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Factors Affecting Profitability of Sunflower Production among Smallholder Farmers in Dodoma Region, Tanzania

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Abstract

Tanzania has continuously been faced with a shortage of edible oil as evidenced by the demand and supply gap for edible oil in the country. This study aimed at analyzing the factors affecting profitability of sunflower production among smallholder farmers in Dodoma Region, Tanzania. Multi-stage sampling was applied to select a total of 138 smallholder sunflower farmers in Kongwa District and Dodoma City in Dodoma region. A semi-structured questionnaire was used to collect data through face-to-face interviews. The study employed a Gross Margin Analysis to estimate the profit and then linear regression analysis to analyze the determinants of profit in the study area. The average Gross Margin of sunflower production was TZS 268,450. The results indicate further that experience, land size, household size, use of improved seeds, pests and disease control, land preparation, use of industrial fertilizer, and use of irrigation were significant in explaining the variation in profit level among sunflower producers in Dodoma region. Therefore, it can be concluded that the majority of the sunflower producers in the study are profit efficient as they use good agriculture practices. Therefore, the study recommends several measures to enhance the increase of sunflower production in the study area that includes: improving production skills through providing training on good agriculture practices, utilization of extension services and considering increasing the size of production which might boost the level of profit among sunflower producers in Dodoma region.

Keywords

Sunflower Production, Profitability, Edible Oil, Strategies

1. Introduction

Tanzania, as other developing countries in the world, intends to transform its agriculture sector to a level that meets local demand for food commodities through domestic production. One of the agricultural crop productions which are being transformed is the production and supply of edible oils including sunflower oil whereby several efforts such as imposition of edible oil strategies have been witnessed (TEOSA, 2012). This is thought important after a long-standing decade of dependency on imports for major food commodities such as edible oils (FAOSTAT, 2015). Sunflower crop was introduced in Tanzania since colonial period, although in the 1970s, it was still a minor crop grown largely in Singida and Dodoma regions. However, in the 1990s, the Government of Tanzania (GoT) through its Extension Services collaborated with NGOs and development agencies, started to promote sunflower production along the Central zone as among the strategies for poverty reduction in the country (Isinika and Mwajombe, 2018).

Currently, annual demand for edible oil in Tanzania is estimated to be 570,000 Tons and which is increasing annually at a rate of 3 percent (FAOSTAT, 2021) Tanzania imports about 60% of its edible oil needs (Salisali, 2017). Therefore, the ever increasing demand for edible oils worldwide and within the regional, has enticed numerous countries to invest and develop the subsector especially supporting primary producers, processors, and other edible oil value chain actors. This trend has also been witnessed in Tanzania, where sunflower production has progressed from being an obscured subsistence crop grown in only few places in 1990 with production of only 3000 Tons to become a leading domestically produced oil crop with the production level of 205,000 Tons in 2021. These efforts are aimed to meet the increasing demand for edible oil in Tanzania which is estimated to reach 1.08 million Tons in 2030 from the current 570,000 Tons (FAOSTAT, 2021).

Moreover, in order to meet the increasing demand for edible oil in the country, crude edible oil imports have increased steadily throughout the years (FAOSTAT, 2021). However, these crude oil imports are also competing with locally produced edible oils and their refined products are sometimes sold at cheaper prices when compared to local produce. Sunflower oil is also one of the imported edible oils and its imports have grown at the quickest rate in 21st century (FAOSTAT, 2021). Malaysia and Türkiye are the largest exporter, accounting for roughly 90% of Tanzanian sunflower oil imports followed by Kenya (5%), Switzerland (5%), and the United States of America (USA) (4%) (FAOSTAT, 2021).

