AFRICAN SWINE FEVER IN SMALLHOLDER PIG FARMS: CONTROL, COST AND PERCEIVED IMPACT OF OUTBREAKS IN AGAGO DISTRICT

BY

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A DISSERTATION SUBMITTED TO THE DIRECTORATE OF RESEARCH AND GRADUATE TRAINING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN ANIMAL PRODUCTION AND MARKETING OF GULU UNIVERSITY

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DECLARATION

I, **Akwero Lucy Aol**, hereby declare that, this research report entitled "African Swine Fever in Smallholder Pig Farms: Control, Cost and perceived Impact of Outbreaks in Agago District" is my original work and has never been published or presented to any University or academic institution for any award.

Signed: ..... **Date:** 16/10/2026

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APPROVAL

This research report entitled "African Swine Fever in Smallholder Pig Farms: Control, Cost and Perceived Impact of Outbreaks in Agago District" has been conducted under our guidance and supervision and is now ready for submission with our approval.

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DEDICATION

This research work is dedicated to my sibling Joshua, Raphael, Bridget, and the entire family of late Ketty Owot and Daniel Owot for their contributions to my upbringing and support towards my education.

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I would like to extend my sincere gratitude to Gulu University especially the Faculty of Agriculture and Environment, Department of animal production and range management for giving me the opportunity to undertake this course.

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TABLE OF CONTENTS

DECLARATION ..... **i**

APPROVAL ..... **ii**

DEDICATION ..... **iii**

ACKNOWLEGDEMENT ..... **iv**

TABLE OF CONTENTS ..... **v**

LIST OF TABLES ..... **ix**

LIST OF FIGURES ..... **x**

LIST OF ACRONYMS AND ABBREVIATIONS ..... **xi**

ABSTRACT ..... **xii**

CHAPTER ONE **1**

INTRODUCTION **1**

1.1. Background 1

1.2. Problem Statement 3

1.3 General Objective 4

1.4 Specific Objectives 4

1.5 Research Questions 4

1.6 Significance of the Study 4

1.7 Justification of the Study 5

1.8 Conceptual Framework 5

CHAPTER TWO **7**

LITERATURE REVIEW **7**

2.1 Overview of African Swine Fever 7

2.1.1 Epidemiology of ASF 8

2.1.2 Prevalence and mortality of ASF 8

2.1.3 ASF control strategies 9

2.1.4 ASF control implementation challenges 10

2.2 Knowledge and practice on control of African swine fever 11

2.3 The economic losses associated with ASF outbreaks 12

CHAPTER THREE 14

METHODOLOGY 14

3.1 Study Area 14

3.2. Study Design 15

3.4. Study Population and Sample Size 15

3.5 Data Collection 15

3.6 Data Collection Procedures 16

3.8. Data Analysis 16

3.8.1 Objective one: To determine farmers' knowledge and practice on control of ASF disease 17

3.8.2 Objective two: To assess the impact and associated control cost of African Swine Fever among smallholder pig farmers 17

3.9 Ethical consideration 17

3.10 Limitation of the study 18

3.11 Dissemination plan 18

CHAPTER FOUR 19

RESULTS 19

4.1 Socio-demographic characteristics of respondents 19

4.2 Herd characteristics of the respondents 20
4.3 Knowledge and practice of smallholder pig farmers on control of African swine fever 20
4.3.1 Knowledge of ASF and associated control and management practices 20
4.3.2 The different ASF control and management practices used by smallholder pig farmers 23
4.4 The associated cost (Uganda shillings) of control of ASF among smallholder pig farmers 25
4.5 The perceived impact of African swine fever among smallholder pig farmers 27
CHAPTER FIVE 30
DISCUSSION OF RESULTS 30
5.1 Socio-demographic characteristics of the respondents 30
5.2 Knowledge and practice of smallholder pig farmers on control of African swine fever 32
5.2.1 Knowledge of African swine fever and its control practices among smallholder pig farmers 32
5.2.1 The different African swine fever control practices used by smallholder pig farmers 36
5.3 Cost incurred by smallholder pig farmers in control of ASF 38
5.4 The perceived impact of African swine fever among smallholder pig farmers 42
CHAPTER SIX 44
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 44
6.1 Summary 44
6.2 Conclusions 45
6.3 Recommendations 46
6.3.1 Recommendations for policy and practice 46
6.3.2 Recommendations for future studies 47

REFERENCES **48**

APPENDICES **57**

Appendix I: Questionnaire 57

Appendix II: Informed Consent Letter 61

Appendix III: GUREC Approval 64

Appendix IV: Plagiarism Certificate 66

LIST OF TABLES

Table 1: Socio-demographic characteristics of the respondents 19

Table 2: Herd characteristics of the respondents 20

Table 3: Knowledge of different control measures for the management of African swine fever disease 21

Table 4: Association between sociodemographic attributes and knowledge of ASF control practices 22

Table 5: Different control measures practiced by smallholder farmers for managing ASF 24

Table 6: Relationship between knowledge of ASF control practices, and use of ASF control practices among smallholder pig farmers 25

Table 7: The associated control cost among smallholder pig farmers 27

Table 8: Perceived impact of the outbreak of ASF on the smallholder pig farmer 28

Table 9: Association between knowledge of ASF control practices and the extent to which smallholder farmers used ASF practices 29

LIST OF FIGURES

Figure 1: Conceptual Framework 6

Figure 2: Map of Agago District showing the study area 14

Figure 3: Level of knowledge on control practices 21

Figure 4: Extent to which smallholder farmers used ASF control practices 24

Figure 5: Perceived cost of controlling ASF 26

Figure 6: Perceived impact of ASF on smallholder pig farmers 28

LIST OF ACRONYMS AND ABBREVIATIONS

ASF	African Swine Fever
CAO	Chief Administrative Officer
DVO	District Veterinary Officer
FAO	Food and Agricultural Organization
FAOSTAT	Food and Agricultural Organization Statistics
GUREC	Gulu University Research and Ethical Committee
MAAIF	Ministry of Agriculture Animal Industry and Fishery
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organizations
NGOs	Non-Governmental Organizations
SOP	Standard Operating Procedures
TADs	Trans-boundary Diseases
UBOS	Uganda bureau of statistics
UGX	Uganda Shillings

ABSTRACT

Smallholder pig farmers are challenged with pig production constraints associated with diseases such as African swine fever (ASF). African swine fever disease reportedly escalates into outbreaks due to low investment in biosecurity. This study aimed to assess the knowledge of control measures of ASF, the associated costs of control and the perceived impact of ASF outbreaks in smallholder pig farms in Agago District. The study used cross-sectional design. A total of 303 small holders pig farmers were purposively selected from three high pig populated sub-counties of Adilang, Lira Palwo and Wol Sub-county. Data were collected using face to face semi-structured questionnaire. Data was coded and analysed using of SPSS version 23. Descriptive statistical tests - frequencies, percentages, mean, standard deviation and standard error to the mean, as inferential statistical tests – chi-square, student t-tests and correlational analysis were run. Most smallholder pig farmers (88.8%) had limited knowledge of AFS and its control and management practices, with only 2.3%, 12.5%, 21.5% and 28.4% of farmers knew the cause of ASF, its control of ASF, how it is transmitted, and how to identify its clinical signs respectively. As a result, there was limited use of ASF control and management practices among most smallholder pig farmers (90.8%). However, knowledge of ASF control and management practice was positively correlated with the use of these practices ($r = 0.225$, $p < 0.001$). The results further show that most (91.1%) smallholder farmers perceived that the cost of controlling and managing ASF is low, with farmers incurring on average UGX 39,140. However, farmers with limited knowledge incurred significantly ($p > 0.05$) higher expenditure (Ugx.40, 053) in supportive-treatment than those with higher knowledge (Ugx. 32806). Most smallholder pig farmers (96.7%) perceived ASF to have had a high impact on their livelihoods. This was mainly due to loss of pigs (99.7%) and loss of income (99.7%), failure to meet home basic needs (97.7%), and high cost of replacing new stock (95.7%). These findings indicate that increasing awareness and investment in biosecurity practices is essential to reduce disease outbreaks and associated economic impact among smallholder pig farmers in Agago District.

Keywords: *African swine fever, Control practices, Economic losses, Knowledge, Smallholders pig farmers*.

CHAPTER ONE

INTRODUCTION

1.1. Background

Globally, the increasing demand for animal protein remains high in low- and middle-income countries, gives room for more expansion of livestock production (Enahoro et al., 2019). Pork in particular is the most consumed meat globally, accounting for more than three quarter of meat consumed worldwide (Soare & Chiurciu, 2017). China is the leading global pig producers, accounting for about 40% of the world's pig production (FAOSTAT, 2021).

In Africa, South Africa and Nigeria leads in pig production with 320 and 309 thousand metric tonnes of pork per year, respectively, followed by Malawi with 279 thousand metric tonnes per year (FAOSTAT, 2021). The study conducted in south Africa indicate that increasing pork consumption and demand is associated with the increasing pig production, pork quality and taste (Magqupu et al., 2024).

In Uganda, the pork consumption per capita is estimated at 3.4 kgs, with annual pork production of 132 thousand tonnes ranks her the highest in East Africa (FAOSTAT, 2021), third in Africa after Nigeria and South Africa (FAOSTAT, 2021). According to UBOS (2021) livestock census report, the pig population in Uganda was 7.1 million. Regionally, western and central region had 4.565 million pigs, having the highest number of pigs followed by the eastern region with 1.396 million pigs, and northern region had the least pig population of 1.121 million pigs.

Pig production systems in Uganda is dominated by smallholder pig farmers. The choice of existing production systems of pigs, namely; extensive system, semi-intensive system and intensive system, depends on farmers' economic status to purchase inputs, with more

extensive system practiced in the rural area than in the urban area (Muhanguzi et al., 2012). The type of production system (intensive, semi-intensive, extensive) affects disease prevalence and management strategies (Dione et al., 2022). Intensive systems often have lower disease risks due to close animal confinement and allow for better biosecurity measures and veterinary intervention (Muhangi et al., 2014). In contrast, extensive systems may expose animals to environmental pathogens and it often result in higher disease transmission (Dione et al., 2020), and the system is associated with low investment in pig enterprise, poor access to quality inputs and veterinary services (Ouma et al., 2013). On average, smallholders maintain average herd size of three pigs (UBOS, 2021). The number of pigs kept is relatively low for all the categories (Ikwap et al., 2014). However, the herd size in large scale commercial farmers is much higher. Pigs are majorly reared for income generation to meet family needs (Carter et al., 2017). However, pig production is constrained by factors such as inadequate feeding, poor reproduction, and infectious diseases, especially the Africa swine fever (ASF) virus (Chenais et al., 2015).

African swine fever (ASF) is a disease of pigs which is cause by African swine fever virus (Dixon et al., 2019). It can cause up to 100% death rate when the herd is infected (Penrith et al., 2021). The disease occurs in different clinical forms which can be described as acute, paracute and chronic forms with clinical signs such as high fever, loss of appetite, skin coloration around ears, incoordination, abortion, and sudden death (Li et al., 2022). African Swine Fever is present in most pig-keeping areas on the African continent (Penrith, 2020), and has remained endemic in most countries such as Uganda (Dione et al., 2022).

There is a wide distribution of ASF disease in Uganda, with Central Region and cross border districts recording the highest number of cases throughout the year with peak outbreaks recorded from April to September (Wampande et al., 2025). The disease is very lethal and can lead to loss of income due to the lack of a vaccine and an effective treatment (Karger et al.,

2019). Its control and prevention relies on quarantine, biosecurity and community sensitization (Atuhaire et al., 2013). However, there is insufficient region-specific data on the direct and indirect economic costs of ASF in northern Uganda, creating a gap in understanding the full extent of its impact on smallholder farmers. Therefore, this study assessed the knowledge on ASF control, economic losses and the cost incurred by farmers in control of African swine fever outbreaks among smallholder pig farmers in Agago District.

1.2. Problem Statement

Smallholder pig farmers are challenged with pig production constraints associated with infectious disease (Y. Li et al., 2025), with ASF being the most dangerous disease which causes up to 100% mortality with no vaccine (Dione et al., 2020). ASF disease has been reported to escalate due to low investment in pig production (Aliro et al., 2022; Chenais, et al., 2017). Study by Chenais, et al. (2017) underscore the need for proper biosecurity and awareness surrounding pig production and disease control in Uganda. Despite research on ASF targeting smallholder pigs' farmers, studies have not covered significant geographical areas in Uganda. Available ASF-related studies focused mainly on high pigs production region such as Lira, Gulu and districts in central Uganda (Aliro et al., 2022; Chenais, et al., 2017; Ndyomugyenyi & Kyasimire, 2015). Yet, smallholders pig farmers do not consider the associated impact of ASF outbreaks on their economic outputs, thereby limiting ability to institute interventions to improve pig production in many localities (Chenais, et al., 2017). further more, knowledge on the control of ASF is a prerequisite in the adoption of biosecurity measures this study therefore, assessed the knowledge on control measures, cost incurred on control practices and the perceived impact of ASF outbreaks among smallholder pig farmers in Agago District.

