Effectiveness of Knowledge and Skills Development Programmes in Improving Productivity of Smallholder Farmers' Organizations: Post-harvest management of fruits and vegetables in Tanzania

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Abstract

This study assessed the effectiveness of the delivery of knowledge and skills development programmes in improving the productivity of smallholder farmers. The study identified the post-harvest handling skills acquired and their effect on productivity, including yield, 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 analysed using descriptive and inferential statistics. Qualitative data were also gathered through focus group discussions and in-depth interviews.

The average farm monthly income of farmers before and after the training were $41.12 and $72.96 respectively. The mean yield before the training for round potatoes and cauliflower were 1905.13kg/acre and 976.11kg/acre respectively, which significantly increased to 2696.13kg/acre and 1415.42kg/acre respectively after the training. Results indicated that skills for post-harvest handling of fruits and vegetables were acquired during the training. These skills contributed significantly to decrease post-harvest loss of fruits and vegetables and increase yields and average incomes.

The overall effect of the development programmes on the productivity of smallholder farmers was positive. However, to further improve productivity, the farmers need more training on post-harvest handling management, climate resilient agricultural practices, and prevention of pest invasion.

Keywords: Knowledge, Post-harvest loss, Productivity, Income, Climate resilience.

Introduction

In Tanzania, agriculture accounts for more than a quarter of the GDP, employing over 80 percent of the workforce and providing 85 percent of exports. However, Tanzania is one of the world's poorest countries. The Tanzanian economy has been growing at a steady rate of about 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 is hardly noticeable in rural areas where most smallholders 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 been one of the most important sectors in the East African Community which accounts for about 80% of the workforce comprising the smallholder farmers in rural areas. According to Mkenda and Van Campenhout (2011), the majority of citizens who are engaged in the agricultural sector are smallholder farmers living in rural areas whose main source of cash income is selling of agricultural products.

In 2015, 80% of overall food produced in Asia, sub-Saharan Africa and Latin America was 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 (CFS, 2015). According to TAHA (2010), the horticultural sub-sector of agriculture in Tanzania is the fastest growing sub-sector with an average growth rate of 8-10%per annum. The sub-sector is largely dependent on smallholder farmers with export of fruits and vegetables alone being 70% dependent on farmers with landholding less than 2 ha. One of the major challenges facing this sector is the post-harvest loss of products, which is specifically high (40%) in the domestic market and lower (10%) in the export sector.

The Tanzanian government, in collaboration with development partners, developed the Marketing Infrastructure, Value Addition and Rural Finance Support (MIVARF) programme to solve the problem of post-harvest losses and improve the general productivity of smallholder farmers in rural areas. The MIVARF programme is a loan agreement financed by three institutions; AFDB (37%), IFAD (54%) and URT Government (9%). The central objective of the programme is to enhance income and alleviate food insecurity on a sustainable basis for rural dwellers in Tanzania.

The programme has a seven-year duration, effective from its implementation in July 2011; its completion is to be on 31st March 2018 and the closing date is 30th September 2018. The programme covers 29 regions and 73 local government authorities (LGAs) in Tanzania. MIVARF has three components which serve as bases 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 and skills) to groups of smallholder producers/processors in the regions and districts, as well as the rehabilitation and providing resources for 13 post-harvest (PH) training centres.

iii. *Producer Empowerment and Market Linkage:* 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 the market information systems, supporting these groups in making optimum use of the warehouses and market infrastructure promoted under sub-component 1, and facilitating their access to finance in order to implement warehouse receipt systems (WRS).

Objectives of the Study

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

2. To assess the effect of post-harvest handling knowledge and skills on performance of smallholder farmer organizations.

3. To identify the challenges that these interventions encounter in increasing the productivity of rural farmers.

Definition of Concepts

Food Security. Food Security was defined in the 1974 World Food Summit as the "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 Summit 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.

Post-harvest Loss (PHL). According to Kader (2002), post-harvest loss can be defined as the degradation in both quantity and quality of a food product 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 some amount of a product. Loss of quantity is more common in developing countries (Kitinoja, 2011).

Post-Harvest Handling. Post-harvest handling starts from harvesting of the produce from the field, to storage, transportation, processing, marketing and final consumption.

Storage. Storage refers to keeping quality agricultural materials and preventing them from deterioration for a specific period of time, beyond their normal shelf life. A wide variety of structures can be used to store horticultural products. 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.

Smallholder Farmers. Smallholder farmers are farmers who own small plots of land on which they grow subsistence crops and one or two cash crops, relying almost exclusively on family labour. They are drivers of the economy in Africa. According to the FAO, 80% of the developing world's food is produced by small farms. For the purpose of this study, smallholder farmers are defined as those that own land not more than 3-5 acres.

