Effectiveness of Knowledge and Skills Development Programs in Improving Productivity of Smallholder farmers' Organization: A Case of Post-Harvest Handling Management of Fruits and Vegetables Lushoto, Tanga, Tanzania

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ABBREVIATIONS

FGD	Focused Group Discussion
FAO	Food and Agriculture Organization
UN	United Nations
EAC	East Africa Community
GDP	Gross Domestic Product
SWOT	Strength, Weakness, Opportunities and Threats
FV	Fruits and Vegetables
PHL	Post-Harvest Loss
PHH	Post-Harvest Handling
MIVARF	Marketing Infrastructure, Value Chain and Rural Finance
IFAD	International Fund for Agricultural Development
CESDEV	Centre for Sustainable Development
TAHA	Tanzania Horticultural Association
URT	United Republic of Tanzania
GOT	Government of Tanzania
AFDB	African Development Bank
AGRA	Alliance for a Green Revolution in Africa.
WRS	Warehouse Receipt System
GPS	Global Positioning System
USD	United State Dollar
TZS	Tanzania Shillings
PCSP	Proper Crop Storage Practices
PCD	Proper Crop Drying
ZEC	Zero Energy Cooler
PCH	Proper Crop Harvesting

EXECUTIVE SUMMARY

The challenges of food insecurity and poverty in the East African Communities and Sub-Sahara Africa as a whole is a big threat to the fulfillment of the Sustainable Development Goal 1 and 2 which aim to have a world with no hunger and zero poverty. Lushoto District in the Tanga region of Tanzania is popularly known for farming of fruits and vegetables because of the mountainous terrain that it is, with bottom level farmlands suitable for growing vegetables all year round.

This study then seeks to assess the effectiveness of the deliveries of knowledge and skills development programs in improving the productivity of smallholder farmers who are classified by farm ownership of less than five acres of farmland per household. The study identified the post-harvest handling skills acquired and its effect on productivity, including quantity of crop loss after harvesting, and income of farmers.

Quantitative and qualitative data of a representative of 255 beneficiaries were captured through interviews with the aid of structured questionnaires. The quantitative data were analyzed using descriptive and inferential statistics. Qualitative data were also gathered through focused group discussion and in-depth Interview.

Results indicated that post-harvest handling skills of fruits and vegetables were acquired during the training which in turn had significant effect on decreased post-harvest loss of fruits and vegetables. The acquired skills also led to improved farmers' income as there was reduced post-harvest loss.

The challenges encountered by the effects of the training on improving the smallholder farmers' productivity were analyzed and climate change especially drought was identified, and recommendation for further training on how to be resilient to climate change by the farmers was given.

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

In Tanzania, agriculture accounts for more than a quarter of GDP, employing over 80% of the workforce, providing 85% of exports, yet Tanzania is one of the world's poorest countries.

The Tanzanian economy has been growing at a steady rate around 7% annually over the last 3-4 years and with an average of about 6-7% GDP growth, Tanzania is among the 20 fastest growing economies worldwide. Despite this notable growth, the effect of this growth is hardly noticeable in rural areas where most small holders Farmers dwell. The reason for this unequal distribution of economic growth is that the growing economy has to be shared among the fast growing rural populations.

Agriculture has being one of the most important sectors in East African Community which accounts for about 80% of the workforce comprising the smallholder farmers in rural areas. According Mkenda et al. 2011, Majorities of citizens who are engaged in agricultural sector are small holder farmers living in rural areas whose main source of cash income is the selling of agricultural products.

In 2015, 80% of overall food produced in Asia, Sub-Saharan Africa and Latin America are supplied by smallholders, but 70% of the 1.4 billion people in extreme poverty live in rural areas and 75% of these rural poor are also smallholders (IFAD CFS, 2015).

According to TAHA, 2011, the horticultural subsector of Agriculture in Tanzania is the fastest growing sub-sector with an average growth rate of 8-10%. The sub-sector is largely dependent on small holder farmers with export of fruits and vegetables alone being 70% dependent on farmers with land holding less than 2 ha. One of the major challenges facing this sector is the Post-harvest loss of the products in Tanzania which is specifically high in domestic market (40%) and (10%) in export sectors.

Therefore, to solve the problem of Post-harvest loss and improving the general productivity of smallholder farmers in rural areas, the Tanzanian government in collaboration with development Partners developed the The Marketing Infrastructure, Value Addition and Rural Finance Support (MIVARF) Programme.

The MIVARF Programme is a loan agreement financed by three institutions; AFDB (37%), IFAD (54%) and URT Government (9%) whose central objective is to enhance income and alleviate Food insecurity on a sustainable basis in Tanzania. This program was founded to address the challenges of poverty and food insecurity especially for the rural dwellers.

The Programme has a seven-year duration whose effective implementation started in July 2011 and its completion date was 31st March 2018 with a closing date of 30th September 2018. The Programme, covers 29 regions and 73 Local Government Authorities (LGAs) in Tanzania.

MIVARF has three components which serves as basis for the implementation of its activities. The components are:

i. **Marketing Infrastructure:** This is aimed at the establishment and sustainable maintenance of improved marketing infrastructure

ii. **Value Addition:** This focuses on the Institutionalization of post-harvest technologies (tools & skills) to groups of smallholder producers/processors in the Regions and Districts, as well as the Rehabilitation and resourcing of 13 Post Harvest (PH) training centres.

iii. **Producer Empowerment and Market Linkages**: This is aimed at providing the necessary capacity building to producers and marketing groups, facilitating the establishment of sustainable market linkages through a public-private partnership (PPP) based on market information system, supporting these groups in making optimum use of the warehouses and market infrastructures promoted under sub-component 1, and facilitating their access to finance in order to implement warehouse receipt systems (WRS).

The overall goal of the program is to eradicate Poverty and enhance Food Security especially for the active rural poor.

1.2 Problem Statement

The rural poor are predominantly smallholder farming households, whose agricultural production and income is insufficient to maintain secure livelihoods (FAO et al. 2013). At the same time, agriculture remains the primary sector of most national economies in Africa (Masset et al. 2011), and African states obtain most of their national food supply from smallholder farmers (AGRA 2013). National and international development policymakers regard rural development as key to sustainable national socio-economic development (IFAD 2011; Word Bank 2007). As a result, there is a great need for increasing support for smallholder farmers.

According to FAO, root crops, fruits and vegetables accounts for 40-50% of the annual food loss globally. In fact, almost half of the fruits and vegetables produced are wasted and Post-harvest losses have proven to be a major constraint to food security in Tanzania.

Studies have shown that there is huge knowledge gap on the post-harvest handling of this horticultural products by smallholder farmers who constitute the main production sector of the horticultural products.

Therefore, it is important to measure the effectiveness of trainings in improving the productivity of smallholder farmers.

1.3 Justification of Study

The relevance of Post-harvest skills and knowledge acquired by small holder farmers to reducing horticultural post-harvest loss cannot be over emphasized. According to FAO, 40-50% of food loss is fruits, vegetables and tubers showing high knowledge gap and according to WUR, 2012, Kenya post-harvest losses are indicated to range between 20-50% and for Tanzania it can be estimated that post-harvested losses will be at least at the same level or even higher which is confirmed by feedback from key informants.

To enhance productivity of small holders farmers via eradication of poverty and food insecurity, post-harvest loss of horticultural products must be stopped and one of most effective the tool for reducing it is post-harvest knowledge and skills.

Therefore, measuring the effectiveness of MIVARF training/coaching especially the effects of the post-harvest skills delivered on productivity of small holder farmers becomes very important as knowing this helps to monitor progress in reduction of horticultural post-harvest loss via trainings/coaching

1.4 Research Question

1) What are the Post-harvest skills acquired and the methodologies used in delivering them?
2) What are the effects of post-harvest handling knowledge and skill on performance of smallholder farmer organizations?
3) What are the challenges the knowledge and skills intervention programs encounter in increasing the productivity of rural farmers

1.5 Research Hypothesis

1. There is no significant difference between yields of the farmers before and after the training.
2. There is no significant difference between the incomes of farmers before and after the training.

1.6 Objectives of the Study

1) To explore the Post-harvest handling knowledge and skills acquired by the beneficiaries and methodology used to deliver them.

2) To assess the effect of post-harvest handling knowledge and skill on performance of smallholder farmer organizations.
3) To identify the challenges that these interventions encounter in increasing the productivity of rural farmers.

1.6.1 Analysis of Objectives of the Study

S/N	*OBJECTIVES*	*DATA COLLECTION*	*DATA REQUIRED*	*METHOD OF ANALYSIS*
1.	To explore the post-harvest handling knowledge and skills acquired by the beneficiaries and methodology used to deliver them	Key Informant Interview and Use of structured questionnaire.	Information on post-harvest handling knowledge and skills acquired by beneficiaries and methodologies used.	Descriptive Statistics, Frequencies, percentages and Cross--tabulations.
2.	To assess the effect of post-harvest handling knowledge and skill on performance of smallholder farmers	Use of structured questionnaires and focused group discussion.	Information on farm production outputs, land area cultivated, postharvest loss, output price, household capitals.	Descriptive Statistics, Frequencies and percentages, t-test, correlation test (PPMC).
3.	To identify the challenges that these interventions encounter in increasing the productivity of rural farmers.	Use of structured questionnaires and key informant interviews.	Information on challenges faced by the farmers while practicing the skills and knowledge acquired.	Frequencies and percentages, SWOT Analysis.

1.7 DEFINITION OF CONCEPTS

1.7.1 FOOD SECURITY

Food Security was defined in the 1974 World Food Summit as:

"***Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices"***

In 1983, FAO expanded its concept to include securing access by vulnerable people to available supplies, implying that attention should be balanced between the demand and supply side of the food security equation: ***"Ensuring that all people at all times have both physical and economic access to the basic food that they need".***

In 1986, the World Bank report on "Poverty and Hunger" focused on the temporal dynamics of food insecurity. The Concept of food insecurity was further explained as ***"Access of all people at all times to enough food for an active, healthy life".***

In 1996, the World Food Summt adopted a more complex definition:

" Food Security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs food preferences for an active and healthy life"

Therefore, Food security occurs when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Household Food Security is the application of the concept of food security to the Family level, with individuals within households as the focus of concern.

1.7.2 POST-HARVEST MANAGEMENT

Post-harvest Loss

According Kader 2002, Post-harvest loss can be defined as the degradation in both quantity and quality of a food production from harvest to consumption. Quality losses include those that affect the nutrient/caloric composition, the acceptability, and the edibility of a given product. These losses are generally more common in developed countries. Quantity losses refer to those that result in the loss of the amount of a product. Loss of quantity is more common in developing countries (Kitinoja and Gorny, 2010).

Post-Harvest Handling

The post-harvest handling starts from harvesting of the produce from the field, the storage, transportation, Processing, Marketing to final consumption.

Storage

Storage is the art of keeping the quality of agricultural materials and preventing them from deterioration for specific period of time, beyond their normal shelf life. For horticultural products, there are wide varieties of structure that can be used to store them. In general the structure needs to be kept cool (refrigerated, or at least ventilated and shaded) and the produce put into storage must be of high initial quality to ensure their preservation.

1.7.3 SMALLHOLDER FARMERS

The Smallholder farmers are also defined as those farmers owning small-based plots of land on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labor. They are drivers of economy in Africa although their potential is usually not brought forward.

