KNOWLEDGE AND ADOPTION LEVELS OF SUNFLOWER FARMING TECHNOLOGIES IN KILOSA AND MVOMERO DISTRICTS, MOROGORO REGION-TANZANIA

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ABSTRACT

This study aimed to document knowledge and adoption levels of sunflower farming innovations at household level in Kilosa and Mvomero Districts. Data were collected using a structured questionnaire. Descriptive and regression analyses were employed to determine knowledge and adoption levels and factors influencing adoption of sunflower farming innovations among small-holder farmers in the project area. Majority of the respondents were knowledgeable on various recommended agronomic practices in sunflower production. However, knowledge level was relatively higher among respondents who have attended FFSacross all the attributes assessed and the differences were statistically significantly different at $p \leq 0.05$. Farmers who attended FFS had adopted and were using most of the recommended agronomic practices and the differences were statistically significantly different at $p \leq 0.05$. Respondents planted Record sunflower variety due to low supply of the promoted hybrid varieties. Availability of important services like markets, processing facilities, fertilizers, high yielding seeds were rated as low to medium. Unreliable weather conditions, plant diseases, low capital, lack of markets and unavailability of high yielding sunflower varieties were the main challenges affecting sunflower productivity. Continuous provision of trainings on proper sunflower agronomic practices, availability of credits, high yielding sunflower varieties and other required inputs, stable markets and strengthening the producer groups could help improve sunflower productivity.Age, membership

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in producer groups and participation in FFS training significantly influenced adoption at $p \leq 0.05$. Therefore, it is recommended that farmers training through FFS on proper sunflower agronomic practices should be strengthened to impart knowledge to more smallholder farmers who could not be reached by the project., smallholder farmers should be empowered through formation of producer groups to allow them obtain credits to facilitate sunflower production and ensure availability of required inputs and high yielding hybrid sunflower varieties that are drought tolerant should be promoted.

Key words: Sunflower, Production, Agronomic practices, Adoption, FFS, Producer groups

Introduction

The agricultural sector in Tanzania is a key to economic development and sustains and large number of people (Majule, 2008). Agriculture contributes about 19.0% of GDP and grows at 4.1%. The rate is still less than the required 6 – 7% to have a significant impact on the lives of the poor (PADEP, 2010). Agriculture in the country face a challenge to feed a population that is increasing at an annual rate of about 3%, and which will double in about 20 years (FAO, 1999). The problem of low productivity in developing countries like Tanzania could be overcome through use of modern agricultural technologies like improved seeds, fertilizers, fungicides, pesticides, agricultural machinery and proper spacing (Liberio, 2009; 2012). Some of the benefits that can occur to farmers from use of improved agricultural technologies include reduced risks from pest and disease pressure thus leading to high harvest index (FAO, 1999). However, productivity of crops is directly linked to the genetic potential of the seed used and varies according to use of recommended complementary inputs and the observance of cultural practices (Mwanga, 2002). Sunflower is an important industry in Tanzania and ranks as one of the most important vegetable oil crop with high value ranking fourth after soybean, oil palm and rapeseed. In Tanzania oil extracted from sunflower by local producers contribute 40% of the national cooking oil requirements. The development of sunflower industry in Tanzania to a larger degree has been triggered by the food value – basically sunflower is grown for its edible oil production and the processing ability by farmers at farm level (Ugulumu, 2008). However, according to (World Bank, 2001; Keenja, 2001; URT, 2003; Liberio, 2009)a number of challenges like ineffective extension services, inadequate use of improved seeds, fertilizers, low

farm produce price compared to production costs , inadequate agro-processing facilities to add value and shelf life to farm produce, weak cooperative unions which fail to organise farmers to form strong farming entity, absence of rural financial institutions to address farmers' credit needs on loan terms, low utilization of appropriate technologies, weak research – extension – farmer linkage which reduces spread of new agricultural technologies and information/knowledge from research experts to farmers, poor rural transportation and infrastructure that have made many areas inaccessible to agricultural innovations including improved seeds, fertilizers, fungicides, pesticides, agricultural machinery and agricultural education and unreliable rains has continuously lead to low sunflower crop productivity.

