO technology is not affected by any of the socio-economic factors listed below

Table: Socio-economic variables that were hypothesized to determine family’s decision to apply IMO technologies include:

Variable	Measurement units	A priori expectation
Schooling	Years	+
Household size	Numbers	±
Experience pig farming (Yrs.)	Years	+
Herd size (No.)	Numbers	±
Access training in pig management IMO)	(1=yes 0 = no)	+
Training on IMO	(1=yes 0 = no)	+
Access credit	(1=yes 0 = no)	±
Market Access	(1=user 0 = non)	+
Age of farmer (years)	Years	±

3.8.5 Data Timeframe and Validity

The data used in this study were collected in 2021. Although three years have passed, the structural conditions affecting pig farming in Mukono District—such as credit access, extension support, and herd dynamics—have not changed significantly according to District Veterinary Office (DVO) reports from 2022–2023. Therefore, the findings remain relevant for current policy and practice. Where possible, triangulation with secondary sources was used to strengthen the validity and reliability of the study.

3.9 Ethical considerations

Ethical clearances to execute the study were sought from Uganda Christian University Research and Ethics Committee. Informed consent was sought from all respondents before administering the questionnaire after explaining the aims and objectives of the study. Assurance was given to the respondents that all information would be treated confidentially, and respondents were free to quit the study when they wished.

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

This chapter presents the findings of the study. The chapter constitutes four sections, which include characteristics of pig farmers in the study area, farmer classification according to use IMO technology and determinants of factors that influence farmer adoption of IMO technology.

4.2 Socio economic characteristics and institutional support of Pig farmers in Mukono

Farmers' characteristics influence the farm management decisions and are important in understanding the adoption of technologies (Kaguongo *et al.*, 2008). The characteristics of interviewed farmers that were considered included household size, age, gender, main occupation, market availability in the area, credit access and membership to a farmers' group or cooperative.

4.2.1 Descriptive statistics for continuous variables on social economic characteristics of pig farmers in Mukono

Table 1 presents descriptive statistics for selected continuous socio-economic variables, comparing IMO users and non-users. The analysis shows that there is no statistically significant difference in age, experience in pig farming, or business experience between the two groups. However, IMO users tend to have more years of formal schooling and come from slightly larger households, although these differences are only marginally significant at the 10% level ($p < 0.10$). The most striking difference lies in herd size, where IMO users maintain significantly larger herds (32.4 pigs on average) compared to non-users (9.2 pigs), with a p-value of 0.000. This suggests that IMO adoption is associated with more intensive pig farming operations, possibly due to higher technical or resource requirements.

Table 1: Descriptive statistics for continuous variables on social economic characteristics of respondents

Item	Non-	IMO user	Total	F	Sig.
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	user				
Age of famer (years)	39.5	37.7	38.9	.652	.421
Schooling (years)	10.1b	13.6a	11.4	2.991	.096
HH members (No.)	5.1b	6.0a	5.4	2.934	.089
Experience in pig farming(years)	6.0	5.3	5.7	.541	.463
Herd size (number of pigs)	9.2b	32.4a	16.2	30.891	.000
Experience in running a business(yrs)	5.3	5.4	5.4	.036	.851

4.2.2 Descriptive statistics for continuous variables on social economic characteristics of pig farmers in Mukono

Table 2 summarizes the distribution of respondents based on categorical socio-economic variables—marital status and religion. The findings show that across all marital groups, most respondents were non-users of IMO technology. Notably, separated respondents had the highest proportion of users (40%), indicating that marital status might influence technology adoption in some cases, though the trend is not strong. Regarding religion, all respondents recorded in the table were Christians, with a higher percentage being non-users (69.5%) compared to users (30.5%). Overall, the data suggest that while there may be some variation by marital status, these categorical variables do not show strong associations with IMO technology adoption.

Table 2: Descriptive statistics for categorical variables on social economic characteristics of respondents

Item	Non -user	IMO user
Marital status		
Married	69.6	30.4
Divorced	10	0.0
Widowed	71.4	28.6
Separated	60.0	40.0
Single	69.2	30.8
Religion		
Christian	69.5	30.5

4.3 Institutional support of pig farmers to production in Mukono district

Kilimo Trust (2019) observed that technological participation approaches have failed to address these issues largely because society is often taken as a collection of equal people with common purpose while in reality, a society is a coming together of individuals and groups who command different levels of power, wealth, influence and ability to express the needs, concerns and rights. This section explores institutional support such as credit access, belonging to networks, access to markets and access to extension services.

4.3.1 Access to credit

88.2% of non-users of IMO technology had access to credit, whereas only 11.8% of IMO users accessed credit. Conversely, 88.2% of IMO users had no access to credit, while only 11.8% of non-users lacked access.

This suggests that IMO users are less likely to access credit than non-users, possibly indicating financial exclusion or a preference for self-financing among IMO users.

Non-users mainly borrowed from friends and relatives (100%) and VSLAs (77.8%). IMO users, on the other hand, borrowed mainly from banks (100%), and to a lesser extent from VSLAs (22.2%). This implies IMO users tend to access more formal sources of credit (like banks), while non-users rely heavily on informal sources.

IMO users only used land as collateral, while non-users relied on guarantees from family/friends (100%) or no collateral (77.7%). This shows IMO users may have access to tangible assets (like land) required for formal credit, while non-users lack such assets and depend on social guarantees or unsecured borrowing.

Table 3: Descriptive statistics for categorical variables on access to credit for pig production

Category	Non- User	IMO user
Access to credit		
Yes	88.2	11.8
No	11.8	88.2
Source of loan		
Friends and relatives	100	0
Banks	0	100
VSLAs	77.8	22.2
Collateral Security for Acquiring Loan		
Land	0	100
Family and friends guarantee	100	0
Nothing	77.7	22.2
Form Of Pay Back		
Cash	100	0
Animals	75	25

Table 4: Descriptive statistics for continuous variables on access to credit for pig production

Item	Non- user	IMO user	Total	F	Sig.
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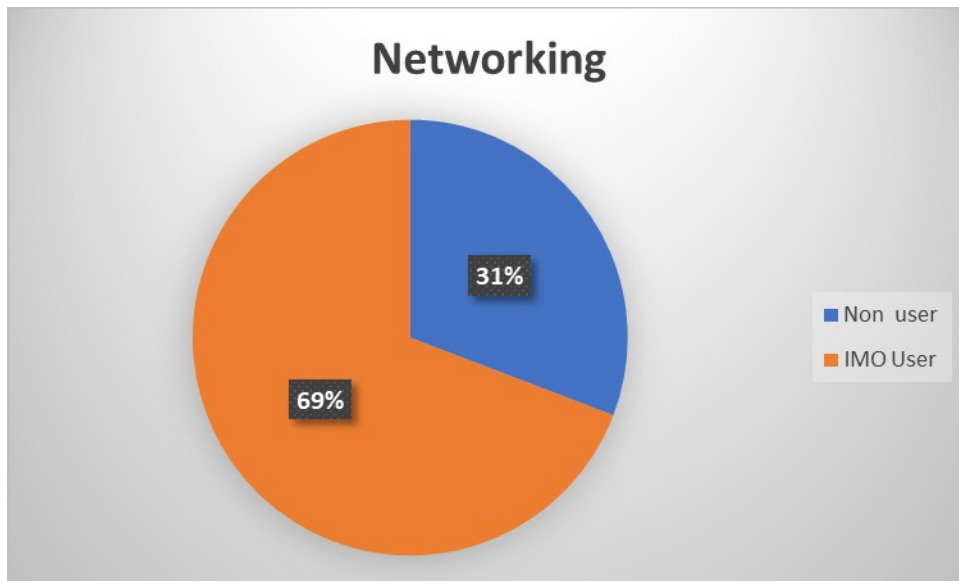
Distance to bank (KM)	5.3	25.0	12.4	44.935	.000
Amount received (shs)	193,333	5,500,000	1,520,000	14.571	.002
Interest rate per month (%)	10.6	12.5	11.3	.270	.614
Duration (months)	4.8	15.0	7.3	12.527	.003
Amount paid back (shs)	152,083	7,425,000	1,970,313	13.655	.002
Amount remaining (shs)	13,333	300,000	101,538	6.715	.025

Furthermore, IMO users access larger, longer-term, and more formal credit than non-users.

