

**COMPLIANCE OF GLOBAL GAP STANDARDS AMONG SMALLHOLDER HOT
PEPPER FARMERS IN LIRA DISTRICT OF NORTHERN UGANDA**

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DECLARATION

I, GERARD NDAYISHIMIYE, certify that this study is original and has not been submitted for any other degree award to any University before.

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DEDICATION

I dedicate this work to my two siblings Vuguziga Ornella and Niyitegaka Sylvia for the sacrifice and always being there for me in hard and good times. I also dedicate this work to my long-time mentor who turned to be my uncle Alireki David for his constant encouragement and guidance through prayers and words of wisdom that have pushed me to higher limits. I would not end this without dedicating this work to Cornerstone Leadership Academy- Rwanda especially Karamuzi Johnson and to the Mastercard Foundation for believing in my dreams and aspirations and sponsoring me for high school and post-secondary studies respectively.

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LIST OF ACRONYMS AND ABBREVIATIONS

AGRA	Alliance for a Green Revolution in Africa
CABI	The Center for Agriculture and Bioscience International
CCAFS	Climate Change, Agriculture and Food Security
EPRC	Economic Policy Research Center
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FCM	False Codling Month
GAP	Good Agricultural Practice
GDP	Growth Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GUREC	Gulu University Research Ethics Committee
HACCPs	Hazard Analysis of Critical Control Points
IFA	Integrated Farm Assurance
ILO	International Labor Organization
IPM	Integrated Pest Management
ISO	International Organization for Standardization
ITA	International Trade Administration

MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MoFPED	Ministry of Finance Planning and Economic Development
MTTI	Ministry of Trade, Tourism, and Industry
NAEZ	Northern Agro ecological zone
NECPA	North - East Chilli Producers Association
RASFF	Rapid Alert System for Food and Feed
UBOS	Uganda Bureau of Statistics
UIA	Uganda Investment Authority
UNBS	Uganda National Bureau of Standards

ABSTRACT

Compliance with food safety standards like Global GAP plays a vital role in farmer's certification, ensuring that their produce is accepted at the export market which contributes to rural development through increased income. However, Global GAP requires adherence to the set standards, but several smallholder farmers struggle to consistently meet the requirements thus, failing to access lucrative export markets. Understanding why some smallholder farmers fail to comply with such standards is important for export promotion. This study investigated Global GAP awareness, level of compliance and the key factors associated with Global GAP adherence among hot pepper smallholder farmers in Lira district of northern Uganda. Primary data were collected from a random sample of 345 hot pepper farmers using pretested structured questionnaires. Data analysis used descriptive statistics and Tobit regression models. The results on level of awareness of Global GAP standards was very low (8.02%) and significantly influenced by years of formal education, access to market information and extension services. The level of Global GAP compliance was 69.29%. This showed that farmers were doing some of good agricultural practices (GAPs) without knowing Global GAP. Among the factors associated with the level of compliance were awareness, family members in chili farming, market information, credit for farming and extension services all with p-values less than 1%. This study concluded that there was very low level of awareness and compliance to Global GAP standards. It recommends that promoters of agricultural export should emphasize the creation of awareness through accessible common channels like radios and extension agents. Further, there is a need to ease access to agricultural credit to enable smallholder farmers make the necessary investment in the inspection and certification processes.

Keywords: *GlobalGAP; Food safety; Export market; Smallholder farmers; Northern Uganda; Horticulture; Hot pepper; Tobit regression*

CHAPTER ONE: INTRODUCTION

1.1 Background

The agrifood system is witnessing stringent changes due to tightening interventions of food safety standards in international export markets of agricultural products. These standards tackle issues on sustainable production, by combining food safety, environmental and social aspects giving emphasis on product traceability (Lemeilleur, 2013). Most importing countries and domestic buyers request agricultural producers to implement good agricultural practices (GAPs) to ascertain the quality and safety of their agricultural products. Furthermore, there is now more emphasis on implementation of such food safety standards (FAO, 2016). The widely known food safety standard and the most common in developing countries that is voluntary but mandatory in nature to access high value markets is Global Good Agricultural Practices (Global GAP). The Global GAP is private standard benchmarked on getting certification from a third party. Farmers are audited by certification bodies accredited by the Global GAP secretariat. Global GAP is managed by retailers and producers, and it traces food at the farm level until to the final consumer to ensure healthy and safety. It uses control points for specified crop, control points are categorized into major must where a producer must comply with them at 100% and minor must with a compliance of 95% and then the recommended which are captured but not graded (Global GAP, 2022).

Food standards affect both the final product quality and entire food supply chain (Hammoudi et al., 2009). The changes in agrifood safety and standards create not only opportunities but also challenges to smallholder farmers who target international markets in developing countries. This has impact on the agricultural sector in the implementing country. Much attention is given to new standard adoption in developing countries. There is ongoing discussion that the standards may act

as a barrier to international market for low-income farmers (Fuchs et al, 2011; Lemeilleur 2013). The strict conditions exclude smallholders and include large farmers who have resources to comply with the standards. Compliance is used in business and organization settings as the act of conforming with laws, regulations, and other official requirements (Rorir & Rooij, 2022). Therefore, compliance with food safety standards like Global GAP standards is to meet requirements for a produce to be called safe for human consumption. In this work, the focus is on compliance of Global GAP standards among smallholder hot pepper farmers in Lira district of northern Uganda.

The agricultural sector in Uganda has shown a vital role in the entire economy of the country. Uganda Bureau of Statistics (UBOS) indicated that in fiscal year 2020/2021, agriculture contributed 23.7% of Gross Domestic Product (GDP), and 31% from exportation. Furthermore, in this same fiscal year, UBOS showed that the agricultural sector employs about 70% (UBOS, 2021).

The International Trade Administration (ITA) has determined that investors perceive Uganda's agricultural capabilities as among the most promising in Africa. This is attributed to factors such as minimal temperature fluctuations, fertile soils, and two distinct rainy seasons across the majority of the nation, enabling multiple crop yields annually. According to the ITA's findings in 2021, Uganda's fertile agricultural land holds the capacity to sustainably provide food for a population of up to 200 million people (ITA, 2021).

Within Uganda, the Ministry of Finance Planning and Economic Development (MoFPED) and the Economic Policy Research Center (EPRC) approximated that the majority of the farming community, comprising 85 percent, is constituted by farmers with an average farm size of 2.5

hectares or less. This underscores the prevalence of smallholder farmers among those involved in agriculture (MoFPED & EPRC, 2019).

Given the relevance of the sector to Uganda's economy, agricultural trade becomes very critical in raising foreign exchange earnings for the country. Whereas Uganda's traditional export crops have been coffee, bananas, and oil seed crops in accordance with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ, 2021), there has deliberate efforts to expand export commodities which now include fruits and vegetables.

The Ugandan government has identified the vegetable sub-sector as priority in its 2040 vision implementation plan because vegetables have short life cycles and thus, contributing significantly to reducing poverty in smallholder farming households by consistently generating income and enhancing nutrition and food security (Surni et al., 2020; Dijkxhoorn *et al.*, 2019).

In 2017, vegetable cultivation was widespread across all districts of Uganda, covering a total area of 250,000 hectares. The combined export volumes of fruits and vegetables reached 400,000 tons, valued at United States dollar (USD) 118 million in 2017 (Dijkxhoorn *et al.*, 2019). The majority of these exports consisted of vegetables, particularly *capsicums* which encompass hot peppers such as Scotch Bonnet, habanero, and chilies. Consequently, the horticultural sector has become integral to the Ugandan economy, playing a crucial role in non-traditional exportation. Primary destinations for horticultural exports include the United Kingdom and Belgium in Europe. (Dijkxhoorn *et al.*, 2019).

Hot pepper is a crop of high value to low-income farmers in developing countries and it is of high importance in Uganda which is mainly produced for international markets (Karungi *et al.*, 2011;

Lin *et al*, 2013). This crop portrays the capacity to mitigate poverty among smallholder farmers and it is among non-traditional crops that are getting attention in Uganda for international markets (Buyinza & Mugagga, 2010).

However, commercialization of hot pepper from Uganda to international markets is limited by pests and their poor management. Fruit flies and the False Codling Moth (FCM) are quarantine pests with tight restriction put by importing countries (Barnes *et al.*, 2015; Roberts *et al.*, 2015). According to UBOS (2017), FCM caused 67% yield loss in 2014 and Muzira (2015) found that fruit flies can cause yield losses of up to 37%. The Uganda investment Authority (UIA) indicated that as the farmers do their best to control these pests, they are increasing the risks of rejection of their products at international markets by going beyond the maximum acceptable pesticide residual levels (UIA, 2009). Furthermore, Dijkxhoorn *et al.*, (2019) indicated that farmers have not yet widely embraced good agricultural practices. The horticultural earnings in Uganda have been declining from an average of USD130 million a year between 2012 and 2014 to between USD 80 and USD100 million between 2016 and 2018 (Wakabi, 2019). Among other factors, stringent conditions to meet lucrative markets like meeting sanitary and phytosanitary standards have been the leading cause of reduction due to abandonment of horticultural subsector towards other forms of investment.

Dijkxhoorn *et al.*, (2019); Wakabi, (2019) indicated that in April 2019, the European Union (EU) gave Uganda a six-months reprieve to put in place sanitary and phytosanitary measures across horticultural value chains or otherwise taking the risk of losing the market share in the European Union. This was due to the false codling moth which was found in hot pepper originating from

Uganda. Later in November 2019, Agricultural portfolio issued statutory instrument limiting exporters of hot pepper to the EU markets.

Onen (2019), indicated that Uganda's food safety system is characterized by fragmentation, evident in the presence of diverse and separated food safety regulations and laws. There is no singular organization in Uganda dedicated to addressing food safety issues independently; instead, various institutions and organizations collaborate to ensure the safety of food. Key players in ensuring food safety include the Parliament of Uganda, the Ministry of Trade, Tourism and Industry, the Ministry of Health, and the Ministry of Agriculture, Animal Industry, and Fisheries (Kankya et al., 2020). The Uganda National Bureau of Standards (UNBS), operating under the Ministry of Trade, Tourism, and Industry (MTTI), plays a pivotal role in establishing and enforcing standards for all food commodities, whether domestic or imported (Kankya et al., 2020). Global GAP, (2022) and Hazem et al., (2020) indicated that Global GAP stands out as a widely used food safety standard thus, its compliance has become a crucial prerequisite for farmers seeking access to high-value global markets. Consequently, any agricultural product destined for European Union markets must adhere to the standards established by Global GAP.

1.2 Statement of the problem

Uganda earns tangible share in export of fresh fruits, and vegetables worth United states dollar (USD) 35 million a year (CABI, 2022). According to Swiss contact (2022), fresh fruits and vegetables are the 5th largest foreign exchange earners for Uganda, with the EU being Uganda's largest buyer. However, Uganda is facing a decrease in revenue from the export of some of horticultural products, attributed to failure to meet food safety standards. The main attribute is the presence of pests and unacceptable levels of pesticide residues found in the commodities at the

destination markets (MAAIF, 2019). Various measures have been implemented to enhance food safety, including a strategic action plan aimed at preventing and controlling aflatoxins in the food supply chain. Additionally, food safety laws and regulations governing the marketing of infant and young child foods provide a legal framework to protect children from harmful artificial breast milk substitutes. The Uganda National Bureau of Standards (UNBS) has also set up food testing laboratories to verify claims related to food products (Atwine, Madina & Nakitende, 2023), however, despite these initiatives, there is knowledge gap as to why smallholder farmers in horticulture sector are failing to meet the food safety standards to optimize export market.

The loss of European Union (EU) consumer confidence in Uganda's export could spell a significant loss of national revenue, financial losses for local SMEs (exporters) and affecting livelihoods for smallholder farmers. This large market is controlled by food safety standard called Global GAP. Thus, compliance with Global GAP standard plays a role in smallholder farmers certification, ensuring that their produce is accepted in the country of destination. However, literature on Global GAP awareness, level of compliance and factors associated with level of awareness and compliance in the case of hot pepper smallholder farmers in northern Uganda is barely available.

Therefore, this study investigated the level of Global GAP awareness, level of Global GAP compliance and institutional and support factors, market factors and socio-economic factors associated with Global GAP awareness and compliance by smallholder hot pepper (*Capsicum*) farmers in Lira district of northern Uganda to recommend the policy makers, export promoters, government and non-government institution the area of intervention to help horticultural farmers to meet export market requirements.

1.3 Objective of the Study

1.3.1 General objective

The general objective was to assess the Global GAP awareness, the level of compliance of Global GAP and factors associated with level of awareness and compliance by smallholder hot pepper farmers in Lira district of northern Uganda.

1.3.2 Specific objectives

The specific objectives were:

1. To determine the level of awareness of Global GAP standards among smallholder hot pepper farmers
2. To estimate Global GAP standards level of compliance among smallholder hot pepper farmers
3. To determine the key factors that influence level of Global GAP compliance among smallholder hot pepper farmers.

1.4 Research questions

1. What is the level of awareness of Global GAP standards for smallholder hot pepper farmers?
2. What is the level of compliance to Global GAP standards by smallholder hot pepper farmers?
3. What are the factors associated with level of awareness and compliance of Global GAP standards in smallholder hot pepper farmers?

1.5 Significance of the study

The outcome of this research inform policy making entities and export promoters, the level of compliance with food safety standards and the factors associated. This would help them to design programs and policy intervention that facilitate smallholder horticultural farmers to meet with food safety standards stipulated by both local, regional and international markets, thus gaining and increasing international market share that earns them reasonable income leading to improved standards of living through increased volume of exports. Furthermore, as the farmers aim at producing quality products with food safety in consideration, the consumers benefit from safe food and hence good health. Moreso, understanding the level of awareness, level of compliance of food safety standards and factors associated with them gives a clear picture to the government, extension workers and export promoters to design agricultural programs that prioritize the key areas and urgent need that highly benefit farmers in export market.

1.6 Conceptual framework

Farmers are more inclined to adhere to Global GAP standards and become more aware of such standards when they benefit from institutional support, such as training and certification. Conversely, a lack of such support may lead to low awareness and non-compliance. Additionally, factors related to socio-economic conditions and the market, such as education level, income, access to market information, and buyer support, can also influence the level of awareness and compliance with Global GAP standards as shown in Figure 1.

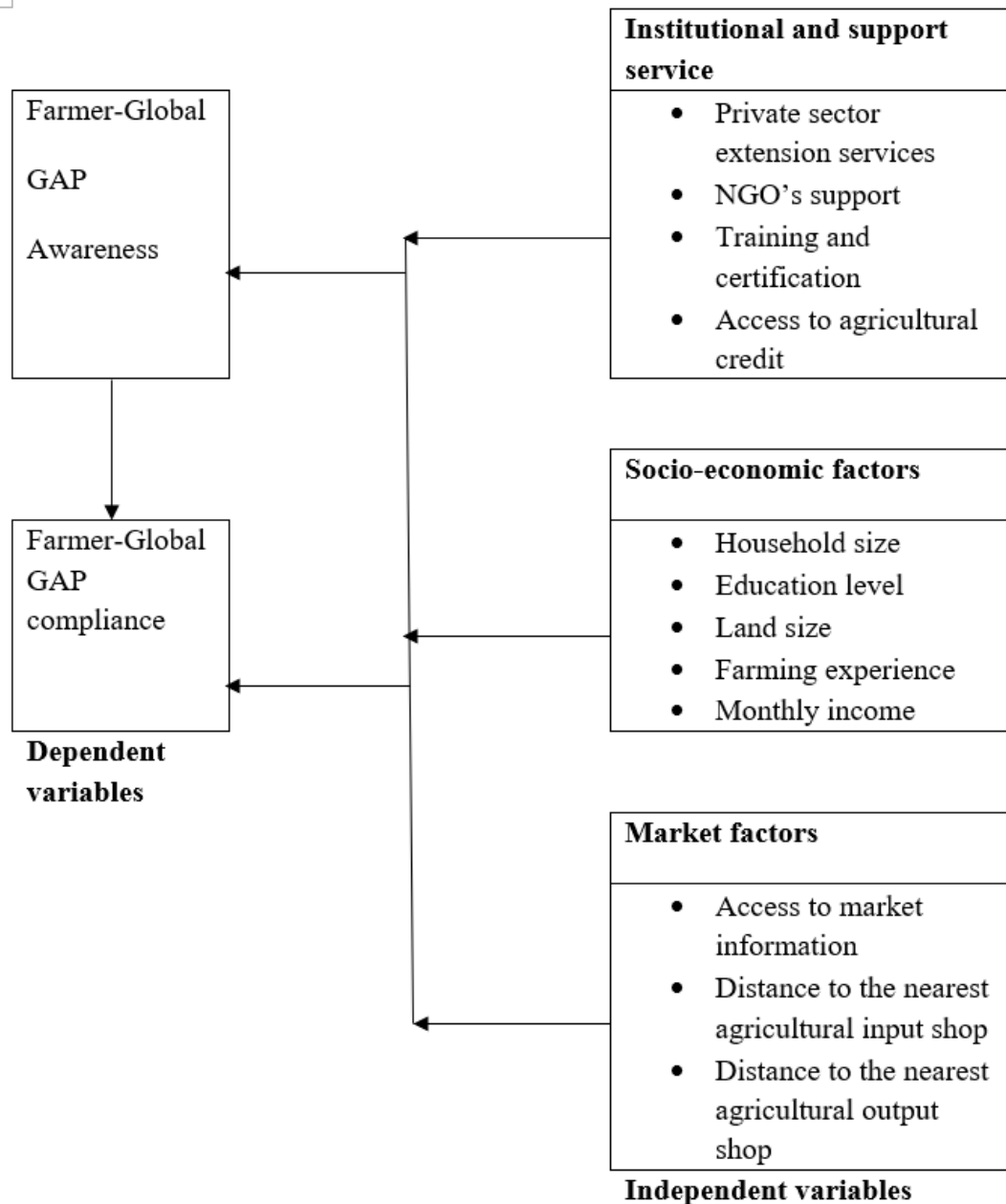


Figure 1: Conceptual framework relating farmer's level of awareness and Global GAP compliance to institutional, socioeconomic and market factors (Adopted from Muriithi, Mburu, & Ngigi, 2011)

CHAPTER TWO: LITERATURE REVIEW

2.1 Horticultural sector

Vegetables serve as fundamental sources of nutrition, supplying vital vitamins, dietary fiber, and minerals crucial for human health (Zou & Zou, 2021). They are increasingly contributing to nutritional security due to their rich micronutrient content and the growing awareness of healthy eating (Fadairo, Williams & Nalwanga, 2019). The cultivation of vegetables creates the source of employment due to its high labor intensive compared to other staple crops in smallholder farms and its world production went up to 71% from 2000 reaching 1.17 billion tonnes in 2022 (FAO, 2023).

