IMPROVED INCOME FOR MSHIKAMANO GROUP THROUGH BOTANICAL PESTICIDES SALES IN MWASAUYA WARD IN SINGIDA RURAL DISTRICT, SINGIDA-TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF COMMUNITY ECONOMIC DEVELOPMENT (MCED)

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CERTIFICATION

The undersigned certifies that I have read and now recommend for acceptance by the Open University of Tanzania a dissertation titled, **"Improved Income for Mshikamano Group through Botanical Pesticides Sales in Mwasauya Ward in Singida Rural District, Singida-Tanzania"** submitted in partial fulfilment of the requirements for the award of the degree of Master of Community Economic Development (MCED).

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Prof. Deus D Ngaruko

(Supervisor)

.....

Date

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DECLARATION

I, **Augustine Mbai Keya,** hereby declare that this dissertation is original and has never been presented in any other institution. I also declare that any secondary information used has been duly acknowledged in this dissertation. It is in this regard that I declare this work as originally mine. It is here by presented in partial fulfillment of the requirements for the award the Degree of Masters in Community Economic Development (MCED).

……..……..

Signature

……

Date

ACKNOWLEDGEMENT

Sincerely, I am honored to say that my supervisors, Prof. Deus D. Ngaruko, deserve credit for their valid concentration on my work, which assisted me in keeping on the right path. Thank you from my dearest heart to Dr Nuru Kipato for data analysis. I appreciate all smallholder farmers, the Singida rural district agriculture office, and RECODA in the study area who participated and provided me with critical information at no cost. I have nothing to do to compensate for what you have offered me but to thank you and be blessed.

DEDICATION

I dedicate this work to all smallholder farmers and those dealing with organic farming, in particular botanical pesticides.

ABSTRACT

This report, based on a Community Need Assessment (CNA) among smallholder farmers in Mwasauya ward, Singida rural district, Tanzania, addresses pest-induced crop losses. According to the Food and Agriculture Organisation of the United Nations (FAO), pests cause 15% of crop losses in Tanzania and 30-40% globally. Due to the problems caused by synthetic pesticides, there's a need for effective, environmentally friendly alternatives. The research used surveys, observations, and interviews with key informants. Quantitative data were analyzed using SPSS-26 and descriptive analysis of frequencies and percentages, while qualitative data were analyzed theoretically. Findings indicated that 51% of respondents prioritized food security, followed by 19.6% focusing on improved agricultural production, 11.8% on environmental protection, 9.8% on good health, and 7.8% on market access. Pests were identified as the main cause of food insecurity, leading to significant pre- and post-harvest losses. The Mshikamano group improved its income and assisted farmers in controlling food losses through the sale of botanical pesticides. The study recommended involving stakeholders in project implementation to build ownership, ensure success, and foster responsibility. It emphasized the importance of targeted interventions to enhance food security, agricultural production, and community development. Addressing these issues is crucial for sustainable development in Mwasauya ward and beyond. In conclusion, pests are a major cause of food insecurity, and effective management strategies, including the use of botanical pesticides, are essential. Collaborative efforts and targeted interventions are necessary to improve food security and promote sustainable agricultural practices in the region.

Keywords: *Improved Income, Mshikamano Group, Botanical Pesticides Sales, Community.*

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LIST OF ABBREVIATION

CBO	Community Based Organisation
CNA	Community Needs Assessment
FAO	Food and Agriculture Organization
FEV	Farmers Exchange Visit
FGD	Focus Group Discussion
FRN	Farmers Research Network
NGOs	Non-Governmental Organization
NM-AIST	Nelson Mandela African Institution of Science and Technology
OUT	Open University of Tanzania
RECODA	Research, Community and Organizational Development Associates
S&P	Sales and Promotion
SWOT	Strength Weakness Oppatunities and Threates
TANESCO	Tanzania Electric Supply Company Limited
TDV	Tanzania Development Vision
USD	United States Dollar
VEO	Village Executive Officer
WEO	Ward Executive Officer

CHAPTER ONE

PARTICIPATORY NEEDS ASSESSMENT

1.1 Background Information

Research, Community, and Organizational Development Associates (RECODA) has worked with Singida rural district to run the Farmers Research Network (FRN) project in six of the district's wards: Mwasauya, Ikhanoda, Mtinko, Merya, Mrama, and Ilongero (Humphrey et al., 2023). Fourteen farmer groups form the network in six wards (Humphrey et al., 2023). The Mshikamano group in the Mwasauya ward is one of the fourteen groups creating the network in the Singida rural district (Santoso et al., 2020). The FRN brings farmer groups, research institutions, development organizations, and other relevant stakeholders into the co-created process of sharing and building knowledge (Humphrey et al., 2023).

In Singida rural district, pest control often relies on high agrochemical inputs, causing negative impacts on users and consumers (Kusolwa et al., 2022). Synthetic pesticides and their residues have led to the need for ecological pesticides with excellent selectivity (Garcia, 2020). Botanical pesticides, made from plants, are used by smallholder farmers in Mwasauya ward to protect crops, products, and the environment from pesticide pollution (Kusolwa et al., 2022).

These plants break down faster than most chemical pesticides and are considered better for the environment and less likely to kill beneficial pests than synthetic pesticides that remain in the environment longer (Garcia, 2020). The community needs assessment identified areas of concern and significant issues for Mshikamano group and community-based organisation (CBO) (Bya et al., 2020). A participatory

approach ensured community ownership and designed strategies for improved income for Mshikamano group through botanical pesticide sales in Mwasauya ward (Bya et al., 2020).

1.2 Community Profile

Mshikamano group in the Mwasauya ward is one of the fourteen groups creating the FRN in Singida rural district. Mshikamano group was established purposefully to facilitate the enhancement of food security in Mwasauya Ward and the community as a whole for sustainable community development. The establishment of Mshikamano group comes from the sensitisation done by the FRN project upon the enhancement of the food security situation in the ward. The group is made up of 10 women and 5 men who work together.

The group's roles are to conduct participatory research in collaboration with the researchers, extension NGOs, and private organisations, to sensitise the whole community of Mwasauya about food security and nutrition, and to manage the group fund for the group member's and their development. The head of the project is a chairperson. The chairperson has the responsibility of chairing all the group programs. The group secretary is the head of the group technincal team, whose responsibilities include keeping records of all programmes or activities taking place. Other positions included project treasurer, who keeps financial records.

1.2.1 Mwasauya Ward Location

Mwasauya ward is one of the 21 wards in the Singida rural district. It is also one of the six wards where the FRN project is being carried out. It lies between 40° 34’ 56"

south and 35° 0’ 0" east (latitude: -4.582127 and longitude: 35.000084). Ikhanoda ward is on the west border of the ward. And the Msange ward in the south and the Manyara region in the north and east.

1.2.2 Mwasauya Ward Human Population

Mwasauya is situated in the Ilongero division, Singida rural district, in the Singida region. The ward has an area of 55.362 km2 and is administratively divided into three villages: Ngamu, Mwasauya, and Mdilu. The ward has a population of 11032, of which males are 5471 and females are 5561.

1.2.3 Mwasauya Ward Climatic Condition

Mwasauya ward has a semi-arid climate. The ward has two seasons: the most extended dry season (April to November) and the rainy season (December to March). The average rainfall is between 600 and 700mm per year, while the temperature ranges from 15C to 30C. The climatic characteristic of Mwasauya ward is a long period of up to seven months of the dry season (from May to November). The ward receives unimodal rainfall, which usually starts in November and ends in March, with typical tropical characteristics.

1.2.4 Mwasauya Ward Socio-economic Activities

In Mwasauya ward, residents have engaged in small-scale farming, particularly the production of different crops such as pearl millet, sorghum, maize, and sweet potatoes as food crops. In contrast, pearl millet is considered the major food crop for the majority. Cash crops are sunflower, finger millet, pigeon peas, chickpeas, celery,

onions, and vegetable production. Also, different types of livestock are kept in Mwasauya ward, including cattle, goats, sheep, donkeys, and chickens.

1.2.5 Mwasauya Ward Social Services

The ward has five primary schools and one secondary school. The ward has two health centres where residents can get essential services. For major cases, the patients are referred to the St. Carolus Hospital at the district level, owned by the Roman Catholic Church. The ward has seasonal dams mainly used for animal drinking water and vegetable production. Ward sources of clean and safe water are taps and two active water wells found in the ward. These measures minimise many water shortage problems, though they are not yet sufficient to satisfy the ward requirement, particularly during the drought seasons.

The ward uses solar power from a different private company and electricity from the Tanzania Electric Supply Company Limited (TANESCO). The ward is accessible, as the road joining the ward to the district headquarters and the Singida Municipal Council and Manyara region makes accessibility to towns easy and transport and transportation of products not a problem. Communication is available from cellular phones owned by different companies found in Tanzania.

1.3 Community Needs Assessment

The researcher conducted a community needs assessment in Mwasauya ward, focussing on capturing data that provided an understanding of the general needs of smallholder farmers in Mwasauya Ward. The evaluation offered opportunities to smallholder farmers aimed at informing future localised interventions.

1.3.1. The General Objective

The general objective of this study was to improve income for Mshikamano group through botanical pesticide sales in Mwasauya ward in Singida Rural District, Singida-Tanzania.

1.3.2 Specific Objectives

i. To identify demographic and socio-economic characteristics of respondents.
ii. To assess the common pesticidal plants used for pest control.
iii. To rank the most pressing needs for Mwasauya ward.
iv. To identify the most critical intervention to meet the essential needs.

1.3.3 Research Questions

i. What are demographic and socio-economic characteristics of the respondents?
ii. What common pesticidal plants are used for pest control?
iii. What are the most pressing needs for Mwasauya ward?
iv. What is the most critical intervention to meet essential needs?

1.3.4 Community Needs Assessment Research Methodology

The selection of research methods considered the situation and condition of the subject respondents, the time available, and the quickest ways to obtain data.

1.3.4.1 Research Design

The researcher used a longitudinal study design and mixed quantitative and qualitative research methods to collect data and achieve our needs assessment objectives (Iii & Singh, 2020). Longitudinal research design allows researchers to

look at changes over time (Thorne, 2020). To track changes in income generation, the researcher in this study explains both before and after the project is launched (Thorne, 2020).A researcher used key informant interviews as a qualitative data collection method to collect data (Thorne, 2020). The data collected from key informant interviews was used to inform quantitative data (Iii & Singh, 2020). The mixed methods provided an expanded understanding of Mwasauya ward needs and the critical intervention needed to meet the most essential Mwasauya ward needs.

1.3.4.2 Sample Size

The study populations are smallholder farmers' households in Mwasauya ward. The total number of smallholder farmer's households in Mwasauya ward is 2449. The sample size of smallholder farmer households enrolled in this study was 51 respondents. Besides smallholder farmer's households, 15 key informants (KIs) were selected purposefully. The key informants included people who were considered knowledgeable about botanical pesticides and the FRN project within the study area.

1.3.4.3 Sampling Techniques

A sampling technique is a method that a researcher uses to choose their sample units(Thorne, 2020). It contains a subset of individuals from within a statistical population to estimate features of the whole population(Iii & Singh, 2020). It is cheap, data collection is faster, and data accuracy and quality can be revised(Thorne, 2020).This research employed purposive sampling, and systematic sampling.

1.3.4.3.1 Purposive Sampling

Purposive sampling is valuable when the sample is taken with a purpose in mind and

the investigator has one or more well-defined groups they are looking for (Thorne, 2020). It can be used when someone wants to quickly reach a specific sample and when sampling is not the main goal (Iii & Singh, 2020). In this research, the target populations are smallholder farmers, FRN project staff, agriculture extension officers, and community development officers. A researcher assessed respondents because they had information regarding our research topic. The technique helped to include smallholder farmers and select those specific key informants for the study.

1.3.4.3.2 Systematic Sampling

The systematic sampling technique is atypes of probability sampling (Xu & Goodacre, 2018). It ensures, at the same time, that each unit has an equal probability of inclusion in the sample (Xu & Goodacre, 2018). In this method of sampling, the first unit is selected with the help of random numbers, and the remaining units are selected automatically according to a predetermined pattern (Xu & Goodacre, 2018). In this study, a researcher used this method to select smallholder farmers.

1.3.4.4 Sampling Procedure for Smallholder Farmers

A researcher requested from WEO a list of smallholder farmer's households. After receiving it, a researcher ensured that it was not ordered in a cyclical or periodic order. The total number of households in the list was 2449, and the researcher used the interval of 48 to yield 51 smallholder farmer households. Therefore, within the households selected, one smallholder farmer from each of the selected households was selected to yield 51 respondents. Purposive sampling was used to guarantee the representation of men and women in different age groups. To get experience with using botanical pesticides, the study included smallholder farmers who are 18 years

old or older and who have a wide knowledge of using pesticides.

1.3.4.5 Sampling Procedure of the Key Informants

Key informants were selected purposefully. The researcher included 15 key informants, considering that the study was a mixed method. According to Kumar, the number of key informants depends on the data to be collected, available time, and resources; therefore, 15–25 key informants are enough (1989). In this study, a researcher selected those who knew the research topic and informed them of their understanding of the Mwasauya ward's needs. The selection considered a particular person's knowledge of botanical pesticides and the FRN project within the study area. The key informants included 5 FRN project staff, 5 agricultural extension officers, and 5 community development officers.

1.4 Pre-Testing of the Study Tools

A researcher pre-tested the study tools to identify the strengths and weaknesses of the questionnaire survey, observation guide checklist, and interview guide for the key informants. A researcher pre-tested tools and a checklist using one ward among the six wards implementing the FRN project in Singida rural district. After pre-testing tools, a researcher reviewed the collected data, and the tools were revised accordingly.

1.5 Data Collection Methods

1.5.1 Primary Data Collection

A researcher collected primary data through a questionnaire survey, observation, and key informant interviews.