They travel farther, receive more, repay more, and have more debt outstanding, but face similar interest rates. Most of these differences are statistically significant, meaning they are unlikely to be due to chance.

This reflects deeper integration of IMO users into formal financial systems — possibly due to more structured or commercial pig farming operations.

4.3.2 Networking and belonging to groups



4.3.3 Access to Information

Surprisingly, a higher proportion of non-users had access to information compared to those who used IMO technology. This suggests that access to information alone did not necessarily lead to adoption of IMO technology in this context.

The type or quality of information received by non-users may not have been persuasive or practical enough to encourage adoption.

IMO users might have relied on alternative, possibly informal, knowledge sources such as peer learning or local demonstrations.

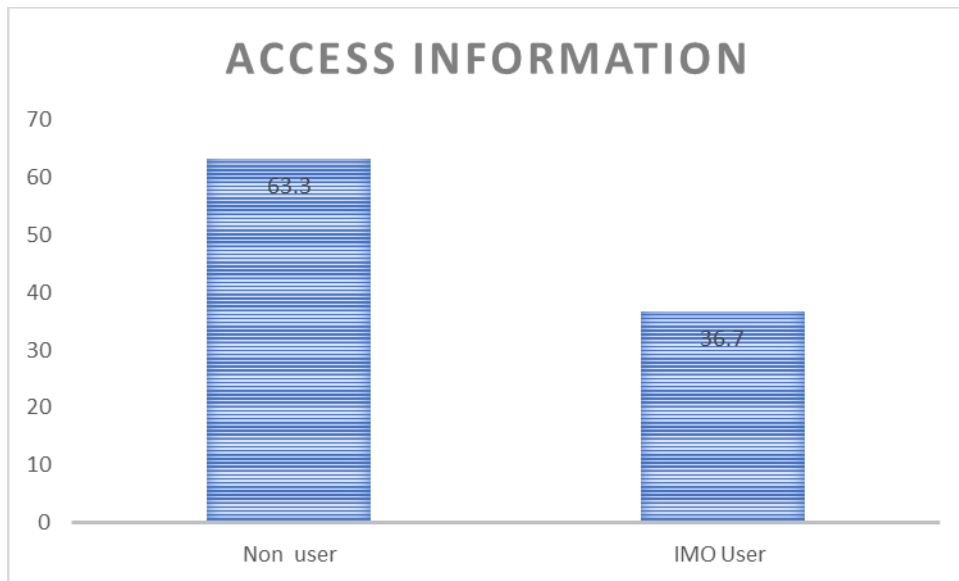
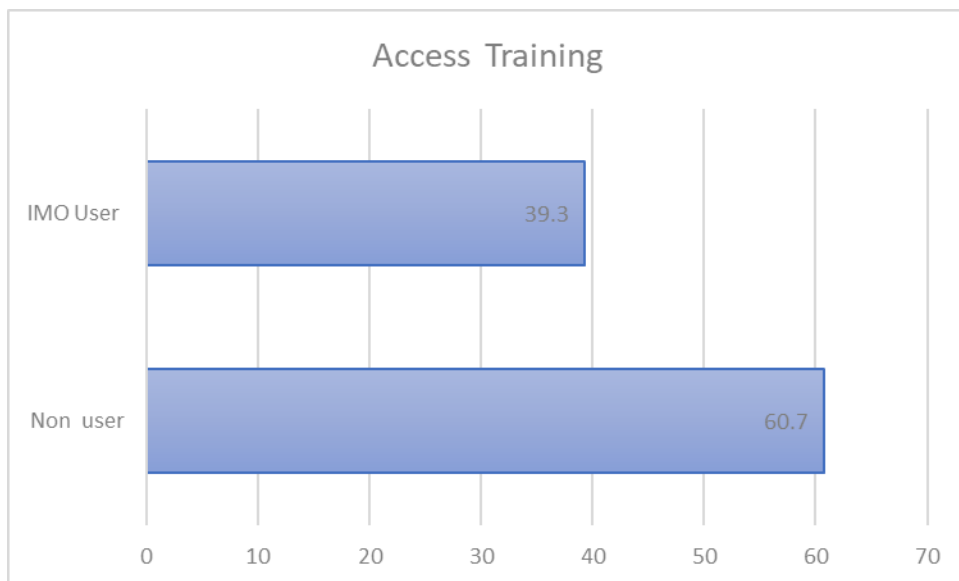


Figure 1: Showing farmers access to IMO technology information

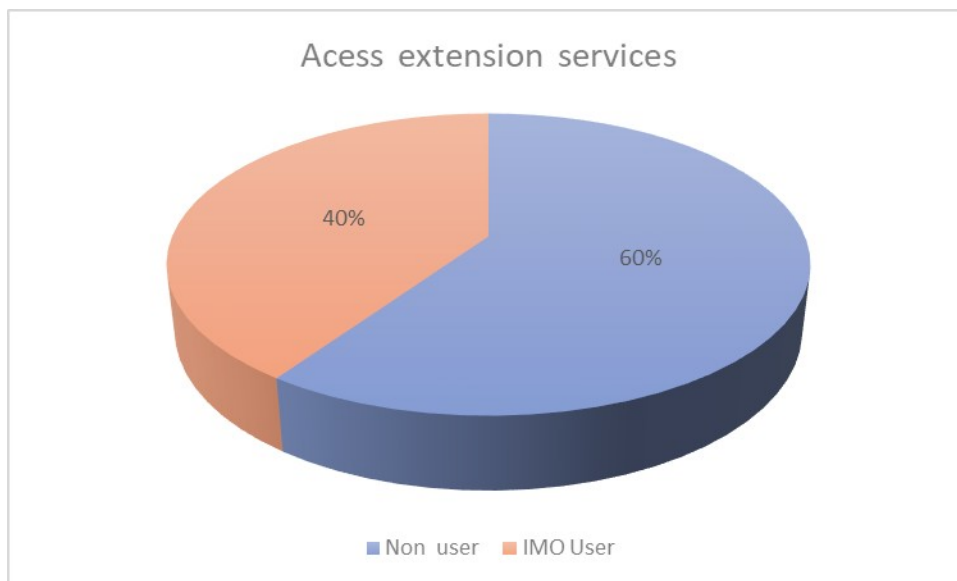
4.3.4 Access to Trainings



A larger proportion of non-users accessed training compared to those who adopted IMO technology. This suggests that training alone was not a strong determinant for IMO adoption among the farmers.