1.3 General Objective

To assess the knowledge on control and economic losses associated with Africa swine fever (ASF) disease among smallholder pig farmers in Agago District.

1.4 Specific Objectives

i. To determine the smallholder farmers' knowledge and practices on control of African swine fever disease.
ii. To assess the perceived impact and associated control cost of African Swine Fever among smallholder pig farmers.

1.5 Research Questions

i. What are the smallholder pig farmers' knowledge and practices towards the control of African swine fever?
ii. What are the perceived impact and associated control cost of African Swine Fever among smallholder pig farmers?

1.6 Significance of the Study

The study assessed the farmers' knowledge on control of African swine, perceived impact and the associated control cost incurred by farmers in controlling ASF. Therefore, the findings from this study may act as benchmark for other researchers who may want to conduct research in the same field. In addition, the study adds to the existing body of literature on the losses associated with African swine fever outbreaks among the smallholder pig farmers. The study also bridges the knowledge gap on the losses associated with African swine fever outbreaks.

1.7 Justification of the Study

The findings of this study will help the Government and other stakeholders such as Operation

Wealth Creation (OWC), Ministry of Agriculture Animal Industry and Fishery (MAAIF) and Non-Governmental Organizations (NGOs) supporting livestock projects at districts to develop more focused and appropriate programs that help in building capacity of pig farmers on ASF control. The findings from this study provides ground for the formulation of policy and assist in lobbing for more resources that can be appropriately used with an aim of controlling ASF outbreaks in the district. It also guides in the allocation and prioritization of available resources in the district production and veterinary department.

1.8 Conceptual Framework

Figure 1 shows relationship between dependent variables and independent variables**.** The framework looked at the knowledge on control of ASF and cost of controlling ASF as the independent variables and the losses due to ASF outbreak as the dependent variables, the relationships between the variables are explained below:

Knowledge on control of ASF (independent variable 1) refers to farmer's awareness on prevention and control of ASF. The relationship here is that farmers with higher knowledge are expected to adopt better control and management practices which reduces pig mortality, limit outbreaks and minimizes economic losses. Conversely, poor knowledge increases the likelihood of delayed outbreak response, inappropriate practice and a greater loss. The expected relationship is that, higher knowledge on ASF control reduces economic losses.

Cost of controlling ASF (independent variable 2) include cost of confining, disinfecting, disposal of dead pig by burning or burying, restricting visitors, stopping the use of communal boar, informing authority, isolation, and boiling of swill feed. High cost may hinder farmers

from effective control measures leading to more server outbreaks and higher economic losses. The relationship is that high management cost increases economic losses through limited adoption of control measures. Affordable cost reduces losses.

Economic losses due to ASF (dependent variable**)** refer to the financial impact due to ASF, including loss of income, reduced sale, abandoning pig rearing, and failure to meet home basic need. This variable is directly influenced by both the farmer's knowledge of control and the cost of control and management.

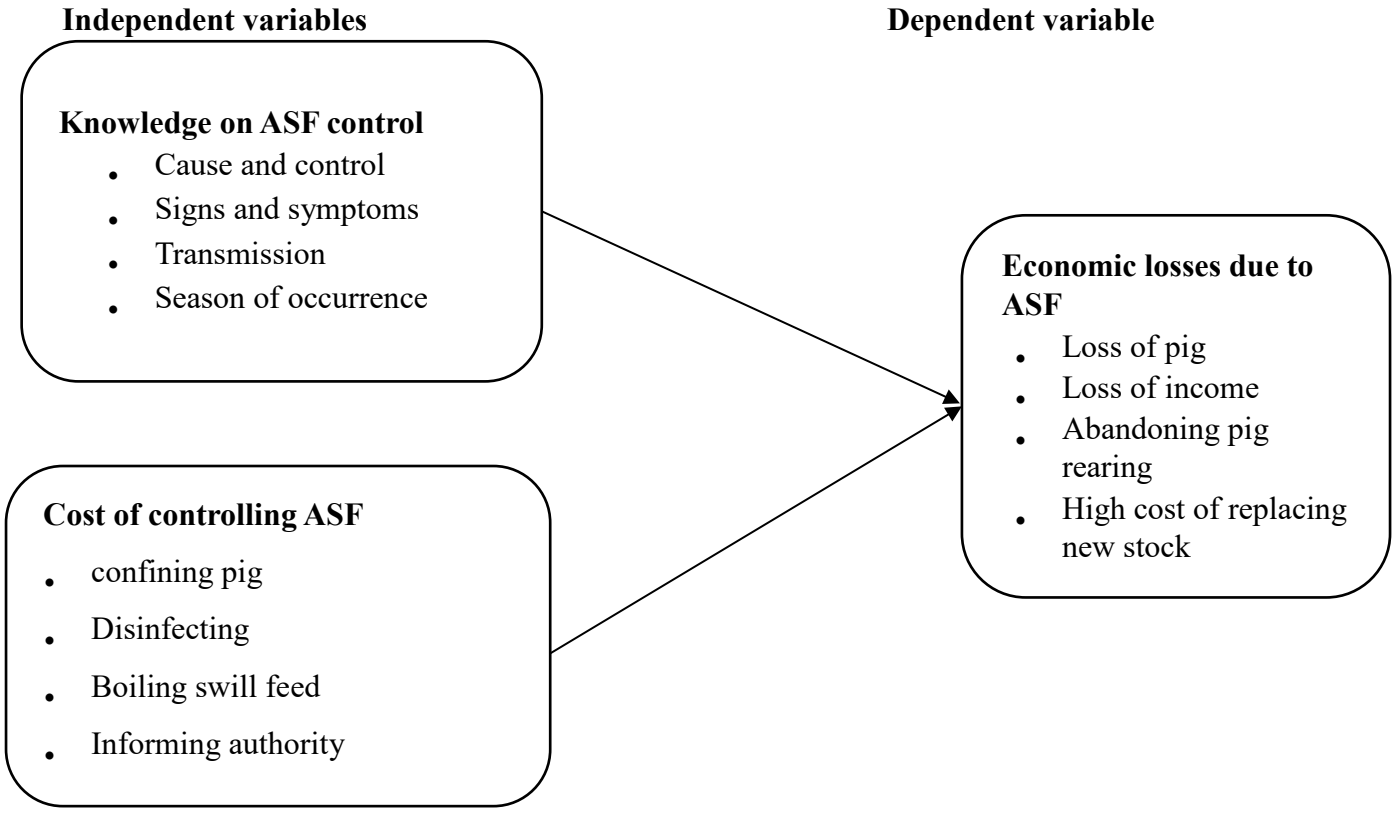


Figure 1: Conceptual Framework

Source: Adopted from Hennessy et al. (2018)

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of African Swine Fever

African swine fever disease was first observed and described in pigs of European settlers in Kenya at the beginning of the Twentieth Century (Montogomery, 1921). ASF disease majorly occurs in western Europe, Africa and western Asia, affecting 52 counties, with cases of domestic pig infection in 48 countries and cases of wild boar infection in 23 countries (Jiang et al., 2022). The disease is also present in most pig-keeping areas on the African continent (Penrith, 2020). In Uganda, ASF is an endemic disease with frequent outbreaks across the country (Dione et al., 2018).

The causative agent of ASF disease is the African swine fever virus (ASFV), a double-stranded DNA virus of the Asfivirus genus (Guinat et al., 2016). The symptom of the disease include; high fever, vomiting, hemorrhages and abortion in pregnant sows (Jori et al., 2023). The disease can be transmitted through direct and indirect contact between animals which are infected, pork or contaminated equipment with healthy pigs. The higher the rate of indirect or direct contacts between pigs in the farm, the faster the spread through the pig population (Dixon et al., 2020). This disease is very difficult to control and eradicate (Penrith, 2020). Therefore, its control and prevention require involvement of different range of stakeholders in pork food system which involves them in implementing appropriate policy instruments, biosecurity, surveillance and outbreak response (Linda et al., 2020). Farmers have therefore reported the loss of pig and reduction in profit margin in pig production as the economic impact associated to the outbreaks of ASF.

2.1.1 Epidemiology of ASF

African swine fever comprise of four different independent epidemiological cycles: sylvatic cycle (wild pig cycle), the tick-pig cycle, domestic pig (pig-pig) cycle and the wild boar habitat cycle (Chenais, et al, 2018). The transmission under sylvatic (wild pig) cycle involves the interaction between the wild pig (warthog and the bush pigs) and the soft tick (Penrith et al., 2019). The tick-pig cycle involves soft ticks of the Ornithodoros species and the domestic pigs (Lv et al., 2022). The tick-pig cycle occurs where there is little or no evidence of contact between wild and domestic pig, which indicates that tick is the agent of transmission of ASF virus disease (Jori et al., 2023). The domestic pig (pig-pig) cycle involves domestic pigs and derived pig products, where transmission occurs through direct and indirect contact between pigs and the infected equipment. Finally, the wild boar habitat cycle involves wild boar, wild boar derived products and its habitat (Chenais et al., 2018).

The common epidemiological cycle in Uganda is the domestic type (Muhangi et al., 2014). The host range of African swine fever virus (ASFV) is restricted to suids (wild and domestic) and soft ticks of the Ornithodoros species (Nawaz et al., 2024). ASFV infection causes mild clinical signs in wild piglets, especially warthogs, due to viremia and can result in longer-term persistent infections (Dixon et al., 2020).

2.1.2 Prevalence and mortality of ASF

African swine fever has been reported as the major trans-boundary disease affecting many countries majorly in Asia, Africa and Europe with about sixteen thousand five hundred and fifty (16,550) reported cases worldwide and has the potential of being spread to many part of the world (Jiang et al., 2022). In Uganda, ASF is an endemic disease with frequent outbreaks across the country (Dione et al., 2018). The study conducted by Chenais et al. (2015) indicates generally high mortality rate from report driven investigation, participatory rural

appraisal and household survey. According to Atuhaire et al. (2013), there were high sero-prevalence of ASFV in apparently healthy slaughtered pigs and also a high proportion of ASFV seropositive but normal pigs in Wambizi slaughter house in Kampala. Pig farming system and the reluctance to use biosecurity measures greatly contribute to the recurrent outbreaks without the need for a wildlife cycle. Collective efforts will help to eradicate ASFV if adequate control measures are instituted (Ebwanga et al., 2022). The pig production fuels the spread of ASF, as extensive systems may expose animals to environmental pathogens and it often result in higher disease transmission (Dione et al., 2020).

2.1.3 ASF control strategies

There are no effective vaccines and drugs available to prevent or treat ASF infection, therefore it is important that area free from ASF are kept free by preventing the introduction of this virus to avoid losses (Penrith, 2020). Control and prevention of ASF relies on measures such as disease surveillance to lower infection rates and reduced economic losses among pig farmers (Alarcon et al., 2021). In many countries, cross border controls have been tighten to prevent the entry of pig and pork product from infected areas in addition to implementation of biosecurity measures (Ito et al., 2023). Additionally, Chenais et al. (2023) recommended a participatory approach in promoting biosecurity measures through increased ownership in controlling diseases. Farmers use ASF control and prevention strategies which involve measures such; erection of fence, enforcing change of footwear and clothing, dipping of tyres, use of footbath at door steps, daily sweeping of premises, use of appropriate disinfectant, boiling of swill feed and proper disposal of dead pigs according to Ouma et al. (2018). Furthermore, active surveillance in slaughter houses, appropriate disposal of dead pigs, isolation of sick pigs, restricting visitor entering farm, disinfection, defining affected areas, wearing personal protective equipment, and fencing was the most important measure that has been implemented (Dione et al., 2014). Study conducted by Aliro et al. (2022)

indicates other preventive practices such as construction of pigsty to confine pigs from other pigs and human contacts, sharing information about outbreak to alert fellow farmers for farm gate selling and buying price to improve on biosecurity measures. Luskin et al. (2021) recommended carcass and waste disposal of pig that died from ASF, surveillance, biosecurity measures, research, public outreach and capacity building to be used to contain the disease. Other studies suggest that interventions such as farmer training, vaccination programs, and improved market access can reduce ASF-related losses if they are implemented effectively (Ekakoro et al., 2023). Quarantine on pig and pig product has been implemented by the Local Government and Ministry of Agriculture Animal Industries and Fisheries (MAAIF) to contain the diseases (ASF) in Uganda. Quarantine as one of the ASF disease control measures should be imposed on custom department including international airport, railway terminal to prevent and control further infection (Liu, Zhang, Qi, Yang, Liu, An, Wu, et al., 2021). Farmers avoid buying pigs during outbreak to prevent ASF disease transmission (Aliro et al., 2022). According to Chenais et al. (2023), farmers suggested among others biosecurity measures such as buying healthy looking pigs, keeping pigs confined all the time, use of own boar, isolation of sick pigs, avoiding contact with equipment contaminated with pork to control ASF disease outbreaks.