In 2018, the global pepper market was estimated at 4.1 billion dollars, with the highest consumption rates in Viet Nam, India, and the US (Research and Market, 2022) it belongs to the genus *capsicum* in *solanaceae* family. This genus consists of roughly 31 species of which, the mostly domesticated ones are *capsicum annum*, *capsicum baccatum*, *capsicum chinense*, *capsicum frutescens* and *capsicum pubescen* (Saleh, Omer & Teweldemedhin, 2018). It has been considered as vital crop due to its economic capacity for smallholder farmers in developing countries. The origin of pepper is traced in the tropical and subtropical regions of Central and South America, making it among one of the earliest crops farmed by humans (Zou & Zou, 2021).

Pepper dominates world spice trade, and the market types are based on fruit shapes and sizes giving more than 20 market types of hot and sweet peppers. These market sizes are grouped into five broad market categories: Fresh market, Fresh processing, Dried spice, Industrial extract, and

ornamental. The marketing types are indicators that there are nutritional and non-nutritional uses of pepper (Lin *et al.*, 2013).

Saleh *et al.*, (2018) indicated that chili peppers are rich in phytochemicals such as vitamins, phenolics and flavonoids which are important antioxidants that contribute to the risk of degenerative diseases reduction. The expansion of hot pepper in Uganda started in 1990s from subsistence farming to commercialized farming with the end goal of international markets (Tusiime *et al.*, 2010).

Uganda earns tangible share in export of fresh fruits, and vegetables worth United states dollar (USD) 35 million a year (CABI, 2022) being the second to Nigeria in Sub-Saharan Africa. According to Swiss contact (2022), Fresh fruits and vegetables are the 5th largest foreign exchange earner for Uganda, with the EU being Uganda's largest buyer. Uganda is facing decrease revenues from exportation of some of these horticultural products due to low compliance with food safety requirements. The main attribute is the presence of pests and unacceptable levels of pesticide residues found in the commodities at the destination markets (MAAIF,2019). The loss of EU consumer confidence in Uganda's export could spell a significant loss of national revenue, financial losses for local SME (exporters) and affecting livelihoods for smallholder farmers and pack house workers of which the majority are women. The new identity and physical checks for hot pepper (*capsicum*) from Uganda increased to 50% from 20% during 2019 to 2021(Swiss contact, 2022).

2.2 Food safety standards

Food safety standards have been emphasised in different parts of the world which address food safety systems in exporting countries for protection of consumers (Rahmat, Cheong & Hamid, 2015). According to Giovannucci and Reardon (2001), standards are explained as criteria that distinguish similar products, categorizing them into groups and providing a uniform terminology that is universally comprehensible among market participants. Worldwide, benchmarks for food safety standards and quality assurance have been established through the adoption of Good Agricultural Practices (GAP), Hazard Analysis Critical Control Points (HACCP), and the International Organization for Standardization (ISO) (Rahmat, Cheong & Hamid, 2015).

Developing countries have difficulties in occupying big share on international markets due to complications in compliance with international food safety standards. Among the reasons are; lack of awareness of quality and safety standards, underfunding of national research institutes, poor information flow between producers and food safety organizations (Rahmat, Cheong & Hamid, 2015). Lamuka (2014) indicated that the success and quality food safety standards in food supply chains depends on the government as its core responsibility to ensure implementation and follow up.

2.3 Global GAP standards

Global GAP is private food safety standards which arose from The GAPs (Good Agricultural Practices). Good Agricultural Practices (GAP), as defined by the Food and Agriculture Organization of United nations (FAO), refer to a set of guidelines for managing on-farm production and post-harvest activities to ensure the production of safe and healthy food and non-

food agricultural products. These practices aim to balance economic, social, and environmental sustainability (FAO, 2023).

Trienekens and Zuurbier (2008), highlighted that it is internationally known public food safety standards. The existence of private food standards came to harmonize the private and public food safety standards (Unnevehr, 2014). The inception of the Global GAP brand dates back to 1997 when it was known as EUREPGAP (Global GAP, 2022). Developed by FoodPLUS GmbH in Cologne, Germany, in collaboration with stakeholders from the food industry, including producers and retailers, Global GAP offers smart farm assurance solutions. These solutions encompass a variety of standards promoting safe, socially responsible, and environmentally sustainable farming practices. The Integrated Farm Assurance (IFA) standard, widely adopted, is specifically designed for fruit and vegetable cultivation (Global GAP, 2022). Fruits and vegetable farmers adhere to 218 control points that are categorized into traceability of produce and its safety, workers' safety, and the health and environmental conditions of the farming area (Mwangi, Chitere & Kariuki, 2022; Global GAP, 2022).

Various Research has explored the significance of private food safety standards throughout the entire food value chain. Fagotto (2013) investigated compliance with these standards, emphasizing their perceived necessity, given that disregarding them could result in a substantial loss of market share. According to Vellema and Boselie (2003), the ultimate objectives of private food safety standards encompass enhancing supplier standards and consistency to prevent product failures, streamlining the certification of processes to eliminate multiple audits of food suppliers and manufacturers, aligning with consumer and retailer objectives by conveying demands upstream in

the chain, and facilitating the generation of accurate and timely information about production processes in the event of non-safety food incidents.

There is incidence of non-compliance with food quality standards and notable variations in the level of awareness among farmers with different food safety standards (Mwangi, Chitere & Kariuki, 2022; Kuwornu & Mustapha, 2013; Muriithi et al., 2011). Some of the major barriers to compliance with food safety among smallholder farmers include limited awareness of existence of those standards, not trusting relevance and enforcement of regulations in place and inadequate finance to implement and comply with food safety standards (Fajarwaty & Jukes, 2022).

2.4 Measuring Awareness of Global GAP Standards

Awareness tests are usually done on the assumption that the concerned study population ought to possess the knowledge of the topic without a specific course of instruction. Now that, the awareness is expected in the population under study, some awareness tests are done with a diagnostic purpose to identify which aspects of the domain of knowledge is lacking in the population, so that a remedial program can be implemented or reinforced (Gafoor, 2012). Awareness can be measured through two methods: Subjective and Objective. Subjective method is more of verbal reports expressed by participants/respondents while Objective method is forced choice (Timmermans & Cleeremans, 2015).

2.5 Factors influencing Global GAP awareness

Embracing agricultural technology or implementing new practices requires awareness and acceptance thereof is affected by different factors and conditions (Joshi, Kalauni & Tiwari, 2019). Bernier et al (2015), conveyed that the awareness of specific practices is contingent upon

individual socio-economic factors, including age, gender, access to diverse information channels, education, as well as household characteristics such as land size, various assets, and social norms and beliefs. A study that was conducted on impact of knowledge of integrated pest management (IPM) in the Cocoa farmers of Ghana, reported that years of formal education, household size and previous trainings had significant impact on knowledge of IPM (Asamoah & David, 2011). In the study on determinants of awareness of good agricultural practices (GAP) among banana growers in Nepal, revealed that with increase of one unit in schooling, the probability of being aware of the GAP increased by 2.68%. Extension program like trainings had great influence on awareness, the same study revealed that one unit increase in trainings, increased the probability of awareness on GAP by 20.1% and if a male, the probability of awareness was higher by 6.9% (Joshi, Kalauni & Tiwari, 2019).

Most studies have been conducted on factors associated with awareness of new agricultural innovations like IPM, GAP in crops like cocoa, banana but literature on chili as potential crop to raise rural economy was barely available. This study, therefore, intended to explore factors that influence the level of awareness of Global GAP among smallholder farmers in chili production.

2.6 Factors associated with level of Global GAP compliance

Like any other kind of innovation in the different sectors, adoption of Global GAP and its level of compliance is associated with varying factors like reduction in production costs and maximizing profit (Kassem et al., 2020). Studies have been conducted to identify factors associated with adoption of GAP; demographic variables like age, education, and membership in farmers associations were associated with farmers' decisions to adapt GAPs (Pandit et al., 2017).

Education, extension services, years in farming of French beans, participation in Global GAP trainings and group membership were positively associated with the adoption of Global GAP while household size, age, information access were negatively associated with adoption of Global GAP (Chelang'a et al., 2023). Other factors include institutional support, infrastructure, economic impact variables and knowledge and attitude level of farmers (Parkhani et al., 2015; Kibet et al., 2018; Ochieng et al., 2019).

Studies have been conducted focusing on factors that were associated with adoption of new agricultural innovation especially on beans (French beans), fruits like mangos. However, adopting an innovation does not necessary mean complying with the requirements, there is limited literature on factors that influence the level of compliance with set standards of a given agricultural innovation and compliance of food safety standards at farm level. Thus, this study aimed at investigating on factors associated with level of compliance of Global GAP standards among smallholder hot pepper farmers.

CHAPTER THREE: METHODOLOGY

3.1 Study Area

The study was conducted in Lira district which is in the Lango sub-region in northern Uganda. The district was selected with the guidance of North-East Chili Producers Association (NECPA), which is the association that helps chili farmers to export their produces to international markets. With the data base provided by NECPA, Lira district ranked number one in having many chili farmers in Northern Uganda and thus contributed reasonable amount of chili delivered to NECPA for exportation during and before the period of this study. Geographically, the district is situated between latitudes 10°21' and 20°42' north of the Equator, and longitudes 20°53' and 30°37' east of Greenwich. Lira district is located within the Northern Agroecological Zone (NAEZ), spanning an area of 42,021.2 km² and experiencing a mean annual rainfall of 1464mm. The average annual temperature fluctuates between 17°C and 31°C (Akongo *et al.*,2017). With reference to the most recent data of Lira district local government, (2020), Lira district shares its borders with Pader district to the north, Otuke district to the northeast, Alebtong district to the east, Dokolo district to the southeast, Apac district to the southwest, and Kole district to the west.

3.2 Research design

A cross-sectional research design was used in this research as it allowed data collection from an exemplary sample of the population of smallholder hot pepper farmers. Cross-sectional study, a form of observational study design, entails examining data from a population at a particular moment in time. In this type of study, researchers simultaneously assess both the outcomes and exposures of the study subjects. Wang & Cheng (2020) described it as taking a “snapshot” of a

group of individuals. Unlike in case-control studies (subjects selected based on the outcome status) or cohort studies (subjects selected based on the exposure status), the subjects in a cross-sectional study are simply chosen from available population of potential relevance to the study questions (Wang & Cheng, 2020). This study approach was selected because it allowed data collection on socio-economic and demographic variables of chili farmers, factors associated with the level of awareness and compliance of Global standards at a go. The scope of this study was from June 2023 to December 2023.

3.3 Study population

This study targeted smallholder horticultural farmers specifically hot pepper farmers because they were the ones mostly affected by international food safety standards here in Uganda. The study was working hand in hand with North-East Chilli Producers Association (NECPA). NECPA helps Chilli farmers who are registered with them to have access to different extension services like training and access to export markets. Some groups of farmers have had the chance to be trained on organic farming practices and Global good agricultural practices (Global GAP), this became the inclusion criteria for selection of the participants of this study and the exclusion criteria was non-NECPA chilli farmers because it would be hard to have access to a farmer who was not registered.

3.4 Sample size determination and sampling technique

3.4.1 Sampling procedure

A multistage sampling technique was used to select all the respondents for the study. In the first stage, Lira district was selected on the basis of its high contribution in hot pepper production and

its big share in hot pepper exported through North-East Chili producers Association (NECPA). Secondly, the sub counties that dominate production of hot pepper were selected purposively with the information provided by NECPA. According to NECPA chili farmers data base, the total number of registered hot pepper producers was 2500 and this formed the sampling frame for the study. In the third stage, simple random sampling was used to identify the hot pepper farmers to answer the questionnaire. Using the database provided by NECPA, 0 and 1 was assigned randomly. The name of the farmer who corresponded to 0 was not given a chance to participate in the interview and the farmer whose name coincided with 1, was picked for the interview. The total of 345 farmers were randomly assigned 1 and the rest were randomly assigned zero.

3.4.2 Sample size determination

The sample size (n) for the study was determined using Yamane (1967) formula where 95% confidence level and P=.5(Maximum variability) were considered. The formula is presented in equation (1).

$$n = \frac{N}{(1+(N(e)^2))} \quad (1)$$

Where n is the sample size, N is the population size, and e is the level of precision.

$$n = \frac{2500}{(1 + (2500(0.5)^2))}$$

$$n=344.8$$

Therefore, 345 hot pepper farmers were interviewed,

3.4.3 Data collection procedure

To get answers to all objectives, primary data were obtained using pretested structured questionnaires (appendix II) as data collection tools. The data collection tool was a combination of control points used by Global GAP to determine the farmers who were Global GAP compliant and socio economic and demographic variables associated with the level of compliance. Demographic variables were formulated and Global GAP control points applicable to chilli crop were selected and included in the questionnaire. Respondents were provided with informed consent forms by clearly explaining to them the nature and the purpose of the study and it was made clear that participation was completely voluntary, and anonymity and confidentiality were the top priority. The respondents were made aware that if there were un comfortability, they would withdraw from the study at any time. Farmers who consented to participate were administered with the pretested structured questionnaire. To get data for the level of compliance, control points provided by the Global GAP standards requisites for fruits and vegetables from Version of GLOBALGAP Integrated Farm Assurance (IFA) English version 5.4-1- GFS Manual (appendix I), obligatory since Jan 2022 was used. Data on the factors associated with the level of Global GAP compliance were scored using structured questions that included the institutional and support services, social-economic characteristics, and market characteristics. To ensure validity and reliability, the study formulated well research objectives and their corresponding research questions. Furthermore, the study ensured approved research method, pretested data collection tools and reporting research findings clearly.

3.5 Data analysis

IBM SPSS statistics 25 and STATA/MP 14.1 were used as tools for data entry and analysis respectively. The STATA output generated from the analysis is attached (appendix V). For the level of compliance of Global GAP standards, descriptive analysis was used. And Tobit econometric analysis was used for the key factors associated with the level of awareness and compliance with Global GAP standards.

3.5.1 Specific objective one: Determining the level of awareness of Global GAP standards among smallholder hot pepper farmers.

The word aware is used to indicate having knowledge of something, something to be present in mind or paying attention to something (Schipper, 2014). Therefore, awareness of Global GAP standards is having the knowledge that Global GAP standards are in existence. The dependent variable of Global GAP standards awareness was measured by asking respondents to mention Global GAP standards they knew. Each farmer's level of awareness was determined by aggregating the numbers of Global GAP standards that he/she was able to recall. Descriptive statistics such as frequencies and percentages were used to determine the level of awareness of Global GAP standards among smallholder hot pepper farmers.

3.5.2 Specific objective two: Estimating the level of compliance to Global GAP standards by smallholder hot pepper farmers

The Global GAP standards requisites for fruits and vegetables from Version of GLOBALGAP Integrated Farm Assurance (IFA) English version 5.4-1- GFS Manual, obligatory since Jan 2022 was used. Control points are classified into 3 categories; Major must which must be complied at

the level of 100%, Minor Must which must be complied at 95% and recommendation of which is scored but not rated. A farmer was coded 1 if he/she adheres to a GLOBALGAP requirement and 0 if otherwise. The Global GAP Compliance criteria used in assessing awareness and compliance are presented in appendix I. There are 31 Global GAP requirements applicable to chili production in the study which were captured in a data collection tool. The level of compliance was computed in accordance with rules for individual producers in Global GAP General regulations valid from 1st October 2022 by summing up the major must control points. The farmer was compliant when she/he had 100% in major must control points. For minor must control point, compliance was computed by summing up minor must control points minus minor must control points that a farmer was not compliant with. A farmer was Global GAP compliant when he/she scored 100% and 95% in major must and minor must control points respectively and he/she was non-compliant when she/he fell below any of the groups of control points. By getting below 100% in major must, the farmer was non-compliant even though he/she got 95% in minor must and in the same manner, getting below 95% in minor must, the farmer was non-compliant even if he/she got 100% in major must. Descriptive statistics were considered in this study to capture quantitative variables important in explaining what influences a farmer to comply with the Global GAP standards. The mean, frequency and percentage of various variables were considered to describe the results.

