Australian Government

Australian Centre for International Agricultural Research

Final report

Project full title	Managing Food Value Chains for Improved Nutrition for Urban Vulnerable Populations in MZUZU City (Malawi) (AfricitiesFood)
project ID	CS/2021/115
date published	21/12/2023
prepared by	Gilbert Siame and Mtafu Manda
co-authors/ contributors/ collaborators	Wiseman Chirwa, Jean Nyondo, Dyton Siyeni, Faith Manda, Tiwonge Baloyi, Atipatsa Kaminga
approved by	ACIAR
final report number	FR2023-061
ISBN	978-1-922983-75-6
published by	ACIAR GPO Box 1571 Canberra ACT 2601 Australia

Contents

1 Acknowledgments

This final research report used a farm–to–market value chain approach, which was a complicated endeavour that required the participation of various actors and institutions at different levels. The research team would like to express its gratitude for the direction and support it received from all the stakeholders and government staff during the two years' implementation process, including those who designed, supervised, and analysed study trials and the quantitative survey.

The research team also acknowledges the role played by the different actors who included farmers, transporters and traders for their dedication and valuable insights by providing information at each stage of the value chain: the harvest, post-harvest, transport, and open markets. The information provided gave insight into the processes, challenges, and possible interventions for the reduction of food and nutritional losses along the value chain.

The research team would like to further acknowledge the support provided by the Government of Malawi counterparts at district and local levels. The research team also appreciate the guidance and interest from Australian Government, Australian Centre for International Agricultural Research (ACIAR) in this project as well as the support from the staff from Mzuzu University and University of Zambia.

Finally, the team recognizes the unwavering support and commitment of the ACIAR team in Kenya to the project. Their insights and constant engagements provided an opportunity for mutual capacity strengthening necessary for the successful implementation of the research project.

2 Executive summary

The Project Research Purpose

This is the final project report of 'Managing Food Value Chains for Improved Nutrition for Urban Vulnerable Populations in MZUZU City (Malawi) (AfricitiesFood)', implemented in Mzuzu City from September 2021 to August 2023. The project was funded by the Australian Government through the Australian Centre for International Agricultural Research (ACIAR) to Mzuzu University in collaboration Urban Research and Advocacy Centre (URAC) with an overall objective to identify and characterize the nature and scale of food and nutrition loss in Mzuzu City's agri-food chains and define its drivers and implications. This research project sought to identify and characterize the nature and scale of food and nutrition loss in urban agri-food chains in Mzuzu City and define its drivers and implications.

Project Background

Malawi is among the fastest urbanizing countries (4.1% per year) with Mzuzu (5.4% per year) projected to become a major urban center in Southern Africa (NSO, 2019). The youthful population of Mzuzu, with over half aged below 20 years gives a high population momentum. According to the Global Network Against Food Crises (2020:34), food and nutrition insecurity is endemic among the urban poor in Malawian cities and towns. Mzuzu city's food insecurity was serious with up to 41% having no food of any kind to eat in the household because of lack of money (Liley, et al, 2018).

According to Erickson (2008:240), nutrition security is driven by factors affecting food availability, food accessibility and food utilization. Food availability and accessibility directly impact nutrition status of cities and towns. However, food loss and waste reduce food availability, accessibility, and utilization. High proportion of food loss is typical in perishable fresh food value chains such as tomatoes, fish, poultry, dairy, and meats. FAO and RUAF Foundation (2019:51) state that "post-harvest losses account for decreased resilience of the city to food insecurity" in cities.

Thus, to address food and nutrition insecurity, there is need to plug in the gaps to address food loss along the whole food value chains, addressing challenges from harvest to markets. With the demographic shift to cities and towns, food value chains now involve several factors that influence the way in which food is produced, processed, distributed, marketed, and consumed. This situation has resulted in increased number of actors, raised questions of actor responsibility and efficiency, both resulting in increased food loss, increased cost of food and reduced nutrition security, especially for the urban poor in Southern Africa (Kaplinsky, 2004; Trienekens, 2011). Therefore, the study aimed at identifying and characterizing the nature and scale of food and nutritional loss in fresh food value chains in Mzuzu City and define its drivers and implications. To address food and nutrition loss in urban agrifood chains, the research team designed interventions that

centered around three objectives that focused on the major determinants and drivers and its implications, as follows:

Objective 1: Whole Chain Data Collection: the purpose was to collect data on how value chain actors operate and relate with each other and analyze the social and gender relationships in the chains, and the roles of each of the actors in the chains.

Objective 2: Whole Chain Analysis: to improve food handling, storage and timely logistics, thereby improving food accessibility and nutrition security. Data collected was analyzed and information gaps were identified and the potential ways of reducing food loss in Mzuzu city.

Objective 3: Prioritizing and Trialing Interventions: this was for exploring and testing contextually relevant food innovations and interventions in production, food handling, preservation and storage, transportation, information use and exchange and other aspects of chain operations to reduce food loss, improve food quality and safety and enhance product flow through the chains.

The following are the research trials that the project conducted:

Trial 1: Fish Feed with Kamuzu View Cooperative: Fish farming, despite being an endeavour that is prone to making huge losses, is one of the agribusinesses that has potential for high returns if well managed compared to other commodities. Economic benefits can be best achieved if fish farmers follow the recommended fish management practices. A critical element is the source of fish fingerings that can respond to feed when stocked in confined environments like ponds. The trial was aimed at assessing the effectiveness of the feed formulated by the project on performance of *Tilapia spp.*

Trial 2: Mainstreaming Gender issues in market governance: Mzuzu City Council By Laws lacked gender issues to recognize the roles women play in market governance. This trailing was in line with key results of the study findings which revealed that women are underrepresented in market committees meaning that they are not actively involved in market governance and decision-making on the trading of fresh foods.

Trial 3: Value addition to tomatoes: Fresh food value chain incur significant losses at all stages. In general, most losses were for fruits and leafy vegetables. In addition to governance and lack of services, the key drivers of food and nutritional losses along the value chain are poor harvesting methods, poor handling at harvest and during transportation, poor and/limited storage facilities and preservations methods among others. As a result of poor handling and storage, rotting accounted for (60.7%), overstaying (46.3%), and exposure to sunlight (45.9%), bruising (28.3%) and drying up (22.3%). This trial was aimed at how the value chain actors including traders could reduce fresh food losses, add value, and increase income.

Research Methodology

The research project utilized a mixed-methods approach, incorporating both quantitative and qualitative components. The project commenced with a quantitative survey conducted from 2nd to the 17th of February 2022. The survey encompassed 740 food actors, including 317 farmers, 107 transporters, and 316 traders. The sample size was determined to be statistically representative of the entire population within the project implementation area. Data collection for the survey was carried out using Google Forms.

For the analysis of qualitative information gathered from various sources and in different formats, the study employed NVIVO-12, a computer-assisted qualitative data analysis software (Richards, 1999). Interviews were recorded and subsequently transcribed in English. The transcripts were cleaned and analyzed. Descriptive statistics such as frequencies, percentages, and means were generated using Microsoft Excel.

KEY FINDINGS, CONCLUSION AND LESSONS LEARNT: A SUMMARY

The overall findings of the research project indicate three significant accomplishments. First, the project has successfully achieved its research objectives by generating outcomes that have improved food governance, food handling practices, and reduced food losses. Stakeholder involvement and engagement have played a crucial role in enhancing understanding among actors involved in the fresh food value chain and clarifying their roles. Gender issues have been effectively addressed and mainstreamed through the project's interventions, leading to improved governance in markets.

Second, the research project has established productive partnership linkages with key government counterparts, including the Government of Malawi (GoM), Mzuzu City Council (MCC), Small and Media Enterprise Development Institute (SMEDI), Malawi Bureau of Standards (MBS), and the Department of Road Traffic. Close collaboration has been maintained with the Department of Fisheries, Mzuzu Agricultural Development Division (ADD), and Mzuzu City Council. This active partnership with stakeholders and government extension staff is crucial for ensuring project sustainability and developing an effective exit strategy.

Third, the project has empowered the women market committee, leading to their incorporation into the Mzuzu City Market By-Law. The project has successfully mainstreamed gender issues into market governance within the Mzuzu City Council. Previously, the market governance bylaws in Mzuzu City lacked adequate gender representation in decision-making market committees. This accomplishment aligns with the study's key results, which revealed the underrepresentation of women in market committees.

In summary, the research project has achieved its intended objectives by improving food governance, addressing gender disparities, establishing partnerships and cooperation with key stakeholders, empowering women in market committees, and capacity building

through training of women in hygienic yoghurt production, training of women in tomato jam making, training of fish farmers in floating fish feed production, review of market by-laws, and training in business skills. These accomplishments contribute to the overall success and impact of the project.

The results show that there are many ways in which fresh food and nutrition are lost in terms of quality and quantity along the agri-food value chains from harvest, post-harvest, transportation and at the food markets.

The findings indicate that the fresh food value chain incur significant losses at all stages. In general, most losses were for fruits and leafy vegetables. In addition to governance and lack of services, the key drivers of food and nutritional losses along the value chain are rotting (60.7%), overstaying (46.3%), exposure to sunlight (45.9%), bruising (28.3%) and drying up (22.3%). Below is a summary of the findings:

(i) Quantitative findings

a. **Harvest stage:** the findings of the study indicate disparities in farm ownership among both genders and youth, with joint ownership being relatively common. Land ownership plays a significant role in decision-making processes related to harvest timing and methods. Climatic factors also influence harvest timing decisions. Furthermore, a high percentage of farmers experience food loss at the harvest stage, particularly for fruits and vegetables, but some waste is repurposed or sold.
    i. The study found that male ownership of farms accounts for approximately 38%, while female ownership stands at 24%. Joint ownership, however, is relatively high at 31%. In terms of youth ownership, they only possess 2% of the farms, indicating a significant disadvantage for this demographic.
    ii. ii. Decision-making regarding the timing and method of harvesting is closely tied to land ownership. Males make approximately 37% of the decisions in this regard, females make 25%, and joint decision-making constitutes 36%. There is minimal pressure (1.3%) from buyers regarding the timing and methods of harvesting.
    iii. Climatic factors have an impact on the timing of harvest. While 45.3% of respondents claimed that they were not influenced by climate, 33.2% stated that rainfall influenced their harvest time, 19.5% mentioned temperature, and 2% identified humidity and drought as factors affecting their harvest timing decisions.
    iv. The study revealed that approximately 93% of farmers experience food loss at the harvest stage, particularly concerning fruits and vegetables. When waste is realised, 47% of it is given away. While this may result in economic loss, it is not necessarily classified as food loss since up to 13% of the waste is sold.

b. **Post-harvest stage:** the key findings at this stage were:

i. The main actors involved in the post-harvest stage include farmers, agents, storage owners, and transporters. These individuals play critical roles in the post-harvest handling and distribution of agricultural products.
ii. The study revealed that there is minimal processing of fresh foods. Preservation methods mainly rely on the use of pesticides and sun drying. The finding regarding pesticide use prompted the study to gather additional information to explore this aspect further.
iii. Storage facilities are limited, particularly for meat, fish, and dairy products. Only a small percentage of respondents (less than 10%) reported having storage facilities for these perishable items. There is a significant need for the establishment of storage facilities for poultry, fish, meat, and milk products to ensure their preservation and minimize losses.
iv. Many farmers operate on a small scale and produce relatively small quantities of crops. However, even with these smaller quantities, significant losses were observed, particularly in the case of leafy vegetables. Farmers were found to lose up to 50kg of leafy vegetables with each harvest. It is important to note that these losses may occur multiple times since the harvest of leafy vegetables is not a one-time event.

c. **Transportation stage:** the Key findings were:

i. The utilization of vehicles for transportation purposes is relatively low, accounting for only 18% of the cases. Among the vehicles used, small vans and light trucks each constitute 5.2%, oxcarts make up 6.6%, and tractors are utilized by 1% of farmers. Most farmers (62.6%) transport their goods by walking, followed by bicycles (10.8%), wheelbarrows (7.7%), and approximately 22% sell their produce directly at the farm.
ii. Among traders, walking remains the primary mode of transportation for merchandise, accounting for 35.7%. This is followed by small vans (29.9%), bicycles (24.1%), wheelbarrows and light trucks each at 21.2%, and motorcycles at 11.2%. These results reflect the short distances between the gardens and the markets.
iii. Food waste during transport is mainly attributed to poor handling practices, exposure to weather conditions, and limited access to transportation options; most of the food waste is discarded (45.6%), while a significant portion is resold at a lower price (31.4%), or reused for other purposes (12.3%). The key factors contributing to food loss during transportation are poor loading and offloading practices (50.3%), exposure to adverse weather conditions (32.3%), and the unavailability of transportation options (13.9%).

d. **Open air market: the** Key findings were:
i. women play a significant role in market trading, particularly in retailing and wholesaling. While cooperatives are not extensively involved, traders, farmers, consumers, local authorities, and political cadres are key actors in this sector. Street trading is preferred by a significant number of traders,

and women face challenges related to public safety, long distances, and high levies, which contribute to food losses. Market levies, typically daily fees, are paid by the majority of traders to the city council. The data reveals that women play a dominant role in market trading, with 71.7% involved in retailing and 59.9% engaged in wholesaling. These percentages may not add up precisely due to the overlapping roles of individuals within the market trading sector.

ii. The key actors involved in open-air market trading include traders, farmers, consumers, local authorities, and political cadres. However, cooperatives are not widely developed, as only 2.1% of respondents mentioned them as major actors in market trading, despite traders being members of market committees.

iii. When it comes to trading preferences, many traders opt for street trading (38.8%), while others prefer trading under shelters (36.5%) or using vending stands (19.6%). Among women traders, the majority (51.7%) prefer street trading, followed by 33.5% who prefer shelters, and 12.7% who prefer stands inside the market.

iv. The main challenges faced by women traders include concerns regarding public safety (30.1%), the long distances they have to travel (21%), and high levies imposed on them (13.2%). Notably, 84% of women reported that these challenges contribute to food losses at the market.

v. Among the traders surveyed, 73% reported paying market levies. These levies mainly consist of daily market fees that are paid to the city council.

e. Services availability: The main findings were:

i. Survey results indicate a shortage of storage facilities, with 69.3% of respondents reporting this issue.

ii There is an unreliable water supply, affecting 65.4% of those surveyed, and an unreliable energy supply, affecting 68.8%.

iii Consequently, self-provisioning is common as reported by 31.1% of respondents.

f. Governance: the main findings were:

i. Instances of corruption in relation to accessing trading spaces, premium trading spaces, accessing market facilities, and considerations for holding office in market committee which disproportionately disadvantage women and the youth.
ii. The market by-laws have not mainstreamed gender.

Qualitative Findings

Qualitative data were collected through 7 Focus Group Discussions (FGDs), 4 stakeholder consultations (Launch, development of tools, preliminary findings, and gap identification), and 38 Key Informant Interviews.

The key findings from these qualitative methods of data collection were:

A. Focus Group Discussions

- Most of the losses are reported in the fresh foods.
- Transportation challenges included corruption by traffic police, punishment of drivers at spots, and detention of vehicle on the way. This practice leads to spoilage of fresh foods as they are exposed to heat and can be damaged due to offloading and re-loading when trader seek alternative transport modes.
- High market fees or levies charged on fresh food at the market.
- Unavailability of services such as water, energy, storage facilities, toilets and waste disposal.
- The roles of market committees and Mzuzu City Council are not clear as some traders think that the committee belongs to the council.
- There are gender disparities in representation in the market governance structures.
- The youth are not included in market governance structures and in decision making along the value chain.
- Trading spaces are not adequate in the designated markets, and this leads to preference to, or actual, trading along the streets.
- The actors in the value chain are linked to many other actors some of them with conflicting rationalities which may have impacts on interventions and trialing.

B. Stakeholders and Key Informant Engagement

The findings show:

- Farmers are not well organized, for example, into cooperative or clubs to take advantage of market opportunities.
- There is absence of cooperative transport arrangements where several traders could organize to collect produce to the market or across markets.
- Inappropriate chemicals are applied to preserve fresh foods.
- Absence of formal foras/platforms where all stakeholders can come together and discuss fresh food loss and market governance issues.
- There is lack of extension services related to food production, processing and transportation, storage and its linkage to human health.
- There is no quality assurance of the food along the value chain.

Success stories:

Success stories were registered in four out of five trials:

i. Local fish feed formulation by Kamuzu View Fish Co-operative.
ii. Mainstreaming gender in market by-laws.
iii. Jam making from waste tomatoes by women market traders.
iv. Improved packaging of yoghurt by Doroba Milk Cooperative.

The unsuccessful was production of tomato powder from waste tomato, which was a result of rainy weather, hence the tomato could not dry and ended up rotting.

(iii) Recommendations

Recommendation 1: **Collaborate** with other development partners to address food and nutrition losses in the value chain. The successful partnership with the Department of Fisheries in the fish feed trial demonstrates the potential for greater economic benefits. Expand such interventions to benefit more fish farmers in Malawi and maximize the spill-over effects of project interventions.

Recommendation 2: Continue the gradual approach of **exploring and learning innovations** together with farmers and value chain actors. The project has shown initial positive outcomes without significant risks. Share the positive outcomes and messages from the project with other cities that didn't directly participate, opening opportunities for additional income generation and value addition through modern processing methods.

Recommendation 3: Further enhance **capacity building** initiatives to empower women in market governance and decision-making related to fresh food trading. While the project has made progress in mainstreaming gender issues, additional efforts are needed to ensure women are fully equipped and adequately represented.

Recommendation 4: **Provide ongoing support** to the dairy value chain to meet the Malawi Bureau of Standards (MBS) specifications for product certification. Farmers require guidance, proper packaging materials, and entrepreneurship capacity building to navigate the complex MBS certification process and successfully market their milk products.

Recommendation 5: **Plan for a smooth transition** from the research project to a full-scale development program. Scale up activities, establish strong relationships with the Government of Malawi (GoM), and work closely with fresh food value chain actors to ensure continuity of activities, capacity building, and problem-solving beyond the project's lifespan. Avoid creating a void that could threaten the sustainability of the positive project outcomes.

Recommendation 6: At the local level, **build stronger partnership** between the Mzuzu University as an academic institution and URAC as a community mobilization institution and Mzuzu City Council as a local government.

2.1 Background

Malawi is among the fastest urbanising countries (4.1% per year) with Mzuzu (5.4% per year) projected to become a major urban centre in Southern Africa (NSO, 2019). The youthful population of Mzuzu, with over half aged below 20 years gives a high population momentum. According to the Global Network Against Food Crises (2020:34), Malawi is among the “most hungry countries” in Southern Africa. These are countries that experience frequent food deficits relative to their national populations. The African Food Security Urban Network (AFSUN) similarly maintains that Malawi cities and towns are among the most food and nutrition insecure in Southern Africa. The AFSUN indicates that food and nutrition insecurity is endemic among the urban poor in Malawian cities and towns. The AFSUN report further reveals that Mzuzu city’s food insecurity was serious with up to 41% having no food of any kind to eat in the household because of lack of money (Liley, et al, 2018). This is a general situation of cities and towns in Malawi which is one of the poorest nations in the world having GDP per capita of only $300 (World Bank 2018 cited by Liley et al, 2018). According to Crush et al (2011a:6), “undernutrition in developing countries has been called the ‘silent emergency’ and the prospects for eliminating it is ‘grim”. Smith (2016) makes a direct link between food and nutrition security

in Sub-Saharan African cities and towns. Informal settlements in these cities and towns are home to concentrated hunger and malnutrition incidences as well as hunger related deaths and stunted growth.

The current food and nutrition insecurity in Malawi cities have yielded major health effects including stunting and permanently reduced cognitive function for small children, promoted child labour and contributed to increased prevalence of nutrition related diseases (Smith, 2016). These consequences will have a lasting damaging effect on economic and human development prospects in Malawi.