1.5.1.1 Questionnaire Survey

A questionnaire survey collected information from a sample of individuals through their responses to questions(Iii & Singh, 2020). Appropriate question design is essential to ensuring that an investigator obtains valid answers to questions (Flick & Flick, 2018). A researcher used a questionnaire to collect data from 51 respondents from Mwasauya ward. It was in the form of closed and open-ended questions.

1.5.1.2 Observation

An investigator used observation to study collaboration among individuals in their situation (Iii & Singh, 2020). Observation involves visualising the community happenings, then watching, recording, and analyzing the practical issues and data obtained in the absence of any direct interaction (Thorne, 2020). The researcher surveyed the Mwasauya ward to observe farming activities, how smallholder farmers grow different crops and other products for earnings, and how they manage pests using botanical pesticides.

1.5.1.3 Interviews with Key Informants

A researcher conducted in-depth interviews in Swahili with key informants. The interview guide was prepared based on the study's specific objectives, and the interview took between 30 and 45 minutes.

1.5.2 Data Management and Analysis

An investigator analysed quantitative data using the Statistical Package for Social Sciences (SPSS-26) and conducted a descriptive analysis of frequencies and percentages. Qualitative data collected from key informant interviews were analysed

theoretically, and the results supported quantitative findings. The data is presented in tables of frequency and percentages to show and validate the information.

1.5.3 Validity and Reliability

To make sure that the data are valid and reliable in this study, a researcher clearly defines the research question and objectives (Sürücü & Maslakçi, 2020). Having a clear and focused research question and objectives helped a researcher select the most appropriate data sources, methods, and tools for the study(Iii & Singh, 2020). A researcher cross-checked the collected data to ensure reliable instruments were used for measuring expected outcomes(Iii & Singh, 2020). A researcher checked and verified that the data and the results were accurate, consistent, and meaningful (Sürücü & Maslakçi, 2020). A researcher compared and contrasted the results with existing literature and communicated the research findings clearly and effectively(Iii & Singh, 2020).

1.5.4 Ethical Approval

The ethical approval of this study has been granted by the Institutional Review Board of the Open University of Tanzania. Each participant provided written consent to participate before the interview. Also, the investigator ensured confidentiality for all study respondents.

1.6 Community Need Assessment Findings

Smallholder farmers and CNA informants helped Mshikamano group and CBO to implement botanical pesticide sales project for improved income and food security in Mwasauya ward in Singida Rural District.

1.6.1 Demographic and Socio-Economic Characteristics of the Respondets

The research study involved 51 respondents and 15 key informants, with 33.3% being male and 66.7% being female, as shown in Table 1.1. This means that most of the people interviewed were women. Women produce between 60 and 80 percent of the food in most developing countries and are responsible for half of the world's food production, and having equal access to productive resources could increase yield and food security by 20% to 30% (Visser & Wangu, 2021). Women's involvement in agriculture is crucial for addressing the issue of gender inequality and promoting sustainable food production (Visser & Wangu, 2021).

The study revealed that the majority of respondents were young, with 11.8% aged 18–25, 33.3% aged 26–35, 23.5% aged 36–45, and 31.4% aged 46 and above. These age categories guaranteed fresh perspectives and diverse ideas for the botanical pesticide sales project. This means that those aged above 46, equal to 31.4% of the population, were experienced and could manage the project effectively. The study revealed that 70.6% of respondents were married, and 72.5% attended primary school. Attending school helped them grow and improve their income through selling botanical pesticides.

The study found that 72.5% of the ward's populations are farmers, 19.6% are employed, and 7.8% are traders. 13.7% have an income below 30000 Tanzania shillings per month, 51% between 30000 and 50000, and 11.8% between 50000 and 70000. Only 23.5% have an income above 70000. The majority of ward members have an income level between 30000 and 50000, with 43.2% being female and 7.8% male. The study revealed that smallholder farmers were poor due to their reliance on

farming activities only. Knowledge-based agriculture approaches, in particular botanical pesticide sales, created decent jobs among Mshikamano group members, met their needs, and improved their lives.

Table 1.1: Demographic and Socio-Economic Characteristics of Respondents

Variable	Frequency	Percentage
Age		
18-25	6	11.8
26-35	17	33.3
36-45	12	23.5
46+	16	31.4
Total	51	100.0
Gender		
Male	17	33.3
Female	34	66.7
Total	51	100.0
Level of Education		
No education	3	5.9
Primary	37	72.5
Secondary	2	3.9
Collage/University	9	17.6
Total	51	100.0
Marital Status		
Single	12	23.5
Married	36	70.6
Widowed	3	5.9
Total	51	100.0
Occupation		
Farmer	37	72.5
Trading	4	7.8
Employed	10	19.6
Total	51	100.0
Income		
<30000	7	13.7
30000-50000	26	51.0
51000-70000	6	11.8
70000+	12	23.5
Total	51	100.0

Source: Study Findings in Mwasauya Ward, 2021.

1.6.2 Farmer's Knowledge of Botanical Pesticides

The practice of using plant materials against pests in indigenous and traditional farming communities has a long history(Kusolwa et al., 2022).. This study found that

82.4% of farmers knew about botanical pesticides, while 17.6% did not know, as shown in Table 1.2. A researcher noticed that the FRN project trained smallholder farmers in Singida rural district about botanical pesticides and their benefits for crop protection. Farmers were trained on crop storage, spraying, chemical extraction, pesticide identification, and sustainable harvesting of pesticidal plants. A study found that within gender, 76.5% of females knew about botanical pesticides, whereas within males, 94.1% of them knew about botanical pesticides. Smallholder farmers faced poor purchasing power which led to reliance on botanical pesticide technologies due to their limited purchasing power (Kusolwa et al., 2022).

Table 1.2: Smallholder Farmers Knowledge of Botanical Pesticides

Gender		Knowledge of Botanical Pesticides		Total
		No	Yes	
Female	Count	8	26	34
	% within Sex	23.5%	76.5%	100.0%
Male	Count	1	16	17
	% within Sex	5.9%	94.1%	100.0%
Total	Count	9	42	51
	% within Sex	17.6%	82.4%	100.0%

Source: Study Findings in Mwasauya Ward, 2021.

The findings reported that 68.6% of respondents mostly controlled pests using botanical pesticides, as indicated in Table 1.3. The study revealed that factors that influenced smallholder farmers in Mwasauya ward to use botanical pesticides were an increase in human and livestock poisoning incidents, a decrease in natural enemy pests, and a disruption of ecological balances. The largest group of smallholder farmers in Mwasauya ward generated between 30000 and 50000 Tanzanian shillings per month; 61.5% of them used botanical pesticides, and 38.5% used synthetic

pesticides. The highest income generator of over 70000 Tanzanian shillings per month 91.7% of them was reported to use botanical pesticides, and the lowest income generator of under 30000 Tanzanian shillings 71.4% of them was reported to use botanical pesticides. The study found that education level doesn't affect the application of botanical and synthetic pesticides. Both school-admitted and non-admitted individuals applied pesticides similarly.

Table 1.3: Mostly Techniques Used to Control Pests

Income		Techniques of Controlling pest		Total
		Botanical Pesticides	Synthetic Pesticides	
<30000 Tsh	Count	5	2	7
	% within Income	71.4%	28.6%	100.0%
31000-50000 Tsh	Count	16	10	12
	% within Income	61.5%	38.5%	100.0%
51000-70000 Tsh	Count	3	3	6
	% within Income	50.0%	50.0%	100.0%
Tsh>70000	Count	11	1	12
	% within Income	91.7%	8.3%	100.0%
Total	Count	35	16	51
	% within Income	68.6%	31.4%	100.0%

Source: Study Findings in Mwasauya Ward, 2021

1.6.3 The Common Pesticidal Plants Used for Pest Control

The study found that the most widely used botanical pesticides in the ward are Tagetes minuta at 39.2%, Lantana camara at 21.6%, Azadirachta indica at 13.7%, Aforex at 9.8%, Tithonia diversifolia at 5.9%, Eupharbia tirucalli at 5.9%, and Cissus quadrangularis at 3.9%. Other techniques used by smallholder farmers are powdered Tagetes minuta and Lantana camara plants that are used to get rid of maize and Mexican bean weevils when they are mixed with grain. Tagetes minuta and Lantana camara plant extracts work well against aphids, Brevicoryne brassicae,

and red spider mites in vegetables. Some of them use Azadirachta indica extracts, which are often used to get rid of a wide range of insects and mites. As well, they use Aforex leaves, combined with onion peels and garlic cloves, to control pest attacks. And Tithonia diversifolia, Eupharbia tirucalli, and Cissus quadrangularis are used in field and storage pest management. The study noticed some of them use wood ash, sunflower ash, and animal ashes, such as cow and sheep ash, for crop storage.

Table 1.4: The Common Pesticidal Plants Used for Pest Control

Pesticidal Plant	Frequency	Percent
Aforex	5	9.8
Azadirachta indica	7	13.7
Cissus quadrangularis	2	3.9
Eupharbia tirucalli	3	5.9
Lantana camara	11	21.6
Tagetes minuta	20	39.2
Tithonia diversifolia	3	5.9
Total	51	100.0

Source: Study Findings in Mwasauya Ward, 2021

1.6.4 Findings from Key Informants Interviews

The findings from the KII showed that smallholder farmers in the ward are using botanical pesticides for field and storage.

> *"Smallholder farmers in Mwasauya ward are using botanical pesticides, and the commonly used pesticidal plants are Tagetes minuta, Lantana camara, Azadirachta indica, Aforex, Tithonia diversifolia, Eupharbia tirucalli, and Cissus quadrangularis and others use wood ash, sunflower ash, and animal ashes, such as cow and sheep ash, for crop storage."(Male, Mwasauya WAEO, 36 years).*

During the KII, a researcher noticed that pesticidal plants are easily accessible in the Mwasauya ward, but smallholder farmers faced some challenges while preparing

their homemade botanical pesticides.

> *"In Mwasauya ward, pesticidal plants are found without difficulty; they grow in the wild or even at homesteads and along farm boundaries." (Male, FRN-Project Staff, 40 years).*

> *"Making botanical pesticides is hard and takes a long time. For example, grinding the bark or leaves of a plant that kills pests into a powder takes a lot of time." (Female, Mwasauya CDO, 38 years).*

The KII revealed that the government of Tanzania recognised the potential of botanical pesticides for controlling food security, though there are a few extension officers trained in botanical pesticides.

> *"The government of Tanzania recognised the potential of botanical pesticides for controlling food security. Although the Ministry of Agriculture has a few extension officers trained in botanical pesticides, the government has created a good environment for private sector involvement in promoting botanical pesticides." (Female, Singida DC-DAICO, 45 years).*

The above testimony from the KII revealed that smallholder farmers in the ward are using botanical pesticides for field and storage. It also proved the accessibility of different varieties of pesticidal plants in Mwasauya ward. The KII informed the researcher about some challenges that smallholder farmers face while preparing their homemade botanical pesticides. From the KII, the government of Tanzania recognised the potential of botanical pesticides for controlling food security, though there are a few extension officers trained in botanical pesticides.The key informants were happy with the idea of setting up a project to sell botanical pesticides. It was observed as the perfect proposal for improved income for the Mshikamano group as well as improved food security in Singida rural district.

1.6.5 Major Community Needs

The study found that 51% of the people who were interviewed said that food security was important to their daily lives in their community. Following that, 19.6% said

that the community had a pressing need for better agriculture production, 11.8% said that protecting the environment was important, 9.8% said that good health was important, and 7.8% said that access to markets was important. The results reflect that pests are the main challenge in this community, which has caused smallholder farmers to lose potential food starting with pre- and post-harvest management. Therefore, through the sale of botanical pesticides, the Mshikamano group improved their income, and smallholder farmers could control the loss of potential food in both pre and post harvest management.

Table 1.5: Major Community Needs

Community Needs	Frequency	Percent
Access to Market	4	7.8
Environmental Protection	6	11.8
Food Security	26	51.0
Good Health	5	9.8
Improved Agriculture Production	10	19.6
Total	51	100.0

Source: Study Findings in Mwasauya Ward, 2021

1.6.6 Most Critical Intervention to Meet the Essential Needs

A researcher used the pair-wise ranking method to identify the best intervention to meet the most crucial needs. Mshikamano group had a list of interventions to meet the most important needs of the community. Botanical pesticide sales were ranked first, followed by vegetable production, fruit sales, livestock keeping, and then sunflower sales. This gave the community and the interested group an idea for establishing a botanical pesticide sales project that helped Mshikamano group improve its income and meet community needs. Members of Mshikamano group asked the agriculture development officer and the FRN project team to help them learn how to commercialise botanical pesticides and make sure that smallholder

farmers have access to food.

Table 1.6: The Most Critical Intervention to Meet the Essential Needs

Intervention	Vegetable Production	Botanical Pesticides Sales	Sunflower Sales	Fruits Sales	Livestock Keeping	Score	Rank
Vegetable Production		Botanical Pesticides Sales	Vegetable Production	Vegetable Production	Vegetable Production	3	2
Botanical Pesticides Sales			Botanical Pesticides Sales	Botanical Pesticides Sales	Botanical Pesticides Sales	4	1
Sunflower Sales				Fruits Sales	Livestock Keeping	0	5
Fruits Sales					Fruits Sales	2	3
Livestock Keeping						1	4

Source: Study Findings in Mwasauya Ward, 2021

1.6.7 Community Needs Assessment Conclussion

The CNA was done among smallholder farmers in the Mwasauya ward of Tanzania's Singida rural district. The study found that 51% of the people who were asked about the most pressing needs for Mwasauya ward said that they should focus on food security. After that, 19.6% said better agricultural production, 11.8% said protecting the environment, 9.8% said good health, and 7.8% said market access was a very important need for the community. The study found that pests were the main cause of food insecurity in Mwasauya ward.