Productivity. Productivity measures 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 labour, land, capital and other related resources. It can also be defined as a ratio of output to resource expended separately or collectively. For the purpose of this study, yield is used as a measure of productivity.

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 and human resources and adaptation options, and will differ between risks and sectors.

Methodology

The study area is in Lushoto district, Tanga region in Tanzania. Tanga region has a land area of 27,348 sq. km, of which 49 percent belongs to Handeni district, 5 percent to Pangani district, 14 percent to Lushoto, 14 percent to Korogwe and 18 percent 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 in 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 German colonial rule, is one of the eight districts of Tanga Region. It is bordered to the northeast by Kenya, to the east by Muheza District, to the northwest by Kilimanjaro Region and to the south by Korogwe District. It has 137 villages and is 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 591 meters, equal to 1,939 feet.

Sampling Procedure and Data Collection Method

The multistage purposive cluster sampling technique was used in selecting the study area. The stages involved were:

Stage 1: The purposive selection of the MIVARF programme in Tanzania.

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

Stage 3: The purposive selection of Lushoto district.

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 in the focal area.

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

Stage 7: The random selection of 255 smallholder farmers.

Results and Discussion

Table 1: Socio-economic characteristics of respondents (n=255)

Variables	Frequency	Percentage
Sex		
Male	138	54.3
Female	117	45.7
Age		
Less than 30	10	3.9
30-40	50	19.5
41-50	83	32.4
51-60	66	25.8
More than 60	46	18.0
Marital Status		
Single	1	0.4
Married	228	89.4
Widowed	21	8.2
Separated	4	1.6
Divorced	1	0.4
Household Farm Size		
Less than 1 Acre	24	9.4
1-3 Acres	146	57.3
3-5 Acres	63	24.7
More than 5 Acres	22	8.6
Highest Educational Attainment		
No Formal Education	24	9.4
Adult Literacy	1	0.4
Primary Education	210	82.4
Secondary Education	17	6.7
Tertiary Education	3	1.2

Source: Field survey, 2018.

Gender. Females constituted 45.7% of the smallholder farmers while the men accounted for 54.3%. This shows that more men were into horticultural farming. Women accounted for 63.3% of the age group less than 40 and men accounted for 36.6%. This indicates that women attend to horticultural farming more in their young active years compared to men.

Age Group. The minimum age was 20 years and maximum was 85 years. The age range of 41-50 had the highest distribution of farmers (32.5%), followed by the age range 51-60 (25.9%). The mean age of farmers was 49.8 which shows that the farmers were still in their active years. The percentage of farmers under the age of 40 was 21.5%, showing low participation of youth in agricultural production, especially in the rural areas.

Marital Status. The majority of the sampled farmers were married (89.9%), followed by the widowed (8.2%), separated (1.2%), and both single and divorced (0.4%). Females constituted 42.3% of the married farmers while 58.6% were male. Further analysis of the gender composition of marital status showed that 76.2% of the widowed were females and the male widowed were 23.8%. According to Opara (2014), married farmers are likely to be under pressure to produce more for family consumption and sale, with incentive of family labour explaining why the majority of the farmers are married.

Household Farm Size. The less than 1 acre household farm size accounted for 9.4%, the 1-3 acre farms accounted for 57.3%, the 3-5 acre farms accounted for 24.7% and farms more than 5 acres accounted for 8.6%. Therefore, the farms 5 acres and below had the highest distribution, buttressing the fact that most of the farmers are smallholders.

Educational Attainment. Most of the farmers (82.4%, 210) had primary education of which 58.3% (123) were males and 41.7% (88) were females. This was followed by farmers who had no formal education (9.4%, (24) comprising 99.6% (23) females and 0.45% (1) males), secondary education (6.7% (17) 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. Mwatawala et al. (2016) affirmed that the majority of the population in developing countries that depend on agricultural activities for a living have low level of education. However, with the right training module on good agricultural practices communicated in a participatory manner, reinforced by commercialization of smallholder farming, the skills and knowledge of farmers on improved agriculture will record increases.

Mode, Location and Methodology of training

The majority of the farmers (63.1%) were trained face to face while the others (36.9%) received face to face and field-based training. Most of the farmers were trained at the ward or village offices (66.7%) and at nearby schools (30.2%). Only a few were trained at post-harvest centres (2%) and conference halls (1.2%).

The methodologies applied during the training generally were practical illustration, farm demonstration, participatory discussion, group formation, use of writing modules and pictorial illustrations on charts or boards.

Generally, the adult learning approach was adopted for training the farmers and learning materials were provided for each participant. The time spent per session did not exceed 2 hours.