4.3.5 Access to Extension services

The respondent's knowledge regarding access to extension services was sought and 60.7% of non-users had access to training. Only 39.3% of IMO Users had access to training.



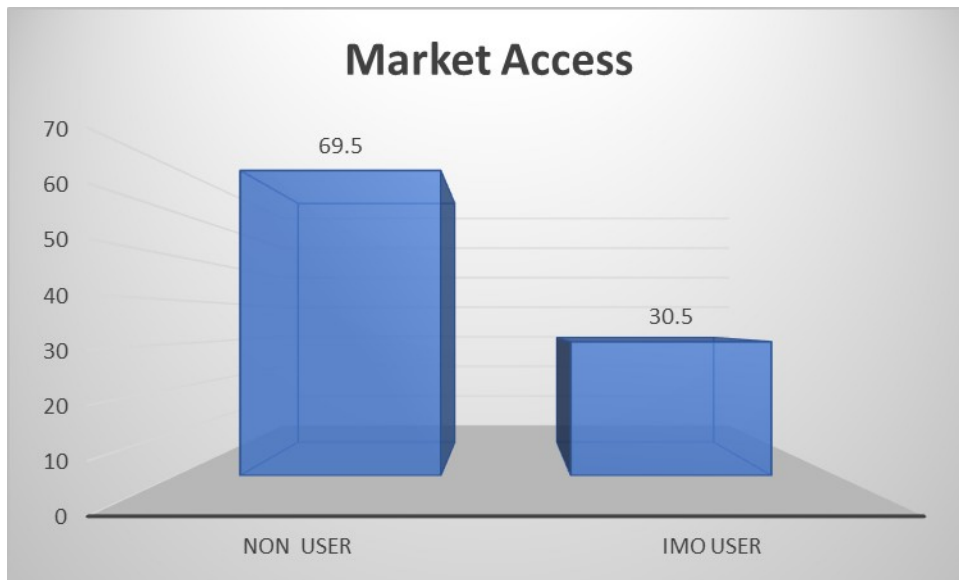
38.9% of these respondents which is the majority reported that they get this extension information through the government. Majority of the respondents (52.4%) reported that they get the information through private visits. It can also be noted that majority of the respondents (90.9%) reported to be getting the extension visits once a month. Overall majority of the respondents 72% reported that they do not have access to agricultural extension services to support them in their pig production and Management (Table 5).

Table 5: Results regarding access to Extension services

Source of information	Frequency(n)	Percentage (%)
Extension	19	14.5
Farmer	83	63.4
Researcher	4	3
Not sure	25	19.1
Total	131	100
Source of Extension information		
Government	7	5.3
NGOs	6	4.6
Both	5	3.8
Not sure	113	86.3
Total	131	100
How information is got from Extension		
Private visits	11	8.4
Group Meetings	7	5.3
Internet and social media	3	2.3
Not sure	110	84
Total	131	100
How many times in a month do you receive extension advice		
1	60	45.8
2	3	2.3
3	1	0.8
5	1	0.8
7	1	0.8
Not sure	65	49.6
Total	131	100
Do you have access to agricultural extension services to support you in your pig production and Management?		
Yes	34	26
No	94	71.8
Not sure	3	2.3
Total	131	100
If yes, have you used extension services in improving your pig production		
Yes	34	26
Not sure	97	74
Total	131	100

4.3.6 Access to markets

The results indicate universal access to market by respondents (100%).



Marketing arrangements

The majority (98%) of whom had no supply contracts. Thus, most of the pigs were sold at the farm (Table 6).

Item	Non- user	IMO user
Contracts	0	100
Spot markets	71.1	28.9

Type of buyer

Table 6: types of traders

Buyer	Non-user	IMO user
Neighbor	76.2	23.8
Bicycle	77.8	22.2
Local agents	70.6	29.4
Final consumer	69.8	30.2
Truck trader	23.1	76.9

Neighbours, bicycle traders, local agents, and final consumers mostly buy from non-users. 76.2% of pigs bought by neighbours came from non-users. This suggests that non-users mostly engage in small-scale, local sales.

Truck traders (large-scale buyers) mostly buy from IMO users. 76.9% of truck trader purchases came from IMO users. This indicates that IMO users are more likely to sell to bulk buyers who transport pigs over longer distances, possibly to urban markets or processors.

4.4 Pig Production and IMO use in Pig Production

4.4.1 Pig production system

Item	Non- user	IMO user
Conventional	9.2	0
IMO	0	36.5
Mixture of IMO and conventional	0	9.0

4.4.2 Pig herd size

Item	Non-user	IMO user	Total	F	Sig.
Herd size (number of pigs)	9.2b	32.4a	16.2	30.891	.000

4.4.3 Training of farmers on IMO technology

According to the results in table 7, the majority (83.3%) of the respondents received training on the use of IMO technology. Of those trained, the majority were trained by fellow farmers (60%), followed by those trained by extension staff from research stations (21%), then Government extension workers (12%). For the respondents that were not trained in making or using IMO, 83% reported that they would be willing to get training in technology.

Table 7: Training of farmers in IMO technology

Variable	Non- User	IMO user
Use IMO technology		
No	22	16.7
Yes	109	83.3
Who trained on IMO		
Government Extension worker	13	11.9
Staff from research station	23	21.4
Fellow farmers	65	59.5
Private company/NGO	8	7.1
Overall	42	32.1

4.5 Factors that influence adoption of IMO in pig production

IMO (1=adopter 0 = non adopter)	Coef.	St.Err.	t- value	p- value	[95% Conf	Interval]	Si g
Schooling (years)	-.039	.152	-0.26	.797	-.336	.258	
Household size (No.)	.523	.354	1.48	.139	-.171	1.217	
Experience pig farming (Yrs.)	-.014	.265	-0.05	.958	-.533	.505	
Herd size (No.)	.319	.187	1.71	.088	-.047	.685	*
Access training in pig management IMO (1=yes 0 = no)	-1.26	3.582	-0.35	.725	-8.28	5.76	
Training on IMO (1=yes 0 = no)	12.967	6.02	2.15	.031	1.168	24.766	**
Access credit (1=yes 0 = no)	11.254	5.439	2.07	.039	.593	21.914	**
Market Access (1=user 0 = non)	-1.979	2.359	-0.84	.401	-6.602	2.644	
Age of farmer (years)	-.184	.14	-1.32	.188	-.458	.09	
Constant	-17.902	11.301	-1.58	.113	-40.052	4.248	
Mean dependent var		0.305	SD dependent var			0.462	
Pseudo r-squared		0.874	Number of obs			131	
Chi-square		140.833	Prob > chi2			0.000	
Akaike crit. (AIC)		42.382	Bayesian crit. (BIC)			74.009	

*** $p < .01$, ** $p < .05$, * $p < .1$

Summary of significant findings

The coefficient for herd size (0.319) implies that for every additional pig in a farmer's herd, the log-odds of adopting IMO technology increase by 0.319. In probability terms, this means that larger herds are more likely to adopt IMO, reflecting economies of scale and a stronger incentive to improve productivity.

