ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue XII December 2024

Assessment of Recommended Sunflower (*Helianthus Annuus* L) Production Practices Adoption among Farmers in Mkalama District, Tanzania

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DOI: https://doi.org/10.51244/IJRSI.2024.11120057

Received: 06 July 2024; Accepted: 23 August 2024; Published: 17 January 2025

ABSTRACT

Sunflower (Helianthus annuus L.) is an important oilseed crop in Tanzania, and in the Mkalama District in particular. This study aimed to assess the level of adoption of recommended sunflower production practices among farmers in the district. Data was collected through a survey of 147 sunflower farmers in six villages. The results showed that most farmers practiced land preparation before planting and used broadcasted seeds during sowing. However, only a small proportion of farmers used recommended fertilizer application practices. The preferred types of seeds were also found to vary among farmers, with the majority preferring farmer-saved seeds apart from hybrid seeds. Most farmers harvested their sunflower crops between 90 and 130 days after planting. The study showcased the need for education and training for farmers to adopt better sunflower production practices, especially with regards to fertilizer application. This could lead to increased productivity, which invariably will have a positive impact on the livelihoods of farmers in the district.

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an annual plant belonging to the family Asteraceae, native to North America, but it is widely cultivated throughout the world (Brammall, 1991). The plant is a member of the order Asterales and family Asteraceae (USDA, 2021). It has been cultivated for food, feed, and industrial use since the 16th century (Gulya, 2013). In Tanzania, sunflower has been cultivated for both food and income generation, with Mkalama district being one of the major sunflowers producing areas in the country (Msinde et al., 2016). Sunflower seeds are used in making oil, animal feed, and biodiesel production (Kandpal, 2014). The oil is used for cooking, in the manufacture of margarine, and in the cosmetics industry (Kumar et al., 2016). Additionally, the by-product of oil extraction from sunflower seeds, referred to as sunflower meal, is an important source of protein for animal feed (Duhan et al., 2017).

The production of sunflower can be hampered by several biotic and abiotic factors, including insect pests, diseases, low soil fertility, and unfavorable climatic conditions (Abate *et al.*, 2015;

Gichangi *et al.*, 2020; Sibiya *et al.*, 2016). However, the use of recommended production practices, such as the use of high-quality seeds, proper planting density, timely weeding, and fertilizer application, can improve the crop's yield and quality (Cheruiyot *et al.*, 2019; Mkuhlani *et al.*, 2019). The adoption of these practices can also minimize the impact of biotic and abiotic factors, leading to a more sustainable and profitable crop production system.

Despite the potential benefits of using recommended production practices, many smallholder farmers in Tanzania do not fully adopt them. Several studies have shown that farmers' low adoption of recommended practices is often attributed to various factors, including lack of knowledge, limited access to inputs,

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue XII December 2024

inadequate extension services, and insufficient credit facilities (Kassie *et al.*, 2018; Mushunje *et al.*, 2018). Therefore, understanding the level of adoption of recommended sunflower production practices is essential for designing effective interventions to improve the crop's productivity and profitability.

In this study, we examined the level of use of recommended sunflower production practices by smallholder farmers in Mkalama district, Tanzania. Specifically, we assessed farmers' adoption of recommended practices related to land preparation, seed selection and spacing, fertilizer use, and harvesting time. The findings of this study will provide insights into the current state of sunflower production in the study area and inform the design of targeted interventions aimed at improving the productivity and profitability of sunflower farming in Tanzania.

MATERIALS AND METHODS

The study was conducted in Mkalama District, Singida region, Tanzania. The study used purposive sampling to select sunflower farmers from Mkalama District, specifically from Mwangeza ward, which is the leading ward in sunflower production within the district for three consecutive years (2018/2019, 2019/2020, and 2020/2021). Proportional sampling was used, and a random sampling technique was employed to obtain the sample size of 147 from the 6 villages in Mwangeza ward. The sampling frame was obtained from the farmers' book of the ward agricultural extension officer. In this study, the researcher used three varieties of seeds, that include local seed, Hybrid and Improved seed.

