MAKERERE UNIVERSITY

VULNERABILITY OF SMALLHOLDER HORTICULTURAL FARMERS TO RISKS IN THE NABUYONGA VALLEY OF MBALE CITY REGION.

BY

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DECLARATION.

I Patricia Nagawa Kiggundu, declare that this is my work and that it has never been submitted to any institution for an academic award.

Signed.

.....

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Date.

26th October 2023

APPROVAL.

This thesis is submitted to the Directorate of Research and Graduate Training with our consent and approval in accordance with the governing regulations.

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DEDICATION.

To my dear parents, Mr Stephen Kiggundu and Mrs Mary Kiggundu, and my late best friend – Maureen Nambejja. May her soul rest in eternal peace.

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LIST OF ACRONYMS.

COVID – 19 - Coronavirus Disease 2019.

FARM-D - Forum for Agricultural Risk Management in Development.

FAO - Food Agricultural Organization.

FSA – Farm Systems Analysis.

INFORM – Index For Risk Management.

MAAIF - Ministry of Agriculture, Animal Industry and Fisheries.

NGOs – Non- Governmental Organizations.

OECD – Organization for Economic Co-operation and development.

PIIRS – Princeton Institute for International and Regional Studies.

SURE – Sustainable Resilient EU Farm Systems.

RUFS - Resilient Urban Food Systems.

UBOS – Uganda Bureau of Statistics.

ABSTRACT.

Smallholder horticultural farmers face a mix of linked risks and challenges which jeopardize their livelihoods, food security and nutrition of these have made them increasingly vulnerable to a spectrum of emerging climatic, health, price, and financial risks. Mbale City has a significant number of smallholder horticultural farmers (comprising of about 60% of the population) whose livelihoods depend on agricultural produce which they sell within the Mbale city region. However, these farmers face numerous risks like: pests and diseases, inadequate market, extreme weather events, market shocks, and others, yet they have limited resources and capacity to cope with risks and any reductions to agricultural productivity can have significant impacts on their food security, nutrition, income and well-being. This study aimed at contributing to a better understanding of the vulnerability of smallholder horticultural farmers to risks so as to enhance urban food system resilience in Mbale City Region with specific objectives of determining Mbale city Region's horticultural food shed in terms of production, location, travel routes, market and consumption points, assessing the risks experienced by smallholder horticultural farmers at household levels in the Nabuyonga Valley and evaluating the effectiveness of risk reduction strategies adopted by smallholder horticultural farmers in the Nabuyonga Valley . Seventy-seven households were randomly and purposively selected for the study. Flow maps were generated to show horticultural food in and out flows with in Mbale city Region depicting travel routes, consumption and market points. Data were analyzed using inferential statistics, independent t- tests and analysis of variance. Results revealed significant risks such as floods and dry spells (88.3%) which mainly affected tomato gardens (72.7%), followed by price fluctuations (76.8%) and stealing of already grown crops (66.2%). It was established that effectiveness of risk reduction strategies adopted was significantly influenced by education levels, income sources and gender (p-value < 0.005). The study recommends several interventions including enhancement of stakeholder engagements, exploration of new technologies, effective mainstreaming of disaster risk management and others. If implemented through a coordinated process, these recommendations could significantly lead to enhanced agricultural productivity and value addition, sustainable livelihood/employment opportunities while concurrently promoting the economic

Key Words: Risks, Food shed, Mbale City Region, Smallholders, Vulnerability.

CHAPTER ONE: INTRODUCTION.

1.1 Background of the study.

Agriculture remains the main source of food, employment, and income for much of the rural population, for instance, in Malawi agriculture provides livelihoods for over 85% of the population many of which are smallholder farmers (Makate et al., 2019). Smallholder farmers constitute 85% of the estimated 450 – 500 million of the world's farming population, (Lowder et al., 2016). They are also estimated to represent half of the hungry population worldwide and probably three-quarters of the hungry in Africa (Gomez, 2020). Consequently, the fate of smallholder farmers will largely determine whether or not the world succeeds in reducing poverty and hunger worldwide (Poole et al., 2013). By virtue of the size of their land holdings, frequently on low-quality sites, and limited financial resources, smallholder farmers are more often vulnerable to market and weather fluctuations than farmers endowed with more farmland and financial resources (Aguilar et al., 2022).

Globally, horticultural farming is essential because it contributes to feeding the over 811 million people who could potentially go hungry more so in urban areas where poverty among the 9.9% low-income earners predisposes them to food insecurity, despite reported progress in global food production over the last decade (Cahiers et al., 2020). For instance, as reported by (Kansiime et al., 2021), between 2019 and 2020, the number of undernourished people grew by as many as 161 million, a crisis driven largely by conflict, climate change and other risks in the agricultural supply chain.

Smallholder horticultural production is faced with multiple uncertainties, particularly, risky events related to weather, market development and other hazards that cannot be controlled by the smallholder farmers but have a direct influence on the returns from horticultural farming. These include risks, such as climate and market volatility, pests and diseases, extreme weather events, and an ever-increasing number of protracted crises and conflicts (Calicioglu et al., 2019). In this context, smallholder farmers have to manage the risks partly as a whole farming business management (Azunre et al., 2019). FAO 2017 report "*The future of food and agriculture: trends and challenges*" further indicates that between 2005 and 2015 natural disasters cost the agricultural sectors of developing countries' economies a staggering $96 billion in damaged or lost crop and

livestock production, $48 billion of which occurred in Asia. Drought, which has battered farmers globally, was one of the leading culprits, FAO furthermore documented that 83 per cent of all drought-caused economic losses were absorbed by agriculture to the tune of $29 billion (Snapp et al., 2018).

Across the tropics, smallholder farmers already face numerous risks in their agricultural production, including pest and disease outbreaks, lack of enough market for their produce, extreme weather events, market shocks among others, which often undermine their household food and income security (Harvey et al., 2014). A sustainable food system delivers food security and nutrition for all in such a way that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised (Balineau & Kessler, 2021). Therefore, because smallholder farmers typically depend directly on agriculture for their livelihoods and have limited resources and capacity to cope with shocks, any disruption in agricultural productivity can have significant impacts on their food security, nutrition, income and well-being (Mapfumo et al., 2013).

Risks not only endanger the farmer's livelihood and incomes, but also undermine the viability of the agriculture sector (Alizadeh-Masoodian, and Nomikos, 2005).

According to Ministry of Finance, Planning and Economic Development, over 1.7 million rural residents who are mainly farmers in Uganda are predicted to have fallen back into poverty in 2020 owing to the difficult and complex risks which include production, market, transport, institutional and human related risks (Tan, 2020).

According to FAO (2020), COVID-19 has had a devastating effect in terms of health and finance effects on the people and the most affected are the smallholder farmers. Farmers lost markets due to the closure of restaurants, schools, universities and Bars which were some of the largest consumers of farm products. The 17th Uganda Economic Update (UEU) (World Bank, 2021) notes that the COVID-19 shock caused a sharp contraction of the economy to its slowest pace in three decades, household incomes fell when firms closed and jobs were lost, particularly in the urban informal sector.

Uganda is currently the second largest producer of fresh vegetables and fruits in sub- Saharan Africa after Nigeria, producing about 5.3 million tonnes per year (Dijkxhoorn et al., 2019). Most of the fruits and vegetables produced in Uganda are by smallholder farmers and consumed locally (Cultiv Aid, 2021). However, the smallholder farmers are chronically food insecure and have

limited access to basic services, such as improved water sources and electricity. Smallholder horticultural farmers also face a mix of interrelated risks and challenges which threaten their livelihoods, food security and nutrition, and they have also become increasingly vulnerable to a spectrum of emerging climatic, health, price, and financial risks and challenges (Dijkxhoorn et al., 2019, Mugagga et al., (2020) point towards adaptation to the resultant effects by the smallholders as a novel way of reducing the spread of the associated risk.

Mbale City is the main administrative, commercial and agricultural hub of Mbale District and the surrounding areas. Therefore, understanding the vulnerability of farmers to risks is particularly important: Moreover, smallholder horticultural farmers makeup approximately 70% of the farming population. Owing to its relatively high fertility when compared to other places along the Nabuyonga river system, Nabuyonga valley is the most inhabited area in Mbale city because it is associated with fertile soils that favor the growth of several horticultural crops, providing water for crop irrigation as well for domestic and industrial use. Small-scale farming is a common activity of residents (Mugagga et al., 2010; Mackay et al., 2022) and lack of formal job opportunities forces many into agriculture. However, there are continuous risks that arise from aspects of production, credit, personal, political and economic aspects.

Given that multiple types of risks are likely to occur simultaneously, several policy-driven initiatives have begun to address these risks more holistically. These initiatives examine risk management issues and strategies that concentrate on multiple sources of risk. They include the Platform on Agricultural Risk Management, the World Bank's Forum for Agricultural Risk Management in Development (FARM-D), and programs in the Center for Resilience. Funders of agricultural research are also beginning to support more projects that focus on the multiple risks that farmers encounter. Examples include the SURE-Farm project, the INFORM index for risk management (Komarek et al., 2020) and RUFS that identified and prioritized actions needed to empower smallholder farmers with skills on sustainable agriculture in Mbale City with essence of enhancing urban food system resilience. In addition, both academics and policy researchers are taking a more earnest focus on risk, such as the PIIRS Global Systemic Risk research community and the recent efforts by the OECD's risk management and resilience topic group. This new focus and reorganization of human and financial resources, often in the context of the resilience of farms

and the agricultural sector to adverse events, suggests that a growing appreciation and multiple types of risk are important.

1.2 Statement of the problem

Statistics from MAAIF following years 2016/17 indicate that agriculture forms the backbone of Uganda's economy contributing approximately 25% of GDP and is the major source of livelihood in Uganda. According to (UBOS, 2016) in the Uganda National Household Survey (UNHS) 2016/17 carried out , 65% of the working population was engaged in agriculture (CultivAid, 2021), and across the tropics, smallholder farmers already face numerous risks to their agricultural production, including pest and disease outbreaks, inadequate market for their goods/produce, extreme weather events and price instabilities, among others, which often undermine their household food and income security. Not only does the occurrence of these shocks endanger already fragile food production systems, but also the mere likelihood of their occurrence makes some of the smallholder farmers more risk-averse and likely to pursue more subsistence-oriented activities, thus causing smallholder poverty to persist (Dercon et al., 2009), however, these smallholder horticultural farmers have adopted coping capacities like continuous irrigation, construction of trenches to drain away excess water in times of floods, purchase and use of pesticides among others. Previous studies such as (Aguilar et al., 2022) point towards projected increase in the vulnerability of smallholder farmers arising out of climate-related risks; while other scholars such as Mugagga et al., (2020) investigated the role of institutional factors affecting adaptation to climate change among smallholder Irish potato farmers in South Western Uganda; whilst (Rose & Chilvers, 2018) documented the factors affecting vulnerability elements affecting smallholder farmers dealing with climbing beans. However, there is still paucity of information about the vulnerability of smallholder horticultural farmers to a range of risks within the Mbale City Region, yet, smallholder farmers have been noted to be critical, so the current study sought to analyze these vulnerabilities so as to come up with plausible recommendations aimed at enhancing urban food systems resilience in Mbale City and beyond.

1.3 Objectives of the study.

1.3.1 General Objective.

To contribute to a better understanding of the vulnerability of smallholder horticultural farmers to risks so as to enhance urban food system resilience in Mbale City Region.

1.3.2 Specific Objectives.

- To determine Mbale city Region's horticultural food shed in terms of production, location, travel routes, market and consumption points.
- To assess the risks experienced by smallholder horticultural farmers at household levels in the Nabuyonga Valley.
- To evaluate the effectiveness of agricultural risk reduction strategies adopted by smallholder horticultural farmers in the Nabuyonga Valley.

1.4 Research questions.

- What is the percentage of horticultural food grown and consumed locally in Mbale City-region?
- What risks affect Smallholder horticultural farmers at household level in the Nabuyonga Valley?
- How effective are the existing agricultural risk reduction strategies adopted by smallholder horticultural farmers in the Nabuyonga Valley?

1.6 Conceptual Framework.

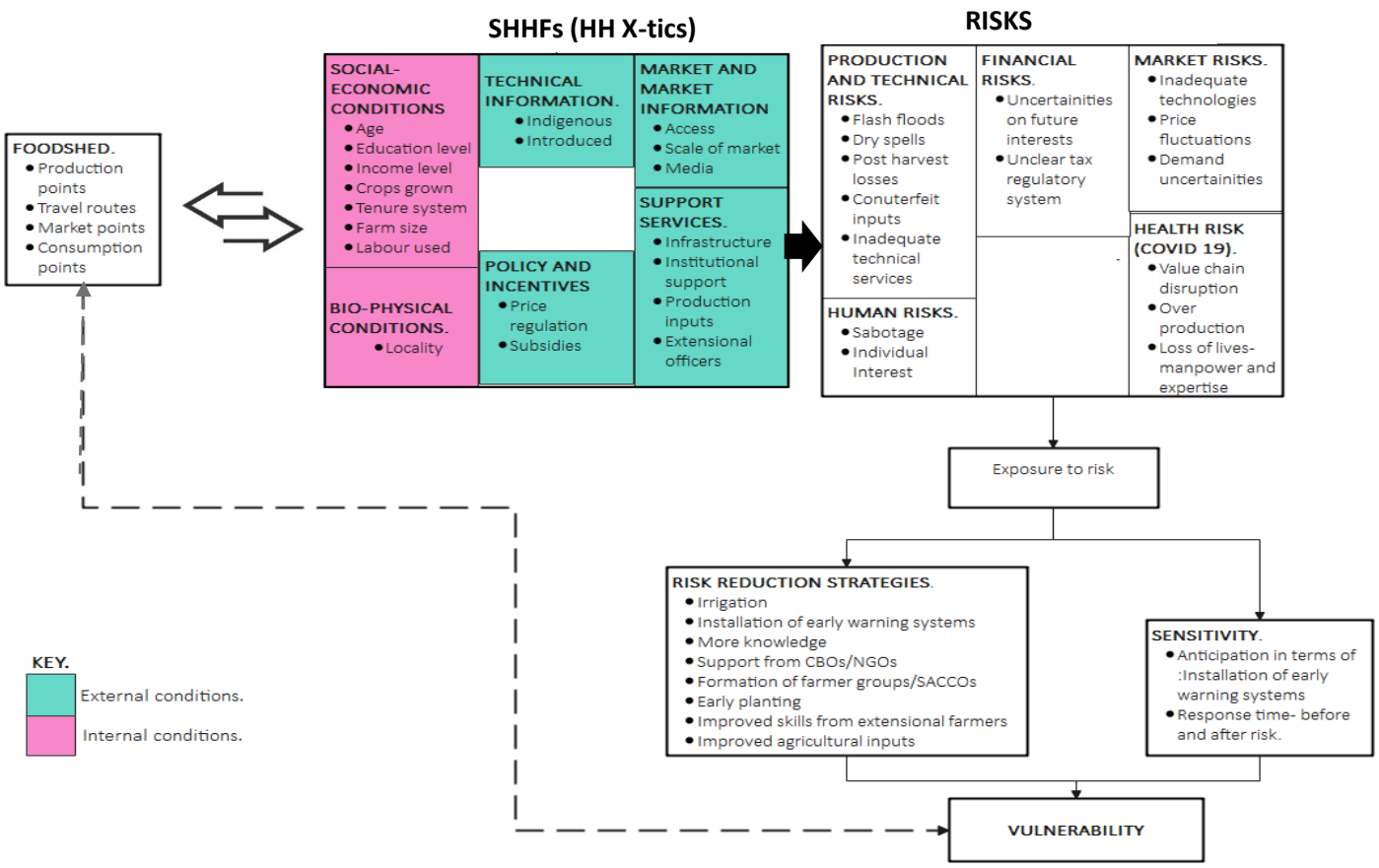

Figure 1: Conceptual framework.