Post-harvest Skills Acquired and Methodology Used

Table 2: Post-harvest Skills Acquired

S/no	Post-harvest skills acquired	Before Training N (%)	After Training N (%)
1.	Proper Crop Storage (PCSP)	103 (40.4)	246 (96.5)
2.	Proper Crop Drying (PCD)	34 (13.3)	181 (71.0)
3.	Processing Technologies	19 (7.5)	174 (68.2)
4.	Proper Crop Harvesting (PCH)	105 (41.2)	238 (93.3)
5	Packaging	78 (30.6)	241 (94.5)
6.	Moisture Control	91 (35.7)	216 (84.7)
7.	Sorting and Grading	95 (37.3)	253 (99.2)
8.	Preparing Business and Work Plan (PBWB)	26 (10.2)	247 (96.9)
9.	Zero Energy Cooler (ZEC)	9 (3.5)	172 (67.5)

Source: Field survey, 2018.

After the training the number of beneficiaries that had acquired post-harvest skills and other relevant skills such as preparing business and work plan increased significantly with sorting and grading recording the highest number (253, 99.2%) followed by preparing business and work plant (247, 96.9%) and proper crop storage (246, 96.5%). Zero energy cooler, though it recorded the lowest (172, 67.5%) was still a highly significant increase.

Productivity Index in Relationship to Post-harvest Skills Acquired

Descriptive Analysis of Fruits and Vegetables Yields

Noticeable differences were observed in the productivity index for fruits and vegetables, measured by yield, before and after the training received by the smallholder farmers (see Table 3). All the fruits and vegetables recorded highly notable increases in yield. Cabbage recorded the highest yield difference with a mean of 2709.70Kg/Acre, followed by carrots with 2217.36 Kg/Acre. The lease difference in yield was obtained for beans with a mean of 257.11Kg/Acre.

Table 3: Descriptive Analysis of Fruits and Vegetables Yields

S/n	Fruits and Vegetables	Mean Yield Before Training (Kg/Acre)	Mean Yield After Training (Kg/Acre)	Differences in Mean Yield
1.	Apple	1405.00	2311.67	906.67
2.	Cabbage	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.

Inferential Analysis of Fruits and Vegetables Yields

Of all the fruits and vegetables, apple was the only item that recorded insignificant difference in yield at P-value 0.15. Cabbage, tomato, carrot, round potatoes and lettuce showed strong significant differences in yield at P-value <0.000 while cauliflower, beetroot, beans, sweet pepper yields were significant at P-value of less than 0.007, 0.031, 0.010, 0.003 respectively.

Table 4: Inferential Analysis of Fruits and Vegetables Yields

Fruits and Vegetables		T-value	Significance	Inference
1.	Apples	3.606	0.150	Insignificant
2.	Cabbage	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.

Table 5: Inferential Analysis of Fruits and Vegetables Post-harvest Losses

Fruits and Vegetables (PHL)		T-value	Significance	Inference
1.	Apples	1.625	0.165	Insignificant
2.	Cabbage	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.

Inferential Analysis of Fruits and Vegetables' Post-Harvest loss

Table 5 shows that only apple did not record significant difference in the quantity of post-harvest loss before and after the training with P-value <0.165. All the other horticultural products showed significant differences from less than 0.000 to 0.016. The P-value <0.000 indicates strong significant difference between quantity of PHL before and after the training. This shows that there was reduced PHL of fruits and vegetables after the training.

Table 6: Paired Sample T-test of Farm Income

Farm Monthly Income	Mean before	Mean after	SD before	SD after	T-Value	Signi-ficance
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.

Paired Sample T-test of Farm Income

The farm monthly incomes (FMI) of the beneficiaries before and after the training are presented in Table 6, The paired T-test analysis to compare the incomes showed that there was significant difference. The average FMI of the beneficiaries before the training was 104687.59 TZS (41.12USD), while the average FMI after the training was 1466779.310 TZS (72.956USD). This shows that there was a significant increase in the monthly income of the farmers.

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

The following skills had a significant effect on increased yield of different horticultural products: processing technology on yield of lettuce at P<0.004; ZEC (zero energy cooler) on yields of apple, round potato, cauliflower, beetroot, lettuce at P-values < 0.059, 0.011, 0.004, 0.058 and 0.058 respectively; proper crop storage practices (PCSP) on yields of carrot, round potato at P-values <0.000 and 0.0519 respectively; proper crop drying practices (PCDP) on yields of carrot, round potato, beetroot, lettuce at P-values < 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 yields of carrot, beetroot, lettuce, beans at P-values < 0.055, 0.003, 0.003 and 0.000 respectively; sorting and grading and preparing business and work plan had no significant effect on the yields of the crops.

Independent Sample T-test (Post-harvest loss in kg/acre against post-harvest skills acquired)

The effects of the PH skills acquired on quantity of PHL reduction are presented in Table 8. The following skills had a significant effect on reduction of quantity of post-harvest losses of the 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-values< 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-values < 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; and 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 effect on reducing the quantity of post-harvest loss.