The study adopted a cross-sectional research design to collect data from the sample of study at one point in time using survey techniques. The population of the study was sunflower smallholder households in Mkalama District. The sample size was determined using the formula by Yamane (1967) and adjusted for a 0.08 allowable error. The final sample size was 147 sunflower farmers.

Data was collected using structured questionnaires containing both open and closed-ended questions. Primary data was collected to obtain respondents' demographic information, knowledge, and practice of sunflower production methods. Qualitative data was collected through in-depth interviews, focus group discussions, and key informant interviews. The quantitative data was analyzed using Statistical Package for Social Sciences (SPSS) version 20, and descriptive analysis was used to compute frequency, percentages, and means. Qualitative data was analyzed using content analysis to develop themes and gain an understanding of the data. Content analysis was also used to enrich the quantitative data.

RESULTS

Results on Table 1 showed that the local seed had attained highest mean average production of 317.79 kg per acre with the total production of 24.47 tons across all villages the usage of local seed has been observed highly at villages like Ikolo and Munguli while Hilamoto marks the lowest usage of it. Similarly results shows that Hybrid seed marks the second usage with an average produce of 324 kg per acre a total production of 14.6 tons, this seed type is commonly used by villages the same as Improved one that is Munguli and Ikolo and the least at Hilamoto village with 200 produce in kg per acre.

On the case of improved seed some villages had not used it including Hilamoto and Ikolo, the leading village in production following the usage of improved seed is Endasiku with 370 kg per acre followed by Munguli by 304 kg per acre the last user being Mwangeza with 261.67 kg per acre mean produce.

Table 1. Seed usage variation across villages (n=147)

Production based on sunflower seed used						
	Improved		**Hybrid**		**Local**	
Villages	**Mean**	**Sum**	**Mean**	**Sum**	**Mean**	**Sum**
Hilamoto	.	.	200.00	200.00	264.00	1320.00

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Endasiku	370.00	370.00	250.00	500.00	312.50	1250.00
Ikolo	.	.	348.00	1740.00	330.00	3960.00
Mwangeza	261.67	1570.00	318.33	1910.00	319.60	7990.00
Dominiki	300.00	2400.00	292.11	5550.00	309.33	4640.00
Munguli	304.00	3040.00	391.67	4700.00	331.88	5310.00
Total	**295.20**	**7380.00**	**324.44**	**14600.00**	**317.79**	**24470.00**

Source: Researcher survey 2022

Following the obtained tabulated results on Table 1, the grouped bar chart was portrayed to look on the pattern of the seed used across villages, and it can be traced that the variation among the usage of Hybrid to local seeds as well as Improved to local seed is relatively high compared the variation between Hybrid and Improved seeds (Figure 1).