According to FAO, Smallholder farmers, 80% of the developing world's food is a product of small-sized farms

For the purpose of this study, Small holder farmers are defined as those that have land ownership of not more than 3-5 Acres (or its equivalent less than two hectares).

1.7.4 PRODUCTIVITY

Productivity is the ability of a production system to produce more economically and efficiently. It can be defined as a measure of efficiency in an agricultural production system which employs labor, land, Capital and other related resources.

It can also be defined as a ratio of output to resource expanded separately or collectively. For the purpose of this study, yields is used as a measure of productivity.

1.7.5 ADAPTIVE CAPACITY

This refers to the ability of a (human) system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" Adaptive Capacity is a function of available financial recourses, human resources and adaptation options, and will differ between risks and sectors

1.7.6 HORTICULTURE

By definition, it is the science of growing and caring for plants, especially flowers, fruits and vegetables. For the purpose of this study, horticultural crops are used to signify Fruits and vegetables. Most fruits and

vegetables are living even after harvest as they continue to respire (release CO_2) and transpire leaving them with very short life span. So, horticultural products are highly prone to early destruction.

1.7.7 POVERTY

UN adopted two definitions in 1995,

Absolute Poverty: This was defined a condition characterized by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. It depends not only on income but also on access to services.

Overall Poverty: It takes various forms including lack of income and productive resources to ensure sustainable livelihoods; hunger and malnutrition; ill health; limited or lack of access to education and other basic services; increased morbidity mortality from illness; homelessness and inadequate housing; unsafe environments and social discrimination and exclusion. It is also characterized by lack of participation in decision making and in civil, social and cultural life. It occurs in all countries: as mass poverty in many developing countries, pockets of poverty amid wealth in developed countries, loss of livelihoods as a result of economic recession or sudden poverty as a result of disaster or conflict.

CHAPTER 2: THEORETICAL FRAME WORK AND LITERATURE REVIEW

2.1 Review of Theory

The Human Capital Theory

Human development is partly a matter of people and communities improving their own lives and taking greater control of their destinies. Social change is largely driven by the instrument of Education. The reference point of education as instrument of social change can be traced far back to the 1960s when Theodore Schultz systematically articulated the human capital theory of development. Schultz argued that population quality and knowledge constitute the principal determinants of the future welfare of mankind. Theodore W. Schultz has defined human capital theory as knowledge and skills obtained by people as capital in the process of vocational and technical education. Such a capital is a product of well-considered investments and it generates income.

Human capital theory reveals that individuals and the whole society gain economic benefits from investments in people (Nafukho, Hairston and Brooks 2004). Human capital theory rests on the assumption that formal education is highly instrumental and even necessary to improve the production capacity of a population. In short, the human capital theorists argue that an educated population is a productive population (Olaniyan, Okemakinde, 2008).

Human capital theory emphasizes how education increases the productivity and efficiency of workers by increasing the level of cognitive stock of economically productive human capability which is a product of innate abilities and investment in human beings (Olaniyan, Okemakinde, 2008). According to Babalola (2003), the rationality behind investment in human capital is based on three arguments:

1) The new generation must be given the appropriate parts of the knowledge which has already been accumulated by previous generations;

2) New generation should be taught how existing knowledge should be used to develop new products, to introduce new processes and production methods and social services;

3) People must be encouraged to develop entirely new ideas, products, processes and methods through creative approaches.

The appeal of Human Capital Theory was based upon the presumed economic return of investment in education both at the individual and society levels. The Theory was premised on the argument that, it is the human resources of a nation, not its capital nor its material resources that ultimately determine the character and pace of its economic and social development.

Human Capital Theory rests on the assumption that formal education is highly instrumental and even necessary to improve the production capacity of a population. In short, the advocates of the theory argue that an educational population is a productive population. The focus on education as a capital good relates

to the concept of human capital, which emphasizes that the development of skills is an important factor in production activities as it is widely accepted that education creates improved citizens and helps to upgrade the general standard of living in a society.

Human capital theory provides the dominant explanation for the economic value of education. The basic tenet is that education and other means of skill formation is economically productive.

Post-Harvest Loss

According to the FAO, food production will need to grow by 70% to feed world population which will reach 9 billion by 2050. Further trends like increasing urban population, shift of lifestyle and diet patterns of the rising middle class in emerging economies along with climate change put considerable pressure strain on the planet's resources: declining freshwater resources and biodiversity, loss of fertile land, etc. Consequently, there is a need for an integrated and innovative approach to the global effort of ensuring sustainable food production and consumption (Nellemann et al., 2009). In the meantime, while the number of food insecure population remains unacceptably high (FAO, 2010; IFAD, WFP and FAO, 2012), each year and worldwide, massive quantities of food are lost due to spoilage and infestations on the journey to consumers (FAO, 2011; Stuart, 2009; FAO, 2002). In some African, Caribbean and Pacific ACP countries, where tropical weather and poorly developed infrastructure contribute to the problem, wastage can regularly be as high as 40-50% (SPORE, 2011). Obviously, one of the major ways of strengthening food security is by reducing these losses. Along the renewed focus on investment in agriculture that began in 2008, there is an increasing interest in effective intervention for Post-Harvest Losses (PHL) reduction. The investment required to reduce PHL is relatively modest and the return on that investment rises rapidly as the price of the commodity increases. In view of this, it was decided to develop a brief technical paper on postharvest losses and strategy to reduce them. The term "postharvest loss" - PHL refers to measurable quantitative and qualitative food loss in the postharvest system (Lucia and Assennato, 1994). The system of Post-harvest management comprises interconnected activities from the time of harvest through crop processing, marketing and food preparation, to the final decision by the consumer to eat or discard the food. Nowadays, interventions in PHL reduction are seen as an important component of the efforts of many agencies to reduce food insecurity. PHL is increasingly recognized as part of an integrated approach to realizing agriculture's full potential to meet the world's increasing food and energy needs. Therefore, reducing PHL along with making more effective uses of today's crops, improving productivity on existing farmland, and sustainably bringing additional acreage into production is critical to facing the challenge of feeding and increased world population.

So essentially, According to ACF 2014, Post-harvest management and Value addition are integral to improving agricultural productivity linkages between farmers and markets which will help contribute to food security and economic development of its target population.

2.2 POVERTY

Facts about Poverty in Tanzania

Tanzania, officially the United Republic of Tanzania, is a country in Eastern Africa that is home to natural wonders like Mount Kilimanjaro and Lake Victoria. Although the country is rich in natural resources, poverty in Tanzania persists. In Tanzania, 67.9 percent of the population lives below the poverty line. Extreme poverty in Tanzania has declined in recent years, from 11.7 percent in 2006 to 9.7 percent in 2012. Poverty leads to hunger and roughly 42 percent of children under five in Tanzania suffer from chronic malnutrition and 16 percent are underweight. Malnutrition affects children's physical development. The rate of stunting in Tanzania ranks third in sub-Saharan Africa, after Ethiopia and the Democratic Republic of Congo.

Many of the most commonly eaten foods in Tanzania, such as potatoes and cassava, are inexpensive but lack essential nutrients. Some schools in Tanzania now hold nutrition classes for students in hopes of reducing malnutrition.

On average, women in Tanzania will have five children. Slowing fast population growth and the high fertility rate by empowering women through education support and family planning services is key to reducing poverty in Tanzania.

Poverty is highest in rural areas, with around 80 percent of the country's poor living in those regions.

Poverty is also highest among female-headed households, particularly those that depend on livestock or food-crop production for their livelihood.

Young girls and women in Tanzania often suffer from more nutritional deficiencies than men. One-third of women are deficient in iron, iodine, and vitamin A and two-fifths are anemic.

Cash transfer programs, which have been successful in other parts of the world, have proven in recent years to be effective in Tanzania. While families do not receive large sums of money, it is enough to free them from constant subsistence farming and allows them to focus on generating additional, more stable, sources of income.

2.3 Review of Empirical Studies

Agricultural Productivity is measured in this study using yields per land area of measurement and Post-harvest loss per land area.

Neo Classical Production Theory

Farm productivity according to Neo classical production theory is;

$$y = f(x1, x2) \qquad (1)$$

where *y* is the quantity of output and *x*i is the quantity of the ith variable input (e.g., Silberberg, p.

69). Equation (1) can include any finite number of variable inputs; $n = 2$ merely allows geometric representation. The properties of (1) are specified by assumptions

(a) *x*i $ 0 and finite (nonnegative, real inputs);

(b) $f(x1,x2)$ is finite, nonnegative, real valued, and single valued for all possible combinations of *x*1 and *x*2;

(c) $f(x1,x2)$ is everywhere continuous and everywhere twice continuously differentiable;

(d) $f(x1,x2)$ is subject to the "law" of diminishing returns.

CHAPTER THREE: METHODOLOGY

3.1 STUDY AREA

The study area is in Lushoto district, Tanga region in Tanzania.

Tanga region has a land area of 27,348 Sq. kms. of which 48 percent belongs to Handeni district and 5 percent belongs to Pangani district, 13 percent to Lushoto, 14 percent to Korogwe and 18 percent of the land area to Muheza. The total area available for agricultural activities is 17,000 sq. kms. With a population of 1,280,262 people, the region is among the smallest and most densely populated regions of Tanzania (about 48.1 people per sq. kms.), after Mtwara, Kilimanjaro and Mwanza regions.

Lushoto (which is the northern side of Tanzania,), also known as Wilhelmstal during the German colonial rule, is one of the eight districts of Tanga Region. It is bordered to the northeast by Kenya, to the east by the Muheza District, to the northwest by the Kilimanjaro Region and to the south by the Korogwe District. It has 137 villages and administratively divided into 32 wards.

The latitude of Lushoto District, Tanzania is -4.965088, and the longitude is 38.501587. Lushoto District, Tanzania is located at Tanzania country in the Districts place category with the GPS coordinates of 4° 57' 54.3168" S and 38° 30' 5.7132" E.

Lushoto District, Tanzania elevation is 591meters height that is equal to 1,939 feet.

FIGURE 3.1: MAP OF TANZANIA SHOWING LUSHOTO IN TANGA REGION

3.2 Research Design

The study employed survey method under which data were collected from different respondents at different locations once through survey questionnaires, FGD (Focus Group Discussions) and interviews. This design was used in order to minimize the chance of drawing incorrect causal inferences from the data, maximize reliability of data and minimize bias. The data collected for the study were both primary and secondary data involving quantitative and qualitative data. SPSS IBM 21 and MS Excel Spread sheet were used to analyze the data

3.3 Study Population

A total of 750 smallholder farmers are beneficiaries of MIVARF. These are divided into 368 male and 382 female and serve as the population of the study.

3.4 Sampling Procedure and Data Collection Method

Multistage purposive cluster sampling techniques was used in selecting the study area and entail:

Stage 1: The purposive selection of MIVARF Program in Tanzania.

Stage 2: The purposive selection of Tanga out of the 29 regions where MIVARF Program is being implemented in Tanzania.

Stage 3: The purposive selection of Lushoto districts.

Stage 4: The purposive selection of 4 wards of Lushoto district.

Stage 5: The purposive selection of all the 13 villages where the training/coaching took place at the focal area.

Stage 6: The random selection of 14 farmers' groups for coaching.

Stage 7: The random selection of 255 smallholder farmers.

Stage 8: The purposive selection of Service Provider for producers' empowerment.