Similarly, a positive and significant coefficient for training indicates that farmers who receive training are many times more likely to adopt IMO technology compared to those without training.

The access to credit variable also shows a strong enabling effect, reflecting how financial support facilitates adoption.

Variable	Significance	Interpretation
Training on IMO	Significant at 5%	Huge positive effect on adoption
Access to credit	Significant at 5%	Strong enabler of adoption
Herd size	Significant at 10%	Larger herds more likely to adopt

CHAPTER FIVE

DISCUSSION OF RESULTS

5.0 Introduction

This section covers discussion of results on socio economic and institutional characteristics of pig farmers, use of IMO in pig production and Factors influencing adoption of IMO in pig production.

5.1 Discussion on socio economic and institutional characteristics of pig farmers

Indigenous microorganism technology is being promoted for enhanced production and productivity in pig production to booster trade in animal and animal products. However, its adoption is still limited. This study investigated the effect of socio-economic and institutional factors on the adoption of the IMO technology in Mukono district. The results show that adoption of IMO technology was low among the pig farmers in Mukono district. Below is the discussion of findings per objective.

5.2 The socio-economic factors associated with use/adoption of IMO technology on commercial pig farms in Mukono District.

Objective one of the study sought to examine the socio-economic factors associated with use/adoption of IMO technology on commercial pig farms in Mukono District. The findings revealed that the adoption of IMO technology was higher among male farmers compared to female farmers. Separated individuals had the highest adoption rate, while divorced individuals did not adopt this technology. Highly educated farmers (university) had a significantly higher adoption rate compared to those with no education. On average, adopting farmers were around 38 years old, had six family members, and six years of experience in pig rearing. Their average pig count was 32.

The findings that highly educated farmers (university) had a significantly higher adoption of Indigenous Micro Organism (IMO) in pig production rate compared to those with no education. This is consistent with existing literature that suggests farmers with higher levels of education are more likely to adopt new technologies (reference). Njarui *et al.* (2012) argued that literacy enhances farmers' ability to interpret and appreciate new methods, increasing the likelihood (OR = 0.129) of them adopting useful strategies. Additionally, Ndambi *et al.* (2007) noted that most pig farmers in Africa have low educational backgrounds, which often limits their capacity to appreciate and adopt complex technologies. On contrary, a study on the adoption rate of forage legumes in Zimbabwe by Mapiye *et al.* (2006) found that most dairy farmers were literate, with at least primary school education. The results of the study were as predicted, with high levels of literacy levels (64%) leading to a higher rate of adoption of forage technology. Abdulai and Huffman (2006) also argued that the role of education in technology adoption may fade over time as literacy levels improve overall. It is possible that as education levels increase in African countries, the impact of education on technology adoption may decrease, but this has yet to be studied in the context of pig production and IMO adoption.

The study also revealed that farmers who adopt Indigenous Micro Organism (IMO) in pig production are around 38 years old is significant. This is in agreement with the findings of Shelton *et al.* (2005) who reported that age is a factor in agricultural technology adoption. Shelton *et al.* (2005), argued that older farmers are often reluctant to pursue new ideas and practices, prefer to rely on their past experiences, and are generally risk averse. Furthermore, Mwakaje (2012) and Kassie *et al.* (2013) also noted the study to be consistent in that the average age of farmers adopting IMO in pig production falls within the age range of younger farmers who are more likely (OR=1.000) to take up new agricultural technologies such as forage technologies. Thus, this suggests that the adoption of IMO in pig production is being

driven by a younger generation of farmers who are more open to innovation and new practices in agriculture. The findings may also suggest that IMO is a relatively new technology that has not yet gained much exposure among older farmers who may have more experience in pig farming. Therefore, more research is needed to understand the factors that impact IMO adoption across different age groups and demographics in pig production.

The research findings also revealed that farmers adopting Indigenous Micro Organism (IMO) in pig production had six family members. This was found to be consistent with the literature on the relationship between family size and agricultural productivity. Swai and Karimuribo (2011), reported that families with more members generally have access to a greater labour force, which can be a significant advantage in agricultural production. This suggests that in t IMO adoption in pig production, a larger family may make it easier and more cost-effective to apply the microorganisms and manage the pigs. Furthermore, the availability of family labour can be particularly important in the adoption of new technologies that are labour-intensive, such as forage technologies. The study by Swai and Karimuribo (2011) highlights the importance of family size in the adoption of forage technologies in the Tanga region of Tanzania. The findings suggest that families with more members were more likely to adopt forage technologies due to their access to a greater labour force.

In support of the above the Chayanovian theory of the peasant economy posits that higher subsistence pressure, or the need to produce enough food for the family to survive, increases the propensity for farmers to adopt new technology. The theory also argues that family size plays a role in this adoption process, with larger families being more likely to adopt new technology due to the increased need to produce sufficient food. In the context of pig production, this theory suggests that pig farmers with larger families may be more apt to adopt IMO (Indigenous Microorganisms) technology due to the increased subsistence pressure and need for efficient production. This technology involves the use of beneficial

microorganisms to improve feed digestion and promote animal health, leading to increased productivity and profits.

The findings further observed that number of pigs owned by farmer was an important determinant for adoption of IMO technology among commercial pig farmers. This is possibly the case because of the benefits associated with the technology such as reduction on smell in pig rearing unit, reduction of noise, feeding costs and pests and diseases among others. The findings agree with numerous studies (Birungi, 2017; Zanu *et al.*, 2012; Caswell *et al* 2001, Kinyangi,2014) that have found a positive and a statistically significant influence on adoption of the technology.

5.3 The institutional factors associated with use/adoption of adoption of IMO technology on commercial pig farms in Mukono District.

The findings revealed that access to extension services was critical for adoption of IMO technology. This is consistent with facts that that Governments could indirectly influence the rate of adoption of technologies using extension services (Kalibaet *al.*, 1997). Unfortunately, formal extension systems are reported to be in general decline throughout Africa (Franze and Wambugu, 2007). The negative influence of absent extension services on adoption rates has been highlighted in several studies (Elbashaet *al.*, 1999; Shelton *et al.*, 2005). However, bad governance has marred the positive influence of government extension workers in Africa (Kassie *et al.*, 2013).

Furthermore, the finding that almost half of the farmers were aware of Indigenous Microorganism (IMO) technology, but very few received training in making or using it, is consistent with the literature on the relationship between farmers' knowledge and perceptions about new technologies and their adoption of these technologies. Seline *et al.* (2015) reported that the information that farmers have about new technology forms the basis of the perceptions and attitudes they develop towards it. It's important to have access to information

about IMO technology through sources such as workshops, extension workers, or other farmers to positively influence farmers' attitudes towards the technology, and in turn, increase the likelihood of its adoption.

Furthermore, Roling and Jiggins (1998) noted that farmers' perceptions of new technologies are closely related to their knowledge about them. If farmers only have partial or incorrect information about IMO technology, they may hold negative attitudes towards it and may be less likely to adopt it. Similarly, the theory of planned behavior suggests that a positive attitude towards an innovation like IMO will increase the likelihood of adoption, while a negative attitude will reduce the probability of adoption (Fishbein, 1975).