The problem that synthetic pesticides and their residues cause has made it more important to find effective, environmentally friendly pesticides with good selectivity to fight against pests. Botanical pesticides are made from plants and kill pests without hurting the environment or causing health problems for consumers or farmers. Smallholder farmers, especially in Mwasauya ward, have started to use

botanical pesticides as one of the best ways to protect their crops, their products, and the environment from pesticide pollution. Thus, through botanical pesticide sales, Mshikamano group increased income and improved food security for smallholder farmers in Singida rural district.

CHAPTER TWO

PROBLEM IDENTIFICATION

2.1 Chapter Overview

This chapter outlines targeted change areas and projects, providing focus and direction. It identifies the problem based on Participatory Assessment findings and outlines a researcher's plan to address it.

2.2 Background to Research Problem

The community needs assessment was conducted in Mwasauya ward to identify the research problem. In a pairwise ranking, the study found improved income through botanical pesticide sales was ranked first, followed by vegetable production, fruit sales, livestock keeping, and finally sunflower sales. According to FAO, 40% of the worldwide crop production is lost to pests (FAO, 2019b). Huge crop production losses are a threat to food security and the incomes and livelihoods of several smallholder farmers in developing countries (Pollmann-larsen, 2024). In Tanzania, domestic food production is not enough to meet the national food needs (FAO, 2019b). Several families experience long periods of food shortages (Pollmann-larsen, 2024). Above USD 200 million is used yearly to import food (URT, 2018). Managing crop production losses could probably offset this shortage.

The best way to get rid of pests and make sure smallholder farmers have food security is to sell botanical pesticides (Kusolwa et al., 2022). Synthetic pesticides are commonly effective but have limited distribution (Garcia, 2020). Misapplication of synthetics through adulteration by dishonest traders is common, as are unsafe application rates due to illiteracy, poor labelling, or expired products; all of this has

contributed to the evolution of pesticide resistance (Kusolwa et al., 2022). Health and safety are also serious issues since smallholder farmers usually work without protective clothing (Mkindi, 2020). In the meantime, users may be exposed to high residues (Lengai et al., 2020b). The environmental impact of synthetics on crop pollinators, natural enemies, soil systems, and food chains are extremely challenging (Garcia, 2020).

Botanical pesticides are well known by farmers and are more environmentally friendly, safer, and cost-effective compared to synthetic pesticides, as well as being more difficult to adulterate, mainly when produced or harvested by farmers themselves (Kusolwa et al., 2022). The important thing is that the cost to farmers is considerably lower than synthetic pesticides and can be calculated in terms of time to harvest and process rather than outgoing (Rwegoshora et al., 2023). It is true that, although smallholder farmers in Singida rural district earned their living from farming, the relative poverty of farming households compared to non-farming households truly worsened.

Pre- and post-harvest losses caused by climate change are one of the causes of poverty among smallholder farmers. In this case, RECODA has collaborated with Singida rural district to encourage farmers to join themselves in FRN group, where they received some support from the government and NGOs for improved income and food security. On the other hand, the CNA identified the causes, effects, and opportunities for intervention.

2.2 Problem Statement

Pest damage to crops is one of the biggest challenges to food security in Tanzania.

Globally, 30% to 40% of crop production is lost to pests (FAO, 2019a), whereas in Tanzania, 15% of the produce is lost to pests (Mkonda & He, 2018). Most synthetic pesticides are used to control pests among smallholder farmers. Because of the problems caused by synthetic pesticides and their residues, smallholder farmers started to use botanical pesticides. It can control pests without harming the environment or having side effects on consumers' and farmers' health compared to synthetic pesticides. It breaks down faster than most chemical pesticides and is thought to be better for the environment and less likely to kill beneficial pests than synthetic pesticides that stay in the environment longer.

Despite their demands, known benefits, and demonstrated success in pest control among smallholder farmers, only a few initiatives have been taken to commercialize botanical pesticides. The botanical pesticides project in Moshi rural district trained farmers to generate income through botanical pesticide sales in legume production (Kusolwa et al., 2022). And, the Gesellschaft Fur Internationale project in Arusha trained farmers to generate income through botanical pesticide sales in vegetable production (Mkindi, 2020).Thus, this project aimed to improve income for Mshikamano group through botanical pesticide sales in Mwasauya ward in Singida Rural District, Singida, Tanzania.

2.3 Project Description

The project aimed to improve income for Mshikamano group through botanical pesticide sales in Mwasauya ward in Singida Rural District, Singida, Tanzania.

2.3.1 Target Community

The project targeted Mshikamano group and smallholder farmers in Singida rural

district. The group is one of the fourteen groups creating the FRN in Singida rural district. Mshikamano group was purposefully established to facilitate the enhancement of food security in Mwasauya ward and the community as a whole for sustainable community development. The study has revealed that for botanical pesticides to be promoted, Mshikamano group must be facilitated in accessing a reasonable market and enabled to acquire skills in developing botanical pesticides and competing with synthetic pesticides in the market. A botanical pesticide sales project was initiated to generate income for Mshikamano group.

Mshikamano group worked under the supervision of their chairperson and the ward extension officer. The District Agricultural Officer (DAICO), the Community Development Officer, and the Tanzania Pesticides Research Institutes also helped out, along with FRN-project staff. The project was carried out well and helped to improve the income for Mshikamano group and the food security of smallholder farmers in Singida Rural District, Singida, Tanzania.

2.3.2 Stakeholders

Table 2.1: Stakeholder's Roles and Affiliations

No.	Stakeholder	Roles of Stakeholders	Affiliations
1	Mshikamano Group	Managing the Project	Project implementer
2	FRN- Farmers	Farmers researcher &customer	Researcher&beneficiary
3	Smallholder Farmers	Consumers	Beneficiaries
4	Extension officers	Provision of extension services	Project advisors
5	Local Government Authority	Technical supporter	Guardian and advisors
6	TPRI	Provision of technical advise	Project advisors
7	RECODA	Funding	Funder

Source: Study Findings in Mwasauya Ward, 2021.

Stakeholders are people or organizations that have an interest in the project's activities. Stakeholders can be affected by or affect the project directly or indirectly. In this project, the stakeholders were Mshikamano group, FRN farmers, smallholder farmers, extension officers, the LGAs, TPRI, and RECODA.

2.3.3 Project Goal

The project goal was to improve income for Mshikamano group through botanical pesticide sales in Mwasauya ward in Singida Rural District, Singida-Tanzania.

2.3.4 Project Objectives

The project achieved the following objectives:

i. 15 members of Mshikamano group equipped with knowledge and skills on sustainable agroecological crop pest management using botanical pesticides and integrated pest management by April 2023.
ii. 15 Mshikamano group members trained on botanical pesticide sales project management by April 2023.
iii. One-acre farm of pesticidal plants established in Mwasauya ward by April 2023.
iv. Tshs 5000000 generated from botanical pesticide sales by April 2023.

2.4 Host Organization

The host organization was RECODA, which has mandates for

i. Sensitizing Mshikamano group to productive activities and other activities aimed at developing them and the nation.
ii. Bridging the technology gap for Mshikamano group in development through research, consulting, capacity building, and the facilitation of community

based projects geared toward poverty alleviation, food security, and environmental conservation.

2.4.1 The Vision and Mission of the RECODA

RECODA's mission and vision are to help and encourage smallholder farmers to take part in socio-economic development and change. The organization wants to see a community that is prosperous, strong, sustainable, educated, and free of poverty and ignorance.

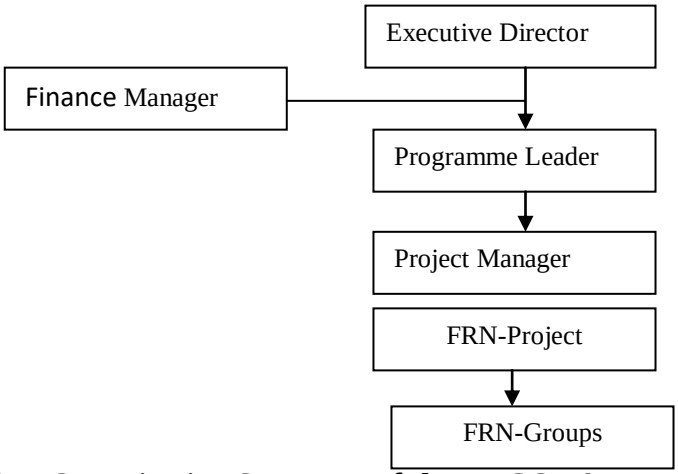

Figure 2.1: Organisation Structure of the RECODA

2.4.2 SWOT Analysis of RECODA

Table 2.2: RECODA SWOT Analysis

Strengths	Weakness	Opportunities	Threats
• Availability of pesticidal plants • The availability of trained botanical pesticides leads farmers • Excellent staff with strong knowledge of botanical pesticides • Good relationship with customers • Successful market strategies	• Limited production skills among members • Inappropriate utilization of botanical pesticides leads farmers • Limited entrepreneurial skills are needed to commercialize botanical pesticides.	• Availability of botanical pesticides in markets • Lead farmers and other experts are ready to volunteer. • High demand for botanical pesticides • Synthetic pesticides are more expensive compared to botanical pesticides.	• Competition from synthetic pesticide suppliers • Lack of skills to utilize botanical pesticides • Promotion from a synthetic pesticide supplier

Source: Study Findings in Mwasauya Ward, 2021.

The strengths, weaknesses, opportunities, and threats of the RECODA were analyzed in Table 2.2

2.5 The Role of CED Student in the Project

The CED student was responsible for organizing meetings with authorities and farmer representatives and following up on the project's implementation. All activities carried out are summarized as follows:

i. To equip members of Mshikamano group with knowledge and skills on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.
ii. To train Mshikamano group members on botanical pesticide sales project management.
iii. To establish a one-acre farm of pesticidal plants in Mwasauya ward.
iv. To ensure Mshikamano group accesses a reliable market for botanical pesticides in collaboration with village and district officers.
v. To consult different stakeholders to access resources needed for the project's implementation.
vi. To facilitate the purchase of project tools and equipment for project implementation.
vii. To organize meetings between local authorities and representatives of Mshikamano group
viii. To facilitate participatory monitoring and evaluation of the project.

2.6 The Roles of the Host Organization

i. To attend and facilitate all required trainings.

ii. To participate in the community sensitization on the botanical pesticide sales project
iii. To take part in the marketing of botanical pesticides.
iv. To engage different stakeholders for funding the project
v. To take part in the process of the project's tool procurement.
vi. To guarantee administrative activities during the project survive.
vii. To guarantee the progressive report is provided as needed.
viii. To guarantee the project's sustainability.

CHAPTER THREE

LITERATURE REVIEW

3.1 Chapter Overview

This chapter reviews the literature on the issues of community livelihood opportunities by making botanical pesticides and project development documented and conducted by other experts. A review of the existing literature, journals, and research papers provides essential data. Information was gathered from theoretical literature where key issues have been defined concerning the best practice for commercialising botanical pesticides among smallholder farmers. In the empirical literature reviews, a researcher reviews to get experiences from other countries, including Tanzania, where botanical pesticide projects were implemented.

3.2 Definition of the Key Terms

Pesticides are substances or mixtures that prevent, destroy, kill, control, or mitigate pests ("FAO's Plant Prod. Prot. Div.," 2022). Pesticidal plants, sometimes called botanical pesticides, are organic pesticides that originate from plants belonging to different families and are either utilized as plant extracts or essential oils (Ratto et al., 2022). The Plant parts used to make botanical pesticides consist of barks, leaves, roots, flowers, fruits, seeds, cloves, rhizomes, and stems (Ratto et al., 2022).

3.3 Theoretical Literature

3.3.1 Botanical Pesticides in Agricultural Sector

In Tanzania, agriculture accounts for almost 45% of the national GDP and is the main occupation of 70% of the Tanzanian population (Rwegoshora et al., 2023). Pest damage to crops is one of the significant challenges to food and nutritional security

in Africa and unreasonably affects crop yield for smallholder farmers (Mkindi, 2020). Globally 200,000 people die annually due to the direct impact of synthetic pesticides (Mlayeh et al., 2020). The consumption of synthetic pesticides in Africa is around USD 31 billion, 2–4% of the international pesticide market (Mlayeh et al., 2020). Africa has the highest human death rate risks because of the incorrect use of synthetic pesticides (Mlayeh et al., 2020). In Tanzania, smallholder farmers started to use botanical pesticides to control pests on their crops (Mkindi, 2020). As a result, they contribute to a safer environment, save the costs of chemicals, and reduce health risks to themselves, their families, and consumers (Mkindi, 2020).

3.3.2 Human Capital Theory

The first writings on human capital come from the 18th century Scottish economist, Adam Smith (Khaykin et al., 2020). Hawever the American economist, Greg Becker, was arguably the biggest pioneer of the human capital theory (Khaykin et al., 2020). Human capital theorized education as an investment good that allows the learners to acquire knowledge and develop skills that, in turn, serve to advance their productivity as economic production factors (Leoni, 2023).In this theory, education's significance is primarily assumed to be in how it increases the individual's production capacity (Khaykin, et al., 2020). Thus their earnings, in turn, boost the economic growth of the larger society by regarding education as an investment (Leoni, 2023).

This theory studies financial gains as the primary rate of returns to measure this investment effectiveness (Khaykin et al., 2020). This theory highlights investment in human capital through the provision of training adopted by several nations and

international agencies such as the Food and Agriculture Organisation of the United Nations (FAO) (Goldin & Katz, 2024), showing the significance of human capital in developing not only smallholder farmers but the nation at large (Davis et al., 2021). To this study, investing in botanical pesticides among Mshikamano group members helped that group to acquire knowledge and develop skills that, in turn, saved to improve smallholder farmers' income as an economic production factor rather than depending on crop cultivation only (Lengai et al., 2020a).

Human capital theory measures payoffs by increased productivity, higher wages, and community economic growth (Leoni, 2023). In that context, the economic rates of return of minority community education are majorly related to the educated populations' likelihood to enter the formal labour market where incomes are higher than those of traditional or home-based work (Goldin & Katz, 2024). In that regard, selling botanical pesticides is mainly seen to create improved members with a better standard of living (Tian & Tóth, 2024). This production of qualitative community is assumed to increase social changes in society (Dui, 2020). Under the human capital theory, selling botanical pesticides is a cost-effective investment with a high return (Tian & Tóth, 2024).