According to Erickson (2008:240), nutrition security is driven by factors affecting food availability, food accessibility and food utilisation. Food availability and accessibility directly impact nutrition status of cities and towns. However, food loss and waste reduce food availability, accessibility, and utilization. High proportion of food loss is typical in fresh food value chains such as tomatoes, fish, poultry, dairy, and meats. FAO and RUAF Foundation (2019:51) state that “post-harvest losses account for decreased resilience of the city to food insecurity” in cities.

To address food and nutrition loss in urban agri-food value chains, Mzuzu University in collaboration with URAC, implemented the two (2) year research regional project in Mzuzu City with cross learning from Lusaka City. Through consultations with stakeholders, the team designed interventions that centered around three objectives that focused on the major determinants and drivers and its implications. The project was designed to reach value chain actors of fresh food and business development services like transporters, Road Traffic, SMEDI, MBS and others. The project was launched in October 2021 in Zambia and Malawi. The project has worked with different stakeholders who have provided technical experts to the value chain actors. The objectives of the project were as follows:

Objective 1: Whole Chain Data Collection: The purpose was to collect data on how value chain actors operate and relate with each other and analyze the social and gender relationships, and the roles of each of the actors in the chains.

Objective 2: Whole Chain Analysis: to collect and analyse data on food handling, storage and logistics, thereby improving food accessibility and nutrition security. Data collected was analyzed and information gaps identified and the potential ways of reducing food loss in Mzuzu city.

Objective 3: Prioritising and Trialing Interventions: This was for exploring and testing contextually relevant food innovations and interventions in production, food handling, preservation and storage, transportation, information use and exchange and other aspects of chain operations to reduce food loss, improve food quality and safety and enhance product flow through the chains.

The following are the research trials that the project conducted:

Trial 1: Fish Feed with Kamuzu View Cooperatives: Conduct a trial to evaluate the effectiveness and efficiency of the feed formulated by the project on the performance of Tilapia spp. Fish farming has the potential for high returns if managed properly, and the

trial aimed to assess the impact of the project's formulated fish feed on fish growth and productivity. By providing fish farmers with quality feed, it wasexpected to improve their management practices and enhance the economic benefits of fish farming.

Trial 2: Mainstreaming Gender issues in market governance: Address the gender disparities in market committees and market governance by incorporating gender issues into Mzuzu City Council By Laws. Currently, women are underrepresented in market committees, limiting their involvement in decision-making processes. This trial aimed to raise awareness, promote gender inclusivity, and empower women to actively participate in market governance and decision-making related to the trading of fresh foods.

Trial 3: Value addition to fresh foods like tomatoes: Explore value addition opportunities for fresh foods, specifically tomatoes, to reduce food and nutritional losses along the value chain. Fresh food value chains often experience significant losses, especially for fruits and leafy vegetables. By implementing value addition techniques, such as processing or preservation methods, the trial aimed to generate evidence and practical steps to minimize losses and increase income for value chain actors, including traders. This can be achieved by addressing key drivers of losses such as poor harvesting methods, poor handling at harvest and during transportation, poor and/limited storage facilities and preservations methods, and climatic conditions among others.

The study therefore aimed at identifying and characterizing the nature and scale of food and nutritional loss in fresh food value chains in Mzuzu City and define its drivers and implications.

3 Objectives

The aim of the project was to identify and characterise the nature and scale of food and nutrition loss in urban agri-food chains in Mzuzu City and define its drivers and implications.

Specific objectives of the project were to:

1. To collect data and map chain actors, processes, communications, power dynamics in the chains, social and gender relationships in the chains, and the roles of each of the actors in the chains; develop, for project use and for wider dissemination, a clear and concise report and data sets on food losses and the urban food chain operations in Mzuzu city.
2. To analyse chain operations in Mzuzu city using the information assembled, information gap identification and determine further data collection; to identify potential ways of reducing food loss, improving food handling, storage, and timely logistics, thereby improving food accessibility and nutrition security for the urban poor in Mzuzu city.
3. To explore and test contextually relevant food innovations and interventions in food handling, preservation and storage, transportation, information use and exchange and other aspects of chain operations to reduce food loss, improve food quality and safety and enhance product flow through the chains.

4 Methodology

Study locations

The data collection took place in various locations, including Mzuzu City markets, Jenda Trading Center, Ekwendeni/Chambo, and Bwengu in Mzimba district, Mpamba Trading Center, and Chigwere in Nkhata Bay. These locations were chosen because they are significant in terms of growing and supplying a substantial amount of fresh foods to Mzuzu City (Figure 1). The study focused on fresh food value chains, specifically dairy products, fish, poultry, meat, and horticulture. The primary targets for data collection were the markets, farmers, and other actors involved in supporting the fresh food value chains, such as transporters. Both qualitative and quantitative methods were used to ensure a comprehensive understanding of the issues and factors affecting the value chains.

Methodological approach

During the inception workshop, the project collaborated with stakeholders to develop the data collection instruments. Following the instrument drafting, a second workshop was held to validate the tools before the actual data collection process began.

The survey was conducted between 2nd and 17th February 2022, utilizing a team of 11 enumerators, consisting of 7 females and 4 males. These enumerators were recent graduates from Mzuzu University and worked under the supervision of the research team. The survey targeted a total of 740 food actors, including 317 farmers, 107 transporters, and 316 traders. To collect survey data, google forms were utilized as the data collection tool. The quantitative data collected during the survey can be found in Appendix 1.

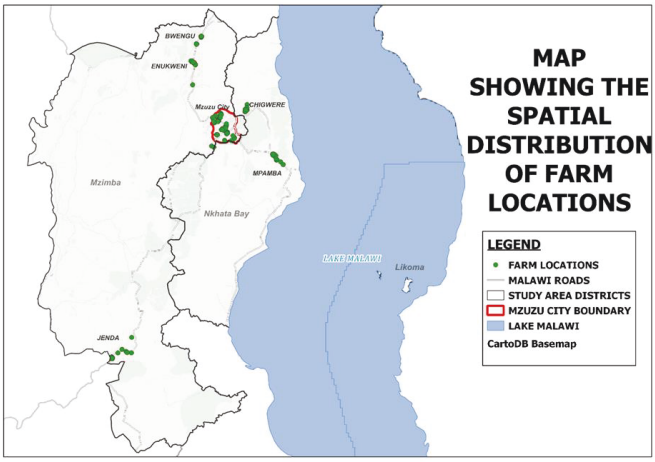


Figure 1: Spatial distribution of study sites

In addition to the survey, qualitative data was gathered from key stakeholders such as the Ministry of Agriculture, Mzuzu City Council, Nyaluwanga Farms, Department of Agriculture Extension Service, agricultural cooperatives, Chiefs, market committees, and the Department of Road Traffic. The qualitative data collection involved interviews with these stakeholders, and the interviews were recorded and transcribed in English.

To analyze the qualitative information collected from various sources and in different formats, the study employed NVIVO-12, a computer-assisted qualitative data analysis software developed by Richards in 1999. The interview transcripts were then cleaned and analyzed. Additionally, Microsoft Excel was used for calculating descriptive statistics such as frequencies, percentages, and means.

Partners and collaborators

The study involved a wide range of stakeholders throughout its various stages. These stakeholders included:

1. Crops Department: The government department responsible for overseeing crop-related activities and providing expertise in crop production.
2. Lunyangwa Research Station: A research institution focusing on agricultural and crop research, providing valuable insights and knowledge.
3. Food and Nutrition Department: The department responsible for food and nutrition-related issues, contributing expertise in this area.
4. Mzuzu City Council: The local government authority responsible for governing Mzuzu City, market governance and infrastructure.
5. Nyaluwanga Farms: A farming enterprise or institution that played a role in providing insights and participating in data collection.
6. Department of Agriculture Extension Service: The department responsible for providing agricultural extension services, offering expertise and guidance to farmers.
7. Agricultural cooperatives: Organizations formed by farmers to collectively engage in agricultural activities, promoting collaboration and mutual support.
8. Chiefs: Traditional leaders who hold influence and authority in the local communities, involved in decision-making processes and representing community interests.
9. Market committees: Committees responsible for overseeing market operations and governance, including representation from various stakeholders.
10. Mzuzu University Faculty of Environmental Sciences: capacity building through built environment and agri-sciences degree programmes.
11. Market masters/managers: Individuals in charge of managing market operations and ensuring smooth functioning.
12. Traders: Individuals involved in buying and selling agricultural products in the markets.
13. Department of Road Traffic: The department responsible for regulating and overseeing road traffic, likely involved in discussions related to transportation and logistics.
14. MUFNet: Mzuzu Urban Framers Network: a federation of small scale informal fresh food producers in Mzuzu City.
15. Synod Development of Livingstonia: A development organization associated with the Livingstonia Synod of the Church of Central Africa Presbyterian (CCAP), involved in community development initiatives.
16. AGRA (Alliance for a Green Revolution in Africa): An organization working to transform African agriculture through partnerships and initiatives.
17. Mzuzu Youth Organization: A youth-focused organization in Mzuzu, potentially involved in youth empowerment and engagement in agricultural activities.
18. NASFAM (National Smallholder Farmers' Association of Malawi): A farmer-led organization promoting smallholder farmers' interests and supporting their agricultural activities.

These stakeholders played various roles throughout the study, including participating in inception meetings, co-producing study tools, revising the tools, and contributing to data collection and analysis. Their involvement ensured a collaborative and multidimensional approach to understanding and addressing the issues related to food and nutrition losses along the value chain in the Mzuzu City region.

5 Achievements against activities and outputs/milestones

Objective 1: To collect data and map chain actors, processes, communications, power dynamics in the chains, social and gender relationships in the chains, and the roles of each of the actors in the chains; develop, for project use and for wider dissemination, a clear and concise report and data sets on food losses and the urban food chain operations in Mzuzu City.

no.	Activity	outputs/ milestones	completion date	Comments
1.1	Stakeholder engagements	Regular contacts and communication with key stakeholders	July to August 2021 to August 2023	Stakeholder involvement and engagement was effective amongst project staff, private sector and GoM counterparts at both the planning level and in field implementation. The project involved several stakeholders during the conceptualization and during project inception workshop. Key stakeholders included the Lunyangwa Research Station, SMEDI, Department of Fisheries, AGRA, NASFAM, officials from government institution, Mzuzu City Council, Nyaluwanga Farms, Mzuzu University, MUFNet
1.2	Inception workshop-WS1(Lusaka) Inception Workshop WS1 (Mzuzu)	Familiarization of project objectives activities and timelines with stakeholders from relevant institutions and stages of the urban food value chains.	6-9th October 2021 12-13 October, 2021	The inception workshop was held in Lusaka, Zambia. Several stakeholders attended the physical meeting. Others attended virtually such as the Australian Ambassador to Zimbabwe, Zambia and Malawi. The workshops provided an opportunity for various stakeholders to come together and achieve common understanding of the projects' aims, objectives outputs, outcomes and implementation modalities.

1.3	Formulation of research themes and instruments.	Worked with stakeholders to collaboratively formulate qualitative and quantitative research instruments.	November 2021	After the launch of the project stakeholders discussed the main themes and categories of fresh foods that would inform data tools formulation. The draft tools were discussed with stakeholders during the inception workshop. After drafting the tools, the project conducted the second workshop to validate the tools before commencing data collection. The instruments were sent to partners for feedback before data collection started. Data tools available in Appendix 3.
1.4	Data collection on the food loss along the four stages of the food value chain in Mzuzu City and surrounding areas.	Field surveys of 740 food actors and Interviews of key informants along the urban agri-food chains.	February 2 to 17 February 2022	Quantitative data collection was done between 2nd and 17th February 2022 and was carried out in Mzuzu city and surrounding areas. (See Map in Section 5.0). Qualitative data collection were triangulated across stakeholders and compared with direct observation. The principal interview methods were focus group discussions (FGDs) and key informant interviews (KIIs). This process was done between March 2022 and May 2022. A data base of quantitative data collected has been attached as Appendix 1.
1.5	Mapping of food flows along the four stages of the food value chain	Map showing the food flows from the farms to the market generated	Feb to March 2022	The project produced a map using GIS to show fresh food flows along the value chain within Mzuzu City and surrounding areas.

1.6	Data analysis	Established the key drivers and dynamics of food loss in Mzuzu City and surrounding areas and gender relations and roles of each of the actors along the food value chain	Feb - March 2022 to June 2023	At each interview session, notes were taken by the facilitators, interpreters, and note-takers. With participants' verbal consent, recordings were made of the FGDs and some of the KIIs sessions. Interview recordings were transcribed in English, cleaned, and analysed using NVIVO 12. Quantitative data was analysed in MS Excel to generate tables, graphs and charts. From the findings, key observations along the value chain are: • Decision-making at harvest stage goes hand in hand with land ownership as about 37% of decision making on time to harvest and method of harvesting is by males and 25% by females while joint decision making is 36%. • The key drivers of food loss during transport are; poor loading and offloading (50.3%), exposure to weather conditions (32.3%) and unavailability of transport (13.9%). • Many traders prefer trading in the streets (38.8%), others prefer shelters (36.5%) and vending stands (19.6%). For women the majority (51.7%) want to be along the streets, 33.5% want shelters and 12.7% want stands inside the market. • The main challenges that women traders face are; public safety (30.1%), long distances (21%), high levies (13.2%). 84% of the women reported that these challenges contribute to food losses at the market. • Corruption was reported to be major issue in accessing trading spaces, premium

				trading spaces, access to market facilities and consideration to hold office.
1.7	Project information dissemination	Regular stakeholder engagements, Focus Group Discussion /workshop to present results of the study	September 2021 to August 2023	The project has been disseminating some of the project activities to the general public through on-farm demonstrations, display of banners, Twitter and media engagement e.g. the project launch was broadcast live on Times TV on 14th October 2021[1].
1.8	Database of key actors and stakeholders as well as data base of food chain food losses	A database that can be accessed by all stakeholders has been built	solutions to food loss	Partners of the project can access the data base and can jointly engage with others to address the food loss.

PC = partner country, A = Australia

Objective 2: To analyse chain operations in Mzuzu city using the information assembled, information gap identification and determine further data collection; to identify potential ways of reducing food loss, improving food handling, storage and timely logistics, thereby improving food accessibility and nutrition security for the urban poor in Mzuzu city.

no. -	**Activity**	**outputs/ milestones**	**completion date**	**Comments**
2.1	Focus Group Discussion	Consensus on understanding of roles of stakeholder relationships, gender, and linkages as determinants of fresh food loss along the chain.	16 March 2022	7 FGDs were conducted for Youth representatives from all markets, Market committees, Stakeholders from Mzuzu City, women representatives from all markets, Doroba milk producers, Ekwendeni/Chambo vegetable producers and Mpamba fish farmers. (See Appendix 4)

[1] Samuel Kalimira, 2021. The launch of the project was reported Malawi Times newspaper and on Times TV on 14 October 2021: Malawi, Zambia in food security initiative - The Times Group Malawi

2.2	Identification of potential food loss solutions	Solutions and interventions were identified	June 2022	Identification of potential solutions and innovations were discussed at a stakeholder workshop which was conducted on 27th May 2022 at Chatonda Lodge. Some of the identified potential solutions were: • Developing technologies to minimize food losses starting from the producer to markets. • Knowledge and skills in proper handling, packaging and storage • Formation and capacity building for farmers and market cooperatives and associations. • Innovative recycling of thrown away and unused food items • Renovation of cold chain storage facilities previously used by fish and other fresh food traders. • Negotiation with the Department of Road Traffic and traffic police to give traders and fresh food transporters special licenses on transportation.
2.3	Gap identification	Gap identification in primary data collection by partners	9th-21st July 2022	The identified gaps included inadequacy of data on beef, fish, and chicken, use of pesticides (chemicals) in farming and preservation of food among farmers.

2.4	Identification of trial sites and development of innovations for trials	Discussion and consensus building on possible sites and innovations	July 2022 to June 2023	Identification of 3 Sites were based on 1) availability of technical staff to support the trials, 2) capacity of the cooperative or governance structure to sustain the innovation 3) the knowledge, skills, and confidence acquired through training and practice would become a permanent feature in their daily life and adequate motivation for future business innovation.
2.5	Documentation of baseline data	Food loss and fresh food performance at trial sites is being documented to form a baseline.	August 2022 to June 2023	The data base was shared with all the stakeholders through presentations which were done by the project. The data base is also available for public use and reference

PC = partner country, A = Australia

Objective 3: To explore and test contextually relevant food innovations and interventions in food handling, preservation and storage, transportation, information use and exchange and other aspects of chain operations to reduce food loss, improve food quality and safety and enhance product flow through the chains.

no.	Activity	outputs/ milestones	completion date	Comments
3.1	Site selection and trialing	Trialing sites for interventions selected and consensus built among stakeholders about the trials.	April 2022 to June 2023	Meetings, site visits and Focus Group Discussions were instrumental in selection of sites by project team and stakeholders. The discussion mainly focused on exploring and testing contextually relevant food innovations and interventions in production, food handling, preservation and storage, transportation, information use and exchange and other aspects of chain operations to reduce food loss, improve food quality and safety and enhance product flow through the chain. Some of the trials that were agreed and implemented were: Trial 1: Fish Feed with Kamuzu View Cooperatives: Trial 2: Mainstreaming Gender issues in market governance Trial 3: Value addition to diary milk value chain to increase income and reduce losses through training of farmers. Trail 4: Value addition to fresh tomatoes

3.2	Engagement of sites for trialing	Sites and their management staff engaged to co-design and co-create the innovations and the trialing processes, data capturing and documentation on site.	From April 2022 to June 2023	One of the big achievement the project has so far made is the stakeholder involvement and engagement. Productive partnership linkages have been created and nurtured with Government of Malawi (GoM) counterparts, Mzuzu City Council (MCC), Small and Media Enterprise Development Institute (SMEDI), Malawi Bureau of Standards (MBS), and the Department Road Traffic Department. The implementation team collaborated closely with Department of Fisheries, Mzuzu ADD and Mzuzu City Council. This active partnership with various stakeholders and government frontline extension staff is key component for project sustainability and exit strategy. The activity is on-going and is expected to continue even if the project phase out by the end of August 2023.
3.3	Focus Group Discussion on identification and agreement on trialing sites	Prioritization of trialing sites identified	26 May 2022	The stakeholders such as market committees, Mpamba fishing cooperative and Doroba Milk Bulking centres as well as Lunyangwa Research Station agreed to prioritize one fishing point, one milk bulking center and one market commodity as trial sites while still analyzing other potential trial sites/issues.

3.4	Exchange visits by fish farmers	Solutions and interventions discussed and adopted by fish farmers in Lusaka and Mzuzu. Focus was on how to reduce the cost of fish feed.	June 2022	These exchange visits to other innovative sites (eg Kamuzu View Cooperative to Zambia) were an effective acquisition of core messages and skills from the project, the introduction of technological options appropriate for local livelihoods, and the confidence in collective problem-solving instilled by the project. Kamuzu View Fish Farmers Cooperative to Lusaka fish cooperatives and individual farmers were meant to explore issues around food loss in the fishing sector and how to reduce cost of fish feed.
3.5	Meetings on improvement of Market Governance	Discussions among key stakeholders to reduce fresh food loss and improving access to the existing yet underutilized market shed	On-going,	Through these meetings, the project managed to review and identify the gaps in the Mzuzu City By-laws. These were discussed with Gomezgani Nyasulu - Mzuzu City CEO who acknowledged the existence of gender gaps. In line with his call, the project organized a workshop in June 2023 where Mzuzu University, URAC, Women Committee, Market committees and Mzuzu City Council discussed and documented proposed reviews to market by-laws. The documented reviews were submitted by Council Secretariat to the full council for debate and resolution.