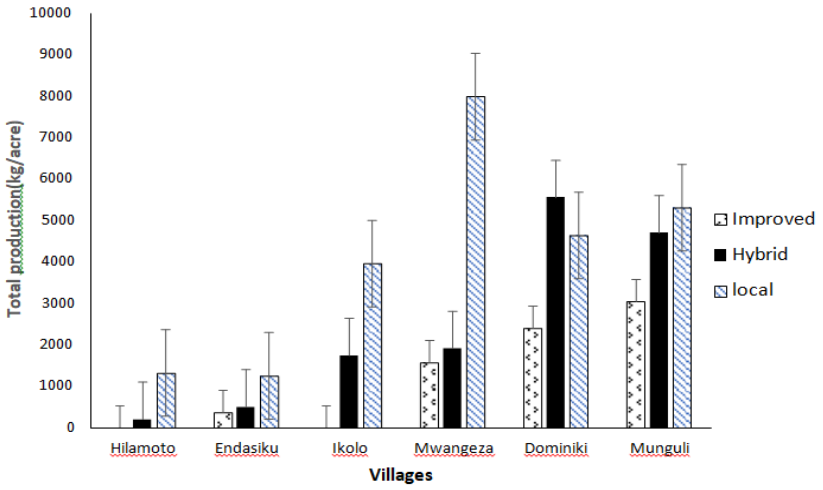

Figure 1. The overall production in kg/acres among villages based on seed usage

Based on the results presented, it appears that the smallholder farmers surveyed have used two different methods of planting - broadcasting and non-broadcasting. Broadcasting involves spreading seeds over a wide area, whereas non-broadcasting involves planting individual seeds in rows or other patterns. Of the total planting area, 68.03% of the farmers used broadcasting and 31.97% used non-broadcasting planting technique with some recommended spacing (Fig 2).

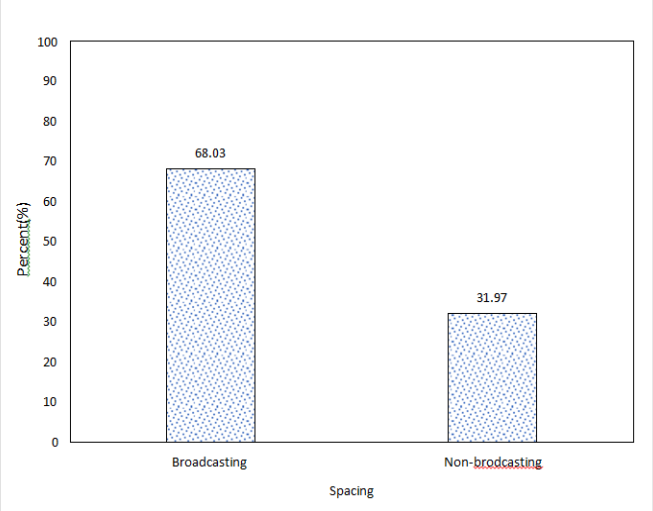

Figure 2. the bar chart showing the use of spacing among farmers

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Application of fertilizers

The application of fertilizer was much essential in the control of production. In this study, results showed that there is significant association ($p<0.05$) in the application of fertilizer across villages in altering production of sunflower. As shown in figure 3, about 91.16% farmers did not use fertilizer, while only about 8.84% used fertilizer. Results showed that those farmers who used fertilizers have highest chance on increase in production compared to those who did not use fertilizers.