3.5.3 Specific objective three: Determining the key factors that influence smallholder farmers in complying with GLOBAL GAP

To relate the key factors influencing compliance with Global GAP standards, a Tobit model was used. The regression results indicated the level at which household, market, farm characteristics,

support services and policy intervention variables were associated with level of compliance with Global GAP.

This study hypothesized that family characteristics, social factors, economic and institutional characteristics affect the level of compliance with Global GAP standards.

3.6 Description of empirical Tobit model used to test the factors associated with the level of awareness and the level of compliance of Global GAP standards

A standard Tobit model (Tobin, 1958; Splett, et al. 1994) was used to identify the factors associated with both the level of awareness and the level of compliance. Separate Tobit regression models were estimated for each of dependent variables which are level of awareness and level of compliance. There are incidents where variables in the model are in limited range. Limited dependent variables regression models have restrictions and that is why they are called so. Ordinary least squares (OLS) may result in biased and inconsistent parameter estimates when the information on regress is disponible for some observations. The bias may arise due to consideration of observable and omitting the rest. With this, there is no assurance that the error term will be equal to zero and without it equaling to zero, no guarantee that OLS estimates are not biased. If the estimate is only based on observable, the intercept and slope coefficients will differ from when all observations are considered (Greene, 2000).

Censored or Tobit regression, truncated regression and sample selected regression models are the types of regression under limited dependent variables models. Tobit models have been predominantly used in the study of censored and limited dependent variables (Greene, 2000; Smith, 2003). Most studies in modeling determining factors, used logit and probit when the dependent variable goes with one if the condition is true or zero otherwise. But this has gotten

disadvantage of possible loss of information when a binary variable is used as dependent variable (Lynne, 1988). Moreso, binomial models portray the probability but not the magnitude at which explanatory variables influence dependent variables. The linear probability model depends on OLS and OLS in censored models inherently bring heteroscedastic disturbance, leading to standard deviation estimates to be biased.

The Tobit model was considered a suitable model to be used to find out the relationship between explanatory variables and dependent variable because in this study, the value of Global GAP awareness and Global GAP compliance have their values clustered at 0 and 1 furthermore Tobit regression model minimizes inadequacies aforementioned (McDonald and Moffit, 1980).

The Tobit model equation is as in equation (2)

$$Y_i^* = \beta X_i + \varepsilon_i \quad (2)$$

$$Y_i = Y_i^* \text{ if } Y_i^* > 0$$

$$Y_i = 0 \text{ if } Y_i^* \leq 0$$

Where:

Y_i^* is an implicit stochastic index (latent variable) for the i^{th} chili farmer which is observed for the values less than 0 and greater than 1, representing Global GAP awareness or Global GAP compliance,

β is a vector of parameters to be estimated,

X_i is a vector representing the independent variables of the model and ε_i is the error term (normally and independently distributed), $i = 1, 2, \dots, n$, n being the number of observations. The two limit Tobit model is defined as in equation (3)

$$Y_i^* = \varphi_0 + \sum_{j=1}^n \varphi_j \omega_{ij} + \mu_i \quad (3)$$

Y_i^* standards for latent variable that represents Global GAP awareness or Global GAP compliance scores which range between 0 and 1. $\varphi_0, \varphi_1, \varphi_2, \dots, \varphi_n$ are parameters to be estimated, ω_i are explanatory variables that are associated with the level of Global GAP awareness and level of Global GAP compliance, μ_i is an error term. Thus, the two limit Tobit model can be presented as in equation (4)

$$Y_i = \begin{cases} 1 & Y_i^* \geq 1 \\ Y_i^*, & \text{if } 0 < Y_i^* < 1 \\ 0 & Y_i^* \leq 0 \end{cases} \quad (4)$$

The two limit Tobit model censors in lower limit and upper limit, the log-likelihood based on the double-censored data and set of two limit is as in equation (5)

$$LnL = \sum_{Y_i=1} Ln \varphi \left[\frac{L_{0i} - X_i' \beta}{\sigma} \right] + \sum_{Y_i=Y_i^*} Ln \frac{1}{\sigma} \varphi \left[\frac{Y_i - X_i' \beta}{\sigma} \right] + \sum_{Y_i=L_{1i}} Ln \left[1 - \varphi \left(\frac{L_{1i} - X_i' \beta}{\sigma} \right) \right] \quad (5)$$

The explanatory variables used to find out factors that are associated with the level of Global GAP awareness and level of compliance are described in Table 1 and 2 respectively.

Table 1: Description of independent variables and their hypothesized signs used in Global GAP awareness Tobit model

Variable	Description	Measurement	Expected sign
Household and farm characteristics	Size of household	Number of counts	+
	Gender of the household head	1: Male, 0: Female	+/-
	Age of the farm household head	Years	+/-
	Size of the household	Number of counts	+/-
	Chili farming experience	Years	+
	Marital status	1: Married, 0: otherwise	+/-
Education	Years of formal education	Years	+
Market	Dummy for access to market information	1: yes, 0: No	+
Infrastructures	Distance to agri input and out markets	Km	-
Institutional and support services	Dummy for access to extension services	1: yes, 0: No	+

Tobit model for the factors associated with the level of Global GAP awareness used is as below

Level of awareness of Global GAP = $\beta_0 + \text{years of formal education } \beta + \text{Household size } \beta + \text{Chili farming experience } \beta + \text{Distance to nearest chili input market } \beta + \text{Access to market information } \beta + \text{training } \beta + \text{Number of farming association } \beta + \varepsilon_i$

Table 2: Description of independent variables and their hypothesized signs used for Global GAP compliance Tobit model

Variable	Description	Measurement	Expected sign
Household and farm characteristics	Size of household	Number of counts	+/-
	Members of households in chili farming	Number of counts	+
	Land size under chili production	Ha	+/-
	Monthly income	UGX	+/-
	Chili farming experience	Years	+
	Gender of farm household head	1: Male, 0: Female	+/-
	Marital status	1: Married, 0: otherwise	+/-
Education	Years of formal education	Years	+
Market	Dummy for access to market information	1: yes, 0: No	+
Infrastructures	Distance to agri input and output markets	Km	-
Institutional and support services	Dummy for access to extension services	1: yes, 0: No	+
	Dummy for Access to farming credit	1: Yes. 0: No	+
Global GAP awareness	The level of Global GAP awareness	N/A	+

Tobit model for the factors associated with the level of compliance is as below

Level of Global GAP compliance = $\beta_0 + \text{level of awareness } \beta + \text{years of formal education } \beta + \text{Household size } \beta + \text{Household members in chili farming } \beta + \text{Chili farming experience } \beta + \text{Land dedicated to chili } \beta + \text{Access to market information } \beta + \text{Monthly income } \beta + \text{access to farming credit } \beta + \text{access to extension service } \beta + \epsilon_i$

3.7 Ethical Consideration of the study

This study observed all legal and ethical expectations governing research as defined within the context of the Republic of Uganda. Before starting the study, ethical clearance (appendix III) was obtained from the Gulu University Research and Ethics Committee (GUREC). An approval letter was obtained from the Chief Administrative Officers to carry out the research in the districts. During data collection, respondents consented (appendix IV) by signing the consent form and this was on a voluntary basis. The research ensured that human rights were fully respected, and all respondents and research assistants participated under healthy and favorable conditions. Proper referencing was observed to avoid all forms of plagiarism and fraud. More so, all resources meant for the study were directed to it and the results of the research will be published for the benefit of all stakeholders.

CHAPTER FOUR: RESULTS

4.1 Characterization of respondents

The results on socio economic and demographic categoric and dummy variables in Table 3 indicate that most respondents were married (87.25%), 58.55% were females, 43.77% indicated to be receiving training support while 73.62% and 69.86% reported to be having access to market information and access to credit for farming respectively.

Table 3: Descriptive statistics of categoric and dummy variables of Socio economic and demographic characteristics of respondents

Variable	Response	Percentage
Marital status	Divorced	3.19
	Married	87.25
	Single	4.06
	Widow/er	5.51
Gender	Female	58.55
	Male	41.45
Training support	No	56.23
	Yes	43.77
Access to market information	No	26.38
	Yes	73.62
Access to finance for farming	No	30.14
	Yes	69.86

The results of continuous socio-economic and demographic variables in Table 4 show that the mean age was 45.05 years. It was found that at least every respondent had been in chili farming by one full year. Despite the large ownership of the land, average land owned being 2.05 ha, only 0.28 ha in average was only found to be dedicated to chili production. Respondents indicated that they had been visited by extension agent, at least 4 times. The results also indicated that some farmers belonged into more than one farming associations. The mean distance to agricultural input

market was found to be 10.91Km while the mean distance to agricultural output market was found to be 2.94Km. The average monthly income was found to be UGX 224415. Additionally, the study found out that among respondents, some had no education at all while others reached university with an average of 5 years of formal education. More so, the mean household size was found to be 7 persons.

Table 4: Descriptive statistics of continuous variables of Socio economic and demographic characteristics of the respondents

Variable	Mean	Std Dev.	Min	Max
Age (years)	45.05	14.45	20	81
Years of formal education	5.29	3.07	0	16
Years in chili farming	2.88	1.18	1	5
Land size owned (ha)	2.05	2.31	0.2	20.23
Land dedicated to chili farming (ha)	0.28	0.23	0.002	2.02
Monthly income (UGX)	224414.5	381386.5	20000	5000000
Distance to agri-input market (Km)	10.91	7.89	0	30
Distance to agri-output market (Km)	2.94	3.32	0	26
Household size	6.52	2.91	1	21
Number of farming association	1.08	0.88	0	4
Times visited by extension agent	3.73	2.87	0	12

4.2 Awareness of Global GAP standards and factors associated

4.2.1 Awareness of Global GAP standards

The results in Table 5 show that 16.52% of the respondents were aware of grading the harvest, 2.9% were aware of health and safety of workers, 16.52% were aware of clean harvest, 5.51% were aware of environmental protection. In addition, 0.58% of the respondents were aware of clean water source for chili farming, 7.83% and 3.48% showed awareness of proper pest management and proper use of manure in chili production respectively. More to that, very small percentage of respondents (0.29%) indicated that they were aware of importance of having access to washroom

as means of food safety standards and control point of Global GAP standards, 8.99% were aware of proper chili drying, 3.77% were aware of record keeping, 18.26% and 11.59% were aware of hygiene and proper storage of the harvest to ensure food safety respectively. The overall level of awareness of Global GAP standards was found to be 8.02% among smallholder chili farmers.

Table 5: Descriptive statistics indicating awareness and overall level of awareness of Global GAP standards

Variable	Percentage (%)	
	No	Yes
Grading harvest	83.48	16.52
Healthy and safety of workers	97.10	2.90
Clean harvest	83.48	16.52
Environmental protection	94.49	5.51
Hygiene	81.74	18.26
Proper storage	88.41	11.59
Record keeping	96.23	3.77
Proper chili drying	91.01	8.99
Proper pest management	92.17	7.83
Clean water source	99.42	0.58
Access to washroom	99.71	0.29
Proper use of manure	96.52	3.48
Overall awareness (%)	8.02	

4.2.2 Factors associated with the level of Global GAP awareness

The Tobit regression model results in Table 6 show that among other factors associated with the level of Global GAP awareness; years of formal education, distance to nearest chili input market, access to market information and provision of extension agent for training purpose were statistically significant all with p-values less than 1%. A unit increase in the years of formal education was associated with 2.2% higher level of awareness. As the distance to the chili input market increased by one unit, the level of Global GAP awareness was 1.05% lower. Furthermore, access to market information and provision of extension agent for training purpose was associated

with higher level of awareness where a unit increase lead to higher Global GAP level of awareness by 23.2% and 24.1% respectively. Household size and number of farming associations that a respondent belonged to, did not have significant association with the level of Global GAP awareness. Meanwhile chili farming experience and the distance to nearest output market were significantly associated with the level of awareness ($p > 0.05$).

Table 6: Tobit regression model results on the factors associated with the level of Global GAP awareness

Factors associated with Global GAP level of awareness	Coef.	Robust Std. Err.	t	P>t
Years of formal education	2.204	0.784	2.81	0.005***
Household size	-0.014	0.754	-0.02	0.985
Chili farming experience	4.613	1.941	2.38	0.018**
Distance nearest chili input market	-1.054	0.279	-3.78	0.000***
Distance nearest chili output market	-1.948	0.859	-2.27	0.024**
Access to market information	23.165	6.502	3.56	0.000***
Ext agent for training	24.058	7.478	3.22	0.001***
Number of farming association	1.217	2.988	0.41	0.684
_cons	-65.002	11.796	-5.51	0
/sigma	32.91502	1.923237		
Number of observations:345				
F (8,337) = 9.19				
Prob > F= 0.0000				
Pseudo R2=0.0523				
Log pseudolikelihood = -607.17173				

***, **, * represent statistical significance at 1%, 5% and 10% levels respectively

4.3 Level of compliance of Global GAP standards among smallholder hot pepper farmers

4.3.1 Compliance of Global GAP Standards

The results from Table 7 on traceability of produce and its safety, respondents complied with Global GAP standards above 80% in the use of containers exclusively for chili, protecting produce

Table 7: Global GAP control points used to determine Global GAP compliance

Variable	Percentage (%)	
	No	Yes
Traceability of produce and its safety		
If you fumigate, do you have written justification for soil fumigation?	89.86	10.14
Interval of 60 days of manure application prior to harvest	82.90	17.10
Evidence of excessive animal activities in crop production area	56.52	43.48
Performance of hygiene risk assessment for harvest	22.61	77.39
Availability of documented hygiene procedures and instructions	48.99	51.01
Smoking, drinking, and eating confined to designated areas	41.74	58.26
Cleaning of equipment used for loading	29.86	70.17
Are the harvest containers used exclusively for chili?	11.30	88.70
Is harvested produce protected from contamination	2.03	97.97
Level of compliance (%)	57.14	
Workers' safety and health		
Availability of suitable changing facilities	34.78	65.22
Do harvest workers have access to appropriate handwashing equipment	11.01	88.99
Do harvest workers have access to clean toilets in the vicinity	6.09	93.91
Are there signs that communicate primary hygiene instruction	44.64	55.36
Do workers receive specific training on hygiene before harvesting	16.52	83.48
Does water used in cleaning the produce meet the microbial standard	24.93	75.07
Level of compliance (%)	77.01	
Farming area environment		
Is water in chili production managed to minimize food safety risks	25.22	74.78
Are all produce collection points maintained in hygienic conditions	4.64	95.36
Are the packing materials appropriate to use and clean	6.09	93.91
Are the bits of packaging materials removed from the field	11.59	88.41
Prevention of chemical contamination of chili	15.94	84.06
Are all forklifts and transport trolleys clean	32.17	67.83
Is rejected and contaminated not introduced in supply chain	17.97	82.03
Are there system for monitoring and correcting pest population	34.20	65.80
Evidence for effectiveness of pest monitoring and correction	41.16	58.84
Records of pest control inspections	56.81	43.19
Wastewater filtering and pH conc. Monitoring	46.96	53.04
Are all label instructions observed?	23.77	76.23
Registration of synthetic products used in production	24.35	75.65
Qualified personnel fumigating	22.90	77.10
Declaration of water used as portable	23.77	76.23
Availability of postharvest plant protection product list	33.33	66.67
Level of compliance (%)	73.70	
Overall level of compliance	69.29	

from contamination and scored very low in soil fumigation justification and proper timing of application of manure. Respondents scored 57.14% overall in traceability of produce and its safety. On workers' safety and health respondents complied with Global GAP standards above 80% on having access to clean toilets in the vicinity, receiving specific training on hygiene before harvesting and access to appropriate washing equipment. The overall compliance with workers' safety and health was 77.01%.

On farming area environment, respondents complied above 80% on maintaining all collection points in hygienic conditions, clean and appropriate packing materials, removing bits of packing materials from the field, prevention of chemical contamination, and avoiding introduction of rejected and contaminated harvest to supply chain. Overall, respondents complied with Global GAP standards on farming area environment at 73.70%

In general, level of compliance with Global GAP standards on Workers' safety and health, traceability of produce and its safety, and farming area environment was found to be 69.29%

4.4 Factors associated with the level of Global GAP compliance

The results in Table 8 indicate that the level of awareness of Global GAP was statistically significant and associated with the level of compliance with Global GAP. A unit increase in the level of awareness of Global GAP standards led to 0.21% higher in the level of Global GAP compliance ($p=0.01$). More so, access to market information, access to farming credits, access to extension service and number of household members engaged in chili farming were associated with the level of Global GAP compliance where a unit increase led to 20.2% ($p<0.01$), 8.5% ($p=0.004$), 11.6% ($p=0.009$), 1.9% ($p=0.003$) higher to the level of Global GAP compliance respectively.