Therefore, the finding that almost half of the farmers had knowledge about IMO technology but very few received training in making or using it highlights the importance of providing farmers with accurate and accessible information about new technologies. This can help to ensure those farmers' perceptions and attitudes towards the technology are positive and can ultimately lead to greater adoption rates. Providing training to farmers can also be crucial in ensuring that they have the necessary skills and knowledge for effective implementation of the technology, and this can increase the probability of adoption.

5.4 Discussion on factors that influence the adoption of IMO technology among pig farmers in Mukono District.

The results show a strong relationship between training on IMO technology and its adoption. The farmers who were trained and therefore knew how technology works, and associated benefits were more likely to adopt it compared to those who were not trained. The finding is consistent with the work of other scholars. Birungi (2017), asserted that farmers' access to information on agricultural technologies through increased Government and Non-governmental Organization investment in extension services is crucial in revealing the opportunities of adopting agricultural technologies. This implies that Government and Non-

Government Organizations play a crucial role in promoting adoption of agricultural technologies through the extension service system in place.

Furthermore, the finding also revealed that the number of pigs kept by the farmer is strongly associated with the adoption of Indigenous Micro Organism (IMO) in pig production. This is consistent with existing literature on the factors influencing the adoption of agricultural technologies. Previous studies (Rajkhowa D. J (2020) have demonstrated that the size of the farm and the intensity of pig production can impact the adoption of new technologies. Larger herds can benefit more from the use of IMO, as the technology can help to prevent diseases and enhance the growth of pigs, leading to higher production and potentially higher profits (Kidega *et al.*, 2021). This is supported by the finding that farmers with herds of more than 30 animals had significantly higher odds of adopting IMO in pig production, compared to those with smaller herds. This suggests that IMO is perceived as a more valuable technology for larger-scale pig producers, who are more likely to see a return on investment.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

The chapter presents the conclusions drawn and recommendations made on the factors associated with adoption of IMO technology in Uganda.

6.1 Conclusion

Objective 1: To assess the socio-economic and institutional characteristics of pig farmers in Mukono District

Conclusion:

The adoption of IMO technology was significantly associated with several socio-economic factors:

- **Education:** Farmers with university education showed a higher adoption rate (63%) compared to those with no education (14%), indicating that education enhances the ability to understand and apply novel technologies.
- **Gender:** Male farmers adopted IMO at a higher rate (33%) than female farmers (27%), suggesting potential gender-related disparities in technology access or decision-making autonomy.
- **Herd Size:** Larger herd sizes (≥ 30 pigs) were positively associated with adoption, highlighting that commercial-scale farmers are more inclined to invest in productivity-enhancing technologies.
- **Household Size:** Slightly larger households tended to adopt more, possibly due to the availability of family Labor to manage IMO applications.
- **Credit Access:** Formal credit access was low among IMO users (only 13%), and most farmers depended on informal sources or had no credit. Yet, those with access to credit—particularly from banks—had significantly higher adoption rates, underlining the role of financial capacity in technology uptake.

Institutional characteristics:

- **Extension Services:** Access was very limited (only 28%) yet positively associated with adoption. This underlines a critical institutional gap.
- **Training and Information:** Surprisingly, many non-users reported having access to training and information, but this did not translate into adoption. This suggests quality, relevance, or delivery mode of training might be inadequate.

- **Market Access:** All farmers reported market access, but the type of buyer (e.g., truck traders) was skewed in favour of IMO users, who are likely better integrated into formal markets.

Objective 2: To evaluate the use/utilization of Indigenous Micro-Organism (IMO) technology among pig farmers

Conclusion:

Only 31% of farmers in Mukono District had adopted IMO technology. Of those:

- 36.5% used IMO exclusively, while 9% used it alongside conventional methods, indicating that full adoption is still emerging.
- Training was a critical enabler: Farmers who had received specific IMO training were 680 times more likely to adopt it (OR=679.552, $p=0.000$). However, many non-users also reported receiving training, suggesting potential mismatches in delivery or perceived benefits.
- Use Characteristics: IMO users maintained cleaner, odour-free, and Labor-efficient environments. They also sold more to large-scale buyers (truck traders), implying that IMO adoption may enhance market readiness or access to better-paying markets.

Despite some awareness (47%) and training coverage (32%), utilization remains low, pointing to gaps in practical support, perceived benefits, or initial investment hurdles.

Objective 3: To determine factors that influence adoption of IMO among commercial pig farmers

Conclusion:

The logistic regression analysis identified three statistically significant predictors of IMO adoption:

1. **Training on IMO Technology**
 - OR = 679.552, $p=0.000$
 - This is the most powerful predictor. Farmers who received training were exponentially more likely to adopt the technology.
2. **Access to Credit**
 - OR = 11.254, $p=0.039$
 - Farmers with access to formal financial services were 11 times more likely to adopt IMO, highlighting the importance of financial capacity.
3. **Herd Size**
 - OR = 21.718, $p=0.030$

- Larger herds made adoption more likely, indicating that more intensive farming operations tend to invest in efficiency-enhancing technologies like IMO.

In Summary,

Non-significant variables included: age, schooling years, market access, household size, and pig farming experience—though these may play indirect roles or interact with the significant variables.

The study found that 31% (41 out of 131) of pig farmers had adopted IMO technology, while 69% (90 farmers) had not adopted. This indicates that IMO is still at an early stage of diffusion in Mukono District, with adoption concentrated among farmers who had access to training and credit.

Adoption rates varied by sub-county, reflecting differences in institutional support. Mukono Town and Goma sub-counties recorded higher adoption, attributed to better extension outreach and training opportunities. In contrast, Nama and Kyampisi showed relatively low adoption, where limited access to training and information hindered uptake.

This finding highlights that IMO technology, though beneficial, has not yet achieved widespread diffusion. It also underscores the importance of geographically targeted interventions to enhance adoption.

The study concludes that while IMO technology holds high potential for sustainable pig farming in Uganda, its adoption is constrained primarily by lack of targeted training, limited credit access, and weak extension systems. Socio-economic attributes like education, herd size, and gender also influence adoption, but institutional support—especially training and credit—are the strongest levers for increasing uptake.

5.2 Recommendations

I would like to recommend the following.

1. Providing more extension services to farmers in the district can be an effective way of increasing adoption rates.
2. Promoting training on IMO technology is also crucial as it was found to be a significant factor in adoption. Therefore, training programs on the technology should be designed and made accessible to farmers in the district and should be specifically targeted at those who have not yet adopted the technology.
3. Promote commercialization of pig farming to enhance adoption of IMO technology.
4. Promote farmers access to credit to increase the adoption of the IMO technology.

5. Conduct research to identify additional factors that could contribute to increased adoption of IMO technology in pig production in the district. This would help stakeholders to develop more informed and targeted strategies to promote widespread adoption of IMO technology.