The Farm Systems Analysis framework (FSA), a widely used analytical framework in understanding decision making processes at the farm household level was adopted and modified for this study. Livelihood assets can help examine a household's capabilities to act and adapt to shocks (Bebbington, 1999, Aguilar et al., 2022) and because the study used smallholder horticultural farmer households as units of analysis, it hinged on the FSA through determining the food shed (food in and out flows) which entails mapping of the travel routes, consumption points and market points which influence the smallholder horticultural household characteristics. The household characteristics were broken down into internal conditions (including socio- economic conditions, and bio-physical conditions) as well as external conditions (including technical conditions, market and market information, support services from extensional workers and policy and incentives). The levels of adequacy and sufficiency of the household characteristics influence the exposure of the smallholder horticultural farmers to risks. The risks were categorized in terms of production, technical, heath, human and market risks. When the smallholder farmers are

exposed to the risks, they will, internally or with external support, come up with adaptive mechanisms in form of risk reduction strategies such as irrigation, early planting, installation of early warning systems and among other interventions. – The effectiveness of the adaptive measures is influenced by the household sensitivity to the shocks in terms of anticipation of and response to the agricultural risk, with a resultant increase or decrease in the vulnerability of the farm household, thereby affecting the whole food shed.

1.7 Significance of the study

Other than providing a reference for future studies, this study is particularly significant as it contributes towards the realization of National Development Plan III, through the agro-industrialization program which aims at addressing the dominant subsistence sector by increasing competitiveness and commercialization of agricultural production and agro processing so as to ensure resilience in food markets by 2025 and this will enable the improvement of livelihoods of horticultural smallholder farmers since they make up majority of Uganda's population.

The Study is also relevant following the recently launched Parish Development Model (PDM) through addressing one of the pillars that is: production, processing and market and an objective that aims at providing incentives and support to smallholder farmers to use their land more productively with essence of boosting their household incomes.

The study further contributes to the realization of Sustainable Development Goals 1, 2, 10 and 11 (No poverty, no hunger, reduced inequalities and sustainable cities and communities.) as it advocates for sustainable intensification of agriculture for increased food production in Mbale-City.

1.8 Justification of the study.

The study was motivated by the noted increasing contribution of smallholder urban farming to urban food systems resilience, especially within cities of Sub-Saharan Africa where a sizable proportion of the population are projected to be urbanized in the coming decades. Moreover, the challenges of achieving food and nutrition security (SDG2) in these urbanizing areas will require protracted efforts of all stakeholders including smallholder farmers on one side and other stakeholders such as researchers to jointly contribute towards urban food risk reduction and resilience building. Thus, this study was timely and well intentioned to contribute knowledge that

could potentially inform future decisions around inclusive spatial planning that recognizes smallholder farming as being part and parcel of the urban space.

1.9 Study scope.

In its geographical scope, the study focused on the Nabuyonga valley where most farmers are situated in Mbale City Region and sought to analyze the vulnerability of smallholder horticultural farmers. In particular, seven parishes were specifically targeted because they hosted households which practiced smallholder horticultural farming along the Nabuyonga Stream and its tributaries of Nabijo and Namatsyo. A detailed explanation on the geographical scope is given in Chapter 3. Specifically, the study aimed at determining Mbale city Region's food shed in terms of production location, travel routes, markets and points of consumption, assessing the risks experienced by smallholder horticultural farmers at household level as well as evaluating the effectiveness of agricultural risk reduction strategies adopted by smallholder horticultural farmers in the Nabuyonga Valley.

1.10 Definition of key words.

The term **"smallholders"** includes small farmers who own/control the land they farm and those who do not. They are producing relatively small volumes on small plots of land (Between 1-3 acres), producing export commodities as a main livelihood activity or as one of many activities, generally less well-resourced than commercial-scale farmers, usually considered part of the informal economy (because they may not be registered, tend to be excluded from aspects of labor legislation, lack social protection and have limited records), depend on family labor and/or may hire workers and are often vulnerable in supply chains (Gomez, 2020).

Horticulture is the art of cultivating plants in gardens to produce food and medicinal ingredients, or for comfort and ornamental purposes. Horticulturists are agriculturalists who grow flowers, fruits and nuts, vegetables and herbs, as well as ornamental trees and lawns. Horticulture is divided into several categories that focus on the cultivation and processing of differentiated plants and foods for specific purposes.

Risk can be defined as the chance of loss or an unfavorable outcome associated with an action. Uncertainty is not knowing what will happen in the future (Crane et al., 2013). The idea of risk is associated with an event that implies some loss or damage and that can occur with some

probability. It implies the existence of some uncertainty but, unlike this latter, the term "risk" emphasizes the loss or negative part of the uncertainty. Risk is an important aspect of the agriculture. The uncertainties inherent in weather, yields, prices, Government policies, global markets, and other factors that impact farming can cause wide swings in farm income.

Risks were categorized into five aspects described here: **Production risk** derives from the uncertain natural growth processes of crops and livestock. Weather, disease, pests, and other factors affect both the quantity and quality of commodities produced. **Market risk** refers to uncertainty about the prices producers will receive for commodities or the prices they must pay for inputs. The nature of price risk varies significantly from commodity to commodity and season to season. **Financial risk** results when the farm business borrows money and creates an obligation to repay debt. Rising interest rates, the prospect of loans being called by lenders, and restricted credit availability are also aspects of financial risk. **Human or personal risk** refers to factors such as problems with individual interests or personal relationships that can affect the farm business and **health risk** which results from the COVID-19 pandemic that retarded the movement of food, resulting from the restrictions imposed by the head of state, causing over production, losses and loss of expertise and had a serious impact on labor availability and productivity in some areas.

Vulnerability is the degree to which a system/community/ society is susceptible to, or unable to cope with, the adverse effects from disasters and hazards for instance: flash floods, pests and diseases, drought and others. It is a function of a character, magnitude and rate of hazard- disaster to which a system is exposed, its sensitivity and adaptive capacity. The concept of vulnerability suggests combination of risk with ability to handle the negative consequences of disaster. Vulnerability of agricultural systems can be defined as the degree to which an agricultural system, or its constituents can respond harmfully in the face of a hazardous event or disaster (Handmer & Dovers, 2009). For example, people can be 'vulnerable' if access to specific resources at various levels is the furthermost critical issue in maintaining secure livelihood or retrieving successfully from a hazardous event. The people having good access to main resources such as financial capital, various management tools, knowledge, know-how and necessary equipment are able to recover most rapidly and with least consequences for them in the face of disaster. However, the most vulnerable people in most cases which are not able to maintain secure livelihood or recover are the poorest one, having little choice and access to finances, tools, equipment, knowledge etc.,

(Chen et al., 2021).

A food shed is defined as a geographical area of food supply that verifies the interaction between urban consumption and peri-urban production, representing the food zone for urbanized areas. The food shed is defined as a “local region that provides enough food products to feed its population” It is also known as production capacity, local food production capacity, or local food shed carrying capacity. (Świader et al., 2018). The concept of the food shed is especially pertinent now that recent food systems could be considered more global than local, which has a destructive impact on the environment and social communities.

CHAPTER TWO: LITERATURE REVIEW.

2.0 Introduction.

This chapter presents a review of literature on the following themes which are in line with the study objectives; the horticultural food shed, the risks faced by smallholder horticultural farmers and the efficiency of risk reduction strategies adopted by smallholder horticultural farmers.

2.1 Food shed.

The food shed is defined briefly as a "local region that provides enough food products to feed its population". The calculation of food shed can be conducted using two approaches, which enable discussions about the functioning of local food systems. The calculation of food shed can be conducted using an approach proposed by Hedden in 1929 to enable discussions about the functioning of local food systems. This approach was based on the relationship between places of food production and its consumer market (Świader et al, 2018). Although agriculture and food shed assessments appear in some metropolitan concepts, there is still a need to introduce the food analysis into the urban concept of sustainability. This need is especially strong because urban consumption centers are dependent on peri-urban and rural agricultural production areas, and urban agriculture is not enough to feed all of the inhabitants of the city (Świader et al, 2018).

Current literature on urban food systems focuses on the city region food systems approach, which is used as a holistic policy framework that includes urban, peri-urban and rural landscapes. Early food shed studies advocated for highly localized food systems and high levels of urban food self-sufficiency (Hemerijckx et al., 2023). This the study analyzed Mbale City region food shed through determining the horticultural food shed in terms of production, location, travel routes, market and consumption points. Kloppenburg *et al.* (1996: 37) describes a foodshed as 'a socio-geographic space: human activity embedded in the natural integument of a particular place'.

Though drawing from the conceptual ideas of the watershed with its boundaries set by somewhat more immutable river-drainage based characteristics, food sheds are perceived as hybrid social and natural constructs. The more 'natural' place variables of micro-weather patterns, soil types, water availability, slope conditions, and others obviously play a role in determining the potential and risks of agriculture – they are spatially bound systems (Marsden *et al.*, 1999). The food shed

concept reconstructs the geography of food systems by compelling social and political decisions on food to be orientated within specific delineated spaces. Advocates hold that 'Food sheds embed the system in a moral economy attached to a particular community and place, just as watersheds reattach water systems to a natural ecology (Starr *et al.*, 2003).

The advantages of local foodsheds are that they can improve consumer-producer relationships, decrease transport costs, greenhouse gas emissions and reliance on (inter-) national infrastructure, and may improve the economic viability of local communities (Hemerijckx et al., 2023). However, high self-sufficiency levels can also pose risks in terms of local civil unrest or natural hazards. Diversified foodsheds might alleviate the risks, which is why a balance between the local, regional, international and global scales is increasingly presented as the solution to mitigate these vulnerabilities

2.2 Risks faced by smallholder horticultural farmers.

The Food and Agriculture Organization of the United Nations (FAO) report of 2017entitled "*The future of food and agriculture: trends and challenges*" identified the requirements for the provision of adequate and affordable food supplies through sustainable agricultural services, in order to meet the growing demands of the increasing world population. This followed the United Nations' General Assembly (2015) introduction of the Sustainable Development Goals (SDGs) to provide food and humanitarian relief and establish sustainable food production by 2030. With this, meeting global food security needs remain a challenge, as food and demand increases at a rate even faster than the population growth (Calicioglu et al., 2019).

Risks come from different sources and are experienced at differing degrees across geographic and political scales. Sources of risks have previously been classified into market risk (output and input price fluctuation, market shocks), financial risk (loans and credits), production risks (weather-related risk, pests and diseases (bio-security threats), technology change, and yields), institutional risk (regulations, legal, and environment and tax policy), human resource risk (physical and mental health) (Calicioglu et al., 2019: Duong et al., 2019) and the health risk; For instance the COVID-19 pandemic which spread extensively and rapidly around the world since late 2019 has had profound implications for the socio-economic situations of the people especially for food security and nutrition (Kassegn & Endris, 2021). The cascading effects of the disease on the planting

activities among smallholder farmers in Uganda resulted mainly from measures put in place by the Government to prevent, and contain the spread of the disease and these were felt because of the interconnectedness and dependence of agricultural systems with other societal systems (Semakula et al., 2023). Studies in Uganda indicate that the regular consumption of fruits decreased by about 30% during the COVID-19 pandemic, compared to periods before the pandemic (Semakula et al., 2023 Kansiime et al., 2021). In agricultural production, production risks are those that affect the expected yield and pose risk to the ability to achieve financial goals. Such risks usually arise from weather related changes, pests, diseases, technology and machinery efficiency and the quality of inputs. Market risks are those that arise from movements of stock prices, interest rates and exchange rates and these production activities into financial success. Some of these include: bargaining power, price variations, demand and supply levels and access to market. Financial risks affect the financial health of the farming business and these include: the cost and availability of capital, ability to meet cash flow needs in a timely manner, ability to maintain and grow equity and ability to absorb short-term financial shock from available financial and credit institutions. People (humans) are a source of risk in ways that translates into individual interest, sabotage of farms, robbery and theft.

Risks not only endanger the farmer's livelihood and incomes, but also undermine the viability of the agriculture sector (Alizadeh and Nomitos, 2005). Thus, the potential of agricultural sector to eradicate the problem of endemic poverty of the farmers has become a big concern, but the bottleneck for agribusiness sector is the existence of variety of risks (Panda et al., 2012). These risks are exacerbated by a variety of factors such as uncertainties in yields and prices, weak rural infrastructure, imperfect markets, climate variability and change, frequent natural disasters and lack of risk mitigation instruments such as credit and insurance (Swaminathan, 2007, Panda et al., 2012).

Climate change remains one of the critical issues affecting Uganda's socio-economic development and the effects of are predicted to be more felt by the largely vulnerable smallholder farmers (Mugagga et al., 2020). Drought and dry spells, seasonal and flash floods and extreme temperatures are impacts that the country is experiencing with adverse consequences for food and water security, water quality, energy and sustainable livelihoods of rural communities. In terms of sectoral impact, agriculture, forestry and water are the most affected. The climate change effect on the agricultural sector alone leaves 60% of Uganda's population vulnerable and in danger of livelihood insecurity

(World Bank, 2020). And for this reason, smallholder horticultural farmers on whose shoulders the Ugandan agricultural sector rests would be adversely affected. According to the 2021 report from the United Nations Intergovernmental Panel on Climate Change (IPCC), in regard to cities taking Mbale City for this case, some aspects of climate change may be amplified, including heat (since urban areas are usually warmer than their surroundings) and flooding from heavy precipitation.

According to Maertens and Swinnen (2006), it is expected that high standards will act as trade barriers for developing countries and cause increased poverty. The authors found that exports have grown sharply despite increasing standards, resulting in income gains and poverty reduction. They further explain that the tightened food standards caused a shift from smallholder contract-based farming to large-scale integrated estate production, changing the means through which poor households' benefit; that is through labor markets instead of product markets. The impact on poverty reduction is stronger as the poorest benefit relatively more from working on large-scale farms than from contract farming.

McCulloch and Ota (2002) sought to examine the linkage between export of horticultural produce and poverty reduction in Kenya. The study makes use of household survey data to compare the incomes of households involved in export horticulture with those which are not. The findings of this study are that households that engaged in export horticulture were better off than those which do not especially in the rural areas. Furthermore, farmers that engaged in horticultural crops production often earned higher incomes than those who engaged in cereal crops production. However, the authors also found that there exist some constraints faced by rural households in determining participation in the sector. These constraints mainly include post-harvest facilities, managerial and marketing skills.

Depending on what type of risk the producer is exposed to and to what extent it has to be covered, the producer can choose which risk management instrument to use (Alizadeh-Masoodian, A. and Nomikos, 2005). Farmers constantly cope with and manage different types of risks. Risk inherently involves adverse outcomes, including lower yields and incomes and can also involve catastrophic events, such as financial bankruptcy, food insecurity and human health problems, although higher expected returns are typically one of the positive rewards for taking risk. Farmers therefore cope simultaneously with and manage multiple risks that can have compounding effects (Wauters et al.,

2014). The compounding effects may affect decisions and outcomes at scales well beyond the farmer. One initial cause of the 2007/08 world food price crisis was an agricultural risk related to severe droughts but the impacts of the ensuing price spikes were exacerbated by some governments imposing export restrictions. During this crisis farmers faced production risk (drought), market risk (price spikes), and institutional risk (unexpected changes in government policy) all within a short period. Thus, risk outcomes can have cascading effects where one type contributes to another type occurring for example, excessive rainfall during harvest is an event that can engender another set of risks such as financial risks associated with being unable to repay loans (Pelka, 2015).