2.1.4 ASF control implementation challenges

African swine fever prevalence and economic impacts varies due to differences in pig production systems, biosecurity practices, and access to veterinary services (Ekakoro et al., 2023). Smallholder farmers in Uganda struggle to control disease outbreaks due to inadequate finances hence face challenges such as limited veterinary infrastructure, high costs of services, and inadequate government support (Atuhaire et al., 2013). Economic constraints hinders farmers from adopting preventive strategies, increasing their financial vulnerability (Qange et al., 2024). Smallholder farmers often lack the resources such as finances and

limited knowledge to implement effective disease management strategies, leading to recurring losses that affect their livelihoods and economic stability (Okello et al., 2020). Costs associated with disease control, prevention, and replacement of infected stock place a heavy burden on small-scale farmers (Ouma et al., 2018). Studies indicate that veterinary expenses, vaccination programs, and biosecurity investments can be costly, particularly for poor farmers in rural areas (Ouma et al., 2018). The uptake of preventive measures is associated with high financial cost and adoption is high on farmers with more knowledge and very low in farmers with limited knowledge (Dione et al., 2020).

Smallholder pig farmers face challenges such as limited knowledge, limited access to feeds and veterinary services which make it hard to implement control and preventive measures against African swine fever disease (Chenais et al., 2022). Additionally, age plays a role in decision-making, as older farmers tend to be more risk-averse and conservative in adopting new technologies, whereas younger farmers are more willing to embrace modern biosecurity measures (Brown et al., 2019). Household size affects disease control implementation, as larger households may have more labor resources to implement preventive measures effectively (Nguyen-Thi et al., 2021). Moreover, knowledge and education levels are critical determinants of livestock disease outcomes, farmers with formal education or participation in extension services are more likely to adopt effective biosecurity measures, reducing the impact of diseases like ASF (Dione et al., 2020). The enforcement of quarantine becomes hard in the informal market, yet many livestock trade take place in informal market (Aliro et al., 2023).

2.2 Knowledge and practice on control of African swine fever

Study conducted in Vietnam indicate that smallholder pig farmers who have had first outbreak of ASF had limited knowledge to control ASF, meanwhile farmers who had frequent

outbreaks show better knowledge of the disease (Arvidsson, 2023). Smallholder farmers have developed strategies to cope up with the reoccurrence of ASF because of the limited knowledge they have on ASF disease (Xu et al., 2021).

Limited knowledge and awareness by pig value chain actors influence the adoption of biosecurity measures (Mutua & Dione, 2021). The benefit of implementing biosecurity measures reduces on the disease introduction and financial losses which occurs due to disease outbreaks (Mutua & Dione, 2021). The main constraints to animal health are lack of knowledge on management and husbandry practices, poor feeding and poor health service delivery systems

(Dione et al., 2014). The control measure to improve health under the intensive pig system mainly relate to improvement in the house design, improved hygiene and preventive measures, reducing herd size, and vaccination (Clark et al., 2019). Enhancing farmers' access to education and veterinary services is essential in minimizing losses and improving livestock productivity (Dione et al., 2020). Studies have shown that experienced farmers are more likely to adopt disease prevention strategies, reducing the number of infections and mortality rates within their livestock farm (Ghimire et al., 2023). Cost benefit analysis study conducted by Fasina et al. (2012) shows that implementation of biosecurity measures reduces the profitability of the pig business as cost for implementing those measures are high.

2.3 The economic losses associated with ASF outbreaks

The impacts of ASF on communities are evidenced by existing livelihood vulnerabilities, as outbreaks lead to an increased pig mortality and reduces pig herds for affected households (Chenais et al., 2017). The social economic and livelihood impacts of ASF is financial losses, livelihood vulnerability and loss of other income sources. Existing literatures highlights variations in ASF prevalence and economic impacts across different geographical regions due

to differences in pig production systems, biosecurity practices, and limited access to veterinary services (Ekakoro et al., 2023). In central Uganda, where commercial pig farming is more practiced, farmers have better access to feeds, equipment and veterinary services suitable for ASF disease control and prevention (Muhanguzi et al., (2012), Whereas in rural areas farmers have limited access to commercial feeds, veterinary equipment and services, access to infrastructures and informal pig trade networks which increase ASF spread, pig mortality and thus economic losses (Ikwap et al., 2014). African swine fever (ASF) and other infectious outbreaks contribute to high morbidity and mortality, leading to severe economic consequences (Kappes et al., 2023). The severity of losses depends on factors such as disease prevalence, extent of disease spread and limited farmers' knowledge of prevention and control strategies (Okello et al., 2020). There was total loss of pig in the farm and the farm workers (farm attendants) lost their job due to death of all the pigs in the farm (Chenais et al., 2016). Further, report indicates psychological and mental stress especially when shooting infected pig in broad day light, shifting from pig to other income generating activity and difficulty in paying debt as the impact associated with the outbreak of ASF (Cooper et al., 2022).

The study recently conducted by Chenais et al. (2025) reported high economic loss due to ASF outbreak in terms of pig mortality and reduction in the pig population. Similarly, loss of pig and reduction in the profit margin due to ASF outbreak was also reported in an earlier study conducted by (Chenais, et al., 2017).

CHAPTER THREE

METHODOLOGY

3.1 Study Area

This research was carried out in Agago District, northern Uganda. The district is bordered by Kitgum District to the north, Kotido District to northeast, Abim district to the east, Otuke district to the south and Pader district to the west. The major economic activity is agriculture; mainly crop production and livestock rearing at subsistence level (Agago district production report, 2020). The district has been selected because of the frequent outbreak of ASF (Atuhaire et al., 2013). Agago district has three counties with nineteen sub-counties and seven town councils. Three sub-counties, each from a county with the highest pig population in the district (UBOS, 2021) were selected for this study, the three sub-counties are: Adilang, Wol and Lira palwo as indicated in the map of Agago District showing the study area in Figure 2 below.

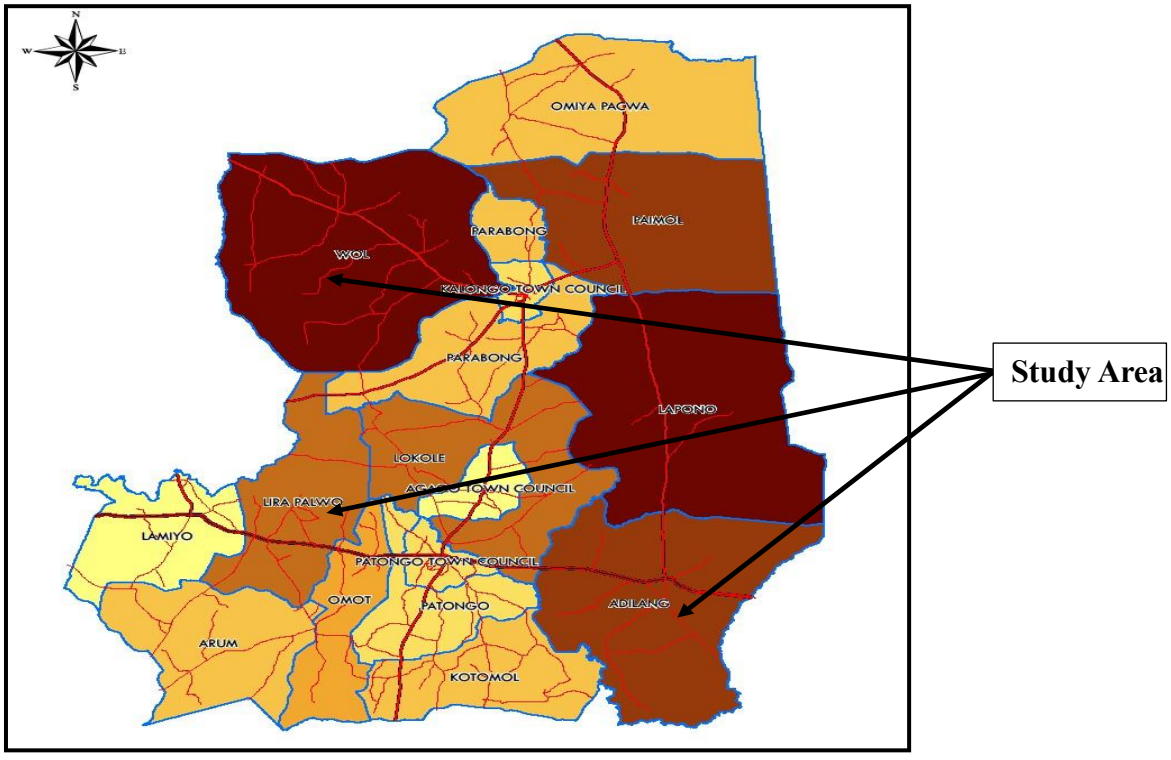


Figure 2: Map of Agago District showing the study area

3.2. Study Design

The study used a cross-sectional survey to assess the knowledge on control of ASF, the perceived impact of ASF and the associated control cost incurred by farmers in control of ASF. Data was generated using a household structured questionnaire containing variables such as socio demographics characteristics, herd characteristics, knowledge on ASF control measures, cost of control measures, and effect of ASF outbreaks.

3.4. Study Population and Sample Size

The study targeted a population of smallholder pig farmers who have had African swine fever outbreaks since 2020. Three hundred and three (303) respondents who were previously affected by ASF outbreaks were purposively selected with guidance from the veterinary assistants in charge of the selected three sub-counties (Adilang, Wol and Lira Palwo) with the highest pig population in the district (UBOS 2008), there were about 1,299 small holders pig farmers in the three sub-counties UBOS 2008. The 303 participants were derived from the formula recommended by Yamane (1967) (Equation 1), at 95% confidence level and snow balling and the veterinary officers were used to identify the respondent.

$$n = \frac{N}{1+N\,e^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{Equation 1}$$

Where n=sample size, N=population and e= marginal error.

3.5 Data Collection

Data was obtained by conducting face-to-face interviews using a structured questionnaire, see attached appendix I. The questions were developed in English and translated in Acholi language for easy understanding by the respondents. The questionnaire had both closed and

open-ended questions giving them options for other answers best described and understood by them. Data on the knowledge, impact and associated control cost was categorized as quantitative since the responses were coded and quantified.

3.6 Data Collection Procedures

The questionnaire was pre-tested for validation before it was used for the actual data collection. The pre-test was conducted on 20 respondents who were not part of the sampled population and was done in a sub-county not under study. Prior to data collection, 5 research assistants were identified and trained on how to administer the questionnaire to the respondents from their homes or farms. Informed consent was obtained from the respondents informing them about the purpose of the study and their right to participate or not to participate before administering the questionnaire sees the attached appendix II. The research assistants interviewed the respondents who included any one of the household members such as father, the mother or any child, aged eighteen years and above found at home.

3.8. Data Analysis

All data gathered was analysed using statistical package for social sciences (SPSS) version 23. The content was presented according to each specific objective. However, Variables under socio-demographics of the respondents and herd characteristics were analyzed using descriptive statistics that is frequencies, percentages, means and standard deviations and or standard errors to the mean were run.

3.8.1 Objective one: To determine farmers' knowledge and practice on control of ASF disease

The study used descriptive statistics such as frequencies and percentages to find out the respondent's knowledge and practice on the control of ASF. The variation in knowledge and extent to which these control and management practices were used were obtained through chi-square tests and spearman's correlation. The information generated was presented in either tabular form, or figures.

3.8.2 Objective two: To assess the impact and associated control cost of African Swine Fever among smallholder pig farmers

Descriptive statistics specifically frequencies, percentages, means, and either the standard deviation or standard error to the mean (S.E), as well as chi-square tests and independent sample tests (students t-test) were used to analyse the data on cost of farm management practices employed by smallholder pig farmers in control of ASF on effects of African swine fever outbreak among smallholder pig farmers**.** The information was also generated and presented in a tabular form and graphical illustrations.