Stage 9: The purposive selection of the district officers that were involved in the Training Program for In-depth Interview.

3.5 Sample Size Determination

The beneficiaries of the MIVARF Training were 750 farmers and these smallholder farmers were chosen as the study population. Then sample size calculator adapted from Survey System available at http://www.surveysystem.com/sscalc.htm was used to determine the sample size of 255. The sample size drawn from the beneficiary population of 750 smallholder farmers used statistical confidence level of 95 percent at interval level of 1.96 that led to get a total of 255 beneficiaries In addition, focused group discussion was conducted to smallholder farmers and In-depth interview for the Service Provider and District officials.

3.6 Nature and Sources of Data

Primary and Secondary

The data collected and used for the study covered both primary and secondary data sources and are both quantitative and qualitative. The secondary data were collected from journals, newsletters, baseline survey, published research works and books. Primary data were collected from smallholder horticultural farmers who participated in MIVARF Trainings and were randomly selected using pre-tested questionnaires that is mainly open-ended; in addition to face-to-face, one-on-one interview, focus group discussions and observations.

Quantitative and Qualitative Data

Quantitative data were collected from smallholder farmers using structured questionnaires and the items measured male and female socio-economic characteristics, farmland cultivated, Farm years of experience, Household head, Household Size, income level etc. The structured questionnaires were pre-tested before the commencement of the research.

Qualitative data were collected from smallholder farmers covering socio-cultural variables of the male and female farmers via focused group discussion guide and In-depth interview guide. Coordinates and photograph of projects and respondents were taken using application of digital cameras, Global Positioning System (GPS) besides voice recorder to tape the interviews with respondents.

The use of combination of tools was to obtain the desired data and validates respondent views and comments in order to ensure the integrity of the information provided. Care was taken to ensure integrity of data and source of data are cited.

3.7 Analytical methods/Technique

The data collected were coded and analyzed using Statistical Package for Social Sciences (SPSS statistics IBM 20) and MS Excel spreadsheet. Collected data were collated, verified, coded, entered, cleaned and merged in data sheet. Both qualitative and quantitative data were generated for the study and presented through combination of cross tabulation, graphical and pictorial representations. Descriptive (frequencies, percentage, ratio, means, and standard deviation) and inferential statistics (t-test) were used to ascertain the distribution of variables in the study to determine the general effectiveness of the MIVARF training programs to the study areas.

Data Collection Procedure

Pre-Test of Survey Instruments

For validity and reliability of the survey instruments, Pre-test was carried out with the help of ward extension officers.

Data collected for the study was generated with the assistance of four (4) field enumerators recruited and trained in a one day pre-field training exercise. The enumerators are extension officers who have practical knowledge of agriculture, fruits and vegetables production and socio-economic and cultural characteristics of the study area. The researcher and field enumerators rode on motorcycles to villages and farms.

3.8 Measurement of Variables and a priori expectations

The study measured input, output, outcome and impact indicators of independent and dependent variables:

Input Indicators: The resources, efforts required in the production of paddy were measured.

Measurement was made of skills and knowledge acquired and the land needed to carry out activities at the different phases of production process required to bring about horticultural products. The farmland cultivated is measured in per acre by the farmer in the groups.

Output Indicators: The study measured deliverables of the production process. The amount of FV fruits and vegetables produced by farmers was measured using standard scaling. The farmers measured their output with the standard *kiroba* (poly bags) which has standardized equivalent in Kilogram.

Other Indicators determined by the study are the socio-economic characteristics of beneficiaries' age, gender, marital status, household heads, farmers groups, educational attainment, income level and constraints to Horticultural farming.

The independent variables measured in this study cover socio-economic characteristics of the respondents namely gender, age, marital status, educational attainment, farm size, farming years of experience, Capacity building on Postharvest handling (PHH), Adaptive Capacity indicators, savings of farmers in addition to constraints and challenges experienced by farmers .

The dependent variable of the study covers productivity and income of the farmers.

Gender

The respondents were asked to identify their gender.

Age

The study requested respondents to state their age. The age was measured to determine their Categorization.

Marital status

The respondents were asked to determine their appropriate marital status to ascertain farmers that are single, married, divorced, separated, and widowed.

Educational attainment

The study measured the educational level of farmers disaggregated into no formal, adult literacy, primary, secondary, advance and tertiary/university. Farmers were asked to state their highest level of educational attainment.

Group membership

The training Program created groups for the farmers based on their villages which were later metamorphosed into AMCOS.

Productivity

Yield was the unit of measurement used for measuring productivity and the unit used is Kg/acre. Also, the quantity of PHL per land area was taken**.**

Income

The farm monthly income of farmers were checked before and after the trainings and the differences were noted.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics

4.1.1 Distribution by age group

The result of the study shows minimum age as 20 years and maximum as 85years. The age range of 41-50 has the highest distribution of farmers which has 32.5%, followed by the age range 51-60 which has 25.9%. The mean age of farmers is 49.8 showing the farmers are still in the active years. The percentage of farmers under the age of 40 is 21.5%, showing low participation of youth in agricultural production especially in the rural areas.

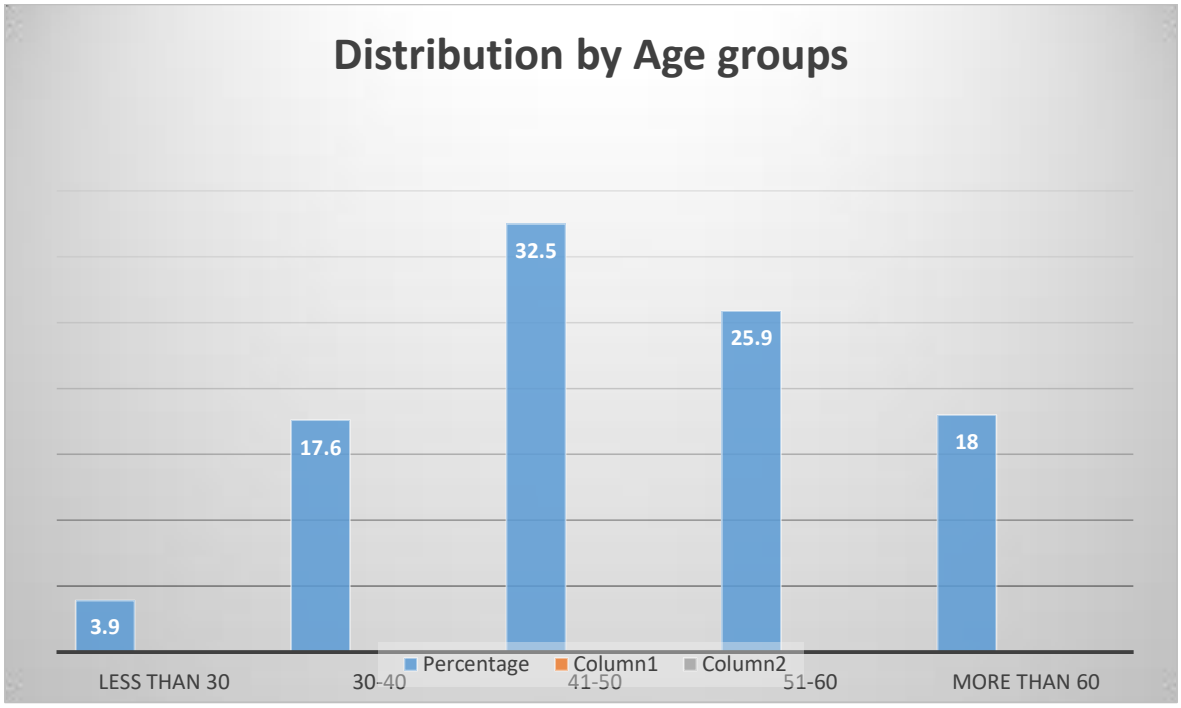


FIGURE 4.1.1: DISTRIBUTION BY AGE GROUP

Source: Field Survey, 2018

4.1.2 Distribution by gender

In figure 4.1.2, the female constitute 45.7% of the smallholder's farmers while the men accounts for 54.3%. This shows that more men are into horticultural farming which is in accordance to the number of beneficiaries of the training. The women also account for 63.3% of the age group less

than 40 and men accounts for 36.6%. This indicates that women attends to horticultural farming at the young active years compared to men.

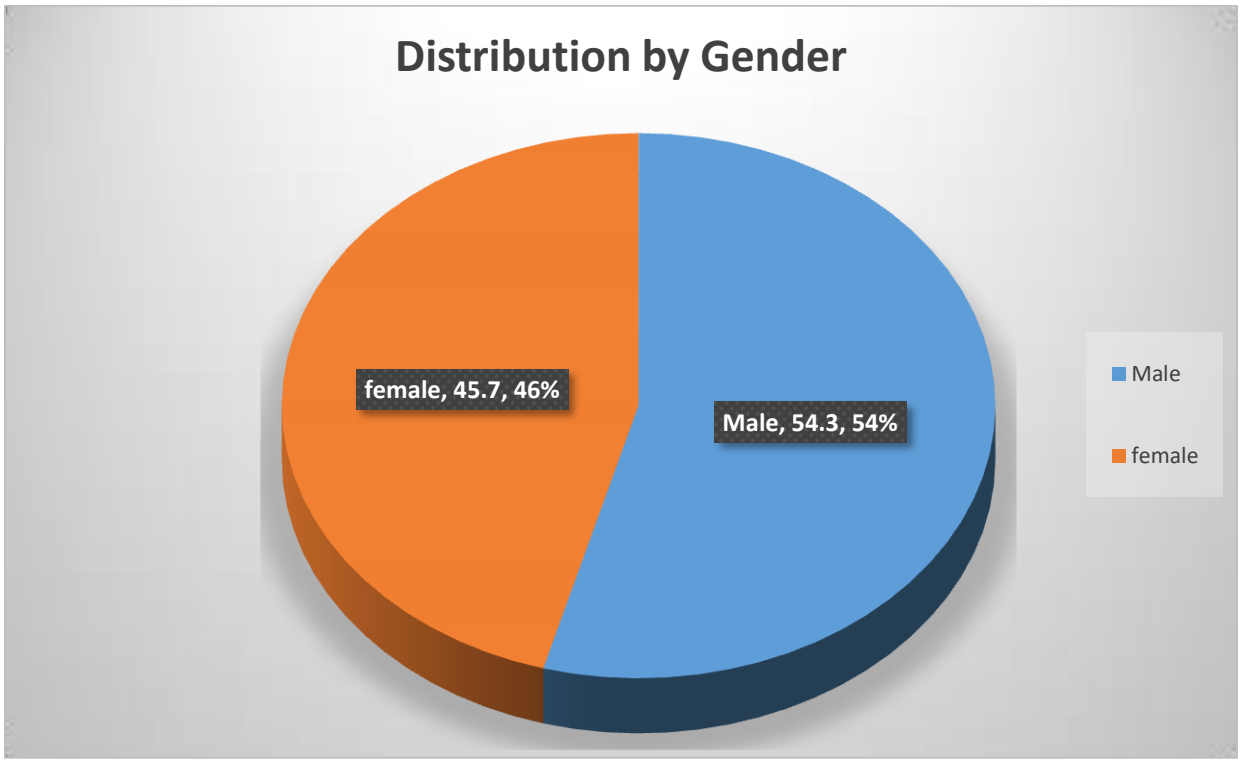


FIGURE 4.1.2: DISTRIBUTION BY GENDER

Source: Field Survey, 2018

4.1.3 Distribution by Marital Status

In Table 4.1.1, the marital status with highest distribution of farmers is married at 89.9%, followed by widowed at 8.2% and separated at 1.2%, with 0.4% for both single and divorced. 42.3% of the married are females and 58.6% are males. Further analysis of the gender composition of marital status showed that 76.2% of the widowed are females and the male widowed are 23.8% are male showing high probability of male farmers to remarry. According to Opara (2014) asserted that married farmers are likely to be under pressure to produce more for family consumption and sales with incentive of family labor.