3.6	Gender and youth Mainstreaming in food market governance.	Women and youth business and entry into market committees promoted	June 2023	Through these meetings, the project has managed to mainstream the gender issues into Mzuzu City Council market governance. Previously the Mzuzu City By-Laws on market governance lacked gender representations in all decision-making market committees. This was in line with key results of the study which revealed that women were underrepresented in market committees meaning that they were not actively involved in market governance and decision-making.

PC = partner country, A = Australia

6 Key results and discussion

7.1. Introduction

The research project has achieved three significant outcomes. Firstly, it has successfully fulfilled its intended purpose to improving food governance, food handling practices, and reducing food losses. Through stakeholder engagement and collaboration, there has been an enhanced understanding of the roles and responsibilities of actors within the fresh food value chain. This increased interaction and dialogue among stakeholders, including value chain actors, food regulators, and supporters, has resulted in the resolution of issues that previously hindered efficiency.

The second notable achievement is the establishment of productive partnership linkages with key counterparts such as the Government of Malawi (GoM), Mzuzu City Council, Small and Medium Enterprises Development Institute (SMEDI), Malawi Bureau of Standards (MBS), and the Department of Road Traffic. The implementation team also worked closely with the Department of Fisheries, and Mzuzu Agricultural Development Division (ADD). This active collaboration with various stakeholders and government extension staff is crucial for the long-term sustainability of the project and the development of an exit strategy.

The third major accomplishment is the empowerment of women in market committees, which has also been incorporated into the Mzuzu City By-Law. Previously, the market governance provisions in the Mzuzu City By-Laws lacked gender representation and women's involvement in decision-making processes within market committees. The project has successfully mainstreamed gender issues and ensured greater female participation in market committees, aligning with the study's findings that highlighted the underrepresentation of women in these roles.

Overall, these achievements demonstrate the positive impact of the research project in improving food governance, fostering partnerships with relevant stakeholders, and promoting gender inclusivity within market governance structures.

7.2. Gender of participants

The project focused on gender participation, relevance, status, and equality. During the qualitative gender analysis an assessment of culturally-defined gender roles and barriers that might impede women's participation in the fresh food value chain was done. This was to identify unintended sources of harm related to gender-based violence taking place in market and understand the public roles of women and men in fresh food value chain.

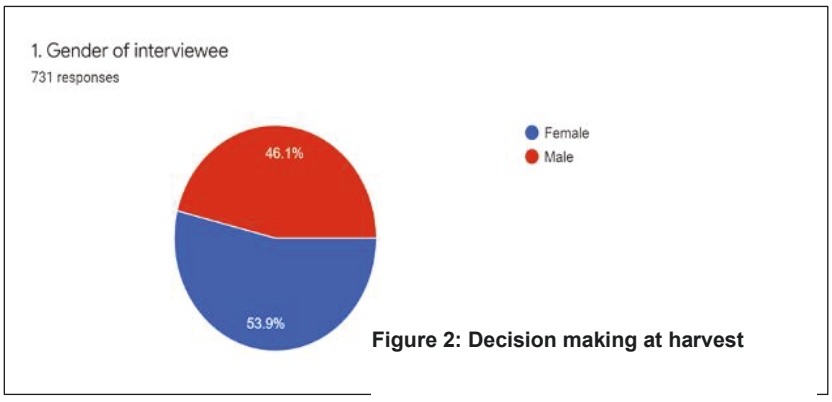


Figure 2: Decision making at harvest

The results from the analysis were used to formulate market governance interventions. In total about 53.9 % of the respondents were female while 46.1% were males. The results show that married people (81.8%) have great influence on marketing issues. This agrees with the FAO report (2007) which stated that women in Sub-Saharan Africa have the highest average rates of

participation in agricultural labour globally and that cultural norms in the region give greater responsibility for women in agricultural production.

7.3. Power relations and decision making along fresh food value chain.

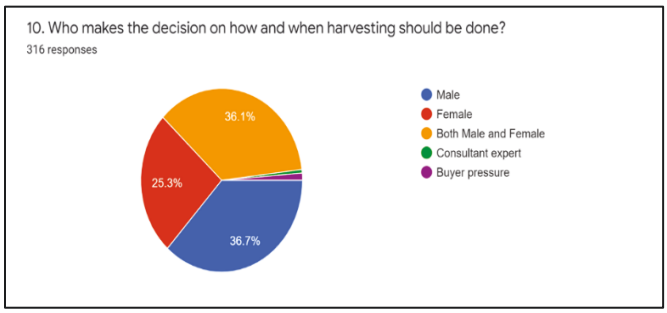


Figure 3: Gender of participants

The study findings reveal the connection between gender and ownership of land and key decision making in the food value chain. It was found that about 38% of farms are owned by males and 24% are owned by females. Much as the female ownership of farms is low, joint ownership is fairly high at 31%. The youths are very disadvantaged because they own only 2% of the farms. The findings also revealed that as men dominate ownership of land they also dominate key decision making processes at pre-harvest and post-harvest stages of the food value chain. The data shows that market trading is women dominated (71.7%) in retailing and in wholesaling (59.9%). These percentages do not add up due to doubling of roles, that is, one can be both a retailor and a wholesaler.

Decision-making at harvest stage goes hand in hand with land ownership as about 37% of decision making on time to harvest and method of harvesting is by males and 25% by females while joint decision making is 36%. But it was observed that there was minimal pressure (1.3%) from buyers for the time to harvest and methods of harvesting. The key observation here is that land ownership is the determining factor in decision making. It was also found that climatic factors have an impact on the time to harvest. Though 45.3% claimed they were not influenced by climate, 33.2% were influenced by rainfall, 19.5% were influenced by temperature, 2% by humidity and drought.

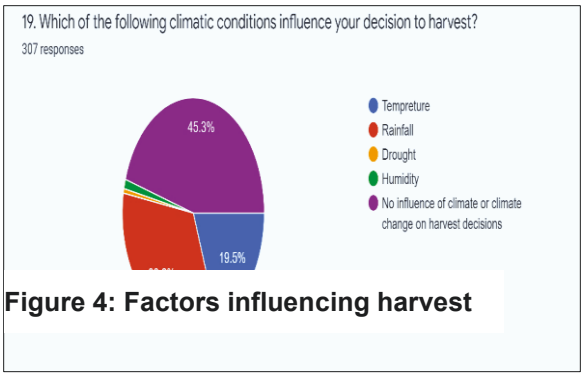


Figure 4: Factors influencing harvest

7.4. Food Losses at Post-harvest stage

About 93% farmers experience food loss at harvest stage. Most losses were for fruit vegetables such as tomatoes and leaf vegetables. The food that is wasted is given away (47%) or sold at a cheaper price. Although this maybe an economic loss (i.e. up to 13% of the waste is sold), it is not essentially food loss.

7.5. Post-harvest stage

Main actors during the post-harvest stage were the farmers, agents, storage owners and transporters. The findings revealed that there is minimum processing of fresh foods and that most of the farmers and traders preserve fresh food through pesticides use and sun drying. The study also found out that there were less storage facilities except for fruit vegetables and roots and tubers. The storage facilities are almost non-existent for meat and fish products (<10%). This shows that there is dire need for storage facilities for poultry, fish, meat and milk products. This could be one of the reasons leading to high fresh food losses amongst the smallholder farmers and traders.

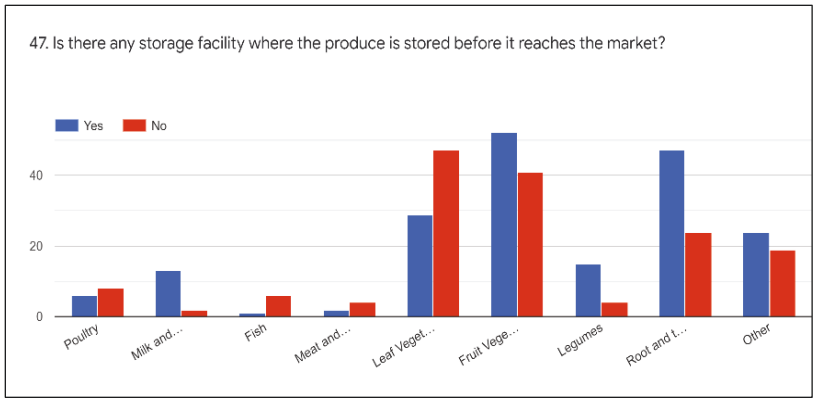


Figure 5: Availability of storage facilities at open air markets

Many of the farmers are small scale who produce small quantities, but these were observed to lose up to 50kg at each time of their harvest of leafy vegetables. These losses could be several times because the harvest of leafy vegetables is not just once.

7.6. Transportation stage:

When it comes to transportation, most farmers and traders in the study area rely on manual methods. Around 62.6% of them transport fresh foods on their heads by walking, followed by bicycles at 10.8% and wheelbarrows at 7.7%. The use of vehicles for transportation is relatively low, accounting for only 18% of the respondents. This includes small vans (5.2%), light trucks (5.2%), oxcarts (6.6%), and tractors (1%). It is worth noting that approximately 22% of the farmers sell their produce directly at the farm.During the transport stage, the majority of food waste is either thrown away (45.6%), resold at a cheaper price (31.4%), or repurposed for other uses (12.3%). For traders, walking is also the primary mode of transporting merchandise (35.7%), followed by small vans (29.9%), bicycles (24.1%), wheelbarrows and light trucks (21.2%), and motorcycles (11.2%). This distribution reflects the relatively short distances between the gardens and markets in the area. The key drivers of food losses during transport identified in the study include poor loading and offloading practices (50.3%), exposure to adverse weather conditions (32.3%), and delays and unavailability of transportation (13.9%). These findings indicate that Mzuzu City experiences significant losses in terms of both the quality and quantity of fresh foods reaching the open markets and final consumers.

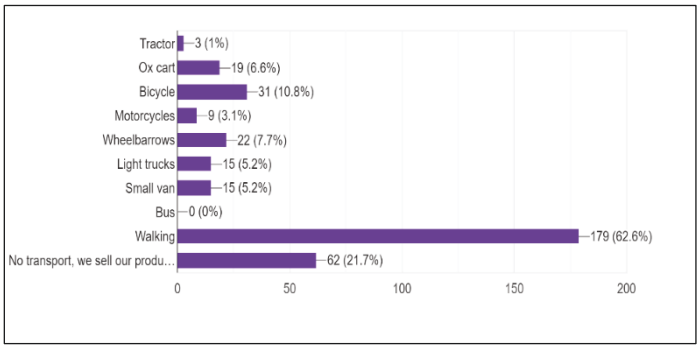
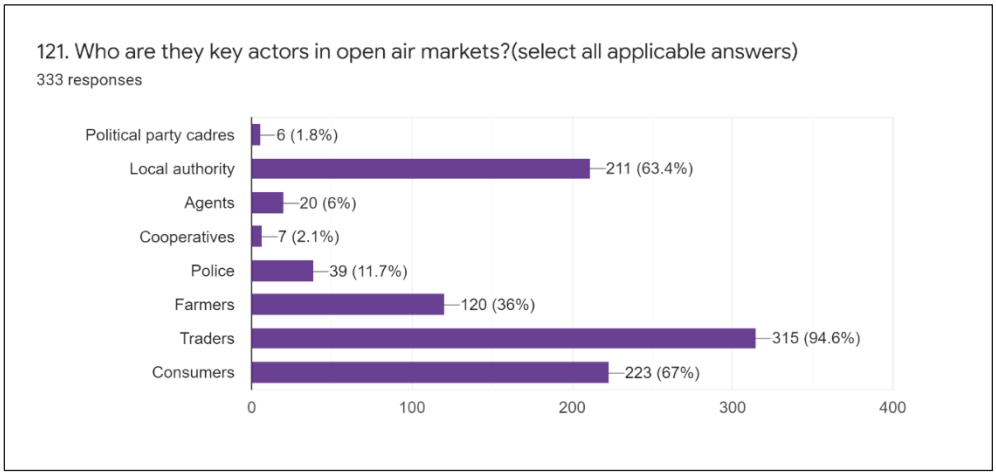


Figure 6: Type of transportation used

Figure 7: Transport mode- Pull-cart

7.7. Open air market stage



Market trading in the study area is dominated by women, with 71.7% involved in retailing and 59.9% in wholesaling. It is important to note that these percentages do not add up precisely due to the doubling of roles by some individuals. The key actors in the open markets include traders, farmers, consumers, local authorities, and political cadres, some of whom hold positions within the ruling political alliance called Tonse Alliance. For instance, the chairman of the market committee also serves as the District Chairman of the ruling Malawi Congress Party.

It was observed that farmers are not well organized into functional cooperatives, associations, or clubs that would enable them to leverage existing market opportunities. Despite government efforts to promote agricultural cooperatives, traders' participation in the open markets was found to be insignificant. Value addition can be pursued in two ways: either the cooperative purchases the necessary machinery or the cooperative enters into partnerships with the private sector to invest in value addition if they recognize the value of such an investment. Additionally, the absence of cooperative transport arrangements was noted, where multiple traders could organize to collect produce for the market or across markets. This suggests that the project could consider either assisting the market committees in transitioning into organized cooperatives or facilitating the formation of traders' cooperatives.

The study revealed that traders prefer conducting their business on the streets (38.8%), while others prefer shelters (36.5%) or vending stands (19.6%). Among women traders, the majority (51.7%) prefer trading along the streets, while 33.5% prefer shelters and 12.7% prefer stands inside the market. Women traders face various challenges, including concerns about public safety

(30.1%), long distances (21%), and high levies (13.2%). It is noteworthy that 84% of women reported that these challenges contribute to food losses at the market.

The findings indicate that 73% of traders pay daily market fees to the city council. The fact that 27% do not pay the market fees raises questions about management inefficiency or potential conflicts in the way the fees are collected.

7.8. Services availability:

The data reveals that there is a widespread shortage of storage facilities (69.3%), unreliable water supply (65.4%), and unreliable energy supply (68.8%) in most markets of Mzuzu city. Consequently, there is a reliance on self-provisioning of these services (31.1%). The lack of essential services such as water, storage facilities, and electricity constitutes a significant issue contributing to food and nutrition losses in the city, particularly for products like fish and milk. The major actors identified within the market context include the local authority, agents, farmers, traders, consumers, and the police. Physical visits to the markets revealed that in order to keep the food fresh, traders regularly sprinkled water over their merchandise. However, the sources of the water used was questionable , raising questions of the implications on human health..

7.9. Governance:

Figure 8: Corruption instances

Figure 9: Rejected 'Ndata' market

The study findings indicate that corruption instances related to accessing trading spaces, premium trading spaces, market facilities, and considerations for holding office (78.7%) were identified as significant challenges in the fresh food value chains. Poor governance within the markets resulted in the rejection of a newly built market structure by traders, rendering it ineffective. **Qualitative data analysis**

Qualitative data collection involved multiple methods, including 7 Focus Group Discussions (FGDs), stakeholder consultations, and 34 Key Informant Interviews (KIIs). The FGDs were conducted separately with specific food chain actors as follows:

The first FGD included officials from Mzuzu City Council and other government departments such as Mzuzu Agriculture Development Division (MZADD). The second FGD involved women traders from 17 active markets in Mzuzu City – out of a total of 21, with 4 not active. The third FGD consisted of market committee leaders from all markets in Mzuzu. The fourth FGD brought together youth food traders and distributors operating in Mzuzu City markets. The last three FGDs

(5, 6, and 7) were conducted separately with farmers at Chambo, Doroba, and Mpamba farming sites.

The design of the FGDs ensured participation from actors at each of the four stages of fresh food losses. Stakeholder consultations were conducted to launch the project, develop data collection tools, discuss preliminary and final findings, identify data gaps, engage with women traders, and involve council officials and councilors. Key Informant Interviews (KIIs) were undertaken prior to the FGDs and involved officials from various departments and organizations, including the road traffic directorate, planning and health departments of Mzuzu City Council, lands department, nutrition, agri-business, crops and extension departments of Mzuzu ADD, fisheries department, Nyaluwanga farms, Malawi Bureau of Standards, Small and Medium Enterprises Development, Lunyangwa research station, ward councillors, and chiefs. The insights gathered from KIIs helped in triangulating the results obtained from the FGDs. The results from the FGDs, stakeholder consultations, and key informant interviews are presented and discussed in the subsequent sections of the research report.

7.10. The key findings from these qualitative methods of data collection were:

7.10.1. Focus Group Discussions

Traffic police officers impound lorries carrying fresh food and charge high penalties just to force out bribes from the transporters and these costs are transferred to traders. If traders or drivers fail to pay penalties, fresh food items can and do rot on the way. The results showed that low yielding horticulture varieties, which are vulnerable to pest and disease attacks and poor management of produce during production, are the causes of the losses of fresh produce from the harvest stage. Farmers claimed to lose between 20–30% of their fresh produce during harvest post-harvest stages.

Challenges during the transportation stage included corruption by traffic police officers, punishment of drivers using spot fines, and detention of vehicles carrying fresh foods which leads to spoilage of fresh foods as they are exposed to heat and can be damaged due to offloading and re-loading when traders seek alternative transport modes. this challenge was described by one woman respondent as follows:

> “Sometimes we do persuade the drivers to pick us up and for that they charge us a large amount since they know that the extra money will be used to pay the police once they arrest the transport owners…”

The findings also revealed that the roles of market committees and City Council are not clear as some traders think that the committee belongs to Mzuzu City council. This was expressed and strongly supported by women. Some of the reasons mentioned by respondent were that there is no transparent way of allocating market space to traders, those with less start-up capital suffer the most as the well-off traders get more spaces in the market. Bribing also takes place for traders to access market space. Another woman had this to say:

> "And just because you are in need of marketing space, you just grab the pocket then you give cash later on you are told again that the place already belongs to someone. That means they need you to add some more cash and sometimes they openly tell you how much to pay to remove the other person, then you grab the pocket again then you pay...then later on you will see someone coming saying for the secretary to sign he/she needs MK1000 and so on"

At the market stage, fresh food losses occur because there are insufficient spaces for trading in open-air markets set aside for fresh produce. This forces traders to display their commodities along the streets where produce is exposed to weather elements that contribute to loses as the shelf life for most perishable products is very short. The findings further demonstrated that fresh food losses in open air markets have been exacerbated by lack of water, energy, and cold storage facilities, all of which are crucial for maintaining the right temperature and climate for produce.
The study revealed that governance is one of the main challenges contributing to food loss in Mzuzu City. For example, gender disparities were noted in representation in the market governance structures. The youth and women are not adequately included in market governance structures and in decision making along the value chain. It was also learnt that some women in trying to access trading spaces were providing sex for favors. These key findings formed a solid basis for one of the project interventions which is geared at addressing the gender-blind nature of market committees. The project mobilized women traders in the city into a women- market traders' committee with the aim of promoting women inclusion and participation in market governance structures by promoting a unified voice in addressing the underlying causes of gender disparities. The women committee has been verbally accepted by Mzuzu city council officials what remains is the formal inclusion in the market by-laws. The women traders' committee has, among other tasks, identified some gender insensitive issues in the market by-laws that need to be reformed. The discrepancies identified in the market by-laws were documented and they were used as an advocacy tool at the gender mainstreaming workshop on 3 June 2023.

The frequency of supposedly market accidents such as fire outbreaks as well as boycotting of market fee payments or refusal to occupy new markets were reported as being caused by arsonists to express displeasure at the way the markets were governed. Another key finding was that trading spaces are not adequate in the designated markets, and this leads to preference to, or actual, trading along the streets.

A strong connection was observed between street trading and fresh food losses because the fresh foods (vegetables, fruit and, potatoes) were laid on bare ground which exposed the fresh foods to direct sunlight, ground moisture and flies. Displaying the fresh foods on bare ground, not only reduced value and nutrient content, but also caused contamination and spoilage of the fresh foods.