Due to recognition of the importance of new technologies in sunflower production, Sokoine University of Agriculture through Enhancing Pro-poor Innovations in Natural Resources and Agricultural Value Chain (EPINAV) Programme introduced a project on Enhancing Sunflower Production for Poverty Alleviation in Kilosa and Mvomero Districts, Morogoro region for the aim among others training smallholder farmers and promoting recommended agronomic practices through Farmer Field Schools (FFS) to generate improved agricultural technologies (Shao, 1994). Technology generation and development is an interactive process and the supply of technologies needs to be driven by demand from the users. Beyond the household, group processes and the ability to harness them can also play a crucial role in adoption decisions, particularly on conservation practices. Moreover, decisions about new technology are frequently prompted by an intervention in the form of a project (Cramb, 2003).

Therefore, the purpose of this project was to popularize use of agricultural practices such as improved sunflower seeds and recommended production technologies, especially chemical fertilizer, crop spacing, timeliness of farm operations, and additional management skills being advocated. However, many reasons have been given for the less impact of improved agricultural technologies among them low adoption of the technologies coupled with abandonment of previously adopted agricultural technologies disseminated to farmers is among the reasons for continued low productivity among smallholder farmers and making them fail achieving increased food availability, reducing poverty, increasing markets for products, address pressing social needs and eventually becoming self-sufficient in basic food requirements (URT, 2002;

URT, 2003 Michelle, 2005). Technology adoption by agricultural producers is an essential prerequisite for economic prosperity among community members (Nkonya et al., 1997). Ehui et al. (2004) explain that a new technology introduced to smallholder farmers by itself alone does not guarantee for wide spread adoption and efficient use. For efficient utilization of the technology, fulfilment of specific economic, technical and institutional conditions are required. From the farmers' perspective, the new technology should be economically more profitable. The new technology should also be technically easily manageable by smallholders and adaptable to the surrounding socio-cultural situations. Similarly, the availability of the new technology and all other necessary inputs to smallholders at the right time and place and in the right quantity and quality should be ensured. The rate of adoption is influenced by the farmers' perception of the characteristics of the innovation, the changes this innovation requires in farm management and the roles of the farm family (van den Ban and Hawkins, 1996). The authors further stated that innovations usually are adopted rapidly when they have a high relative advantage for the farmers; compatible with the farmers' values, experiences and needs; are not complex; can be tried first on small scale and easy to observe the results. However, technology adoption incorporates two essential elements, the embracement of the technology by individuals and its embedment in society (Deligiannaki and Ali (2011).

Therefore, this study intended to track knowledge level and adoption level of the promoted agronomic practices among smallholder farmers in the project area. Specifically the study intended to measure adoption level of sunflower farming innovations among smallholder farmers in the project area; determine knowledge level; identify factors associated with adoption of sunflower farming innovations and gauge socio-economic contributions of sunflower crop to smallholder farmers in the project area.

Research Methodology

This study was conducted in Kilosa and Mvomero districts which were under the project. The climate in the area is semi-arid with annual rainfall ranging from 500 – 800 mm.The research adopted a cross-sectional survey where data were collected at a single point in time. Data collected were used for simple description purposes as well as determining relationships between variables. Six villages, four from Kilosa and two from Mvomero districts where the project

trained smallholder farmers and where sunflower is produced were included in the study. From a stratified population of project and non-project smallholder farmers growing sunflower, a simple random sampling was employed to select a sample size of 114 smallholder farmers who constituted the study population. In addition, Focus Group Discussions were conducted from a group of 10 smallholder farmers in each village. Primary data including socio-economic characteristics of respondents as well as production practices and knowledge on sunflower production was collected. Data were analyzed to obtain the quantitative description of information, frequencies and percentages. Similarly, relationship between variables was used to describe the exhibited knowledge and adoption levels of sunflower farming technologies among smallholder farmers.