Table 4.1.1: Marital status of Respondents.

S/n	*Marital status*	*Frequency*	*Percentage (%)*
1.	Single	1	0.4
2.	Married	229	89.8
3.	Widowed	21	8.2
4.	Separated	3	1.2
5.	Divorced	1	0.4
	TOTAL	**255**	**100**

Source: Field Survey, 2018

4.1.4 Distribution by household head

In figure 4.1.3, the percentage of female headed household is 11% and the male headed household accounts for 89%. The study also revealed that in land ownership of between 1-3 acres, the female headed household has 11.6% and male has 88.4% of that land ownership. In Africa, Female headed household tends to have limited access to resources especially land ownership. According to Addis et al, 2001, female headed households are more limited to and control over resources.

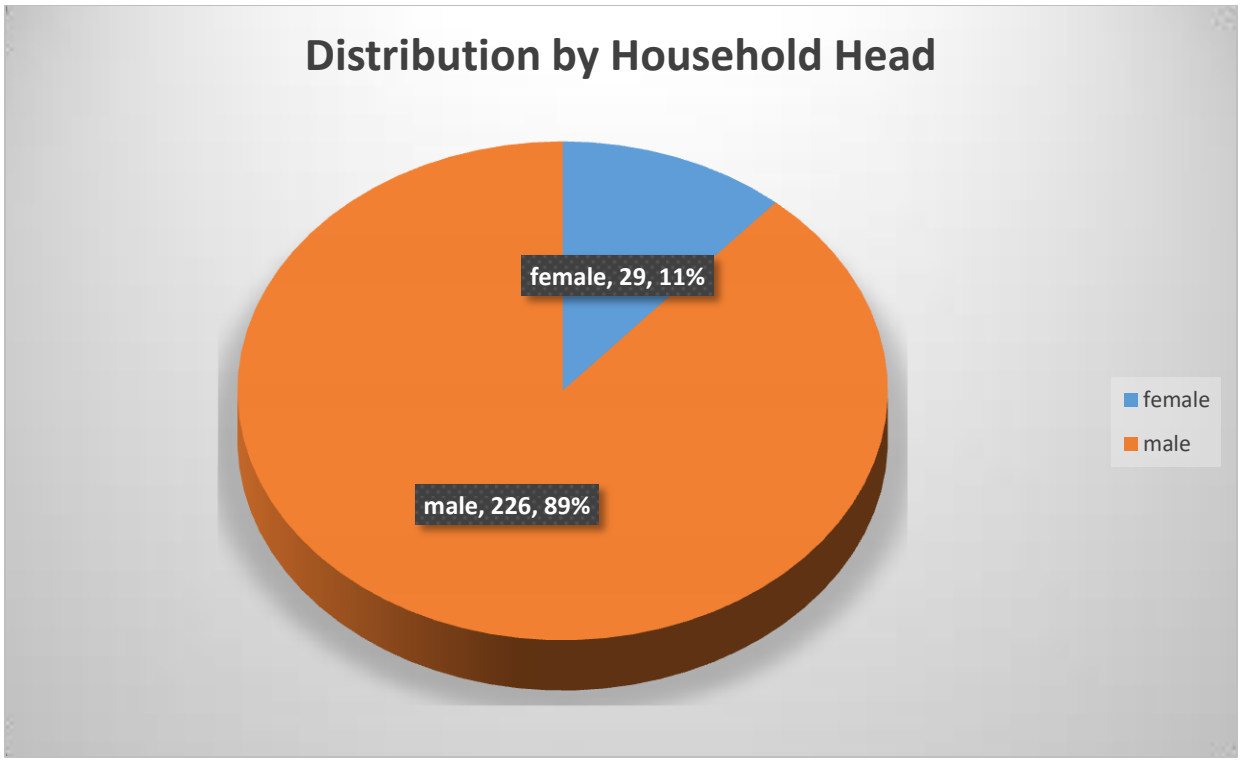


FIGURE 4.1.3: DISTRIBUTION BY HOUSEHOLD HEAD

Source: Field Survey, 2018

4.1.5 Distribution by household head occupation

In Table 4.1.2, farming accounts for 99.6% of the household heads occupation of participants and trading as 0.4 %. Even in the Secondary Occupation, 81.2% of the household heads are farmers and 18.8% are traders. This indicates little diversity in beneficiaries' source of income as most farmers are into farming only.

Table 4.1.2: Household Head Occupation

S/n	*Household head Occupation*	*Frequency*		*Percentage*	
		Farming	**Trade**	**Farming**	**Trade**
1.	Primary Occupation	254	1	99.6	0.4
2.	Secondary Occupation	207	48	81.2	18.8

Source: Field Survey, 2018

4.1.6 Household farmland size and ownership

In figure 4.1.4,the less than 1 acres household farm size accounts for 9%, 57.6% accounts 1-3 acres of farm size, 24.7% accounts for 3-5 acres farm size and 8.5% accounts for more than 5 acres household farm size. Therefore, 5 acres land and below has the highest distribution ascertaining that most of the farmers are Smallholder farmers.

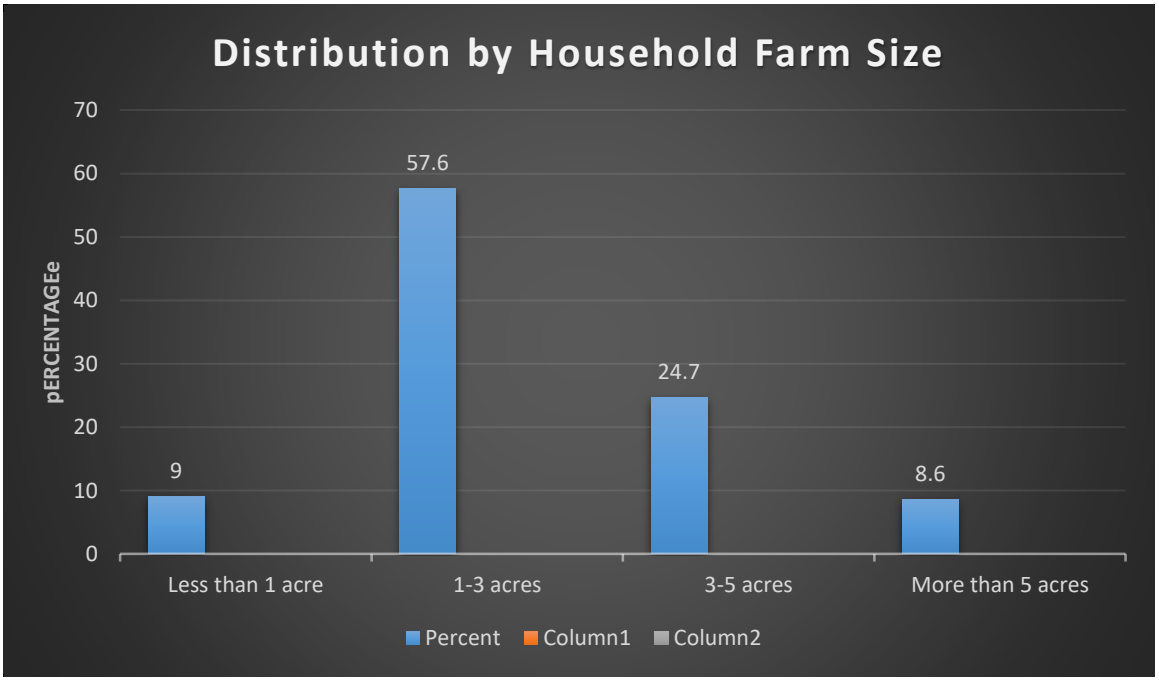


FIGURE 4.1.4 DISTRIBUTION BY FARM SIZE

Source: Field Survey, 2018

According to table 4.1.3, of the land owned by the households, 78% is self-owned, 20.4% inherited and 1.6% borrowed. 13% of less than 1 Acres household farm size is borrowed showing possibilities of farmers to increase their land cultivation area by borrowing. By MIVARF standard, the land ownership of between 3-5 acres (below 2 hectares) is used for classifying Smallholder farmers.

Table 4.1.3: Household farm ownership

S/n	*Farm Ownership*	*Frequency*	*Percent (%)*
1.	Borrowed	4	1.6
2.	Self-owned	199	78.0
3.	Inherited	52	20.4
	TOTAL	**255**	**100**

Source: Field Survey, 2018

4.1.7 Highest Educational Attainment

In Table 4.1.4, the primary education accounts 82.8% (211) of the highest educational attainment of the farmers with males 58.3% (123) and 41.7% (88) females, 9.4% (24) for No formal education (of which 99.6% (23) are females and 0.45% (1) males, 6.7% (17) Secondary education (64.7% (11) males and 35.3% (6) females), 0.8% for Tertiary Education (100% (2) males), and 0.4% (1) for adult literacy (100% males). This shows a low level of education among female farmers compared to male farmers and according to Mwatawala *et al* (2016), they affirmed that majority of developing countries population who depends on agricultural activities have low level of education but with the right training module on good agricultural practice communicated in a participatory manner, reinforced by commercialization of smallholder famers, the skill and knowledge of farmers on improved agriculture will record increase.

Table 4.1.4: A cross tabulation of Gender and Highest Educational Attainment of the Respondents.

S/n	*Highest Educational Attainment*	*Male*	*Female*
1.	No Formal Education	1	23
2.	Adult Literacy	1	0
3.	Primary Education	123	88
4.	Secondary Education	11	6
5.	Tertiary Education	2	0
	TOTAL	**138**	**117**

Source: Field Survey, 2018

4.1.8 Farming experience, Household Size, Number of dependency

Table 4.1.5 summarizes, the mean of the farming experience, Household Size, Number of dependency. The mean farming years' experience, household size and Number of dependency is 20.89 years, 5.72 and 3.39 respectively indicating that averagely most farmers are experienced, have relative size of household size and number of dependency.

Table 4.1.5: Descriptive Analysis of Farming Experience, Household Size and Number of Dependency

S/n	*Variables*	*Min*	*Max*	*Mean*	*Standard Deviation*
1.	Farming Experience	0	52	20.8941	13.8953
2..	Household Size	1	14	5.7176	2.27072
3.	Number of Dependency	0	10	3.3922	2.05513

Source: Field Survey, 2018

4.1.9 Adaptive Capacity of Farmers to Climate Change

In table 4.1.6, 93.3% of the farmers have received training on Crops before, 0.8% on fisheries, 27.5% on Livestock and 2.4% on Forestry. This shows focus on a kind of training and which could imply farmers are not equipped for diversity in Agriculture rather are mostly grounded in crops production alone.

For non-agricultural training, 4.7% are trained in crafts, 1.6% in metal works, 39.6% in Services and 14.1% in Trade. This also implies farmers are not exposed to non-agricultural trainings that could buffer their livelihood should climate change leads to low agricultural yields.