3.9 Ethical consideration

The rights, interest, values and welfare of the research participant was protected during and after this study was approved in accordance with UNCST (2014), National guidelines for research involving human as research participant. Consent of each of the respondent was obtained before involving them in the study. More so, confidentiality, justice, voluntary participation, and respect for every participant in this study was highly observed by the research team.

Ethical clearance was obtained from the Gulu University Research Ethical Committee (GUREC) with GUREC Approval Number GUREC-2023-500), and this report was also subjected to plagiarism check and plagiarism check report was issued, see attached appendix iii and vi. In addition, an introductory letter was obtained from the Department of Animal Production and Range Management, Faculty of Agriculture and Environment, Gulu University.

3.10 Limitation of the study

Finance and time were the main constraints of this research. The time of traveling to the sub-counties and cost of traveling hindered the study with the high cost of fuel. Additionally, some of the respondents were not willing to give the right information, especially on the cost they incurred in prevention and control of ASF. Despite the finance, time and biasness, the study ensured probing questions, pretesting instrument and identifying 5 research assistants thus ensuring the validity of the findings on knowledge on control, cost and perceived impact.

3.11 Dissemination plan

This study assessed the control knowledge and economic losses associated with ASF disease on smallholder pig farmers in Agago district. The findings/research report will be published on an online resource for access by scientists, policy makers, professional and the general public. This is to ensure effective communication of the research findings to the public.

CHAPTER FOUR

RESULTS

4.1 Socio-demographic characteristics of respondents

The results showing the sociodemographic attributes of smallholder pig farmers in Agago district are presented in Table 1.

This study results in Table 1 show that the majority of the respondents were male (60.1). Most of the smallholder pig farmers were aged between 31-40 years (38.0%), while 46.9% had attained at least secondary education. Additionally, most of smallholder pig farmers (92.7%) were married.

Table 1: Socio-demographic characteristics of the respondents

Sociodemographic Attributes	Frequency (Percentage)
Gender of Household Head	
Male	182 (60.1)
Female	121 (39.9)
Age of the Respondent	
Below 20	4 (1.3)
21-30	50 (16.5)
31-40	115 (38.0)
41-50	86 (28.4)
Above 50	48 (15.8)
Educational Level of the Respondent	
Never attended	38 (12.5)
Primary	114 (37.6)
Secondary	142 (46.9)
Tertiary	8 (2.6)
University	1 (0.3)
Marital Status of the Respondent	
Single	13 (4.3)
Married	281 (92.7)
Widow/Widower	9 (3.0)

Note: N = 303
Source: primary data 2024

4.2 Herd characteristics of the respondents

This study indicates that 96% of the farmers were keeping pigs, with most of the farmers (84.5%) tethering their pigs (Table 2). Majority of the farmers (98.3%) kept local breeds of pigs with an average experience of 8 years in pig rearing with the standard deviation of 9.8. On average, each farmer kept three piglets, one grower and one breeder in their farms.

Table 2: Herd characteristics of the respondents

Characteristic	Frequency (n)	Percentage (%)
Categorical		
Respondents keeping pigs		
Yes	291	96.0
No	12	4.0
Production system		
Free range	21	6.9
Tethered	256	84.5
Intensive	26	8.6
Breeds of pig kept		
Local breed	298	98.3
Cross breed	5	1.7
Continuous	**Mean**	**Std**
Experience in pig production (in years)	8.7	0.5
Number of pigs kept (number of animals)		
Number of piglets	3	3
Number of growers	1	1
Number of breeder pigs	1	1

Source: Primary data 2024

4.3 Knowledge and practice of smallholder pig farmers on control of African swine fever

4.3.1 Knowledge of ASF and associated control and management practices

The results in Table 3 indicated that 2.3% of the respondents had knowledge on cause of ASF, while 12.5% had knowledge on control of ASF. Additionally, 21.5% were knowledgeable about the transmission of ASF, while 28.4% knew the signs and symptoms of ASF. In the same vein, most respondents understood that ASF outbreaks occurred mainly in dry season (94.7%) especially from December to March (91.7%). On overall, the results in Figure 3

show that most smallholder farmers (88.8%) had limited knowledge of different practices that can be used for controlling and managing ASF.

Table 3: Knowledge of different control measures for the management of African swine fever disease

Knowledge and practice on African swine fever	Frequencies (n = 303)	Percentage (%)
Cause of ASF		
Yes	7	2.3
No	296	97.7
Control of ASF		
Yes	38	12.5
No	265	87.5
Transmission of ASF		
Yes	65	21.5
No	238	78.5
Signs and symptoms of ASF		
Yes	217	71.6
No	86	28.4
Months of outbreak of ASF		
Dec-March	278	91.7
Jun – July	13	4.3
Others	12	4.0
Season of outbreak of ASF		
Dry season	287	94.7
Rainy season	16	5.3

Source: Primary data 2024

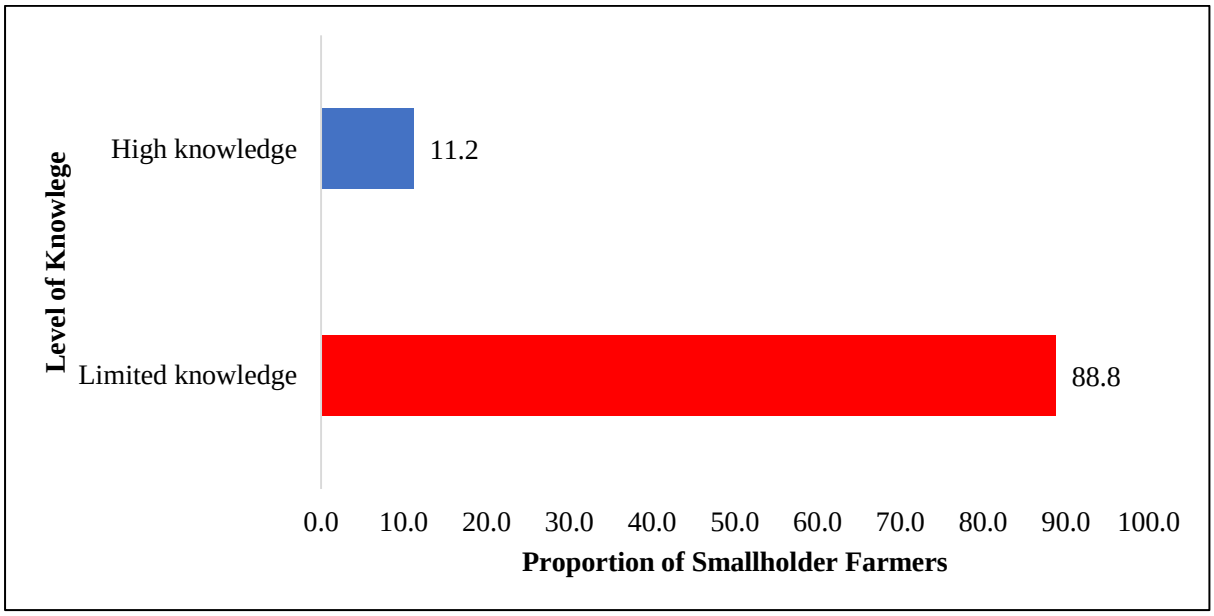


Figure 3: Level of knowledge on control practices

Source: Primary data 2024

This study results in Table 4 show that the majority of the respondents who had limited knowledge of ASF control practices were male (61.7%), while the majority of those who had high knowledge of ASF control practices were females (52.9%). However, there was no significant association between the sex of the household head and the level of knowledge of ASF control practices ($\chi2 = 2.7$, p-value = 0.100). Similarly, the results show that there was no significant association between age of the respondent and the level of knowledge about control and management measures for ASF ($\chi2 = 1.30$, p-value = 0.861), with the majority of those who had limited knowledge and high knowledge of ASF control practices being 31-40 years old.

Table 4: Association between sociodemographic attributes and knowledge of ASF control practices

Sociodemographic Attributes	**Knowledge of ASF Control Practices**		**$\chi2$ (p-value)**
	Limited Knowledge	**High Knowledge**	
Categorical Attributes	**n (%)**	**n (%)**	
Gender of Household Head			
Male	166 (61.7)	16 (47.1)	2.701 (0.100)
Female	103 (38.3)	18 (52.9)	
Age of the Respondent			
Below 20	4 (1.5)	0 (0.0)	1.30 (0.861)
21-30	45 (16.7)	5 (14.7)	
31-40	101 (37.5)	14 (41.2)	
41-50	75 (27.9)	11 (32.4)	
Above 50	44 (16.4)	4 (11.8)	
Educational Level of the Respondent			
Never attended	33 (12.3)	5 (14.7)	3.317 (0.506)
Primary	99 (36.8)	15 (44.1)	
Secondary	130 (48.3)	12 (35.3)	
Tertiary	6 (2.2)	2 (5.9)	
University	1 (0.4)	0 (0.0)	
Marital Status of the Respondent			
Single	11 (4.1)	2 (5.9)	1.403 (0.496)
Married	251 (93.3)	30 (88.2)	
Widow/Widower	7 (2.6)	2 (5.9)	

Source: Primary data 2024

4.3.2 The different ASF control and management practices used by smallholder pig farmers

The results showing the different ASF control and management practices and the extent to which they were used by smallholder farmers are presented in Table 5 and figure 4.

This study results show that out of the 303 respondents, 97 (%) incurred cost on confining pigs. Only one percent of smallholder farmers incurred cost on disinfectant as a means of managing ASF. Similarly, only three percent (9/303) of smallholder farmers embraced stopping the use of communal boar amounting as a strategy for controlling and managing ASF outbreak in their farms. Furthermore, 38.9 (%) respondents incurred managed and controlled ASF by informing authorities of its outbreak. Visitor restriction (3.6%), isolation of sick pigs (15.5%), disposing off dead animals (1.3%), using supportive treatments (13.5%), selling sick pigs (7.9%), use of natural concoctions or local herbs (10.2%), and use of ARVs (3.9%) were the other means adopted by smallholder farmers to control ASF across the district. On overall, the results show that most smallholder farmers (90.8%) had limited use of ASF control and management practices. The results in Table 6 show that there was a weak positive but significant relationship between knowledge of ASF control and management practices and the use of ASF control practices ($r = 0.225$, $p < 0.001$). This implies that a unit increase in the knowledge of ASF control and management practices leads to 5% increase in the use of ASF control practices among smallholder pig farmers.

Table 5: Different control measures practiced by smallholder farmers for managing ASF

Practice on African swine fever	Frequency (N)	Percentage (%)
Confining pig		
Yes	122	40.3
No	181	59.7
Using disinfectant		
Yes	2	0.7
No	301	99.3
Informing authority		
Yes	118	38.9
No	185	61.1
Stopping the use of communal boar		
Yes	9	3
No	294	97
Isolation of sick pig		
Yes	47	15.5
No	256	84.5
Restricting visitors		
Yes	11	3.6
No	292	96.4
Disposing off dead pig by burring or burning		
Yes	4	1.3
No	299	98.7
Supportive treatment		
Yes	41	13.5
No	262	86.5
Selling sick pig		
Yes	24	7.9
No	279	92.1
Use of natural concoctions/local herbs		
Yes	31	10.2
No	272	89.8
Use of ARVs		
Yes	12	3.9
No	291	96.1

Source: Primary data 2024

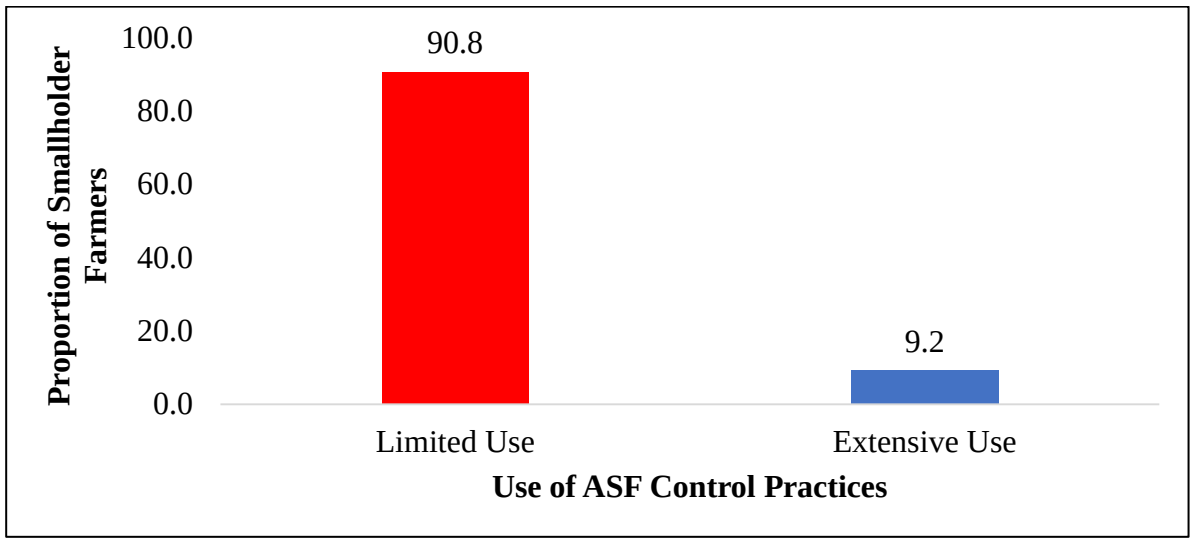


Figure 4: Extent to which smallholder farmers used ASF control practices
Source: Primary data 2024

Table 6: Relationship between knowledge of ASF control practices, and use of ASF control practices among smallholder pig farmers

Attribute	Knowledge of ASF Controls Practices	Use of ASF Control Practices
Knowledge of ASF control practices	1.000	
Use of ASF control practices	.225**	1.000

Note: N = 303, **. Correlation is significant at the 0.01 level (2-tailed).