2.3 Risk reduction strategies adopted by smallholder horticultural farmers.

Initiatives and investments to intensify agricultural production can expose smallholder farmers to increased risks (Vanlauwe et al., 2014). Farmers have always faced multiple risks; for example, in pre- modern Iceland major concerns for farmers included weather variability and personal illness. Campbell et al. (2016) argue that the growing number of studies that focus almost exclusively on the link between weather variability and crop yields provide only marginal increases in knowledge and by only studying one risk we only gain an inadequate picture of all the types of risk farmers encounter. The implication of this argument is that analyses of multiple concurrent sources of risks are likely to generate more useful insights. The IPCC (2019) reinforces this view by discussing how diverse types of risks co-occur or reinforce each other and how such co-occurrence can limit the effectiveness of adaptation planning for climate change. The IPCC indicates a possible remedy may be policymaking that considers multiple risks. Other researchers have also argued that the risks associated with climate change, economic volatility, globalization, and political instability have become more pronounced and severe (Hansen et al., 2019), Whether farmers' exposure to risks, in general, has increased over time remains an open question as the quantitative evidence seems mixed and context specific, especially for weather and commodity prices (Wildemeersch et al., 2015), However, unanticipated events with considerable impacts on farmers continue to occur (Just, 2001) which suggests that the nature of risk has changed over time. The challenges to the agricultural sector from a growing world population, from changing diets with higher demand for animal-source foods, and from climate change, make managing multiple risks more important than ever.

To develop the country, Uganda elaborated a national vision, launched in 2010 and entitled "Uganda Vision 2040". The vision statement is "A Transformed Ugandan Society from a Peasant to a Modern and Prosperous Country within 30 years". The implementation was planned for 30 years through three 10-year plans, six 5-year National Development Plans (NDPs), Sector Investment Plans (SIPs), Local Government Development Plans (LGDPs), Annual work plans and Budgets. The Uganda Vision is an indication of a multi-sectoral and detailed level of planning responsibilities established in the country. The vision was developed under the coordination of the National Planning Authority. The vision also recognized that climate change and other disasters needed to be tackled effectively in the country. In this regard, the vision suggested the establishment of "clear milestones and analytical tools" in order to monitor the country's progress in dealing with climate change issues.

Specifically, to disaster risk management, Uganda possesses a National Policy for Disaster Preparedness and Management since 2011 with a goal of reducing vulnerability levels, risk mitigation, disaster prevention, preparedness, effective response and recovery in a manner that integrated disaster risk management with development planning and programming. The policy was developed in a comprehensive approach and through consultations with a range of stakeholders, from communities in rural villages through the districts to stakeholders at national level, including all the lead sectors, local governments, international development and humanitarian partners, the private sector and the NGOs. The policy also sets a framework for coordination with the Government playing a supportive role and citizen being responsible for disaster risk management (Bahal'Okwibale, 2018).

Ideally, new initiatives that aim at promoting and supporting risk management holistically should be underpinned by evidence on how farmers cope with multiple risks, projects have been put up to explore new ways to address some of these issues, including using non-traditional distribution systems for Purdue Improved Crop Storage (PICS) sacks such as agro-dealers' networks, and adapting distribution systems.

The rising stress on food security and demand for high-quality nutritional food such as from horticultural products must be addressed sustainably by minimizing environmental impacts and maximizing social opportunities (Calicioglu et al., 2019) by carrying out land risk assessment and use of organic manure as supplements for crop growth.

Particularly in a short term, a rapid introduction of new crop varieties and production techniques often offers a potential for improved efficiency, but may at times yield poor results. In contrast, the threat of obsolescence exists with certain practices (for example, using machinery for which parts are no longer available), which creates another, and different, kind of risk. Examples include: Natural conditions; biological and environmental hazards; technological level; natural disaster; demand; policy decisions. (Girdžiūtė, 2012).

Farming is risky and smallholder farmers live with these risks, making decisions for better farming operations which is the principal activity in managing risk (Kahan, 2013). However, these are not accurate enough to eradicate the risk and for effective decisions to be taken, farmers must have all the necessary information regarding input prices, output prices and yields, as well as other technical data needed to manage the risks. Smallholders require options that are relatively low-risk, but that do provide short-term returns on investment. Consequently, building resilient systems is key, both from the perspective of risk management and sustainability. This requires investments beyond plot-level technologies into policy and other institutional issues (Vanlauwe et al., 2014) that can enable adoption and reduce smallholder vulnerability to agricultural risk. Therefore, this study sought to analyze the vulnerability of smallholder horticultural farmers, examining the effectiveness of risk reduction strategies adopted by the farmers.

2.4 Knowledge gaps.

From the above studies, the foodshed is illustrated as a whole in policy frameworks and this study comes in to show the level of self-sufficiency through mapping the foodshed by determining this through market and consumption points. Smallholder farmers have been noted to be the future of urban food supply and subsistence in Sub- Saharan Africa and South East Asia and in fact, most of the horticultural foods in Uganda are being produced by smallholder farmers despite their vulnerabilities to a variety of risks. These (risks) have had significant impacts on food security, nutrition, income and well-being of the farmers. The current study thus sought to analyze these vulnerabilities so as to come up with plausible recommendations aimed at enhancing urban food systems resilience in Mbale City and beyond. The above literature review shows a lot has been said and studied from the different angles of the globe about the foodshed in line with sufficiency, risks affecting several value chains and risk reduction strategies adopted by the smallholder farmers. From the literature available; the food shed, risks in aspects of technical and production,

market, financial and health, and risk reduction strategies adopted by the smallholder farmers have been put up very well in a qualitative manner. However, the literature doesn't show the effects of hybrid solar projects on livelihood. This study, therefore, addressed this gap focusing on analyzing the vulnerability of smallholder horticultural farmers to risks.

To fill the methodological gap, both qualitative and quantitative approaches were used to bridge the gap of the previous studies, which focus on the qualitative way of understanding the foodshed, risks affecting the smallholder farmers and risk reduction strategies, inferential statistics were also used since current studies focus on descriptive statistics.

CHAPTER THREE: METHODS AND MATERIALS.

3.0 Introduction

This chapter provides a justification of the methodology that was used for the study. The key themes presented include: the research design, study population area, sample size, sampling techniques and procedure, data collection methods, data collection instruments, validity and reliability, data quality control, data analysis, data measurements, ethical considerations and limitations of the study.

3.1 Study Area.

The study was carried out, along the Nabuyonga Stream and its tributaries of Nabijo, Nashibisho and Namatsyo; all found in Mbale City. Mbale City is found in Mbale District which is bordered by Sironko District to the north, Bududa District to the northeast, Manafwa District to the southeast, Tororo District to the south, Butaleja District to the southwest and Budaka District to the west, Paliisa and Kumu Districts in the northwest. Mbale City is the largest town in the district. The location of the district headquarters is located approximately 245 km, by road, northeast of Kampala, the capital city of Uganda. Mbale City is the main, administrative and commercial center of the district. It has an area 158.441 sq. km (UBOS, 2016).

The study was carried out in Nabuyonga valley transcending 6 sub-divisions including: Northern, Wanale, Lwasso, Nakaloke, Bungokho - Mutoto and Industrial divisions. From these divisions, seven (8) parishes namely: Nabuyonga, Namatala, Namakwekwe, Boma, Lwasso, Doko, Bumboi and Namalogo were specifically targeted because they hosted households which practiced horticultural farming along the Nabuyonga Stream and its tributaries of Nabijo and Namatsyo.

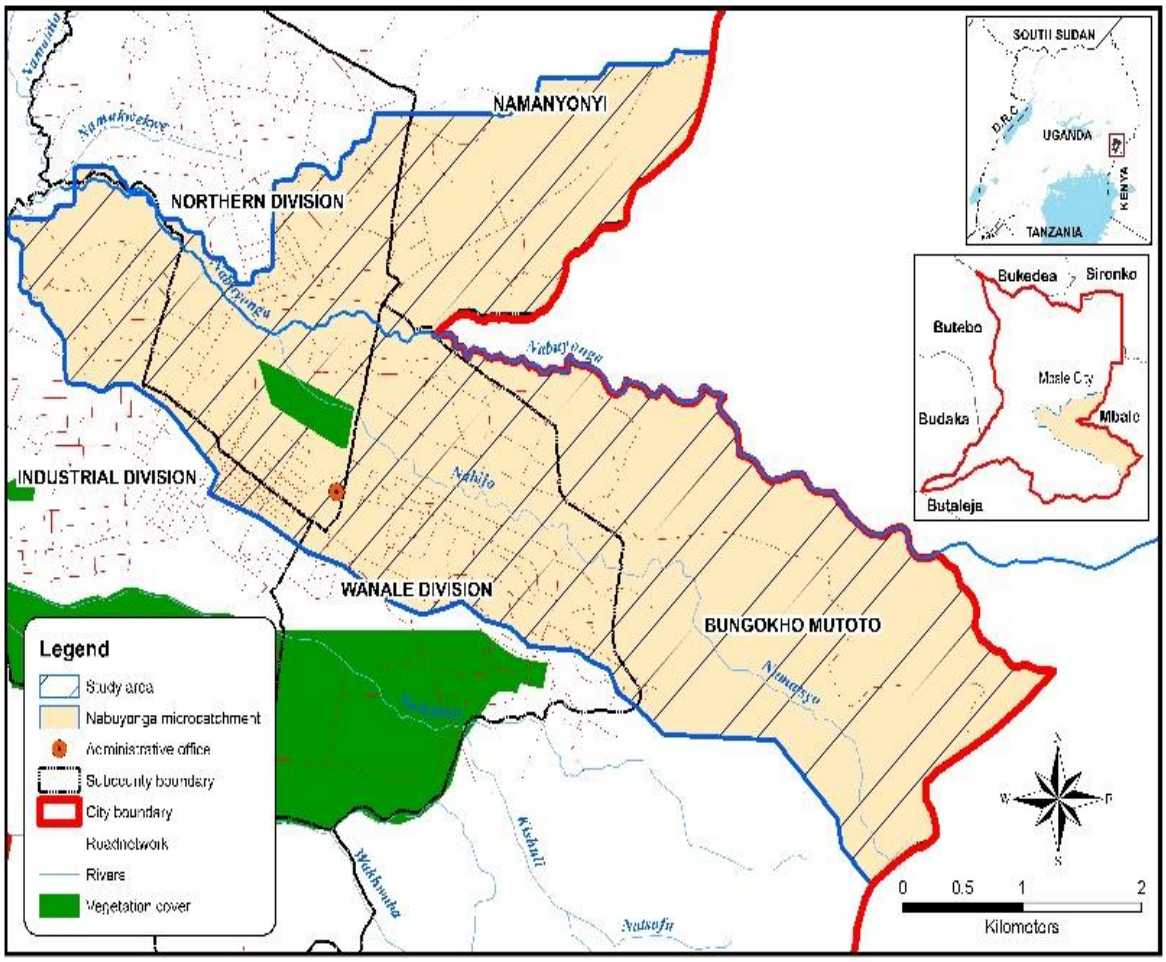

Figure 2: The Nabuyonga valley- Mbale city region.

3.2 Research Design.

The research design is intended to provide an appropriate framework for a study (Thwaites, 2020). The study employed a descriptive survey design to determine the food flows and assess the risks faced by the smallholder horticultural farmers. Exploratory and interpretive research designs were followed to evaluate the effectiveness of risk reduction strategies adopted by the small holder horticultural farmers.

3.3 Sampling frameworks, techniques and sample size.

This study employed both probability and non-probability sampling techniques. Probability sampling techniques included simple and stratified random sampling which were used to select smallholder horticultural farmers in the Nabuyonga Catchment. This was to ensure that there is

representativeness. Besides, it provided an equal chance to all of being selected. Non-probability sampling techniques included purposive sampling of key informants (Traders, Consumers, Production officer- Mbale City, Extensional agricultural officers and others) to ensure people with particular information about the effectiveness of risk reduction strategies adopted by smallholder horticultural farmers were selected. Snowball sampling was used to reach respondents through referrals and enable the researcher interview respondents who could provide data on the topic under study.

3.4 Determination of the sample size.

Units of analysis were households and sample selection were based on records/lists obtained from the Production Office - Mbale City. Seventy-seven (77) households involved in smallholder horticultural farming were purposively selected for the study. Forty-two (42) First order respondents were randomly selected from the lists of farmers and contacted through phone calls and thirty-five (35) second order respondents were obtained through snow balling.

3.5 Data sources and collection instrument

Majorly, two types of data sources – secondary and primary data sources were used for this study.

3.5.1 Data sources, Collection Procedure and Instruments

Primary data were collected using questionnaires and direct interviews. Qualitative data was collected through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs). Quantitative methods were used to generate quantifiable data, using a questionnaire, which was the main instrument used because of its convenience and efficiency in data collection. The different tools and data sources were used to make triangulation feasible (Amin 2005).

Observation and photography were used to see, analyze, understand and appreciate the existence of the numerous horticultural farms for several selected households along the Nabuyonga stream in the selected Parishes. Observation is particularly useful to better understand how land is utilized, to discuss particular problems (and opportunities) of the various ecological zones of the local area. For the study roll out, this tool helped the researcher and the community to see and highlight the conditions of both the land and water resources such as community access roads, the water sources, soil fertility and key marketable horticultural crops grown.

3.5.2 Questionnaire

Ahuja (2009) defines a questionnaire as a structured set of questions that are given to people in order to collect facts or opinions about something. For this study, a Kobo toolbox/software, loaded on a tablet, helped in coding the questionnaire (appendix 1) and collection of data needed, as will be elaborated later. The researcher used closed-ended questions because they are easy through the use of a Likert scale and quick to answer, and they are helpful in improving consistence of the responses. This was used in assessing the risks faced by the smallholder horticultural farmers at household level and evaluating the effectiveness of risk reduction strategies adopted by the smallholder horticultural farmers in the Nabuyonga valley.

3.5.3 Interviews.

According to Ahuja (2009), an interview is a two-person conversation initiated by the interviewer for the specific purpose of obtaining research-related information. It focuses on the content specified by the research objectives, description and explanation. An interview guide, which is referred to as a set of questions (Appendix 1) for which answers, were used by a researcher to interview respondents. The use of this tool gave the researcher control over the line of questioning hence time saving. The purpose of the interview was explained, as well as, reassuring respondents of confidentiality of the information provided. Key informant interviews (Appendix 2) were conducted on various respondents (including, agricultural Extension Officers, Market Leaders, Model Farmers and the Local Leaders) to collect qualitative information. KIIs generated in-depth information that enabled understanding of the horticultural food shed, policies and bi-laws put in place in favor of the Smallholder farmers and effectiveness of these risk reduction strategies adopted by the Smallholder horticultural farmers in the study area. The format of the interview was an informal conversation where pertinent questions were asked to several respondents.

3.5.4 Observation and photography.

Observation and photography were other methods used in the study. Observation involved the researcher engaging in the actual experience. This allowed the researcher to see activities undertaken as well as some discernible physical risks that were encountered by the smallholder farmers. It was also involved tracing and mapping the travel routes, consumption points and market points ultimately helping to determine the inflows and outflows of horticultural crops and pictures were taken concurrently with in Mbale City – Region.

3.6 Data collection procedure.

The researcher obtained a recommendation and an introductory letter from Makerere University, after which sought permission from the different respondents in Mbale City Region before engaging the various respondents.

3.7 Data Quality Control.

3.7.1 Reliability of the questionnaire.

According (Bruton et al., 2000), reliability is established by testing the instruments for analysis of Alpha values for each variable under study. Sekaran (2001), notes that Alpha values for each variable under study should not be less than 0.6 for the statements in the instruments to be deemed reliable. To ensure that all variables are subjected to this test, the researcher used the internal consistency method that provides a unique estimate of reliability for the given test administrations. The most popular internal consistency reliability estimate has been given by Cronbach's Alpha (Ekolu & Quainoo, 2019) i.e.:

$a = \frac{N \cdot \bar{c}}{\bar{v} + (N-1) \cdot \bar{c}}$ where: N is the number of test items or questions.