Table 8: Tobit regression model results on the factors associated with the level of compliance with Global GAP standards

Global GAP compliance	Coef.	Robust Std. Err.	t	P>t
Level of awareness	0.205	0.078	2.6	0.01***
Years of formal education	-0.105	0.344	-0.3	0.762
Household size	0.224	0.436	0.51	0.608
Household members in chili farming	1.903	0.637	2.98	0.003***
Chili farming experience	-0.355	1.018	-0.35	0.728
Land under chili production	1.622	1.455	1.11	0.266
Monthly income	1.836	0.806	2.28	0.024**
Access to market information	20.155	3.355	6.01	0.000***
Farming credit	8.468	2.903	2.92	0.004***
Access to extension service	11.626	4.437	2.62	0.009***
_cons	12.315	9.502	1.3	0.196
/sigma	21.965	1.044	2.6	
Number of observations =345				
F (10, 335) =19.47				
Prob > F= 0.0000				
Pseudo R2 = 0.0419				
Log pseudolikelihood = -1552.3397				

***, **, * represent statistical significance at 1%, 5% and 10% respectively.

Monthly income was positively associated with the level of compliance($p < 0.05$), a unit increase in the monthly income led to 1.8% higher to Global GAP compliance. On the other hand, years of formal education, household size, chili farming experience, land dedicated to chili production did not show statistically significant association with the level of Global GAP compliance.

CHAPTER FIVE: DISCUSSION OF RESULTS

5.1 Characterization of respondents

The study revealed that a significant majority of respondents were married. This indicates a strong presence of married individuals in farming in search to diversify the source of income and to improve their economy. These results are in line with the findings of Sennuga et al. (2023) in the study on factors influencing farmers' adoption of improved technologies in maize production in Kuje area council of FCT-Abuja, Nigeria where they found that 77.3% of the respondents were married. The results also align with findings of Vu et al. (2020).

Females constituted a substantial portion of the respondents, making up approximately six in ten respondents. The prominence of female participation in farming is a common trend in developing countries, as supported by findings from AGRA (2016) in Tanzania, which reported that 54% of the labour force in agriculture was women.

Additionally, respondents reported to have access to market information. This is possible because they indicated to be belonging in multiple farming associations which facilitates easy access of production and market information. Mwalusaka (2021) highlighted that inadequate of relevant agricultural information is barrier to rural farmers' efforts towards agricultural productivity. While Sennuga et al. (2023) highlighted that belonging to farming associations increases the likelihood of embracing agricultural technologies.

More so, the study showed that respondents were visited by extension workers approximately four times, with the visits serving various purposes such as training, produce collection, monitoring crop health and the like. Agricultural extension services help farmers to have production

information and extend services on technical and capacity building to enhance the embrace of agricultural innovations (Anang & Zakariah, 2022).

Further, the results of this study showed that farmers have access to credit. This is possible because, the study focused on farmers who belonged in farming groups which facilitate access to basic farming services. The results align with the study on impact of farmers' associations on household income in tea farms of Vietnam, where farmers in associations had access to agricultural credit services and support services from agricultural officials (Vu et al., 2020). Ololade & Olagunju, (2013); Owusu, (2017) indicated that farmers in most developing countries have a challenge of accessing credit that enhances acquiring of essential agricultural inputs to improve productivity which becomes a barrier to adoption of agricultural innovations.

In addition, the study identified a considerable gap between the land owned and land dedicated to chili production. Only 9.65% of the total land owned was found to be dedicated to chili farming. This is possible because smallholder farmers allocate land for income and food crops. This indicates that all the land could not be allocated to chili production because smallholder farmers are normally involved in the production of more than one crop. The results are consistent with some previous studies. Adjimoti & Kwadzo (2018) highlighted that households were growing many crops to gain high yield and to become food secure.

The study further revealed that respondents were largely on the active working age. This age range is important for chilli production given that it is an intensive activity and requires very active and committed farmers. Older farmers tend to avoid very intensive crop enterprises and the results are in line with previous studies (Sennuga et al., 2023; Vu et al., 2020).

The results on distance to input and output market indicate that farmers had to cover substantial distances to access agricultural inputs and output markets. This increases the cost of production through transport costs and discourages market participation. This is aligning with the study on determinants of market participation among smallholder farmers in Southwest Ethiopia, Haile et al. (2022) found that one-minute increase of walking to the market decreased the level of market participation by 4%.

Furthermore, the results of the study found that the average monthly income among the respondents accords with the results of Uganda household surveys of 2019/2020 where the median household income was found to be UGX 190,000 with exception of Kampala with household income of UGX 667,000(UBOS, 2021).

The average years of formal education among the respondents were around five years, reflecting that many of them possessed basic literacy skills in reading and writing. This is possible because according to Sell & Minot, (2018) indicated that Uganda made tremendous progress in terms of education where they had 91% of primary school children enrolled.

Additionally, the mean household size was estimated at about seven members, this is possible and reasonable because, the results are close to Uganda household survey of 2019/20 found, which was 5 members per households (UBOS, 2021).

5.2 Determining the level of awareness of Global GAP standards among smallholder hot pepper farmers

5.2.1 Global GAP awareness

Generally, the study results showed very low level of awareness of Global GAP standards in chili production. This is possible because, with reference to very small land that was dedicated to chili production despite having enough land, it was direct indicator that respondents were not fully engaged in chili farming as a business. Related study on awareness of good agricultural practices among smallholder farmers in Murang'a count in Kenya however, indicated that farmers were quite knowledgeable about proper pest management (64%), grading of their harvest (59%), maintaining hygiene practices (60%), and using protective equipment when handling agrochemicals (39%). Additionally, they also had a reasonable level of awareness regarding pesticide spraying intervals (39%), and a quarter of them were cognizant of the importance of having a toilet in vicinity their farms (Mwangi et al., 2022). Furthermore, a separate study conducted by Sennuga et al. (2020), focusing on the awareness and adoption of good agricultural practices among smallholder farmers participating in the Adopted Villages program in Nigeria, revealed that 58% of the respondents were informed about the proper utilization of manure as part of good agricultural practices, while 7% remained unaware.

5.2.2 Factors associated with the level of Global GAP awareness

Results of the study showed that educated farmers were more aware of the Global GAP. This finding was expected given that education plays a vital role in raising awareness on vital issues and different topics through various ways. This corroborates with the findings of Joshi et al. (2019), who observed a positive correlation between years of schooling and awareness of Good

Agricultural Practices (GAP) among banana farmers in Nepal, with a unit increase in education leading to a 2.68% increase in GAP awareness. Similarly, Daberkow & McBride (2003) found similar results, indicating that education enhances a farmer's capacity to learn and adopt new agricultural innovations. Farmers with higher levels of education are often early adopters of new agricultural practices.

Furthermore, farmers who had access to extension services, particularly training were more aware of the Global GAP. This is because through extension services, farmers are able to access vital information regarding to new agricultural innovations. This finding is consistent with the results of Joshi et al. (2019), where a unit increase in training led to a 20.1% increase in GAP knowledge. The results suggest that training and extension services play a crucial role in enhancing farmers' awareness and knowledge of good agricultural practices.

Additionally, the study revealed positive association of access to market information with Global GAP awareness. This is possible because through market information producers are able to know what is trending on new agricultural practices and why the market is demanding a change in quality and standards. Bonephace et al. (2022) in their study on assessment of awareness of farmers on agricultural information services in Mara Region in Tanzania, highlighted that farmers need agricultural and market information to become aware of innovative farming system.

The distance to both input and output markets was found to be negatively associated with the level of awareness. This indicates that farmers who are near agricultural input and output markets tend to be more aware of new agricultural innovations and active participants in the market. This aligns with the results of Haile et al. (2022) who found that increment of distance to the market, reduced the market participation in Ethiopia.

Household size and the number of farming associations to which a respondent belonged to did not show significant associations with the level of Global GAP awareness. However, findings of Joshi et al. (2019) indicated that a unit increase in household size led to a 0.2% increase in GAP awareness.

Years of chili farming was positively associated with the Global GAP awareness. This is possible because Lira smallholder hot pepper farmers who have been consistently farming hot pepper are more informed on what trends on hot pepper production and the market requirement that farmers who have few years of hot pepper production. Furthermore, farmers with more years of farming tend to be aware of quality and other product standards required for the crops they have been cultivating. Similar results were found by Joshi (2019).

5.3 Determining the key factors associated with the level of Global GAP compliance among smallholder hot pepper farmers

5.3.1 Level of compliance of Global GAP standards

The study results exhibited about fifty-eight percentage compliance on traceability of produce and its safety. This highlights lower compliance, and it is possible because chili from Uganda has been facing rejection at international markets due to presence of false codling moth and high level of pesticide residuals (Dijkxhoorn et al., 2019; Wakabi, 2019). In the context of farm area and environmental considerations, compliance reached about seventy four percent. This is possible because some of the farmers under NECPA received trainings on chili organic farming practices and they were also introduced to Global GAP trainings but there is still a lot to do because this level of compliance does not meet the set standard of Global GAP. In the study conducted by Kassem et al. (2020), it was noted that respondents demonstrated satisfactory compliance with

Global GAP standards in terms of traceability but fell short of compliance in environmental aspects. Furthermore, a separate study on the Awareness and Adoption of Good Agricultural Practices among Smallholder farmers in Nigeria (Sennu et al., 2020) revealed deficiencies in appropriate water management in farming areas and inadequate pest management.

Worker safety and health achieved a level of compliance of seventy seven percent which implied that health of the work is somewhat taken in consideration however this percentage does not meet the Global GAP set standards. Similar findings were reported in other studies, where farmers displayed limited compliance with Global GAP requirements concerning worker safety, health, and welfare (Pandit et al., 2017; Kassem et al., 2020). Ensuring the personal hygiene of agricultural workers is crucial for reducing biological hazards and preventing the spread of diseases, whether through food contamination, contaminated water, toilets, or other facilities (EU, 2012). It is noteworthy that the inspection of agricultural workers' conditions has received limited attention, as highlighted by the International Labour Organization (ILO, 2016).

5.3.2 Factors associated with the level of Global GAP compliance

Access to extension services showed positive relationship with Global GAP compliance. This is because extension services like training enhances dissemination of new agricultural innovations to the farmers. This implies that Lira smallholder hot pepper farmers with access to extension services are more likely to comply with food safety standards. This finding is consistent with the findings of Chelang'a et al. (2023), where they found that the access to extension services like training were statistically significant with Global GAP compliance. This emphasises that farmers who partake training through either government or private organizations are likely to adopt and show higher levels of compliance.

Farmers with access to credit were observed to be compliant with Global GAP standards. This implies that Lira smallholder hot pepper farmers who have farming credit are more likely to comply with food safety standards. This is possibly because it helps farmers to have money needed for implementation of what is required to meet the criteria. This was in line with the study on factors influencing the sustained adoption of innovative techniques by urban farmers in Lubumbashi by Nsele et al. (2022), where access to credit was significantly associated with adoption of integrated soil fertility management innovation package and the use of motor pumps for irrigation in urban farming.

The level of awareness was found to be positively associated with the level of Global GAP compliance. This implies that Lira farmers who had more of awareness were more compliant and this is possible because as farmers become aware of existence of Global GAP standards, requirements, and benefits of meeting those requirements, farmers aim at achieving the standards to enjoy the privileges. These findings were in line with the results from Gichuki et al (2020) that availability of Global GAP information through trainings significantly influenced GAP certification for all types of farmers.

A family with more members participating in chili farming was found to be compliant with Global GAP standards. This implies that as more family members engage in farming, they ease the labour burden and thus facilitating the implementation of required standards which is applicable to smallholder farmers in Lira districts. Similarly, Abdulai et al. (2011) found that increase in family size participating in farming increased the adoption of irrigation technologies. More so, Shikuku et al. (2017) found related result in their study on smallholder farmers' attitudes and determinants of adaptation to climate risks in East Africa.

Years of formal education did not have significant relationship with the level of compliance of Global GAP standards. This is possible because educated people tend to abandon agriculture because it highly perceived as the last option which is likely to be similar case in Lira district. However, Srisopaporn et al. (2015) found that education improves farmers' ability to adjust to changes. Furthermore, Krause et al. (2016) noted that years of formal education among orchid farmers positively influenced the adoption of Public Good Agricultural practices. More so, Chelang'a et al. (2023) suggested that households with members with high number of years of formal education were more equipped with skills to understand the importance of Global GAP and thus influencing adoption and level of compliance.

Household size did not show significant relationship with the level of Global GAP compliance. Contrary, Nthambi et al. (2013) reported that an increase in the number of household members resulted in a decrease in individual farm compliance with GAP in export of vegetables. Additionally, Chelang'a et al. (2023) found that household size was negatively and statistically significant where addition of household member reduced the adoption of Global GAP by 11%. This is possible because different household members are likely to pursue different forms of investment to diversify income streams.

Chili farming experience showed no significant association with the level of Global GAP compliance. This implied that smallholder chili farmers in Lira trusted their old practices than adapting to new changes. Huang & Karimanzira (2018), noted that producers with more years of farming experience were more likely to stick with the original methods that were familiar to them instead of trying newer farming practices. Contrary, Chelang'a et al. (2023); Suwanmaneepong et

al. (2016) found that the number of years in farming were positively associated with implementation of good agricultural practices.

Land size under chili production did not significantly influence the level of Global GAP compliance. This possible because, smallholder farmers tend to produce both income and food crops dedicating small size of land to chili production which makes it not profitable to meet the cost of implementation of Global GAP requirements. However, the results from the study of Sennuga et al. (2023), revealed that farm size was positively and significantly associated with the likelihood of adopting improved technologies in maize production in Nigeria. But land size cultivated negatively influenced wealthy farmers to invest in Global GAP certification (Gichuki et al., 2020).

Farmers with higher monthly income were observed to be compliant with Global GAP standards and this possible because they have economic capacity to meet the costs of implementing Global GAP requirements. Contrary, Gichuki et al, (2020) found that the empirical estimates revealed that wealth index of farmers did not significantly influence compliance of Global GAP. This implies that higher monthly income makes people to invest in other businesses rather than agriculture. However, smallholder hot pepper farmers in Lira with more income invested more in hot pepper farming as potential business to diversify income streams.

Farmers who had access to market information were positively associated with the level of Global GAP compliance. Access to market information alerts producers on what is trending in the market and help them to plan according to the market requirements. Similarly, Magesa et al, (2014) indicated that market information facilitates farmers in planning their production in line with market demand, time the harvest for optimum profit and decide which market to sell their produce.

This implies that to increase the level of compliance among smallholder farmers in Lira and in other areas where horticulture is practiced easing accessibility to the market information is the key.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

This study focused on compliance of Global GAP standards among smallholder farmers in chili production and it determined the level of awareness, level of compliance and factors associated with the level of awareness and level of compliance of Global GAP standards.

On awareness, this study found low level of awareness and highlights the various factors influencing the level of awareness of Global GAP among smallholder chili farmers. Education, training, access to market information, proximity to markets, and farming experience were found to be significant determinants of awareness, while household size and farming associations showed less pronounced associations.

On level of Global GAP compliance, averagely the study found that farmers did not meet the compliance percentage of Global GAP standards and shed lights on the multifaceted factors influencing Global GAP compliance among chili farmers, emphasizing the role of education, extension services, access to farming credit, creation of awareness, and household participation in promoting adherence to these standards.

6.2 Conclusion

Awareness of Global GAP was found to be averagely low (8.02%). Among the possible reasons as to why the level of awareness was low in comparison with the level of compliance was the way level of awareness was captured. The respondent had to recall Global GAP control points from the head. Meanwhile level of compliance involved an interviewer observing the field where needed and mentioning Global GAP control point to interviewee, and the interviewee could answer yes if he/she practices and answer no, if she/he does not practice. This could have limited the practices

that a farmer could recall for level of awareness, in comparison of saying yes or no to the Global GAP control point mentioned by the interviewer. Another possible reason is that farmers might be doing a good agricultural practice without knowing that it is part of Global GAP standards and find him/herself practicing it when it is mentioned on the list of control point while an interviewer is capturing data for Global GAP compliance. Awareness is the baseline to compliance with agricultural innovations. The level of awareness of Global GAP was associated with chili farming experience, distance to nearest input and output market but more emphasis was observed on access to extension services especially training service to the farmers, access to market information and the level of education of the farmer.

In the context of the study, these results suggest that there is a need for increased awareness and education regarding good agricultural practices, particularly with regard to Global GAP standards. The majority of the surveyed farmers had low awareness (8.02%), which could impact the quality of their agricultural practices and potentially limit their productivity and sustainability thus a barrier to lucrative export markets.

Due to the fact that the level of Global GAP compliance should be 100% in major must control points and 95% in minor must control points of Global GAP standards, the level of compliance (69.29%) is very low. This proves the reasons as to why chili has been facing limitations to international markets especially EU markets where Global GAP standards must be met. However, it was observed that the level of compliance was high compared to the level of awareness.

Among the factors associated with the level of Global GAP compliance were access to farming credit, access to extension services, number of households in chili farming, access to market information, and the level of awareness.

6.3 Recommendations and study limitation

6.3.1 General Recommendations

Agricultural export especially horticultural products have potential to economically improve rural and agricultural communities in developing countries, but this is possible when farmers can embrace agricultural innovations, technologies, meeting international market requirements and food safety standards set by countries receiving those products. The study found that farmers are barely aware of agricultural innovations and food safety standards, thus this study recommends policy makers, export promoters and other influential government and non-government entities to create interventions that emphasize awareness of agricultural innovations like food safety standards that will facilitate compliance of export market prerequisites.