Another major finding was that many actors in the value chain are linked to many other actors some of them with conflicting interests which had impacts on identification, analysis and harmonization of potential interventions and trialing. For example, the qualitative interviews revealed that some of the leaders of the market committees were linked to political parties which made them influential in decision making and market governance.

7.10.2. Stakeholders and Key informant interviews

The findings revealed that farmers and traders were applying inappropriate chemicals to preserve fresh foods. This shows that there is lack of extension services related to food production,

processing, transportation and trading which can affect human health. Lack of extension services from the government and relevant institutions that deal with pesticides is a main concern here. This also implies that there is no quality assurance of the fresh foods along the value chains.

Farmers and traders do not have cooperative transport arrangements. As a result, they hire expensive vehicles from an association of transporters based at one of the city markets. Lack of their own transport contributes to poor handling of fresh foods, which are often transported together with unrelated goods such as timber and tobacco bales. The Malawi Government however sought to address fish transportation and storage challenges by procuring refrigerated van that will pool fishermen and fish farmers potentially into a larger regional co-operative

6.1 DESCRIPTION AND ANALYSIS OF FRESH FOOD VALUE CHAINS

7.10.3. Economic analysis

The value chain analysis conducted in Mzuzu City revealed that the informal and unstructured fresh foods market plays a significant role in absorbing almost the entire output of the city. It is crucial to understand the dynamics of this market if smallholder farmers are to be successfully integrated into it. The analysis showed that the main actors in the fresh food value chains of Mzuzu City are smallholder farmers and small-scale traders/vendors. The qualitative analysis confirmed that food losses within the value chain start at the production stage and increase as the fresh foods move through the value chain from one actor to another.

In certain cases, such as in the fish and milk value chains, losses can reach up to 100%. For instance, during a truck drivers' strike in 2021, full milk tanker trucks were unable to make deliveries, resulting in the wastage of all the milk. These losses are either discarded or utilized as feed for livestock. These findings highlight the need to address food losses at each stage of the value chain, starting from production, in order to improve the overall efficiency and reduce waste. By understanding and addressing the specific challenges faced by smallholder farmers and SMEs in the fresh food market, it is possible to enhance their integration and contribute to food security and economic development in Mzuzu City.

Table 1: Milk losses

Milk Value chain	Average volume of milk delivered per day (Liters)	Percentage of milk	Prices per Liter (MK)	Monthly estimated value (MK)	Yearly Volume in value (MK)
Full Capacity of milk handled (Liters)	250	100	500	3,750,000	45,000,000
Volume of Fresh milk delivered (Liters)	180	72	500	2,700,000	32,400,000
Volume of fresh milk losses	50		500	750,000	9,000,000
Percentage loss	27.78				

Source: Field survey 7th April 2022

The research study reveals that about MK9 million loss is incurred by farmers per year. Assuming that the cooperative has everything working perfectly, about MK32.4 million could have been earned by farmers through supplying fresh milk to the cooperative. Losses experienced by farmers in the fish value chain due to fish fingerlings are not different. This emphasizes the significance of addressing the factors contributing to these losses to maximize the earnings and overall profitability of farmers in the sector. Table 5 illustrates Loses in fish value chain Table 2: Fish losses

Fish Value chain	Average No stocked per fish pond	Number of fish ponds (50 by 20) sq meters	Average weight of each fish at 6 month (Kg)	Total kilograms produced per 6 months	Fish Prices per kilograms (MK)	estimated Sales (MK) per harvest cycle	Yearly Sales (MK)
Number of fish fingerings stocked	3,000	50	0.2	30,000	3,000	90,000,000	180,000,000
Estimated fish fingerings losses at 30%	900	50	0.2	9,000	3,000	27,000,000	54,000,000
Estimated fish fingerings losses at 60%	1,800	50	0.2	18,000	3,000	54,000,000	108,000,000
Average losses	1350	50	0.2	13,500	3,000	40,500,000	81,000,000

Source: field survey calculation 9th April 2022

7.11. Factors for Fresh Food Losses in the chain

7.11.1. The value chain of milk: Doroba Milk Cooperative

The cooperative has 83 shareholders (17 males & 66 females) who own 35 dairy cows. The cooperative started with 10 dairy cows donated by Land O Lakes as a pass-on project. Each of the farmers is responsible for management of their dairy cows and sell milk through collective bulking. The cooperative supply dairy products (fresh milk & Chambiko) to the residents of Mzuzu City. On average, the cooperative has a capacity to collectively bulk over 250 litres of milk daily but due to challenges such as broken down equipment, it is only handling about 180 litres of milk per day. The cooperative has its own kiosk as an outlet market for its products in Luwinga Township.

The findings show that the cooperative is losing about 27.78% of fresh milk which translate to about MK9 million per year in economic loss.. The milk that is supplied to Doroba Cooperative comes from individual farmers surrounding the cooperative and within a radius of 10 Kilometers.

These are the members who received dairy cows through the pass-on program. The dairy products are distributed through hired transport system to various customers. The dairy products are also sold locally by the women hired to sell the products.

Challenges faced at different levels and possible solutions.

The cooperative is currently experiencing milk losses ranging from 28% to 40%. The fresh milk that is lost is either discarded or processed into Chambiko. When milk sours, the water content (50% of milk) settles, separating from the calcium and other nutrients. This results in a potential loss of up to 50% of the fresh milk if it were to be sold in that state.

At the individual level, farmers face several challenges:

1. Lack of improved dairy breeds for crossbreeding with their cows. Crossbreeding could enhance milk productivity. Currently, farmers rely on artificial insemination, which is ineffective due to their lack of training and limited support from the veterinary officer who resides far from the processing site. A possible solution would be for the cooperative to obtain dairy breeds for crossbreeding and establish a refrigerated facility for storing semen, although this would require access to electricity or strong solar energy, which is currently unavailable at the processing plant.
2. Poor dairy kraals contribute to animal diseases like mastitis, which affects milk quality and can lead to 100% milk loss. Farmers can construct better kraals with cement floors and adopt hygienic measures during milking to address this issue.
3. Inefficient transportation system for milk delivery to the cooperative. One solution would be for the cooperative to have its own transport system equipped with cooling facilities.
4. Inadequate milk collection materials, such as using pails and 20-liter buckets instead of proper milk cans. This affects the freshness and lifespan of milk during transportation to the cooperative. The cooperative should provide farmers with appropriate milk collection facilities by acquiring more milk cans and implementing a refrigerated transport system.
5. Farmers located at a considerable distance, ranging from 10 to 15 kilometers, face challenges due to heat buildup in pails or buckets during milk transportation. The use of milk cans and a proper transport system can help address this issue. Establishing sub-cooling processing centers could also be considered.
6. Lack of knowledge on producing feed, such as hay and silage, when there is an abundance of grass or fodder. Farmers also struggle to access animal treatment drugs, as veterinary specialists do not visit frequently due to limited extension services. Training farmers and para-veterinary personnel within the community can provide support and treatment for sick animals.

The cooperative experience losses ranging from 30% to 100% in terms of quantity due to the following reasons:

1. Unreliable electricity supply for preserving fresh milk. The cooperative currently relies on solar energy, which is ineffective due to the weather patterns in the Mzuzu area. The generator they have is not functioning and requires major repairs or replacement. Electricity challenges can result in 100% loss in quality and 50% loss in quantity when processing fresh milk into Chambiko (yogurt).
2. Lack of protective gear such as gloves, white gumboots, and white work suits in the processing plant. Additionally, there is a shortage of clean reticulated water supply, which poses a challenge for the cooperative to obtain certification from the Malawi Bureau of Standards. Installing a borehole or connecting to the reticulated system would be costly

due to the distance where the pipelines pass. Currently, the cooperative relies on a communal borehole located about 200 meters away, compromising hygiene due to the large number of households using it. Moreover, the water from the borehole is salty, affecting the milk quality.

3. Inadequate storage facilities for fresh milk. The lack of storage facilities forces dairy farmers to process surplus fresh milk into yogurt. Unreliable solar energy results in an inability to store fresh milk for an extended period. Processing yogurt (chambiko) was unplanned initially, as farmers were losing milk that couldn't be stored. The cooling facilities have worn-out seals, which are difficult to obtain within Malawi. Processing Chambiko results in a 50% loss in milk value. The cooperative should invest in proper cooling facilities and value addition equipment to process fresh milk into dairy products like cheese, yogurt, and well-packaged fresh milk. Alternatively, importing seals from manufacturers could be considered for seal repairs.
4. Limited handling equipment such as cans and modern testing kits for dairy products. The cooperative currently has only 20 cans donated by the American Embassy, which is insufficient to support milk bulking from 35 dairy cows. Additional cans of various sizes (10 and 20 liters) are needed for each farmer.
5. Inadequate packaging materials for Chambiko, resulting in lower selling prices. The cooperative lacks proper packaging materials that are well-labelled and can be sold at higher prices than the current K500 per liter measured in thin plastic containers. Poor packaging alone leads to about 40% economic milk loss. Improvements in packaging have allowed a 300ml bottle to be sold at K400, more than twice the previous selling price.
6. Additionally, the cooperative lacks protective gear such as gloves, white gumboots, and white work suits for use in the processing plant.

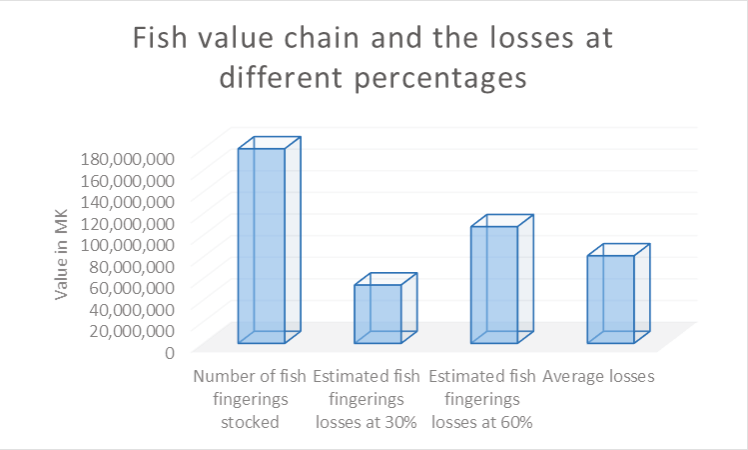
Challenges at market level:

The main factors for milk losses are the following;

The cooperative employs unhygienic practices when transporting fresh milk to the market. They utilize pails and buckets, which contribute to milk losses due to heat and bacterial contamination. Furthermore, fresh milk is sold in thin unsealed plastic sachets that lack hygiene standards and labelling. Such unhygienic practices make customers unwilling to buy fresh milk. The fresh milk losses are estimated at 50% and the balance is returned to the cooperative for processing into yoghurt (Chambiko/ sour milk). Addressing these issues, it was crucial for the cooperative to improve hygiene practices, minimize milk losses, expand market opportunities and work towards obtaining certification from Malawi Bureau of Standards as it was learnt that the farmers earned more from selling chambiko than fresh milk, the famers can concentrate their efforts on value addition to chambiko.

7.12. FISH VALUE

The cooperative has total membership of 98 shareholders (61 females & 61 males) out of which 37 are youth. The cooperative has 50 fish ponds ranging from 20 by 25 square meters to 25 by 50 square meters. Fish ponds were supported with grant from the Agricultural Commercialization (AGCOM) project. The fish ponds at a demonstration site are managed by individuals who have shares. As a cooperative they have not yet started collectively harvesting and selling fish. Each fish pond is stocked with an average of 3,000 Tilapia species. With this average fish stock capacity, the cooperative has the capacity to produce at least 30 metric tons of Tilapia species weighing about 200 grams each and selling at MK3000 per kilogram. The cooperative has not



started supplying fresh fish to the market but, individual farmers have been supplying fish to Mpamba Trading Center and Mzuzu City.

The cooperative is experiencing fish losses of about 30 to 60 percent losing an average of MK54,000,000 annually due to various challenges such as farmer access to quality fish feed and fish breeds.

Figure 10: Fish value chain losses

Challenges faced at the individual level in fish farming include:

1. Expensive imported feed: Farmers face difficulties in obtaining affordable and high-quality fish feed, which is often imported from Zambia. This leads to insufficient nutrition for the fish, resulting in stunted growth and losses. One possible solution is for the cooperative to produce fish feed locally and to increase their shares and apply to various institutions for grants that can support fish farmers, with farmers contributing a certain percentage.
2. Lack of aquaculture equipment: Farmers lack essential equipment such as fish harvesting nets, water quality testing kits, rulers, oxygen cylinders, and buckets. The use of buckets during harvesting leads to a loss of approximately 30 to 60% of fresh fish. The cooperative should consider purchasing these items, even though some may be expensive. Additionally, linking with development agencies that provide grants, where communities contribute a certain percentage, can be another solution.
3. Inadequate skills and knowledge: Farmers often lack the necessary skills and knowledge to effectively manage fish ponds. Overcrowding of fish in a single pond and inadequate feeding practices lead to competition for food, resulting in losses. Training farmers in proper aquaculture technologies is crucial to address this challenge and improve productivity.
4. Absence of refrigerated transportation: Once fish are harvested, there is a need for proper transportation with cooling facilities to maintain the freshness of the fish. Currently, the cooperative lacks a refrigerated van for this purpose. The cooperative should consider acquiring a transport system with cooling facilities to ensure the quality of the fish during transportation.
5. Predators and theft: Predators such as animals and even human beings pose a threat to fish pond farming. Fish are vulnerable to theft, which can result in significant losses. To mitigate this challenge, the cooperative should consider implementing preventive measures such as fencing or installing razor wire around the fish ponds to deter predators and protect against theft.
6. Water shortage during the dry season: The cooperative faces a shortage of water during the dry season, which negatively affects fish growth and increases fish mortality. The heat from the sun can have detrimental effects on the fish in such conditions. To address this challenge, the cooperative should explore water conservation techniques such as rainwater harvesting or implementing efficient irrigation systems to ensure a sustainable water supply for the ponds.

7. Flooding during the rainy season: Excessive rainfall and flooding during the rainy season can lead to the loss of fish in the ponds. As experienced in April 2022, mass loss of fish can occur due to flooding. Implementing proper drainage systems and maintaining the appropriate water levels in the ponds can help mitigate the impact of flooding and reduce fish losses.
8. Absence of integrated fish farming: Farmers resort to using chemical fertilizers to stimulate plankton growth in the ponds, which can be costly. Integrating fish farming with other agricultural practices such as utilizing organic fertilizers or adopting integrated aquaculture-agriculture systems can help reduce the dependency on expensive chemical fertilizers and promote a more sustainable and cost-effective approach to fish farming.

Addressing these challenges requires the cooperative's active involvement, exploring grant opportunities, providing training programs, and investing in necessary equipment, infrastructure proactive measures, such as implementing security measures to deter predators and theft, implementing water management strategies to ensure sufficient water supply throughout the year, and exploring sustainable and integrated farming practices to reduce reliance on costly inputs.

Predators and human theft pose significant challenges to fish pond farming for the cooperative. Predators, such as birds, otters, and other aquatic animals, can cause substantial damage to the fish population in the ponds. Additionally, human beings stealing fish from the ponds further exacerbates the problem.

The cooperative is confronted with a scarcity of water during the dry season, which poses challenges to fish farming. As the water level decreases, the intense heat from the sun adversely affects the growth of fish, resulting in a high mortality rate. Conversely, during the rainy season, ponds often experience flooding, leading to significant fish losses, as was observed in April 2022.

Figure 11: Onsite training of farmers during stocking of fish at Mpamba

Addressing the water shortage issue may require exploring water conservation methods, such as the installation of rainwater harvesting systems or the use of alternative water sources. Implementing proper pond management techniques and infrastructure, such as pond liners or water recirculation systems, can help mitigate the effects of both water scarcity and flooding. Currently, farmers rely on chemical fertilizers to stimulate plankton growth in the pond, which is crucial for fish nutrition. However, the cost of purchasing chemical fertilizers is high, posing a financial burden on the farmers.

To tackle the challenge of expensive chemical fertilizers, the cooperative can explore alternative organic or natural methods for enhancing plankton growth in the ponds. This may involve promoting the use of organic manure, composting, or biofertilizers, which can provide a more cost-effective and sustainable solution. Additionally, providing training and education to farmers on integrated fish farming techniques, including the use of natural fertilizers and the promotion of ecosystem balance in the ponds, can help reduce reliance on chemical inputs and enhance overall productivity in a more environmentally friendly manner.

One solution for tackling theft and predation is to install fences or use razor wire around the fish ponds. Fencing the ponds can create a physical barrier that deters predators from accessing the fish, reducing the risk of predation. Similarly, the presence of fences and razor wire acts as a deterrent to potential human thieves, making it more difficult for them to access and steal fish from the ponds.

Challenges at Cooperative level

Unavailability of fast breeding Tilapia Species is a big challenge. This is further complicated with poor management systems due to lack of knowledge and skills in raising fish fingerlings. There is need to start stocking same sex fingerlings to avoid overbreeding in each pond.

There is a lack of infrastructures like a building which could have a refrigerated or cooling facilities for storing fresh fish harvested by farmers. With this, cold chain fish losses would be minimized.

Climate change also poses a big challenge to fish farming. There is need for the cooperative to install some solar powered boreholes which should be supplying fresh water once the water levels drop down during winter period.

The cooperative does not have equipment like cooler boxes, oxygen cylinder which farmers can borrow when transporting and harvesting fish. There is also need for the cooperative to purchase its own cooler boxes, water testing kits, oxygen cylinders etc which farmers could be accessing for individual ponds. The cooperative does not have protective gear like gloves, sterilizing chemicals, gumboots, work suits to wear while feeding fish.

Challenges at Market level

The cooperative lacks a refrigerated van to carry the fresh fish to the markets. The cooperative lacks outlet markets where fresh fish could be sold. One of the solutions is to partner with reliable shops where they can be delivering their fish once they harvest for sale. A good example of reliable partner is Viphya Chambo Investment in Mzuzu who has a van and ability to bulk fish at Lusangazi in Mzuzu.

7.13. Chambo Horticulture Farmers Association

This is a new farmer organization which is in the process of registering into a cooperative with a total membership of 53 (shareholders). Each member already contributed MK10,000.00. As a cooperative they have not yet started collectively harvesting and selling horticulture produce. The members of the cooperative supply fresh food to Mzuzu through vendors/traders who come to buy. Some members sell through Ekwendeni Trading Center and other members supply to Mzuzu Markets. According to the respondents interviewed, the Cooperative has potential to supply horticultural produce of over 50 metric tons.

Challenges in the marketing of fresh foods in Mzuzu City and possible solutions

Input level challenges

- Expensive inputs: The high cost of inputs like hybrid F1 seeds poses a challenge for farmers. To address this, farmers can collectively contribute by increasing shares and adopting modern management practices, which can help reduce costs and improve efficiency.
- Seasonal water availability: The cultivated land becomes dry during winter and floods during the rainy season, affecting crop production. Farmers need to explore the use of modern irrigation technologies such as efficient water pumping systems and greenhouse technologies to mitigate the impact of water availability fluctuations.

Packaging and transportation challenges

- Inappropriate packaging materials: The use of baskets and pails for packaging contributes to food losses. Once the cooperative is registered and formalized, the group should invest in better packaging materials to ensure the protection and preservation of fresh produce during transportation.
- Poor transportation infrastructure: Bad roads and inadequate transport facilities make it challenging to transport fresh foods to the market. Improvement of road networks and access to reliable transportation can help minimize losses during transportation.

Storage and handling challenges

- Lack of proper storage facilities: Insufficient storage facilities lead to shorter shelf life for perishable crops. The group should invest in better storage facilities to prolong the shelf life of harvested crops.
- Inappropriate handling practices: Poor handling at the market stage such as mixing fresh tomatoes and cabbages with hardware merchandise on shop shelves contributes to food losses. Farmers should be trained on proper handling techniques to minimize damage and maintain the quality of their produce.