Results and Discussion

Socio-economic Characteristics of the Respondents

Out of 114 respondents, 64 (56.1%) were from Lubungo and Manza villages of Mvomero district while the remaining 50 (43.9%) were from Madudu, Mfulu, Kitete and Msowero villages of Kilosa district. Of the 114 respondents, 59 (51.8%) were males and the remaining 55 (48.2%) were females. Out of 114 respondents, 48 (42.1%) their age ranged from 18 to 35 years, and the remaining 38 (33.3%) and 28 (24.6%) their age ranged from 36 to 50 years and 51 to 87 years, respectively. Most, 98 (86.0%) of the respondents had completed primary education level. The remaining 10 (8.8%) four (3.5%) and two (1.8%) had completed secondary education, had no formal education and had attended adult education, respectively. Of the 114 respondents 54 (47.4%) indicated that they attended training on sunflower production improved agronomic practices through farmer Filed School (FFS) approach.

Out of the 114 respondents, 58 (50.9%) were members of the sunflower producer groups formed. Again, 30 (26.3%) were members of the sunflower platform, 22 (19.3%) were members of the sunflower processing groups and nine (7.9%) indicated that they were members of the sunflower crop marketing groups. A few respondents also indicated that they were involved in different community formed groups like beekeeping, Village Cooperative Bank (VICOBA), Savings and Credits Cooperative Societies (SACCOS), Poultry keeping groups and environmental conservation committee.

The Knowledge level of Respondents on Recommended Sunflower Agronomic Practices

The knowledge level of the respondents on proper agronomic practices in sunflower production is shown in Table 2. Generally, majority of the respondents indicated that they were knowledgeable on various recommended agronomic practices in sunflower production. However, the knowledge level on proper agronomic practices for Sunflower production was relatively higher among respondents who have attended FFS compared to the NFFS respondents across all the attributes assessed and the differences between those who said were knowledgeable and those who were not knowledgeable and between FFS and NFFS respondents across all assessed attributes were statistically significantly different at $p \leq 0.05$. All smallholder farmers who have attended FFS indicated that they were knowledgeable that they were supposed to do early land preparation; use proper plant spacing, do two weeding; top dress to boost plant growth; uproot infected plants; do timely harvesting to minimize crop losses and dry the crop properly to maximize oil yield.

Table 2: Knowledge level of respondents on recommended agronomic practices for Sunflower production

Knowledge level on recommended agronomic practices	FFS		NFFS		p- value
	n	%	n	%	
I Understand proper sunflower production agronomic practices	54	100	55	99.7	0.037**
I Understand it is required to do early land preparation	54	100	53	88.3	0.009**
I Understand it is required to do thorough land ploughing	53	98.1	51	85.0	0.013**
I Understand it is required to do harrowing	51	94.4	46	76.7	0.007**
I Understand it is required to plant good sunflower variety	52	96.3	46	76.7	0.002**
I know the sunflower variety to plant	53	98.1	53	88.3	0.043**
I Understand you have to use proper plant spacing for high yield	54	100	51	85.0	0.002**
I Understand it is required to do first weeding	54	100	51	85.0	0.002**
I Understand it is required to do second weeding and soiling up	54	100	50	83.3	0.001**
I Understand it is required to do thinning depending on spacing	53	98.1	49	81.7	0.004**
I Understand it is required to do top dressing to boost plant growth	54	100	52	88.3	0.009**

I Understand it is required to do scouting to inspect for insect pest	54	100	50	83.3	0.001**
I Understand it is required to uproot infected plants	54	100	49	81.7	0.001**
I Understand it is required to control insect pests infestations	53	98.1	48	80.0	0.002**
I Understand it is required to do timely harvesting to minimize post-harvest loss	54	100	55	91.7	0.037**
I Understand it is required to do proper crop drying	54	100	55	91.7	0.037**