77.6% of the farmers have been exposed to Irrigation Practice, 97.6% have freedom to plant any type of crops and 98.8% are free to participate in any agricultural enterprise for consumption and sales. This implies the training has certain positive effect on Adaptive capacity of the farmers.

The average year of formal education is 6.2years, implying averagely all the benefitting farmers have primary education.

Table 4.1.6: Adaptive Capacity of Farmers to Climate Change.

S/n	Adaptive Capacity	Frequency	Percentage
		Yes	% Yes
1.	Agricultural training- Crops	238	93.3
2.	Agricultural training- Fisheries	2	0.8
3.	Agricultural training-Livestock	70	27.5
4.	Agricultural training-Forestry	6	2.4
5.	Non-agricultural training- Crafts	12	4.7
6.	Non-agricultural training- Metal works	4	1.6
7.	Non-agricultural training- Services	101	39.6
8.	Non-agricultural training- Trade	36	14.1
9.	Irrigation practices	198	77.6
10.	Freedom to plant any crops	249	97.6
11.	Agricultural Enterprise for consumption and sales	252	98.8

Source: Field Survey, 2018

RESULTS TO OBJECTIVE 1

4.2.1 POST-HARVEST SKILLS ACQUIRED AND METHODOLOGY USED

Table 4.2.1 shows that before the trainings, only 40.4% (103) were trained on Proper Crop Storage, 13.3% (34) on Proper Crop drying, 7.5% (19) on Processing technology, 41.2% (78) on Proper crop Harvesting, 30.6% (78) on Packaging, 35.7% (91) on Moisture Control, 37.3% (95) on Sorting and Grading, 10.2% (26) on Preparing business and work plan and 3.5% (9) on Zero Energy cooler.

After the training the number of beneficiaries that has acquired Post-harvest skills and other relevant skills as Preparing business and work plan has increased as a result of the training. 96.5% (246) has acquired Proper Crop Storage, 71% (181) on Proper Crop drying, 68.2% (174) on Processing technology, 93.3% (238) on Proper crop Harvesting, 94.5% (241) on Packaging, 84.7% (216) on Moisture Control, 99.2% (253) on Sorting and Grading, 96.9% (247) on Preparing business and work plan and 67.5% (172) on Zero Energy cooler.

Table 4.2.1: Post-harvest Skills Acquired.

S/n	***Post-harvest skills acquired***	***Frequency***		***Percentage***	
		Yes(before)	***Yes(After)***	***Yes(Before)***	***Yes(After)***
1.	Proper Crop Storage (PCSP)	103	246	40.4	96.5
2.	Proper Crop Drying (PCD)	34	181	13.3	71.0
3.	Processing Technologies	19	174	7.5	68.2
4.	Proper Crop Harvesting (PCH)	105	238	41.2	93.3
5	Packaging	78	241	30.6	94.5
6.	Moisture Control	91	216	35.7	84.7
7.	Sorting and Grading	95	253	37.3	99.2
8.	Preparing business and work plan (PBWB)	26	247	10.2	96.9
9.	ZEC	9	172	3.5	67.5

Source: Field Survey, 2018

4.2.2 Mode, Location and Methodology of training

According to table 4.2.1, 63.1% of the farmers were trained face to face while 36.9% were received face to face and field based training.

Table 4.2.2: Mode of training

S/n	Mode of training	Frequency	Percentage (%)
1.	Face to face training	161	63.1
2.	Face to face training and field based training./ coaching	96	36.9%

Source: Field Survey, 2018

From figure 4.2.1, 2% were trained at the Post-harvest Centres, 66.7% at the Ward or Village Offices, 30.2% at Nearby Schools and 1.2% at Conference halls.

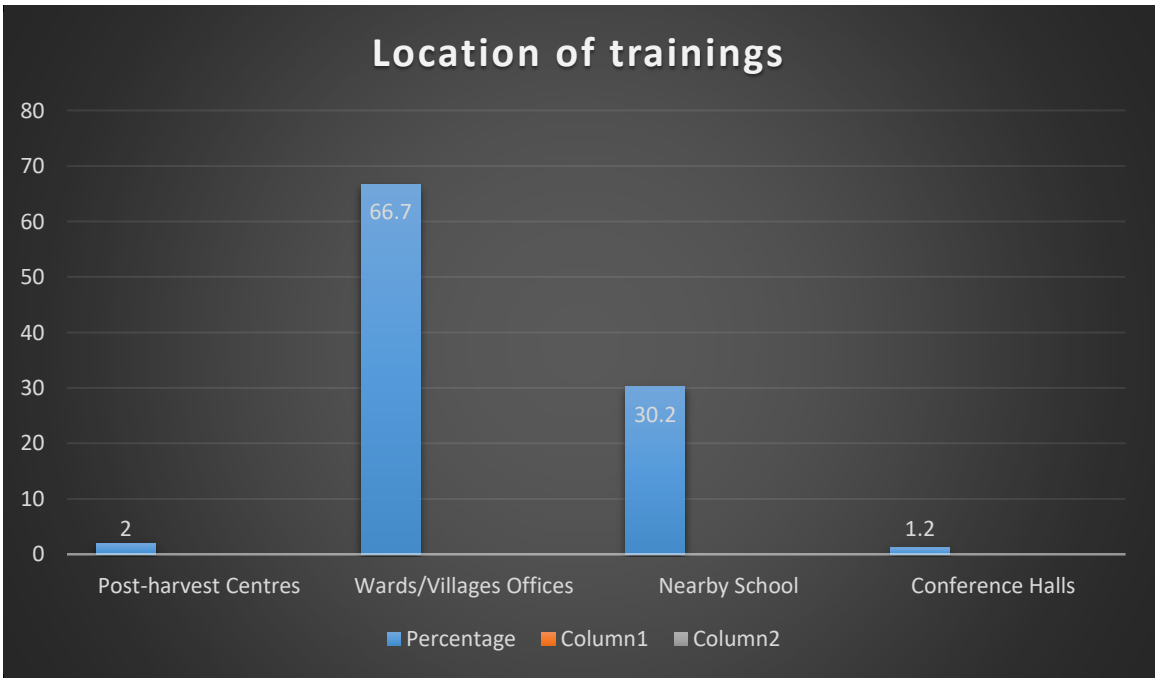


FIGURE 4.2.1. LOCATION OF TRAINING

Source: Field Survey, 2018

Methodologies used.

The Methodology applied during the training generally were Practical illustration, Farm demonstration, Participatory discussion, Group formations, Use of writing modules and pictorial illustration on charts or boards.

Generally, Adult Learning Approach was adopted as the methodology for training the farmers and the time spent per session was not exceeding 2 hours and Learning materials were provided for each participants.

RESULTS FOR OBJECTIVE 2

4.3.1 Descriptive Analysis of Fruits and Vegetables' Yield.

According to Table 4.3.1, noticeable difference in productivity index measured by yield is noted in the fruits and vegetables production table for the small holder farmers. The differences in yield before and after the training for the different horticultural product is as follows; Apple is 906.6 7Kg/Acre, 2709.70Kg/Acre for Cabbages, 1231.93 Kg/Acre for Tomato, 2217.36 Kg/Acre for Carrot, 791.00 Kg/Acre for Round Potatoes, 439.31Kg/Acre for Cauliflower, 712.49 Kg/Acre for Beetroot, 757.14 Kg/Acre for Lettuce, 257.11 for Beans and 1316.80 Kg/Acre for Sweet Pepper. All these differences in yields are highly notable.

Table 4.3.1: Descriptive Analysis of Fruits and Vegetables' Yield.

S/n	Fruits and Vegetables	Mean Yield (Kg/Acre Bf)	Mean Yield (Kg/Acre After)	Differences in mean Yield.
1.	Apples	1405.00	2311.67	906.67
2.	Cabbages	2212.81	4922.51	2709.70
3.	Tomato	3266.36	4498.29	1231.93
4.	Carrot	4922.51	7139.87	2217.36
5.	Round Potatoes	1905.13	2696.13	791.00
6.	Cauliflower	976.11	1415.42	439.31
7.	Beetroot	1076.23	1788.79	712.49
8.	Lettuce	899.05	1656.19	757.14
9.	Beans	411.65	668.76	257.11
10.	Sweet Pepper	1725.60	3024.40	1316.80

Source: Field Survey, 2018

4.3.2 Inferential Analysis of Fruits and Vegetables' Yields.

From Table 4.3.2, inferences about the significant difference in yield of horticultural products were checked and the following were the result; There is insignificant difference at P-Value

<0.150. For Cabbages, Tomato, Carrot, Round Potatoes and Lettuce, there is a strong significant difference for differences in yield at P-Value < 0.000. Cauliflower, Beetroot, Beans, Sweet Pepper also significant at P-Value < 0.007, 0.011, 0.010, 0.003 respectively.

Table 4.3.2: Inferential Analysis of Fruits and Vegetables' Yields

	Fruits and Vegetables	T-value	Significance	Inference
1.	Apples	3.606	0.150	Insignificant
2.	Cabbages	8.473	0.000*	Significant
3.	Tomato	4.651	0.000*	Significant
4.	Carrot	5.663	0.000*	Significant
5.	Round Potatoes	9.326	0.000*	Significant
6.	Cauliflower	2.965	0.007*	Significant
7.	Beetroot	2.313	0.031*	Significant
8.	Lettuce	3.028	0.000*	Significant
9.	Beans	2.643	0.010*	Significant
10.	Sweet Pepper	3.272	0.003*	Significant

***Significance level is at 5% interval**

Source: Field Survey, 2018

Research Hypothesis 1

Null Hypothesis: There is no significant difference between yields of fruits and vegetables before and after the training.

Alternate Hypothesis: There is significant difference between yields of fruits and vegetables before and after the training.

Therefore, since there is significant difference between the yields of fruits and vegetables before and after the training, we reject the null hypothesis and accept the alternate hypothesis.

4.3.3 Inferential Analysis of Fruits and Vegetables' Post-Harvest loss.

Table 4.3.3 shows only Apple did not record significant difference in the Quantity of Post-harvest loss before and after the training with P-Value <0.165. Other horticultural product;

Cabbage, Tomato, Carrot, Round Potato, Cauliflower, Beetroot, Lettuce, Beans, Sweet Pepper have significant differences at P-Value<0.000, 0.000, 0.000, 0.000, 0.016, 0.002, 0.011, 0.000, 0.001 respectively. The P-Value<0.000 indicates strong significant difference between Quantity of PHL before and after the training. Showing there is reduced PHL of fruits and vegetables.

Table 4.3.3: Inferential Analysis of Fruits and Vegetables' Post-Harvest loss.

	Fruits and Vegetables (PHL)	T-value	Significance	Inference
1.	Apples	1.625	0.165	Insignificant
2.	Cabbages	13.992	0.000*	Significant
3.	Tomato	3.992	0.000*	Significant
4.	Carrot	3.859	0.000*	Significant
5.	Round Potatoes	5.724	0.000*	Significant
6.	Cauliflower	2.602	0.016*	Significant
7.	Beetroot	3.556	0.002*	Significant
8.	Lettuce	2.747	0.011*	Significant
9.	Beans	5.017	0.000*	Significant
10.	Sweet Pepper	3.664	0.001*	Significant

***Significance level at 5% interval**

Source: Field Survey, 2018

4.3.4 Paired Sample T-test of Farm Income

In Table 4.3.4, running a paired T-test analysis to compare the Farm monthly income of the beneficiaries before and after the training, there was a significant difference in the incomes. The average FMI of the beneficiaries before the training was 104687.59 TZS (41.12USD), while the average FMI after the training is 1466779.310(72.956USD). This shows that there was a significant increase in the monthly income of farmers

Table 4.3.4: Paired Sample T-test of Farm Income.