4.4 The associated cost (Uganda shillings) of control of ASF among smallholder pig farmers

The associated economic cost of controlling ASF among smallholder farmers is presented in Table 7 and Figure 5. In Table 7, this study shows that on average, smallholder pig farmers spent Ugx. 105,525.8 on confining pigs as an ASF control and management strategy. However, there was no significant difference in the costs incurred by smallholder farmers who had limited knowledge and high knowledge of ASF control and management practices in confining pigs (t = 1.04, p-value = 0.301). Only those that had little knowledge of ASF control and management practices incurred costs in stopping the use of communal boars (Ugx. 222.2), using natural concoctions (Ugx. 3096.8) and disinfectants (Ugx. 32,500) in the management of ASF. On the other hand, no costs were incurred in boiling, restricting visitor entry, disposing dead pigs and selling sick animals as well as using ARVs for treating sick pigs.

Smallholder pig farmers also spent an average amount of Ugx 1180.3 and Ugx.10212.8 on informing authorities and isolating sick pigs respectively, as an ASF control and management strategy. There was, however, no significant association between the use of these control and management measures that is informing authorities and isolating sick pigs, and the level of

knowledge on different range of ASF control and management practices ($p > 0.05$). The results reveal that on overall, farmers used on average Ugx. 20625.0 in providing supportive treatments for managing ASF, with those who had limited knowledge of different control and management practices incurring significantly higher costs (Ugx. 40,053.2) in providing supportive treatments than those who had higher knowledge of different ASF control and management practices (Ugx. 32806.5, $t = -2.241$, $p = 0.031$). The results also reveal that, smallholder farmers spent on average Ugx. 39140.0 in practicing different measures used for managing ASF, with no significant differences observed among the costs incurred by those who had limited knowledge and those who had higher knowledge of these ASF management and control practices ($p > 0.05$). In Figure 5, it is evident that most smallholder farmers (91.1%) perceived that they incurred low costs in the management of ASF.

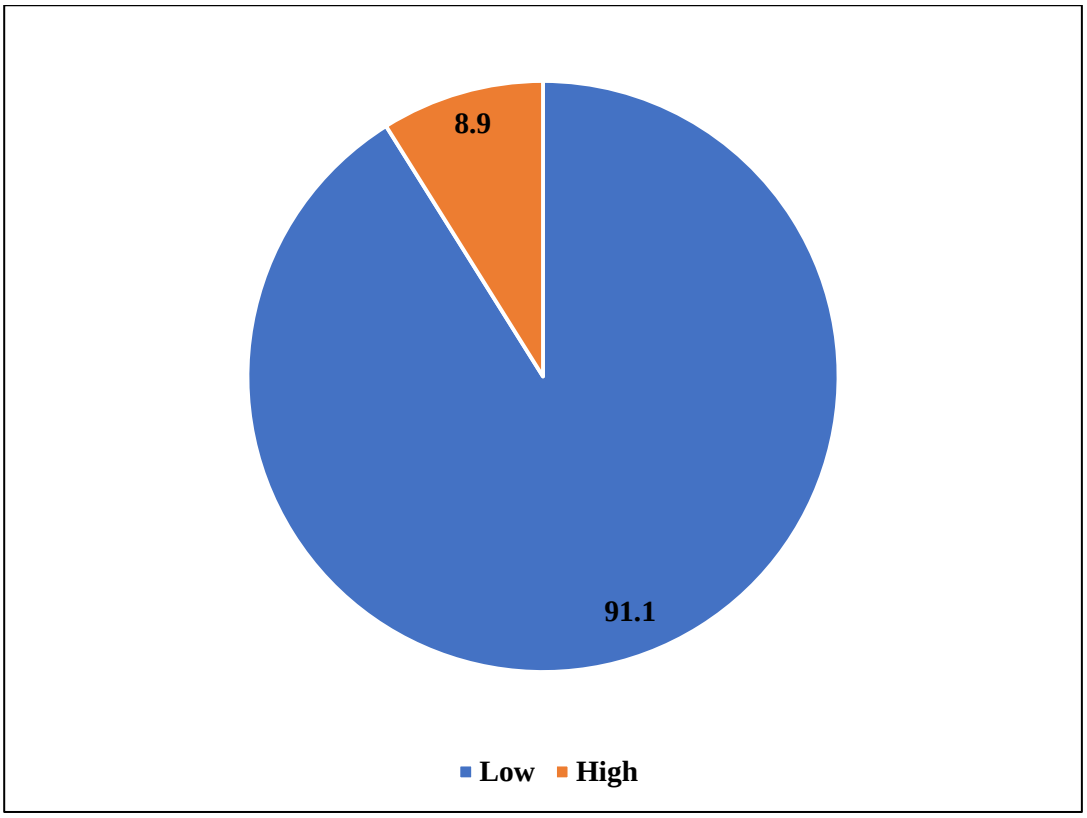


Figure 5: Perceived cost of controlling ASF

Source: Primary data 2024

Table 7: The associated control cost (Uganda shillings) among smallholder pig farmers

Cost Incurred in ASF Control	Average Costs Incurred (Ugx)			t (p-value)
	Overall	Knowledge of Control Measures		
		Low	High	
	Mean ± SE	Mean ± SE	Mean ± SE	
Confining pigs	105525.8 ± 89334.8	109238.1 ± 10039.3	81538.5 ± 18745.8	1.041 (0.301)
Boiling swill feed	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	-
Disinfectants	32500.0 ± 3535.5	32500.0 ± 3535.5	0.0 ± 0.0	-
Restricting visitors	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	-
Stopping the use of communal boars	222.2 ± 222.2	222.2 ± 222.2	0.0 ± 0.0	-
Informing the authorities	1180.3 ± 800.5	1151.4 ± 718.5	1423.1 ± 1320.5	-1.158 (0.249)
Isolating the sick pig	10212.8 ±1619.1	11111.1 ± 1974.4	7272.7 ± 2397.3	1.004 (0.321)
Disposing the dead pig	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	-
Supportive treatments	20625.0 ±14312.8	17464.3 ± 2341.5	28000.0 ± 4696.9	-2.241 (0.031)
Selling sick pigs	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	-
Natural concoctions	3096.8 ± 1402.3	3096.8 ± 1402.3	0.0 ± 0.0	-
Use of ARVs	0.0 ± 0.0	0.0 ±0.0	0.0 ± 0.0	-
Overall Costs of Control	39140.0 ± 1495.3	40053.2 ± 23200.6	32806.5 ± 24596.6	1.614 (0.108)

Source: Primary data 2024

4.5 The perceived impact of African swine fever among smallholder pig farmers

The results showing the perceived impact of ASF on smallholder pig farmers are presented in Tables 8 & 9, and Figure 6.

In Table 8, the results show that most smallholder pig farmers significant losses or mortalities (99.7%) and loss of income due to ASF outbreak. In addition, most smallholder pig farmers also reported significant failures in their ability to meet home basic needs (97.7%), incurred high cost of replacing new stock was (95.7%).

In Figure 6, the results show that most smallholder farmers (96.7%) perceived that ASF highly impacted them.

In Table 9, even if the results show that among farmers that believe that they either experienced low impact (90%) or they were highly impacted (88.7%), there was no significant association between the perceived impact of ASF and the knowledge of different ASF control and management practices used (χ^2 = 0.015, p = 0.901). Similarly, the results show that there was no significant association between extent to which ASF control and management practices were used by smallholder farmers and the perceived impact of ASF, with most farmers that either experienced low impacts or high impacts of ASF being from those that exhibited limited use of ASF control and management practices (χ^2 = 1.053, p = 0.305).

Table 8: Perceived impact of the outbreak of ASF on the smallholder pig farmer

Perceived impacts due to ASF outbreak	Frequency (n)	Percentage (%)
Loss of pigs	302	99.7%
Loss of income	302	99.7%
High cost of replacing new stock	290	95.7%
Abandoned pig rearing	80	26.4%
Failure to meet some basics home needs	296	97.7%
Others	263	86.8%

Source: Primary data 2024

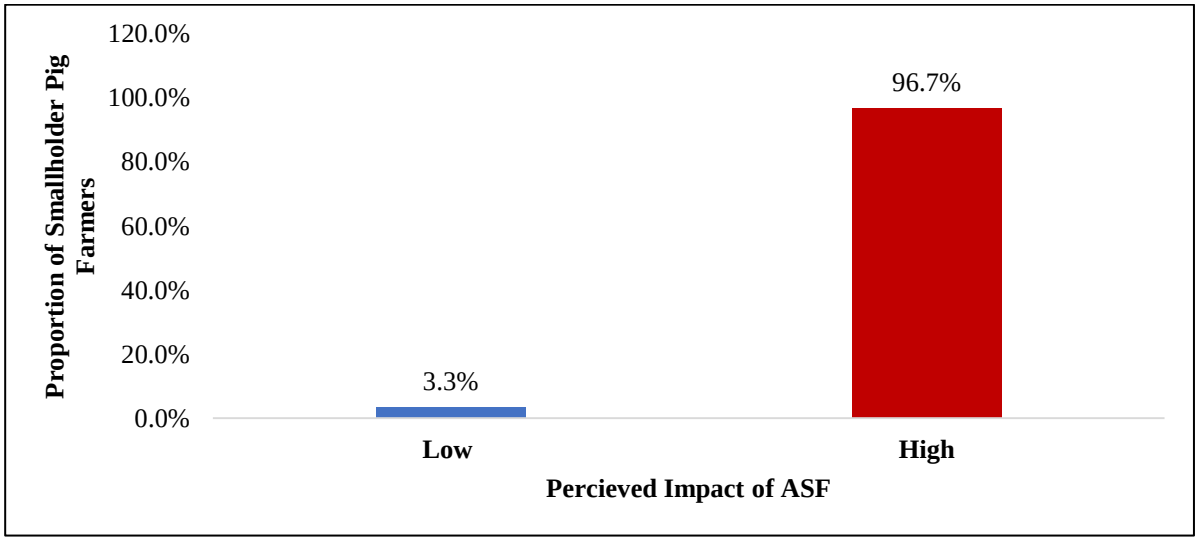


Figure 6: Perceived impact of ASF on smallholder pig farmers
Source: Primary data 2024

Table 9: Association between knowledge of ASF control practices and the extent to which smallholder farmers used ASF practices

Knowledge & Use of ASF Control & Management Practices		Perceived Impacts of ASF		χ^2 (p-value)
		Low Impact	High impact	
		n (%)	n (%)	
Knowledge of Control Practices	Low knowledge	9 (90.0)	260 (88.7)	0.015 (0.901)
	High knowledge	1 (10.0)	33 (11.3)	
Control Practices Used	Limited	10 (100.0)	265 (90.4)	1.053 (0.305)
	Extensive	0 (0.0)	28 (9.6)	

Source: Primary data 2024

CHAPTER FIVE

DISCUSSION OF RESULTS

5.1 Socio-demographic characteristics of the respondents

The predominantly male-led households are likely to provide labor and contribute resources to control ASF this could help to boost the pig production and enable farmers to earn income from pig rearing. Though men and women consider different activities to carry out in their farms, some of the activities are jointly implemented, especially the biosecurity measures. This agrees with the study conducted in Lira and Masaka by (Dione et al., 2020) which reported that men play key roles such as construction of pig houses, spraying, deworming, and enforcing implementation of control of ASF, while women clean pig houses and feed the pigs, but jointly carry out biosecurity measures such as disinfecting. The male led households demonstrate the nature of resource ownership that men have in the community regarding ownership of assets such as livestock. This finding is consistent with the study which indicated that men are the sole decision makers and owners of assets in the society (Carter et al., 2017). The attained secondary education level in this study, indicated a significant ease of access of information and adoption of ASF control and preventive measures, but lack of technical training on ASF, could partially contribute to frequent ASF outbreaks in the area. This concurs previous research by Wang et al. (2023) where educated farmers are associated with better awareness of disease transmission and control measures.