An assessment of human capital theory laid on its assumption that farmers with the same level of education will be able to get jobs at a given wage range, which is higher than for farmers without education (Czyżewski et al., 2021). For a researcher to conceptualise making botanical pesticides as human capital, there is a need to minimise the unconstructive perception and attitudes of Mshikamano farmer group towards botanical pesticides, as it has verified the significance to the economic

development of several societies(Lengai et al., 2020a).

3.4 Empirical Literature

3.4.1 Safety of Plants Extracts

Botanicals are widely safer to use and handle than synthetic ones, are environmentally kind, are less harmful to beneficial insects, and are difficult to degrade (Lengai et al., 2020a).Their uses have motivated smallholder farmers and global agencies concerned with agriculture sustainability and demonstrated fewer chances for human and environmental risks (Rwegoshora et al., 2023). Pesticidal plant species have varied modes of action based on phytochemical composition (Rwegoshora et al., 2023). Therefore, it helps to delay resistance building in target insect pests, leading to efficient pest management (Lengai et al., 2020a).

Similarly, the compound of pesticidal plant source is thermos-UVlabile, as a result existing for a short period in the crop and the environment, ensuring that foods are free from residues (Lengai et al., 2020b). Pesticidal plants harbourr other insect species, such as natural enemies and pollinators, by providing forage and breeding sites and, as a result, increasing possibilities for natural pest regulation in crop fields (Rwegoshora et al., 2023). Such an alternative to synthetic pesticides is also acclaimed for its low persistence in the environment and low mammalian toxicity, leaving less ecological toxicity (Garcia, 2020).

3.4.2 Availability of Plants Extracts Species

Pesticidal plants are broadly available at minimal cost to smallholder farmers and have been used for centuries, so they are culturally relevant (Rwegoshora et al.,

2023). Pesticidal plants are available in several areas of Tanzania, specifically Singida rural district (Garcia, 2020). Plant parts used to make botanical pesticides consist of barks, leaves, roots, flowers, fruits, seeds, cloves, rhizomes, and stems(Garcia, 2020). In the current era, botanical pesticides are an alternative to synthetic pesticides in organic pest management (Rwegoshora et al., 2023).

The availability of botanical pesticides influences smallholder farmers to use botanical pesticides (Garcia, 2020). Plant extracts can be locally prepared and applied, demanding simple machines and using local skills among smallholder farmers while requiring less care (Rwegoshora et al., 2023). Plant species such as T.diversifolia, L.camara, and Tagetaminuta are good examples of freely available pesticide plant species in smallholder farmer's societies (Garcia, 2020). Pesticidal plant materials thrive on roadsides, abandoned fields, and in field margins, making their availability sure among smallholder farming societies (Ratto et al., 2022).

3.4.3 Sustainable Conservation and Cultivation of Botanical Pesticides

Pesticidal plant parts used for pest control consist of leaves, fruits, seeds, bark, roots, and flowers(Ratto et al., 2022). Smallholder farmers collect pesticidal plants from the wilds and overharvest. Therefore, it can cause biodiversity loss, and weekly but invasive species are at no risk of overcollection(Ratto et al., 2022). Collecting some plant parts, such as roots or barks, from slow-growing indigenous trees and shrubs can be mainly harmful, thus weakening or killing the plant (Rwegoshora et al., 2023). In several cases, unsustainable collection methods have made some plant species challenging to find in the wild (Garcia, 2020). Therefore, training guidelines have been produced on how to sustainably collect wild plants, and it is

recommended that the use of pesticidal plants follow the procedure (Rwegoshora et al., 2023). In addition, the sustained availability of pesticidal plants may be maintained if they are managed, domesticated, conserved, and used efficiently, thus helping to meet the needs of the present and future generations (Ratto et al., 2022).

3.4.4 Application of Botanical Pesticides in Tanzania

The health risk of chemical pesticides has made several smallholder farmers use botanical pesticides in Tanzania (Garcia, 2020). Therefore, several researchers and institutions have recommended some potential botanical pesticides for pre- and post-harvest management of crop production (Rwegoshora et al., 2023). These are Neem, Tephrosia, Lippajavanica, Lantana Camara, Tithoniadiversifolia, Tagetaminuta, Pyrethrum, Aloe Ferox, Solanumincanum, Chilli Pepper, Tobacco, Garlic, Dolichos kilimandscharicus, Vernonia, Dysphania ambrosioides, Securidaca Longepedunculata, Zanha Africana, and Euphorbia candelabrum (Garcia, 2020).

In reality, botanical pesticides are readily available and less costly (Ratto et al., 2022). In areas where botanical pesticides are unavailable, farmers establish pesticide plants in their home gardens to ensure availability when needed (Rwegoshora et al., 2023). The botanical pesticides project report in Moshi rural district shows that farmers who engaged in making botanical pesticides generated income (Makirita, 2020), but the need for them was how they could move from farm-based production and use to local commercialisation of extracts (Makirita, 2020).

The Gesellschaft Fur Internationale (GTZ) project in Arusha, in collaboration with Integrated Pest Management (IPM) farmers in Arusha and the extension staff, has

reported that botanical pesticides could be helpful to a wide range of vegetables and other food crops(Violet, 2021). A field trial in the Kilimanjaro region of Tanzania showed that the botanical pesticide derived from the plant Tephrosiavongelii performed similarly to commercial synthetic pesticides (Mkindi, 2020). Been yields rose from about 1200 kilogrammes when untreated to 1900 per hectare using a 10% weight/volume (Mkindi, 2020). At the same time, farmers using synthetic pesticides reported a yield of 1500 kilogrammes per hectare, signifying that botanical pesticides can perform well at a similar level when using synthetic pesticides (Mkindi, 2020).

In addition, the botanical pesticide treatment had lower adverse effects on pollinators and predators than the synthetic treatments (Ratto et al., 2022). So although the pesticide plant's treatment was not 100% effective in eliminating all pests and insect species, crop protection was facilitated through several beneficial species, such as ladybirds, spiders, robber flies, and hoverflies, killed when using synthetic pesticides (Makirita, 2020).

The top two ranked plants in Tanzania's Kilimanjaro and Singida regions were Tephrosiavogelii and Lantana camara (Ratto et al., 2022). The main reason for higher ranking, according to the farmers, is because the botanical pesticides also acted as foliar fertilisers, as well as controlling pests, and their crop is doing better compared to where it is not applied (Mkindi, 2020). Testimonies were given for productivity increase using different local units of measurement, which averaged an increase of between 100% and 300% (Makirita, 2020). The FRN project conducted in Tanzania recommended that farmers understand botanical pesticides can be slow-

acting, requiring repeated application and labour to collect, process, and apply (Mkindi, 2020).

3.5 Policy Review

The National Agriculture Policy (2013) aims to ensure food security for the nation, including improving the national nutrition and living standards among smallholder farmers (Kessy, 2021). The Tanzania Development Vision 2025 (TDV) is a long-term vision that the Government of Tanzania introduced to guide its development, in particular agriculture sector development (Oldiges & Cosmas, 2022). The government aims that by 2025 the economy will be transformed from a low-productivity agricultural economy to a semi-industrialised one(Kessy, 2021). Tanzania will build a strong foundation for a highly effective, competitive, and dynamic economy (Kessy, 2021).

The National Strategy for Growth and Reduction of Poverty is one of the national strategies to move the nation towards Vision 2025 and achieve the Millennium Development Goals (MDGs) (Oldiges & Cosmas, 2022). The strategy requires increased resource mobilisation (Kessy, 2021). The strategic intervention cluster is Growth and Reduction of Income Poverty, focussing on equitable and employment-generating growth, sustainable development principles, food security, affordable and reliable modern energy services, and adequate infrastructure for production purposes (Oldiges & Cosmas, 2022).

Agriculture is one of the key growth areas and means to attain TDV 2025(Kessy, 2021). According to the Tanzania agriculture policy and the TDV, the agriculture

sector is an important sector where the government will implement strategic projects to build a strong, solid foundation for a highly productive, competitive, and dynamic economy (Oldiges & Cosmas, 2022). Organic farming, a particularly botanical pesticide, is described in the National Agriculture Policy of 2013 as a window of opportunity that can increase national and farm incomes (Kessy, 2021). The ministry emphasises the importance of botanical pesticides to control pests but onlyfew initiatives have been taken to promote botanical pesticides by the Ministry of Agriculture in Tanzania (Oldiges & Cosmas, 2022). Therefore, the private sector in Tanzania is taking the lead in supporting and enhancing the development of organic agriculture (Kessy, 2021).

3.6 Chapter Review

Pest damage to crops is one of the main barriers to food security in Tanzania and unreasonably affects crop yield for smallholder farmers. According to FAO, globally, 30 % to 40% of crop production is lost to pests, whereas in Tanzania, 15% of the produce is lost to pests (FAO, 2022). The typical approach used to control pests is the application of synthetic pesticides, which may negatively impact users and consumers and severely impact target invertebrates that can otherwise be beneficial to food production through pollination or natural pest control.

The problem caused by synthetic pesticides and their residues has increased the need for botanical pesticides among smallholder farmers as a prime means to protect crops, their products, and the environment from pesticide pollution. Botanical pesticides can control pests without harming the environment or having side effects on consumers' and farmers' health. Botanicals degrade more rapidly than most

chemical pesticides and are considered relatively environment-friendly and less likely to kill beneficial pests than synthetic pesticides with longer environmental retention. Despite its demand, known benefits, and demonstrated success in pest control among smallholder farmers, few initiatives have been taken to commercialise botanical pesticides. The botanical pesticides project in Moshi rural district trained farmers to generate income through botanical pesticide sales in legume production. The Gesellschaft Fur Internationale project in Arusha also helped trained farmers generate income through botanical pesticide sales in vegetable production.

CHAPTER FOUR

PROJECT IMPLEMENTATION

4.1 Chapter Overview

This chapter outlines the project's procedures, including the planning and intervention of activities to achieve predetermined objectives. An implementation plan is a schedule of activities indicating completion dates, ensuring timely completion and efficient resource allocation. The chapter presents the project's products and outputs, detailing planning, implementation, and the implementation report, highlighting important activities and results.

4.2 Project Implementation

The project's aim was to improve income for Mshikamano group through botanical pesticide sales. The McKnight Foundation, through RECODA, provided technical and financial support for the group, while the group contributed land and manpower to establish the project.

4.3 Project Products and Outputs

4.3.1 Project Products

The main product of the project was a botanical pesticide, which was marketed and sold to generate income.

4.3.2 Project Outputs

The project successfully prepared, performed, and achieved the following outputs by April 2023:

i. 150 ward members sensitised on sustainable agroecological crop pest

ii. management using botanical pesticides and integrated pest management.

iii. 15 Mshikamano group members trained on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.

iv. 15 group members trained on botanical pesticides sales project management.

v. Market plan established on how to sell botanical pesticides.

vi. One acre of pesticidal plant established in Mwasauya ward.

vii. 1,000 kg of botanical pesticides produced.

viii. Tsh 5,000,000 generated from botanical pesticide sales.

Table 4.1: Project Output

Objectives	Output	Activities
1. 15 members of the Mshikamano group equipped with knowledge and skills on sustainable agroecological crop pest management using botanical pesticides and integrated pest management by Apr. 2023.	50 ward members sensitised on sustainable agroecological crop pest management using botanical pesticides and integrated pest management	1.1 Setting meeting agenda 1.2 Organize meeting venue 1.3 Inviting participants' 1.4 To conduct advocacy meetings 1.5 Report writing
2. 15 Mshikamano group members trained on Botanical pesticides sales project management by April 2023.	5 Mshikamano group members trained on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	2.1 Organize training venue 2.2 Inviting participants' 2.3 Sensitizing and training 15 group members 2.4 Report writing
3. 15 Mshikamano group members trained on Botanical pesticides sales project management by April 2023.	5 group members trained on Botanical pesticides sales project management.	1.1 Organize training venue 1.2 Inviting participants' 1.3 Training 15 group members 1.4 Report writing
.	Iarket plan established on how to sell botanical pesticides.	2.1 Organize training venue 2.2 Inviting participants' 2.3 To conduct one day session on market plan. 2.4 Report writing
4. One-acre farm of pesticidal plants established in Mwasauya ward by April 2023.	ne acre of pesticidal plants established in Mwasauya ward.	1.1 Finding farm and signing contract 1.2 Collection of pesticidal plant seeds 1.3 Farm layout and planting 1.4 Harvesting and processing
5. Tshs 5,000,000 generated from botanical pesticides sales by April 2023.	1. 1,000 kg of botanical pesticides produced. 2. Tshs 5,000,000 generated from botanical pesticides sales.	1.1 Procurement of package material 1.2 Packing crop storage botanical pesticides 1.3 Packing crop spraying botanical pesticides 2.1 Promote botanical pesticides 2.2 Selling botanical pesticides

Source: Study Findings in Mwasauya Ward, 2021.

4.4 Project Planning

Project planning provides detailed information on activities performed during the six-month period of implementation, the responsible persons for each duty, and the timeline and resources used.

4.4.1 Project Implementation Plan

To be sure of the smooth implementation of the planned objectives, a work plan was prepared, and different activities to be carried out were indicated, along with the required resources, time frame, and the person responsible for each objective. Different stakeholders were engaged according to the kind of support they offered within the project. Mshikamano group members were fully engaged from the initial stage, as they were key implementers of the project. The project implementation plan in Table 4.2 shows how the activities were conducted from January to April 2023.