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Appendix ii

	US E IM O (1= use 0= No ne use r)	train ing in pigge ry mana geme nt? (1=Y es 0= No)	train ed Indig enous Micro Organ ism techn ology? (1= Yes 0= No)	infor mation concern ing pig production? (1=Y es 0=N o)	agri cultural extension services (1= Yes 0= No)	credit services for use in your pig production system? (1= Yes 0= No)	supply contract s? (1= Yes 0= No)	Year of school ing	total number of hours	number of pigs conv entio nal	Num ber of total bank loan amounts	distance to loan in month s	Dur ation in month s	pa id back	amo unt remain ing			
USE IMO (1=us e 0=No ne user)	Pear son Corr elati on Sig. (2- taile d)																	
N		1	.278**	.783**	.298**	.329**	-.157	.231**	.327	.149	.440**	.517**	.888**	.714**	.687**	.703**	.616*	
		.001	.000	.001	.000	.073	.008	.096	.089	.000	0.000	.000	.002	.003	.002	.025		
		131	125	131	128	131	131	27	131	131	91	131	14	16	16	16	13	
train ing in pigge ry mana geme nt (1=Y es 0= No)	Pear son Corr elati on Sig. (2- taile d)																	
N		.278**	1	.223*	.348**	.563**	-.124	.105	.279	.157	.145	-.044	.168	.558*	-.633*	-.196	-.638*	-.709**
		.001	.012	.000	.000	.158	.232	.159	.073	.099	.680	.054	.038	.008	.468	.008	.007	
		131	125	131	128	131	131	27	131	131	91	131	14	16	16	16	13	

trained using making Indigenious Micro Organism technology? (1=Yes 0=No)	Pearson Correlation	.783**	.223*	1	.264**	.223*	-.106	-.112	.245	.075	.144	.091	.228*	.803**	.608*	.510*	.600*	.509
	Sig. (2-tailed)	.000	.012		.003	.013	.238	.216	.229	.406	.110	.410	.010	.002	.013	.043	.014	.075
	N	125	125	125	125	123	125	125	26	125	125	85	125	12	16	16	16	13
information concerning pig production? (1=Yes 0=No)	Pearson Correlation	.298**	.348**	.264**	1	.355**	-.009	.069	.165	.163	.124	-.024	.157	.245	.223	.073	.237	.082
	Sig. (2-tailed)	.001	.000	.003		.000	.920	.435	.410	.063	.159	.824	.074	.399	.406	.789	.377	.789
	N	131	131	125	131	128	131	131	27	131	131	91	131	14	16	16	16	13
agricultural extension services to support your pig production and	Pearson Correlation	.329**	.563**	.223*	.355**	1	-.338**	.093	-.198	.098	.091	-.231*	.177*	.573*	-.457	.077	-.467	-.510
	Sig. (2-tailed)	.000	.000	.013	.000		.000	.296	.323	.272	.309	.030	.046	.032	.075	.776	.068	.075
	N	128	128	123	128	128	128	128	27	128	128	88	128	14	16	16	16	13

Management? (1=credit services for use in your pig production system? (1=Yes 0=No))																			
Pearson Correlation	-.157	-.124	-.106	-.009	-.338**	.1	-.059	-.206	-.011	-.075	.028	-.089	-.936*	.297	-.230	.298			.510
Sig. (2-tailed)	.073	.158	.238	.920	.000		.502	.302	.900	.396	.796	.314	.000	.264	.391	.263			.075
N	131	131	125	131	128	131	131	27	131	131	91	131	14	16	16	16	16	13	
Pearson Correlation	.231**	.105	-.112	.069	.093	-.059	.1	.b	.089	.717**	.b	.790**	.b	.b	.b	.b	.b	.b	.b
Sig. (2-tailed)	.008	.232	.216	.435	.296	.502		0.000	.310	.000	0.000	.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	131	131	125	131	128	131	131	27	131	131	91	131	14	16	16	16	16	13	
Year of schooling	.327	.279	.245	.165	-.198	-.206	.b	.1	.429*	.297	.514*	.173	.991**	1.000*	.b	1.000*			.b
Sig. (2-tailed)	.096	.159	.229	.410	.323	.302	0.000		.026	.132	.035	.390	.001	0.000	0.000	0.000			0.000

N	27	27	26	27	27	27	27	27	27	27	17	27	5	3	3	3	2
number of household members in your family	Pearson Correlation	.149	.157	.075	.163	.098	-.011	.089	.429*	.173*	-.049	.151	.129	.432	.494	.420	.380
	Sig. (2-tailed)	.089	.073	.406	.063	.272	.900	.310	.026	.048	.641	.084	.660	.094	.052	.105	.201
N	131	131	125	131	128	131	131	27	131	131	91	131	14	16	16	16	13
number of pigs you have on your farm	Pearson Correlation	.440**	.145	.144	.124	.091	-.075	.717**	.297	.173*	1.000**	.892**	.382	.951**	.529*	.951**	.959**
	Sig. (2-tailed)	.000	.099	.110	.159	.309	.396	.000	.132	.048	0.000	.000	.178	.000	.035	.000	.000
N	131	131	125	131	128	131	131	27	131	131	91	131	14	16	16	16	13
Number of pigs conveyed	Pearson Correlation	.06	-.044	.091	-.024	-.231*	.028	.06	.514*	-.049	1.000*	-.064	-.046	-.089	-.355	-.406	.297
	Sig. (2-tailed)	0.000	.680	.410	.824	.030	.796	0.000	.035	.641	0.000	.546	.907	.783	.258	.190	.438
N	91	91	85	91	88	91	91	17	91	91	91	91	9	12	12	12	9
IMO total cost	Pearson Correlation	.517**	.168	.228*	.157	.177*	-.089	.790**	.173	.151	.892**	-.064	.622*	.957**	.554*	.961**	.950**
	Sig. (2-tailed)	.000	.054	.010	.074	.046	.314	.000	.390	.084	.000	.546	.010	.000	.020	.000	.000

tailed)	0									0			7	0	6	0	
N	131	131	125	131	128	131	131	27	131	131	91	132	14	16	16	16	13
9 Pearson distance to bank (KM)	.888**	.558*	.803**	.245	.573*	-.936**	.b	.991**	.129	.382	-.046	.622*	1	.b	.b	.b	.b
Sig. (2-tailed)	.000	.038	.002	.399	.032	.000	0.000	.001	.660	.178	.907	.017					
N	14	14	12	14	14	14	14	5	14	14	9	14	14	1	1	1	0
Amount did you receive	.714**	-.633**	.608*	.223	-.457	.297	.b	1.000**	.432	.951**	-.089	.957**	.b	1	.670**	.999**	.983**
Sig. (2-tailed)	.002	.008	.013	.406	.075	.264	0.000	0.000	.094	.000	.783	.000			.004	.000	.000
N	16	16	16	16	16	16	16	3	16	16	12	16	1	16	16	16	13
Duration in months	.687**	-.196	.510*	.073	.077	-.230	.b	.b	.494	.529*	-.355	.554*	.b	.670**	1	.654**	.614*
Sig. (2-tailed)	.003	.468	.043	.789	.776	.391	0.000	0.000	.052	.035	.258	.026		.004		.006	.026
N	16	16	16	16	16	16	16	3	16	16	12	16	1	16	16	16	13
How much is paid back	.703**	-.638**	.600*	.237	-.467	.298	.b	1.000**	.420	.951**	-.406	.961**	.b	.999**	.654**	1	.984**

	Sig. (2- taile d)	.00 2	.008	.014	.377	.068	.263	0.00 0	0.00 0	.105	.00 0	.190	.0 00	.00 0	.00 6	.000		
	N	16	16	16	16	16	16	16	3	16	16	12	16	1	16	16	16	13
How much is remai ning	Pear son Corr elati on	.61 6*	-.70 9**	.509	.082	-.510	.510	. b	. b	.380	.95 9**	.297	.9 50 **	. b	.98 3**	.61 4*	.98 4**	1
	Sig. (2- taile d)	.02 5	.007	.075	.789	.075	.075	0.00 0		.201	.00 0	.438	.0 00	.00 0	.02 6	.00 0		
	N	13	13	13	13	13	13	13	2	13	13	9	13	0	13	13	13	13

APPENDIX II

ASSESSING FACTORS AFFECTING THE ADOPTION OF INDEGENOUS MICRO-ORGANISM TECHNOLOGY IN PIG PRODUCTION. CASE OF MUKONO DISTRICT

INTRODUCTION

This questionnaire is designed for a master's student at Uganda Christian University pursuing a research study on the assessing factors affecting the adoption of indigenous micro-organism technology in pig production in Mukono District, Central Uganda. You have been selected as a key respondent and we kindly request you to give your knowledge about the study. This discussion will not last more than 1 hour and the information you provide to us will be kept and used in the report with utmost confidentiality. Therefore, I request you for your time to fill it, thank you in advance.