$\bar{c}$ is the average of all covariances between the paired test items.

$\bar{v}$ is the average of all variances of the test items.

3.7.2 Validity of the questionnaire.

After developing the questionnaire, the researcher contacted the supervisors and other experts to ensure that the tools to collect the required data is valid and in line with the study objectives. Hence, the researcher ensured validity of the instruments by using expert judgment method as suggested by (Amron et al., 2020). With the case of metaphors – because the study area is involved with Bagisu, prepositions were used in case of any complicated words and the researcher moved with an agricultural officer who helped in translations when the language became hard.

3.8 Data Processing.

In order to ascertain the accuracy, consistency, uniformity, proper arrangement and completion of the data, the researcher used the computer software -KOBO Tool Box for data entry, editing and data coding. The KOBO Tool Box software was used because it increases the speed of computation and data processing and handles huge volumes of data, which is not possible manually. This facilitated copying, editing, saving and retrieving the data easier and in validation, checking and correction of data.

3.8.1 Data Analysis.

Descriptive statistical analysis tools (Excel and SPSS, Version 25 IBM New York, NY, USA), were used in quantitative data analysis while, ArcGIS extensions like Data Management tools, Spatial Analyst Tools, were used for construction of flow maps and mapping of consumption points and travel routes. To explore the nature and trend of risks and evaluate the effectiveness of risk reduction strategies adopted by the farmers, the data were analyzed using descriptive statistics of mean, frequencies, standard deviation and percentages. Inferential statistical tests of independent t- tests and one-way analysis of variance (ANOVA) were performed to uncover linkages between particular risks and adopted risk reduction strategies and summarized based on the aggregated data from descriptive statistics. The Likert scale was analyzed following a scale of 2 – 10 for instance: Strongly Disagree (2), Disagree (4), Moderately Agree (6), Agree (8) and Strongly Agree (10) and body language in line with the skeptism of the answer given by the respondents (smallholder farmer).

3.9 Ethical consideration.

Ethical considerations were taken care of by, first seeking authorization from the Makerere University administration and other relevant authorities in the study area. Questionnaires were structured in such a way that there is no mention of the interviewee's name which ensures strict confidentiality in data.

Informed consent was obtained from informants/respondents prior to engaging in the interviews. They were promised confidentiality about the information they provide. The researcher explained to the respondents the purpose of the study as purely academic and that the information obtained would be treated with utmost confidentiality. If anybody other than the University authority was to have access to the information, the researcher would first seek the consent of the respondents.

Furthermore, participation in the survey was optional and respondents were at liberty to withdraw from the interview as long as they felt uncomfortable. Ethical considerations were taken care of by the researcher by briefing the respondents on the purpose of the research, their relevance in the research process, and expectations from them as explained by Lloyd Bevan (2009).

CHAPTER FOUR: PRESENTATION OF FINDINGS.

4.1 Introduction:

This chapter presents the findings of the study in tandem with the objectives viz; a) determining Mbale City Region's food shed in terms of production points, consumption points, market points and travel routes, b) risks affecting smallholder farmers and c) effectiveness of the adopted risk reduction strategies.

4.2 Socio-demographic information of the respondents.

The rationale of socio – economic variables is that they influence farmers' decision-making processes and shapes the amount of input and output for horticultural and livelihood development these include: income sources, education levels, access to information community safety and others. These are both internal and external conditions.

Table 1: Socio demographic status of the respondents.

Internal conditions	Categories	Frequency	Percentage
Sex	Female	29	38
	Male	48	62
Age	Less than 24 years	3	4
	25 - 34	20	26
	35 - 44	25	33
	45 - 54	22	29
	55 and above	7	9
Marital status	Single	7	9
	Married	60	78
	Divorced / Separated	1	1
	Widowed	9	12
Education level	No formal education	10	13
	Primary Level	23	30
	Secondary	35	46
	Higher	9	12

Duration in the area (years)	1 - 5 years	8	10
	6 - 10 years	21	27
	11 - 15 years	9	12
	16 years and above	39	51
Average monthly income	Less than 3,000,000	57	79
	4,000,000 - 6,000,000	15	21
Percentage of income from the horticultural value chain	Below 20%	31	44
	30 - 50%	34	49
	60 - 80%	4	6
	90 and above	1	1
Nature of land ownership	Self-owned	30	39
	Hire	41	53
	Both	6	8
Horticultural crops	Tomatoes	56	73
	Onions	14	18
	Cabbages	49	64
	Sukuma-wiki (collard green- brassica raphanus)	41	53
	Carrots	3	4
	Green pepper	7	9
	Peas	2	3
	Nakati (ethiopian eggplant - solanuma-ethiopicum)	3	4
	Irish potatoes	2	3
	Other	32	42

A total of seventy-seven (77) smallholder horticultural farmers participated in this study as presented in Table 1. The breakdown shows that in terms of gender, males (62%) who participate in cultivation of horticultural crops were more than females (38%). The average household size

was 6 members of which four were children and two were adults (3.6 ± 2.1 and 2.4±1.6) respectively. The respondents' age groups were classified into five categories: Less than 24 years, 25 – 34 years, 35 – 44 years, 45 – 54 years and 55 years and above. There were more smallholder horticultural farmers within the 35- 44 years' category and these constituted 32.50%. Regarding marital status, most of the participants were married (77.90%). The result for education level portrayed that most of the respondents had secondary school education followed by primary level at 45.5% and 29.90% respectively.

More than half of the farmers (50.60%) reported a farming experience of 16 years. For land ownership, most of the farmers were hiring their farming plots (53.20%), 39.00% of the plots were under individual ownership while 7.80% owned and hired farming plots with reasons of increasing productivity.

Horticultural crops mostly grown by the smallholder farmers include: tomatoes (72.70%), cabbages (63.60%) and Sukuma-wiki (collard green- brassica raphanus) -(53.20%).

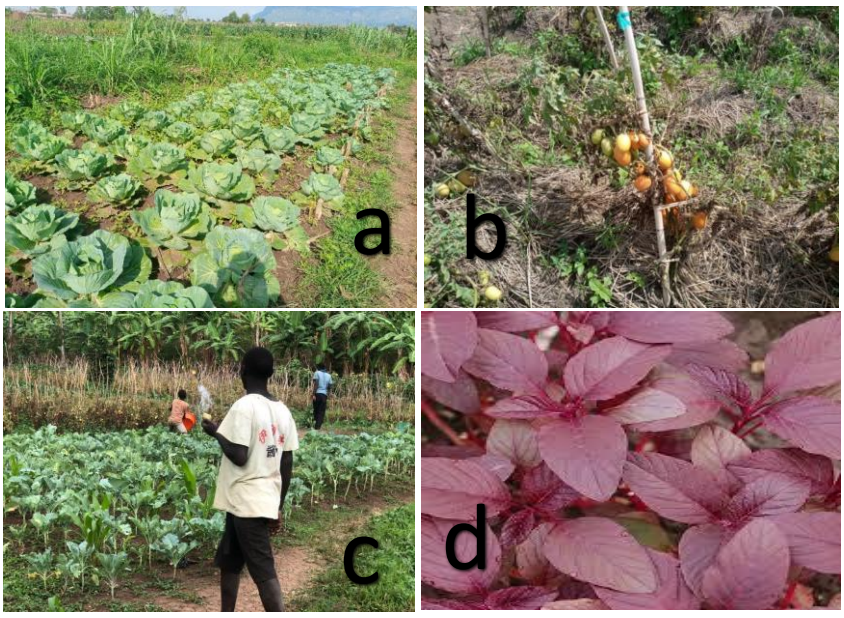

Plate 1: *Show some of the horticultural crops grown in the Nabuyonga valley including Cabbage(a), tomatoes(b), Sukuma wiki(c) and Red- amaranthus(d).*

External conditions that characterize smallholder farming activities in Nabuyonga Valley.

Smallholder farming activities are characterized by a range of external conditions. Findings from this study reveal that the most dominant means of transport used by farmers is through manual or human labour (97.40%), followed by use of motorcycles (48.10%) and middlemen buying horticultural produce from gardens (36.40%). Scale of market for the smallholder farmers was generally local (100%) but some farmers had national market (within Ugandan cities) (13.50%) and international market (6.50%). Sources of information about horticultural market and knowledge used by the farmers was the community radios (7.80%). Farmers attained support services from fellow community members (98.70%) and cooperative/ associations (54.30%) which provided financial support to facilitate the production process of the horticultural crops from the garden to the market. With regard to problem solving, results indicate that smallholder farmers run to community individuals (fellow farmers) for solutions in case of any pest and disease outbreak. The two main sources of inputs for majority of horticultural farmers are input dealers and suppliers (68.80%) and self/individual saving of inputs that indicated 66.20%.

Table 2: External conditions that characterize smallholder horticultural farming activities.

External conditions	Categories	Frequency	Percentage
Transport means	Motorcycle (boda boda)	37	48
	Human (carry)	75	97
	Bicycle	6	8
	Vehicles (mini lorries)	5	7
	Middlemen	28	36
	Producer associations	5	7
	Other	2	3
Scale of market	Local	77	100
	National	10	13
	International	5	7
Sources of information	Radio FM	1	1
	TV	1	1
	Community radio	6	8

	News papers	3	4
	Conferences/ meetings/ workshops	3	4
Support and support services	Community/ Individuals	76	99
	Cooperatives/ association	8	10
Co-operatives/ associations	Savings group (SACCO)	18	55
	Horticultural farmers' group	10	30
	Youth group	3	9
	Others	2	6
Problem solving	Agricultural extensional workers	13	17
	Community	71	92
Supply of inputs	Input producers	53	69
	Individuals	51	66
	Operation Wealth Creation (OWC)	2	3
	Others	2	3

As depicted in Figure 3, the two technical information sources of the smallholder farmers included introduced and indigenous. For the introduced sources, most farmers obtain technical information from innovative farmers (65.3%), living within the catchment and agricultural extension officers delegated from the city offices. (23.6%). More than three quarters of farmers attained technical information from indigenous sources which include fellow farmers (84.7%) and family (37.5%).

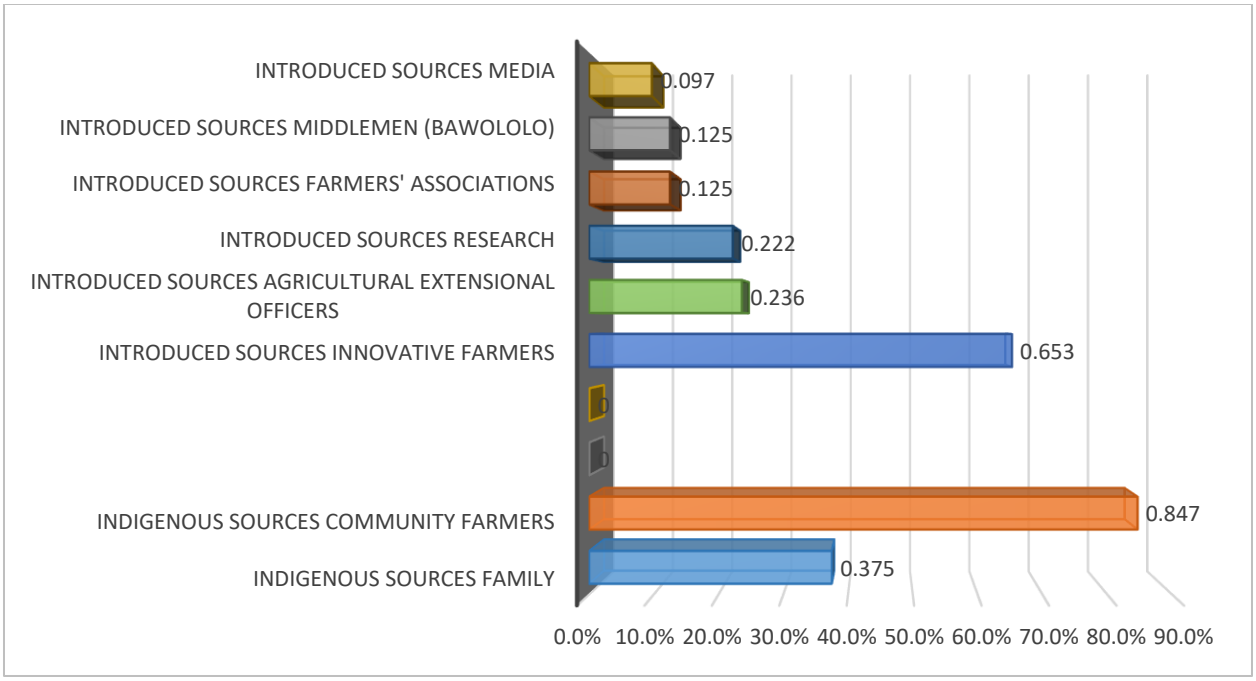

Figure 3: Sources of technical information used by the Smallholder Farmers for improvement in skills and productivity.

4.3 Mbale City Region's horticultural food shed.

The first research question sought to determine Mbale City Region horticultural food shed in terms of travel routes, market and consumption points. In order to answer this question, responses were obtained from market leaders (traders), production office and smallholder horticultural farmers. The movement of horticultural food produced in Mbale City to surrounding districts and outside the country is indicated in Table 3. The magnitude (percentages) is represented by the thickness of flows/ lines to destination points for instance: 5% - 0.5, 10% - 1, 20% - 2, 30% - 3, 40% - 4 and 60% - 6 and arrows show the direction of the food. (Figure 2).

Table 3: Percentages showing food inflows and outflows in Mbale City Region.

Horticultural Food shed	Percentages
Namunsi Juba Stage	
Inflows	
Kapchorwa	60
Sironko	10
Wanale	30
Outflows	
Juba	30
Kenya	10

Democratic Republic of Congo	10
Arua	10
Adjumani	5
Moyo	5

Bugwere Market	
Inflows	
Mbale	80
Kapchorwa	10
Budadiri	5
Wanale	5
Outflows	
Kampala	20
Soroti	10
Tororo	5
Iganga	5
Namutumba	5
Arua	5

Mbale Central Market	
Inflows	
Wanale	20
Lwasso	20
Manafwa	15
Bududa	10
Bulambuli	10
Outflows	
Gulu	20
Nebbi	10

These are flow maps showing percentage proportions of horticultural food inflows and outflows across Mbale City Region and the country at large.

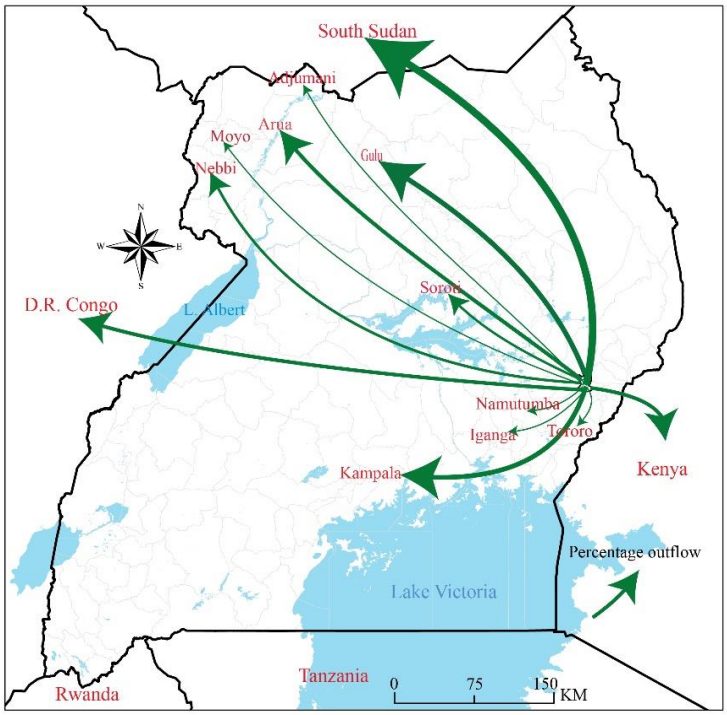

Figure 4: Horticultural food outflows from Mbale City to destinations.