The Adoption level of the Recommended Sunflower Agronomic Practices

The adoption level of the respondents on proper agronomic practices in sunflower production is shown in Table 3. Generally, majority of the respondents who had attended FFS indicated that they adopted and were using most of the recommended agronomic practices in sunflower production. Generally, the adoption level of proper agronomic practices for Sunflower production was higher among respondents who have attended FFS compared to the NFFS respondents across all the attributes assessed and the differences between those who said they adopted and those who were did not adopt and between FFS and NFFS respondents across most of the assessed attributes were statistically significantly different at $p \leq 0.05$. However, most FFS and NFFS respondents did not indicate to have adopted top dressing for boosting plant growth and the differences between groups were not statistically significantly different ($p=0.304$) and both FFS and NFFS respondents adopted timely harvesting and the differences between groups were not statistically significantly different ($p=0.129$). Poor adoption on applying topdressing among respondents might have been attributed by lack of enough supply of fertilizers and or the notion among farmers that their soils were fertile enough to an extent that they thought top dressing might have not brought significant impact on sunflower yield.

Table 3: Adoption level of recommended agronomic practices in Sunflower production

Adoption level on recommended agronomic practices	FFS		NFFS		p-vlue
	n	%	n	%	
I do early land preparation	53	98.1	46	76.7	0.001**
I do thorough land ploughing	51	94.4	44	73.3	0.002**
I do harrowing	49	90.7	35	58.3	0.0001**
I plant good sunflower variety	50	92.6	39	65.0	0.001**
I do first weeding	52	96.3	50	83.3	0.023**
I do second weeding and soiling up	52	96.3	49	81.7	0.013**
I do top dressing to boost plant growth	12	22.2	10	16.7	0.304ns
I do scouting to inspect for insect pest	52	96.3	45	75.0	0.001**
I uproot infected plants	49	90.7	44	73.3	0.014**
I control insect pests infestations	36	66.7	15	25.0	0.0001**
I do timely harvesting to minimize post harvest loss	53	98.1	55	91.7	0.129ns
I do proper crop drying to maximize oil extraction	54	100	51	85.0	0.002

Regression results on factors influencing adoption of recommended agronomic practices in sunflower production are shown in Table 4. According to the findings, ages of respondents, being member of producer groups and participation in FFS highly influenced adoption levels and were statistically significant at $p< 0.05$. Age of respondents was negatively correlated to adoption level implying that young trained farmers were more likely to adopt the recommended practices compared to older farmers. Involving relatively younger farmers increased adoption levels by approximately 16.0%. Membership in producer groups and participation in FFS were positively correlated to adoption levels observed and highly influenced adoption of the recommended practices. Membership of smallholder farmers in producer groups increased adoption by almost 18.0% while training farmers by using farmer Field School approach increased adoption of the recommended practices by almost 37.0%

Table 4. Regression results on factors influencing adoption of sunflower agronomic practices

Variable	ß	Std. Error	t-value	Sign. level
Constant	2.674	0.255	10.503	0.001
Age of respondent	-0.159	0.043	-3.729	0.001
Sex of respondents	0.074	0.062	1.187	0.236
Education level of respondents	-0.014	0.076	-0.179	0.858
Member of producer group	0.176	0.077	2.294	0.022
Participation in FFS	0.365	0.076	4.783	0.001
Availability of Extension services	0.076	0.141	0.573	0.592

Sunflower variety and plant spacing used by respondents

The type of sunflower variety planted, planting spacing used and number of plants left after thinning are shown in Table 5. Majority, 74.1% and 73.3% of FFS and NFFS respondents, respectively indicated that they all planted Record and again 22.2% of the FFS respondents hopefully among those who participated in testing the new hybrid varieties, indicated that they planted hybrid seeds and a few respondents indicated that they planted Kenya Fedha. To indicate the impact of training, most FFS respondents planted sunflower by using the recommended planting spacing of either 30Cm by 60 Cm or 30 Cm by 75 Cm and thinning to either one or two plants depending on the spacing used or germination of the sown seeds, while, NFFS respondents indicated that they were hesitant in using the spacing of 30Cm by 60 Cm and even some of them indicated that they planted sunflower using unspecified spacing and some of them could not thin at all.