1.0 IDENTIFICATION

- 1.1 Date of interview: _____
- 1.2 Name of the respondent: _____
- 1.3 Contact: _____
- 1.4 Village: _____
- 1.5 Parish: _____
- 1.6 Subcounty: _____

2.0 SOCIO ECONOMIC CHARACTERISTICS

- 2.1 Gender of respondent: 1= Male 0=Female
- 2.2 Age of respondent (age in years): _____
- 2.3 The level of education: 1= None; 2= Primary; 3= Secondary; 4= College 5) University ;
- 2.4 Year of schooling
- 2.5 Marital status of the respondent: 1= Married 2= Divorced 3= Widowed 4= Separated 5= Single
- 2.6 What is your religion? 1) Christian 2) Muslim 3) Traditionalist
- 2.7 What is the total number of household members in your family?.....
- 2.8 For how long (years) have you been keeping pigs farming?
- 2.9 What is the total number of pigs you have on your farm?
- 2.10 How many years have you been running a business?
- 2.11 The main occupation of respondent: 1= Subsistence farmer; 2= Commercial farmer; 3= Trader/Business; 4= Salaried worker; 5= Casual worker; 6= Specify; _____
- 2.12 The main source of family livelihood: 1= Crop farming; 2= Livestock farming; 3=Fishing; 4= others, specify

3.0 INSTITUTIONAL FACTORS

3.1 Access to Credit:

- 3.1.1 Did you access credit for pig production in the past year? (Yes/No)
- 3.1.2. If yes, please specify the main source(s) of your credit. (Bank/Friends and relatives/Village savings and loan association/Other)
- 3.1.3. Did you use any collateral security for acquiring the loan? (Land/Family and friends guarantee/None)
- 3.1.4. What was the average amount of money you received as credit for pig production? (Open-ended response)

3.1.5. What was the interest rate per month for the credit you received? (Open-ended response)

3.1.6. On average, how far did you have to travel to access credit? (Open-ended response)

3. 2. Access to Information:

3.2.1 Are you aware of Indigenous Microorganism (IMO) technology for pig farming? (Yes/No)

3.2.2 Have you received any training in making or using Indigenous Microorganisms? (Yes/No)

3.2.3 If yes, please specify who provided the training. (Government Extension worker/Staff from research station/Fellow farmers/Private company/NGO/Other)

3.2.4 If no, would you be willing to receive training in the technology? (Yes/No)

3.3. Access to Extension Services:

3.3.1 Do you receive information regarding pig production through agricultural extension services? (Yes/No)

3.3.2 If yes, please specify the main source(s) of your extension information. (Government/NGOs/Both/Other)

3.3.3 How do you usually receive extension advice? (Private visits/Group meetings/Internet and social media/other)

3.3.4 How frequently do you receive extension advice in a month? (Once/Two times/Three times/Five times/seven times)

3.3.5 Do you have access to agricultural extension services to support you in your pig production and Management? (Yes/No)

3.3.6. If yes, have you used extension services in improving your pig production? (Yes/No)

3.4. Access to Markets:

3.4.1 Do you have a supply contract for selling your pigs? (Yes/No)

3.4.2 If yes, have you met the contract requirements? (Yes/No)

3.4.5 Where do you usually sell your pigs? (Home/farm/Urban market/Other)

4.0 PIG PRODUCTION METHOD

4.1 What method of pig rearing do you use on your farm including the number of pigs reared under each method?

Method of pig rearing	Indicate 1) Yes 0) No	Number of pigs
Conventional		
Indigenous Micro Organism (if you use)		
Both methods		

4.2 What are the total costs incurred on the following under each method of production?

Method of pig rearing	Purchase of feeds	Vaccination and drugs	Veterinary assistance	Daily maintenance daily e.g sanitation
Conventional				
Indigenous Micro Organism (if you use)				
Both methods				

4.3 What challenges do you experience under each production system?

Method of pig rearing	Challenges
Conventional	
Indigenous Micro Organism	
Both methods	

5.0 AWARENESS AND APPLICATION OF INDIGENOUS MICRO-ORGANISM TECHNOLOGY

5.1 Are you aware of the Indigenous Micro Organism technology (IMO) used in pig rearing?

1) Yes 0) No

5.2 Have you heard of the IMO technology used in pig rearing in this village (*you need to describe the technology to the farmers*)? 1) Yes 0) No

5.3 If yes, how did you access the information about IMO method of pig farming?

Source of information on IOM	Indicate 1) Yes 0) No
Farmer contact	
Extension agents contact	
Veterinary officers contact	
Radio contact	
Television contact	
Friends/ Neighbors contact	
Newspapers contact	
Workshops contact	

5.4 If no, would you like to know how the IMO method works in pig farming? 1) Yes 0) No

5.5 If No,

why?.....

.....

.....

5.6 Do you apply or use the Indigenous Micro Organism technology on your pig farming? 1) Yes 0) No

5.7 If yes, for how long (years) have you been using this technology on your farm?.....

5.8 What are the benefits of using this technology on your piggery farm?

Benefits	Indicate 1) Yes 0) NO
Used to break down organic matters in pig stay for pigs to feed on	
Reduces the smell in the pig rearing unit	
Reduces noise in the pig rearing unit as pigs are busy	
Reduce feeding costs	

Reduces on pest and disease infestation especially worms	
Other mention	
Other mention	
Other mention	

5.9 If yes, describe the steps you go through in the process of making or using the technology in your pig rearing?.....

.....

5.10 What challenges do you experience in making or using Indigenous Micro Organism technology?.....

.....

6.0 ACCESS TO TRAINING

6.1 Have you received any training in piggery management? 1)Yes 0) No

6.2 If yes, what type of training? 1) Farming 2) Animal health 3) Marketing information 4) Other.....

6.3 How many times are you trained in a month?

6.4 Who conducts the training? 1) Government extension officers 2) NGO extension officers

3) Other farmers 4) Researchers 5) Other.....