This study showed many smallholder famers with experience in pig rearing for over 8 years, with majority found keeping pigs in their homesteads despite frequent ASF outbreaks, demonstrating how pigs are important as source of household income. The findings attributed to ready market created by high pork demand and other benefits of pig rearing for income generations such as boar hire service and sale of pig manure. The finding is in line with the

study conducted by Omowumi et al. (2021) which indicated that smallholder pig farmers are involve in pig production because of the high demand of pork and other pig products such as manure. Focusing on keeping fewer pigs across specific categories, such as piglets (n=3), growers (n=1), or breeders (n=1), indicated a strategy probably for ease of management using the limited available resources and coping strategies of losing small number of pigs in the herd, thus lowering cost of production, though during ASF outbreaks farmers with larger herd sizes tend to experience significant economic losses compared to farmers having smaller herd sizes (Liu et al., 2021). This also relate to a similar study by Ikwap et al. (2014) who reported that majority of the respondents kept all pig category with an average of 3.1 breeders, 2.3 growers and 8.0 piglets, a slightly higher number per category compared to the current study.

Tethering was the most widely practiced system of pig rearing among the respondents compared with free-range and confined systems. This indicated a low-cost system of pig rearing where scavenging or free-range practice is being replaced with a similarly low cost, but with a reduced risk of ASF infection compared to an expensive extensive system not affordable. Few respondents were practicing confined rearing, possibly because ASF disease control and they are able to meet the higher costs requirements in terms of feeding and housing involved. This finding also relates to a study conducted by Ikwap et al. (2014) in Gulu and Soroti where majority of the surveyed population were reported practicing tethering.

Contrary to this study, Ndyomugyenyi & Kyasimire (2015) and Muhanguzi et al. (2012) reported that majority of the farmers in western Uganda reared pigs in semi intensive system. This geographical disparity could be attribute to, shortage of land, knowledge of pig rearing and access to industrial bi-product feeds, which is not a case in Agago district.

5.2 Knowledge and practice of smallholder pig farmers on control of African swine fever

5.2.1 Knowledge of African swine fever and its control practices among smallholder pig farmers

The finding that a minimal proportion (2.3%) of smallholder farmers had knowledge of the cause of African swine fever (ASF) is explained by the fact that most farmers lacked an adequate understanding of the infectious agent responsible for ASF. African swine fever is caused by African swine fever virus (ASFV), a large double-stranded DNA virus that affects domestic pigs and wild suids. As such, its is great importance to smallholder pig production because it can cause severe mortalities in pigs and hence substantial economic losses and disruption of livelihoods of smallholder pig farmers. Limited knowledge of its viral aetiology may lead farmers to attribute pig illness and mortality to inappropriate causes, seek ineffective treatments or delay reporting suspected cases to veterinary personnel. This finding is consistent with those by Dione et al. (2020), who in their intervention study among smallholder pig farmers in Uganda argued that is essential to strengthen farmers' knowledge of ASF epidemiology and biosecurity. This implication of this result is that agricultural extension services should strengthen farmers' understanding of the viral cause of ASF. They should also explain why preventive biosecurity, rather than reliance on conventional antibacterial treatment, is central to disease control. This will support more appropriate responses to suspected outbreaks, reduce expenditure on ineffective interventions and encourage timely veterinary consultation, thereby protecting pig stocks and household income.

The observation that few smallholder farmers possessed knowledge of ASF control measures could be attributed to the lack of awareness of practical disease-prevention and management strategies among the smallholder pig farmers. This finding is essential in that effective

control of ASF depends on preventive management, early recognition and appropriate responses to suspected infection. This is consistent with findings by Ekakoro et al. (2023), who in their survey of pig farmers in ASF-affected districts of Uganda, showed that there were shortcomings in farm-level biosecurity. This reinforces concerns about the practical challenges of preventing disease transmission in smallholder production systems. Similarly, Dione et al. (2020) demonstrated in their study that participatory training of farmers improved their knowledge of ASF biosecurity measures, even when the gains in knowledge did not translate into sustained changes in practice. These findings therefore indicate that limited knowledge is a barrier to effective prevention of ASF, which calls for an urgent need for veterinary and agricultural extension programmes to deliver practical demonstrations, repeated training and farm-level follow-up on prevention of ASF. Such interventions should be accompanied by accessible veterinary services and attention to the financial and logistical barriers that prevent farmers from implementing recommended measures. Improving these capacities reduces avoidable herd losses, stabilise pig production and protect the income that smallholder households derive from pig sales.

The result that only 21.5% of respondents were knowledgeable about ASF transmission can be attributed to limited knowledge required to prevent the introduction and circulation of ASF virus within and between herds of smallholder pig farmers. Given that, ASFV may spread through direct contact with infected pigs and exposure to infected blood, tissues and secretions, as well as through contaminated equipment, vehicles, clothing, pork products and other materials, the movement of infected pigs and the inappropriate handling or disposal of infected carcasses could facilitate its transmission. In smallholder production systems therefore, where animal purchases, informal trading, shared equipment and contact between neighbouring herds may occur, failure to understand these pathways undermines preventive measures. This means that farmers who do not recognise the risks associated with introducing

pigs from unverified sources or sharing contaminated materials may inadvertently expose their herds to infection. This is in alignment with Ekakoro et al. (2023) who in their study identified that there were deficiencies in biosecurity practices among pig farmers in selected ASF-affected districts of Uganda. This re-enforces the importance of strengthening disease prevention at the farm-level. Dione et al. (2020) also demonstrated the value of incorporating ASF transmission and biosecurity into participatory farmer training. The shows that extension interventions should explain transmission pathways using locally relevant examples, which include among others the risks associated with animal movement, contaminated equipment, visitors and potentially infected pork products. As such, farmers should be encouraged to responsibly source parent pig stock, isolate newly introduced animals, minimise unnecessary contact between herds and implement effective hygiene procedures. This will reduce opportunities for the introduction of the disease and its onward transmission, hence protecting smallholder pig populations and reducing the economic consequences of ASF outbreaks.

The finding that most smallholder pig farmers had limited knowledge of ASF control and management practices can be attributed to the fact that knowledge deficiencies extend beyond individual aspects of ASF, to the broader understanding required to prevent infection, recognise suspected outbreaks and elicit appropriate responses. This result, together with observation that the low proportions of smallholder farmers knew the cause of ASF (2.3%), control measures (12.5%), transmission routes (21.5%) and clinical signs and symptoms (28.4%) is an indication that farmers may possess fragmented knowledge of the disease. Such limitations may prevent them from connecting the recognition of sick pigs with appropriate preventive action, including restricting animal movements, isolating suspected cases, avoiding potentially contaminated materials and reporting disease promptly. These findings are consistent with concerns raised by Ekakoro et al. (2023), who reported that there were weaknesses in biosecurity among pig farmers across most ASF-affected districts of Uganda.

These results are also in agreement to the intervention evidence presented by Dione et al. (2020), who in their randomised controlled trial involving 830 pig farmers in Uganda found that participatory biosecurity training improved knowledge after 12 months. This means that ASF control programmes should integrate disease education with practical biosecurity demonstrations, accessible veterinary support, community surveillance and clear reporting procedures. Interventions should also consider the affordability of biosecurity measures, the structure of informal pig markets and the practical challenges of implementing movement restrictions in smallholder systems. Without addressing these constraints, even well-informed farmers may be unable to apply recommended measures consistently. Strengthening both knowledge and the capacity to implement preventive practices could reduce herd mortality, minimise recurrent production losses and improve the resilience of smallholder pig enterprises.

The observation that most male smallholder farmers had limited knowledge of ASF control practices as compared to females, the majority of which had high knowledge of ASF control practices could be explained by the fact that women and men may have different responsibilities within smallholder pig production systems. This creates differences in their exposure to husbandry activities, animal health information and veterinary extension services. For example, individuals who regularly feed, clean and observe pigs may acquire practical knowledge through repeated contact with the animals, while those responsible for purchasing pigs, marketing livestock or making household investment decisions may encounter different sources of information. However, the distribution of these responsibilities varies between households and should not be assumed without supporting evidence from the study area. Crucially, the association between sex of the household head and knowledge of ASF control practices was not statistically significant. Therefore, the observed differences do not provide sufficient evidence to conclude that sex was associated with knowledge in the

study population. This observed descriptive pattern also differs from some findings reported by Dione et al. (2020), whose analysis identified male gender as a positive factor in knowledge gain and attitudes towards biosecurity following participatory training. However, Dione et al. (2020) in their study assessed changes following an intervention, whereas the present finding concerns the distribution of knowledge levels in a cross-sectional assessment. The means that extension programmes should provide inclusive opportunities for women and men to acquire and apply ASF prevention knowledge, taking account of their actual responsibilities in pig production. As such, training should not be allocated on the assumption that one sex is inherently more knowledgeable or more capable of implementing biosecurity.

5.2.1 The different African swine fever control practices used by smallholder pig farmers

The result that most smallholder pig farmers had limited use of ASF control and management practices could be attributed to the fact that farmers may be responding to ASF through a limited number of individual actions rather than implementing a coordinated set of complementary practices. This observation, when considered alongside the low reported use of disinfectants (approximately 1%), visitor restriction (3.6%), communal boar discontinuation (3%), carcass disposal (1.3%) and isolation of sick pigs (15.5%) becomes very essential in this area. This is due to the fact that even if 38.9% of respondents reported informing authorities about outbreaks, reporting alone cannot prevent transmission if it is not accompanied by appropriate animal movement controls, biosecurity and outbreak management.

This finding in the present study is consistent with that by Ekakoro et al. (2023), who found that 98 of 99 farmers surveyed in selected ASF-affected districts of Uganda had biosecurity scores below 70%. This indicated that there were widespread shortcomings in farm-level

disease prevention. Similarly, Dione et al. (2020) demonstrated that participatory training could improve knowledge of ASF biosecurity, but improvements in knowledge did not consistently translate into corresponding changes in practices. Therefore, they provide a baseline that limited adoption of control measures is not unique to the present study population and effective disease prevention requires attention to practical and structural barriers as well as knowledge. This implies that ASF management interventions should promote a coordinated package of affordable measures, including pig confinement, controlled animal movement, visitor management, cleaning and disinfection, isolation of suspected cases, safe carcass disposal and timely reporting. These interventions should be supported by practical demonstrations, accessible veterinary services and appropriate community-level surveillance. Such an approach could reduce the risk of ASF transmission, protect household pig assets and strengthen the sustainability of smallholder pig production.

The finding that knowledge of ASF control and management practices had a weak but statistically significant positive relationship with the use of those practices indicates that respondents with greater knowledge tended, on average, to report greater use of ASF control measures. The positive correlation is consistent with the expectation that understanding disease transmission, prevention and management may support the adoption of appropriate biosecurity behaviours. However, the weak correlation is an indication that knowledge alone only account for a limited proportion of the variation shared between the knowledge of the practices and their use. This result is consistent with Dione et al. (2020), who demonstrated that participatory biosecurity training significantly improved knowledge after 12 months, but produced more limited changes in actual practices at 12 and 28 months. Similarly, Ekakoro et al. (2023) reported that the widespread deficiencies in the use and application of biosecurity among pig farmers in ASF-affected districts of Uganda. This implies that ASF-control programmes should combine farmer education with interventions addressing the cost of

biosecurity materials, access to veterinary services, availability of suitable pig housing, enforcement of movement restrictions and the economic incentives influencing animal sales and disease reporting.