Market-related challenges

- Absence of grades and standards: The absence of grades and standards for fresh foods hampers the establishment of premium prices based on quality. Farmers should work towards implementing standardized grading systems to encourage the production of high-quality fresh foods and reward farmers accordingly.
- Inefficient local marketing: Lack of cooperation among farmers and collusion among traders and retailers result in inefficient local marketing. Encouraging collaboration among farmers, promoting fair market practices, and establishing stronger market linkages can improve marketing efficiency.

Addressing these challenges requires a collective effort from farmers, cooperatives, government agencies, and relevant stakeholders. By implementing appropriate solutions such as adopting modern agricultural technologies, improving infrastructure, enhancing packaging and storage facilities, and promoting standardized grading and fair market practices, the losses in the marketing of fresh foods can be minimized, ensuring better returns for farmers and improved availability of quality fresh produce in the market.

7.14. VALUE ADDITION METHODS FOR EACH VALUE CHAIN PRODUCT

The challenges faced in the fresh food value chains also present several opportunities for value addition that can benefit entrepreneurs and farmers. To tap into these opportunities and promote the development of viable farm businesses, the project should consider the following interventions that were suggested:

1. **Stakeholder collaboration**: Bring together various actors involved in the fresh food value chain to create a shared vision and mission. Engage both existing and new actors to foster collaboration, knowledge exchange, and cooperation among all stakeholders.
2. **Capacity building:** Implement capacity building activities that focus on empowering organized actors within the value chain. Provide training, technical assistance, and resources to enhance their skills, knowledge, and capabilities to sustainably support the development of the fresh food value chain.

3. **Value chain development:** Identify and promote specific interventions that can enhance the value chain. This may include activities such as improving production techniques, optimizing post-harvest handling and processing, exploring new market opportunities, and implementing quality assurance measures.
4. **Market linkages:** Facilitate connections between farmers and potential buyers, including retailers, processors, and distributors. Create platforms or networks that enable farmers to access wider markets, negotiate fair prices, and establish long-term partnerships.
5. **Innovation and technology adoption:** Encourage the adoption of innovative practices and technologies that can add value to fresh food products. This may involve promoting sustainable farming practices, exploring new packaging and processing techniques, and leveraging digital platforms for market information and online sales.
6. **Financing and investment:** Facilitate access to finance and investment opportunities for farmers and entrepreneurs involved in the fresh food value chain. This could involve partnerships with financial institutions, providing guidance on accessing grants and loans, and supporting the development of business plans and investment proposals.
7. **Policy advocacy:** Advocate for policies and regulations that support the growth and sustainability of the fresh food value chain. Engage with relevant government agencies and policymakers to address any barriers or bottlenecks and create an enabling environment for value chain development.

By implementing these interventions, the project can support the development of a vibrant and resilient fresh food value chain, creating opportunities for entrepreneurs, improving income generation for farmers, enhancing food security, and promoting sustainable agricultural practices.

Additional interventions proposed by FDG Participants to address the challenges in the fresh food value chains. These include:

1. **Formation and strengthening of farmer cooperatives:** Cooperatives can play a vital role in facilitating collective marketing of fresh foods and procuring inputs. By organizing farmers into cooperatives, they can pool resources, negotiate better prices, access market information, and collectively address common challenges. It is important to invest in the formation and capacity building of these cooperatives to ensure their effectiveness and sustainability.
2. **Strengthening existing horticultural clubs and associations:** Alongside cooperatives, horticultural clubs and associations should also be strengthened. These existing groups provide a platform for farmers to exchange knowledge, share experiences, and collectively work towards improving the value chain. Supporting these groups through training, technical assistance, and networking opportunities can enhance their capacity to address common issues and advocate for their members.
3. **Access to credit facilities:** Farmers and cooperatives often face challenges in accessing credit to invest in their businesses. There is a need to explore and facilitate access to credit facilities offered by organizations such as the National Economic Empowerment Fund (NEEF), Agricultural Commercialization (AGCOM), or other non-governmental organizations. Providing financial support can enable farmers to invest in infrastructure, equipment, improved seeds, and other inputs necessary for value chain development.

By implementing these proposed interventions, farmers and entrepreneurs in the fresh food value chains can benefit from improved collective marketing, increased access to inputs and credit, enhanced knowledge sharing, and stronger advocacy for their interests. These measures can

contribute to the growth, resilience, and sustainability of the fresh food value chains, ultimately benefiting both the producers and consumers.

STATISTICAL ANALYSIS:

7.14.1. LEAFY VEGETABLE LOSSES

According to the data presented in table 6 and figure 17, varying quantities of leafy vegetables were lost at different stages of the value chain, including harvest, post-harvest(storage), transportation, and before selling at the market. The losses incurred at the harvest stage were found to be higher compared to those at storage, transportation, and pre-market stages.

These findings indicate that a significant portion of leafy vegetables is lost immediately after harvest. This may be attributed to factors such as improper handling, inadequate storage facilities, unfavorable environmental conditions, and lack of appropriate harvest management practices. These losses highlight the need for attention and intervention to minimize wastage and improve the overall efficiency of the value chain.

Table 3: Leafy vegetables loss

Stage of food loss	Average amount of food loss (Kgs)	Standard Deviation	Standard Error	*P* value*
Harvest	14.47	82.07	4.62	
Post-harvest (Storage)	0.46	1.343	0.08	
Transportation	2.36	18.11	1.02	<0.0001
Market	2.16	18.35	1.03	

*Analysis of Variance (ANOVA)

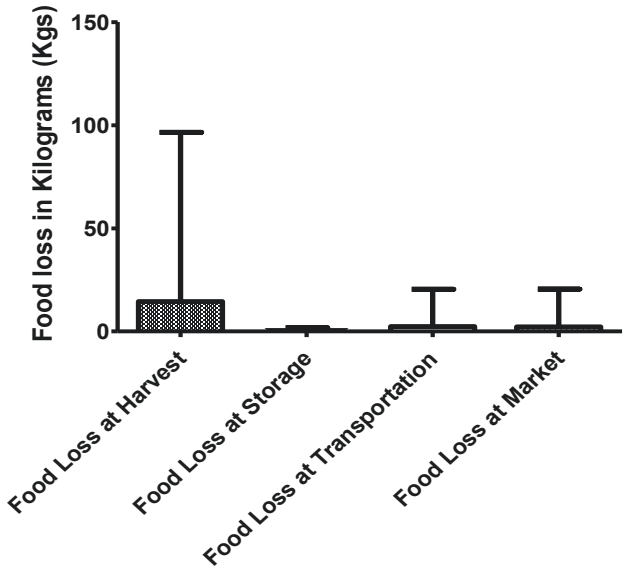


Figure 12: ANOVA analysis leafy vegetables loss

Table 4: Comparison of leafy vegetable losses

Stage of food loss	**1**	**2**	**3**	**4**
1 Harvest	-	*P* < 0.0001	*P* < 0.001	*P* < 0.001
2 Post harvest (Storage)		-	*P* > 0.05	*P* > 0.05
3 Transportation			-	*P* > 0.05
4 Market				-

P values are from Bonferoni paired comparisons test.

It is possible to reduce the losses and enhance the marketable quantity of leafy vegetables by implementing strategies and interventions to address the specific challenges observed at the harvest stage, such as improved handling techniques, proper storage facilities, and effective harvest management practices. This would have a positive impact on the economic viability of farmers, promote food security, and contribute to sustainable agricultural practices.

7.14.2. FRUIT VEGETABLE LOSSES

Based on the information provided, table 8 and figure 18 display the quantities of fruit vegetables lost at various stages of the value chain, including harvest, post-harvest, transportation, and before being sold at the market. Notably, the data reveals that the highest losses of fruit vegetables occur at the post-harvest stage compared to the losses during post-harvest/storage, transportation, and pre-market stages.

The higher losses at the harvest stage suggest that there are challenges and issues related to handling, storage, and overall harvest management of fruit vegetables. Factors such as improper harvesting techniques, inadequate storage facilities, inadequate temperature and humidity control, and lack of proper packaging contribute to these losses (table 9).

Table 5: Fruit vegetable losses

Stage of food loss	Average amount of food loss (Kgs)	Standard Deviation	Standard Error	P value*
Harvest	15.00	79.05	4.45	
Post-harvest (Storage)	3.61	25.03	1.41	
Transportation	2.05	8.44	0.47	<0.0001
Market	0.08	1.43	0.08	

*Analysis of Variance (ANOVA)

The variations in food losses confirm the findings at harvest stage where climatic factors such as rainfall, temperature, and humidity and drought had significant impact on time to harvest fresh farm produce which led to 47% losses in fruits and vegetables alone. In addition, interviews with

farmers revealed that crop varieties, type of pesticide and handling techniques contributed to fresh food losses at the harvest stage.

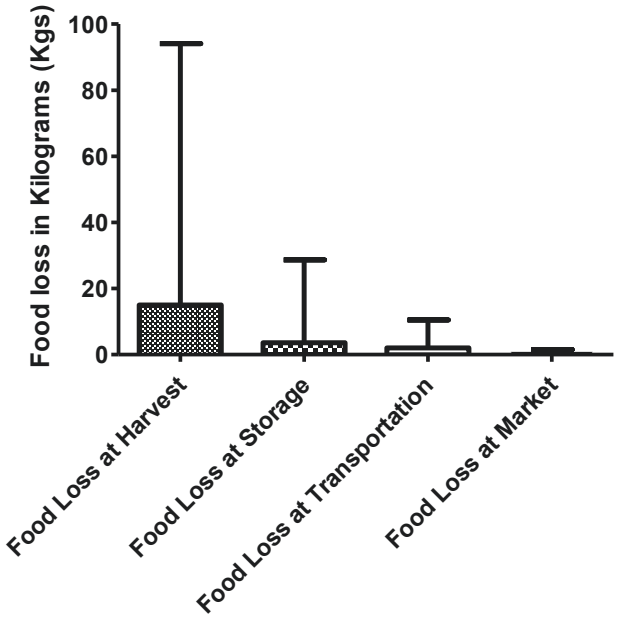


Figure 13: ANOVA analysis of fruit vegetable loss

Table 6: Comparison of fruit vegetable losses

Stage of food loss	1	2	3	4
1 Harvest	-	*P* < 0.001	*P* < 0.0001	*P* < 0.0001
2 Post-harvest (Storage)		-	*P* > 0.05	*P* > 0.05
3 Transportation			-	*P* > 0.05
4 Market				-

P values are from Bonferoni paired comparisons test.

Addressing the issues at the harvest stage is crucial to minimizing the losses of fruit vegetables. Implementing effective harvest practices, including proper harvesting methods, appropriate storage conditions, and suitable packaging, can significantly reduce losses and improve the quality and marketability of the produce. By investing in harvest infrastructure, providing training and resources to farmers and other actors in the value chain, and promoting good agricultural practices, it is possible to mitigate the losses of fruit vegetables and enhance the overall efficiency and profitability of the value chain.

7.14.3. POULTRY PRODUCTS LOSSES

Table 10 and figure 19 present data on poultry product losses at various levels of food handling. The results indicate that there were no significant differences in poultry product losses across different stages of the food handling process. This suggests that the losses of poultry products were relatively consistent throughout the value chain, including production, processing, storage, transportation, and retail. The lack of significant differences implies that challenges and factors leading to losses were not specific to any particular stage but rather affected the poultry products consistently at each level.

Table 7: Poultry food losses

Stage of food loss	Average amount of food loss (Kgs)	Standard Deviation	Standard Error	P value*
Harvest	1.09	13.41	0.75	
Post-harvest (Storage)	0.10	0.73	0.041	
Transportation	0.32	2.86	0.16	0.2833
Market	0.24	2.48	0.14	

*Analysis of Variance (ANOVA)

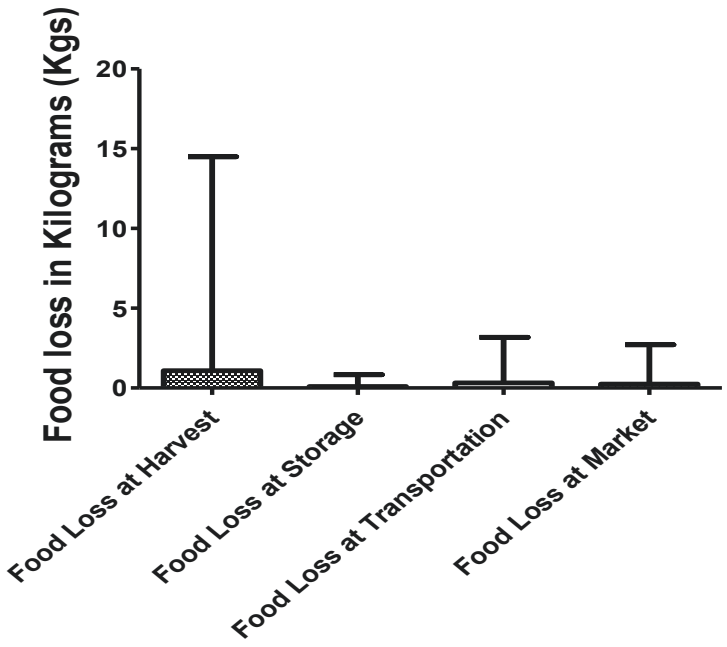


Figure 14:ANOVA analysis of poultry food loss

To effectively address poultry product losses, a holistic approach is required, focusing on improving practices and addressing challenges throughout the entire value chain. This may involve implementing measures such as improved biosecurity practices on farms, proper storage and refrigeration facilities, efficient transportation systems, and quality control measures during processing and retail. By adopting comprehensive strategies to reduce losses and improve the overall handling of poultry products, stakeholders in the value chain can enhance the quality, safety, and profitability of poultry products, resulting in a more sustainable and efficient poultry industry.

7.14.4. MILK AND MILK PRODUCTS FOOD LOSSES

The results in table 11 and figure 20 display data on milk and milk products losses at various levels of food handling. The results indicate that there were no significant differences in losses of milk and milk products across different stages of the food handling process.

This implies that the losses of milk and milk products were relatively consistent throughout the entire value chain, including production, processing, storage, transportation, and retail. The absence of significant differences suggests that challenges and factors contributing to losses were not specific to any particular stage but rather impacted milk and milk products consistently at each level.

Table 8: Milk and Milk product losses

Stage of food loss	Average amount of food loss (Kgs)	Standard Deviation	Standard Error	P value*
Harvest	0.37	1.92	0.11	
Post-harvest (storage)	0.40	4.35	0.24	
Transportation	0.17	2.03	0.11	0.1821
Market	0.00	0.00	0.00	

*Analysis of Variance (ANOVA)

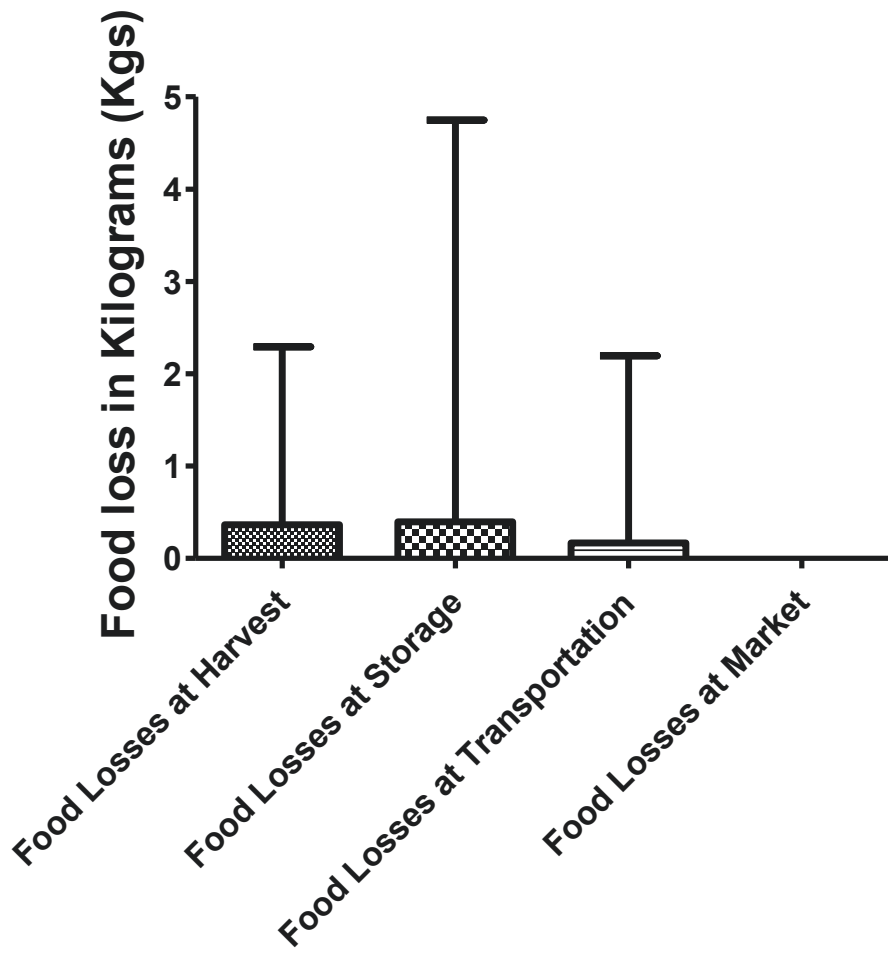


Figure 15: ANOVA analysis of milk and milk product losses

To effectively mitigate losses and enhance the handling of milk and milk products, a comprehensive approach is necessary. This may involve implementing measures such as improving hygiene practices during milking and processing, ensuring proper storage and refrigeration facilities, enhancing transportation logistics, and implementing quality control measures throughout the value chain. By adopting integrated strategies to minimize losses and improve the overall handling of milk and milk products, stakeholders in the value chain can enhance product quality, prolong shelf life, and reduce waste. This can lead to improved profitability for dairy farmers and processors while ensuring that consumers have access to high-quality and safe milk and milk products.

7.14.5. FISH LOSSES

The results in table 12 and figure 21 present data on fish product losses at various levels of food handling. The results indicate that there were no significant differences in losses of fish products across different stages of the food handling process. This suggests that the losses of fish products remained relatively consistent throughout the entire value chain, including harvesting, processing, storage, transportation, and retail. The absence of significant differences implies that challenges and factors contributing to losses were not specific to any particular stage but affected fish products consistently at each level.