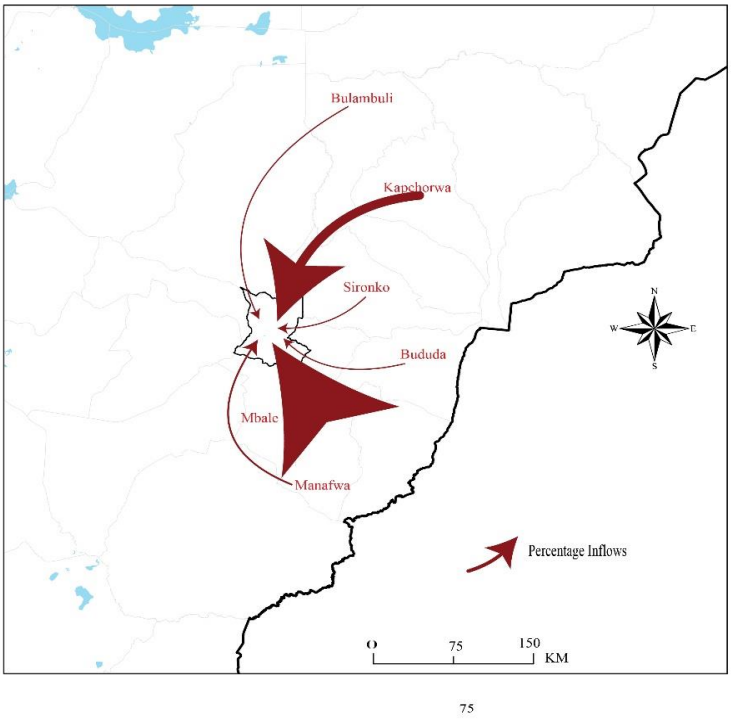

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Figure 5: Horticultural food inflows to Mbale City from several surrounding districts.

Specifically, from Mbale Central market, 35% of the market stock are horticultural crops like carrots, cabbages, tomatoes and irish potatoes which are collected from surrounding districts of Bududa (10%), Bulambuli (10%), Manafwa (15%), within Mbale City from Wanale (20%) and Lwasso (20%). Thirty percent of the horticultural products are taken to surrounding districts of Nebbi (10%) and Gulu (20%) and the rest is consumed by the population within Mbale City and the district at large as shown in figure 4.

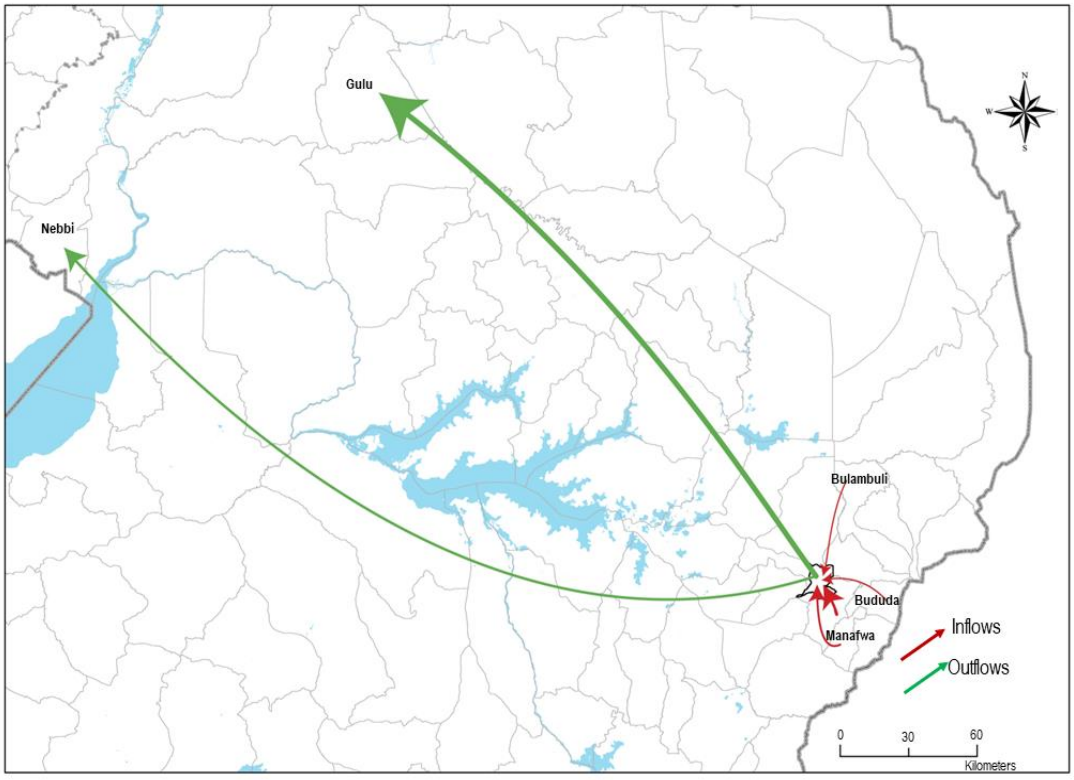

Figure 6: Horticultural product flows in and out of Mbale City's Central market.

Plate 2: Fresh horticultural crops in the Mbale Central market.

From Namunsi Juba Stage, horticultural crops like: Irish potatoes, onions, cabbages, carrots and green peppers are collected from Kapchorwa (70%), Sironko (10%) and Wanale (30%) and are taken to surrounding districts of Arua, Adjumani and Moyo and outside the country to the Democratic Republic of Congo, South Sudan and Kenya. 30% of the products is consumed within Mbale City as shown in figure 5.

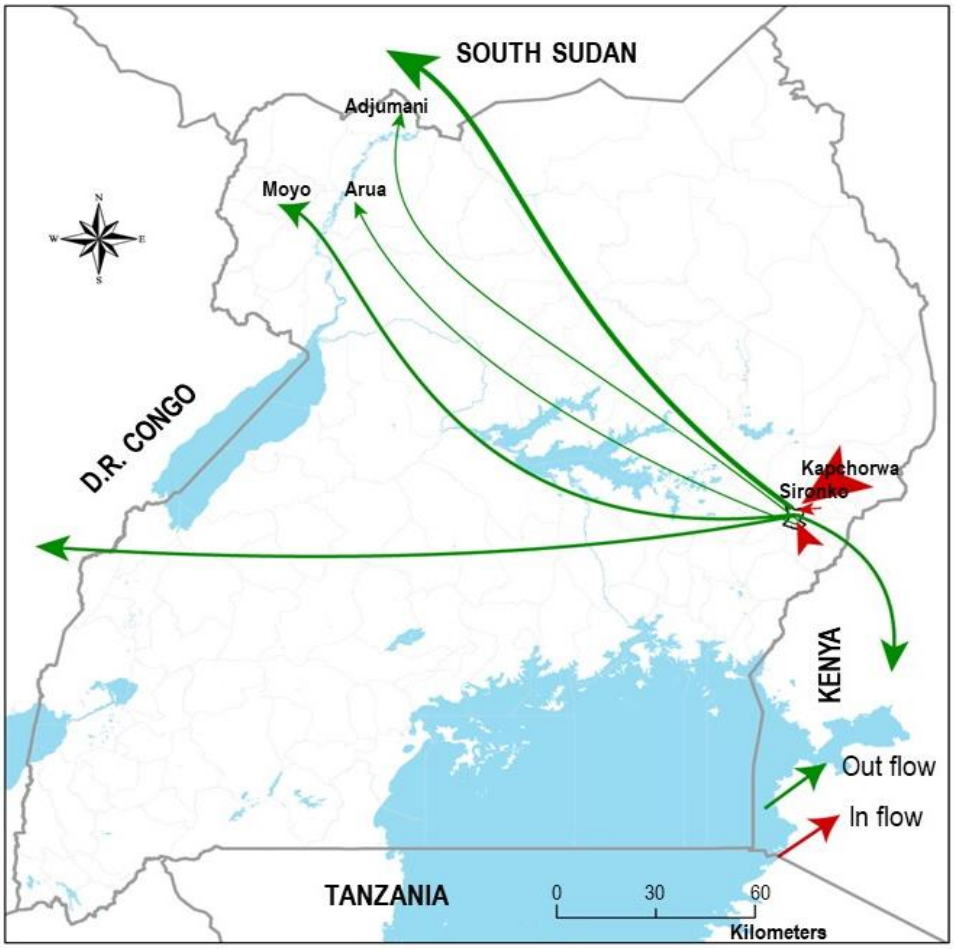

Figure 7: Horticultural food flows in and out of Namunsi market.

Plate 3: Trucks of cabbages headed to South Sudan and Democratic Republic of Congo.

Plate 4: Irish potato bags sorted and packed at Namunsi Market by farmers and middlemen

From Bugwere Market, 80% of the horticultural crops like tomatoes, onions, cabbages, carrots and greens are from Mbale City. Fifteen percent of the horticultural crops like Irish potatoes, cabbage and onions are from Kapchorwa, Budadiri- Bujibone and Wanale. Fifty percent of these are taken to surrounding districts of Tororo, Iganga, Namutumba, Soroti, Arua, and Kampala and the rest is consumed within Mbale City as shown in figure 6.

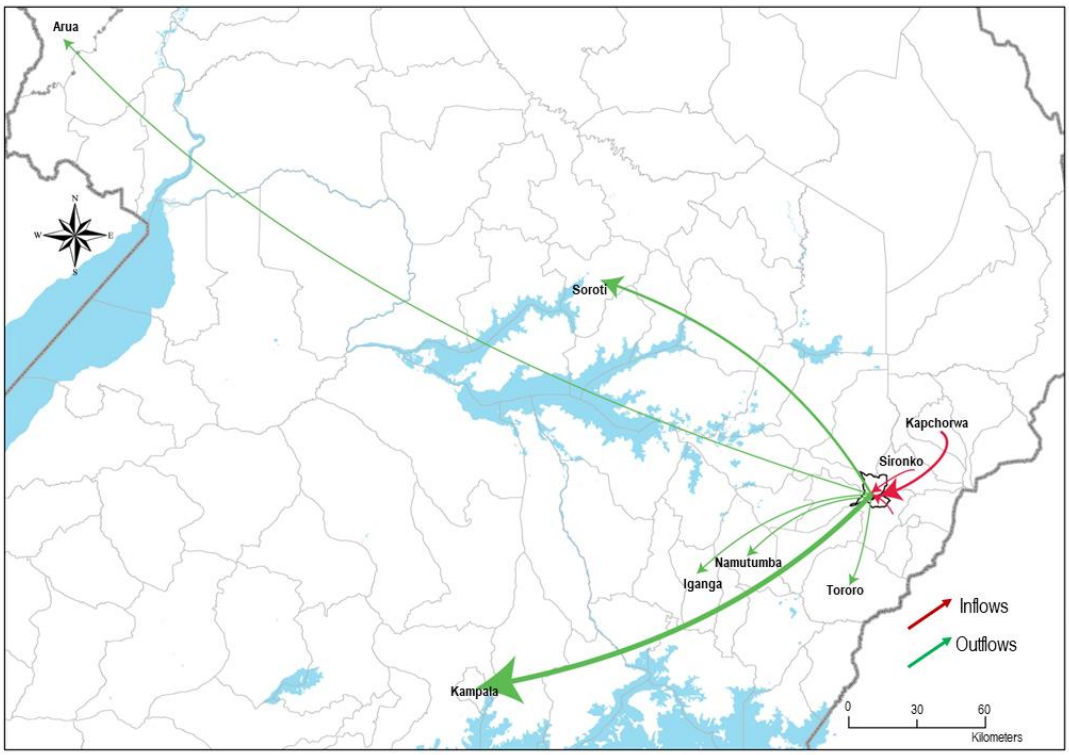

Figure 8: Horticultural product flows in and out of Bugwere market flows.

The rest of the horticultural products are consumed with in Mbale City and the district at large. As shown in Figure 7, the other mapped markets for instance Malukhu-Adra, Musoto, I.U.I.U, Kikindu, Mutukula, Bugema, Kukubo and Munkaga confirmed that the horticultural produce is mainly consumed by the population within Mbale City.

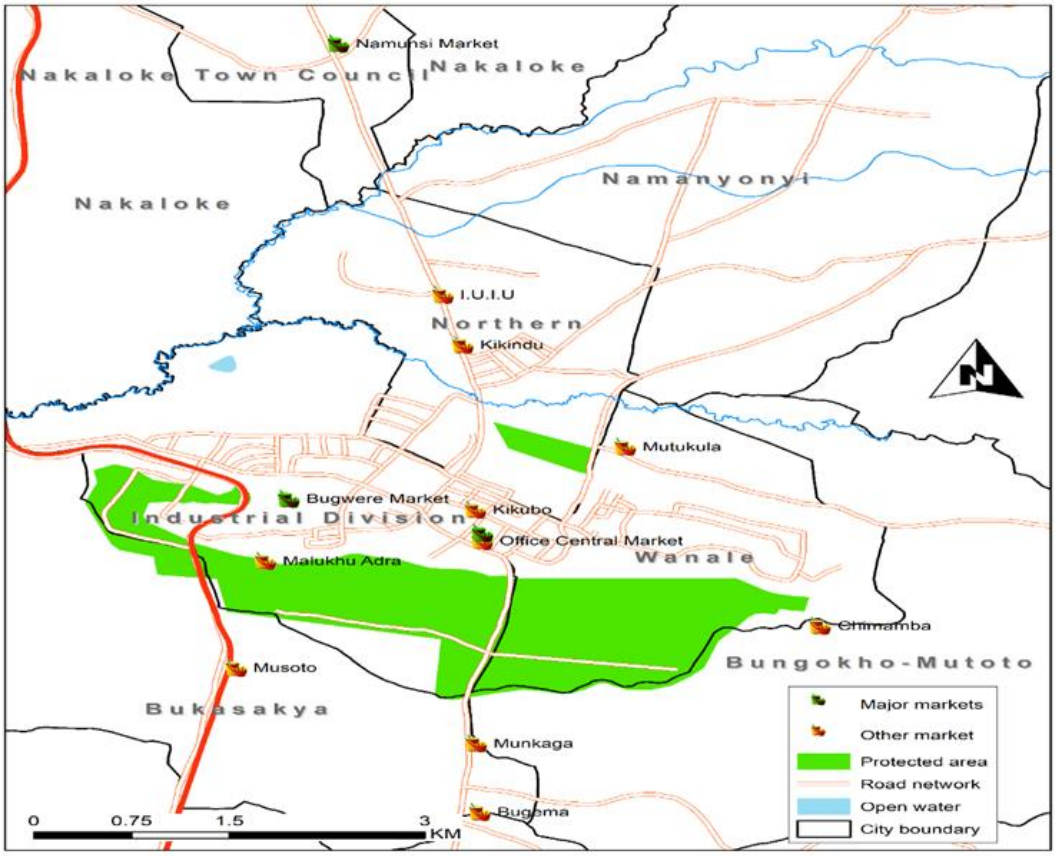

Figure 9: A map showing other markets and travel routes used in the transportation of the horticultural crops within and outside Mbale City.