Table 5. Sunflower variety and planting spacing used by respondents

Parameter	FFS		NFFS		p-vlue
	n	%	n	%	
Sunflower variety planted					
Record	40	74.1	44	73.3	

Hybrid seed	12	22.2	3	5.0	0,003
Kenya Fedha	2	3.7	8	13.3	
Spacing Used					
30 Cm X 60 Cm	38	70.4	34	56.7	
30 Cm X 75 Cm	11	20.4	12	20.0	0.084
60 Cm X 90 Cm	5	9.3	8	13.3	
Unspecified	-	-	6	10.0	
Number of plants left after thinning					
One plant under 30 Cm X 60 Cm	38	70.4	33	55.0	
Two Plants under 30 Cm X 75 Cm	14	25.9	12	20.0	0.006
I didn't thin	2	3.7	15	25.0	

The use of Agrochemicals and Extension Services in Sunflower Production

The use of agrochemicals and extension services in sunflower production is shown in Table 6. Despite of most (94.7%) of the respondents indicating that they made use of extension services in their areas, majority 85.3%; 76.3% and 66.7% of the respondents indicated that they were not using inorganic fertilizers, insecticides and new promoted sunflower seed varieties, respectively. The low use of agrochemicals could be attributed to low supply and expenses related to the inputs and low use of new promoted sunflower seed varieties might be due to unavailability of the seed varieties as they are still being tested for their suitability and adaptability to local conditions

Table 6: Use of agrochemicals and promoted sunflower seed varieties

Variable	Yes		No	
	n	%	n	%
Use of Agrochemicals/services				
Inorganic fertilizers	19	16.7	95	85.3
Insecticides	27	23.7	87	76.3
New Promoted seed varieties	38	33.3	76	66.7
Extension services	108	94.7	6	6.3

The Availability of services for enhancing sunflower productivity

The availability of extension services were rated as high to medium as shown by 76.3% of the respondents, while availability of sunflower markets were rated as low to medium (75.5%); sunflower processing services was rated as low to medium (79.8%) ; Fertilizers availability rated as low to medium (72.9%) availability of good sunflower seeds also was rated as low to medium (73.7%) and pesticides/insecticides availability was rated as low to medium as indicated by a total of 69.3% of the respondents

Challenges and problems affecting Sunflower production

The challenges and problems affecting sunflower production in the project area are shown in Table 7. Of the 114 respondents, 79.8% said unreliable weather conditions highly affected sunflower production and other challenges and or problems that were indicated to affect sunflower production in the project area include plant diseases (66.7%); low capital for investing in sunflower production (52.6%); lack of good sunflower markets (50.0%); unavailability of high yielding sunflower varieties (37.7%); birds eating sunflower (34.2%) and lack of required inputs (agrochemicals) (23.7%). However, all the aforementioned problems could be alleviated by ensuring availability of high yielding sunflower varieties that are drought tolerant and which suffer minimal bird attack due to its conical shaped sunflower heads.

Other challenges and problems given by the respondents that were found to affect sunflower production in the project area include land conflicts between farmers and agro-pastoralists (11.4%); lack of extensions services (10.5%); lack of sunflower processing facilities (8.8%); lack of knowledge of proper agronomic practices (7.9%); poor soil fertility (7.0%); high land hiring charges (5.3%); mice eating sunflower seeds immediately after planting (3.5%) and higher transportation charges. However, the current efforts by the project to establish a number of farmer producer groups and impart knowledge on proper agronomic practices in sunflower production will help solve a number of mentioned challenges facing farmers in the project area.