Farm Monthly Income	Mean before	Mean after	SD before	SD after	T-Value	Significance
Before and After(TZS)	104687.590	146779.310	191087.620	182284.250	4.429	0.000*
Before and After (USD)	41.115	72.956	56.117	157.67	3.828	0.000*

Source: Field Survey, 2018

Research Hypothesis 2

Null Hypothesis: There is no significant difference between the incomes of farmers before and after the training.

Alternate Hypothesis: There is significant difference between the incomes of farmers before and after the training.

Therefore, since there is significant difference between the income of farmers before and after the training, we reject the null hypothesis and accept the alternate hypothesis.

4.3.5 Income Perception of Farmers

In figure 4.3.1, the farmers were asked of their perception towards their income. 92.9% responded that there was improvement in their income, 4.3% recorded worsened income and 2.7% responded as no changes in their income. This shows that although there was an overall increase in beneficiaries' income, certain percentage of benefiting farmers still experienced worsened income or no changes after the training.

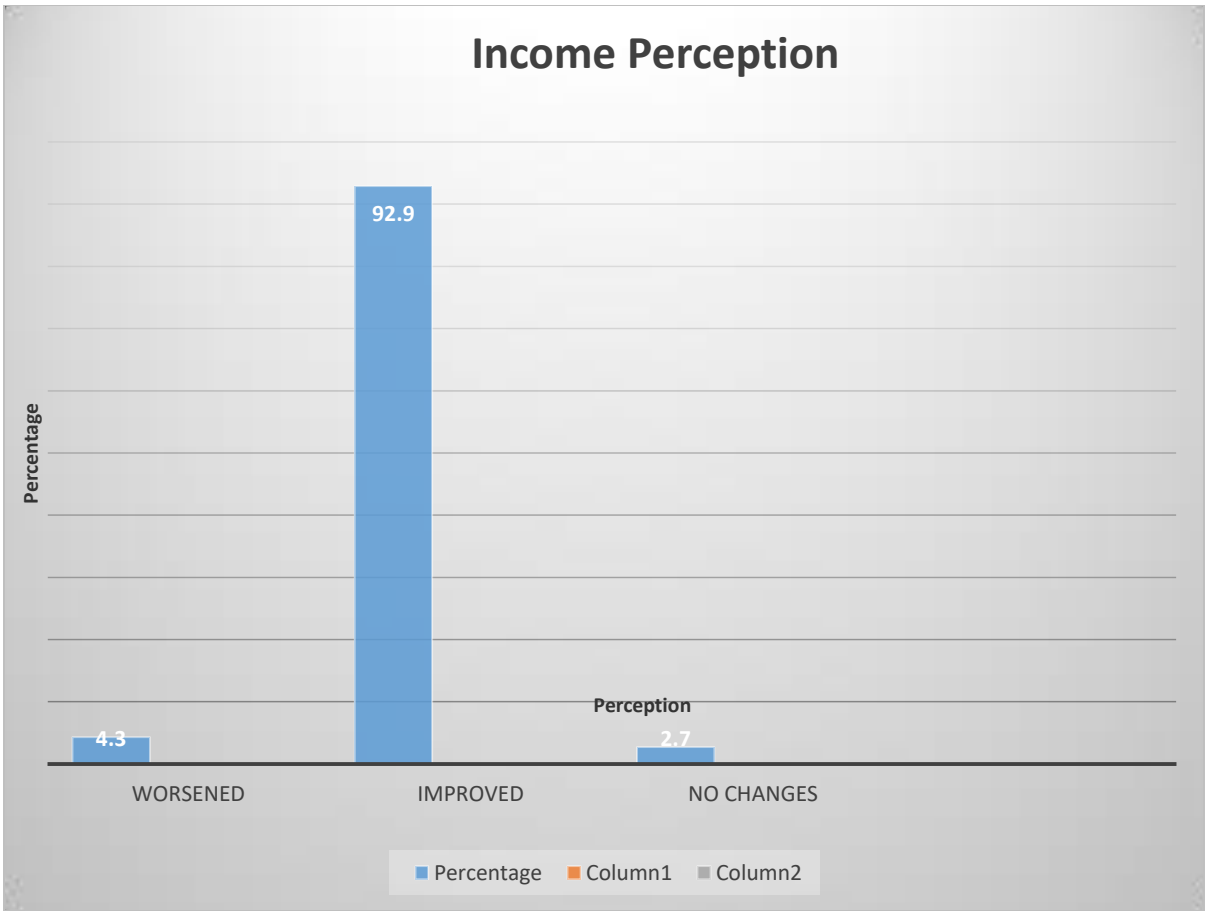


FIGURE 4.3.1: DISTRIBUTION BY INCOME PERCEPTION.

Source: Field Survey, 2018

4.3.6 Independent Sample T-test for Yields in Kg/Acre against Post-harvest Skills

Table 4.3.5 shows the relationship between the PH skills acquired and their effects on increasing yields. The following Skills has a significant relationship on increased yield of different horticultural products; Processing technology on yield of Lettuce at P< 0.004, ZEC (Zero Energy Cooler) on yield of Apples, Round Potato, Cauliflower, Beetroot, Lettuce at P-Value < 0.059,0.011,0.004, 0.058 and 0.058 respectively. Proper Crop Storage Practices (PCSP) on yield of Carrot, Round Potato at P-Value < 0.000 and 0.0519 respectively. Proper Crop Drying Practices (PCDP) on yield of Carrot, Round Potato, Beetroot, Lettuce at P-Value < 0.015, 0.095.0.097,0.097 respectively. Proper Crop Harvesting (PCH) on yield of Cabbage at P-Value < 0.028, Packaging on yield of Carrot at P-Value < 0.001, Moisture Control on yield of Carrot, Beetroot, Lettuce, Beans at P-Value < 0.055, 0.003, 0.003 and 0.000 respectively. Sorting and Grading and Preparing business and work plan had no significant relationship on the yields of the crops.

Table 4.3.5: Independent Sample T-test for Yields in Kg/Acre against Post-harvest Skills

PH Skills		Apples	Cabbage	Tomato	Carrot	Round Potato	Cauliflower	Beetroot	Lettuce	Beans	Sweet Pepper
Processing Tech.	F	0.786	1.014	1.282	0.285	2.539	1.680	3.934	10.022	0.871	1.177
	S	0.381	0.316	0.263	0.594	0.112	0.208	0.061	0.004***	0.354	0.289
ZEC	F	6.827	0.360	0.667	0.002	6.645	10.212	4.037	4.037	1.199	0.780
	S	0.059*	0.550	0.418	0.964	0.011**	0.004***	0.058*	0.058*	0.277	0.386
PCSP	F	-	1.391	-	18.055	0.417	-	-	-	0.076	-
	S	-	0.241	-	0.000***	0.0519*	-	-	-	0.078	-
PCDP	F	0.969	0.292	1.363	6.085	2.814	0.550	3.037	3.037	0.878	0.293
	S	0.381	0.590	0.248	0.015**	0.095*	0.466	0.097*	0.097*	0.352	0.594
PCH	F	-	4.948	0.109	0.186	5.879	2.654	-	-	0.508	-
	S	-	0.028**	0.743	0.668	0.16	0.118	-	-	0.478	-
Packaging	F	-	1.800	-	11.384	0.192	2.862	1.570	1.570	0.012	-
	S	-	0.182	-	0.001***	0.662	0.105	0.225	0.225	0.913	-
Moisture Control	F	-	0.040*	3.133	3.773	1.392	2.300	11.190	11.190	69.996	0.522
	S	-	0.842	0.82	0.055**	0.239	0.144	0.003***	0.003***	0.000***	0.478
Sorting & Grading	F	-	1.728	-	-	0.248	-	-	-	-	-
	S	-	0.191	-	-	0.619	-	-	-	-	-
PBWP	F	-	-	-	0.207	0.604	-	-	-	0.385	-
	S	-	-	-	0.650	0.438	-	-	-	0.535	-

***represents significance at 1%, **represents significant at 5%, *represents significant at 10%, F represents Levene's Test for equality of variance and S signifies Significant.

Source: Field Survey, 2018

4.3.7 Independent Sample T-test (Post-harvest loss in kg/acre against Post-harvest Skills Acquired)

According to Table 4.3.6, the relationship between the PH skills acquired and their effects on Quantity of PHL reduction. The following Skills has a significant relationship on reduction of quantity of Postharvest loss of different horticultural products; PCSP on quantity of PHL of Round Potato at P-Value < 0.086, PCDP on quantity of PHL of Apples, Carrot, Round Potato, Cauliflower, Lettuce, Sweet Pepper at P-Value < 0.022, 0.050, 0.013, 0.097, 0.095 and 0.090 respectively. Processing Technology on quantity of PHL of Apples, Cauliflower, Beetroot, Lettuce, Beans, Sweet Pepper at P-Value < 0.022, 0.059, 0.055, 0.048, 0.074, 0.088 respectively. Proper Crop Harvesting on quantity of PHL of Apples at 0.028. Moisture Control on quantity of PHL of Lettuce and Beans at P-Value, 0.079 and 0.003 respectively. ZEC on quantity of PHL of Cauliflower at P-Value 0.046. Packaging, Sorting and Grading and Preparing business and work plan had no significant relationship on reducing the quantity of Postharvest loss.

Table 4.3.6: Independent Sample T-test (Post-harvest loss in kg/acre against Post-harvest Skills Acquired)

PH SKILLS		Apples	Cabbage	Tomato	Carrot	Round Potato	Cauliflower	Beetroot	Lettuce	Beans	Sweet Pepper
PCSP	F	-	1.391	-	0.125	2.977	-	-	-	0.506	0.300
	S	-	0.241	-	0.724	0.086*	-	-	-	0.484	0.586
PCDP	F	13.171	0.292	2.398	3.912	6.325	3.015	0.064	2.996	0.574	3.140
	S	0.022**	0.590	0.127	0.050*	0.013**	0.097*	0.803	0.095*	0.451	0.09*
Processing Tech	F	13.171	1.014	0.702	3.171	0.969	3.967	4.135	4.295	3.268	3.185
	S	0.022**	0.316	0.406	0.780	0.327	0.059*	0.055*	0.048*	0.074*	0.088*
PCH	F	4.948	0.015*	0.600	-	0.013	0.652	-	-	0.863	-
	S	0.028*	0.903	0.440	-	0.908	0.428	-	-	0.356	-
Packaging	F	-	1.800	-	0.210	0.528	0..652	1.365	-	0.002	-
	S	-	0.182	-	0.648	0.468	0.428	0.265	-	0.967	-
Moisture Control	F	-	0.040*	0.007	2.080	0.052	0.374	7.475	3.337	9.199	0.001
	S	-	0.842	0.932	0.152	0.819	0.547	0.013**	0.079*	0.003***	9.76
Sorting & Grading	F	-	1.728	-	-	1.252	-	-	1.027	-	-
	S	-	0.191	-	-	0.264	-	-	0.320	-	-
PBWP	F	-	-	-	0.546	0.432	-	-	0.649	1.117	-
	S	-	-	-	0.461	0.511	-	-	0.428	0.294	-
ZEC	F	3.566	0.360	0.736	0.879	0.229	4.467	2.680	2.346	-	4.221
	S	0.132	0.550	0.395	0.351	0.633	0.046**	0.117	0.138	-	0.51

***represents significance at 1%, **represents significance at 5%, *represents significance at 10%.

Source: Field Survey, 2018

RESULT FOR OBJECTIVE 3

4.4.1 Challenges facing farmers after the intervention.

Table 4.4.1 shows 100% of beneficiary farmers attested to lack of Capital as a major challenge to them in practicing of farm as a business and implementing the skills that have been acquired. 70.6% acknowledged insufficient knowledge about Postharvest skills as a challenge. Many farmers would like to be further trained in Postharvest skills especially processing technologies to enhance diversity of their livelihoods. 59.2% acknowledged insufficient Land area as a challenge debarring their productivity, 98% of the farmers were adversely affected by Climate Change especially drought, flooding of farmlands especially those without flood drains and Pest invasion in the recent years. 99.6% identified insufficient access to input as a roadblock to their improved productivity. 90.2% and 86.7% identified Market unavailability and Inadequate access to financial institution respectively as challenges hindering their productivity.