Table 4.2: Project Implementation Plan

Objectives	Output	Activities	Month, 2023				Resource	Responsible
			1	2	3	4		
1. 15 members of the Mshikamano group equipped with knowledge and skills on sustainable agroecological crop pest management using botanical pesticides and integrated pest management by April 2023.	150 ward members sensitised on sustainable agroecological crop pest management using botanical pesticides and integrated pest management	1.1.1 Setting meeting agenda 1.1.2 Organize meeting venue 1.1.3 Inviting participants' 1.1.4 To conduct advocacy meetings 1.1.5 Report writing					Stationary Airtime Airtime Stationary Stationary Experts Stationary	Mshikamano Mshikamano Mshikamano WEO RECODA RECODA Mshikamano
	15 Mshikamano group members trained on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	1.2.1 Organize training venue 1.2.2 Inviting participants' 1.2.3 Sensitizing and training 15 group members 1.2.4 Report writing 1.2.5 Report writing					Airtime Stationary Stationary Refleshment Experts Stationary	 Mshikamano Group leader Mshikamano Mshikamano RECODA Mshikamano
2. 15 Mshikamano group members trained on Botanical pesticides sales project management by April 2023.	15 group members trained on Botanical pesticides sales project management	2.1.1 Organize training venue 2.1.2 Inviting participants' 2.1.3 Training 15 group members 2.1.4 Report writing					Airtime Stationary Stationary Experts Refleshment Stationary	Mshikamano Group leader Mshikamano RECODA Mshikamano
3. One-acre farm of pesticidal plants established in Mwasauya ward by April	One acre of pesticidal plants established in Mwasauya ward	3.1.1 Finding farm and signing contract 3.1.2 Collection of pesticidal plant seeds 3.1.3 Farm layout and planting 3.1.4 Harvesting and processing					Land Casual Labour	Mshikamano Mshikamano Mshikamano Mshikamano
4. Tshs 5,000,000 generated from botanical pesticides sales by April 2023.	1,000 kg of botanical pesticides produced	4.1.1 Procurement of package material 4.1.2 Packing crop storage botanical pesticides. 4.1.3 Packing crop spraying botanical pesticides. 4.1.4 Promote botanical pesticides					Casual Labour Packaging Stationary Microphone/ Speakers generators Personnel's Transport	Mshikamano Mshikamano Mshikamano Mshikamano

Source: Study Findings in Mwasauya Ward, 2021.

4.4.2 Logical Framework

A logical framework is an analytical tool used for project planning, monitoring, and evaluation. It includes a hierarchy of objectives, objectively verifiable indicators, means of verification, and assumptions. The tools helped Mshikamano group members, Singida rural district agriculture officers, and other stakeholders link planned goals and objectives with anticipated activities. The logical framework of this project is illustrated in Table 4.3.

Table 4.3: Logical Framework Matrix

Hierarchy of Objectives	Objectively Verifiable Indicators	Means of Verification	Assumptions
Goal: Improved income for Mshikamano group through botanical pesticides sales for enhancement of food security in Mwasauya ward in Singida Rural District, Singida-Tanzania.	Mshikamano group members households income and food security status	Annual sales report, survey and observation reports	Willingness of each group member to reveal their economic status
Objective 1: 15 members of the Mshikamano group equipped with knowledge and skills on sustainable agroecological crop pest management using botanical pesticides and integrated pest management by April 2023.			
1: Output: 150 ward members sensitised on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	The meeting conducted	Meeting report	Ward members attended
2: Output: 15 Mshikamano group members trained on sustainable agroecological crop pest management using botanical pesticides and integrated pest managemen.	Training and sensitization conducted	Training report	Group members attended
Activities for Output 1			
1.1.1 Setting meeting agenda 1.1.2 Organize meeting venue 1.1.3 Inviting participants 1.1.4 To conduct advocacy meetings 1.1.5 Report writing	Meeting agenda created Meeting venue organized Participants invited Advocacy meeting conducted Report wrote	Meeting report	Effective agenda created Better venue accessed Participants attended Participants attended Useful report
Activities for Output 2			
1.2.1 Organize training venue 1.2.2 Inviting participants 1.2.3 Sensitizing and training 15 group members 1.2.4 Report writing	Training venue organized Participants invited 15 group members sensitized and trained Report wrote	Training report	Better venue accessed Participants attended Participants attended Useful report

Objective 2: 15 Mshikamano group members trained on botanical pesticides sales project Management by April 2023.			
1. Output 15 group members trained on Botanical pesticides sales project management.	Training conducted	Training report	Participants attended
2. Output Market plan established on how to sell botanical pesticides.	Market plan established	Existed market plan	Existed market plan
Activities for Output 1			
2.1.1 Organize training venue 2.1.2 Inviting participants 2.1.3 Training 15 group members 2.1.4 Report writing	Training venue organized Participants invited 15 group members trained Report wrote	Training report	Better venue accessed Participants attended Participants attended Useful report
Activities for Output 2			
2.2.1 Organizing meeting venue 2.2.2 Inviting participants 2.2.3 To conduct one day session on market plan 2.2.4 Report writing	Meeting venue organized Participants invited One day session on market plan conducted Report wrote	Meeting report Meeting report Meeting report Meeting report	Get better venue Participants attended Participants attended Useful report
Objective 3: One acre farm of pesticidal plants established in Mwasauya ward by April 2023.			
1: Output One acre of pesticidal plants established in Mwasauya ward.	Existence of one acre of pesticidal plants farm in mwasauya ward.	Farm contract Farm progress report	One acre of pesticidal plant farm planted
Activities for Output 1			
3.1.1.Finding farm and signing contract 3.1.2 Collection of pesticidal plant seeds 3.1.3 Farm layout and planting 3.1.4 Harvesting and processing	One acre farm found and contract signed Pesticidal plant seeds colleted Farm layout and planting conduted Harvested and processed botanical pesticides	Farm contract Farm progress report Farm progress report Farm progress report	Group member offered farm Quality seeds collected Group members participated effeectivelly Quality botanical pesticides harvested and processed
Objective 4 Tshs 5000000 generated from botanical pesticides sales by April 2023.			
1: Output: 1000kg of botanical pesticides produced. 2: Output: Tsh 5000000 generated from botanical pesticides sales.	1000kg of botanical pesticides produced Botanical pesticides generated Tsh 5,000,000/=	Project report Sales report	Successfully production Market Accessed
Activities for Output 1			
4.1.1 Procurement of package material 4.1.2 Packing crop storage botanical pesticides. 4.1.3 Packing crop spraying botanical pesticides.	Package material procured Storage botanical pesticides packed Spraying botanical pesticides packed	Sales report Sales report Sales report	Material accessed Botanical pesticides packed Botanical pesticides packed
Activities for Output 2			
4.2.1 Promote botanical pesticides 4.2.2 Selling botanical pesticides	Botanical pesticides promoted Botanical pesticides sold	Sales report Sales report	Successfully promotion Successful sales

Source: Study Findings in Mwasauya Ward, 2021.

4.4.3 Inputs

The project used inputs such as time, financial resources, and human capital to facilitate project implementation. Financial resources included support from RECODA and collections from Mshikamano group members. These resources helped to get physical inputs such as stationery materials, refreshments during training sessions, airtime, land, casual labour, pesticide plant seed and its collection bags, pesticidal plant harvesting bags, transport fare, packaging material, microphones for promotion of botanical pesticides, speakers for promotion of botanical pesticides, as well as generators. These resources also covered meeting, workshop, and training expert costs, as shown in Table 4.2.

4.4.3.1 Staffing Pattern

Mshikamano group leaders managed the project, and other members were selected to form a committee that deals with advertising and marketing. Other stakeholders, like RECODA and the district agricultural office, were project advisors. The group leadership was selected based on leadership skills, ability to write reports, and ability to estimate revenue and expenditure. The group leaders were given the task of providing a report to group members, RECODA, and the district agriculture office as the project advisors.

4.4.4 Project Budget

The project's annual budget was shared by the sponsor and Mshikamano group. This budget plan and implementation approach created a sense of we-feeling and togetherness during project implementation. The project budget was Tsh 1,155,300; through the FRN project, RECODA facilitated a sum of Tsh 937,000;

and Mshikamano group members contributed Tsh 218,300. The detailed budget is indicated in Table 4.4.

Table 4.4: Project Budget

Objectives	Output	Activities	Item	Unit	Cost	Total
1. 15 members of the Mshikamano group equipped with knowledge and skills on sustainable agroecological crop pest management using botanical pesticides and integrated pest management by April 2023.	1. 150 ward members sensitised on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	1.1.1 Setting meeting agenda	Stationary	1	5000	5000
			Airtime	1	3000	3000
		1.1.2 Organize meeting venue	Airtime	1	3000	3000
		1.1.3 Inviting participants'	Stationary	1	5000	50000
		1.1.4 To conduct advocacy meetings	Stationary	1	10000	10000
			Experts	1	30000	30000
		1.1. 5 Report writing	Stationary	1	10000	10000
	15 Mshikamano group members trained on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	1.2.1 Organize training venue	Airtime	1	3000	3000
		1.2.2 Inviting participants'	Stationary	1	5000	5000
		1.2.3 Sensitizing and training 15 group members	Stationary	1	10000	10000
			Refleshment	17	2500	42500
			Experts	1	30000	30000
		1.2.4 Report writing	Stationary	1	10000	10000
2 15 Mshikamano group members trained on Botanical pesticides sales project management by April 2023.	1. 15 group members trained on Botanical pesticides sales project management.	2.1.1 Organize training venue	Airtime	1	3000	3000
		2.1.2 Inviting participants'	Stationary	1	5000	5000
		2.1.3 Training 15 group members	Stationary	1	10000	10000
			Experts	1	30000	30000
			Refleshment	17	2500	42500
		2.1.4 Report writing	Stationary	1	10000	10000
	2. Market plan established on how to sell botanical pesticides.	2.2.1 Organize training venue	Airtime	1	3000	3000
		2.2.2 Inviting participants'	Stationary	1	5000	5000
		2.2.2 To conduct one day session on market plan	Stationary	1	10000	10000
			Experts	1	30000	30000
			Refleshment	17	2500	42500
		2.2.4 Report writing	Stationary	1	10000	10000
3 One-acre farm of pesticidal plants established in Mwasauya ward by April 2023.	1. One acre of pesticidal plants established in Mwasauya ward.	3.1.1 Finding farm and signing contract	Land	1	40000	40000
		3.1.2 Collection of pesticidal plant seeds	Casual Labour	3kg	2500	7500
			Collection Bags	1	300	300
		3.1.3 Farm layout and planting	Casual Labour	1acre	25000	25000
		3.1.4 Harvesting and processing	Casual Labour	1 acre	25000	25000
			Harvesting bags	7	500	3500
4 Tshs 5000000 generated from botanical pesticides sales by April 2023.	1. 1000 kg of botanical pesticides produced.	4.1.1 Procurement of package material	Transport	1	2000	2000
		4.1.2 Packing crop storage botanical pesticides	Casual Labour	500	50	25000
			Packeges	500	50	25000
		4.1.3 Packing crop spraying botanical pesticides	Casual Labour	500	50	25000
			Packeges	500	1000	500000
	2. Tshs 5000000 generated from botanical pesticides sales.	4.2.1 Promote botanical pesticides	Stationary	1	5000	5000
			Microphone	1	5000	5000
			Speakers	1	10000	10000
			Generators	1	15000	15000
		4.2.2 Selling botanical pesticides	Personnel's	10	3000	30000
Grand total						**1,155,300**

Source: Study Findings in Mwasauya Ward, 2021.

A Gantt chart has been prepared to ease the involvement process and to indicate a series of activities to be performed to ensure that all planned activities are implemented as planned. A Gantt chart outlines a series of activities for each month and week to be implemented. The chart helped to implement all activities on time due to the availability of funds at the time. The chart displays objectives, expected output, and activities, as detailed in Table 4.5.

Table 4.5: Project Implementation Gantt Chart for the Year 2023

Objectives	Output	Activities	January				February				March				April			
			W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
1. 15 members of the Mshikamano group equipped with knowledge and skills on sustainable agroecological crop pest management using botanical pesticides and integrated pest management by April 2023.	1. 150 ward members sensitised on sustainable agroecological crop pest management using botanical pesticides and integrated pest management. 2. 15 Mshikamano group members trained on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	1.1.1 Setting meeting agenda 1.1.2 Organize meeting venue 1.1.3 Inviting participants' 1.1.4 To conduct advocacy meetings 1.1.5 Report writing 1.2.1 Organize training venue 1.2.2 Inviting participants' 1.2.3 Sensitizing and training 15 group members 1.2.4 Report writing															
2. 15 Mshikamano group members trained on Botanical pesticides sales project management by April 2023.	1. 15 group members trained on Botanical pesticides sales project management. 2. Market plan established on how to sell botanical pesticides	1.1.2 Organize training venue 1.1.3 Inviting participants' 1.1.4 Training 15 group members 1.1.5 Report writing 2.2.1 Organize training venue 2.2.2 Inviting participants' 2.2.3 To conduct one day session on market plan.															
3. One-acre farm of pesticidal plants established in Mwasauya ward by April 2023	1. One acre of pesticidal plants established in Mwasauya ward.	3.1.1 Finding farm and signing contract 3.1.2 Collection of pesticidal plant seeds 3.1.3 Farm layout and planting 3.1.4 Harvesting and processing															
4. Tshs 5000000 generated from botanical pesticides sales by April 2023.	1. 1000 kg of botanical pesticides produced. 2. Tshs 5000000 generated from botanical pesticides sales.	4.1.1 Procurement of package material 4.1.2 Packing crop storage botanical Pesticides 4.1.3 Packing crop spraying botanical pesticides 4.2.1 Promote botanical pesticides 4.2.2 Selling botanical pesticides															

4.4.5 Project Implementation Gantt Chart

A Gantt chart has been prepared to ease the involvement process and to indicate a series of activities to be performed to ensure that all planned activities are implemented as planned. A Gantt chart outlines a series of activities for each month and week to be implemented. The chart helped to implement all activities on time due to the availability of funds at the time. The chart displays objectives, expected output, and activities, as detailed in Table 4.5.