Table 7: Challenges and problems affecting Sunflower production

Challenges/Problems affecting sunflower production	n	%
Unavailability of high yielding sunflower varieties	43	37.7
Lack of good markets for sunflower	57	50.0
Lack of extension services	12	10.5
Lack of knowledge on proper agronomic practices	9	7.9
High land hiring charges	6	5.3
Poor soil fertility	8	7.0
Low capital for investment	60	52.6
Unreliable weather conditions	91	79.8
Lack of required inputs (Agrochemicals)	27	23.7
Plant diseases	76	66.7
Birds Eating sunflower	39	34.2
Land conflicts (Farmers Vs. Pastoralists)	13	11.4
Mice eating sunflower seeds immediately after planting	4	3.5
Lack of sunflower processing facilities	10	8.8
Transportation charges	3	2.6

Benefits and advantages for growing sunflower

Respondents were also asked to indicate some benefits they obtained from growing sunflower in the project area. Majority of the respondents said they obtained good cooking oil and that sunflower production lead to increased household income as shown by 97.4% and 96.5% of the respondents, respectively. Again, 82.5% of the respondents said they obtained additional products like sunflower seed cake to feed their animals. Other advantages obtained from growing sunflower as indicated by the respondents include obtaining knowledge on proper agronomic practices from the project (19.3%); growing sunflower was an advantage as the crop is drought tolerant (14.9%); sunflower production was an engagement and provided employment (13.2%); sunflower production helped them pay school fees and meet other household needs (11.4%); sunflower has a good market (4.4%) and by products were used as organic fertilizers as shown by 3.5% of the respondents. Therefore, as seen from Table 8 there are a lot of benefits and or advantages that farmers could obtain by producing sunflower in the project area.

Respondent's opinions on improving sunflower productivity

Respondents' opinions on improving sunflower productivity in the project area could be categorized into four main points and they include continuous provision of trainings on proper sunflower agronomic practices as indicated by 74.6% of the respondents; credit availability to facilitate sunflower production; ensuring availability of high yielding sunflower varieties and ensuring availability of a stable sunflower markets as indicated by 57.9%; 52.5% and 53.5% of the respondents, respectively. Additional opinions given by respondents for improving sunflower productivity include ensuring availability of required inputs (seeds and agrochemicals) (31.6%), strengthening the producer groups formed (10.5%), resolving land conflicts (3.5%), availability of sunflower processing machines (2.6%), ensuring availability of irrigation facilities (1.8%) and offering study visits to farmers to facilitate learning and exchanging ideas among sunflower producers as shown by 0.9% of the respondents. Some of the opinions given like ensuring availability of high yielding varieties and training farmers and strengthening producer groups were among the objectives targeted to be addressed by the project.

Conclusion and Recommendations

From the above findings it can be concluded that;

- Majority of the respondents were knowledgeable on various recommended agronomic practices in sunflower production. However, the knowledge level on proper agronomic practices for Sunflower production was relatively higher among respondents who have attended FFS compared to the NFFS respondents across all the attributes assessed.
- Adoption level of recommended agronomic practices in sunflower production was higher among respondents who had attended FFS.
- Majority of respondents planted Record sunflower variety as the supply of the promoted hybrid varieties was still very low.
- Most respondents made use of extension services in their areas for obtaining advises, however majority of them were not adopting use of inorganic fertilizers, insecticides and new promoted sunflower seed varieties,
- Availability of extension services were rated as high to medium while availability of sunflower markets, sunflower processing services, fertilizers pesticides and insecticides were rated low to medium.

- Sunflower production in the project area was highly affected by unreliable weather conditions, plant diseases, low capital for investing in sunflower production, lack of good sunflower markets, unavailability of high yielding sunflower varieties, birds eating sunflower and lack of required inputs.
- Respondents benefited from sunflower production by obtaining good cooking oil, increased household income, getting additional products like sunflower seed cake to feed their animals, obtaining knowledge on proper agronomic practices from the project and paying school fees and meet other household needs.

Therefore it is recommended that

1. Farmers training through FFS on proper sunflower agronomic practices should be strengthened to impart knowledge to more smallholder farmers who could not be reached by the project.
2. Smallholder farmers should be empowered through formation of producer groups to allow them obtain credits to facilitate sunflower production and ensure availability of required inputs.
3. Promotion of high yielding sunflower varieties that are drought tolerant, ensuring stable sunflower markets should be strengthened.

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