Table 9: Fish losses

Stage of food loss	Average amount of food loss (Kgs)	Standard Deviation	Standard Error	P value*
Harvest	0.95	12.77	0.72	
Storage	0.00	0.00	0.00	
Transportation	0.00	0.00	0.00	0.1808
Market	0.08	1.43	0.08	

*Analysis of Variance (ANOVA)

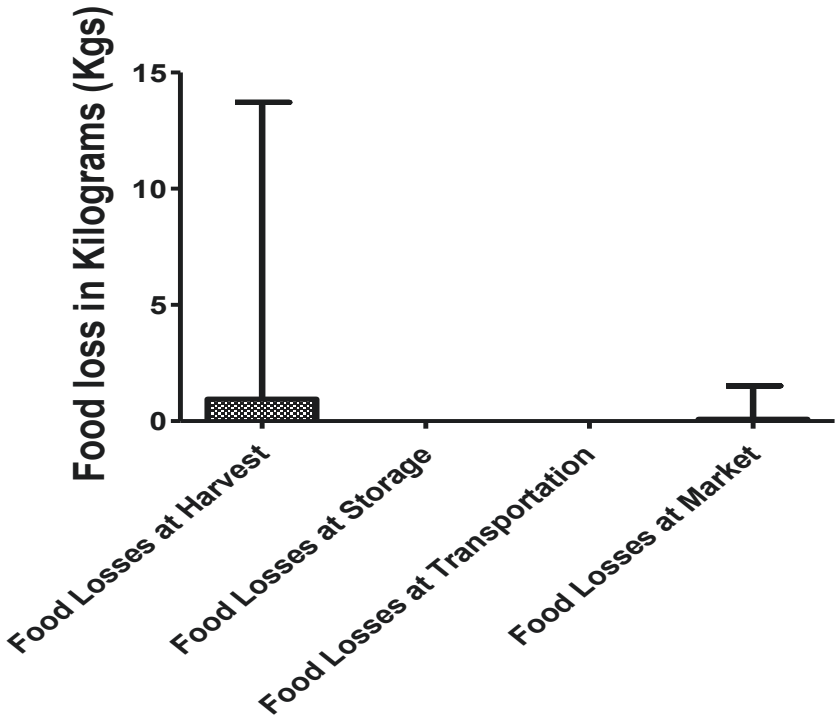


Figure 16: ANOVA analysis of Fish losses

To effectively address losses and improve the handling of fish products, a holistic approach is necessary. This may involve implementing measures such as proper handling and storage techniques during harvesting, ensuring adequate and hygienic processing facilities, improving transportation logistics to maintain product quality, and enhancing storage and refrigeration capabilities to prolong shelf life. By adopting comprehensive strategies to minimize losses and improve the overall handling of fish products, stakeholders in the value chain can enhance product quality, reduce waste, and ensure the availability of fresh and safe fish products for consumers. Additionally, investing in training and capacity-building programs for fish farmers and processors can contribute to better practices and increased efficiency throughout the value chain.

7.14.6. MEAT AND MEAT PRODUCTS FOOD LOSSES

Table 13 and figure 22 below present data on meat and meat product losses at various levels of food handling. The results indicate that there were no significant differences in losses of meat and meat products across different stages of the food handling process. This implies that the losses of meat and meat products remained relatively consistent throughout the entire value chain, including slaughter, processing, storage, transportation, and retail. The absence of significant differences suggests that challenges and factors contributing to losses were not specific to any particular stage but affected meat and meat products consistently at each level.

Table 10: Meat and meat products losses

Stage of food loss	Average amount of food loss (Kgs)	Standard Deviation	Standard Error	P value*
Harvest	0.75	12.70	0.71	
Storage	0.03	0.48	0.03	
Transportation	0.08	1.44	0.08	0.2923
Market	0.88	5.82	0.33	

*Analysis of Variance (ANOVA)

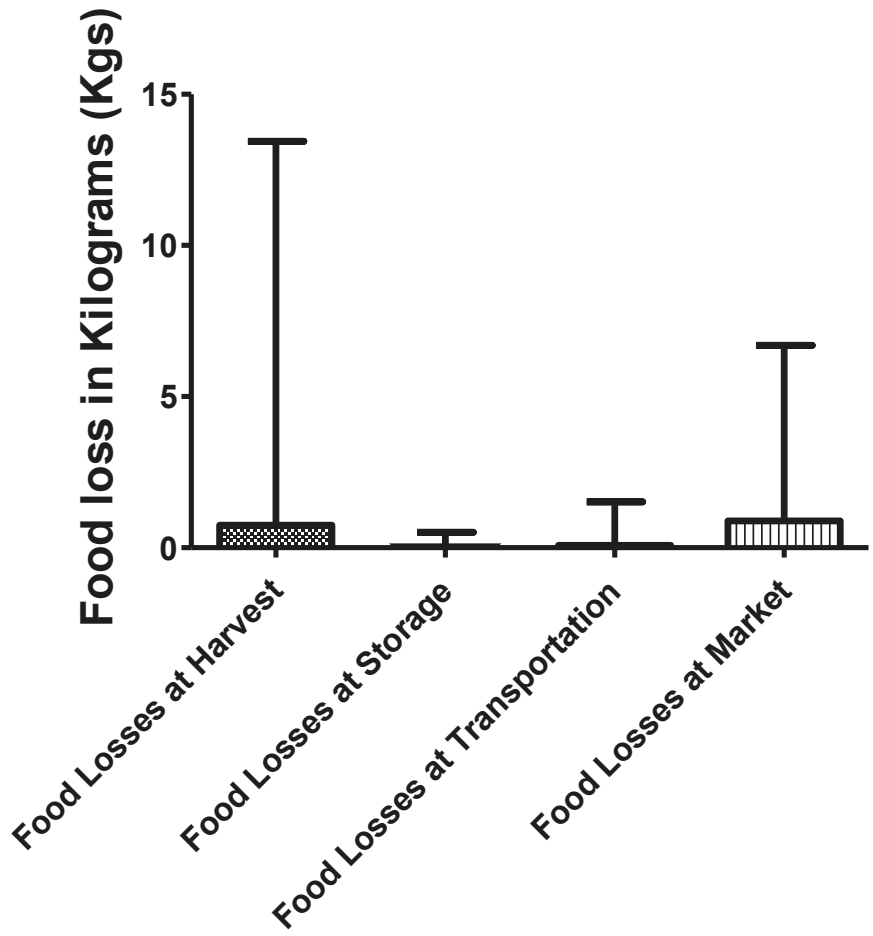


Figure 17: ANOVA analysis of meat and meat products losses

To effectively address losses and improve the handling of meat and meat products, a comprehensive approach is necessary. This may involve implementing measures such as proper handling and storage techniques during slaughter and processing, ensuring hygienic and controlled storage conditions, improving transportation logistics to maintain product quality, and enhancing packaging and labeling practices to minimize spoilage and extend shelf life. Furthermore, investing in training and capacity-building programs for meat producers, processors, and retailers can promote better practices and adherence to food safety standards throughout the value chain. Additionally, establishing regulatory frameworks and quality control systems can help monitor and enforce compliance with food safety guidelines, reducing the risk of contamination and spoilage. By adopting comprehensive strategies to minimize losses and improve the overall handling of meat and meat products, stakeholders in the value chain can enhance product quality, reduce waste, and ensure the availability of safe and nutritious meat products for consumers.

7.14.7. LEGUMES LOSSES

Table 14 and figure 23 display data on legume product losses at various levels of food handling. The results indicate that there were no significant differences in losses of legume products across different stages of the food handling process. This suggests that the losses of legume products remained relatively consistent throughout the entire value chain, including harvesting, post-harvest handling, storage, transportation, and retail. The absence of significant differences implies that challenges and factors contributing to losses were not specific to any particular stage but affected legume products consistently at each level.

Table 11: Legumes losses

Stage of food loss	Average amount of food loss (Kgs)	Standard Deviation	Standard Error	P value*
Harvest	1.08	6.43	0.36	
Storage	0.92	7.40	0.42	
Transportation	0.57	3.76	0.21	0.6475
Market	0.65	4.01	0.23	

*Analysis of Variance (ANOVA)

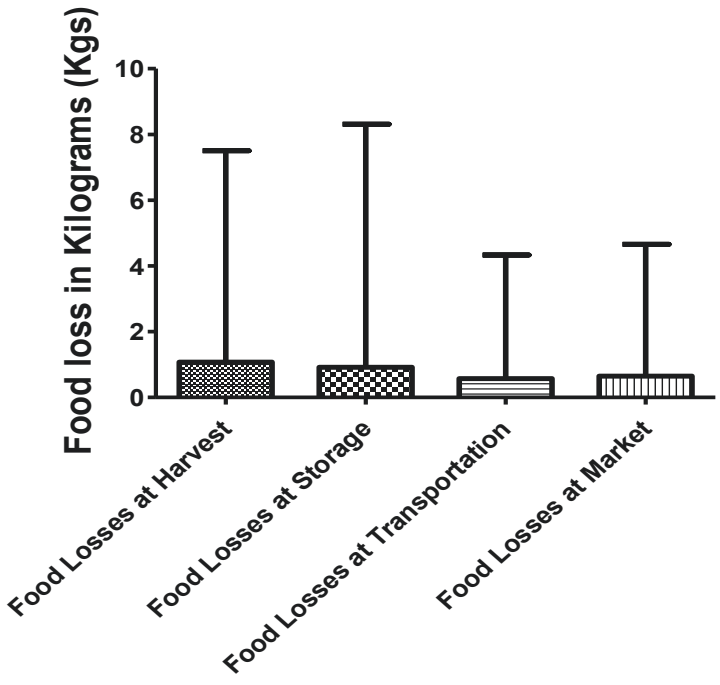


Figure 18: ANOVA analysis of Legume losses

To address losses and improve the handling of legume products, it is important to implement appropriate measures at each stage of the value chain. This may include adopting proper harvesting techniques to minimize damage and contamination, implementing effective post-harvest handling practices such as sorting and drying, ensuring suitable storage conditions to prevent spoilage and insect infestation, optimizing transportation logistics to minimize physical damage and maintain product quality, and improving packaging and labeling practices to extend shelf life and enhance marketability. Furthermore, providing training and education programs for farmers, processors, and traders on best practices for legume production, handling, and storage can contribute to reducing losses. Additionally, promoting the use of appropriate technologies and equipment, such as improved drying methods or hermetic storage solutions, can help mitigate losses caused by moisture, pests, and microbial growth.

7.14.8. ROOT TUBERS FOOD LOSSES

Similar to leaf and fruit vegetables, varying quantities of root tubers experienced losses at different stages, including post-harvest, storage, transportation, and prior to selling at the market. The details can be found in table 15 and figure 24. Specifically, the losses of root tubers were more pronounced during the post-harvest stage compared to storage, transportation, and pre-market stages, as indicated in table 16.

Table 12: Root and tuber food losses

Stage of food loss	Average amount of food loss (Kgs)	Standard Deviation	Standard Error	P value*
Harvest	16.43	65.45	3.68	
Storage	3.33	24.70	1.39	
Transportation	2.27	17.74	1.00	< 0.0001
Market	0.24	2.48	0.14	

*Analysis of Variance (ANOVA)

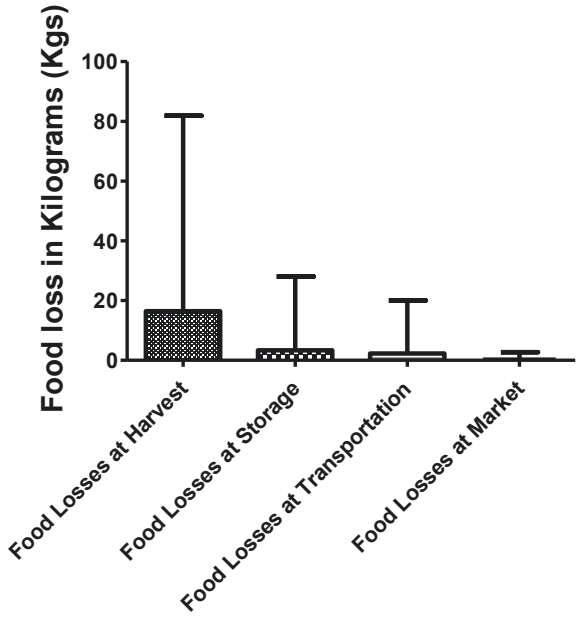


Figure 19:ANOVA analysis of root and tuber losses

Table 13: Comparison of root and tuber food losses

Stage of food loss	1	2	3	4
1 Harvest	-	$P < 0.0001$	$P < 0.0001$	$P < 0.0001$
2 Storage		-	$P > 0.05$	$P > 0.05$
3 Transportation			-	$P > 0.05$
4 Market				-

P values are from Bonferoni paired comparisons test.

7.14.9. OTHER FOOD LOSSES

Additionally, different amounts of other food products were lost at post-harvest, storage, transportation and before selling at the market. table 17 and Figure 25 show the details. In particular, the amount of other food products lost at post-harvest was more than that lost at storage, transportation, and before selling at the market (table 18).

Table 14: Other food products losses

Stage of food loss	Average amount of food loss (Kgs)	Standard Deviation	Standard Error	P value*
Harvest	9.22	43.40	2.44	
Storage	1.91	12.97	0.73	
Transportation	1.13	7.17	0.40	< 0.0001
Market	0.00	0.00	0.00	

*Analysis of Variance (ANOVA)

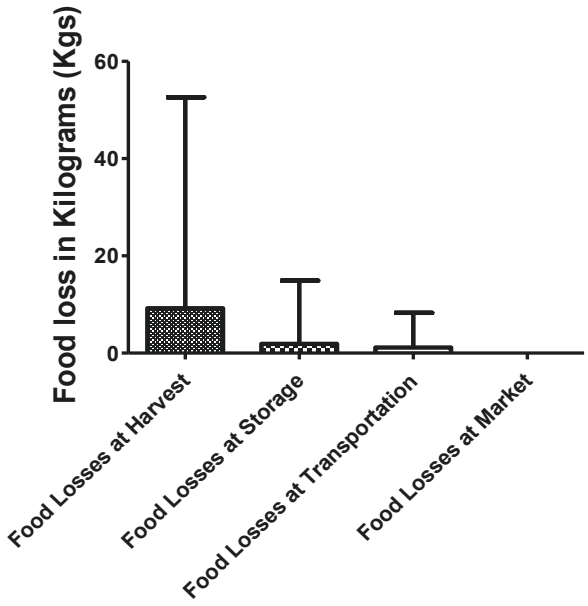


Figure 20: ANOVA analysis of losses

Table 15: Comparison of other food products losses

Stage of food loss	**1**	**2**	**3**	**4**
1 Harvest	-	*P* < 0.0001	*P* < 0.0001	*P* < 0.0001
2 Storage		-	*P* > 0.05	*P* > 0.05
3 Transportation			-	*P* > 0.05
4 Market				-

P values are from Bonferoni paired comparisons test.

The statistical analysis shows that food loss occurred at all stages of the value chain. Specifically, smaller amounts of food losses occurred in the food products such as poultry, milk and milk products, meat and meat products, and legumes. The losses were evenly distributed across the value chain. However, larger amounts were incurred in products such as leaf vegetables, fruit vegetables, root tubers, and other food products. The amounts of losses for these were not evenly distributed across the preceding four stages of the food chain. That is, relatively larger amounts were lost at harvest and post-harvest, than at transportation, and before selling at the market.

7.14.10. TOTAL FOOD LOSSES ACROSS THE CHAIN

To examine whether the loss amounts varied across different food product categories, a comparison was made between the distributions of food loss amounts for each category. The independent sample test, using one-way analysis of variance (ANOVA), was employed to compare the distributions, while the Bonferroni's Multiple Comparison Test was utilized to compare the distributions between pairs of food product categories.

Table 16: Average Food Losses along the value chain

	AVERAGE FOOD LOSSES			
PRODUCE	**HARVEST**	**STORAGE**	**TRANSPORTATION**	**MARKET**
Poultry	1.09	0.1	0.32	0.24
Fish	0.95	0	0	0.08
Leaf Vegetables	14.47	0.46	2.36	2.16
Milk and Milk Products	0.37	0.4	0.17	0
Meat and Meat Products	0.75	0.03	0.08	0.88
Fruit Vegetables	15	3.61	2.05	0.08
Legumes	1.08	0.92	0.57	0.65
Root And Tubers	16.43	3.33	2.27	0.24

The results revealed significant differences in the distributions of the loss amounts among the food product categories. Specifically, when compared to Poultry, Milk and Milk products, Fish, and Meat and meat products, higher levels of food losses were observed in the following categories: Fruit Vegetables, Leaf Vegetables, and Roots and Tubers. Furthermore, Fruit and Leaf vegetables exhibited greater losses compared to legumes. Additionally, Fruit Vegetables experienced more significant losses compared to other food categories. Lastly, a lower number of legumes was lost compared to Roots and Tubers. Further details can be found in tables 19, 20, 21 and figure 26.

Table 20: Distribution of food losses

Food Product	Mean	Standard deviation	Standard Error	**P value
Poultry	1.748	15.61	0.8782	
Milk and Milk products	0.9304	7.080	0.3983	
Fish	1.027	12.84	0.7224	
Meat and Meat products	1.750	15.39	0.8660	
Leaf Vegetables	23.66	97.13	5.464	<0.0001
Fruit Vegetables	30.40	103.3	5.812	
Legumes	3.215	12.57	0.7073	
Roots and Tubers	22.27	98.91	5.564	
Other	12.26	52.05	2.928	

**P value for one way analysis of variance (ANOVA)

Table 171: Mean differences of the pairwise comparisons

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1. Poultry	-	0.8180	0.7215	-0.001582	-21.91***	-28.65***	-1.467	-20.52***	-10.51
2. Milk and Milk products		-	-0.09652	-0.8196	-22.72***	-29.47***	-2.285	-21.34***	-11.33
3. Fish			-	-0.7231	-22.63***	-29.37***	-2.188	-21.24***	-11.24
4. Meat and Meat products				-	-21.91***	-28.65***	-1.465	-20.52***	-10.51
5. Leaf Vegetables					-	-6.741	20.44***	1.389	11.39
6. Fruit Vegetables						-	27.18***	8.130	18.13**
7. Legumes							-	-19.05**	-9.047
8. Roots and Tubers								-	10.00
9. Other									-