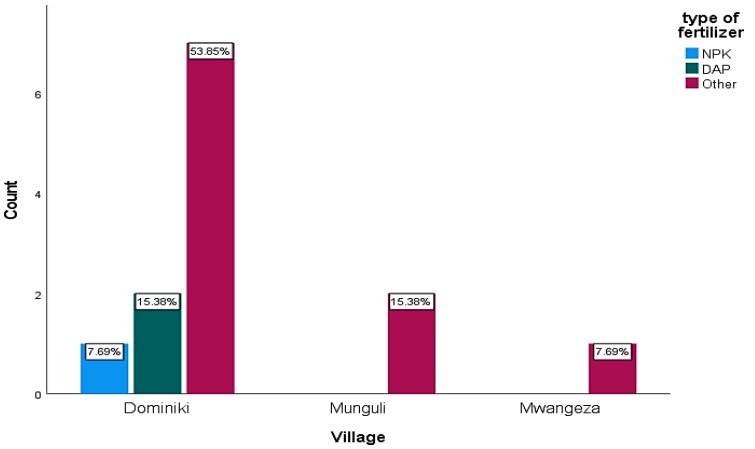


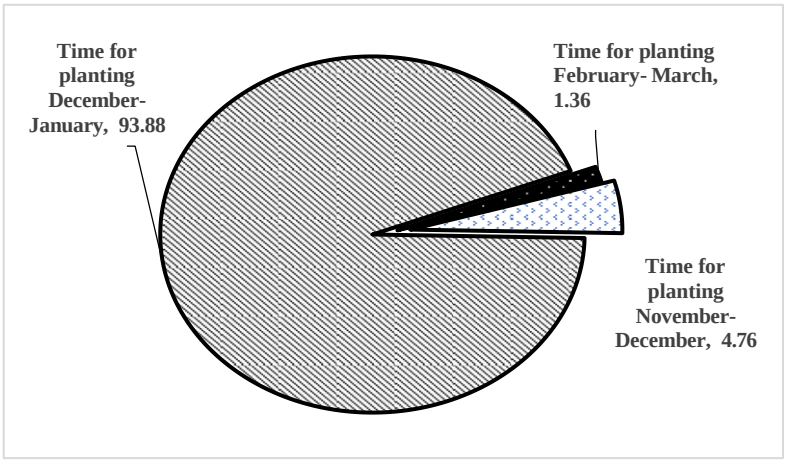
Figure 3. The usage of fertilizer in altering sunflower production across villages

Similar to this, figure 3.6.4 shows that Dominiki village is the only village that used fertilizer of about 7.69% on NPK and 15.38 on DAP the rest of villages like Munguli use 15.38% and Mwangeza by 7.69% on other forms of fertilizer (manure) where Dominiki village had 53.85% on other forms of fertilizer.

Table 2, results showed that most of farmers practiced preparation of farms before planting the other batch of sunflower plants as about 95.24% of farmers agreed on these facts, this is also statistically justifiable ($p<0.05$), hence the availability of association in the practice among villages. The villages with highest commitment in practicing farm preparation before planting were Dominiki, Munguli and Mwageza. About 84.35% of smallholder farmers engaged in some form of farm preparations before harvesting, as seen in Table 2.

In terms of the time of planting, most farmers (93.88%) planted their crops between December and January, with only a small percentage (4.76%) planted in November-December and a slightly larger percentage (1.36%) planted in February-March. This inferred that the December-January period was the most suitable for planting for the farmers surveyed.

Regarding harvesting time, the farmers had slightly different timelines for harvesting. The majority (51.70%) harvested their crops between 90 and 130 days after planting; 35.37% harvested between 90 and 125 days after planting, while 12.93% harvested between 80 and 120 days after planting. This could be due to variations in crop types or other factors that affected the time needed for the crops to mature.



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Statistical association among Recommended practices across villages

Table 2 showed that 84.35% of the villages utilized the recommended practice of preparation before harvesting, and this association is significant at the 0.05 level with a Chi-square value of 15.65 and 5 degrees of freedom (df). Similarly, the use of fertilizer is significantly associated with villages (Chi-square value of 16.915 and 5 df), where 91.16% of villages use fertilizer. The results also showed that the practice of spacing is significantly associated with villages, with 68.03% of villages using broadcasting and 31.97% of villages using non-broadcasting methods. The Chi-square value of 57.198 was obtained with 15 df, indicating a significant association between the use of spacing methods and the villages.

In contrast, the results showed that the use of weeding, and experience with pests are not significantly ($p>0.05$) associated with the villages. The Chi-square values are 6.028 and 8.085, respectively. The results for the time of planting and harvesting were also shown in the table, with no significant associations ($p>0.05$) with villages, of which the Chi-square values are 9.255 and 65.845, respectively.

Table 2. The association on the uses of recommended practices varying across villages (n=147)