4.4 Risks affecting Smallholder horticultural farmers in the Nabuyonga Valley.

The second research question aimed at assessing risks experienced by smallholder horticultural farmers at household level in the Nabuyonga Valley. The risks were categorized into production and technical, health, market, financial and human risks. To answer this question, responses were obtained from smallholder horticultural farmers in parishes of Namakwekwe, Nabuyonga, South Central, Namatala, Lwasso, Bumboi, Namalogo, Doko, Boma and Busamaga East.

The responses of the farmers using a five-rating scale Likert-type questions are presented in Table 4. This was analyzed following a scale of 2 – 10 for instance: Strongly Disagree (2), Disagree (4), Moderately Agree (6), Agree (8) and Strongly Agree (10) and body language in line with the skeptism of the answer given by the respondents (smallholder farmer).

Table 4: Risks faced by smallholder horticultural farmers.

Perceptual statement	**Level of Agreement (%)**						
Production and Technical Risks	**SD**	**D**	**MA**	**A**	**SA**	**Mn**	**SD**
Flash floods and dry spells greatly affect the horticultural farms and output.	0	0	3	9	88*	5	0
Post-harvest losses affect the quality and quantity of horticultural crops grown.	0	1	4	42	53	5	1
Counterfeit inputs on the market greatly impact the quality of horticultural crops harvested.	0	0	9	8	83	5	1
Inputs from Government organizations are not served in the rightful seasons.	3	0	17	20	61	4	1
Technical services from agricultural officers have not improved farmer's skills and knowledge.	58	8	4	17	13	2	2
To be a farmer, one must own land.	73	21	3	0	4	1	1
Health Risks							
COVID- 19 resulted into over production.	0	0	3	26	71*	5	1
Restrictions in movement (transport) disrupted the horticultural value chain.	1	1	7	60	31	4	1
Manpower and people with expertise were lost due to COVID -19.	4	9	66	20	1	3	1
Financial Risks							
Fear of high interest rates retards more horticultural investments.	0	8	33	35	25	4	1
Unfavorable and ever rising taxes discourage farmers to take produce to the market places	0	9	38*	27	27	4	1
Market Risks							
Price fluctuations due to change in seasons greatly affects farmers' profits.	0	9	13	1	77*	5	1
Less improved technologies reduce the quality and quantity of the horticultural yields.	0	0	13	38	49	4	1

Middle-men greatly influence the prices of horticultural produce.	1	0	18	17	64	4	1
Human Risks							
Fellow farmers sabotage and steal already grown horticultural crops on farms.	1	4	12	17	66	4	1
Individual interests within farmers also retards horticultural agriculture.	0	1	5	35	58*	5	1

For the production and technical risks, 88% of the farmers strongly agreed that flash floods and dry spells greatly affect the horticultural farms and output. Majority of the farmers (53%) strongly agreed that post-harvest losses affect the quality and quantity of horticultural products. However, 83% of the smallholder farmers strongly agreed that counterfeit inputs on the market greatly impact the quality of horticultural crops harvested. 61% consider and strongly agreed that inputs from Government Programmes like Operation Wealth Creation (OWC) are not served in the rightful seasons. With practice and problem solving, 58% strongly disagreed that the technical services from agricultural officers have not improved / increased farmer's skills and knowledge. Seventy-three percent of the smallholder farmers strongly disagreed to owning land as a definition of a farmer, confirming the bigger percentage of land hired at 53% in the internal characteristics of the farmer.

Plate 5: Pests and diseases in a tomato garden.

Plate 6: A tomato garden washed away by a flood.

Plate 7: A cabbage garden destroyed by too much sunshine. (left)

Plate 8: A cabbage garden washed away by floods. (right)

For the health risks, 71% of smallholder farmers strongly agreed that COVID 19 outbreak resulted into over production which retarded the market of the horticultural produce; 60% agreed that restrictions in movement (transport) disrupted the horticultural value chain and 66.20% of the respondents moderately agreed to the loss of manpower and expertise to COVID 19.

With the financial risks, 35% of the smallholder farmers agreed that fear of high interest rates retards more horticultural investments, while another 38% moderately agreed that the unfavorable and ever rising taxes discourage farmers from taking produce to the market places.

Responses in regard to market risks indicated that smallholder horticultural farmers strongly agreed that price fluctuations due to change in seasons greatly affects farmers' profits, less improved technologies reduce the quality and quantity of the horticultural yields and that middle-men greatly influence the prices of horticultural produce at 77%, 49% and 64% respectively.

With human risks, smallholder farmers strongly agreed to fellow farmers sabotaging and stealing already grown horticultural crops on farms at 66% and individual interests within farmers that retard horticultural farming at 58%.

As will be presented below, discussions with Key informants (particularly Model farmers and market leaders) also confirmed the above risks faced by smallholder farmers. For instance, Smallholder farmers from Namakwekwe, indicated that the major risks were dry spells, pests and diseases that destroyed several crops.

Plate 9: KII with a model farmer in Namakwekwe- Northern division.

Smallholder farmers from Doko- Malukhu prisons, indicated that the major risks were the changing seasons in form of dry spells and floods that destroyed horticultural gardens, pests and diseases and exploitation by middle men who buy cheaply from the garden in bulk and sell expensively in markets.

Plate 10: KII with a model farmer in Doko – Malukhu prisons. Plate 11: Middle men buying tomatoes in bulk at Malukhu prisons

The main risk that caused inconsistencies in the in and out flows (food shed) of the horticultural crops was due to change in seasons(drought) and price fluctuations resulting from differences in demand and supply.

Plate 12: Conducting KII with the information and research officer - Mbale Central Market.

From the KII with vendors at Namunsi Market, it was revealed that the inconsistencies in food flows are caused by difference in seasons, floods, dry spells and poor transport infrastructures in farmlands upstream leading to delays of horticultural crops to reach the markets which cause price fluctuations and exploitation of the producers (smallholder farmers).

Plate 13: Conducting KII interview with Market leaders in Namunsi.

Leaders from Bugwere market also indicated that inconsistencies in food flows in the market are caused by differences in seasons and prices of inputs leading to price fluctuations.

Plate 14: Conducting KII interview with Market leaders in Bugwere market.

Mr Mumbya – Chairman Namashere Cell in Bumboi emphasized that *across the parishes in the valley (Lwasso and Nabuyonga), roads are in a poor state and unevenly distributed, with many farming areas lacking roads that connect them to the main city* he added that *even the main roads are often accessible only during the dry season*.

Plate 15: Logs (middle ground) put across the river for farmers to access their gardens and take produce to the market.

Focus Group Discussions was conducted with members of the Nabuyonga Horticultural Farmers Group and Malo Farmers' Group situated in Nabuyonga ward and Boma ward respectively. From the discussions, it was revealed that the most risks faced included; weather instabilities in form of floods in and dry spells, over production leading to price instability (fluctuation) since a lot of produce was on the market , exploitation by the middlemen, stealing of already grown crops in gardens by individuals in the Nabuyonga communities, expensive counterfeits inputs sold by agro input dealers, pests and diseases, poor transport infrastructure to access the gardens during the production processes especially during harvesting time and "dormant or dried up" seeds served by OWC off seasons. The farmers furthermore indicated that the fear of high interest rates limits them from accessing credit facilities/loans from financial institutions and the expensive land rented for agriculture also limits them from accessing more land for more horticultural production (*this is based on what will be planted in a season, so landlords do not take into account the losses incurred after a particular season).*

Plate 16: Focus group discussion with the Nabuyonga Horticultural Farmers' group

Analysis of data from the household survey revealed that on average, males were more affected by the fore mentioned production and technical risks than their female counterparts; One probable reason for this is that compared to females, males had invested more in the horticultural food production. There was no significant difference in relation to financial and human risks with socio-economic conditions of the farmer households. Results from the statistical were not significantly different at ($p>0.05$) for the variables which indicated that production and technical, health, financial, market and human risks do not vary with education level, land ownership and household size. However, for market and human risks, the results indicated a significant difference by source of income at 0.032 and 0.000 respectively.

Table 5: Risks faced smallholder farmers versus household internal conditions.

Risk	**Social demographic characteristics**		**Mean**	**Std deviation**	***p-value***
Production Risk	Sex	Female	3.6	0.3	0.051*
		Male	3.7	0.4	
	Education Level	No formal education	3.6	0.2	0.382
		Primary Level	3.7	0.4	
		Secondary	3.6	0.4	
		Higher	3.8	0.4	
	Land ownership	Self-owned	3.7	0.4	0.594
		Hire	3.7	0.4	
		Both	3.6	0.4	
	Household size	Below 5	3.7	0.3	0.073
		5 to 9	3.7	0.4	
		10 and above	3.4	0.4	
	Income source	Casual/business	3.6	0.3	0.680
		Agriculture	3.7	0.4	
		Formal	3.7	0.4	

Health Risks	Sex	Female	4	0.3	0.474
		Male	4	0.4	
	Education Level	No formal education	4.1	0.2	0.088
		Primary Level	3.9	0.4	
		Secondary	4	0.3	
		Higher	3.9	0.3	
	Land ownership	Self-owned	4	0.4	0.718
		Hire	3.9	0.3	
		Both	4	0.2	
	Household size	Below 5	3.9	0.4	0.747
		5 to 9	4	0.3	
		10 and above	3.9	0.4	
	Income source	Casual/business	3.8	0.4	0.056
		Agriculture	4	0.3	
		Formal	3.9	0.4	
Financial Risks	Sex	Female	3.5	1	0.107
		Male	3.9	0.8	
	Education Level	No formal education	3.6	1	0.132
		Primary Level	3.9	0.8	
		Secondary	3.5	0.9	
		Higher	4.4	0.8	
	Land ownership	Self-owned	3.7	0.7	0.170
		Hire	3.9	0.9	
		Both	3	1	
	Household size	Below 5	3.9	1	0.581
		5 to 9	3.8	0.7	
		10 and above	3.4	1.1	
	Income source	Casual/business	3.4	0.8	0.166

	Agriculture	3.9	0.9	
	Formal	4	0.7	

Risk	Social demographic xtics		Mean	Std deviation	*p-value*
Market risks	Sex	Female	4.4	0.7	0.726
		Male	4.4	0.6	
	Education Level	No formal education	4.5	0.5	0.082
		Primary Level	4.6	0.5	
		Secondary	4.2	0.7	
		Higher	4.6	0.5	
	Land ownership	Self-owned	4.5	0.5	0.663
		Hire	4.4	0.6	
		Both	4.2	0.7	
	Household size	Below 5	4.4	0.6	0.158
		5 to 9	4.5	0.5	
		10 and above	4	1	
	Income source	Casual/business	3.8	0.4	0.036*
		Agriculture	4	0.3	
		Formal	3.9	0.4	
Human risks	Sex	Female	4.4	0.9	0.286
		Male	4.5	0.5	
	Education Level	No formal education	4.6	0.5	0.058
		Primary Level	4.7	0.5	
		Secondary	4.2	0.8	
		Higher	4.7	0.4	
	Land ownership	Self-owned	4.6	0.5	0.430
		Hire	4.4	0.8	

	Both	4.7	0.4	
Household size	Below 5	4.5	0.8	0.287
	5 to 9	4.5	0.5	
	10 and above	4.1	1.2	
Income source	Casual/business	3.9	1	0.000*
	Agriculture	4.7	0.4	
	Formal	4.6	0.4	

4.5 Effectiveness of risk reduction strategies adopted by smallholder horticultural farmers in the Nabuyonga valley.

The third research question aimed at evaluating the effectiveness of the risk reduction strategies adopted by Smallholder horticultural farmers in the Nabuyonga Valley. To answer this question, responses were obtained from smallholder horticultural farmers in the parishes of Namakwekwe, Nabuyonga, South Central, Namatala, Lwasso, Bumboi, Namalogo, Doko, Boma and Busamaga East.

The responses of the farmers using a five-rating scale Likert-type questions are presented in Table 6. The Likert scale was analyzed following a scale of 2 – 10 for instance: Strongly Disagree (2), Disagree (4), Moderately Agree (6), Agree (8) and Strongly Agree (10) and body language in line with the skeptism of the answer given by the respondents (smallholder farmer).

Table 6: Perceptual statements indicating effectiveness of risk reduction strategies adopted by smallholder farmers.

Perceptual Statement	**Level of agreement (%)**						
Production and technical Risks	**SD**	**D**	**MA**	**A**	**SA**	**Mn**	**SD**
Restoration of riparian areas has reduced floods along the Nabuyonga stream.	0	1	1	21	77	5	1
Early warning systems have been installed and these have helped with floods risk.	4	4	14	66	12	4	1

Early planting in seasons has enabled farmers to exhaust the seasons.	1	3	1	38	58	4	1
Farmers practice irrigation for continuous for sustainable water supply in horticultural activities.	0	0	0	16	84*	5	0
Strict monitoring and supervision of extensional agricultural officers has pushed them to the fields.	49	21	0	17	13	2	1
Improvement in storage for quality has improved the value addition in the horticultural value chain.	1	1	10	56	31	4	1
Setting laws and arresting those individuals that sell counterfeit agricultural in-puts has not been done.	10	3	13	52	22	4	1
Engagement in farmer workshops encouraged farmer trainings for improved knowledge and skills in the production process.	0	0	13	21	66	4	1
Efficient utilization of land in small spaces through application of technologies for urban farming has led to increase in horticultural yields.	0	0	5	21	74	5	1
Health Risks							
Improved post handling storage facilities were adopted by farmers.	4	33	7	51*	4	3	1
Financial Risks							
Formation of agricultural credit and insurance by financial institutions has helped smallholder horticultural farmers acquire capital for investment.	0	9	19	41	31	4	1
Subsidization and reduction of taxes on bulk horticultural crops has encouraged farmers to formulate groups and acquire such preferences.	0	16	64*	4	16	3	1
Market Risks							
Formation of farmer groups has been of help in acquiring a common favorable market.	0	0	14	18	66*	5	1

For the production and technical risks, 77% of the smallholder farmers strongly agreed that restoration of riparian areas through activities like dredging, snagging, construction of levee embankments, sills and weirs, planting of riparian vegetation has reduced floods along the Nabuyonga stream. sixty six percent of the smallholders agreed that early warning systems have been installed and these have helped with flood risk control, 58% strongly agreed that early planting has enabled farmers to exhaust the seasons, 84% strongly agreed that smallholder horticultural farmers practice irrigation as a remedy for continuous and sustainable water supply in horticultural activities, 49% of the smallholder farmers strongly disagreed that strict monitoring and supervision of extensional agricultural officers has pushed them to the fields, 56% agreed that improvement in storage for quality horticultural products has improved the value addition in the horticultural value chain, 52% agreed that setting laws and arresting those individuals that sell counterfeit agricultural in-puts has not been done, 66% of the smallholder farmers strongly agreed that engagement in farmer workshops enhanced the farmers' improved knowledge and skills in the production process. Seventy-four percent strongly agreed that efficient utilization of land in small spaces through application of technologies for urban farming has increased horticultural yields.

Plate 17: Bamboo planted on the banks of Nabuyonga stream to control floods.

From the health risks, 51% of the smallholder farmers strongly agreed that improved post handling storage facilities were adopted by farmers engaging in horticultural agriculture.

With the financial risks, 41% of the smallholder farmers agreed that formation of agricultural credit and insurance by financial institutions has helped smallholder horticultural farmers acquire capital for investment in their horticultural gardens and 64% somewhat agreed that Subsidization and reduction of taxes on bulk horticultural crops has encouraged farmers to formulate groups and acquire such preferences.

Responses in regard to market risks indicated that 66% of the smallholder horticultural farmers strongly agreed that formation of farmer groups has been of help in acquiring a common favorable market for the horticultural crops.