5.3 Cost incurred by smallholder pig farmers in control of ASF

This study revealed that smallholder pig farmers incurred a mean of (Ugx 105,525) for confining pigs during an outbreak, being spent on construction materials and labor for construction works. This indicates a higher cost compared to other cost of control practices (such as the use of a dis-infectant, informing authority and the use of communal boar) being implemented by the respondent. This finding suggests that confining pig is the control practices that the respondents are knowledgeable about despite the cost implication, therefore adoption of a control practice is associated with knowledge of the practice. The results concur with a study conducted by Aliro et al. (2022) who reported that majority of farmers prioritize buying construction material for pig sty to confine pig during ASF outbreaks to control the disease. Similarly, study from Ouma et al. (2018) also reported that costs associated with disease control, prevention, replacement of infected stock place a heavy burden on small-scale farmers.

Very low cost incurred on stopping the use of communal boar (Ugx 2,000), use of disinfectant (Ugx 32,500), and informing authority (Ugx 1,252), the amount being spent on buying chemicals to be used as foot bath at the entrance of the farm or pig sty, airtime for informing authorities such as local leaders and veterinary officers and control of access to the farm. This indicates that very few farmers were practicing this important control measures, suggesting limited knowledge, financial constraint and the production system since majority of the respondents were practicing tethering method. This relate to the study by Ekakoro et al. (2023) who found that implementation of control measures for ASF varies due to differences

in pig production systems, and access to veterinary services. Consequently, the cost implication also reduces the ability of the farmer to use disinfectants for control of ASF, a reason for the frequent outbreaks of the disease.

The use of un-recommended disposal methods such as dumping of infected carcasses or dead pig in an open field or bush, selling or giving out sick or dead pigs pose risks for ASF disease transmission. This finding suggest that the practices were not common and the respondent lacked knowledge about these control measures for ASF. The findings is in line with Atuhaire et al. (2013) who reported that many smallholder farmers in developing regions face challenges such as limited veterinary infrastructure, high costs of services, and inadequate government support.

This study findings also showed that the smallholder farmers spent Ugx 20,466 on nonconventional control practices like the use of ARVs, water guard, indigenous herbs and supportive treatment to cope-up and respond to ASF outbreaks. This indicates that they are available, cheaper and accessible by the farmers. The results also agree with a study conducted by Chenais et al. (2017) who highlighted the need for affordable biosecurity measures to enhance disease control in resource-limited settings.

The finding that smallholder pig farmers spent an average of UGX 39,140.00 on the different ASF control and management measures is an indication that even if there was limited use of these practices by smallholder pig farmers, the prevention and response to ASF involved financial commitments. The absence of a statistically significant difference in overall expenditure between farmers with limited and high knowledge indicates that no meaningful difference in the mean expenditure was detected from the two groups. This finding is important because knowledge alone may not determine how much a farmer spends on biosecurity. This is due to the fact that expenditure may depend on herd size, the number and

type of measures adopted, existing housing infrastructure, access to materials, labour availability, previous disease experience and household purchasing power.

Furthermore, higher expenditure does not necessarily indicate better ASF control. This is because a farmer who spends heavily on treatment after an outbreak may experience greater financial costs than one who invests in effective preventive measures. This is in agreement with Ouma et al. (2018) who found that biosecurity interventions in Ugandan smallholder pig value chains could not only reduce ASF outbreaks but also impose costs. These costs affected farmer profit margins when implemented in isolation. Through their modelling, they noted that combining biosecurity interventions with improved market integration could produce better outcomes for both disease control and economic performance. Similarly, Aliro et al. (2023) found that smallholder farmers experienced economic pressure from forgone pig-sale revenue, additional feeding costs and expenditure on biosecurity during ASF-related restrictions. This means that the economic evaluation of ASF control should assess not only how much farmers spend but also the effectiveness of the measures purchased and the losses avoided. Therefore, extension services, farmer organisations and local authorities should promote cost-effective biosecurity packages and explore financing arrangements that reduce the immediate financial burden on smallholder households. Such approaches could help farmers protect their herds without undermining the profitability and continuity of pig production.

The finding that 91.1% of smallholder pig farmers in this study area perceived that the costs of ASF management as low could be attributed to the fact that most smallholder pig farmers did not consider their expenditure on the assessed control measures to be high. However, this perception should be distinguished from an objective economic assessment of affordability. This is because, farmers may consider costs low because they spent little, adopted only a few measures, relied on unpaid household labour or, as observed in this study, did not implement

more expensive practices. On the other hand, the perceived low costs of managing and controlling ASF could have reflected the cost of the measures relative to the household's available resources or previous experience of losses. Therefore, a high proportion of smallholder farmer's reporting of low perceived costs does not necessarily mean that comprehensive ASF control is affordable or that the financial burden is negligible.

Thompson (2021) demonstrated that recommended biosecurity measures can conflict with smallholder farmers' livelihood priorities when confinement and restrictions affect the anticipated returns from pig keeping. Ouma et al. (2018) similarly showed that the costs of implementing biosecurity could reduce farmer profit margins when disease control was not accompanied by complementary value-chain interventions. Recent evidence by Aliro et al. (2023) highlighted the additional costs of feeding unsold pigs, implementing biosecurity and foregoing revenue during ASF-related quarantine. This shows that farmers' perceptions of immediate expenditure may not capture the wider economic burden of ASF prevention and control, including lost income, additional labour, feed costs and foregone market opportunities. As such, future assessments should combine farmers' perceived costs with measured expenditure, opportunity costs, foregone revenue and the economic value of pigs lost or retained during outbreaks. This would provide a more comprehensive understanding of affordability and help policymakers design interventions that are both epidemiologically effective and economically feasible for smallholder pig farmers.

While many farmers do not incur significant costs for ASF control measures, a considerable number of farmers still face expenses in the control of the disease, with only a small percentage of farmers spending larger amounts, particularly in confining pigs, isolating sick pigs, stopping the use of communal boar and informing authority. This suggests that, while ASF control practices are largely not cost-effective for many, a few farmers still incurred cost despite limited knowledge and financial challenges. This corresponds with study conducted

by Okello et al. (2020) who reported that farmers often lack the resources to implement effective disease management strategies, leading to recurring losses that affect their livelihoods and economic stability, indicating a lower investment in the disease control practices. This result corresponds with the study conducted by Dione et al. (2014) who reported that pig production system in Uganda, characterized by low inputs and poor management practices, is majorly constrained by ASF. Therefore, such production systems avoid veterinary expenses, vaccination programs, and biosecurity investments that can be costly for resource-limited farmers in rural areas (Ouma et al., 2018).

5.4 The perceived impact of African swine fever among smallholder pig farmers

This current study revealed that ASF outbreak caused a significant economic loss on the smallholder pig farmers, with majority reported loss of income and loss of pigs, failure to meet home basic needs as the major losses due to outbreaks, a reason for the poor economic status experienced by every smallholder pig farmer in the surveyed population. Therefore, the observation most smallholder pig farmers perceived ASF to have had a high impact on their livelihoods could be linked to the fact that farmers assessed the impact of ASF not only in terms of animal mortality but also in terms of its consequences on household economic security and the continuity of pig production. This is because a disease outbreak can have cumulative effects due to the fact that the loss of animals reduces immediate productive capacity, while diminished income limits farmers' ability to invest in improved housing, feeding, veterinary services and preventive measures. This is supported by Aliro et al. (2023), who reported that farmers were the most economically affected stakeholders during ASF quarantine in the Ugandan pig value chain. This implies that ASF should be treated as a recurrent livelihood risk for smallholder pig farmers rather than solely as a veterinary problem. As such, the district veterinary services, agricultural extension personnel and

relevant development partners should prioritise locally feasible prevention measures, rapid outbreak notification, clear risk communication and support for affected households.

This portrayed a wide spread of ASF, disrupting their farming activities, reducing farmers' ability to sustain their livelihoods as some had started shifting to other income generating activities and abandoning pig rearing. These findings align with Cooper et al. (2022) who indicated that ASF outbreaks result in severe financial constraint to smallholder farmers due to high mortality rates. In addition to that Chenais et al. (2017) reported that the impacts of ASF on communities are evidenced by existing livelihood vulnerabilities as outbreaks lead to an increased pig mortality and reduces pig herds. This study further concurred with Cooper et al. (2022) who indicated that farmers experienced psychological and mental stress as their affected animal are short dead, causing shift from pig to other livelihood activities, difficulty in paying debt as the impact of ASF. Similarly, ASF and other infectious outbreaks contribute to high morbidity and mortality, leading to severe economic consequences (Kappes et al., 2023). Therefore, pig farmers sell off their sick pigs to reduce the losses, however this contributes to maintaining the disease circulation in domestic pig population (Costard et al., 2015). Some of the farmers in this study have abandoned pig farming due to the endemic nature of African swine fever, this also correspond with the study by (Arvidsson et al., 2023) who reported that because of the health issues of pigs, farmers have abandoned pig production.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

Smallholder farmers were less knowledgeable of ASF and its control and management practices. Only 2.3%, 12.5%, 21.5% and 28.4% of farmers knew the cause of ASF, its control of ASF, how it is transmitted, and how to identify its clinical signs respectively. As such, 88.8% of farmers had limited knowledge of AFS and its control/management practices. There was no statistically significant association between sex, marital status, age and education level with the respondents' knowledge of ASF control and management practices. As a result, there was limited implementation of several reported ASF control and management practices among smallholder farmers, with only 32.0%, 38.9%, 15.5%, 3.6%, 3.0%, 1.3%, 1.0% of smallholder farmers practicing either pig confinement, informing authorities, isolated sick pigs, restricted visitors, stopped using communal boars, disposed off carcasses and used disinfectants respectively. Other reported practices included use of supportive treatments (13.5%), natural concoctions (10.2%), selling sick pigs (7.9%) and the use of products described as ARVs (3.9%). Overall, there was limited use of ASF control and management practices among most smallholder farmers (90.8%). Knowledge was positively associated with practice use ($r=0.225$, $p<0.001$).

Most (91.1%) of smallholder farmers perceived the costs of ASF control and management as low, with the average expenditure across incurred being UGX 39,140. However, farmers with limited knowledge incurred significantly higher expenditure (Ugx.40, 053) in supportive-treatment than those with higher knowledge (Ugx. 32806).

The findings showed that almost all farmers (99.7%) reported significant pig losses or mortality and income loss due to ASF outbreaks. In addition, 97.7% and 95.7% had

difficulties meeting basic household needs and had high costs of replacing pig stocks. Overall, 96.7% perceived ASF to have had a high impact on their livelihoods. There was no statistically significant association between knowledge of ASF control and management practices and perceived impact (χ^2 = 0.015, p=0.901). Likewise, no statistically significant association was found between the extent of using ASF control and management practices and perceived impact ((χ^2 =1.053, p=0.305).

6.2 Conclusions

Most farmers lack knowledge on control and prevention measures of ASF, contributing to the widespread and persistence of the disease, making pigs more vulnerable to infection. The knowledge gaps underscore the need for comprehensive farmer education and awareness programs.

While some cost was incurred in confining pigs, isolating sick pig and informing authority, most farmers do not invest adequately in control practices such as the use of disinfectants, proper disposal of dead pigs Most farmers lack knowledge on control and prevention measures of ASF, contributing to the widespread and persistence of the disease, making pigs more vulnerable to infection and restricting visitors from entering the farm. This lack or low investment in disease control and prevention measures increases the risk to ASF outbreaks, further increasing economic losses.

African swine fever disease has a severe financial impact on smallholder pig farmers, reducing their economic viability and often forcing some to abandon pig farming. Often many farmers keep pigs despite frequent outbreaks and associated death of all pigs. The impact of ASF reported by farmers such as loss of pigs, failure to meet some home basic needs coupled with production challenges, significantly limits the ability of farmers to recover. Without intervention, ASF will continue to threaten smallholder pig farming.

6.3 Recommendations

6.3.1 Recommendations for policy and practice

The District Veterinary Officer, through the district production department and agricultural extension workers should establish regular, community-based ASF awareness and farmer-training programmes to explain the viral cause of ASF, routes of transmission, clinical signs, reporting procedures and scientifically recommended prevention measures. This is to correct misconceptions, improve early recognition and reporting, and equip farmers with the knowledge required to make informed disease-prevention decisions.

The District Veterinary Services, agricultural extension officers, farmer organisations and other should develop and promote locally feasible farm-biosecurity packages that prioritise separation of pigs from potentially infected animals, controlled introduction of replacement stock, restriction of unnecessary visitors and pig movements, cleaning and appropriate disinfection, prompt reporting of suspected outbreaks, and safe handling and disposal of carcasses under veterinary guidance. This is to translate knowledge into consistent implementation of measures that reduce the risk of ASF introduction and spread.