Government and other responsible entities can increase access to extension services by providing training and evaluating its effectiveness, providing timely and adequate market information to the farmers, public sensitization in community meetings and other social gatherings while helping farmers to realize the importance of new agricultural innovations thus increasing the level of awareness of new agricultural innovations.

The level of Global GAP compliance was not satisfactory and it was highly associated with access to farming credit, access to market information, access to extension services, the number of family members in chili farming and the level of awareness of Global GAP. Government and non-government entities should create intervention to increase the level of compliance with food safety standards. They should focus on programs that can increase the level of awareness possibly through trainings and follow ups to find out whether the training created the intended impact.

More so, provision of on-time and right market information through channels accessed by most smallholder farmers like radios, extension agents, input and output markets should be given a priority. Additionally, easing access to farming credit would solve lots of issues like increasing land size dedicated to horticultural production, motivating other household members to engage in farming as potential business and helping the farmer to meet market and food safety standards and thus, accessing lucrative export market.

Due to high risks farming is always associated with, farmers have difficulties in accessing adequate finance to do farming as a stable business, government and other financial institutions are urged to work together to ease the terms and conditions to finance smallholder farmers and to attract more business-oriented farmers in the sector since it is the backbone of economic prosperity in developing countries.

6.3.2 Study limitation

This study had only one limitation which was limited access to already existing published research. The majority of primary authors who were contacted to share their articles were not responding. Articles which were not on free access and not accessible through our institution were hard to get.

6.3.3 Recommendations for further studies

Despite the knowledge that chili is among the crops that can potentially improve farmers' livelihoods in rural communities, smaller parcels of land were allocated to hot pepper production. This study recommends exploring factors associated with the land allocation decisions and choice of enterprises for smallholder farmers. Further, there is need conduct other studies ascertain factors that constrain hot pepper production and marketing participation in Uganda.

REFERENCES

- Abdulai, A., Owusu, V. & Bakang, J.E.A. (2011). Adoption of safer irrigation technologies and cropping patterns: Evidence from Southern Ghana. *Ecol.Econ*, 70, 1415-1423.
- Acaye, G. & Odongo, J.C.W. (2018). Contributions of African Bird's Eye Chili (*Capsicum frutescens*) to Household Income of Smallholder Farmers in Northern Uganda: A case Study of Paicho Sub-County. *Asian Journal of Agricultural Extension, Economics & Sociology*, 23(2), 1-9. doi:10.9734/AJAEES/2018/39829
- Adjimoti, G. & Kwadzo, G. (2018). Crop Diversification and Household Food Security Status: Evidence from Rural Benin. *Agriculture and Food Security*, 7(82), 1-12. doi:10.1186/s40066-018-0233-x
- AGRA. (2016). Tanzania Early Generation Seed Study, AGRA-SSTP for the United State Agency for International Development: Washing. *Alliance for Green Revolution in Africa (AGRA)*. Washington DC, USA.
- Ali, D., Frederick, B., Klaus, D., Marguerite, D. (2016). Investigating the Gender Gap in Agricultural Productivity: Evidence from Uganda. *World Development*, 87, 156-170. doi:10.1016/j.worlddev.2016.06.006
- Anang, B.T. & Zakariah, A. (2022). Socioeconomic drivers of inoculant technology and chemical fertilizer utilization among soybean farmers in the Tolon District of Ghana. *Heliyon*, 8(2022). doi:<https://doi.org/10.1016/j.heliyon.2022.e09583>
- Asamoah, C. & David, S. (2011). Farmer knowledge as an early indicator of IPM adoption: A case study from cocoa. *Journal of Sustainable Development Africa*, 13(4), 213-224.
- Atwine, B., Guloba, M & Nakitende, P. (2022). *Does Uganda's food policy environment respond to the food safety needs of the population?* Kampala: EPRC. Retrieved July 17, 2023, from <https://eprcug.org/publication/does-ugandas-food-policy-environment-respond-to-the-food-safety-needs-of-the-population/?wpdmdl=15376&refresh=6761e32647f111734468390>
- Baah, P. A., Akwasi, M.B & Jatoe, D. (2013). Compliance with Global GAP standards among smallholder pineapple farmers in Akuapem-South, Ghana. *Journal of Agribusiness in Developing and Emerging Economies*. doi:10.1108/JADEE-05-2013-0017
- Barnes, B.N., Hofmey, J.H., Groenewald, S., Conlong, D.E. and Wohlfarter, M. (2015). The sterile insect technique in agricultural crops in South Africa: A metamorphosis... but will it fly? *African Entomology*, 23(1), 1-18.
- Bernier, Q., Meinzen-Dick, R., Kristjanson, P., Kovarik, E.H.,... & Bryan, E. (2015). Gender and Institutional Aspects of Climate-Smart Agricultural Practices: Evidence from Kenya working paper No.79. *Copenhagen: CGIAR Research Program on Climate change, Agriculture and Food Security (CCAFS)*.

- Bonephace, E.M., Gui, X. & Makawia, P.J. (2022). Assessment of awareness of farmers on agricultural information services in Mara Region, Tanzania. *Library Philosophy and Practice (e-journal)*. Retrieved Nov 9th, 2023, from <https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=13830&context=libphilprac>
- Buyinza, M. & Mugagga, F. (2010). Economic viability of hot pepper (*Capsicum frutescens*). *Journal of Innovation and development strategy*, 4(1), 12-17.
- CABI. (2022, September 21). Uganda enjoys increased capacity to access more profitable regional and European markets. Retrieved December 8th, 2022, from <https://www.cabi.org/news-article/uganda-enjoys-increased-capacity-to-access-more-profitable-regional-and-european-markets/>
- Chelang'a, N.C., Kariuki, I.M., Obare, G.A., & Otieno D.O. (2023). Determinants of adoption of Global GAP standards: Evidence from smallholder French beans farmers in Murang'a county, Kenya. *Cogent Food & Agriculture*. doi:<https://doi.org/10.1080/23311932.2023.2176949>
- Daberkow, S.G. & McBride, W.D. (2003). Farm and operator characteristics affecting the awareness and adoption of precision agriculture technologies in the US. *Precis. Agric.*, 4(2), 163-177.
- Dijkshoorn, Y., Galen, M., Barungi, J., Okiira, J., Gema, J. & Janssen, V. (2019). *Uganda vegetables and Fruit sector: Competitiveness, investment and Trade Options*. Wageningen: Wageningen Economic Research.
- EPRS. (n.d.). *Which sectors can be large scale job creators for Uganda*. Economic Policy Research center (EPRS). Retrieved May 20, 2022, from : https://eprcug.org/press-releases/which-sectors-can-be-large-scale-job-creators-for-uganda-2/?utm_source=rss&utm_medium=rss&utm_campaign=which-sectors-can-be-large-scale-job-creators-for-uganda-2
- EU. (2012). Protecting health and safety of workers in Agriculture, livestock farming, horticulture and forestry. Retrieved October 5th, 2023, from <https://osha.europa.eu/en/tools-and-publications/publications/protecting-health-and-safety-workers-agriculture-livestock>
- Fadairo, O., Williams, P.A. & Nalwanga, F.S. (2019). Perceived livelihood impacts and adaption of vegetable farmers to climate variability and change in selected sites from Ghana, Uganda and Nigeria. *Environmental, Development and Sustainability*. doi:<https://doi.org/10.1007/s10668-019-00514-1>
- Fagotto, E. (2013). Private roles in food safety provision: the law and economics of private food safety. *European Journal of Law and Economics*, 37, 83-109.
- Fajarwaty, T. & Jukes, D. (2022). Assessing food safety compliance for food SMEs in Indonesia. *IOP Conference Series: Earth and Environmental Science* (p. 1041). IOP Publishing. doi:[10.1088/1755-1315/1041/1/01/2074](https://doi.org/10.1088/1755-1315/1041/1/01/2074)

- FAO. (2016). *A scheme and training manual on good agricultural practices(GAP) for fruits and vegetables* (Vols. The scheme-standard and implementation infrastructure). Bangkok: FAO.
- FAO. (2023). *Agricultural production statistics 2000-2022*. Rome: FAO. doi:10.4060/cc9205en
- FAO. (2023, July 4). *Good Agricultural Practices (GAP) in a simple and easy way*. Retrieved from Food and Agriculture organization of the United Nations: [https://www.fao.org/lebanon/news/detail/Good-Agricultural-Practices-\(GAP\)-in-a-simple-and-easy-way/en#:~:text=Good%20Agricultural%20Practices%2C%20as%20defined,%2C%20social%20and%20environmental%20sustainability%E2%80%9D](https://www.fao.org/lebanon/news/detail/Good-Agricultural-Practices-(GAP)-in-a-simple-and-easy-way/en#:~:text=Good%20Agricultural%20Practices%2C%20as%20defined,%2C%20social%20and%20environmental%20sustainability%E2%80%9D).
- Fuchs, D., Kalfagianni, A & Havinga, T. (2011). Actors in Private food governance: The legitimacy of retail standards and multistakeholder initiatives with civil society participation. *Agriculture and Human Values*, 8(3).
- Gafoor, K. (2012). Considerations in the measurement of awareness . *National Level seminar on Emerging Trends in Education* . Kerala, India: University of Calicut.
- Gichuki, C.N., Han, J., & Njagi, T. (2020). Global GAP Production Standards: Evidence from Smallholder farmers in Kenya. *Agriculture*, 10(2), 50. doi:<https://doi.org/10.3390/agriculture10020050>
- Giovanucci, D., & Reardon, T. (2001). Understanding grades and standards and how to apply them. A guide to developing agricultural markets and agroenterprises. *The Worldbank*. Washington.
- GLobalGAP. (2022). *How we created a common standard*. GLOBAL G.A.P. Retrieved July 12th, 2022, from <https://www.globalgap.org/about/history/#:~:text=Our%20story%20begins&text=In%201997%2C%20the%20working%20group,for%20best%20practices%20in%20agriculture>.
- Greene, W. (2000). *Econometric analysis* (Fourth ed.). New York: Pretice Hall International, Inc.
- Haile, K., Gebre, E. & Workye, A. (2022). Determinants of market participation among smallholder farmers in Southwest Ethiopia: Double-hurdle model approach. *Agric & Food security*, 11(18). doi:<https://doi.org/10.11186/s40066-022-00358-5>
- Hammoudi, A., Hoffmann, R. & Surry. Y. (2009). Food safety standards and agri-food supply chains: an introductory overview. *European Review of Agricultural Economics*, 36(4), 469-478.
- Handschuch, C., Wollni, M. & Villalobos, P. (2013). Adoption of food safety and quality standards among Chilean raspberry producers-Do smallholders benefit? *ELSEVIER*.
- Hazem, S. K., Bader A., Aldosari F.O., Herab,A.& Ghozy, R. (2020). Factors influencing smallholder orange farmers for compliance with Global GAP standards. *Saudi Journal of Biological science*. doi:<https://doi.org/10.1016/j.sjbs.2020.11.070>

- Horton, D. (2008). *Facilitating pro-poor market chain innnovation: An assessment of the participatory market chain approach in Uganda*. International Potato Center. Social Sciences.
- Huang, Z., & Karimanzira, T.T.P. (2018). Investigating Key Factors Influencing Farming Decisions Based on Soil Testing and Fertilizer Recommendation Facilities (STFRF). A case study on rural Bangladesh. *Sustainability*, 10(11), 4331. doi:<https://doi.org/10.3390/su10114331>
- ILO. (2016). Safety and Health in Agriculture. *Internation Labour Organization*. Geneveva. Retrieved October 5th, 2023, from https://www.ilo.org/wcmsp5/groups/public/—ed_protect/—protrav/—safework/documents/publication/wcms_110193.pdf
- ITA. (n.d.). *Uganda-Country Commercial Guide*. International Trade Administration. Retrieved June 1, 2021, from <https://www.trade.gov/country-commercial-guides/uganda-agricultural-sector>
- Joshi, A., Kalauni, D. & Tiwari, U. (2019). Determinants of awareness of good agricultural practices (GAP) among banana growers in Chitwan, Nepal. *Journal of Agriculture and Food Research*. doi:10.1016/j.jafr.2019.100010
- Kankya, C., Mukungu,T., Hoona,J.J., Mukanga,A., Nantongo,S, Nanyanzi, J., Nasinyama,G., Ayebale,R., & Justine, O.J. (2020). *Situation analysis of Food Control system in Uganda*. Kampala.
- Karungi, J., Kyamanywa, S., Adipala, E. & Erbaugh, M. (2011). Pesticide utilization, regulation and future prospects in small scale horticultural crop production systems in a developing country. In M. Stoytcheva, *Pesticides in the modern World - pesticides use and management*. Kampala (Uganda).
- Kassem, S.H., Alotaibi, A.B., Aldosari, O.F., Herab, A. & Ghazy, R. (2020). Factors influencing smallholder orange farmers for compliance with GlobalGAP standards. *Saudi Journal of Biological Science*, 28(2021), 1365 - 1373.
- Kibet, N., Obare, G.A., Lagat, J.K. (2018). Risk attitude effects on GlobalGAP certification decisions by smallholder French bean farmers in Kenya. *Journal of Behavioural Experimental Finance*, 18, 18-29.
- Krause, H., Lippe, R. S., & Grote, U. (2016). Adoption and income effects of public GAP standards: Evidence from the horticultural sector in Thailand. *Horticulture*, 2(4), 18. doi:<https://doi.org/10.3390/horticulturae2040018>
- Lamuka, P. (2014). Challenges of developing countries in management of food safety. *Encyclopedia of food safety*, 20-26.
- Lemeilleur, S. (2013). Smallholder Compliance with Private Standard Certification: The Case of GlobalGAP Adoption by Mango Producers in Peru. *International Food and Agribusiness Management Review*, 16(4).

- Lin, S., Chou, Y., Shieh, H., Elbert, A.W., Kumar, S., Mavlyanova, R.....& Gniffke, P.A. (2013). Pepper (*Capsicum* spp.) Germplasm Dissemination by AVRDC- The World Vegetable Center: An overview and Introspection. *Chronica Horticulturae*, 53.
- Lynne, G. (1988). Attitude and Farmer Conservation Behavior. *American Journal of Agricultural Economics*, 70, 12-19.
- MAAIF. (2019). *The press briefing on phytosanitary/end-market standards for compliance for horticultural exports from Uganda 09th April 2019*. Kampala: Uganda Media center. Retrieved Feb 15, 2023, from <https://www.mediacentre.go.ug/media/press-statement-phytosanitary-end-market-standards-compliance>
- Magesa, M.M., Michael. K. & Ko, J. (2014). Agricultural Market Information Services in Developing Countries: A review. *ACSIJ Advances in computer Science: An International Journal*, 3(3).
- Malkanthi, S.H.P., Thenuwara, A.M. & Weerasinghe, W. (2021). Attitude of vegetable farmers in Galle district in Srilanka towards Good Agricultural Practices (GAP). *Contemporary Agriculture*, 70(1-2), 54-66. doi:10.2478/contagri-2021-0010
- McDonald, JF. and Moffit, R.A. (1980). The uses of Tobit Analysis. *Review of Economics and Statistics*. 62, 318-321.
- MoFPED&EPRC. (2019). *Agricultural year book 2019: Development finance for Agri-industrialization*. Kampala: Ministry of Finance Planning and Economic Development and Economic Policy Research Center (MoFPED& EPRC).
- Muriithi, B., Mburu, J. & Ngigi, M. (2011). Constraints and determinants of compliance with EurepGAP standards: A case of smallholder French bean exporters in Kirinyaga District, Kenya. *Journal of Agribusiness*, 27(2), 193-204.
- Mustapha, S. & Kuwornu, J.K. (2013). Global GAP standards compliance and smallholder pineapple farmers' access to export markets: Implications for incomes. *Journal of Econ. Behav. Stud.*, 5(2), 69-81.
- Muzira, F. (2015). Incidence, yield loss and economic injury levels of key insect pests of hot pepper (scotch bonnet) in major growing districts of Uganda. Msc Thesis.
- Mwalusaka, N. (2021). Agricultural information sources used for climate change adaptation in Tanzania. *Library Review*, 62(4), 66-292. doi:<https://doi.org/10.1108/LR-12-2011-0096>
- Mwangi, J. M., Chitere, P. O., Kariuki, J. G. (2022). Social inequalities influencing awareness of good agricultural practices among smallholder farmers in Murang'a county in Kenya. *Journal of Agribusiness and Rural development*, 3(65), 189-195. doi:<http://dx.doi.org/10.17306/J.JARD.2022.01568>
- Mwangi, J.M, Chitere, P.O, Kariuki, J.G. (2022). Social inequalities influencing awareness of Good Agricultural Practices among smallholder farmers in Murang'a County in Kenya. *Journal*