In order to gain an insight into the effectiveness of risk reduction strategies adopted by the smallholder horticultural farmers and household characteristics, the statistical analysis by way of independent t- tests and one-way analysis of variance tests (ANOVA) as presented in Table 7 below indicate a significant mean difference ($p < 0.05$) between gender and production and technical risks. This depicts that male smallholder farmers had adopted effective risk reduction strategies with regard to production and technical risks. The statistical test however indicated no significant mean differences ($p > 0.05$) between variables. For instance, production and technical risks against household size and income source; health risks against gender, education level, duration in the area, household size and income source; financial risks against gender, duration in the area, household size and income source; market risks against gender, education level, duration in the area and household size as shown in the table 7 below.

Table 7. Statistics showing relationships between effectiveness of the risk reduction strategies and internal conditions of smallholder farmers households.

Risk	**Social demographic**		**Mean**	**Std deviation**	***p-value***
Production Risk	Sex	Female	4	0.4	0.036*

		Male	4.2	0.3	
	Education Level	No formal education	4.1	0.3	0.006*
		Primary Level	4.2	0.3	
		Secondary	4	0.4	
		Higher	4.4	0.4	
	Duration in the area	1 - 5 years	3.8	0.4	0.053*
		6 - 10 years	4.1	0.4	
		11 - 15 years	4.2	0.3	
		16 years and above	4.2	0.3	
	Household size	Below 5	4.1	0.4	0.271
		5 to 9	4.2	0.3	
		10 and above	3.9	0.5	
	Income source	Casual/business	4	0.4	0.168
		Agriculture	4.2	0.3	
		Formal	4.1	0.4	
Health Risks	Sex	Female	3	1.1	0.258
		Male	3.3	1.1	
	Education Level	No formal education	3.2	1.2	0.702
		Primary Level	3.3	1.1	
		Secondary	3	1.1	
		Higher	3.5	0.9	
	Duration in the area	1 - 5 years	3	0.9	0.503
		6 - 10 years	2.9	1.2	
		11 - 15 years	3.6	0.7	
		16 years and above	3.3	1.1	
	Household size	Below 5	3.4	1	0.479
		5 to 9	3.1	1.1	
		10 and above	2.8	1	
	Income source	Casual/business	3.3	1	0.683
		Agriculture	3.2	1.1	

		Formal	2.9	1.1	
Risk	**Social demographic**		**Mean**	**Std deviation**	***p-value***
Financial Risks	Sex	Female	3.5	0.9	0.379
		Male	3.8	0.8	
	Education Level	No formal education	4.1	0.6	0.015*
		Primary Level	3.8	0.8	
		Secondary	3.2	0.8	
		Higher	4.4	0.7	
	Duration in the area	1 - 5 years	3.6	1.1	0.912
		6 - 10 years	3.7	0.9	
		11 - 15 years	3.9	0.9	
		16 years and above	3.7	0.8	
	Household size	Below 5	3.9	0.9	0.302
		5 to 9	3.7	0.8	
		10 and above	3.2	0.8	
	Income source	Casual/business	3.6	0.8	0.484
		Agriculture	3.6	0.9	
		Formal	4.1	0.9	
Market risks	Sex	Female	4.5	0.7	0.832
		Male	4.5	0.8	
	Education Level	No formal education	4.5	0.7	0.827
		Primary Level	4.6	0.7	
		Secondary	4.4	0.8	
		Higher	4.7	0.7	
	Duration in the area	1 - 5 years	4	0.9	0.116
		6 - 10 years	4.5	0.7	
		11 - 15 years	4.3	0.9	
		16 years and above	4.7	0.7	
	Household size	Below 5	4.5	0.7	0.975

	5 to 9	4.5	0.8	
	10 and above	4.5	0.8	
Income source	Casual/business	4.2	0.8	0.009*
	Agriculture	4.7	0.7	
	Formal	4.2	0.8	

Discussions with key informants (such as model farmers, horticultural farmer groups and market leaders) also confirmed the effectiveness of risks reduction strategies adopted by smallholder farmers.

From these interactions, it was revealed that risk reduction strategies adopted by for instance, the market leadership committee included organizing training sessions for farmers to improve knowledge and skills on post-harvest handling processes. Some of the training sessions were conducted by Rikolto - *an NGO in senior quarters working with the youth to build their resilience* and market leaders have extended financial support to farmers giving them loans at friendly interest rates for continuous horticultural production and emphasized that they are advocation for urban agriculture through these supportive NGOs.

It was also emphasized that management of risk through construction of stores (e.g. by NGOs such as IFDC (*Global Food Security Solutions*)) that keep the buffer stock and giving traders the produce so that they pay after selling in other districts and cities would be the other strategies to address the risks. Also getting loans from savings groups formed among traders (such as *Namunsi Traders' Farmers' Savings and Credit Association* and *Bugwere Irish Potato Traders*) to acquire capital as well as encouraging women to sell Irish potatoes as potato chips and crisps with essence of reducing buffer stock and getting a remedy to perishability and value addition, were echoed.

Plate 18: An onion store for buffer stock

*Plate 19: Harvested onions being sorted for grading in Namunsi Market Juba stage. *The face of the person sorting onions was hidden/blurred upon request for confidentiality*

Irrigation, construction of trenches and diversification of crops were the other risk reducing practices that were recommended because they would keep the production processes ongoing

throughout the seasons especially for the horticultural farmers established downstream and mulching for the farms found upstream as seen in the photographs below.

Plate 20: Irrigation using water reserved in trenches in Doko – Malukhu prisons.

Plate 21: A boy irrigating tomatoes using a basin in Lwasso (middle back ground of the photograph).

Plate 22: Trenches constructed to drain away excess water and to hold water during the dry season in Doko (downstream).

Plate 23: A mulched onion garden in Wanale (upsteam).

Plate 24: A garden with a variety of horticultural crops in Namakwekwe.

In summary, Mbale City horticultural food inflows and outflows transcends local, regional and national boundaries, making, Mbale a key player in the region's food system.

Risks that affect smallholder horticultural farmers and stood out include technical and production risks like: floods and dry spells along the Nabuyonga stream and pests and diseases, market risks and exploitation of farmers by middlemen.

For effectiveness of risk reduction strategies, the most visible risk reduction strategies adopted by smallholder horticultural farmers in the Nabuyonga Valley were continuous irrigation across Nabuyonga stream, construction of trenches to drain away excess water during wet seasons in areas of Doho, mulching of horticultural farms to keep water in the soil especially during the dry seasons in areas of Wanale. Farmers have mobilized themselves into groups that have helped in enhancing their adaptive capacities as well as improving their mitigative potentials towards adverse risks. They have also diversified their crops and farming practices in response to changing circumstances.

CHAPTER FIVE: DISCUSSION OF RESULTS.

This chapter discusses the key findings from the study in line with the available literature and related studies.

5.1 Mbale city region food shed.

Flow maps were developed to determine Mbale City Region's food shed by showing extents and how far horticultural food produced in Mbale goes and know the percentages of horticultural food produced within Mbale and the surrounding areas. The flow charts also aided the understanding of the level of self-sufficiency at local and regional levels. As postulated by Kurtz et al., (2020), mapping the food shed can be an important tool in assessing the sustainability of the urban food system. Uganda is well positioned in the region and through Mbale, she supplies neighboring countries like Kenya, South Sudan and Democratic Republic of Congo (DRC) (Dijkxhoorn et al., 2019). Different flow maps were generated, basing on the "main markets" taking different production and consumption patterns into account.

The city region food shed of Mbale demonstrates that producers, traders and consumers adopt to the strategy of diversifying the sources where they obtain continuous horticultural food season after season, however, basing on that, Mbale City has a low self-sufficiency level for this was confirmed from the findings showed that percentages of horticultural crops produced from surrounding districts of Kapchorwa and Bududa are more than those produced from within Mbale and this is also backed by studies by (Dijkxhoorn et al., 2019).

Discussions with market leaders provided insights on engaging in urban agriculture for a self-sufficient food system but this is occasionally taken as an insignificant trait. However, if embarked on, urban agriculture will provide twice the equivalent retail value in food to consumers in Mbale, therefore, urban agriculture is not to be dismissed when it comes to planning urban food strategies which resonates with studies made by (Hemerijckx et al., 2023) made in Kampala City where Mbale City will be in years to come.

5.2 Smallholder horticultural farmer's vulnerability.

In the Nabuyonga Valley, smallholder farmers live in precarious conditions and are intrinsically vulnerable to shocks that affect their agricultural systems. They live in unsophisticated houses,

own few assets and rely on the river Nabuyonga and its tributaries for fertile soils and water for irrigation. Horticultural farming is the mainstay of farmer livelihoods, serving both as the primary source of household food and principal means of income generation for most of them in the valley, so consequently, the fate of these smallholders is closely interwoven with that of horticultural farming. Nabuyonga farmers are particularly vulnerable to any reductions in crop productivity for a variety of reasons as asserted by (Harvey et al., 2014), the farm lands that were more vulnerable were those that had farms staged in the midstream and downstream areas of Nabuyonga, Namatala and Doko.

First, these smallholder farmers cultivate on very small pieces of land (less than 2 ha) - which is managed under customary tenure system and these same farmers fear to buy land due to rampant land conflicts in Mbale (Mugagga, 2013). Some work from verandas due to lack of land, offer most of their land (owned and hired) to crop production for household consumption and obtain low crop yields resulting from a number of risks, which makes it insufficient to meet household needs. In focal group discussions conducted, smallholder farmers reported obtaining seeds from OWC which are served in different seasons, sometimes dried-up already and these cannot yield anything. Furthermore, they indicated that inputs are so expensive and there are a lot of counterfeits on the market which retards their crop productivity. (Harvey et al., 2014) reported that the low return horticultural yields in the valley probably reflect the limited use of inputs (fertilizers, pesticides, improved seed varieties), the use of low technology practices, adoption of better farming methods (sustainable agricultural practices), and land degradation—all of which have been identified as constraints to agricultural productivity elsewhere.

Another factor that increases smallholder farmer vulnerability in the Nabuyonga valley is the remoteness of horticultural farm lands especially in areas upstream and lack of adequate road infrastructure which acts as a setback in the transportation of horticultural crops down to the markets in Mbale City, which also reduces the quality of the horticultural produce. The livelihood gap in this is significant for farmers have difficulties in getting their horticultural products to markets (mainly use Manual labour) and obtaining agricultural inputs; in addition, farmers generally have to pay higher prices for agricultural inputs in remote areas, which reduces their profit margins.

Another main factor that exacerbates smallholder farmer vulnerability are that most households lack access to finance as formal safety backups to which they could turn in times of need. Most of the smallholder farmers remain outside a formal credit or banking system, lack capital and are unable to access credit or loans due to high interest rates which creates fear in them to acquire these from financial institutions and this has been reported by other studies. (Harvey et al., 2014) emphasized that there are no developed insurance markets (agricultural insurance) and instead farmers rely on informal support systems, borrowing money or inputs from individual farmers in communities they reside in. In addition, although there are numerous agricultural extension officers staged at the city offices, there are barely no formal extension services and only 17% of the farmers currently receive technical support from the extension officers. "*These are paid to sit in offices and have no knowledge about the activities happening in the field*" they said. Farmers are further constrained by having limited access to market information (most of them depend on community for information), which could help inform farm management decisions, such as the choice of horticultural crops, planting dates and management strategies, which could serve as early warning systems for rampant floods.

Addressing the inequity in access to productive resources, services and markets for women farmers (who account for a large percentage of smallholder farmers in table 1) is not only a rights issue, but also an efficiency issue (Meinzen-dick et al., 2014). Discussions with farmers confirmed that children and women farmers barely own land but rather act as labor on family farms, doing all the hard work in the food system but during the harvest times the men take over and collect the money from the produce to plan better. This gender inequality has led to inefficient allocation of resources, which in turn means reduced horticultural productivity. (Meinzen-dick et al., 2014) further more emphasizes that, lower productivity persists in female-owned plots and female-headed households in Uganda, hence closing the gender gap in agriculture which has high returns that accrue to the entire society, not just women (Fabiana Meijon Fadul, 2021).

5.3 Risks.

Secondary cities like Mbale face a range of development challenges associated with rapid, unplanned and uncoordinated urbanization that has often left segments of their population, marginalized and vulnerable, and unable to access basic public goods and services (Programme,

2020). Across the studied area (Nabuyonga valley), smallholder farmers live in pre- carious conditions and are intrinsically vulnerable to any shocks that affect their agricultural systems, these are multiple, recurring and substantial to their agricultural production and livelihoods culminated as risks owing to pests and diseases (particularly cabbage worms and army worms) and disease outbreaks (particularly foliar and rural sprout in tomatoes)., risks related to weather events and climate change, and those related to market access/price volatility, financial access, health and human related risks.

In addition, smallholder horticultural farmers are frequently subjected to extreme weather events, which result into horticultural crop losses, as well as damage to agricultural fields, roads and homes. Floods and dry spells are prominent in Mbale and have great impact on the smallholder farmers like: retardation of crop yields, food shortage, farmers move into poverty for these (floods and dry spells) leave little or nothing to re-plant or recover for the next seasons. Generally, Mbale City has experienced disastrous impacts from either a combination of droughts (which affects most smallholder farmers), floods and landslides (which are the most frequent events). This is evident from the recent flood that hit Mbale City on 31stJuly 2022 following heavy rains and the bursting of the Nabuyonga river banks around the city causing floods. This flooding caused significant damage that emerged from environmental degradation through encroachment on fragile riparian areas and bad agricultural practices. Reports from the Office of the Prime Minister and Mbale City Disaster Management Committee, indicated that floods affected an estimated population of 18,102 people and over 7,000 farm structures were destroyed. The reoccurrence of adverse climatic events leading to catastrophic situations in Mbale City dates long back in 1940/1997/2020 and 2022 (*anecdotal information from an old citizen*) and also backed up by other studies for instance (Bahal'Okwibale, 2018).

Smallholder horticultural farmers are also affected by market risks of market access and price volatility, where they have difficulty in getting their produce to market, owing to the lack of road infrastructure as well as differences in levels of demand and supply. They experience exploitation by middlemen who buy cheaply in bulk and sell to consumers expensively.

5.4 Effectiveness of risk reduction strategies.

Smallholder horticultural farmers choose to adopt risk reduction strategies and some of have been these successful while others shown to be limited by many factors, including the absence of transparent information, limited institutional support, and lack of capital.

Diversification of crops is one of the strategies that has been adopted by smallholder farmers in the Nabuyonga valley, where these have engaged in agro-forestry (having horticultural crops grow with specific tree species) with essence of mitigating the flood risk effect, tapping into the market and reduce the circumstances caused by pests and diseases. This is evident in *table 1* which shows the horticultural crops grown and is aimed at creating a sustainable increase in horticultural farming to achieve self-sufficiency (Adnan et al., 2020) in Mbale City. However, this has not been effective enough since smallholder horticultural farmers along the Nabuyonga stream decide to cultivate individually having different decisions, practices and techniques following differences in risk attitudes and perceptions among them (farmers) and this does not help in case of an attack from a recognized risk like pests and disease, flood or drought risks as seen in other studies like: (Duong et al., 2019).

Existence and formation of horticultural farmer groups was another interesting risk reduction strategy adopted by smallholder farmers in the Nabuyonga Valley, where households had members inclined to horticultural farmer groups particularly for saving funds and have a shared market base. This resonates with studies in Kenya by Mburu (2016), who noted that many farmers use group savings to pull resources with essence of reducing vulnerability in case of a dry spell. This social capital is important since it allows interaction among farmers and it empowers them to achieve their goals. They (smallholder farmers) confirmed that this helped in having shared knowledge on better practices and techniques that improved horticultural production through access of extension services *especially those in Boma – Wanale division- Malo Farmers' Group* collectively. Furthermore, findings from (Sibiko, 2012) also revealed that with farmer groups, new users learn from the other members in the social network, hence, generating significant technology spillovers and improving their allocative efficiency and buy water tanks for each member in return.