Variable			**Village frequency**						**Chi-Square Tests**		
		D	**E**	**H**	**I**	**MU**	**MW**	**Total (%)**	**Pearson**	**df**	**Sig.**
Preparation	No	4	0	3	9	0	7	15.65	14.629	5	0.012*
	Yes	23	17	6	9	38	31	84.35			
Weeding	No	1	2	0	2	3	2	6.80	6.028	5	0.304
	Yes	42	5	6	15	38	31	93.20			
Experience pests	No	11	2	1	7	10	5	24.49	8.085	10	0.621
	Yes	31	5	5	10	28	31	74.83			
Apply fertilizer	No	32	7	6	17	36	36	91.16	16.915	5	0.005*
	Yes	10	0	0	0	2	1	8.84			
Spacing	Broadcasting	18	7	13	14	20	28	68.03	57.198	15	0.000*
	Non-broadcasting	5	9	7	5	10	11	31.97			
Time for planting	Nov-Dec	4	0	0	1	1	1	4.76	9.255	10	0.508
	Dec-Jan	38	7	6	16	35	36	93.88			
	Feb- Mar	0	0	0	0	2	0	1.36			
Harvesting time	80 to 120	11	0	5	1	1	1	12.93	65.845	15	0.000*
	90 to 125	15	3	1	1	14	18	35.37			
	90 to 130	16	7	5	15	23	10	51.70			

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***** meaning the Chi-square statistic is significant at the .05 level**.**

Key: D=Dominiki, **E**=Endasiku, **H**=Hilamoto, **I**=Ikolo, **MU**=Munguli, **MW**=Mwangeza

Generally, Table 2 showed that the use of recommended practices varied significantly across villages, particularly for the practices of preparation, fertilizer, and spacing. These results may be useful for identifying the specific practices that are most commonly used in different villages and for designing targeted interventions to improve agricultural productivity and sustainability in small holder farming communities.

Based on the inputs from the Focused Group Discussion (FGD) and Key Informants (KI), several challenges and potential solutions for sunflower production in Mkalama have been identified. These include the need for irrigation systems, strategies to address bird damage, training farms, and access to credit and quality seeds. It was also noted that diseases, soil problems, and temperature fluctuations can impact crop productivity. To ensure successful sunflower production in Mkalama, farmers need to adopt good agricultural practices, including proper cropping calendars, seed selection, fertilizer use, and disease management. By implementing these practices and addressing the identified challenges, sunflower production in Mkalama can become more efficient and profitable for smallholder farmers.

DISCUSSION

The results indicated that most farmers in the district, practice farm preparation before planting, with the villages of Dominiki, Munguli, and Mwageza exhibiting the highest commitment to this practice. This finding is consistent with previous research on sunflower production in other regions, which has highlighted the importance of proper soil preparation in achieving good yields (Shah *et al.*, 2017). Mostly, farm preparations are conducted between January to December whereas planting is usually in January and February.

The preference for local seeds in some villages could be attributed to the fact that these seeds are well adapted to the local growing conditions, as reported by previous studies (Liu et al., 2014; Hernández et al., 2018). Moreover, the high production yields of local seeds observed in this study suggest that they are still an important option for farmers in the Mkalama District. Hybrid seeds, on the other hand, were the second most used seed type in the study, with high usage in most of the villages. The adoption of hybrid seeds can be attributed to their higher yields and better performance under certain environmental conditions, as reported in previous studies (Joshi et al., 2016; Otieno et al., 2019). However, the observed mean production average of hybrid seeds in this study was not significantly different from that of local seeds, indicating that the benefits of using hybrid seeds may not be sufficient to justify their higher cost for some farmers in the Mkalama District. Improved seeds were the least commonly used seed type in the study, with low usage in Hilamoto and Ikolo villages. The lower adoption rate of improved seeds could be attributed to factors such as their higher cost, limited availability, and lack of awareness among farmers (Obare et al., 2014; Kahimba et al., 2016). However, the highest mean production average of improved seeds observed in this study was in Endasiku village, indicating the potential benefits of using improved seeds for sunflower production in certain areas.

The study also found that most farmers in the district prefer to plant two seeds per hole at an area of 75cm x 60cm, with only a small proportion of farmers opting for other planting densities. This finding is consistent with previous research that has recommended a planting density of 3-5 plants per square meter, as this density has been shown to produce good yields (Grygoruk *et al.*, 2017). However, the fact that some farmers are using different planting densities suggests that there may be a need for greater education and awareness-raising among farmers about the optimal planting density for sunflower production.