Other noted challenges is unavailability of Storage facilities in the study area.

Table 4.4.1: Challenges facing farmers after the intervention.

S/n	Challenges	Frequencies		Percentage	
		Yes	**No**	**% Yes**	**% No**
1.	Lack of Capital	255	0	100	0
2.	Insufficient Knowledge about Harvest Skills	180	75	70.6	29.4
3.	Insufficient Land area for expansion.	151	104	59.2	40.8
4.	Climate change(drought)	250	5	98	2
5.	Insufficient access to Inputs	254	1	99.6	0.4
6.	Market Unavailability	235	20	90.2	9.8
7.	Inadequate access to financial institution	231	34	86.7	13.3

Source: Field Survey, 2018

4.3.2 SWOT ANALYSIS OF THE MIVARF TRAINING PROGRAMS.

STRENGTHS

- Market demand driven; Production is driven based on market demands.
- Capacity Building in form of trainings on Good Agricultural Practices, Post-harvest handling, Farming as business and Recording.
- Increased Productivity
- Collective Action as a result of Group Formation.

WEAKNESSES

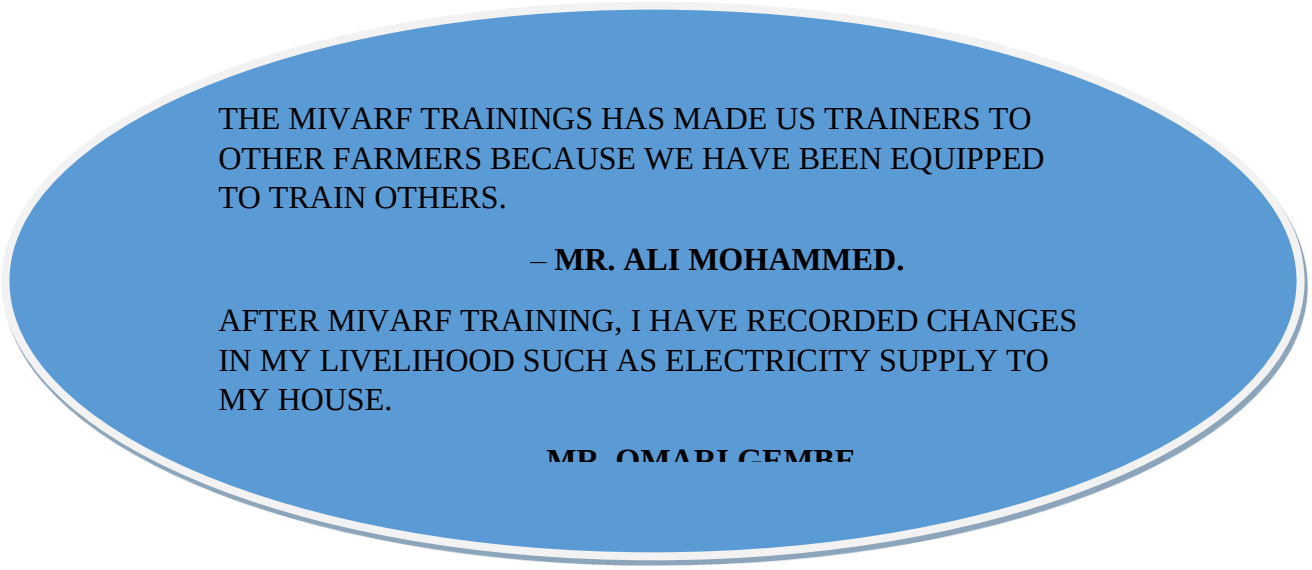
- Lack of coordination among Farmers' groups to meet market demands.
- Insufficient Post-harvest Trainings especially on Processing Technologies

OPPORTUNITIES

- Market Linkages.
- Access to loans through AMCOS (Agriculture Marketing Cooperative Society) formed**.**
- Exposure to Professional trainings in Horti Tengeru, Arusha and Seeds of Expertise for the Vegetables Industry of Africa, Moshi.

THREATS

- Climate Change: The Change in climatic condition such as drought, flooding and Pest invasion
- Poor Infrastructure especially for Irrigation purpose.



CHAPTER 5: SUMMARY AND CONCLUSION AND CONCLUSIONS

5.1 Summary

The summary of the Socio economic characteristics of the smallholder FV farmers of Lushoto district varies with majority of them as adults with mean age 49, married and had attained primary education though male farmers are more educated than females.

The Adaptive capacity of farmers to climate change was also measured and it was noted that most farmers were exposed to crop agricultural trainings but very little were exposed to other forms of agricultural trainings such as livestock, fisheries and forestry. Also, very few percentage of the farmers are exposed non-agricultural trainings implying low diversity for their livelihood.

This means that should climate change affects their farm yields adversely, their coping mechanism will be low.

During the course of the MIVARF Training, different Post-harvest Skills were acquired and the methodology adopted for training was Adult Learning Approach with the location of the training mostly being Ward/Village Offices and Nearby Schools.

The mean yield and quantity loss after the training showed significant difference compared to the yield before and there was significant relationship between the Skills acquired and the improved yields of the farmers.

The farmers identified certain challenges such as Lack of Capital, Insufficient Post-harvest skills, Climate Change (especially drought and flooding), inadequate access to financial institutions and market unavailability as major obstacles encountered in increasing their productivity.

SWOT Analysis of the MIVARF training program showed that the training was strong in capacity building by delivering skills such as GAP, PHH and FBS (Farming as business) to farmers. Also, the training lead to formation of groups that gave birth to AMCOS through which smallholder farmers can access credits from financial institution with greater ease.

However, lack of coordination and insufficient Post-harvest skills especially processing technologies among the smallholder farmers was a major weakness. The threats of climatic condition and Poor infrastructural system for irrigation are major laybacks that the training can be improved upon, so that climate resilient farmers will be built.

5.2 Conclusion

The MIVARF training has largely helped to improve the farmers' productivity, income and reduce PHL of smallholder farmers. The skills acquired during the training has been of great benefits to the farmers.

The lesson learnt from the success and sustainability of the groups formed from the training can be used to improve the productivity of other smallholder farmers in Tanzania, EAC and Africa as a whole.

Also, addressing the challenges the training encountered in improving productivity of smallholder farmers such as providing climate resilient agricultural trainings and providing more trainings on post-harvest skills especially on food processing will foster increased productivity and reduced PHL among the farmers. Consequently, leading to eradication of poverty and food insecurity in rural areas where the largest percentage of the poor lives and the country, Tanzania as a whole.

5.3 Recommendations

GOT

I strongly recommend further trainings on Climate resilient agricultural practices as many farmers are largely affected by drought in some times of the year and flooding during the raining season.

Smallholder farmers' organization should be given strong aid for accessing loans from the financial institutions. Interest rates of these loans should be lowered for smallholder farmers groups to encourage practice of farming at a commercial level.

Market linkage for farmers has to be strengthened as much needs to be done to encourage practice of commercial agriculture.

Trainings on Handling of pest invasion especially the recent outbreak of Tomato leaf miners needs to be addressed at the grass root level.

FARMERS

Strong recommendation is given to the farmers to participate in trainings like this that will help build their capacities and improve their productivity.

Farmers must also coordinate themselves even at the AMCOS level and ensure to meet deadlines for their market demands. Also, practice of the skills acquired during the training should be done consistently as that is the only guarantee for sustained increased in productivity.

Finally, the farmers should pull resources together to get irrigation infrastructures which can be used under the monitoring of the ward extension officers to ensure they are practicing climate resilient agriculture instead of rain-fed system of agricultural practices.

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APPENDICES

IFAD-MDP FIELD PRACTICUM

EFFECTIVENESS OF KNOWLEDGE AND SKILLS DEVELOPMENT PROGRAMMES IN IMPROVING PRODUCTIVITY OF SMALLHOLDER FARMERS' ORGANIZATION: CASE STUDY OF POST-HARVEST HANDLING OF FRUITS AND VEGETABLES IN LUSHOTO, TANGA, TANZANIA.

INTRODUCTION

This survey is aimed at assessing the effectiveness of knowledge and skills development programs in improving productivity of smallholder farmers' organization. A case study of Post-harvest handling of fruits and vegetables in Lushoto, Tanga, Tanzania. This questionnaire is designed to elicit information from smallholder farmers who have benefitted from the knowledge and skills development programs conducted by MIVARF. Information obtained will be treated with strict confidentiality. Thank you for your cooperation.

Name of Respondent:_____ Questionnaire ID:_____

Name of Enumerator: _____ Date and Signature: _____

SECTION A: BASIC INFORMATION.