4.5 Actual Project Implementation Report

The implementation of the project started in January 2023, as illustrated in the project implementation plan, and it followed the sequenced order of activities that resulted in the realisation of project objectives. The CED student, an FRN project staff under RECODA, the Singida rural district agriculture office, Mwasauya ward leaders, and Mshikamano group members, participated in all stages to ensure appropriate and regular monitoring of all project activities.

The implementation started by conducting a CNA, through which community needs were identified, a project was selected, and the community to implement the project was identified. The project's implementation was based on three aspects: the sensitisation and training of 15 Mshikamano group members and 150 smallholder farmers on botanical pesticides and entrepreneurial and business management skills. Mshikamano group was involved in the identification of the botanical pesticide sales activity, sensitisation of the community on the botanical pesticide sales project, and selling of botanical pesticides. Another crucial activity in which Mshikamano group was involved was ensuring the accessibility of funds for the project. The task was

successfully achieved in collaboration with different stakeholders who were interested in the project.

Group members worked closely with the FRN project staff to monitor the project's implementation closely to ensure it proceeded as planned. The community economic development expert participated in the monitoring exercise in collaboration with the group monitoring team from the beginning to familiarise the group members with the monitoring tasks for the daily interventions. Pre-evaluation and intermediate evaluations were conducted to assess the project's feasibility and viability. Monitoring and evaluation allowed flexibility in activities to suit the implementation environment, achieving predetermined objectives. Monitoring and evaluation enabled flexibility in activities, achieving predetermined objectives. Midterm and annual evaluations were conducted after the project began.

Advocacy meetings and sensitisation training were conducted for 150 ward and 15 group members on sustainable agroecological crop pest management using botanical pesticides. 15 group members were trained in botanical pesticide sales, project management, and marketing plans. The training focused on areas such as marketing team development, leadership, sales coordination, and techniques. The group developed a marketing plan for selling botanical pesticides, enabling the business to achieve sales objectives and exceed them. The group organised a farmer’s exchange visit trip to Moshi and Arusha to learn about botanical pesticides from NM-AIST and the East African Impact Centre. The visit focused on challenges and opportunities in businesses, addressing production, processing, marketing, and value chain gaps.

The group members found one acre of land in Mwasauya and signed a contract with land owners to offer legal protection in the event of a dispute, which can be used in a court of law if necessary. Therefore, one acre of pesticidal plants was established in Mwasauya ward. The group opted to use Tagetes minuta plants as the most commonly used botanical pesticides in the Singida rural district. Tagetes minuta seeds were collected, a farm layout was conducted, and the farm planted botanical pesticidal plants. After one month, the group started harvesting and processing botanical pesticides. The group harvested and processed botanical pesticides, procured package material, and began packing both spraying and storage pesticides.

It is reported that 950 kg of botanical pesticides were produced, but 400 kg were packed in 500-gramme bags for crop storage and 300 kg for spraying. 250 kg are still unpackaged and waiting for marketing.The project promoted pesticide benefits for food security through local market campaigns to boost brand image and sales. Group members promoted botanical pesticides at ward meetings, markets, and farmer-to-farmer exchanges.

It is reported that all 400 picies of storage botanical pesticides were sold for 5000 Tanzanian shillings each and generated Tanzanian shillings 2000000, and 200 picies of spraying botanical pesticides were sold for 5000 and generated Tanzanian shillings 1000000. The other 100 picies of botanical pesticides for spraying crops are still in the process of being sold. Therefore, until now, the group has collected a total of 3000000 Tanzanian shillings from the sale of botanical pesticides. The project generated a profit of 1844700, despite a budget of 1155300, and unpacked 250 kg of botanical pesticides and unsold 100 picies of spraying.

Figure 4.1: Farmers Exchange Visit Trip at the ECHO

Source: Study Findings in Mwasauya Ward, 2021

Figure 4.2: Farmers' Exchange Visit Trip at the NM-AIST

Source: Study Findings in Mwasauya Ward, 2021

Figure 4.3: Training on Botanical Pesticides

Figure 4.4: One-Acre Farm of Pesticidal Plants Established in Mwasauya Ward.

Figure 4.5: Mshikamano Group Members Harvesting Pesticidal Plants Farm

Figure 4.6: Mshikamano Group Members Showcase Botanical Pesticide Products

Figure 4.7: Mshikamano Group Member selling crop storage Botanical Pesticide

Figure 4.8: Mshikamano Group Member selling crop spraying Botanical Pesticide

Source: Study Findings in Mwasauya Ward, 2021.

Table 4.6: Actual Project Implementation Report

Objectives	Output	Activities	Implementation status	Reasons
1. 15 members of the Mshikamano group equipped with knowledge and skills on sustainable agroecological crop pest management using botanical pesticides and integrated pest management by April 2023.	1. 150 ward members sensitised on sustainable agroecological crop pest management using botanical pesticides and integrated pest management. 2. 15 Mshikamano group members trained on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	1.1.1 Setting meeting agenda 1.1.2 Organize meeting venue 1.1.3 Inviting participants' 1.1.4 To conduct advocacy meetings 1.1.5 Report writing 1.2.1 Organize training venue 1.2.2 Inviting participants' 1.2.3 Sensitizing and training 15 group members 1.2.4 Report writing	Agenda set Venue orgarganized Participants' Invited Advocacy meetings conducted Report wroten Venue orgarganized Participants' Invited 15 group members were traineed and sensitized Report writen	Completed Completed Completed Completed Completed Completed Completed Completed Completed
2. 15 Mshikamano group members trained on Botanical pesticides sales project management by April 2023.	1. 15 group members trained on Botanical pesticides sales project management 2. Market plan established on how to sell botanical pesticides.	2.1.1 Organize training venue 2.1.2 Inviting participants' 2.1.3 Training 15 group members 2.1.4 Report writing 2.2.1 Organize training venue 2.2.2 Inviting participants' 2.2.3 To conduct one day session on market plan. 2.2.4 Report writing	Venue orgarganized Participants' Invited 15 group members were trained Report writen Venue orgarganized Participants' Invited One day session on market plan conducted Report writen	Completed Completed Completed Completed Completed Completed Completed Completed

Objectives	Output	Activities	Implementation status	Reasons
3. One-acre farm of pesticidal plants established in Mwasauya ward by April 2023.	One acre of pesticidal plants established in Mwasauya ward.	3.1.1 Finding farm and signing contract 3.1.2 Collection of pesticidal plant seeds 3.1.3 Farm layout and planting 3.1.4 Harvesting and processing	Farm found and contract signed Pesticidal plant seeds collected Farm layout done and planted	Completed Completed Completed Completed
4. Tshs 5000000 generated from botanical pesticides sales by April 2023.	1. 1000 kg of botanical pesticides produced 2. Tshs 5000000 generated from botanical pesticides sales.	4.1.1 Procurement of package material 4.1.2 Packing crop storage botanical pesticides 4.1.3 Packing crop spraying botanical Pesticides 4.2.1 Promote botanical pesticides 4.2.2 Selling botanical pesticides	Package material Procured Crop storage botanical pesticides packed Crop spraying botanical pesticides packed Botanical pesticides promoted Botanical pesticides were sold. Tsh 3000000 was collected, but 250 kg were unpacked, and 100 pieces were unsold. Currently, the sales have generated a profit of Tsh 1844700.	On progress On progress On progress On progress On progress

Source: Study Findings in Mwasauya Ward, 2021.

CHAPTER FIVE

PROJECT PARTICIPATORY MONITORING, EVALUATION AND SUSTAINABILITY

5.1 Chapter Overview

This chapter outlines participatory monitoring and evaluation to ensure project sustainability. It assessed implementation, progress, and success, determining if the project went in the right direction and how future efforts could be improved. Project sustainability refers to the project's ability to generate the required results after the project ends or the sponsors have completed their roles. Proper monitoring and evaluation are essential for determining the right direction and improving future efforts.

5.2 Participatory Monitoring

The objective of conducting participatory monitoring was to collect information on all aspects of activities that involved Mshikamano group in project implementation. Participatory monitoring was conducted by analyzing the current situation, identifying problems and finding solutions to problems, keeping project activities on schedule, measuring project progress towards success, and formulating and making decisions. It was used as the major tool and approach at all levels of monitoring. It was done using the set indicators in the logical framework matrix in Table 9. It was simple to identify the project's failure and success by monitoring beneficiaries.

Monitoring was based on determining the project's relevance, whether the project and its activities address its broader development objective, effectiveness, and efficiency, and demonstrating whether project activities have been completed

efficiently and effectively. Monitoring was conducted every second week of the second month based on monitoring tools developed and verifiable indicators such as the number of meetings held, the number of CNA meetings held with the community, the number of trainings conducted, the type of training conducted, and the number of participants who attended, the area cultivated, the number of botanical pesticides sold, and the income generated by botanical pesticide sales, the cost and expenditure of the project, and the tools and equipment received.

5.2.1 Monitoring Information System

A system was developed to collect and report project activities for the project team to plan, monitor, evaluate, and report on operations and performance. The system involved a consultative process with stakeholders like WAEO, CED students, and RECODA. It required data on activities, cost, expenditure, staff knowledge, commodities, tools, equipment, and cultivated area.

5.2.2 Participatory Monitoring Tools

Three participatory methods were used to monitor the project's implementation: structured interviews, direct observation, and focus group discussions. Structured interviews collected information on the area and botanical pesticide sales project, sensitisation to sustainable agroecological crop pest management, and access to a reliable market. Direct observation allowed for observations of pesticidal plant farms and customer responses to botanical pesticides in the market, recording issues accordingly.

5.2.2.1 Focus Group Discussion

A focus group discussion involved 15 respondents discussing project performance issues, using facilitation skills to avoid individual dominance. Participants were free to share their experiences, ensuring a comprehensive understanding of the topic.

5.2.2.2 Interview

The project required additional information from key informants, including district council officials, RECODA extension officers, ward and village leaders, and Mshikamano group members. The researcher gathered this information through interviews with Mshikamano group leaders.

5.2.2.3 Observation

Mshikamano group, researchers, village leaders, RECODA, extension officers, and researchers used observation to evaluate planned activities' efficiency, observing equipment, training participants, and sensitization meeting attendants.

5.2.2.4 Documentation

The botanical pesticide sales project's documents were well organised, including receipt books, payment vouchers, meeting minutes, product records, an equipment list, and market information. Mshikamano group chairperson ensured that the secretary and treasurer kept all necessary documents for project members and stakeholders. An expert helped the group members learn proper report writing and kept reports in order. Expert, district officials, extension officers, and RECODA officials collaborated to create daily record book for project income, scientific run,

and sustainability.

5.2.3 Monitoring Tools

The main monitoring tools that were used in this study are the project work plan, the monitoring plan, and the project budget. The monitoring exercise was done through the review of reports, which provide relevant monitoring information.

5.2.4 Monitoring Findings

Information collected during the monitoring process was recorded, processed, analyzed, and compared to the different responses and information collected. The data was used to see whether the planned activities of the project were going well, what challenges were encountered during implementation, and what action should be taken to overcome those challenges.

Table 5.1: Participatory Monitoring Plan

Objectives	Output	Activities	Item	Unit	Cost	Total
1. 15 members of the Mshikamano group equipped with knowledge and skills on sustainable agroecological crop pest management using botanical pesticides and integrated pest management by April 2023.	1. 150 ward members sensitised on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	1.1.1 Setting meeting agenda	Stationary	1	5000	5000
			Airtime	1	3000	3000
		1.1.2 Organize meeting venue	Airtime	1	3000	3000
		1.1.3 Inviting participants'	Stationary	1	5000	50000
		1.1.4 To conduct advocacy meetings	Stationary	1	10000	10000
			Experts	1	30000	30000
		1.1. 5 Report writing	Stationary	1	10000	10000
	15 Mshikamano group members trained on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	1.2.1 Organize training venue	Airtime	1	3000	3000
		1.2.2 Inviting participants'	Stationary	1	5000	5000
		1.2.3 Sensitizing and training 15 group members	Stationary	1	10000	10000
			Refleshment	17	2500	42500
			Experts	1	30000	30000
		1.2.4 Report writing	Stationary	1	10000	10000
2 15 Mshikamano group members trained on Botanical pesticides sales project management by April 2023.	1. 15 group members trained on Botanical pesticides sales project management.	2.1.1 Organize training venue	Airtime	1	3000	3000
		2.1.2 Inviting participants'	Stationary	1	5000	5000
		2.1.3 Training 15 group members	Stationary	1	10000	10000
			Experts	1	30000	30000
			Refleshment	17	2500	42500
		2.1.4 Report writing	Stationary	1	10000	10000
	2. Market plan established on how to sell botanical pesticides.	2.2.1 Organize training venue	Airtime	1	3000	3000
		2.2.2 Inviting participants'	Stationary	1	5000	5000
		2.2.2 To conduct one day session on market plan	Stationary	1	10000	10000
			Experts	1	30000	30000
			Refleshment	17	2500	42500
		2.2.4 Report writing	Stationary	1	10000	10000
3 One-acre farm of pesticidal plants established in Mwasauya ward by April 2023.	1. One acre of pesticidal plants established in Mwasauya ward.	3.1.1 Finding farm and signing contract	Land	1	40000	40000
		3.1.2 Collection of pesticidal plant seeds	Casual Labour	3kg	2500	7500
			Collection Bags	1	300	300
		3.1.3 Farm layout and planting	Casual Labour	1acre	25000	25000
		3.1.4 Harvesting and processing	Casual Labour	1 acre	25000	25000
			Harvesting bags	7	500	3500
4 Tshs 5000000 generated from botanical pesticides sales by April 2023.	1. 1000 kg of botanical pesticides produced.	4.1.1 Procurement of package material	Transport	1	2000	2000
		4.1.2 Packing crop storage botanical pesticides	Casual Labour	500	50	25000
			Packeges	500	50	25000
		4.1.3 Packing crop spraying botanical pesticides	Casual Labour	500	50	25000
			Packeges	500	1000	500000
	2. Tshs 5000000 generated from botanical pesticides sales.	4.2.1 Promote botanical pesticides	Stationary	1	5000	5000
			Microphone	1	5000	5000
			Speakers	1	10000	10000
			Generators	1	15000	15000
		4.2.2 Selling botanical pesticides	Personnel's	10	3000	30000
Grand total						**1,155,300**

Source: Study Findings in Mwasauya Ward, 2021.