All the beneficiary farmers (100%) cited lack of capital as a major challenge in practicing farming as a business and implementing the skills that have been acquired. Insufficient knowledge about post-harvest skills was acknowledged as a challenge by 70.6% of the farmers. Many farmers would like to receive further training in post-harvest skills, especially processing technologies, to enhance diversity of their livelihoods. Many farmers (59.2%) acknowledged insufficient land area as a challenge debarring their productivity, while 98% indicated that they were adversely affected by climate change in the form of drought, flooding of farmlands, especially those without flood drains and pest invasion in recent years. Almost all the farmers (99.6%) identified insufficient access to inputs as a major hindrance to improved productivity while 90.2% identified market unavailability and 86.7% cited inadequate access to financial institutions as challenges hindering their productivity. Another noted challenges was unavailability of storage facilities in the study area.

Table 7: 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.

Table 8: 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

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

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

Source: Field survey, 2018.

Table 9: Challenges Faced by Farmers after the Intervention

S/n	Challenges	Yes N (%)	No N (%)
1.	Lack of Capital	255 (100.0)	0 (0.0)
2.	Insufficient Knowledge about Harvest Skills	180 (70.6)	75 (29.4)
3.	Insufficient Land Area for Expansion	151 (59.2)	104 (40.8)
4.	Climate Change (drought)	250 (98.0)	5 (2.0)
5.	Insufficient Access to Inputs	254 (99.6)	1 (0.4)
6.	Market Unavailability	235 (90.2)	20 (9.8)
7.	Inadequate Access to Financial Institution	231 (86.7)	34 (13.3)

Source: Field survey, 2018.

Summary, Conclusions and Recommendations

Summary

The majority of the smallholder FV farmers of Lushoto district were married adults with mean age 49, who had attained primary education, though male farmers were more educated than females. The adaptive capacity of the farmers to climate change was also assessed and it was noted that most farmers were exposed to crop agricultural training but very few were exposed to training on other forms of agriculture, such as livestock, fishery and forestry. Also, a small percentage of the farmers were exposed to non-agricultural training, implying low diversity for their livelihood. This means that should climate change affect their farm yields adversely, their coping mechanism would be low.

During the course of the MIVARF training, different post-harvest skills were acquired and the methodology adopted for training was the adult learning approach with the location of the training mostly being in the ward/village offices and nearby schools. The mean yield and quantity of loss after the training showed significant difference compared to the yield before and there was a significant relationship between the skills acquired and the improved yields of the farmers. The farmers identified 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 trying to increase their productivity.

SWOT analysis of the MIVARF training programme showed that the training was strong in capacity building and delivered skills such as GAP, PHH and FBS (farming as business) to farmers. Also, the training led to the formation of groups that gave birth to AMCOS, through which smallholder farmers can access credit from financial institutions with greater ease. However, lack of coordination and insufficient post-harvest skills, especially processing technologies, were major weaknesses. The threats of climatic conditions and a poor infrastructural system for irrigation were major setbacks that the training can help the farmers to deal with, so that farmers can practice climate-resilient farming.

Conclusion

The MIVARF training has largely helped to improve the farmers' productivity, income and reduce post-harvest losses. The skills acquired during the training have been of great benefit to the farmers. The lessons 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, the EAC and Africa as a whole. Also, addressing the challenges the training encountered in improving the productivity of smallholder farmers such as providing training on climate-resilient agriculture and providing more training on post-harvest skills, especially on food processing, will foster increased productivity and reduced PHL among the farmers and consequently lead to the eradication of poverty and food insecurity in rural areas where the largest percentage of the poor live and in Tanzania as a whole.

Recommendations

Government of Tanzania (GOT)

Further training on climate-resilient agricultural practices is strongly recommended as many farmers are largely affected by drought at certain times of the year and flooding during the raining season.

Smallholder farmers' organizations should be given strong aid for accessing loans from the financial institutions. Interest rates on these loans should be lowered for smallholder farmers groups to encourage the practice of farming at a commercial level. Market linkage for farmers has to be strengthened as much needs to be done to encourage the practice of commercial agriculture. Training on handling of pest invasion, especially the recent outbreak of tomato leaf miners needs to be addressed at the grass root level.

Farmers

Farmers are strongly recommended to participate in training that will help build their capacities and improve their productivity. Farmers must also coordinate themselves even at the AMCOS level and ensure they meet deadlines for their market demands. Also, the skills acquired during the training should be practiced consistently as that is the only guarantee for sustained increase in productivity. Finally, the farmers should pool resources to get irrigation infrastructure which can be used under the supervision of the ward extension officers to ensure they are practicing climate-resilient agriculture instead of the rain-fed system of agricultural practices.

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