6.5 Have you ever been trained in using or making Indigenous Micro Organism technology? 1) Yes 0) No

6.6 If yes, who trained you? 1) Gov't Extension Workers 2) Staff from Research Station 3) Fellow Farmer 3) Private company/NGO

6.7 If no, would you be willing to be trained in making IMO for use in pig farming? 1) Yes 0) No

6.8 If no, why?.....

7.0 LAND RESOURCE

7.1 What is the total land available for this household? ____ acres

7.2 How was this land acquired? 1= Bought 2= Inherited 3= Borrowed 4= Family land

7.3 What is the land tenure? (1= Customary; 2= Titled; 4= Squatting; 5= Others, specify;)

8.0 MEMBERSHIP TO THE GROUP

8.1 Do you belong to any farmer group/organization? (1) Yes (2) No

8.2 What activities is your group engaged in 1) Crop production 2) Pig rearing 3) Cattle rearing 4) Poultry 5) Rabbit rearing 6) Others...specify.

8.3 What is your role in the group/organization? (1) Leader (2) Member

9.0 ACCESS TO INFORMATION AND EXTENSION SERVICE

9.1 Do you receive any form of information concerning pig production? 1=Yes 0=No

9.2 Source of information: 1= Extension 2= Farmer 3= researcher

9.3 If you get information from extension, specify whether it is from; 1= government 2= NGOs 3= Both

9.4 How do you get the information from the extension? 1) Private visits 2) Group meetings/seminars 3) Both 4) Others....

9.5 How many times in a month do you receive extension advice?.....

9.6 Do you have access to agricultural extension services to support you in your pig production and Management? 1) Yes 0) No

9.7 If yes, have you used extension services in improving your pig production 1= Yes 2= No

9.8 If yes, who provided the extension services including the frequency per month?

Source of extension services	Indicate 1=Yes 0=No	Number of times in a month
Government extension officers		
NGO extension officers		
Other farmers		
Researchers		
Other.....		

9.9 What extension services have you accessed and used to improve pig production on your farm?

Extension advice	Accessed advice 1=Yes 0=No	Used advice on the farm (1=Yes 0=No)
Selection of right pig breed		
Proper feeding in pigs		
Production and use of indigenous Micro Organism		
Use of improved breeds		
General management and care of pigs		

10.0 ACCES TO CREDITS

10.1 Do have access to credit services for use in your pig production system? 1=Yes 0=No

10.2 What is the distance between your residence and the bank (KM)

10.3 Did you get a loan last year? (1=Yes 0=No)

10.4 If yes, how much amount did you receive? _____

10.5 What was the main purpose of the loan? 1= buying basics (food & cloths); 2= medicine; 3= paying fee; 4= invested in crop production; 5= invested in pig production; 6= Building a house; 7= Others, specify.

10.6 From whom did you receive the loan? 1= Friends and relatives; 2= Banks; 3= Farmers groups; 4= VSLAs; 5= MFIs; 6= SACCOs; 7= Others, specify;)

10.7 What was the interest rate per month? _____

10.8 Duration in months _____

10.9 Collateral security for acquiring the loan; (1= Animals; 2= Land; 3= family and friends guarantee; 4= none; 5= crop produce; 6= Other;)

10.10 Form of pay back 1= cash; 2= crop produce; 3= animals; 4= Other;)

10.11 How much is paid back? _____

10.12 How much is remaining? _____

11.0 MARKETING

11.1 Place where selling takes place (1) home/ farm (2) village (3) roadside (4) daily markets (5) urban markets (6) other _____

11.2 Type of buyer (1) Neighbour (2) bicycle trader (3) local agents (3) retailers (4) final consumer (5) factory (6) Cooperative (7) truck traders (8) other _____

11.3 Market arrangements (1) contract basis (1), best offer selling (2), cooperative (3) other _____

11.4 Form of payment: (1) Cash (2) Credit (3) Cheque (4) inputs (5) Product (5) other _____

11.5 Forms of transport: (1) Carry (2) Bicycle (3) Motorbike (4) Cart (5) Tractor (6) Pick up (7) public transport (9) other _____

11.6 Do you have supply contracts? 1) Yes 0) No.

11.7 If yes, with whom did you have the supply contract? 1) Cooperative union/Producer 2) Institutional buyers (Hotels, pork joints, hospitals, etc) 3) Processor 4) Other (Specify) ---

11.8 Did you sufficiently meet your contract last year? 1) Yes..... 2) No.....

11.9 If you didn't meet the contract, state the main reason for failure 1) Buyer rejected the animals due to poor quality 2) Quantity available was not enough for the buyer 3) I got a better price elsewhere 4) Buyer did not show up 5) Other, specify -----

11.10 Do you have access to Market Information? 1= Yes 0= No

11.11 What challenges do youth face in pig rearing on your farm?

Challenge	Solution

END



UGANDA CHRISTIAN UNIVERSITY

A Centre of Excellence in the Heart of Africa

DIRECTORATE OF POSTGRADUATE STUDIES DISSERTATION CORRECTION COMPLIANCE FORM (POST VIVA FORM)

Date: 17th/09/2025

Name of Candidate: CORNELIUS SSEMBUUSI

Reg. No: J18M43/052


Title of Dissertation: FACTORS INFLUENCING THE ADOPTION OF INDIGENOUS MICRO-ORGANISM TECHNOLOGY (IMO) ON COMMERCIAL PIG FARMS. A CASE STUDY OF MUKONO DISTRICT.

S/N	COMMENTS BY; EXTERNAL EXAMINER	ACTION TAKEN	INDICATOR
1	Student should name the authors on whom the TAM is based and relate the model to his study.	The authors were clearly quoted when describing and explaining the model.	Pages 8&9
2	The student should systematically present results by objective.	Results were presented per objective in Chapter 4.	Pages 36-49
3	The student should make substantive conclusions on each study objective.	Conclusions were made per objective.	Pages 56-58
	INTERNAL EXAMINER	ACTION TAKEN	INDICATORS
1	Student needs to correct all grammatical mistakes.	All grammatical mistakes have been corrected.	The whole dissertation

2	Student needs to come up with concrete objectives, because objective 1&2 are basic.	Revised objectives were brought up.	Page 4
3	Student needs to specify the gap this study is trying to address in the justification.	The knowledge gap was clearly explained.	Page 5
	SUGGESTIONS BY VIVA VOCE PANEL	ACTION TAKEN	REMARKS
1.	Your presentation lacked an acknowledgement section.	The acknowledgement section is clearly written in the dissertation.	It's on page iv of the dissertation.
2.	For objective 3, you need to justify the choice of factors included in the analysis.	The factors were well explained stating reason for their inclusion.	Pages 28 & 29
	In the conceptual framework, use arrows and clear linkages to illustrate relationships between independent and dependent variables.	The arrows were well drawn.	Page 12
	Justify the timeframe of your data. Using outdated years without explanation may weaken the validity of your study. Consider updating or triangulating your data to strengthen relevance.	The time frame was added to the dissertation.	Page 34
	Clearly explain the regression model used, including its assumptions and justification.	The model was clearly explained plus its assumptions clearly stated.	Pages 30 to 33
	o Interpret coefficients in practical terms. For example, when reporting a coefficient of 0.0319 for herd size, explain what this means in relation to the probability of adoption of IMO	Tables were clearly explained.	This particular coefficient was clearly explained on page 48.

technology.		
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Candidate's Name:

Signature  Date 17th / 09 / 25
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CORNELIUS SSEMBUUSI

Supervisor's Name:


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Signature Date
John Livingstone Mutyaba PhD