- of *Agribusiness and Rural Development*, 3(65), 189-195.
doi:<http://dx.doi.org/10.17306/J.JARD.01568>
- Nsele, M.K., Fyama, J.N.M., Marechal, K.& Dogot, T. (2022). Factors Influencing the Sustained Adoption of innovative Techniques by Urban Farmers in Lubumbashi, Democratic Republic of Congo. *Agriculture*, 12, 1157.
doi:<https://doi.org/10.3390/agriculture12081157>
- Nthambi, M., Mburu, J. I., & Nyikal, R. (2013). Smallholder Choice of Compliance Arrangements: The case of Global GAP adoption by French Bean Farmers in Kirinyaga, Mbooni, and Buuri/Laikipi Districts (No. 309-2016-5178). *Agri. Econ.*
doi:<https://dx.doi.org/10.22004/ag.econ.161471>
- Ochieng, J., Schreinemachers, P., Ogadac, M., Dinssad, F.F., Barnose, W., Mndigaf, H. (2019). Adoption of Improved amaranth varieties and good agricultural practices in East Africa. *Journal of Land use policy*, 83, 187-194.
- Ololade, R.A. & Olagunju, F.I. (2013). Determinants of access to credit among rural farmers in Oyo state, Nigeria. *Glob.J.Sci. Front. Res. Agric. Veterz.Sci.*, 13(2), 16-22.
- Onen, G. (2019). *Challenges and benefits of international guidelines, standards, and regulations: The Ugandan case. International Symposium on Food Safety and Quality: Application of Nuclear Related Techniques.*
- Owusu, S. (2017). Effect of access to credit on agricultural productivity: evidence from cassava farmers in the Afigya-Kwabre district of Ghana. *Int. J. Innov. Res. Soc. Sci. Strat. Manag. Tech.*, 4(2), 55-67.
- Pandit, U., Nain, M.S., Singh, R., Kumar, S., Chahal, V.P. (2017). Adoption of Good Agricultural Practices (GAPs) in Basmati (scented) rice: A study of prospects and retrospect. *Indian Journal of Agricultural Science*, 87(1), 36-41.
- Parikhani, M.P., Borkhani, F.R., Fami, H.S., Motiee, N., Hosseinpoor, A. (2015). Major barriers to application of Good Agricultural Practices (GAPs) technologies in sustainability of livestock units. *International Journal of Agricultural management and Development*, 5(3), 169-178.
- Rahmat, S., Cheong, C.B. & Hamid, M.S. (2015). Challenges of developing countries in complying quality and enhancing standards in food industries. *Procedia-Social and Behavioral Sciences*, 224(2016), 445-452.
- RAM. (n.d.). *World-Pepper-Market Analysis, Forecast,Size,Trends and Insights*. Retrieved September 20, 2023, from <https://www.researchandmarkets.com/report/pepper>
- Roberts, R., Kasirye, I. & Roberts, K. (Eds.). (2015). *Agricultural Finance yearbook 2015*.
- Rooij, B.V, & Rorie, M. (2022). *Measuring compliance: Assessing Corporate Crime and Misconduct Prevention*. Cambridge University Press. Retrieved Jan 16th, 2023, from

https://www.google.co.ug/books/edition/Measuring_Compliance/VxhdEAAAQBAJ?hl=en&gbpv=1&dq=what+is+compliance&printsec=frontcover

- Saleh, B.K, Omer, A. & Teweldemedhin, B. (2018). Medicinal uses and health benefits of chili pepper (*Capsicum* spp.): a review. *MedCrave*, 6(4).
- Sanko, R., Njue, E., Ssebuliba, J. & De Jager, A. (2005). *The horticultural sector in Uganda*. International Society of Horticultural Science (ISHS).
- Schipper, B. (2014). *Logics for Knowledge and Belief*. London: College publications.
- Sell, M. & Minot, N. (2018). What factors explain women's empowerment? Decision-making among small-scale farmers in Uganda. *Women's studies International forum*, 71, 46-55. doi:[hptt://doi.org/10.1016/j.wsif.2018.09.005](https://doi.org/10.1016/j.wsif.2018.09.005)
- Sennuga, S.O., Baines, R.N., Conway, J.S. & Angba, C.W. (2020). Awareness and Adoption of Good Agricultural Practices among Smallholder Farmers in relation to the Adopted Villages programme: The case study of Northern Nigeria. *Journal of Biology, Agriculture and Healthcare*, 10(6). doi:10.7176/JBAH/10-6-06
- Sennuga, S.O., Bamidele, J., Bankole, O.L., Alabuja, F.O., Preyor, T.J., Barnabas, T.M. & Haruna, L.Z. (2023). Factors Influencing Farmers' Adoption of Improved Technologies in Mainze Production in Kuje Area Council of FCT-Abuja, Nigeria. *Journal of Agriculture and Research*, 6(4), 25-41. doi:10.5281/zenodo.7924557
- Sharifzadeh, M.S., Abdollahzadeh, G., Damalas, C.A. Rohollah, R. (2018). Farmers' criteria for pesticide selection and use in the pest control process. *Journal of Agriculture*, 8(24). doi:10.3390/agriculture8020024
- Shikuku, K.M., Winowiecki, L., Twyman, J., Eitzinger, A., Perez, J.G., Mwongera, C. & Laderach, P. (2017). Smallholder farmers' attitudes and determinants of adaption to climate risks in East Africa. *ELSEVIER*, 16, 234-245. doi:<http://dx.doi.org/10.1016/j.crm.2017.03.001>
- Singh, D. & Yadav, S.K. (2014). Knowledge and Adoption gap of Tribal farmers of Bastar towards Rice Production. *American International Journal of Research in Humanities, Arts and Social Sciences*, 5(1), 54-56.
- Smith, D. (2003). Tobit Models in Social Science Research: Limitation and a More General Alternatives. 31, 364 - 388.
- Splett, N.S., Barry, P.J., Dixon BL and Ellinger, P.N. (1994). A Joint Experience and Statistical Approach to Credit Scoring: Agricultural Finance Review. 54, 39-54.
- Srisopaporn, S., Jourdain, D., Perret, S. R., & Shivakoti, G. (2015). Adoption and continued participation in a public Good Agricultural Practices Program: The case of rice farmers in the Central Plains of Thailand. *Technological Forecasting and Social Change*, 96, 242-253. doi:<https://doi.org/10.1016/j.techfore.2015.03.016>

- Suwanmaneepong, S., Kullachai, P., & Fakkhong, S. (2016). An investigation of factors influencing the implementation of G.A.P. among fruit farmers in Rayong Province in Thailand. *International Journal of Agricultural Technology*, 12(7.2), 1745-1757.
- Swisscontact. (2022). *Swisscontact and hortifresh organize a dialogue meeting on the new EU measures on capsicum exports from Uganda*. Retrieved June 15, 2022, from <https://www.swisscontact.org/en/news/swisscontact-and-hortifresh-organize-a-dialogue-meeting-on-the-new-eu-measures-on-capsicum-exports-from-uganda>
- Terry, K. W. & Boyhan, G. (2006). Pepper Histroty, Scope, Climate and Taxonomy. In *Commercial Pepper Production Handbook*. (p. 56). The University of Georgia Co-operative Extention Bulletin.
- Timmermans, B. & Cleeremans, A. (2015). How can we measure awareness? An overview of current methods. Oxford University Press.
- Tobin, J. (1958). Estimation of Relationship for Limited Dependent Variables. *Econometrica*. 26, 29-39.
- Trienekens, J., & Zuurbier, P. (2008). Quality and safety standards in the food industry, developments and challenges. *International Journal of Production Economics*, 107-122.
- Tusiime, G., Tukamuhabwa, P., Nkalubo, S., Awori, E. & Tumwekwase, S. (2010). Development of a hot pepper root rot and wilt rot disease management strategy through genetic resistance, chemical application and proper choice of rotational crops. *The second RUFORUM Biennial meeting 20-24 September 2010*. Entebbe.
- UBOS. (2021). *Uganda National Household survey: Uganda National Survey Report 2019/2020*. Kampala: Uganda Bureau of Statistics. Retrieved October 20, 2023, from https://www.ubos.org/wp-content/uploads/publications/09_2021Uganda-National-Survey-Report-2019-2020.pdf
- UBOS. (2021). Quartely Gross Domestic product, 4th quarter 2020/2021.
- UIA. (2009). Investment in Uganda. Potentials in fresh and minimally processed fruits and vegetables for export.
- Unnevehr, L. (2014). Food safety in developing countries: Moving beyond exports. Global food security.
- Vellema, S & Boselie, D. (2003). Cooperation and competence in global food chains. Perspectives on food quality and safety. *Shaker Publishing, Maastricht*.
- Vu, H.V., Ho, H. & Le, Q.H. (2020). Impact of Farmers' Associations on Household Income: Evidence from Tea Farms in Vietnam. *Economies*, 8(4), 92. doi:<https://doi.org/10.3390/economies8040092>

- Wakabi, M. (2019). *Uganda restricts Chili export to avoid EU ban*. The EastAfrican. Retrieved July 6, 2019, from <https://www.theeastafrican.co.ke/tea/business/uganda-restricts-chilli-exports-to-avoid-eu-ban-1433472>
- Wakholi, C., Cho, B.K., Mo, C. & Kim, M.S. (2015). Current State of Postharvest Fruit and Vegetable Management in East Africa. *Journal of Biosystems Engineering*. doi:<http://dx.doi.org/10.5307/JBE.2015.40.3.238>
- Wang, X & Cheng, Z. (2020). Cross- sectional studies: Strengths, Weaknesses, and recommendation. *CHEST*. doi:<https://doi.org/10.1016/j.chest.2020.03.012>
- Yamane, T. (1967). *Statistics: An introductory Analysis* (2nd ed.). New York: Harper and Row.
- Zou, Z. & Zou, X. (2021). Geographical and Ecological Differences in Pepper Cultivation and Consumption in China. *Frontiers in Nutrition*. doi:10.3389/fnut.2021.718517

APPENDIX

Appendix I: Table of control points and compliance criteria of Global GAP

No	Control point	Compliance Criteria	Level	Yes (1)	No (0)	N/A	Justification
FV	FRUIT AND VEGETABLES						
FV 1	SITE MANAGEMENT						
FV 1.1	Risk Assessment						
FV 1.1.1	Does the risk assessment for the farm site carried out as identified in AF 1.2.1 make particular reference to microbial contamination?	As part of their risk assessment for the farm site (see AF 1.2.1), producers shall identify the locations of nearby commercial animal operations, composting and potential sources for ingress by domestic and wild animals, and other contamination routes such as floodwater intrusion and dust.	Major Must				
FV 1.1.2	Has a management plan that establishes and implements strategies to minimize the risks identified in FV 1.1.1 been developed and implemented?	A management plan addresses the risks identified in FV 1.1.1 and describes the hazard control procedures that justify that the site in question is suitable for production. This plan shall be appropriate to the products being produced and there shall be evidences of its implementation and effectiveness.	Major Must				
FV 2	SOIL MANAGEMENT (N/A IF NO SOIL FUMIGATION IS PRACTICED)						

FV 2.1	Soil Fumigation (N/A if no Soil Fumigation)						
FV 2.1.1	Is there a written justification for the use of soil fumigants?	There is written evidence and justification for the use of soil fumigants including location, date, active ingredient, doses, method of application and operator. The use of methyl bromide as a soil fumigant is not permitted.	Minor Must				
FV 2.1.2	Is any pre-planting interval complied with prior to planting?	Pre-planting interval shall be recorded.	Minor Must				
FV 3	SUBSTRATES (N/A IF SUBSTRATES ARE NOT USED)						
FV 3.1	Does the producer participate in substrate recycling programs for substrates where available?	The producer keeps records documenting quantities recycled and dates. Invoices/loading dockets are acceptable. If there is no participation in a recycling program available, it should be justified.	Recom.				
FV 3.2	If chemicals are used to sterilize substrates for reuse, have the location, the date of sterilization, type of chemical, method of sterilization, name of the operator and pre-planting interval been recorded?	When the substrates are sterilized on the farm, the name or reference of the field, orchard, or greenhouse is recorded. If sterilized off farm, then the name and location of the company that sterilizes the substrate are recorded. The following are all correctly recorded: The dates of sterilization (day/month/year), the name and active ingredient, the machinery (e.g., 1000 l tank, etc.), the method (e.g. drenching, fogging, etc.), the operator's name (i.e. the person who actually applied the chemicals and did the sterilization), and the pre-planting interval.	Major Must				

FV 3.3	If a substrate of natural origin is used, can it be demonstrated that it does not come from designated conservation areas?	Records exist that attest the source of the substrate of natural origin being used. These records demonstrate that the substrate does not come from designated conservation areas.	Minor Must				
FV 4	PRE-HARVEST (REFER TO 'ANNEX FV 1 GLOBALG.A.P. GUIDELINE: MICROBIOLOGICAL HAZARDS DURING GROWING AND HANDLING')						
FV 4.1	Quality of Water Used on Pre-Harvest Activities (This Applies to Water Used on all Farm Activities and on the Product Itself Before it is Harvested)						
FV 4.1.1	Is there evidence of a risk assessment covering the microbiological quality of the water used in all pre-harvest operations?	A written risk assessment of microbiological quality of the water is conducted. It includes water source, proximity to potential sources of contamination, application timing (growth stage of the crop), application method, and placement of application (harvestable part of the crop, other parts of the crop, ground between crops, etc.).	Major Must				

FV 4.1.2a	In case of leafy greens (also called potherbs, greens, vegetable greens, leafy greens, or salad greens); is water used on pre-harvest activities analyzed as part of the risk assessment and at a frequency in line with that risk assessment (FV 4.1.1) and no less than indicated in Annex FV 1?	GLOBALG.A.P. producers shall comply with the local applicable limits for microbiological contaminants in the water used on pre-harvest activities, and in their absence use the WHO recommendations as a reference for the decision-making process for preventive and/or corrective actions (see Annex FV 1). Compliance with the applicable thresholds shall be verified through water tests carried out in a frequency as indicated by the decision tree in Annex FV 1 (risk assessment). Water testing regime shall reflect the nature and extent of the water system as well as the type of product. Where substantially different water sources are used, they shall be considered separately regarding sampling. Where one water source services multiple systems or farms it may be possible to treat this as the single origin for sampling purposes. Samples from field level shall be taken from places that are more representative of the water source, usually as close to the point of application as possible.	Major Must				
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FV 4.1.2 b	For all crops not mentioned under FV 4.1.2a; is water used on pre-harvest activities analyzed as part of the risk assessment, at a frequency in line with that risk assessment (FV 4.1.1), and no less than indicated in Annex FV 1?	GLOBALG.A.P. producers shall comply with the local applicable limits for microbiological contaminants in the water used on pre-harvest activities, and in their absence use the WHO recommendations as a reference for the decision-making process for preventive and/or corrective actions (see Annex FV 1). Compliance with the applicable thresholds shall be verified through water tests carried out in a frequency as indicated by the decision tree in Annex FV 1 (risk assessment). Water testing regime shall reflect the nature and extent of the water system as well as the type of product. Where substantially different water sources are used, they shall be considered separately regarding sampling. Where one water source services multiple systems or farms it may be possible to treat this as the single origin for sampling purposes. Samples from field level shall be taken from places that are more representative of the water source, usually as close to the point of application as possible.	Minor Must (will become a Major Must as soon as additional guidance by GLOBALG.A.P. for other crops is published.)				
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FV 4.1.3	In the case the risk assessment or the water tests require it, has the producer implemented adequate actions to prevent product contamination?	When the risk assessment based on the water testing indicates risks of product contamination, action shall be required. Possible strategies to reduce the risk of product contamination arising from water use include, but are not limited to: • Treating water before use • Preventing water coming into contact with the harvestable portion of the crop • Reducing the vulnerability of the water supply • Allowing sufficient time between application and harvest to ensure an appropriate decline in pathogen populations Producers implementing these strategies shall have an adequate and reliable validation process to demonstrate that product contamination is being avoided.	Major Must				
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FV 4.1.4	According to the risk assessment, FV 4.1.1, and current sector specific standards, does the laboratory analysis consider microbiological contamination, and is the laboratory accredited against ISO 17025 or by competent national/local authorities for testing water?	Analyses are carried out by an appropriate laboratory accredited against ISO 17025 or equivalent standard, and capable of performing microbiological analyses, or by laboratories approved for water testing by the competent national/local authorities. No N/A.	Major Must				
FV 4.2	Application of Organic Fertilizer of Animal Origin						

FV 4.2.1	Does the interval between the application of organic fertilizer and the product harvest does not compromise food safety?	Records show that the interval between use of composted organic fertilizers and harvest does not compromise food safety (see also CB 4.4.2). When raw animal manure is used, producers shall conduct a risk assessment (CB 4.4.2) and incorporate the raw manure into the soil. • For tree crops: Prior to bud burst, or exceptionally it may be incorporated in a shorter interval based on the risk assessment but never shorter than 60 days prior to harvest; • For all other crops: At least 60 days prior to harvest for all other crops. In the case of leafy greens (also called potherbs, greens, vegetable greens, leafy greens, or salad greens) it cannot be applied after planting even if the growing cycle is longer than 60 days. Refer to Annex FV 1.	Major Must				
FV 4.3	Pre-Harvest Check						
FV 4.3.1	Is there lack of evidence of excessive animal activity in the crop production area that is a potential food safety risk?	Appropriate measures shall be taken to reduce possible contamination within the growing area. Example subjects to be considered include: Livestock near the field, high concentrations of wildlife in the field, rodents, and domestic animals (own animals, dog walkers, etc.). Where appropriate buffer areas, physical barriers, fences should be used.	Major Must				