5.3 Participatory Evaluation

Participatory evaluation involves examining and assessing projects by stakeholders and beneficiaries to build capacity and achieve objectives. It is reflective, action-orientated, and involves stakeholders as question-makers, planners, data gatherers, and problem solvers. Higher levels of involvement indicate more effective use of evaluative knowledge. In April 2023, a midterm and annual evaluation was conducted, involving experts, FRN project officers, Mshikamano group members, and Singida rural district officers, to assess project objectives, fulfil expectations, and suggest improvement opportunities.

5.3.1 Performance Indicators

Performance indicators assess a project's change, quality, quantity, and progress towards outputs and outcomes. They demonstrated relevance, performance, and effectiveness. Table 15 links objectives, output, activities, and resources needed. Effective resource allocation leads to the desired output and objectives. Participants refer to output and performance indicators during monitoring and evaluation to ensure alignment.

5.3.2 Participatory Evaluation Methodology

5.3.2.1 Evaluation Tools

The project's midterm evaluation in April 2023 utilized Participatory Rural Appraisal, involving structured interviews, observations, focus group discussions, and document reviews. Key evaluation tools included meetings, checklists, effective listening, and monitoring reports.

5.3.3 Project Evaluation Findings

During evaluation, four major project objectives were examined using several performance indicators for each objective. Expected outcomes and actual outcomes were also examined and noted in detail during the midterm evaluation exercise, which was conducted in April 2023.

Table 5.2: Project Evaluations Results Summary

Objectives	Output	Activities	Indicators	Data source	Tools	Responsible	Time
1) 15 members of the Mshikamano group equipped with knowledge and skills on sustainable agroecological crop pest management using botanical pesticides and integrated pest management by April 2023.	1)150 ward members sensitised on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	1.1.1Setting meeting agenda	List of meeting agenda	Meeting report	Intervie	Mshikaman	April 2023
		1.1.2 Organize meeting venue	Venue in place	Meeting report	Intervie	Mshikaman	April 2023
		1.1.3 Inviting participants'	List of participant	Meeting report	Intervie	Mshikaman	April 2023
		1.1.4 To conduct advocacy meetings	List of 150 ward members attended	Meeting report	Intervie FGD	Mshikaman &RECODA	April 2023
		1.1.5 Report writing	Submitted report	Meeting report	Intervie	Mshikaman &RECODA	April 2023
	2) 15 Mshikamano group members trained on sustainable agroecological crop pest management using botanical pesticides and integrated pest management.	1.2.1 Organize training venue	Venue in place	Training report	Intervie	Mshikaman	April 2023
		1.2.2 Inviting participants'	List of participant	Training report	Intervie	Group ader	April 2023
		1.2.3 Sensitizing and training 15 group members	List of 15 group members attended	Training and project progress report	Intervie FGD	Mshikaman &RECODA	April 2023
		1.2.4 Report writing	Submitted report	Training report	Intervie	Mshikaman	April 2023
2) 15 Mshikamano group members trained on Botanical pesticides sales project management by April 2023.	1) 15 group members trained on Botanical pesticides sales project management.	2.1.1 Organize training venue	Venue in place	Training report	Intervie	Mshikaman	April 2023
		2.1.2 Inviting participants'	List of participant	Training report	Intervie	Mshikaman	April 2023
		2.1.3 Training 15 group members	List of 15 group members attended	Training report	Intervie FGD	Mshikaman &RECODA	April 2023
		2.1.4 Report writing	Submitted report	Training report	Intervie	Mshikaman	April 2023
Objectives	2) Market plan established on how to sell botanical pesticides.	2.2.1Organize training venue	Venue in place	Training report	Intervie	Mshikaman	April 2023
4) Tshs 5000000 generated from botanical pesticid sales by April 202		2.2.2 Inviting participants'	List of participant	Training report	Intervie	Mshikaman	April 2023
		2.2.3 To conduct one day session on market plan	List of 15 group members participated in one day session on market plan	Training report	Intervie Observat on	Mshikaman	April 2023
		2.2.4 Report writing	Submitted report	Training report	Intervie	Mshikaman	April 2023

Source: Study Findings in Mwasauya Ward, 2021.

5.4 Project Sustainability

A sustainable project provides long-term benefits to the target group after donor assistance ends. It involves environmentally sensitive development activities that lead to long-lasting improvements beyond the project's boundaries and time, without dependency. The CBO must develop its definition of sustainability, its connection to its context, focus, and state of affairs.

5.4.1 Institutional Sustainability

The sustainable botanical pesticide sales project relies on available human resources, including the Project Committee, Mshikamano group head, and Singida Rural District Agriculture Office. Beneficiaries pledge to contribute 25% of their income after selling botanical pesticides, which will be used for production and sales next season. Capacity building in entrepreneurial and business management skills will improve production and commitment. Participation in identification, planning, implementation, monitoring, and evaluation were essential for fostering ownership and project sustainability.

5.4.2 Financial /Economic Sustainability

The project received support from RECODA through the FRN project and the Mshikamano group, which contributed Tsh. 1000000 and Tsh. 155300, respectively. Therefore, in the next season, capital will not depend on RECODA or other institutions, but the growing demand for botanical pesticides indicates sustainability. Income from the project will finance production and other costs, ensuring the project's sustainability.

5.4.3 Political Sustainability

The Singida rural district council, management team, Mshikamano Group leadership, WEO, and VEO jointly support the project to help smallholder farmers in Mwasauya ward. The FRN project funded it to support the National Strategy for Growth and Poverty II.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Chapter Overview

Chapter presents community study's conclusions, recommendations, and project impact summary, covering problem identification, implementation, monitoring, evaluation, and sustainability.

6.2 Conclusion

A participatory need assessment was conducted in Mwasauya ward to rank the most pressing needs of smallholder farmers and identify the most critical intervention to meet the essential needs. A researcher got information by using a survey questionnaire, observing, and talking to key informants. The study found that improved food security is a crucial community need. Pests are the source of food insecurity. Pests cause smallholder farmers to lose food in both the pre- and post-harvest stages. Consequently, the study revealed that the most critical intervention to meet the essential needs was the sale of botanical pesticides.

From the literature review, it was learnt that pest damage to crops is one of the biggest challenges to food security in Tanzania, and reduces smallholder farmers' crop yields. According to the FAO, globally, 30% to 40% of crop production is lost to pests, whereas in Tanzania, only 15% of the produce is lost to pests. Mostly smallholder farmers use synthetic pesticides to control pests, which have side effects on human health and kill beneficial insects that can help with pollination or natural pest control. This challenge influenced smallholder farmers in Mwasauya ward to opt for the botanical pesticide sales project. Botanical pesticides control pests

without harming the environment or having side effects on consumers' and farmers' health. It breaks down faster than most chemical pesticides and is thought to be better for the environment and less likely to kill beneficial insects than synthetic pesticides that stay in the environment longer.

The implementation of the project started in January 2023, as illustrated in the project implementation plan, and it followed the sequenced order of activities that resulted in the realisation of project objectives. The CED student, the FRN project staff under RECODA, the Singida rural district agriculture office, Mwasauya ward leaders, and Mshikamano group members, participated in all stages to ensure appropriate and regular monitoring of all project activities. The project's implementation was based on three aspects: sensitisation and training of 15 Mshikamano group members and 150 smallholder farmers on botanical pesticides and entrepreneurial and business management skills.

All project objectives and planned activities were done accordingly, except for one activity, which is the annual evaluation. Training Mshikamano group and some of the smallholder farmers on botanical pesticides, and entrepreneurial and business management skills contributed to the success of the project. Thus, annual evaluations will be successfully implemented due to the skills obtained during training.

Monitoring was conducted every second week of the second month based on the monitoring method, tools developed, and verifiable indicators. Three participatory methods were applied in monitoring the project's implementation. These are structured interviews, direct observation, and focus group discussions. Verifiable

indicators used are the number of meetings held, the number of CNA meetings held with the community, the number of trainings, the type of training, and the number of participants who attended, the area cultivated, the cost and expenditure, and the equipment received. A midterm evaluation was conducted in April 2023, while the annual evaluation will be conducted in December 2023. The evaluation involved project committee leaders, monitoring experts, FRN project officers, and Singida rural district officers. It assessed project objectives, fulfilled expectations, and suggested improvement opportunities.

Until now, there have been no unexpected incidences that could greatly affect the ability to complete the project and achieve the overarching goal and the specific project objectives. However, the project anticipates achieving specific objectives upon successful completion of the botanical pesticide sales project.

6.3 Recommendations

6.3.1 Government and Private Sectors

Tanzania's Ministry of Agriculture acknowledges botanical pesticides' potential for pest control but lacks a specific policy for their development. The study suggests increasing the number of extension officers trained in botanical pesticides and considering policy issues to support growth. The government and private sectors should promote small-scale producers, develop policy directives for large-scale production, create market opportunities, support investments in microprocessing and small-scale industries, and invest in research for pesticidal plant varieties.

6.3.2 Project Stakeholders

The host organisation, community development officer, extension officer, and trade

officer should supervise the group for capacity building, mentoring, and market linkage. They should provide practical guidance on producing quality botanical pesticides, branding, packaging, marketing, and training on business management, financial management, project management, and conflict resolution to prevent disintegration.

6.3.3 CED Practitioners

Establishing strong producer groups was a challenging process that took time and involved phases. The training helped clarify group purpose and expectations and guided members through understanding constitutions and leader elections. This helped member's feel connected and kept the group together. Mobilising all members from the beginning to the end of the project was easy, but conflict resolution trainings are recommended to maintain unity and prevent disintegration among the 15 beneficiaries.

6.3.4 Scholars and the Community

A community economic development approach is recommended for future projects. The approach has helped the host organisation and other stakeholders get a direct answer to community needs. This approach enhanced ownership and sustainability by identifying real needs and involving stakeholders in both material and financial aspects. The project helped smallholder farmers create income-generating activities for improved food security. Although the project succeeded, it's insufficient to meet the community's needs. Complementary projects are needed to create a significant impact.

REFERENCES

Bya, I., Bikoreramo, M., Bijyanye, K. U., & Serivisi, N. A. (2020). *Mugonero Adventist Hospital Catchment Area*.

Czyżewski, B., Sapa, A., & Kułyk, P. (2021). *Human capital and eco-contractual governance in small farms in Poland: Simultaneous confirmatory factor analysis with ordinal variables. Agriculture (Switzerland)*, *11*(1), 1–16.

Davis, K., Gammelgaard, J., Preissing, J., Gilbert, R., & ... (2021). *Investing in farmers: Agriculture human capital investment strategies*. https://books.google.Com/Books?Hl=En&Lr=&Id=4mtveaaaqbaj&Oi=Fnd&Pg=PR7&Dq=Agripreneur+Behaviour&Ots=Z66b3ue9rt&Sig=Swlbmd84byk8pbw_Ekxidturq5y

Dui, H. (2020). Review of Human Capital Theory. *International Journal of Advance Research and Innovative Ideas in Education*, *6*(6), 87–89. www.ijariie.com

FAO's Plant Production and Protection Division. (2022). *FAO's Plant Production and Protection Division*. https://doi.org/10.4060/cc2447en

FAO. (2019a). *FSIN Food Security Information Network Global Report on Food Crises*. http://www.fsinplatform.org/sites/default/files/resources/files/GRFC 2019_Full Report.pdf

FAO. (2019b). SDG 12.3.1.a Food Loss Index. *Food Loss and Food Waste: Causes and Solutions*, *December*. http://www.fao.org/food-loss-and-food-waste/flw-data

Flick, U., & Flick, U. (2018). Triangulation in Data Collection. In *The SAGE Handbook of Qualitative Data Collection*. https://doi.org/10.4135/9781526416070.n34.

Garcia, L. (2020). *Insecticides in Tanzanian Farms Ecological and Economic Benefits and Risks of Using Botanical Insecticides in Tanzanian Farms*.

Goldin, C., & Katz, L. F. (2024). *The Incubator of Human Capital :*

Humphrey, S. C., Respikius, M., & Mabebe, N. (2023). The role of farmer research networks (frn) principles in influencing farmers adoption of improved groundnut cultivars in Singida Rural District of Semi-Arid Central Tanzania. *Journal of Agricultural Extension and Rural Development*, *15*(2), 102–116.

Kessy, A. (2021). Climate Change and Poverty Reduction Strategies: Challenges and Lessons from Tanzania. *Tanzania Journal for Population Studies and Development*, *28*(2), 81–99. https://doi.org/10.56279/tjpsd.v28i2.128

Khaykin, M. M., Lapinskas, A. A., & Kochergina, O. A. (2020). *The Development of the Theory of Human Capital in the Historical Dimension*. *139*(Icemt), 505–510.

Kusolwa, P., Philipo, M., & Mbega, E. (2022). *Effects of Tephrosia vogelii and rabbit urine formulation on insect pests and yields of cowpea Singida, Tanzania*.

Lengai, G. M. W., Muthomi, J. W., & Mbega, E. R. (2020a). Phytochemical activity and role of botanical pesticides in pest management for sustainable agricultural crop production. *Scientific African*, *7*, e00239. https://doi.org/10.1016/j.sciaf.2019.e00239

Lengai, G. M. W., Muthomi, J. W., & Mbega, E. R. (2020b). Phytochemical activity and role of botanical pesticides in pest management for sustainable agricultural crop production. *Scientific African*, *7*. https://doi.org/10.1016/j.sciaf.2019.e00239

Leoni, S. (2023). A Historical Review of the Role of Education: From Human Capital to Human Capabilities. *Review of Political Economy*, *0*(0), 1–18.