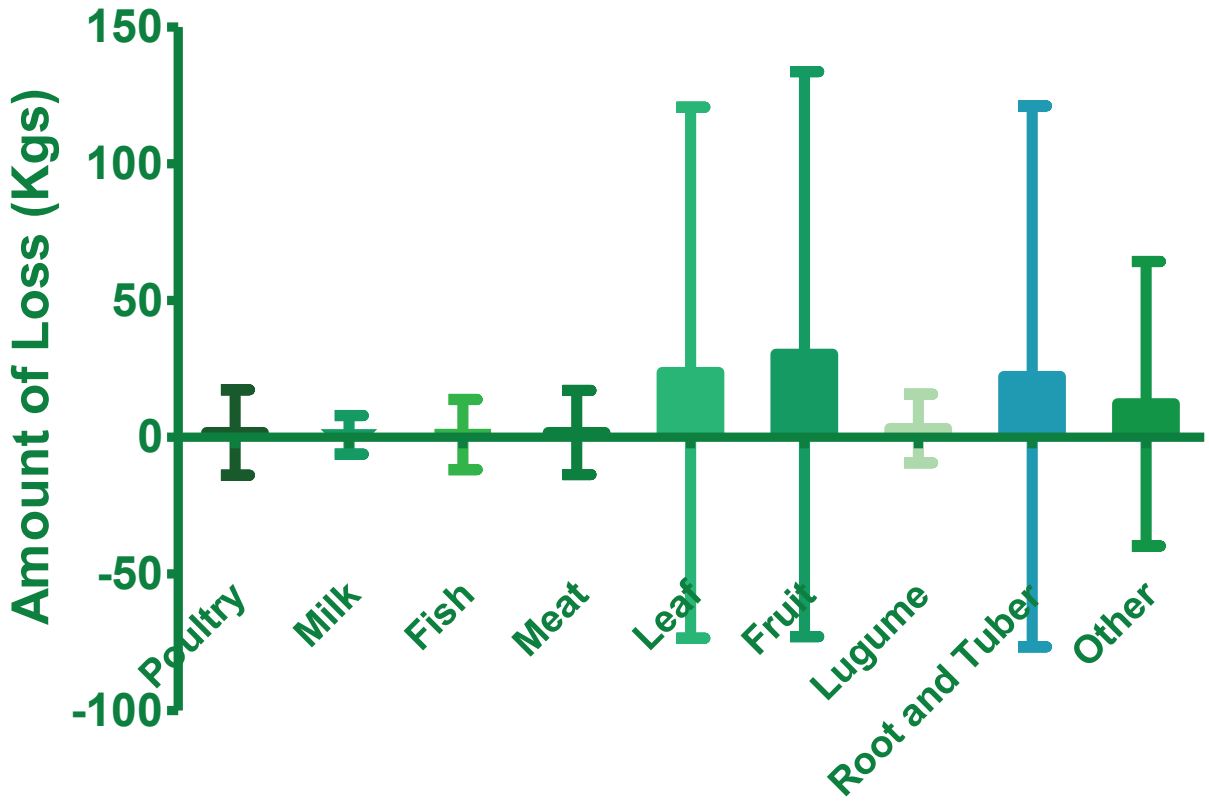


Figure 21: Distribution of food losses across the food product categories

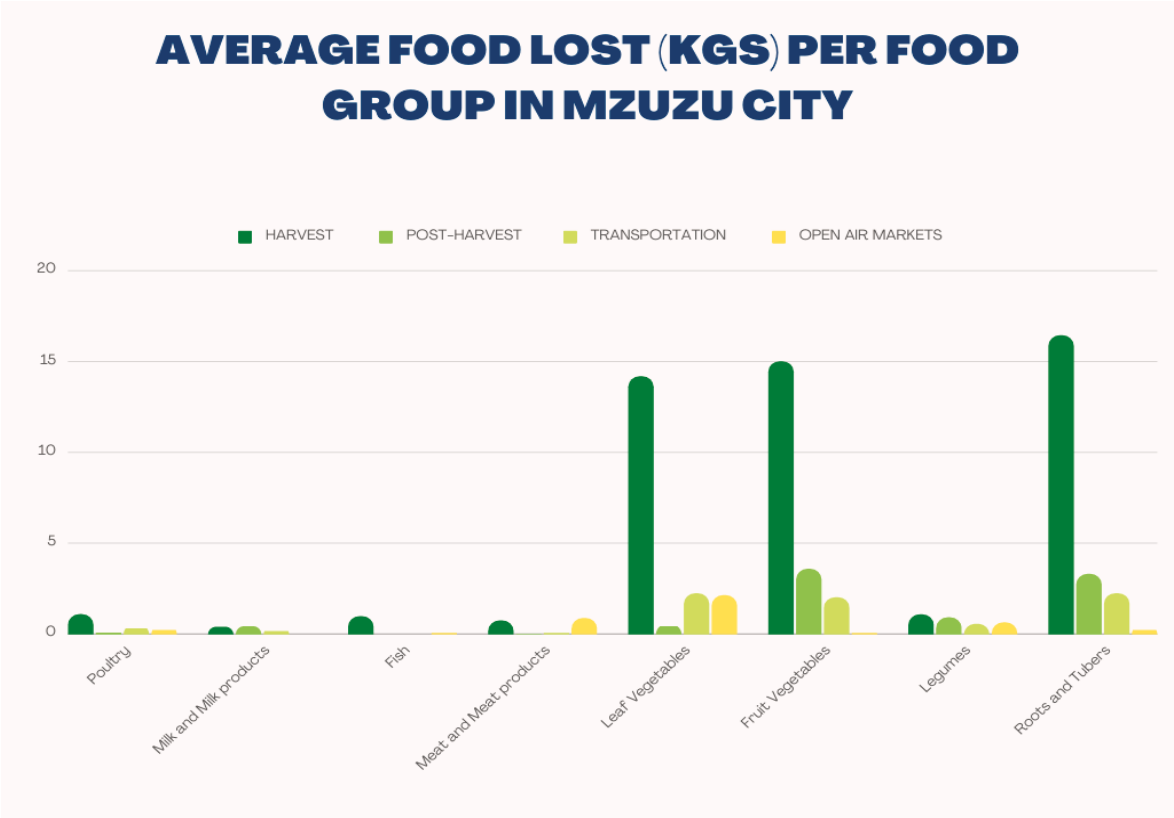


Figure 27: Average food losses in Mzuzu City

7.14.11. NUTRITIONAL LOSSES

The project conducted a nutritional analysis of two food items (tomatoes and fish), to assess the nutritional loss associated with these products. Tomatoes were chosen as a representative fruit vegetable due to their high food loss rates within the fresh food category. Fresh fish was selected because it is known to experience significant post-harvest losses along the value chain (22.25%). Additionally, fish is recognized as an important source of nutrition, contributing to food security and poverty alleviation in the country. The nutritional analysis focused on specific nutrients for each food item. For tomatoes, the study considered Vitamin A (RAE), Energy, Vitamin C, and Iron. These nutrients are commonly lacking in the Malawian diet, especially among children under the age of five, contributing to protein-energy malnutrition, which remains a concern in Malawi. According to the standardized Malawian Food Composition Table provided by the Government of Malawi (2019), the quantities per 100 grams of fruit vegetables (tomatoes) are as follows: Vitamin A (RAE) = 42 mcg, Energy = 26 Kcalories, Vitamin C = 14 mg, and Iron = 8.7 mg.

For fish (tilapia), the analysis focused on Energy, Protein, and Calcium. These nutrients were selected based on their importance and contribution to addressing nutritional deficiencies in the Malawian population. The nutritional values per 100 grams of fish (tilapia) are as follows: Energy = 95 Kcalories, Protein = 10.7 g, and Calcium = 110 mg.

To assess the nutritional loss for each nutrient, denoted as NL_i in this study, the calculations were performed using the provided nutritional values.

$$NL_i = \left(\frac{T}{100}\right) \times FC_i$$

Where, *T* is the total amount of concerned food lost (in grams) across the four stages of food handling, and FC_i is the amount of nutrient *i* per 100 grams. Using this formula, we computed the following nutritional losses.

Table 182: Total nutrient loss of Fish

Food Category	Vitamin A (RAE)	Energy	Vitamin C	Iron	Protein	Calcium
Chambo	-	308,275 Kcalories	-	-	34721.5 g	356,950 mg

Table 23: Tomato Nutrition loss along the value chain

		Total Nutritional Loss		
Stage of Food Loss	**Total Loss in Grams**	**Vitamin A (RAE) in mcg**	**Vitamin C in mg**	**Potassium in mg**
Harvest	4,739,500	1,990,590	663,530	11,232,615
Post-Harvest (Storage)	1,141,500	479,430	159,810	2,705,355
Transportation	648,000	272,160	90,720	1,535,760
Market	25,500	10,710	3,570	60,435
GRAND TOTAL	**6,554,500**	**2,752,890**	**917,630**	**15,534,165**

Fresh foods such as fruit vegetables and fish contribute a lot to Malawian food security and contain vitamins, minerals and other chemicals that the body needs to stay healthy. Fruits vegetables such as tomatoes are among the most perishable food groups and more at risk of food and nutritional loss.

Nutrient loss in fresh food accelerates if they are mishandled or exposed to elements such as heat and light during storage. Findings for the two fresh foods as shown in table 22 and 23, revealed that tomato (major fruit vegetable) lost substantial amount of nutrients like potassium (15,534grams), vitamin A (2,752.89 grams), , vitamin C (917.63 grams) along the tomato value chain. Furthermore, different amounts of tomatoes were lost at harvest, storage, transportation and before selling at the market (table 23). Most nutritional losses occurred at harvest followed by storage, transportation lastly market before selling. At each stage and overall, potassium was the most nutrient lost followed by vitamin A (RAE) then vitamin C. As already alluded to above, fish has vital nutritional benefits such as protein and minerals. Therefore, fish has a significant impact on food and nutrition security in Malawi. The findings in this study have shown that fresh fish losses major nutrients such as proteins, energy and calcium. Post-harvest loss of fish is caused by a number of factors: poor handling practices, processing methods that expose fish to contaminants and long periods of exposure to high temperatures, lack of storage facilities and poor transportation. Results from survey revealed the following as major factors leading to nutritional losses: Overstaying of produce on shelves (43.3%), exposure to sunlight (45.9%), Bruising (28.3%),

Rotting (60.7%) and drying (22.3%). Measures to mitigate nutritional losses include proper handling of produce (37.5%), protect produce from sunlight (30.2%), Use of proper storage facilities (14.2%), and preservation of produce (11.7%).

7.14.12. ECONOMIC LOSS

We also calculated economic losses in relation to the food losses reported for the six fresh foods. In this regard, economic loss for food category j was denoted by ECL_j and was defined as follows.

$$ECL_j = T_j \times P_j$$

Where T_j is the total amount of food lost (in kilograms) for the food category j across the food handling stages, and P_j is the best market price per kilogram for the food category j. The Table 24 below gives a summary of current best market prices per kilogram for the considered food categories.

Table 24: Best Current Market Prices for fresh foods

Food category	MK per kilogram (kg)
Poultry	1,995
Fish (tilapia)	5,000
Meat	4,500
Leafy vegetable	500
Fruit vegetable (Tomato)	800
Root tubers (Irish potato)	550

MK=Malawi Kwacha.

Thus, using the above information, the economic losses in Table 23 were estimated.

Table 25: Total economic loss of fresh foods

Food category	Total economic loss (in MK)

Poultry	1,102,237.50
Fish (tilapia)	1,622,500.00
Meat	2,488,500.00
Leafy vegetable	3,737,500.00
Fruit vegetable (Tomato)	7,684,000.00
Root tubers (Irish potato)	3,869,800.00
Total economic loss (in MK)	**20,504,537.50**

MK=Malawi Kwacha.

The economic losses incurred for six food categories, namely poultry, fish (tilapia), meat, leafy vegetables, fruit vegetables (tomato), and root tubers (Irish potato), amounted to MK20,504,537.50. Among these categories, fruit vegetables (tomato) accounted for approximately 37.5% of the total economic losses, while root tubers accounted for around 18.9%. Leafy vegetables accounted for about 18.2% of the losses, meat accounted for approximately 12.1%, fish (tilapia) accounted for about 7.9%, and poultry accounted for around 5.4%. Figure 28 provides a visual representation of this information.

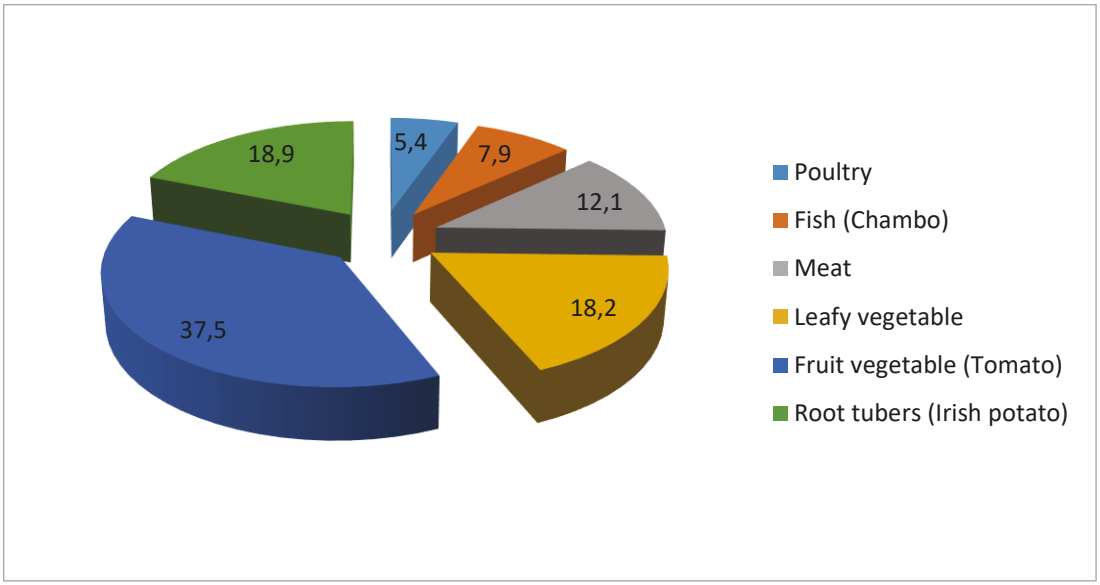


Figure 28: Proportion of economic loss

These findings shed light on the occurrence of substantial physical and quality losses at each stage of the food chain, leading to economic losses.

The results of this study provide valuable insights into the dynamics of the fresh food value chain, including the identification of specific areas where losses occur. By understanding these loss hotspots, practical interventions can be developed to mitigate the nutritional and economic losses associated with fresh foods. This information serves as a foundation for

implementing effective strategies to address the challenges and improve the overall efficiency of the fresh food value chain.

7 Impacts

7.1 Scientific impacts – now and in 5 years

(i) The project has employed scientific research methods to generate valuable data, which is being shared with stakeholders for broader utilization. This data has started contributing to a better understanding of fresh food losses along the urban fresh food value chain in Mzuzu and can inform evidence-based decision-making and interventions.

(ii) This study is the first of its kind to focus on fresh food losses along the urban fresh food value chain in Mzuzu City by engaging the stakeholders. It has served as a foundation for future studies and data collection efforts in this area. It is expected that subsequent studies will build upon the findings and insights gained from this study.

(iii) Through practical trials, the project has developed innovative approaches that have the potential to significantly reduce food losses in urban agri-food chains. By bridging the gap between research and food loss reduction, the project has paved the way for the direct application of research findings to real-world solutions.

(iv) A map has been created to illustrate the flow of food within Mzuzu City and its surrounding areas. This map provides a visual representation of how food moves through the city, aiding in the identification of potential areas for improvement and targeted interventions (Annex 3).

(v) The study analysed and mainstreamed gender and the youth in fresh food value chains and food and nutrition loss in Mzuzu City. This aspect of the study sheds light on the gender and youth dynamics within the value chain and their influence on food and nutrition loss. By understanding these relationships, it becomes possible to develop more inclusive and gender-responsive strategies to address food loss and improve overall food security.

7.2 Capacity impacts – now and in 5 years

a) The project took a transdisciplinary approach and leveraged the participation of different skill sets from the stakeholders and actors. Research activities and trialing exercises undertaken provided a platform for mutual capacity building among the stakeholders who included the Government of Malawi (GoM), Mzuzu City Council (MCC), Small and Media Enterprise Development Institute (SMEDI), Malawi Bureau of Standards (MBS), and the Department of Road Traffic. It being a regional project, a lot of cross learning activities such as workshops, site visits and stakeholder engagements and workshops were facilitated. Findings and lessons learnt have been used to strengthen food governance and analysis of food loss within and among the different actors particularly at the municipal level. The capacity that has been built and close synergies developed with key institutions such as the Department of Fisheries, Mzuzu Agricultural Development Division (ADD), and Mzuzu City Council is crucial for ensuring actions and lessons learnt can be institutionalized and adopted in food governance practices in Mzuzu but also at national level.

7.3 The project has further supported two master's students to further their studies in Food systems and GIS, and Urban Planning and Climate Change. It is anticipated that further capacity will be developed through these interactions and processes.

7.4 Community impacts – now and in 5 years

7.1.1 Economic impacts

The project has a significant impact on the value chain actors, particularly smallholder farmers, by helping them increase their production and productivity. Through interventions aimed at reducing food losses, farmers can save more of their produce, resulting in increased profit margins. By minimizing losses along the value chain, more revenue can be generated from the sale of fresh foods.

In the case of the fish value chain, the project's efforts to support farmers in producing their own feed has had a positive impact. By training the farmers to produce their own feed, fish farmers have drastically reduced input costs and increased their profitability. This aspect of self-sufficiency in feed production and management has contributed to the overall economic viability and sustainability of the fish value chain.

The reduction in food losses and improved profitability for small-holder farmers ultimately will lead to increased availability of fresh foods for consumers. With higher production and improved supply chain efficiency, consumers will access a greater variety of fresh foods at affordable prices. This not only enhances food security but also contributes to improved nutrition and overall well-being of the local population.

Overall, the project's focus on reducing food losses, increasing productivity, and improving value chain efficiency has the potential to positively impact the profit margins of smallholder farmers and ensure a steady supply of fresh foods for consumers in the region.

7.1.1 Social impacts

The project has made significant strides in promoting inclusiveness in the governance of markets and the management of processes along the value chain. By actively involving stakeholders from both the Mzuzu City Council staff, women market committee and the traders operating in the markets, the project has created a platform for dialogue and collaboration, hitherto far-fetched.

The participation of Mzuzu City CEO, Council staff, Councillors and market traders in workshops and discussions has facilitated a more inclusive decision-making process. It has provided an opportunity for these stakeholders to voice their perspectives, concerns, and suggestions, ensuring that their voices are heard in matters related to market governance and value chain management.

Furthermore, the project has sparked conversations on the role of various actors within the food system, such as food agents, women, and youth, particularly within the markets. These discussions have contributed to a better understanding of the unique challenges and opportunities faced by these actors and open avenues for addressing their specific needs.

By fostering inclusiveness in market governance and value chain management, the project has laid the foundation for collaborative and participatory approaches that can lead to more effective and sustainable solutions. It has promoted the involvement of diverse stakeholders, creating a sense of ownership and shared responsibility in the development and management of the food system in Mzuzu.

7.1.1 Environmental impacts

The project is expected to have positive environmental impacts, which are outlined as follows:

Reduction of food losses: By providing training and exposure to the stakeholders, the project aimed at reducing food losses along the value chain. This reduction in food losses will result in less disposal of wasted food, thereby minimizing the environmental impact associated with food waste. When less food is lost, fewer resources such as water, energy, and land are wasted in the production and distribution of food that ultimately goes to waste.

Improved food handling: The project emphasized the importance of improved food handling practices to minimize food losses. Proper handling will prevent food spoilage and contamination, reducing the need for disposal and the release of harmful substances into the environment.

The project has already contributed to an improved understanding among stakeholders regarding the connection between food loss and the environment. This increased awareness fosters a holistic perspective on the environmental implications of food loss, encouraging stakeholders to take proactive measures in addressing the issue. By recognizing the environmental consequences of food loss, stakeholders will make informed decisions and implement sustainable practices to minimize waste and its impact on the environment.

7.5 Communication and dissemination activities

The project utilized various engagement activities to disseminate information and foster collaboration. These activities included:

Focus Group Discussions (FGDs): Seven FGDs were conducted to gather insights and perspectives from different stakeholders. FGDs provided an interactive platform for participants to share their knowledge, experiences, and ideas.

Stakeholder Workshops: Several workshops were organized to bring together stakeholders from various sectors involved in the urban agri-food value chain. These workshops served as forums for discussion, knowledge sharing, and collaborative problem-solving.

Engagement with Mzuzu City Council elected officials and staff: Meetings and workshop led to the adoption of gender as a key issue in market governance. The Mzuzu City Council agreed to the need to mainstream gender not just in the market by-laws but also in all city by-laws.

Key Informant Interactions: Approximately over 20 key informants were engaged in one-on-one interactions. These individuals possessed specialized knowledge and expertise relevant to the project and were consulted to gather valuable insights and information.

Social Media Engagement: Information about the project was shared through Twitter posts by the handle @MalawiUrac. Social media platforms provided a means to reach a wider audience, disseminated updates, and engaged with stakeholders in real-time.

Media Coverage: The inception workshop of the project was reported by the media, as evidenced by the article available at www.times.mw/malawi-zambia-in-food-security-initiative/. Media coverage helped raise awareness about the project and its objectives among a broader audience.

Project Website: Additional information about the project can be accessed on the website www.uracmalawi.org. The website serves as a central platform to provide project updates, resources, and related information.

Through these engagement activities, the project aimed to create dialogue, foster collaboration, and disseminate information to a diverse range of stakeholders. By utilizing both traditional and digital communication channels, the project ensured that information reached various audiences and facilitated their participation in the initiative

8 Conclusions and recommendations

8.1 Conclusions

The analysis of the study results highlights both technical and process-oriented challenges, as well as institutional governance issues and gender disparities. The following key challenges were identified:

- Process Challenges: Poor and inappropriate food handling methods, lack of storage facilities, and inadequate food shelters at farms and markets were identified as contributing factors to food loss. These challenges need to be addressed to ensure proper handling and preservation of fresh foods.
- Gender and Social Relationships: Gender disparities were observed, particularly in the lack of social facilities and sanitation services at markets, which disproportionately affect women who struggle to navigate these social complexities. Gender-responsive interventions are needed to address these challenges and create a more inclusive and supportive market environment.
- Institutional Governance Challenges: Weak market regulatory frameworks, non-representativeness of market governance structures, administrative and managerial under-capacity of the City Council, and the lack of interactive fora between market users and city governance institutions were identified as institutional governance challenges. These issues need to be addressed to improve market governance and ensure effective coordination and decision-making.
- Role of Food Agents: The role of food agents was not widespread. However, the study highlighted the lack of transparency and manipulative practices by food agents in the value chains, which disadvantages smallholder farmers and traders. Addressing these issues requires appropriate regulatory mechanisms and transparency in the market processes.