S/N	QUESTIONS	RESPONSE	CODING
1	Gender	(1) Male { } (2) Female { }	1 2
2	GPS Coordinates	(1) Latitude _____ (2) Longitude _____ (3) Altitude _____	
3	Location	(1) Ward _____ (2) Village _____ (3) Group _____	
4	Age (in years)	{ }	
5	Marital Status	(1) Single { } (2)Married { } (3)Widowed { } (4)Separated { } (5)Divorced { }	1 2 3 4 5
6	Highest Educational Attainment	(1) No Formal Education { } (2) Adult literacy { } (3) Primary Education. { } (4)Secondary Education { } (5)Tertiary Education { }	1 2 3 4 5
7	Average years of Education	_____	
8	Household head (HH)	(1) Female { } (2) Male { }	1 2

9a	Primary Occupation of Household head	(1)Farming{ } (2) Trade{ } (3)Crafts { } (4) Others,_____	1,2 3,4
9b	Secondary Occupation of Household head	(1)Farming{ } (2) Trade{ } (3)Crafts { } (4) Others,_____	1,2 3,4
10	Main Source of Income for household	(1)Farming{ } (2) Business{ } (3)Civil servant { }(4) others_____	1,2 3,4
11	Other Source of Income for household	(1)Farming{ } (2) Business{ } (3)Civil servant { }(4) others_____	1,2 3,4
12	Household size (How many people are in your house including you?)		
13	How many numbers of dependents (People not working) are in your household?	_____	
14	What is the size of your household farm (Acres)?	(1) Less than 1 Acres { } (2) Between 1-3 Acres { } (3) Between 3-5 Acres { } (4) More than 5 Acres { }	1 2 3 4
14b	What is the farm ownership of the land area owned by household?	(1)Borrowed{ } (2) Self Owned { } (3) Inherited { }	1,2 3
15	What are the household assets you owned before the MIVARF post-harvesting trainings? (**multiple answers allowed**)	(1)Electrical Appliances { } (2)Electricity installation { } (3)Motor Bikes{ }(4)Mattress{ } (5)Chairs{ }(6)Bicycle{ } (7)Others specify, _____	1 2 3,4 5,6 7
16	What is your farming experience (Years)?	_____	
17	Which of the following agricultural trainings have you ever received?	(1)Crops{ } (2) Fisheries { } (3) Forestry{ } (4) Livestock{ }	1,2 3,4
18	Which of the following non-agricultural training have you ever received?	(1) Crafts { } (2) Services { } (3)Metal Works{ } (4) Trade { } (5) Others, specify_____	1,2 3,4 5
19	Have you received any training on irrigation practices before?	(1) Yes { } (2) No { }	1 2
20	Are you allowed to grow any type of crop?	(1) Yes { } (2) No { }	1 2
21	Are you allowed in any agricultural enterprise for consumption and sale to the market?	(1) Yes { } (2) No { }	1 2
22	Are involved in another Post-harvesting training Program apart from MIVARF?	(1) Yes { } (2) No { }	1 2

SECTION B: POST-HARVEST KNOWLEDGE AND SKILLS AND METHODOLOGY OF TRAINING.

1) Have you benefitted in MIVARF post-harvest handling training? (1) Yes { } (2) No { }

2) What kind of new skills and knowledge have you acquired through being trained by MIVARF? Please tick

S/n	Skills and Knowledge acquired	Before the training (Yes/No)	After the training (Yes/No)	Describe what you are doing differently after the training?
a	Group Formations			
b	Proper Crop Storage Practices			
c	Proper Crop Drying			
d	Processing Technologies			
e	Proper Crop Harvesting			
f	Packaging			
g	Moisture Control			
h	Sorting and Grading			
i	Preparing Business and Work Plans.			
j	Temperature and relative Humidity Control			
k	Transportation			
l	Zero Energy Cooler			

S/n	QUESTIONS	REPONSE	CODING
3	Do you dry your fruits and vegetables?	(1) Yes { } (2) No { } If yes, how? _____	1 2
4	Do you store your fruits and vegetables?	(1) Yes { } (2) No { } If yes, how? _____	1 2
5	Were you trained on how to build zero energy cooler (ZEC) to store your fruits?	(1) Yes { } (2) No { }	1 2
6	Have you personally built a zero energy cooler (ZEC)?	(1) Yes { } (2) No { } If No, why? _____	1 2
7	Do you practice processing of your fruits and vegetables?	(1) Yes { } (2) No { }	1 2
8	If (yes in question 5 above), What processing equipment do you use?	(1) Local Equipment{ } (2) Machines { }	1 2
9	How do you transport your crops?	(1) On my head { } (2) On bicycle { }	1 2

		(3) On Motorbikes { } (4) Through Trucks { } (5) Sell at farm gate { }	3 4 5
10	Do you practice sorting and grading of your products?	(1) Yes { } (2) No { }	1 2
11	Do you practice record keeping for your farm business?	(1) Yes { } (2) No { } If No, why?_____	1 2
12	Do you have a production calendar?	(1) Yes { } (2) No { }	1 2
13	Do you plant to meet the peak demand period?	(1) Yes { } (2) No { }	1 2
14	If No in question 13, why?	_____	
15	Are you involved in fruits and vegetables packaging?	(1) Yes { } (2) No { }	1 2
16	Where did the MIVARF trainings take place?	(1) Post-Harvest Training Centres { } (2) Ward/Village Offices { } (3) Conference Halls { } (4) Nearby Schools { } (5) Other(s),please specify _____	1 2 3 4 5
17	How were you trained? (**multiple answers allowed**)	(1) Face-to-face training { } (2) Computer based trainings { } (3) Field-based training { } (4) Others, specify_____	1 2 3 4
18	How has the trainings been beneficial to your farming business?	(1) Reduced loss of fruits and vegetables { } (2) Improved Storage of fruits and vegetables{ } (3) Increased marketability { } (4) Increased income { }	1 2 3 4
19	Was it easy for you to learn the skills and knowledge under the training?	(1) Yes { } (2) No { }	1 2
20	How did the trainers made it easy for you to acquire the skills and knowledge?		

SECTION C: POST-HARVEST HANDLING KNOWLEDGE AND SKILLS ON SMALLHOLDER FARMER'S PERFORMANCE.

(1)What is the size of your farm land for cultivating fruits and vegetables, Production/Output and Price per bags? The fruits and vegetables are: **Cabbage, Tomatoes, Cauliflowers, Carrots, Broccoli, Irish Potatoes, Sweet pepper, Spinach, Beetroots, Zucchini, Onions, Red cabbage, Pears, Apples and Plums.**

S/n	Names of fruits and vegetables	Before the Training (Year 2014)				After the Training (Year 2017)			
		Land area cultivated (Acres)	Harvested Output (in bags/tins)	Quantity Loss After Harvesting (in bags/tins)	Price per bag/tin (TZS)	Land area cultivated (Acres)	Harvested Output (in bags/tins)	Quantity Loss after Harvesting (in bags/tins)	Price per bag/tin (TZS)
a									
b									
c									
d									
e									
f									
g									
h									
i									
j									
k									
l									
m									

S/n	QUESTIONS	RESPONSE	CODING
2.	What are the household assets recently acquired after the MIVARF post-harvest trainings? (**Multiple answers allowed)**	(1)Electricity installation{ }(2)Electrical appliances{ } (3)Chairs { }(4)Motor bikes{ } (5)Mattress { } (6)Bicycle{ } (7)Others specify_____	1,2 3,4 5,6 7
3	Have you acquired new farm machineries after the trainings?	(1) Yes{ } (2) No { }	1 2
4	If Yes in question 3 above, name them.	(1) _____ (2) _____ (3) _____	

5	What is your average farm income per harvest season (3 months) before the training (year 2014) in TZS?	_____	
6	What is your average farm income per harvest season (3 months) after the training (year 2017) in TZS?	_____	
7	What can you say about your income after MIVARF Training?	(1) Improved { } (2) No changes { } (3) Worsened { }	1 2 3
8	Have you being able to make savings from your income after the training?	(1) Yes { } (2) No { } If yes, how much in TZS?_____	1 2
9	Which of the following happened to your household farm size after the training?	(1) Increased { } by how much_____ (2) No changes { } (3) Decreased { }by how much_____	1 2 3

SECTION D: CHALLENGES OF KNOWLEDGE AND SKILLS DEVELOPMENT PROGRAM IN IMPROVING PRODUCTIVITY.

The following factors have been limiting the impacts of MIVARF post-harvesting training on my productivity. Please tick as applicable.

S/n	FACTORS	YES	NO
1	Lack of Capital		
2	Insufficient Knowledge about Post-Harvest Skills		
3	Insufficient land area for expansion.		
4	Climate Changes (for instance drought).		
5	Insufficient access to Inputs (Fertilizers, improved seeds etc.)		
6	Market unavailability		
7	Inadequate access to financial institutions		
8	Preference for traditional methods		
9	Educational level		

General Comments:

Please provide your comments based on post-harvest management skills acquisition.

(1) How would you like the trainings to be and what other knowledge will you like to learn?

_____

_____

_____

(2) Did the training really met your needs and if you are had paid, would it have worth it?

_____

_____

SWOT Analysis Questions for Focused Group Discussion

STRENGTHS

1. Why did you join the MIVARF Post-harvesting Trainings?
2. What were the motivating factors and influences of you joining the MIVARF Trainings?
3. What has the Post-harvesting Trainings by MIVARF done well?
4. What is the major commodity produced on your farm?
5. Why is it the major commodity?
6. How has the MIVARF Post-harvesting training helped you by the skills and knowledge gained to increase your production (in volumes, quality assurances and food safety)?
7. How has the MIVARF post-harvesting training helped to increase the income of the small holder's farmers?
8. What have been your most notable achievements since you join the MIVARF Post-harvesting Trainings?

WEAKNESSES

1. What does the MIVARF Post-Harvesting Training not do well?
2. What does other who is not a beneficiary of MIVARF Post-harvesting training see as the weaknesses of this programme?
3. What should the MIVARF Post-harvesting training programme avoid?
4. Did you enjoy maximum attention and response to your questions during the MIVARF Post-harvesting training programmes?
5. What challenges do you face in increasing your production outputs after the training?

OPPORTUNITIES

1. Has the MIVARF Post-harvesting trainings made it possible for you to secure better productivity?

2. What new relationship can the MIVARF training programs develop to enhance better productivity?
3. What methods can the training programs by MIVARF adopt to improve your incomes?
4. Are there new government policies and programs available for the MIVARF Post-harvesting training programs to leverage on?
5. What social patterns, population, profiles and lifestyles changes occurring that could improve the delivery of MIVARF Post-harvesting trainings?

THREATS

1. Are the trainings received from MIVARF on post-harvesting skills and knowledge enough?
2. Are there post-harvesting skills and knowledge passed down that could reduce your income?
3. How are changes in technology threatening the profitability of your farm?
4. Are there other programs that carry out post-harvesting trainings apart from MIVARF?
5. Did they train better than MIVARF?
6. Are there benefits attached to being trained by other programmes that MIVARF training programmes does not have?

QUESTION GUIDE FOR In-depth Interview

Please introduce yourself sir

1. When did you begin the trainings for MIVARF in this district?
2. Explain what you do for MIVARF in regards to trainings delivered (and specifically trainings delivered on Post-harvest handling) in Lushoto District Council?
3. What trainings have been conducted to farmer groups and on what basis?
4. How were these trainings carried out, I mean the methodologies used for training the farmers?
5. What changes has happened to the farmers as a result of the trainings (Benefits)?
6. Can you say these trainings have improved farmers post-harvest handling of their fruits and vegetables?

7. What challenges do you think are facing the farmers in practicing what they have been taught?
8. Was any training given to the farmers on how to be climate resilient especially for drought, flooding and pest invasion which is common to the district?

PLAN OF THE STUDY; WORK PLAN

S/N	ACTIVITY	MARCH 2018				APRIL 2018				MAY 2018			
		WEEKS											
		1	2	3	4	1	2	3	4	1	2	3	4
1	Preparation and travel plans												
2	Arrival and settlement at field site												
3	Visit some field site 1												
4	Project design planning												
5	Sourcing for relevant information on project												
6	Data Collection & recording												
7	Visit to field site 2												
8	Developing internship report												
9	Presentation of Internship Report												
10	Preparation and travel plan from												

	site												

Pictures

FIGURE 1:PRE-TEST OF QUESTIONNAIRE AT MNADANI VILLAGE

FIGURE 2; FOCUSED GROUP DISCUSSION WITH FARMERS' GROUPS

FIGURE 1: SAMPLE COLLECTION

FIGURE 4: TRAINING OF EXTENSION OFFICERS.

FIGURE 2: WITH THE PROJECT OFFICER OF MIVARF TRAINING