FV 5	HARVEST AND POST-HARVEST (PRODUCT HANDLING) ACTIVITIES Control points covered in FV 5.1.1 to FV 5.8.10 may be applicable during harvest and/or handling at the point of harvest (on field) and/or handling in packinghouse (facility) and/or during storage/cooling. All these points shall be evaluated in all cases when and where applicable.					
	<i>Four main activities may take place after the growing season: harvest, handling at the point of harvest (on field), handling in a packinghouse (in facility), and storage/cooling. Although not all of these activities are carried out on every farm, the need to follow the appropriate hygiene principles and to maintain the tools, equipment and facilities are common and equally important for all these activities regarding food safety. Producers shall evaluate the requirements aggregated in this section considering all the applicable activities on the farm.</i>					
FV 5.1	Principles of Hygiene (Refer to ‘Annex FV 1 GLOBALG.A.P. Guideline: Microbiological Hazards During Growing and Harvest’)					

FV 5.1.1	Has a hygiene risk assessment been performed for the harvest, pre- and post-farm gate transport process, and post-harvest activities including product handling?	There is a documented hygiene risk assessment covering physical, chemical (incl. allergens) and microbiological contaminants, spillage of bodily fluids (e.g., vomiting, bleeding), and human transmissible diseases, customized to the products and processes. It shall cover all harvest and product handling activities carried out by the producer, as well as personnel, personal effects, equipment, clothing, packaging material, transport, vehicles, and product storage (also short-term storage at farm). Activities during storage and transport shall prevent cross-contamination of produce from agricultural inputs, cleaning agents, or personnel who come directly or indirectly into contact with other sites, animals, or produce. The risk assessment shall define what workers should do with products that fall to the ground or are dropped, excluding produce that grows in the ground (carrots, potatoes, etc.) The hygiene risk assessment shall be tailored to the activities of the farm, the crops, and the technical level of the business and be reviewed every time risks change and at least annually. No N/A.	Major Must				
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FV 5.1.2	Are there documented hygiene procedures and instructions for the harvest and post-harvest processes including product handling (also when they take place directly on the field, orchard, or greenhouse) designed to prevent contamination of crop, crop production areas, food contact surfaces, and harvested product?	Based on the risk assessment, there are documented hygiene procedures for the harvesting and post-harvesting processes. The effectiveness of the hygiene procedures in eliminating food safety risks shall be measured. The procedures shall include - evaluating whether workers are fit to return to work after illness. - housekeeping, cleaning, and disinfection, with descriptions of how these activities are implemented, maintained, and monitored.	Major Must				
FV 5.1.3	Are the hygiene procedures and instructions for the harvest and post-harvest activities, including product handling, implemented?	The operation shall nominate the farm manager or other competent person as responsible for the implementation of the hygiene procedures by all workers and visitors. When the risk assessment determines that specific clothing (e.g., smocks, aprons, sleeves, gloves, footwear. See Annex FV 1, 5.4.2) shall be used, it shall be cleaned when it becomes soiled to the point of becoming a risk of contamination and shall be effectively maintained and stored. Visual evidence shows that no violations of the hygiene instructions and procedures occur. No N/A.	Major Must				

FV 5.1.4	Have workers received specific training in hygiene before harvesting and handling produce?	There shall be evidence that the workers received specific induction and annual training regarding the hygiene procedures for the harvesting and product handling activities. Workers shall be trained using written (in appropriate languages) and/or pictorial instructions to prevent physical (e.g., snails, stones, insects, knives, fruit residues, watches, mobile phones, etc.), microbiological and chemical contamination of the product during harvesting. Training records and evidence of attendance shall be available.	Major Must				
FV 5.1.5	Are signs that communicate the primary hygiene instructions to workers and visitors, including at least instructions to workers, to wash their hands before returning to work clearly displayed?	Signs with the main hygiene instructions shall be visibly displayed in the relevant locations and include clear instructions that hands shall be washed before handling produce. Workers handling ready-to-eat products shall wash their hands prior to start of work, after each visit to a toilet, after handling contaminated material, after smoking or eating, after breaks, prior to returning to work, and at any other time when their hands may have become a source of contamination.	Major Must				
FV 5.1.6	Are smoking, eating, chewing, and drinking confined to designated areas segregated from growing areas and products?	Smoking, eating, chewing, and drinking are confined to designated areas away from crops awaiting harvest and are never permitted in the produce handling or storage areas, unless indicated otherwise by the hygiene risk assessment. (Drinking water is the exception).	Major Must				

FV 5.1.7	Are vehicles used for transport of harvested produce and/or packed product and any equipment used for loading, cleaned, and maintained where necessary according to risk?	Farm vehicles used for loading and transport of harvested produce and/or packed products are cleaned and maintained so as to prevent produce contamination (e.g., soil, dirt, animal manure, spills, etc.).	Major Must				
FV 5.2	Sanitary Facilities						
FV 5.2.1	Do harvest workers who come into direct contact with the crops have access to appropriate handwashing equipment and make use of it?	Wash stations shall be available and maintained (hand soap, towels) in a clean and sanitary condition to allow workers to clean their hands. Personnel shall wash their hands prior to start of work, after each visit to a toilet, after handling contaminated material, after smoking or eating, after breaks, prior to returning to work, and at any other time when their hands may have become a source of contamination. Water used for handwashing shall at all times meet the microbial standard for drinking water. If this is not possible, sanitizer (e.g., alcohol-based gel) shall be used after washing hands with soap and water with irrigation water quality. Handwashing stations shall be provided inside or close to toilet facilities. No N/A.	Major Must				

FV 5.2.2	Do harvest workers have access to clean toilets in the vicinity of their work?	Field sanitation units shall be designed, constructed, and located in a manner that minimizes the potential risk for product contamination and allows direct accessibility for servicing. Fixed or mobile toilets are clean and easily accessible to workers. Not applicable is only possible when harvest workers do not come in contact with marketable produce during harvesting (e.g., mechanical harvesting). Toilets shall be appropriately maintained and stocked. (For guidance, see Annex FV 1, 5.4.1)	Major Must				
FV 5.2.3	Do workers handling the product on the field or in a facility have access to clean toilets and handwashing facilities in the vicinity of their work?	Handwashing facilities, containing non-perfumed soap, water to clean and disinfect hands, and hand-drying facilities shall be accessible and near to the toilets (as near as possible without the potential for cross-contamination). Workers shall wash their hands prior to start of work, after each visit to a toilet, after using a handkerchief/tissue, after handling contaminated material, after smoking, eating, or drinking, after breaks, prior to returning to work, and at any other time when their hands may have become a source of contamination. When handling takes place in a facility, toilets shall be maintained in a good state of hygiene and shall not open directly onto the produce handling area, unless the door is self-closing.	Major Must				

FV 5.2.4	Are the harvest containers used exclusively for produce and are these containers, the tools used for harvesting and the harvest equipment appropriate for their intended use and cleaned, maintained, and able to protect the product from contamination?	Reusable harvesting containers, harvesting tools (e.g., scissors, knives, pruning shears, etc.) and harvesting equipment (e.g., machinery) are cleaned and maintained. A documented cleaning (and, when indicated by the risk assessment, disinfection) schedule is in place to prevent produce contamination. Produce containers are only used to contain harvested product (i.e., no agricultural chemicals, lubricants, oil, cleaning chemicals, plant or other debris, lunch bags, tools, etc.).	Major Must				
FV 5.2.5	Are there suitable changing facilities for the workers?	The changing facilities should be used to change clothing and protective outer garments as required.	Recom.				
FV 5.3	Water Quality						
FV 5.3.1	If ice, water, and/or steam is used during any operations relating to harvest or cooling, does it meet the microbial standards for drinking water, and is it handled under sanitary conditions to prevent produce contamination?	Any ice, water, and/or steam used in relation to harvest, or cooling shall meet microbial standards for drinking water and shall be handled under sanitary conditions to prevent produce contamination. The only exception is in the case of cranberry fields that are harvested by flooding, where producers shall at a minimum guarantee that the water is not a source of microbiological contamination.	Major Must				

FV 5.3.2	Is water not intended for use in food production, if available on site, managed to minimize food safety risks?	If water from an untested source (e.g., rainwater collection, cisterns, etc.) is stored on site or near the handling area, it shall be labeled as not for food handling use. Workers shall be trained on what applications of the water are allowed (e.g., watering lawns, washing external windows, etc.).	Major Must				
FV 5.4	Packing and Storage Areas (N/A When There is no Product Packing and/or storing)						
FV 5.4.1	Is harvested produce protected from contamination?	All harvested produce (regardless stored bulk or packed) shall be protected from contamination. In the case of produce packed and handled directly in the field, it shall all be removed from the field during the day (not stored on the field overnight in open-air conditions), in accordance with the harvest hygiene risk assessment results. Food safety requirements shall be complied with if produce is stored on a short time basis at the farm.	Major Must				
FV 5.4.2	Are all collection/storage/distribution points of packed produce, also those in the field, maintained in clean and hygienic conditions?	To prevent contamination, all on- and off-farm storage and produce handling facilities and equipment (i.e., process lines and machinery, walls, floors, storage areas, etc.) shall be cleaned and/or maintained according to a documented cleaning and maintenance schedule that includes defined minimum frequency. Records of cleaning and maintenance shall be kept.	Major Must				

FV 5.4.3	Are packing materials appropriate for use, and are they used and stored in clean and hygienic conditions so as to prevent them from becoming a source of contamination?	Packaging material used shall be appropriate for the food safety of the products packed. To prevent product contamination, packing materials (including re-useable crates) shall be stored in a clean and hygienic area.	Major Must				
FV 5.4.4	Are bits of packaging material and other non-produce waste removed from the field?	Bits of packaging material and non-produce waste shall be removed from the field.	Major Must				
FV 5.4.5	Are cleaning agents, lubricants, etc. stored to prevent chemical contamination of produce?	To avoid chemical contamination of produce, cleaning agents, lubricants, etc. shall be kept in a designated secure area, away from produce.	Major Must				
FV 5.4.6	Are cleaning agents, lubricants, etc. that may come into contact with produce approved for application in the food industry? Are label instructions followed correctly?	Documented evidence exists (i.e., specific label mention or technical data sheet) authorizing use for the food industry of cleaning agents, lubricants, etc. that may come into contact with produce.	Major Must				

FV 5.4.7	Are all forklifts and other driven transport trolleys clean and well maintained and of a suitable type to avoid contamination through emissions?	Internal transport should be maintained in a manner to avoid produce contamination, with special attention to fume emissions. Forklifts and other driven transport trolleys should be electric, or gas driven.	Major Must				
FV 5.4.8	Is rejected, contaminated, and/or non-conforming produce not introduced in the supply chain and is waste material effectively controlled in a way that it does not pose a risk of contamination?	Produce that poses a microbial food safety hazard is not harvested or is culled. Culled produce, non-conforming produce, and waste materials are stored in clearly designated and segregated areas designed to avoid contamination of products. These areas are routinely cleaned and/or disinfected according to the cleaning schedule. Only daily accumulations of rejected produce and waste materials are acceptable.	Major Must				
FV 5.4.9	Are breakage safe lamps and/or lamps with a protective cap used above the sorting, weighing, and storage area?	In case of breakage, light bulbs, and fixtures suspended above produce or material used for producing handling are of a safety type or are protected/shielded so as to prevent food contamination.	Major Must				
FV 5.4.10	Are there written procedures for handling glass and clear hard plastic in place?	Written procedures exist for handling glass and/or clear hard plastic breakages, which could be a source of physical contamination and/or damage the product (e.g., in greenhouses, produce handling, preparation, and storage areas).	Minor Must				
FV 5.5	Temperature, Humidity, Air and Compressed Gasses						

FV 5.5.1	Are temperature and humidity controls (where applicable) maintained and documented?	If produce is stored either on-farm or in a packinghouse, temperature, and humidity controls (where necessary to comply with quality requirements and also for controlled atmosphere storage) shall be maintained and documented.	Minor Must				
FV 5.5.2	Are air and compressed gasses which could impact food safety regularly monitored, adequately stored, and handled in order to minimize food safety risks?	Testing of compressed air or gas systems shall be conducted at a frequency determined by the risk assessment, which may range from no testing to routine testing intervals. If the risk assessment determines that testing is necessary, testing shall be conducted at least annually.	Major Must				
FV 5.6	Pest Control						
FV 5.6.1	Is there a system for monitoring and correcting pest populations in the packing and storing areas?	Producers shall implement measures to control pest populations in the packing and storing areas appropriate to the farm condition. No N/A.	Major Must				
FV 5.6.2	Is there visual evidence that the pest monitoring and correcting process are effective?	A visual assessment shows that the pest monitoring and correcting process are effective. No N/A.	Major Must				
FV 5.6.3	Are detailed records kept of pest control inspections and necessary actions taken?	Monitoring is scheduled and there are records of pest control inspections and follow-up action plan(s).	Major Must				

FV 5.7	Post-Harvest Washing (N/A When no Post-Harvest Washing)						
FV 5.7.1	Is the source of water used for final product washing potable or declared suitable by the competent authorities?	The water has been declared suitable by the competent authorities and/or a water analysis has been carried out at the point of entry into the washing machinery within the last 12 months. The levels of the parameters analyzed are within accepted WHO thresholds or are accepted as safe for the food industry by the competent authorities.	Major Must				
FV 5.7.2	If water is re-circulated for final product washing, has this water been filtered and are pH, concentration and exposure levels to disinfectant routinely monitored?	Where water is re-circulated for final produce washing (i.e., no further washing done by the producer before the product is sold), it is filtered and disinfected, and pH, concentration, and exposure levels to disinfectant are routinely monitored. Records are maintained. Filtering shall be done using an effective system for solids and suspensions that have a documented routine cleaning schedule according to usage rates and water volume. Where recording of automatic filter backwash events and changes in dosage rates by automated sanitizer injectors may be impossible, a written procedure/policy shall explain the process.	Major Must				
FV 5.7.3	Is the laboratory carrying out the water analysis a suitable one?	The water analysis for the product washing is undertaken by a laboratory currently accredited to ISO 17025 or its national equivalent or one that can demonstrate via documentation that it is in the process of gaining accreditation.	Major Must				

FV 5.8	Post-Harvest Treatments (N/A When no Post-Harvest Treatments)						
FV 5.8.1	Are all label instructions observed?	There are clear procedures and documentation available, (e.g., application records for post-harvest biocides, waxes, and plant protection products) that demonstrate compliance with the label instructions for chemicals applied.	Major Must				
FV 5.8.2	Are all the biocides, waxes, and plant protection products used for post-harvest protection of the harvested crop officially registered in the country of use?	All the post-harvest biocides, waxes, and plant protection products used on harvested crop are officially registered or permitted by the appropriate governmental organization in the country of application. They are approved for use in the country of application and are approved for use on the harvested crop to which they are applied as indicated on the labels of the biocides, waxes, and crop protection products. Where no official registration scheme exists, refer to 'Annex CB 3 GLOBALG.A.P. Guideline: Plant Protection Product Use in Countries that Allow Extrapolation' on this subject and the 'FAO International Code of Conduct on the Distribution and Use of Pesticides'.	Major Must				

FV 5.8.3	Is an up-to-date list maintained of post-harvest plant protection products that are used, and approved for use, on crops being grown?	An up-to-date documented list that considers any changes in local and national legislation for biocides, waxes, and plant protection products is available for the commercial brand names (including any active ingredient composition) that are used as post-harvest plant protection products for produce grown on the farm under GLOBALG.A.P. within the last 12 months. No N/A.	Minor Must				
FV 5.8.4	Is the technically responsible person for the application of post-harvest plant protection products able to demonstrate competence and knowledge regarding the application of biocides, waxes, and plant protection products?	The technically responsible person for the post-harvest biocides, waxes, and plant protection products applications can demonstrate a sufficient level of technical competence via nationally recognized certificates or formal training.	Major Must				
FV 5.8.5	Is the source of water used for post-harvest treatments potable or declared suitable by the competent authorities?	The water has been declared suitable by the competent authorities and/or within the last 12 months a water analysis has been carried out at the point of entry into the washing machinery. The levels of the parameters analyzed are within accepted WHO thresholds or are accepted as safe for the food industry by the competent authorities.	Major Must				

FV 5.8.6	Are the biocides, waxes and plant protection products used for post-harvest treatment stored away from produce and other materials?	To avoid the chemical contamination of the produce, biocides, waxes, and plant protection products, etc. are kept in a designated secure area, away from the produce.	Major Must				
FV 5.8.7	Are all records of post-harvest treatments maintained and do they include the minimum criteria listed below? • Identity of harvested crops (i.e., lot or batch of produce) • Location • Application dates • Type of treatment • Product trade name and active ingredient - Product quantity	The following information is recorded in all records of post-harvest biocide, wax, and plant protection product applications: • The lot or batch of harvested crop treated • The geographical area, the name or reference of the farm, or harvested crop-handling site where the treatment was undertaken • The exact dates (day/month/year) of the applications • The type of treatment used for product application (e.g. spraying, drenching, gassing etc.) • The complete trade name (including formulation) and active ingredient or beneficial organism with scientific name. The active ingredient shall be recorded, or it shall be possible to connect the trade name information to the active ingredient. • The amount of product applied in weight or volume per liter of water or other carrier medium No N/A.	Major Must				
	Are records of all post-harvest treatments kept and do they also include the following criteria:						

FV 5.8.8	Name of the operator?	The name of the operator who has applied the plant protection product to the harvested produce is documented in all records of post-harvest biocide, wax, and plant protection product applications.	Minor Must				
FV 5.8.9	Justification for application?	The common name of the pest/disease to be treated is documented in all records of post-harvest biocide, wax, and plant protection product applications.	Minor Must				
FV 5.8.10	Are all of the post-harvest plant protection product applications also considered under points CB 7.6?	There is documented evidence to demonstrate that the producer considers all post-harvest biocides and plant protection products applications under control point CB 7.6, and acts accordingly.	Major Must				
FV 5.9	Environmental Monitoring						
FV 5.9.1	Has a risk-based environmental monitoring program been established?	A risk-based approach shall be in place to define the microbiological environmental monitoring program which shall be established, implemented, and maintained to reduce the risk of food contamination. The environmental monitoring program may rely on water test results or may include additional activities such as swabbing for pathogens. This control point does not require swabbing for compliance.	Major Must				
FV 5.10	Labeling						

FV 5.10.1	Is product labeling, where final packing takes place, done according to the applicable food regulations in the country of intended sale and according to any customer specifications?	Where final packing takes place, product labeling shall follow the applicable food regulations in the country of intended sale and any customer specifications.	Major Must				
FV 5.10.2	Where the risk assessment indicates potential food allergen cross-contamination, are the products labeled to identify them?	Where the risk assessment indicates potential cross-contamination, the product shall be labeled according to country of production and destination legislation regarding food allergens. Cross-contamination risk (potential and intentional) shall be considered where food allergens have, for example, been packed on the same line or using the same equipment. Harvesting and packing equipment and personal protective equipment shall also be considered (cross-reference with AF 1.2.1, AF 1.2.2, Annex AF 2, and FV 5.1.1).	Major Must				
FV 5.11	Stock and Finished Product Management						

FV 5.11.1	Are finished product, work in progress, and all other materials used in the correct order and within the allocated shelf life if applicable?	Finished product should be managed so that product is shipped and moved to customers in the correct order. A procedure shall be established, implemented, and maintained. The same first-in first-out procedure should apply to all purchased materials, work in progress, and finished products, ensuring use within the allocated shelf life if applicable.	Major Must				
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Appendix II: Data collection tool used in the survey.