Based on these findings, several interventions were implemented, including:

- Improving market governance through the development of stronger regulatory frameworks and the establishment of representative governance structures in markets.
- Enhancing linkages along the market chain to ensure adequate support for fresh food value chain actors, with a focus on value addition and marketing services, more specifically for fish, tomato and dairy farmers and traders.
- Improving gender relations by reviewing market by-laws to incorporate women in market committees and by establishing Mzuzu City Market women committee which can leverage further support in form of credit and training targeted at women..

By addressing these challenges and implementing the proposed interventions, it is expected that the fresh food marketing sector in Mzuzu City can be developed, leading to increased productivity, reduced food losses, and improved satisfaction of the demand for fresh foods.

8.2 Recommendations

The study has provided several recommendations to reduce food and nutrition losses along the value chain. These recommendations are as follows:

Recommendation 1: Develop coordinated fresh food marketing by establishing wholesale markets with storage facilities in strategic locations. This will allow farmers to sell their produce through wholesale markets rather than at the farm gate, reducing transaction costs and improving market efficiency.

Recommendation 2: Seek solutions to food and nutrition losses through partnerships with other development partners. Engage with relevant actors and stakeholders to collaborate on interventions and trials, as demonstrated by the successful fish feed trial with Kamuzu View Cooperatives. Expand such interventions to benefit a wider range of fish farmers in Malawi.

Recommendation 3: Continue the gradual approach of exploring and learning innovations together with farmers and value chain actors. The project has shown initial economic and social benefits with manageable risks. Open the positive outcomes and messages from project interventions to surrounding cities that did not directly participate. Explore additional income and value-adding opportunities using modern processing machines.

Recommendation 4: Enhance capacity building for women in market governance and decision-making processes. Despite mainstreaming gender issues in market governance, further capacity building is needed to ensure full representation and active participation of women in fresh food trading.

Recommendation 5: Provide support for the entire milk value chain, from input suppliers to farmers, processors, and the market. This includes providing proper packaging materials, product certification, and entrepreneurship capacity building. Address challenges related to meeting Malawi Bureau of Standards (MBS) specifications and guide farmers in navigating the market.

Recommendation 6: Design a transition from the research project to a full-scale development program. Scale up successful interventions and establish relationships with the Government of Malawi (GoM) and private sector to ensure support for the beneficiary population. Work closely with fresh food value chain actors to sustain and further develop activities, capacity building, and problem-solving initiatives introduced during the research project. It is crucial to avoid a void in activities after the closure of the research project, as it could jeopardize the sustainability of the positive project outcomes.

9 References

9.1 References cited in report

Aika O. Aku. (2017), *Influence of farmer organizations as a market information system on market access and income of smallholder vegetable farmers in Babati district,* Tanzania. Egerton University. Retrieved from https://pdfs.semanticscholar.org/c052/ac13cbbc744fb8b9ae0de350890f95d50a02.pdf

Al-Hassan Ramatu, Sarpong Daniel & Mensah-Bonsu Akwasi. (2019), *Linking smallholders to markets*. Retrieved from https://ideas.repec.org/p/fpr/gsspwp/1.html

Ashby, J., Heinrich, G., Burpee, G., Remington, T., Ferris, S., Wilson, K., & Quiros, C. (2011), Preparing groups of poor farmers for market engagement: Five key skill sets. In: A. Bationo, B. Waswa, J. M. Okeyo, F. Maina & J. M. Kihara (Eds.), *Innovations as key to the Green Revolution in Africa:* Exploring the scientific facts (Vol. 1, Part I, pp. 103–111). Dordrecht, Heidelberg, London, New York, NY: Springer.

Bamber, P., Fernandez-Stark, K., Gereffi, G. & Guinn, A. (2013). *Connecting local producers in developing countries to regional and global value chains-update.* OECD Trade Policy Paper No. 160. Retrieved from: http://www.cggc.duke.edu/p

Bamber, Penny. Fernandez-Stark Karina, Gary Gereffi and Guin Andrew. (2014), "Connecting Local Producers in Developing Countries to Regional and Global Value Chains: *Update", OECD Trade Policy Papers*, No. 160, OECD Publishing, Paris. Retrieved from *https://www.oecd-ilibrary.org/connecting-local-producers-in-developing-cou...*

Correia Vicente de Paulo. (2014), *Analysis of Linking Farmers to Markets for Carrots, Cabbages and Snow Peas in Aileu Vila, Maubisse and Hatubuilico, Timor Leste*, School of Management, Curtin University pp 19-30.

Department of Agricultural Extension Services (2015), *Draft Agribusiness Strategy for promoting farmer organizations integrations and partnerships with agribusiness players in Malawi for 2016-2021*, Lilongwe, Malawi.

Fischer Elisabeth & Qaim Matin (2012), Linking Smallholders to Markets: *Determinants and Impacts of Farmer Collective Action in Kenya*, doi:10.1016/j.worlddev.2011.11.018

Government of Malawi (2019), Malawian Food Composition Table, Lilongwe.

Haggblade, S., Theriault, V., Staatz, J., Dembele, N., & Boubacar, D. (2012*). A conceptual framework for promoting inclusive agricultural value chains*. Retrieved from: http://fsg.afre.msu.edu/IFAD-WA/conceptual_framework.pdf.

Kothari, C. R. (2004). *Research Methodology: Methods and Techniques* (2nd Edition). New Age International, New Delhi, India. P. 256.

KPMG, (2013). *The agricultural and food value chain: Entering a new era of cooperation*. Retrieved from: http://www.kpmg.com/US/en/IssuesAndInsights/ArticlesPublications/Documents/agricultural-food-value-chain-report.pdf.

Kristen Lowitt, Gordon M. Hickey, Wayne Ganpat and Leroy Phillip. (2015). *Linking Communities of Practice with Value Chain Development in Smallholder Farming Systems*; World Development Vol. 74, pp. 363–373, 2015, 0305-750X/_ 2015 The Authors. Published by Elsevier Ltd.

Makuwira Jonathan, (2018) *Power and development in practice*: NGOs and the development agenda setting, Development in Practice, 28:3, 422-431, DOI: 10.1080/09614524.2018.1433816

9.2 List of publications produced by project

The project documents are found on the drive here:

https://drive.google.com/drive/folders/1m26r0K45Gyo_nvOFeiUSpSB7PbqQ2NvH

The following papers are being drafted and will be submitted to journals for publications:

(a) Urban Fresh Food Value Chain Analysis: Case of Milk Fish and Tomatoes in Mzuzu City, Malawi.'

(b) 'Nutrition loss in fresh foods along the value chain in Mzuzu City, Malawi'

(c) 'Spatial Distribution of Fresh Foods Supplied to Mzuzu City, Malawi.'

(d) Market Governance and gender relations in Mzuzu City, Malawi

(e) The impact on pond fish growth of different feeding methods: Case of Mpamba Co-Operative

(f) Working paper on Food and Nutrition Loss along the value chain in Mzuzu City, Malawi

The following success story briefs have been accomplished. These briefs will be expanded into three full academic papers:

(a) Fish Feed trialing and its impact on *Tilapia spp*. Growth

(b) Tomato Jam Processing by Market Women in Mzuzu City, Malawi

(c) Mainstreaming Gender in Market Governance in Mzuzu City

10 Appendixes

10.1 Appendix 1: Data Base

Data Base File.zip

10.2 Appendix 1: Study Instruments-Questionnaire

DATA COLLECTION TOOLS.rar

10.3 Appendix 3: Results Summary-PPT

Africities-Food Loss Mzuzu Results 16March2022-Chatonda-EDITED.zip

10.4 Appendix 4: Reports on FGDs

FGD Reports.zip

10.5 Appendix 5 : Study Maps

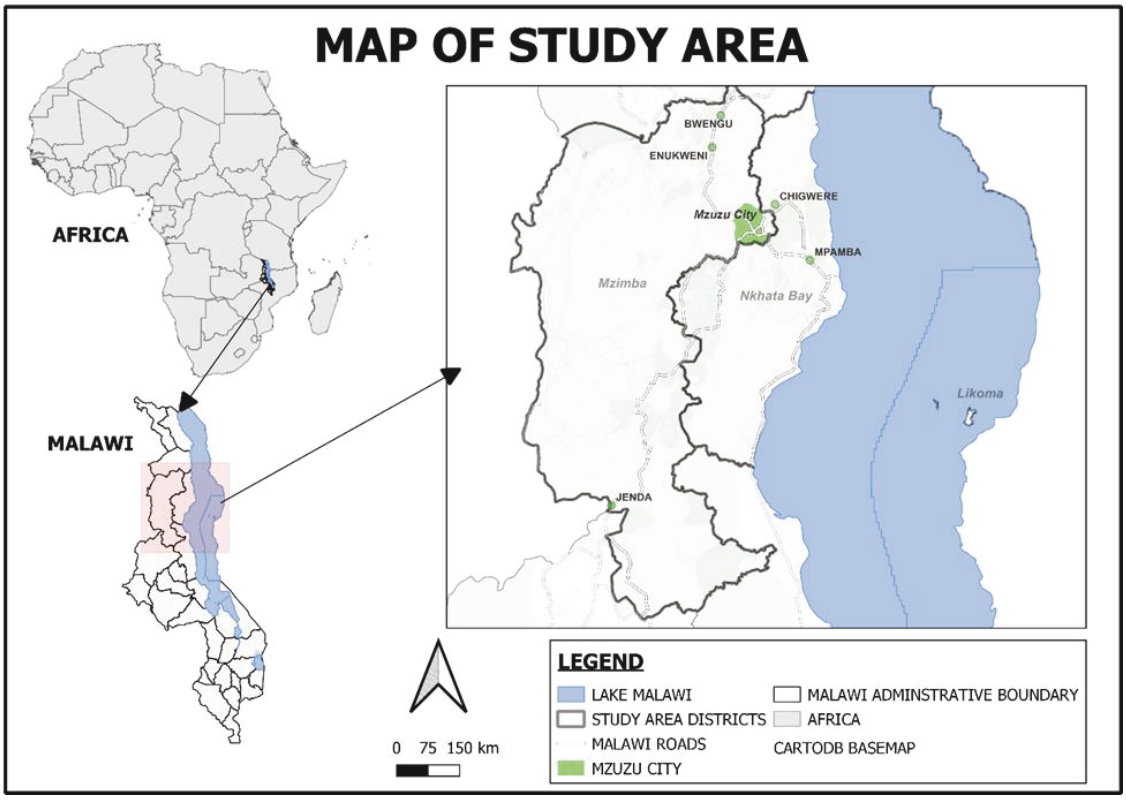


Figure 22: Study area

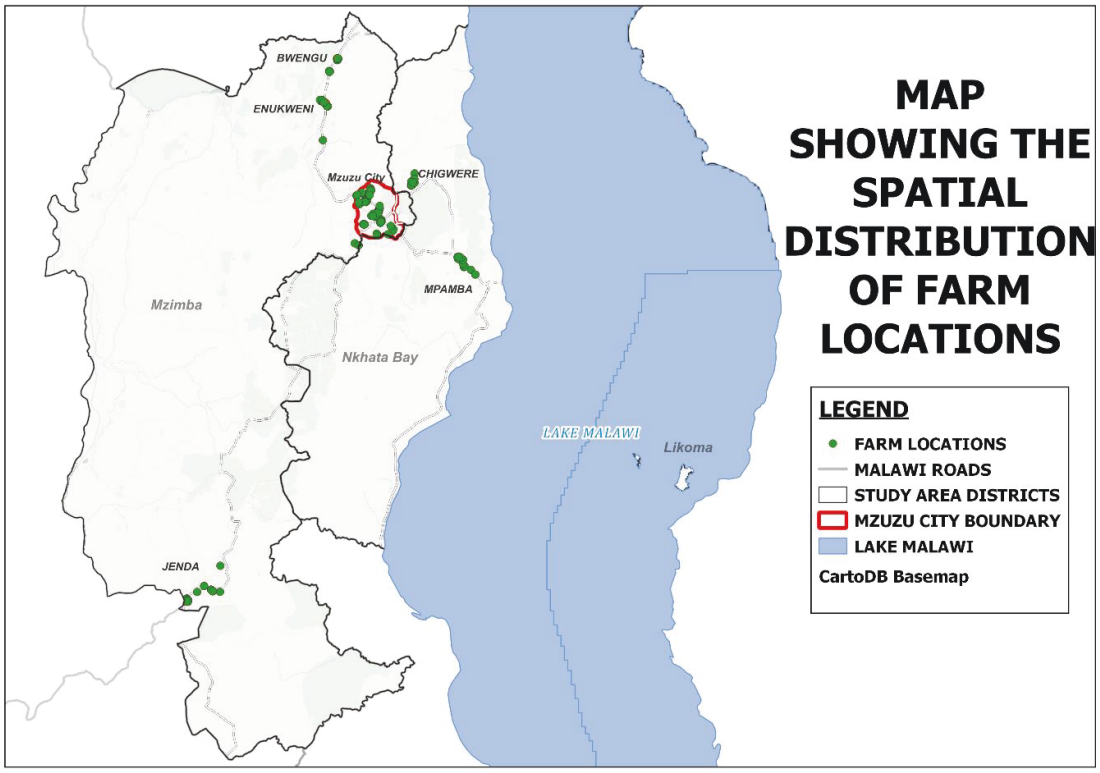


Figure 23: Spatial distribution of farm locations

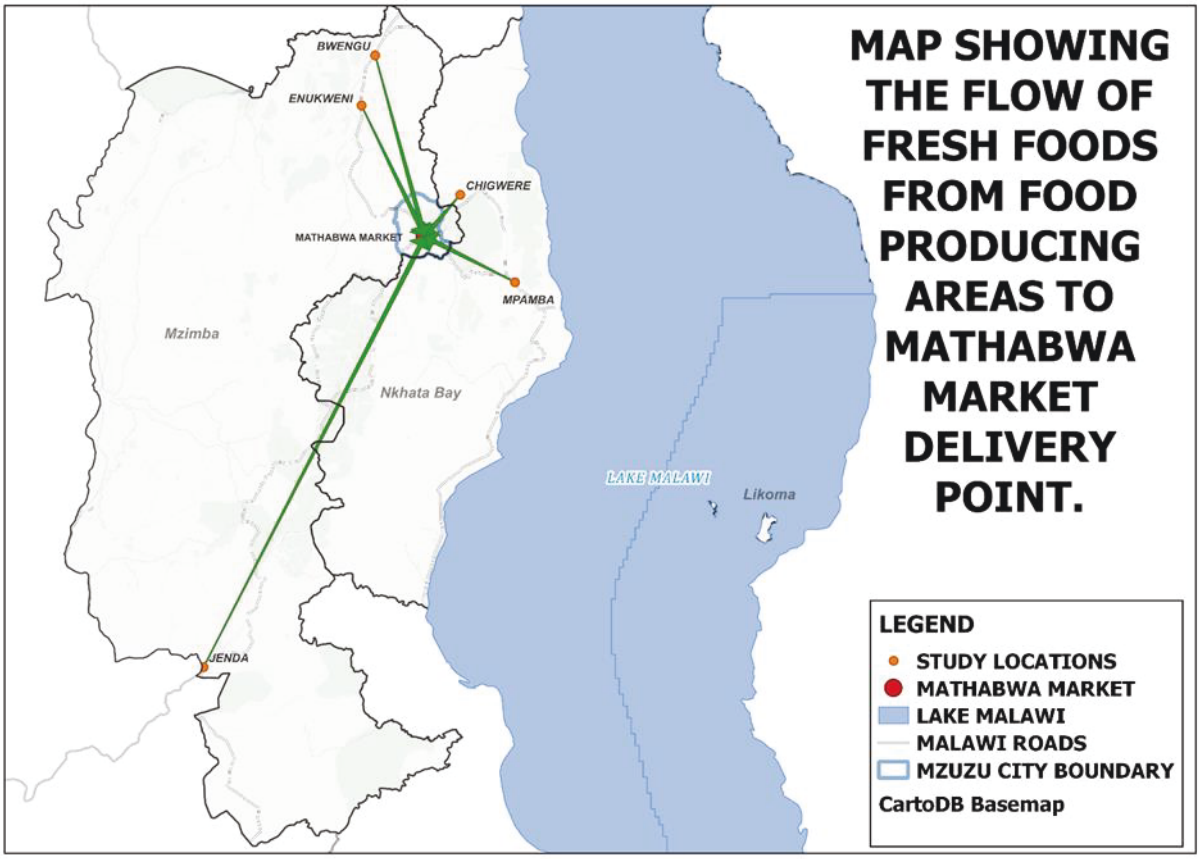


Figure 24: Fresh food flow from fresh food producing areas to Mzuzu city

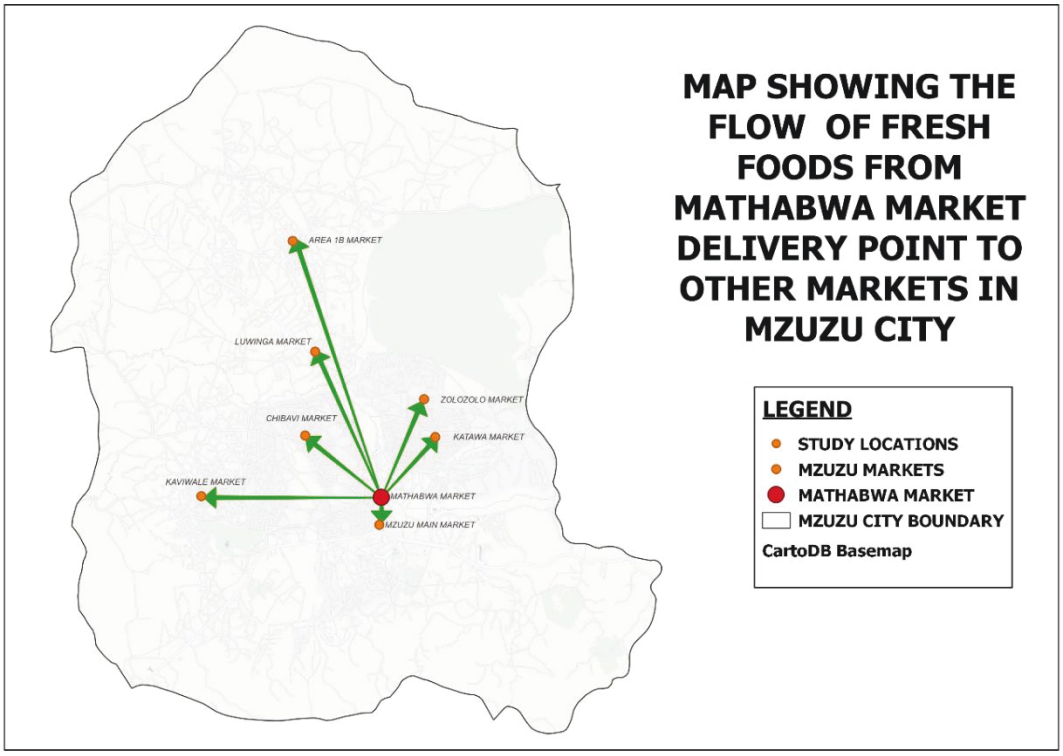


Figure 25: Fresh food flow from delivery point to markets in Mzuzu city