In terms of fertilizer use, the study found that most farmers in the district do not use fertilizer, with only a small proportion of farmers using NPK and DAP fertilizers. This finding is consistent with previous research that has highlighted the low level of fertilizer use among smallholder farmers in Tanzania (Mbaga *et al.*, 2016). However, the fact that some farmers are using fertilizer suggests that there may be a need for greater education and awareness-raising among farmers about the benefits of using fertilizer to improve yields.

The timing of planting and harvesting can have a significant impact on crop yields and quality. In the case of sunflower production in the Mkalama District of Tanzania, the majority of farmers (93.88%) plant their crops

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue XII December 2024

between December and January. This aligns with previous research that has found that sunflower performs best when planted during the dry season, which typically occurs between December and March in Tanzania (Kilic et al., 2017). The timing of planting can also affect the incidence of pest and disease infestations, which are more likely to occur when crops are planted outside of the recommended season (Ratnadass et al., 2012). When it comes to harvesting, the surveyed farmers appeared to have slightly different timelines for harvesting. The majority (51.70%) harvest their crops between 90 and 130 days after planting, while 35.37% harvest between 90 and 125 days after planting, and 12.93% harvest between 80 and 120 days after planting. This variation in harvest timing could be due to a variety of factors, including differences in crop varieties, environmental conditions, and farm management practices. However, it is worth noting that harvesting sunflower too early or too late can result in reduced yields and quality (Bilalis et al., 2018)

The findings of this study suggest that there are significant differences in the use of recommended agricultural practices across villages in the study area. Specifically, the use of preparation before harvesting, fertilizer application, and spacing methods vary significantly across villages, while weeding and experience with pests do not. The use of preparation before harvesting is an important recommended practice as it helps to ensure that the crops are ready for harvest and that the harvest is of good quality. The high percentage (84.35%) of villages that use this practice indicated that it is widely recognized as beneficial by farmers in the study area. This is consistent with the findings of other studies that have shown that pre-harvest preparation is associated with improved crop yield and quality (Zhao et al., 2024). Similarly, the use of fertilizer is also important for crop growth and yield. The high percentage (91.16%) of villages that applied fertilizer indicated that farmers in the study area recognize its benefits. This finding is consistent with research research findings that fertilizer application can increase crop yield and improve soil fertility (Zingore et al., 2008). Broadcasting is the most commonly used method in the study area, with 68.03% of villages that used it. This finding is consistent with the finding that showed that broadcasting is a common method of spacing in smallholder farming systems (Johansen et al., 2012). However, the use of non-broadcasting methods may have some advantages, such as increased crop yield and reduced weed pressure (Derkersen et al., 2002). The lack of significant associations between weeding, experience with pests, time of planting, and harvesting time, and villages suggests that these practices may be less influenced by local conditions and farmer preferences than the other recommended practices. However, it is important to note that these practices are still important for crop growth and yield, and further research may be needed to understand why they are not associated with specific villages in this study.

CONCLUSION

Generally, this study revealed that sunflower production practices in Mkalama District are sub- optimal, with many farmers not using recommended practices such as the use of fertilizer, proper seed selection, and timely harvesting. However, it is encouraging to note that the majority of farmers do practice farm preparation before planting. The preferred type of seed used by farmers is dominated by local seeds, which may be due to lack of access to improved seeds. The broadcasting was found to be the most common practice, although this may not be the best practice for maximizing yields. Given these findings, it is recommended that extension services in Mkalama District should focus on educating farmers on recommended sunflower production practices such as the use of improved seed varieties and appropriate spacing, as well as the use of fertilizers to improve soil fertility. The government and other stakeholders should work towards providing farmers with access to improved seeds and fertilizers, as well as other agricultural inputs and extension services to enhance their agricultural productivity and income. This may involve collaboration with local seed companies, input dealers, and other agricultural service providers.

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