SECTION A: SOCIO-ECONOMIC AND SOCIO-DEMOGRAPHIC DATA. PLEASE INDICATE AND TICK WHERE APPLICABLE.

E

Qn.	Question	Responses
1.	Gender of the respondent	1. Male 2. Female
2.	Age (in completed years)	
3.	Number of years of formal educational (years)	
4.	Marital Status	1. Married 2. Single 3. Widowed/Widower 4. Divorced
5.	Household size (all household members)	
6.	How many members of your household are involved in chili farming?	
7.	Experience in chili production (years of chili farming)	
8.	Land size owned (acres)	
9.	Land size allocated to chili production (Acres)	
10.	Do you cultivate any other crop other than chili?	1. Yes 2. No
11.	If yes, which other crops? (Tick all applicable)	1. Maize 2. Beans 3. Millet 4. Vegetables (cabbage, egg plants, onions etc) 5. Casava 6. Soybeans 7. Sunflower 8. Sweet potatoes 9. Others (please specify)
12.	Apart from farming, do you have any other source of income?	1. Yes 2. No
13.	If yes, which one? (Tick all applicable)	1. Salaried employment 2. Casual workers 3. Shop keeper 4. Boda-boda 5. Charcoal selling 6. Brick laying 7. Firewood selling 8. Others(specify).....
14.	Do you rear livestock?	1. Yes 2. No

15.	If yes, which ones? (Tick all applicable)	1. Cows 2. Goats 3. Pigs 4. Hens 5. Rabbits 6. Others (Please specify)
16.	How much is your monthly income? (UGX)	
17.	Do you have access to market information?	1. Yes 2. No
18.	If yes, from where? (Tick all applicable)	1. Buyers 2. Farmers association 3. Radio 4. Government extension agent 5. NGO extension agent 6. Others (please specify)
19.	Distance to nearest chili input market (in km)	
20.	Distance to nearest chili output market (in km)	
21.	Have you ever borrowed money for farming?	1. Yes 2. No
22.	If yes, from where?	1. Commercial Bank 2. Village saving groups (VSLA) 3. A friend /family 4. SACCO 5. Others (please specify)
23.	What was the purpose of the last loan you borrowed?	1. Seeds and fertilizers 2. Land preparations 3. Irrigation 4. Others (please specify)
24.	Do you belong to any of the farming associations/ cooperatives?	1. Yes 2. No
25.	If yes, how many farming associations/cooperatives do you belong to?	
26.	What advantages do you attribute to belonging to farming associations/ cooperatives?	
27.	Do you receive any support from a buyer?	1. Yes 2. No
28.	If yes, which kind of support	1. Market information 2. Loan 3. Training 4. Inputs 5. Others (please specify)
29.	Have you ever been visited by an extension agent?	1. Yes 2. No

30.	If yes, who provided him/her?	1. Government 2. Buyer 3. Organization (NGO/private organization) 4. Farmer group or cooperative 5. Others (please specify)
31.	If yes, how many times where you visited in 2022?	
32.	What was the purpose of the visit?	1. Training 2. Technical advice 3. Agricultural input delivery 4. Others (please specify)
33.	Do you own a mobile phone?	1. Yes 2. No
34.	If yes, what is its use in your farming activities? (Tick all applicable)	1. Receiving and sending money 2. Communication with buyers 3. Communication with farming associations 4. Communication with extension agent 5. Others (Please specify)

**SECTION B: LEVEL OF AWARENESS OF GLOBAL GAP STANDARDS AMONG
SMALLHOLDER CHILI FARMERS**

S/N	Statement	YES	NO	
35.	Do you know Global GAP			
36.	If yes, are you a certified Global GAP farmer or in the process of being certified?			
37.	If no, were you certified before and later stopped?			
38.	If yes, why did you stop being a Global GAP certified farmer?			1. High maintenance cost of Global GAP requirements 2. Low price of the produce 3. Lack of training and support services 4. Lack of market and market information 5. Lack of agricultural input 6. Poor climatic conditions (too much sunshine, too much rain) 7. Others
39.	If yes, please mention all the Global GAP standards that you can recall			1 2 (separate blank page)
40.	If yes, what are the benefits of Global GAP Compliance to a farmer like you? (Tick all applicable)			1. Access to the export market 2. Healthy food 3. Conservation and protection of the environment 4. Protection of workers at the workplace 5. High and premium prices 6. Others (Please specify)
41.	If yes, what are the limitations of Global GAP Compliance? (Tick all applicable)			1. High implementation/maintenance cost 2. Lack of institutional support 3. Inadequate information about food safety standards 4. Lack of market information 5. Poor infrastructure 6. Lack of access to credit 7. Others (Please specify)

SECTION C: LEVEL OF GLOBAL GAP COMPLIANCE

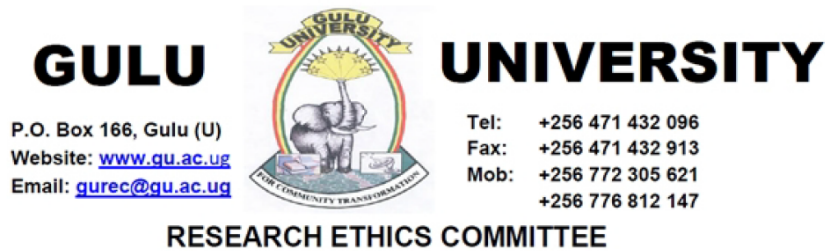
S/N	Statement	YES	NO	
Traceability of produce and its safety				
42.	Is your chili farm near by animals' farms or their passage (cows, goats, pigs etc)			
43.	When it rains, does your farm flood or water flows near your farm?			
44.	Do you fumigate your soil before planting or after harvest?			
45.	If yes, do you have written justification for soil fumigation?			
46.	Do animals drink from the same source of water for irrigation?			
47.	Do you use organic manure?			
48.	If yes, what interval between application and harvest?			1. 60 prior to the harvest 2. 30 days prior to the harvest 3. Less than 30 days prior to the harvest
49.	Is there evidence of excessive animal activity in the crop production area that is a potential food safety risk?			
50.	Is a hygiene risk assessment performed for the harvest, pre- and post-farm gate transport process, and post-harvest activities including product handling?			
51.	Are there documented hygiene procedures and instructions for the harvest and post-harvest processes including product handling?			

52.	Are smoking, eating, chewing, and drinking confined to designated areas segregated from growing areas and products?			
53.	Are vehicles used for transport of harvested produce and/or packed product and any equipment used for loading, cleaned, and maintained where necessary according to risk?			
54.	Are the harvest containers used exclusively for produce and are these containers, the tools used for harvesting and the harvest equipment appropriate for their intended use and cleaned, maintained, and able to protect the product from contamination?			
55.	Is harvested produce protected from contamination?			
Workers' safety and healthy				
56.	Are there suitable changing facilities for the workers?			
57.	Do harvest workers who come into direct contact with the crops have access to appropriate handwashing equipment and make use of it			
58.	Do harvest workers have access to clean toilets in the vicinity of their work?			
59.	Are their signs that communicate the primary hygiene instructions to workers and visitors, including at least instructions to workers, to wash their hands before returning to work clearly displayed?			
60.	Do workers receive specific training in hygiene before harvesting and handling produce?			
61.	Do workers handling the product on the field or in a facility have access to clean toilets and handwashing facilities in the vicinity of their work?			
62.	If ice, water, and/or steam is used during any operations relating to harvest or cooling, does it meet the microbial standards for drinking water, and is it handled under sanitary conditions to prevent produce contamination?			

Farming area environment				
63.	Is water not intended for use in food production, if available on site, managed to minimize food safety risks?			
64.	Are all collection/storage/distribution points of packed produce, also those in the field, maintained in clean and hygienic conditions?			
65.	Are packing materials appropriate for use, and are they used and stored in clean and hygienic conditions to prevent them from becoming a source of contamination?			
66.	Are bits of packaging material and other non-produce waste removed from the field?			
67.	Are cleaning agents, lubricants, etc. stored to prevent chemical contamination of produce?			
68.	Are cleaning agents, lubricants, etc. that may come into contact with produce approved for application in the food industry? Are label instructions followed correctly?			
69.	Are all forklifts and other driven transport trolleys clean and well maintained and of a suitable type to avoid contamination through emissions?			
70.	Is rejected, contaminated, and/or non-conforming produce not introduced in the supply chain and is waste material effectively controlled in a way that it does not pose a risk of contamination?			
71.	Is there a system for monitoring and correcting pest populations in the packing and storing areas?			
72.	Is there visual evidence that the pest monitoring and correcting process are effective?			
73.	Are detailed records kept of pest control inspections and necessary actions taken?			
74.	If water is re-circulated for final product washing, has this water been filtered and are pH, concentration and exposure levels to disinfectant routinely monitored?			

75.	Are all label instructions observed?			
76.	Is an up-to-date list maintained of post-harvest plant protection products that are used, and approved for use, on crops being grown?			
77.	Is the technically responsible person for the application of post-harvest plant protection products able to demonstrate competence and knowledge regarding the application of biocides, waxes, and plant protection products?			
78.	Is the source of water used for post-harvest treatments potable or declared suitable by the competent authorities?			
79.	Are the biocides, waxes and plant protection products used for post-harvest treatment stored away from produce and other materials?			

Appendix III: Clearance letter from Research Ethics Committee



21/07/2023

To: Gerard Ndayishimiye

Gulu University
+250781844380

Type: Initial Review

Re: GUREC-2023-530: COMPLIANCE OF GLOBAL GAP STANDARDS AMONG SMALLHOLDER HOT PEPPER FARMERS IN LIRA DISTRICT, NORTHERN UGANDA

I am pleased to inform you that at the **99th** convened meeting on **04/05/2023**, the Gulu University REC meeting voted to approve the above referenced application.

Approval of the research is for the period of **21/07/2023** to **21/07/2024**.

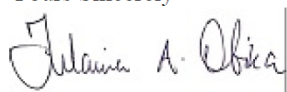
As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

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 **21/07/2024** 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	Covid-19 risk management plan	English	3.0	2023-07-18
2	Protocol	English	2	2023-06-23
3	Informed Consent forms	Luo	2	2023-06-23
4	Informed Consent forms	English	2	2023-06-23
5	Data collection tools	English	2	2023-06-23
6	Data collection tools	Luo	Luo	2023-02-19

Yours Sincerely



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

Appendix IV: Informed consent form

**Title of the Study: Global GAP Compliance Among Smallholder Farmers in Hot Pepper
Production in Lira District of Northern Uganda.**

Investigator: Gerard Ndayishimiye

Institution: GULU UNIVERSITY

Introduction

My name is Gerard Ndayishimiye, a master's student from the Department of Rural Development and Agribusiness, Faculty of Agriculture and Environment, Gulu University, Uganda. I am currently doing research on the topic: **“Global GAP Compliance Among Smallholder farmers in Chili Production in Lira district of Northern Uganda.”** This study is purely academic and purposely intended to help researchers understand the level of awareness, level of compliance and their associated factors in Global GAP standards in Lira district. You have been selected randomly to participate in this survey, please note that the information provided by you will be treated confidential and there will be no way to identify you as the one who gave specific information. I would be glad if you could spare some time (between 20 to 30 minutes) to answer research questions of this study. As an appreciation for your time, you will be given a blue bar soap and a half kilogram of sugar which have the value of 6000 UGX.

Thank you.

A brief description of the sponsors of the research project

This study is funded by the Mastercard foundation through RUFORUM in Collaboration with Tagdev Gulu University.

Purpose:

The study seeks to analyze compliance of Global GAP standards in Lira district. The study will serve as a suitable tool for agricultural researchers, planners, and policymakers in designing interventions to increase horticultural export earnings in Northern and entire Uganda.

Procedures:

Your participation in this study will involve answering the questions while filling in the questionnaires as requested.

Who will participate in the study?

You have been chosen to participate in this study because you are a smallholder hot chili farmer. The interview will last for approximately thirty minutes or less and the participants will be 345 with you inclusive.

Risks/discomforts:

There is no foreseeable risk of harm or discomfort that will arise from your participation in this study. The only risk or discomfort will be the inconvenience in terms of time spent during the interview.

Benefits:

The potential benefit of this study is that identifying factors associated with compliance with international food safety standards like Global GAP, will guide the government, nongovernment organizations, and private companies to design interventions for increasing horticultural export earnings with the informed decision. This will lead to increased income for smallholder horticultural farmers who target international markets thus improving standards of living. Research participants will also get feedback on the findings and progress of the study, and any new information that affects the study participants (including incidental findings) will be made available to research participants.

Confidentiality:

Your identity will not be revealed to anyone as we shall only use codes to identify participants. Information obtained will only be accessible to the research team. Soft copies of the data will be protected by password and hard copy files will be kept under lock and key. Confidential information will only be accessed by the principal investigator.

Alternatives:

You do not have to participate in this study if you are not interested. You will not lose any benefit in case of no participation.

Cost:

There will not be any additional cost incurred as a result of participating in this study.

Questions:

If you have any questions related to the study or your rights as a research participant, you can contact the principal investigator, Gerard Ndayishimiye at 0741535954 or via email at sir.gerard.ndayishimiye@gmail.com

Statement of voluntariness:

Participation in this research study is voluntary and you may join of your own free will. You have a right to withdraw from the study at any time without penalty.

If you have any issues about your rights and participation in the study, please contact the Chairperson, Gulu University Research Ethics Committee, Dr. Gerald Obai, Tel: No., 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 Tel 0414705500.

Statement of consent

.....has described to me what is going to be done, the risks, the benefits involved, and my rights as a participant in this study. I understand that my 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 aware that I may withdraw at any time. I understand that by signing this form, I do not waive any of my legal rights but merely indicate that I have been informed about the research study in which I am voluntarily agreeing to participate. A copy of this form will be provided to me.

Name of participant.....Signature/Thumbprint..... Date.....

Name of witness.....Signature/Thumbprint..... Date.....

Name of interviewer..... Signature/Thumbprint..... Date.....

Appendix V: STATA output used in data analysis

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use "C:\Users\Admin\Desktop\r comments\Data analysis\Final database used.dta"
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Appendix VI: Plagiarism check report

GULU P.O. Box 166 Gulu, Uganda		UNIVERSITY Tel: +256-471-32924 Fax: +256 471343095 Emails: ul@gu.ac.ug URL: www.gu.ac.ug
OFFICE OF THE UNIVERSITY LIBRARIAN		

PLAGIARISM CHECK

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

Name: GERARD NDAYISHIMIYE

Personal File No.(staff) Reg. (student) 21/X/3355/MAE/PS

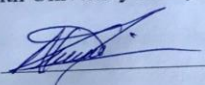
Faculty/Institute: AGRICULTURE

Department: RURAL DEVELOPMENT AND AGRIBUSINESS

Title and bibliographic description of the work
**COMPLIANCE OF GLOBAL GAP STANDARDS AMONG SMALLHOLDER HOT
PAPPER FARMERS IN LIRA DISTRICT OF NORTHERN UGANDA**

Declaration.

1. I understand what plagiarism is and I am aware of the University policy on this regard,
2. I declare that this ...**Thesis**... (thesis, 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 18.12.2023

Originality Report

The article/thesis/document titled above have been subjected to plagiarism check and the level was found to be.....**19%** (percent) this is classified as:

☒ **Minor**
☐ Moderate
☐ Serious

Yours sincerely,


Dr. Ongaya Kizito (PhD)
Senior Librarian