Other identified risk reduction strategies were mulching and construction of trenches which were applied to mitigate dry spell effect and flood effect in the Nabuyonga valley areas of Bumboi and Doko – Malukhu prisons, respectively. Mulching was adopted by the smallholder farmers

upstream with essence of reducing runoff and keep water in the soils for continuous cultivation. Such interventions are also backed up by studies by Shirish et al., (2013).

Smallholder farmers urgently need better access to efficient risk management tools and strategies to increase their resilience to a spectrum of risks. Initiatives such as agricultural insurance can help farmers take productivity enhancing risks, although their commercial viability for a smallholder clientele is still being studied. In the face of volatile crop prices, Following studies made by (Gomez, 2020), collaboration is needed among the private sector, governments and donors, to design innovative and flexible market- based price stabilization tools such as hedging in future markets (Adnan et al., 2020) that are suitable for smallholder farmers. Even though risk management is challenging, there are many professional resources available like extensional agriculture officers - resonating with studies from (Ali et al., 2021) and smallholder horticultural farmers in the Nabuyonga Valley should not feel isolated. Agricultural extension officers and university extension specialists are trained to provide educational programs and leadership to help implement the planning process.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS.

6.1 Conclusion.

Mbale City horticultural food inflows and outflows transcends local, regional and national boundaries, making, Mbale a key player in the region's food system, however her (Mbale City) getting to a bigger city urban agriculture has been adopted to provide twice the equivalent retail value in food to consumers in Mbale.

Smallholder horticultural farmers in the Nabuyonga valley are highly vulnerable to risks, though to differing degrees. The vulnerability of these areas are compounded into risks categorized in aspects of production and technical, human, market, health and financial risks compounded with climate related vagaries like: frequent floods, pests and diseases and drought. Interventions such as: seed provisions through government programs like Operation Wealth Creation (OWC) is ineffective given the discrepancy between seasonality and supply time and limited access to extension services.

While these coping strategies like irrigation, construction of trenches, formation of farmer groups and others clearly help to reduce impacts on farmer livelihoods, the fact that most farmers have limited access to resources and recognition in decision making processes suggests that these coping strategies are insufficient. So, because other studies have similarly shown that farmer perceptions on how best to manage risk are important factors driving the adoption of different livelihoods strategies and adaptation measures (Harvey et al., 2014), there is therefore an urgent need to provide efficient coping strategies and safety nets like: formulation of farmer groups, continuous irrigation and others which can better alleviate farmer resilience, both in regular years and in times of stress.

6.2 Recommendations.

Smallholders require options that are relatively low-risk, and provide short-term returns on investment. Consequently, building resilient systems is key, both from the perspective of risk management and sustainability. This requires investments beyond plot-level technologies into policy and other institutional issues that can enable adoption and reduce smallholder risk (Vanlauwe et al., 2014). Smallholder horticultural farmers make decisions every day that affect horticultural operations. Many of the factors that affect the decisions they make cannot be predicted with complete accuracy. Horticultural farming has become increasingly risky as

smallholder farmers strive to become more commercial. Farmers need to understand risks and develop the requisite management skills to better anticipate problems and reduce their negative impacts. With regard to this, the following recommendations are proposed to ensure that smallholder farmers are able to manage the risks they face in the long run to enhance the resilience of the Mbale City Region's Urban food system:

New technologies should be explored, evaluated and adopted by smallholder horticultural farmers like small-scale low-cost irrigation system especially in areas further away from River Nabuyonga to enable continuous production throughout the year for instance: adoption of gravity fed irrigation models especially those upstream.

Enhancement of stakeholder engagements by government through the ministry of agriculture, animal, industry and fisheries should be done to enable participation of all parties within the horticultural value chain to develop support and make decision together towards better mitigation strategies and timely knowledge skills and better manage the risks. This implies that the voices of smallholder farmers in governance matters need to be heard, respected and considered by all stakeholders in Uganda (Farmers, 2021).

Better support from government in form of operational funds should be accorded to agricultural extension officers from respective local government to enable them equip smallholder horticultural farmers with regular and adequate and timely knowledge/ skills to better manage agricultural skills.

Exploring and investing in affordable storage facilities should be done by the smallholder farmers to enable them better store their bumper harvest produces to improve post- handling and value addition for quality and better prices.

Encouraging youth participation in agriculture is also essential in realizing agricultural growth, improving food security and nutrition and promoting overall development. Young farmers should be targeted to increase profitability through organization of better agricultural trainings, improved land rights and enhanced access to financial and non-financial services in the Nabuyonga valley.

There is a need for effective mainstreaming of disaster risk reduction through the agricultural sector in Uganda at large; for this is key to agricultural sustainable development and building resilience of food systems to risks, protecting the most vulnerable people (smallholder farmers) and their livelihoods. This is in line with the objective of the National Policy for Disaster Preparedness and Management aimed at reducing vulnerability levels, risk mitigation, disaster prevention, preparedness, effective response and recovery in a manner that integrated disaster risk management with development planning and programming.

There should also be exploration of agents in crop and livestock insurance, nutritionists, marketing specialists, lenders, attorneys and others by the smallholder horticultural farmers for these are available and well qualified to help with risk management planning.

6.3 Further Research.

There is need for further research focusing on policies and laws that govern and protect smallholders from risks especially market and financial risks.

There is also need for studies focusing on the efficacy of peer-to-peer learning engagements as a flagship capacity building intervention among smallholder farmers.

6.4 Limitations of the study.

The study was hindered by the flood incident that hit Mbale City on 1st August 2022 which happened to be the same time, data collection was taking place. The flood ravaged Nabuyonga Valley, thereby compromising the sample size; data collection had to be stopped to avoid biased responses from the farmers.

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APPENDICES.

Appendix 1: Questionnaire.

QUESTIONNAIRE.

MAKERERE  **UNIVERSITY**

Dear Respondent,

You have been selected to participate in this study. Please kindly spare your time and fill this questionnaire. The study seeks to analyse on the vulnerability of small holder horticultural farmers to agricultural risks in Mbale City Region. The information provided shall be used for academic purposes only thus total confidentiality is guaranteed for all information provided.

Please indicate by ticking in the provided boxes provided what best represents the category in which you lie.

Analysis of the Vulnerability of Smallholder Horticultural farmers to Agricultural risks in the Nabuyonga Valley_ Mbale City Region.

Background information

Analysis of the Vulnerability of Smallholder Horticultural farmers to Agricultural risks in the Nabuyonga Valley_ Mbale City Region. I am Patricia Nagawa Kiggundu, a Master of Geographical Sciences student at Makerere University, I am conducting a research study that seeks to analyze the vulnerability of Smallholder Horticultural farmers to Agricultural risks in the Nabuyonga Valley Mbale City Region. This interview is part of an independent academic aiming at determining the Mbale City Region's food shed in terms of transport routes, production location, consumption points, and market points, assessing the agricultural risks faced by smallholder horticultural farmers at the household level in the Nabuyonga valley and evaluating the effectiveness of agricultural risk reduction strategies adopted by smallholder horticultural farmers in the Nabuyonga Valley. Your participation in this interview is completely voluntary and the

information provided shall be used for academic purposes ONLY thus total confidentiality is guaranteed for all information provided.

Interviewer

- Patricia

Sub-county/ Division

- Industrial Division
- Northern Division
- Wanale Division
- Lwasso
- Nakaloke
- Bungokho-Mutoto

Parish/Ward

- Namatala
- Nabuyonga
- Namakwekwe
- Busamaga East
- Lwasso
- Bumboi
- Namalogo
- Boma
- Doko
- Namatala.

SECTION A: SOCIAL ECONOMIC AND EXTERNAL CONDITIONS. (HOUSEHOLD CHARACTERISTICS)

1. a) Gender of respondent.

- Female
- Male

b) Age of respondent

- Less than 24 years
- 25 - 34
- 35 - 44
- 45 - 54
- 55 and above

c) Marital status

- Single
- Married
- Divorced / Separated
- Widowed

d) Education Level

- No formal education
- Primary Level
- Lower secondary
- Upper secondary
- Tertiary (diploma)
- Tertiary (degree)

e) For how long have you been living in the area selected.

- 1 - 5 years
- 6 - 10 years
- 11 - 15 years
- 16 years and above

f) Household size

- Number of Children
- Number of Adults

g) Source of income.

- Casual Business
- Agriculture
- Formal
- Others

h) Average monthly income

- Less than 3,000,000
- 4,000,000 - 6,000,000
- 7,000,000 - 10,000,000
- 11,000,000 and above

i) Percentage of income from the horticultural value chain

- Below 20%
- 30 - 50%
- 60 - 80%
- 90 and above

j) Land ownership and utilization (Nature of ownership)

- Self-owned
- Hire

j-ii) Size of land under horticultural cultivation. (Hectares)

k) Nature of labour employed.

- Family labour
- Introduced labour
- Self labour

l) Horticultural crops grown

- Tomatoes
- Onions
- Cabbages
- Sukuma-wiki (collard green- brassica raphanus)
- Carrots
- Green pepper
- Peas
- Nakati (Ethiopian eggplant - solanuma-ethiopicum)
- Irish potatoes
- Other

2. External conditions

a) Market access

i) Transport means

- Motorcycle (boda boda)

- Human (carry)
- Bicycle Vehicles (mini lorries)
- Others

ii) Middle men (Bawololo)

- Yes
- No

iii) Producer association.

- Yes (association name)
- No

b) Scale of market

- Local
- National
- International

c) Market Information.

i) Media

- Radio FM
- TV
- Community radio
- Newspapers
- Conferences/ meetings/ workshops
- Word of mouth (local contacts)
- Mega phones
- Social media (specify)

d-i) Support.

- Credit institutions
- Community/ Individuals
- Cooperatives/ association

Co-operatives/ associations

- Savings group (SACCO)
- Horticultural farmers' group
- Youth group
- Women's group
- Others (specify)

d-ii) Problem solving.

- Agricultural extensional workers
- Community

d-iii) Supply of inputs

- Input producers
- Individual
- Operation Wealth Creation (OWC)
- Others (specify)

e) Technical information.

e-i) Indigenous sources

- Family
- Community Farmers

e-ii) Introduced sources

- Innovative farmers
- Farmers' associations
- Middlemen (Bawololo)
- Agricultural extensional officers
- Research
- Media

SECTION B: AGRICULTURAL RISKS.

How do you rate the following agricultural risks faced by Smallholder horticultural farmers in the Nabuyonga Valley? Rating Scale; 1= Strongly Agree, 2 = Agree, 3 = Moderately Agree, 4 = Disagree, 5 = Strongly Disagree

1. Production and technical Risks

a) Flash floods and dry spells greatly affect the horticultural farms and output of the smallholder horticultural farmers.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

b) Post-harvest losses affect the quality and quantity of horticultural crops grown.

- Strongly Agree
- Agree
- Moderately Agree

- Disagree
- Strongly Disagree

c) Counterfeit inputs on the market greatly impact the quality of horticultural crops harvested.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

d) Inputs from Government organizations are not served in the rightful seasons.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

e) Technical services from agricultural officers have improved/ increased farmer's skills and knowledge.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

f) To be a farmer, one must own land.

- Strongly Agree

- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

2. Health risk

a) COVID- 19 resulted into over production.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

b) Restrictions in movement (transport) disrupted the horticultural value chain.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

c) Manpower and people with expertise were lost due to COVID -19.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

3. Financial risks

a) Fear of high interest rates retards more horticultural investments.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

b) Unfavourable and ever rising taxes discourage horticultural farmers to take produce to the market places.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

4. Market risks

a) Price fluctuations of horticultural crops due to change in seasons greatly affects smallholder horticultural farmers' profits.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

b) Use of less improved technologies reduce the quality and quantity of the horticultural yields.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

c) Middle-men greatly influence the prices of horticultural produce.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

5. Human risks

a) Fellow farmers sabotage and steal already grown horticultural crops on farms.

- Strongly Agree
- Agree
- Moderately Agree
- Disagree
- Strongly Disagree

b) Individual interests with in smallholder farmers also retard horticultural agriculture in the Nabuyonga Valley.

- Strongly Agree
- Agree
- Moderately Agree

- Disagree
- Strongly Disagree

SECTION C: EFFECTIVENESS OF RISK REDUCTION STRATEGIES.

How do you rate the following effectiveness of risk reduction strategies adopted by the smallholder horticultural farmers in the Nabuyonga Valley? Rating Scale; 1= Strongly Agree, 2 = Agree, 3 = Somewhat Agree, 4 = Disagree, 5 = Strongly DisagreeC1.

1.Production and Technical Risks

a. Restoration of riparian areas through activities like: dredging, snagging, construction of levee embankments, sills and weirs, planting of riparian vegetation has reduced floods along the Nabuyonga stream.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

b. Early warning systems have been installed and these have helped with floods risk.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

c. Early planting in seasons has enabled farmers take advantage of the seasons.

- Strongly Agree
- Agree

- Somewhat Agree
- Disagree
- Strongly Disagree

d. Horticultural farmers practice irrigation as a remedy for continuous for sustainable water supply in horticultural activities.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

e. Strict monitoring and supervision of extensional agricultural officers has pushed them to the fields.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

f. Improvement in storage for quality horticultural products has improved the value addition in the horticultural value chain.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree

- Strongly Disagree

g. Setting laws and arresting those individuals that sell counterfeit agricultural in-puts has not been done.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

h. Engagement in farmer workshops has encouraged farmer trainings for improved knowledge and skills in the production process for instance; application of inputs to horticultural crops on what time and quantity to be applied.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

i. Efficient utilization of land in small spaces through application of technologies for urban farming has led to increase in horticultural yields.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

2. Health Risks.

a. Improved post handling storage facilities were adopted when everyone (most farmers) engaged in horticultural agriculture.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

3. Financial Risks.

a. Formation of agricultural credit and insurance by financial institutions has helped smallholder horticultural farmers acquire capital for investment in their horticultural gardens.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

b. Subsidization and reduction of taxes on bulk horticultural crops has encouraged farmers to formulate groups and acquire such preferences.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

4. Market Risks.

a. Formation of farmer groups has been of help in acquiring a common favourable market for the horticultural crops.

- Strongly Agree
- Agree
- Somewhat Agree
- Disagree
- Strongly Disagree

Thank You So Much.

Appendix 2. Key Informant Interview.

KEY INFORMANT INTERVIEW.

The targeted respondents include: Agricultural officers, Environmental officers.

You have been selected to participate in this study. Please kindly spare your time and fill this questionnaire. The study seeks to analyze on the vulnerability of small holder horticultural farmers to production risks in Mbale City Region. The information provided shall be used for academic purposes only thus total confidentiality is guaranteed for all information provided.

Agricultural officers, Environmental officers.

1. Do all farmers suffer the same risk?
2. How do households manage agricultural risks?
3. What interventions have been made for a sustainable food system?
4. How effective have the interventions impacted the aimed at agricultural risks?
5. Which policies have been set up for continuous agricultural development at city level?

6. To what extent have production practices favored efficient use of abiotic resources?

7. How compliant are officers to inspection of food processing and storage facilities in the city?

Market heads/ representatives.

1. Where does the food in the market come from?
2. What percentage of the horticultural crops sold here?
3. What are these horticultural crops?
4. How far does the horticultural food go from the market?
5. Who are the consumers of this food?
6. Do you get any inconsistencies in the food flows?
7. If yes, why and what rings these inconsistencies?
8. What has been done to reduce or overcome these inconsistencies?
9. How effective are the solutions implored?
10. Are there any policies governing the market and how effective are these policies?