District local government officials such as veterinary officers, in partnership with relevant livestock-development partners should assess the costs of recommended ASF prevention measures and identify low-cost options appropriate for smallholder production systems. This is to facilitate the provision of practical guidance on the costs and benefits of prevention, strengthen access to veterinary advice and investigate targeted support for resource-constrained farmers. This not only reduces the financial and practical barriers to implementation of effective biosecurity measures but also to help farmers make better-informed decisions about prevention investments.

District veterinary and production departments, working with other stakeholders, should establish coordinated outbreak-response and recovery mechanisms that combine rapid veterinary assessment and reporting, risk communication, practical biosecurity support and post-outbreak livelihood assessment to reduce further transmission, support safer restoration of pig production and minimise the risk that livestock losses pose to household food security and the ability to meet basic needs.

6.3.2 Recommendations for future studies

Future studies should use mixed-methods designs to investigate the sources of farmers' ASF knowledge, the accuracy of seasonal beliefs, and the effectiveness of different farmer-training approaches in improving knowledge retention to establish whether particular communication approaches produce lasting improvements in farmers' understanding of ASF transmission and prevention.

Future studies should combine farmers' perceived costs with measured expenditure, opportunity costs, foregone revenue and the economic value of pigs lost or retained during outbreaks. This would provide a more comprehensive understanding of affordability and help policymakers design interventions that are both epidemiologically effective and economically feasible for smallholder pig farmers.

Future studies should investigate the factors influencing the adoption and consistent implementation of individual ASF control measures. This can be by examining the influence of financial capacity, farm infrastructure, access to veterinary services, social networks, farmer perceptions and local institutional support, while distinguishing between self-reported use of ASF control practices. This will help in identifying barriers that constrain adoption of ASF control and management practices, and hence determine which practical interventions lead to sustained improvements in biosecurity and reductions in ASF outbreaks.

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APPENDICES

Appendix I: Questionnaire

Dear respondent,

My name is Akwero Lucy Aol a student pursuing Master of Science in Animal production and marketing of Gulu University under taking a study on **African Swine Fever in Smallholder Pig Farms: Control, Cost and Impact of Outbreaks in Agago District**. This questionnaire therefore seeks relevant information on the above. Please note that this is strictly for academic purposes and your responses shall be treated with maximum confidentiality.

1. Identification

Telephone number	
Sub-county.	
Parish.	
Village.	
Date of survey.	
The number of the respondent	

Social demographic information

1.1. Respondent gender (.....) (Male=1, female =2)

1.2. Age of the respondents

Age categories	tick where applicable
a) -Below 20 years	
b) 21-30 years	
c) 31-40 years	
d) 41-50 years	
e) Above 50 years	

1.3 Educational level of the respondents. Tick where applicable

a)-Never attended	b)-primary	c)-Secondary	d)-Tertiary	e)-University

1.4 Respondent's marital status. Tick where applicable

Single	**Married**	**Widow/widower**	**Others**
A	B	C	Specify…….

2. General information on pig's herd structure and management

3.1.Are you keeping pig? ☐ (Yes=2, No=1)

3.2.When did you start keeping pigs? _____

3.3.What type/breeds of pigs do you keep?

1=Local ☐ 2=Cross ☐ 3=Exotic ☐

3.4.Indicate the different pig age categories you are currently keeping

Category	**Number**
Piglets	
Growers	
Breeders	

3.5.What production system (s) are you practicing? (Also, observe and record)

System	**Tick where applicable**
1.Free range	
2.Tethered	
3.Confined	

3.6.What is the main source of feeds to your pigs? Tick all that apply

1……

2……..……

3……

4…….

5…….

3.7. Did you incur cost in the pig production? (Yes=1 No=2)

If yes which cost and how much

Cost.	Amount.
1. Feeding.	
2. Breeding.	
3. Health.	
4. Labor.	
5. Marketing.	
6. Housing.	

3. **Health of pigs**

4.1.Did your pigs ever suffered from African swine fever? 1YES… 4.2.What do you know about Africa swine fever?

General knowledge	**1YES 2NO**
Cause	
Spread/transmission	
Control	
Prevention	
Signs and symptoms	
Others	

4.3.In which month and periods of the year, did your pigs suffer from ASF?

1= Rain season ☐ 2=Dry season ☐

Specify the month……

4.4.Did any pig die on this farm since 2020? ☐ (1= Yes, No=2)

If yes tick the cause of death and enter number of deaths

Category of pigs	**Number of pigs that died**	**Cause of death**	**tick cause of death**	**If due to sickness which disease**
Piglets		1. Diseases		
Growers		2. Poison		
Sow		3.Injury		
Boars				

4.5.At what age do death of pigs commonly occur?

1=before weaning ☐ 2=after weaning ☐ 3=Adults ☐ 4= all ages)

4.6.What do you practice on your farm in an attempt to control African swine fever and at what cost dose the control and management practices are? Tick where applicable

Practices	**Tick where applicable**	**Enter cost**	**Practices**	**Tick where applicable**	Enter cost
1. Confining pigs in house/fence			5. Informing authority		
2 boiling of swill feed			6. Isolation of sick pigs		
3. Use of disinfectant/foot bath			7. Disposing of dead pig by burning or		
4. Restricting visitors					

entering the farm			8. Others specify 1…… 2……. 3……. 4…….		
5. Stop the use of communal boar					

4.7. When pigs are ill on your farm, who usually treats them?

Persons	**Tick**	**Persons**	**Tick**
1. Farmer		4. AHO	
2. Veterinary assistant		5. Agriculture Officer	
3. Veterinary Officer		6. Others (specify)	

4.8. How far away from your farm is the nearest Veterinarian?

Distance (KMs)		**Tick**	**Distance (KMs)**		**Tick**
1	<5	2	11-15		
3	6-10	4	>15		

4.9. What are the general effect of the incident/economic losses of African swine fever on your farm?t

1…….

2 …….

3…….

4…….

5…….

6……

7……

Thank you very much for your co-operation. I would be very glad to answer any question that you may have.

Appendix II: Informed Consent Letter

Investigator(s): Akwero Lucy Aol
Institution(s): Gulu University

Sponsor: The study is self-sponsored.

Salutation

Good morning /afternoon? (The interviewer mentions the name)

Introduction

I am a student of Gulu University in the faculty of Agriculture and Environment, i am conducting a study on the topic: **AFRICAN SWINE FEVER IN SMALLHOLDER PIG FARMS: CONTROL, COST AND IMPACT OF OUTBREAKS IN AGAGO DISTRICT.**

This study has been approved by Gulu University Research Ethics Committee (GUREC).

Please feel free to ask any question for clarity or anything you would like to understand about the study at any given time. After the study has been explained, any questions you may have will have been answered, and as you have decided to participate in the study. You will be asked to sign a consent, which you will be given a copy to keep.

1.1.1. Purpose of the study

findings of this study is believed to help the Government and other stakeholders such and other Non-Governmental Organizations (NGOs) supporting livestock projects at the district to develop app programs that shall help in building capacity of pig farmers on ASF. The findings from this study assist in lobbing for more resources that can be appropriately used with an aim of controlling ASF outbreaks in the district. It may also guide the allocation and prioritization of available resources in the district production and veterinary department.

1.1.2. Procedures

You will provide responses to the questionnaire if you are among the 303 identified smallholders pig farmers who have had the incident of Africa swine fever in Agago district.

1.1.3. Risk

There will be no any risk or harm that may arise on your participation in this study.

1.1.4. Benefit

There will be no immediate benefit however, feedback and result of the study will be shared with you. The information you will give will be useful to improve production and income of pig farmers

1.1.5. Confidentiality

Nobody will reveal your identity to any one as codes will be used to identify participant, the information gathered will only be accessed by the research team. Confidential information will only be accessed by the principal investigator.

1.1.6. Alternatives

It's your choice whether to participate or not in this study.

1.1.7 Cost

There will not be any cost incurred as a result of your participation in this study. There will be an additional cost incurred, that is your time that you will spend to give your responses if you accept to participate in the study.

1.1.8. Compensation to the research participant.

There will not be any direct competition to the participant in term of cash due to the limited resources available because of the self-sponsored nature of the study but the participant will be provided with refreshment (soda and biscuit) when giving their responses.

1.1.9. Time to be taken.

On average you will take 45 minutes when giving your responses.

1.1.10. Questions

If there is any question related to the study or your right as a participant, you can contact the principle investigator Akwero Lucy Aol on 0785423472 or via email on lucyakweroaol@gmail.com

1.1.11. Statement of voluntariness

Your participation in this research is voluntary and you may join at will or have a right to withdraw from the study anytime without penalty.

In case of any issue pertaining your rights and participation in this study, you can contact the chairperson Gulu University Research and Ethical committee Dr Gerald Obai on telepnone number 0772305621 Email: lekobai@yahoo.com/lekobai@gmail.com or the Uganda National Council for Science and Technology on plot 6 Kimera road Ntinda, Kampala on telepnone number 0414705500

1.1.12 Statement of consent

……have described to me what is going to be done, the risk involved, the benefits and right to participate in this study. I understand that the decision to participate in this study will not affect me in any way. In the use of this information, my identity will be concealed i am also aware that i may decide to withdraw from the study at any time. i understand that by signing this form i do not wave any of my legal rights but merely indicate that i am voluntarily agreeing to participate in the study and a copy of this form will be provided to me.

Name of the participant……. Sign/thumb print……Date…….

Name of witness……. Signature……Date…….

Name of the interviewer……. Signature……. Date……

Appendix III: GUREC Approval

GULU UNIVERSITY

P.O. Box 166, Gulu (U)
Website: www.gu.ac.ug
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RESEARCH ETHICS COMMITTEE

12/07/2024

To: lucy Akwero

Gulu university
+256785423472

Type: Initial Review

Re: GUREC-2023-500: Evaluation of the economic losses associated with African swine fever on smallholder pig farmers in Agago district, Uganda

I am pleased to inform you that at the **96th** convened meeting on **15/02/2023**, the Gulu University REC meeting voted to approve the above referenced application.
Approval of the research is for the period of **12/07/2024** to **12/07/2025.**

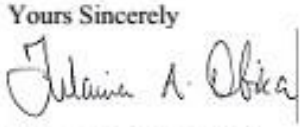
As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes.
3. Reports of unanticipated problems involving risks to participants or any new information which could change the risk benefit: ratio must be submitted to the REC.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by participants and/or witnesses should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Continuing review application must be submitted to the REC **eight weeks** prior to the expiration date of **12/07/2025** in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study.
6. The REC application number assigned to the research should be cited in any correspondence with the REC of record.
7. You are required to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of all documents approved in this application by Gulu University REC:

No.	Document Title	Language	Version Number	Version Date
1	Informed Consent forms	Acholi	3	2024-06-30
2	Data collection tools	English	3	2024-06-30
3	Covid19 Risk management plan	English	3	2024-06-30
4	Protocol	English	3	2024-06-30
5	Informed Consent forms	English	2.0	--

Yours Sincerely



Julaina A. Obika (PhD)
For: Gulu University REC

Appendix IV: Plagiarism Certificate

GULU UNIVERSITY

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PLAGIARISM CHECK

Declaration for Originality Form

This form must be completed and signed for all scholarly work produced.

Name: _ _____ AKWERO LUCY AOL (MS)_____

Personal File No.(staff) Reg. (**student**).___ REG.No. 20/U/1995/MSA/PS_

Faculty/Institute:___ AGRICULTURE AND ENVIRONMENT, GULU UNIVERSITY

Department:____ ANIMAL PRODUCTION AND RANGE MANAGEMENT ___

Title and bibliographic description of the work

KNOWLEDGE AND ECONOMIC LOSSES ASSOCIATED WITH AFRICAN SWINE FEVER AMONG SMALL HOLDER PIG FARMERS

Declaration.

1. I understand what plagiarism is and I am aware of the University policy on this regard,
2. I declare that this … **Thesis** … (Proposal, Dissertation, essay, assignment, paper, report etc.) is my original work and has not been submitted elsewhere for examination, award of a degree or publication. Where other people's work or my work has been used, this has been properly acknowledged and referenced in accordance with Gulu University requirements,
3. I have not sought or used the services of any professional agency to produce this work,
4. I have not allowed, and shall not allow anyone to copy my work with the intention of passing it off as his/her own,
5. I understand that any false claim of this work shall result in disciplinary action in accordance with University Policy on Plagiarism.

Signature _____ Date 01 · OCT · 2025 ·

Originality Report

The article/thesis/document titled above have been subjected to plagiarism check and the level was found to be……**12%** (percent) this is classified as:

- ✓ Minor
- ☐ Moderate
- ☐ Serious

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Yours sincerely,

Clement Ataaya Nabutto Claire (PhD)
University Librarian