Makirita, W. E. (2020). Development of bio-pesticide for management of spodoptera frugiperda (J.E. Smith) and other lepidopter apests of maize in Tanzania. In *Journal of nanoscience and nanotechnology* (Vol. 20, Issue 3).

Mkindi, A. G. (2020). *Enhancement Of Plant Extracts Use For Pest Control And Growth Promotion Of Common Bean (Phaseolus vulgaris)*. 1–109.

Mkonda, M. Y., & He, X. (2018). Climate variability and crop yields synergies in Tanzania's semiarid agroecological zone. *Ecosystem Health and Sustainability*, *4*(3), 59–72.

Mlayeh, S., Annabi, K., Daly, A. Ben, Jedidi, M., & Dhiab, M. Ben. (2020). Pesticide poisoning deaths: a 19-year retrospective study of medicolegal autopsies in center Tunisia. *Egyptian Journal of Forensic Sciences*, *10*(1). https://doi.org/10.1186/s41935-020-00201-7.

Oldiges, C., & Cosmas, S. G. (2022). *DRAFT: Pro-poor Poverty Reduction in Tanzania in the New Millennium?* https://iariw.org/wp-content/uploads/2022/11/Oldiges-and-Cosmas-IARIW-TNBS-2022.pdf

Pollmann-larsen, M. (2024). Food loss and waste. *Nature Food*, *5*(8), 639. https://doi.org/10.1038/s43016-024-01041-7

Ratto, F., Bruce, T., Chipabika, G., Mwamakamba, S., Mkandawire, R., Khan, Z., Mkindi, A., Pittchar, J., Chidawanyika, F., Sallu, S. M., Whitfield, S., Wilson, K., & Sait, S. M. (2022). Biological control interventions and botanical pesticides for insect pests of crops in sub-Saharan Africa: A mapping review. *Frontiers in Sustainable Food Systems*, *6*.

https://doi.org/10.3389/fsufs.2022.883975.

Rwegoshora, L. M., Tairo, V. E., & Olotu, M. I. (2023). Efficacy of the Botanical Extracts, Azadirachta indica (Sapindales: Meliaceae) and Tagetes minuta (Asterales: Asteraceae) in the Control of Cabbage Insect Pests in Iringa District, Tanzania. *Tanzania Journal of Science*, *49*(2), 402–412.

Santoso, M., Bezner-Kerr, R., Kassim, N., Mtinda, E., Martin, H., Hoddinott, J., & Young, S. (2020). Predictors of Program Participation in a Nutrition-Sensitive Agroecological Intervention in Singida, Tanzania. *Current Developments in Nutrition*, *4*, 053_108.

Sürücü, L., & Maslakçi, A. (2020). Validity and Reliability in Quantitative Research. *Business & Management Studies: An International Journal*, *8*(3), 2694–2726.

Thorne, S. (2020). Beyond theming: Marking qualitative matter. Nursing Inquiry. In *Qualitative Psychology* (Issue January 2021).

Tian, X., & Tóth, A. (2024). New human capital theory from the perspective of time allocation: Evolution and prospects. *Prosperitas*, *11*(In press), 1–13.

URT. (2018). *The United Republic Of Tanzania Ministry of Agriculture National Post-Harvest Management Strategy-NPHMS Dodoma , Tanzania October , 2018 Table of Contents Table of Contents*

Violet, A. (2021). *Tanzania : National Report On Alternatives To Highly Hazardous Pesticides (Hhps) - Second Phase May 2021*. *May*.

Visser, J., & Wangu, J. (2021). Women's dual centrality in food security solutions: The need for a stronger gender lens in food systems' transformation. *Current Research in Environmental Sustainability*, *3*(May), 100094.

Xu, Y., & Goodacre, R. (2018). On Splitting Training and Validation Set: A Comparative Study of Cross-Validation, Bootstrap and Systematic Sampling for Estimating the Generalization Performance of Supervised Learning. *Journal of Analysis and Testing*, *2*(3), 249–262.

APPENDICES

Appendix: I Concert Forms for Participants

ID No: _____

Greetings,

My Name is Augustine Mbai Keya. I'm a student at the Open University of Tanzania studying Master of community economic development. Currently, I am doing research on improved income for mshikamano farmer group through botanical pesticides sales in Mwasauya ward in Singida rural district, Singida-Tanzania.

Purpose of the study

The purpose of the study is to improve food security and income among smallholder farmers through botanical pesticides sales.

Participation

If you agree to participate in the study you will be involved in In-depth interviews or filling in questionnaire. We would like to hear your thoughts about the challenge of food security and botanical pesticides sales. We will ask some questions and you will be free to respond based on your opinion.

Confidentiality

Your information will be treated with great confidentiality and will be used for study purpose only. Personal identifiers including names will not be attached to any of the reports.

Benefits

Your views and those of other people with regards to food security and botanical

pesticides will help to establish botanical pesticides sales project that will benefit smallholder farmers towards food security and generating income through botanical pesticides sales.

Although this is not a direct personal benefit but we hope that the entire community and nation will benefit from the improving food security through botanical sales project. We do not anticipate any major risk in this study but psychological risk associated with some questions which may not be pleasant to you. However, you may feel free not to answer questions which you may feel uncomfortable to answer.

Right to withdraw and alternatives

To participate in this study is completely voluntary. You can freely choose not to participate in this study and even if you have already accepted to participate in this study you can quit at any time if it is necessary. No penalty or loss will be encountered upon refusal to participate or withdraw from the study.

Who to consult?

If you ever have questions about this study, feel free to contact the following:

1. Augustine Mbai Keya (Principal Investigator)

Open University of Tanzania (OUT),

P.O.Box 10633, Arusha, Mob: 0767087634 or Email (augustinekeya@gmail.com)

2. Prof. Deus Ngaruko (the study Supervisor), or Mob: 0764378575 or Email ngaruko.papers@gmail.com

INFORMED CONSENT FORM

Do you have any question?

If you agree to participate in this study you are requested to indicate by signing below:

I have been informed about this study and my questions have been answered and I am satisfied. I agree to participate in this study and I have not violated my rights by signing [this consent form].

Name_____Signature/thumbprint_____Date_____

Witness_____Signature/thumb print_____Date_____

Researcher_____Signature_____Date_____

Appendix: II Data Collection Tools in English

SURVEY QUESTIONNAIRE ON IMPROVED INCOME FOR MSHIKAMANO GROUP THROUGH BOTANICAL PESTICIDES SALES IN MWASAUYA WARD IN SINGIDA RURAL DISTRICT, SINGIDA-TANZANIA

Name of Interviewer ……Phone ……..

Name of Interviewee …… Phone ……

Date of interview |___|___| |___|___| |__|___| (Date/ Month/ Year)

SECTION A: DEMOGRAPHIC INFORMATION (circle where is apply)

0.01 Sex a. Male b. Female

0.02 Age: a. 18-25b. 26-35 c. 36-45 d. >46

0.03 Education level

a. No education
b. Primary
c. Secondary
d. College /university
e. Others (specify)……

0.04 Marital status

a. Single
b. Living with partners
c. Married
d. Widowed
e. Divorced
f. Separated

0.05 Occupation

a. Trading

b. Farmer

c. Craft

d. Employed

e. None

f. Others (specify)……

0.06 Income per month

a. < 30000 Tsh

b. 31000 -50000Tsh

c. > 51000-70000 Tsh

d. More than 70000 Tsh

SECTION B: FARMERS PRESSING NEEDS AND INTERVENTIONS

0.07 How do you currently control pest?

a. Synthetic pesticides

b. Botanical pesticides

c. Both

d. Others (Specify)……

0.08 Do you have any knowledge about botanical pesticides?

a. Yes b. No

0.09 If Yes, explain

……

0.10 What common pesticidal plants are available and used for pest control?

a. ……

b. ……

c. ……

0.11 What are the most pressing needs for Mwasauya ward?

a. ……

b. ……

c. ……

d. ……

e. ……

0.12 What is the most critical intervention to meet essential needs?

a. .....

b. ……

c. ……

d. ……

e. ……

SECTION C: INTERVIEW QUESTIONS FOR KEY INFORMANTS PERTICIPANTS

0.13 What common pesticidal plants are available and used for pest control?

0.14 Does the smallholder farmers in the ward are using botanical pesticides?

0.15 How do farmers access botanical pesticides?

0.16 How does the government support application of botanical pesticides?

SECTION D: OBSERVATIONAL CHECKILIST

0.17 Identify the availability of natural plants used as pesticides in the ward.

a. Available b. Not available

0.18 Identify the input shop/farmer that sells botanical pesticides

a. Available b. Not available

Appendix: III Data Collection Tools in Swahili

DODOSO LA UTAFITI JUU YA UBORESHAJI WA KIPATO CHA KIKUNDI CHA MSHIKAMANO KUPITIA MAUZO YA DAWA ZA KUUA WADUDU ZITOKANAZO NA MIMEA YA ASILI KATIKA KATA YA MWASAUYA WILAYANI SINGIDA VIJIJINI, SINGIDA-TANZANIA

Jina la Mhojaji ……Simu ……..

Jina la Mhojiwa …… Simu ……

Tarehe ya Kuhojiwa |___|___| |___|___| |__|___| (Tarehe/ Mwezi/ Mwaka)

SEHEMU A: TAARIFA ZA KIDEMOGRAFIA (Zungushia Mduara)

0.01 Jinsia a. Mwanaume b. Mwanamke

0.02 Umri: a. 18-25 b. 26-35 c. 36-45 d. >46

0.03 Kiwango cha Elimu

a. Hajasoma
b. Elimu ya msingi
c. Elimu ya sekondari
d. Elimu ya chuo
e. Nyingine (Fafanua)……

0.04 Hali ya ndoa

a. Hajaoa
b. Anaishi na mpenzi
c. Ameoa
d. Mjane
e. Mgane
f. Wameachana

0.05 Kazi

a. Biashara
b. Mkulima
c. Ufundi
d. Ameajiriwa
e. Hana ajira
f. Nyingine (Fafanua)……

0.06 Mapato kwa mwezi

a. < 30000 shilingi za Tanzania
b. 31000 -50000 shilingi za Tanzania51000-70000 shilingi za Tanzania
c. Zaidi ya 70000 shilingi za Tanzania

SEHEMU B: MAHITAJI YA WAKULIMA NA NAMNA YA KUYAFIKIA

0.07 Je unadhibiti vipi wadudu kwa sasa?

a. Viuatilifu vya viwandani
b. Viuatilifu vinavyotokana na mimea ya asili
c. Vyote viwili

d. Nyingine (Fafanua)……

0.08 Je una ujuzi wowote kuhusu viuatilifu vinavyo tokana na mimea ya asili?

a. Ndiyo b. Hapana

0.09 Kama Ndiyo, fafanua

……..

0.10 Je ni mimea gani ya asili inapatikana kwa wingi na inatumika sana kama kiuatilifu kuwadhibiti wadudu?

a. ……

b. ……

c. ……

0.11 Je ni mahitaji gani muhimu zaidi kwa kata ya Mwasauya?

a. ……

b. ……

c. ……

d. ……

e. ……

0.12 Ni hatua gani muhimu zaidi ili kukidhi mahitaji hayo muhimu?

a. .....

b. ……

c. ……

d. ……

e. ……

SEHEMU C: MASWALI YA MAHOJIANO KWA WADAU MUHIMU

0.13 Ni mimea gani ya asili inayo tumika sana kudhibiti wadudu na inapatikana kwa wingi?

0.14 Je, wakulima wadogowadogo katika kata wanatumia viuatilifu vinavyo tokana na mimea ya asili?

0.15 Je, wakulima wanapata vipi viuatilifu vinavyo tokana na mimea ya asili?

0.16 Je, serikali inaunga mkono vipi matumizi ya viuatilifu vinavyo tokana na mimea?

SEHEMU D: ORODHA YA UCHUNGUZI

0.17 Tambua upatikanaji wa mimea ya asili inayotumika kama kiuatilifu katika kata

a. Inapatikana b. Haipatikani

0.18 Tambua duka la pembejeo/mkulima anauza viuatilifu vinavyotokana na mimea ya asili.

a.Yapo b. Hayapo

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

THE OPEN UNIVERSITY OF TANZANIA

Ref. No OUT/ PG202001837 **28th July, 2023**

Executive Director,

Research Community and Organizational Development Association (RECODA)

P.O. Box 10633,
ARUSHA.

Dear Director,

RE: RESEARCH CLEARANCE FOR MR. AUGUSTINE MBAI KEYA, REG NO: PG202001837

2. The Open University of Tanzania was established by an Act of Parliament No. 17 of 1992, which became operational on the 1st March 1993 by public notice No.55 in the official Gazette. The Act was however replaced by the Open University of Tanzania Charter of 2005, which became operational on 1st January 2007.In line with the Charter, the Open University of Tanzania mission is to generate and apply knowledge through research.

3. To facilitate and to simplify research process therefore, the act empowers the Vice Chancellor of the Open University of Tanzania to issue research clearance, on behalf of the Government of Tanzania and Tanzania Commission for Science and Technology, to both its staff and students who are doing research in Tanzania. With this brief background, the purpose of this letter is to introduce to you **Mr. Augustine Mbai Keya, Reg. No: PG202001837),** pursuing **Masters in Community Economic Development (MCED).** We here by grant this clearance to conduct a research titled "**Improved Income for Mshikamano Group through Botanical Pesticides Sales in Mwasauya Ward in Singida Rural District, Singida-Tanzania**". He will collect his data at your office from 31st July to 31st August 2023.

4. In case you need any further information, kindly do not hesitate to contact the Deputy Vice Chancellor (Academic) of the Open University of Tanzania, P.O.Box 23409, Dar es Salaam. Tel: 022-2-2668820.We lastly thank you in advance for your assumed cooperation and facilitation of this research academic activity.

Yours sincerely,
THE OPEN UNIVERSITY OF TANZANIA

Prof. Magreth S.Bushesha
For: VICE CHANCELLOR