Therefore, based on increasing demand for sunflower oil and also trying to minimize imports, the Government of Tanzania tried to strengthen and support the sunflower oil sub-sector by developing and implementing the National Sunflower Oil Sector Development Strategy in order to improve its competitiveness and organization in the country (URT, 2020). In this strategy, five strategic objectives were developed and which included: 1) enhancement of sunflower pro-

duction and productivity by implementing contemporary production techniques, 2) its modernization by improving coordination, institutional capacity, and capabilities across the value chain, 3) improvement of sunflower product quality in order to meet both national and international requirements, 4) stimulation of growth in the sunflower industry by implementing consistent and supportive policies that are aligned with national development goals and 5) provision of timely and adequate market entrance support in order to effectively build market (URT, 2020). Thus, in order to realize these objectives, the target was to reform the whole sunflower value chain and develop its local and international markets. This is possible through the development of the Strategy's Plan of Action (PoA), which aims to address the sector's significant constraints (URT, 2020). However, despite the efforts by the GoT and other stakeholders to revamp the sunflower oil sub-sector through National Sunflower Oil Sector Development Strategy and EOS, there is still a shortage of sunflower oil in the Tanzanian market. This might be attributed to the use of local methods of farming by sunflower farmers in most producing areas including the study areas which lead to low production.

2. Theory of the Firm

According to the Theory of the Firm, every producer, especially farmers, strives to maximize output while lowering expenses and increasing profits (Debertin, 2012). However, in most cases, it is not possible to optimize all of them; that is, some farmers will produce more efficiently than others given the same inputs and technologies. However, in estimation techniques in econometrics, it allows for differences in observed decisions towards optimal ones due to inefficiency in optimization or random shocks by some farmers (Mlote et al., 2013). The assumption is that the firm exhibits constant returns to scale with a production possibility set fully described by unit isoquant while considering two inputs and one output. The implication is that every set of inputs along the unit isoquant is considered as technically efficient while any point above and to the right of it is defines inefficient producer. The boundary of the production possibilities set is known as PPF. It is the important part of the production possibilities set because at any point on it shows the efficient production due to the opportunity cost that the producer will make on the selection of inputs. Its slope reflects the opportunity cost because it describes what must be given up in order to acquire more products. They are concave towards the origin due to the principle of diminishing marginal return. This helps the producers to determine the maximum capacity or output that they can achieve with the available resources/method of production (good agriculture practice).

This study used the cost-minimization approach in production processes. In the cost, minimization approach farmers strive to minimize the cost of production by finding the combination of agricultural practices with the least costs (Debertin, 2012). The study seeks to find the best agriculture practice that is

cost-effective and brings maximum return to sunflower farmers. Theoretically, farmers are considered to be rational but are limited to being so due to uncertainties such as weather changes and market prices (Ankarloo, 2002). Thus, farmers decide to adopt new technologies if they perceive that the adoption benefits exceed the adoption costs. Also, the study used the profit maximization principle that explains the necessary and sufficient conditions for profit maximization (Debertin, 2012; Zhou et al., 2013). If this condition holds then, it may imply that a farmer is in a position to make a profit out of sunflower production by being efficient in inputs utilization to attain an output to be traded in the market.

3. Empirical Review

In the past two decades, a large number of adoption studies have been conducted in order to explore factors determining adoption of good agricultural practices in particular improved seeds. The literature shows various factors that empirically have influence on farmers decision-making regarding to use or not to use a particular practice. A review by Mwangi and Kariuki (2015) on factors determining adoption of new agricultural practices by smallholder farmers in developing countries identified broad categories of factors influencing adoption of good agricultural practices. The categorization is made in terms of the practices itself, economic, institutional and household specific factors. Findings of most studies on factors influencing adoption of agricultural technologies fall into these four categories: technological factors, economic factors, institutional factors, and household specific factors.

Using the case of improved pigeon pea to study the determinants of good agricultural practices adoption in Tanzania, Simtowe (2012) found that ownership of livestock, distance to the agricultural office, access to pigeon pea seeds, and land size have significant effects on influencing adoption of improved pigeon pea. Furthermore, Beyene and Kassie (2015) found that social capital and networks, and information from the extension workers are important in speeding up the adoption of improved maize varieties in Tanzania. Sustainable agriculture is now on the agenda of agricultural institutions around the world and can be one of the solutions to controversial farming issues as it can ensure profitability, food quality and safety (TEOSA, 2012). Studies have shown that farmers are very receptive in changing to sustainable agriculture as stipulated by GAP, and stakeholders should join hands to ensure sustainable agriculture is being practices. It has also shown a correlation between farmers' quality of life and attitude towards sustainable agriculture (Iringo, 2013). The intention to practice sustainability among farmers is important indicator to adopt good agricultural practice. Similarly, In order to motivate farmers to change to sustainable agriculture it is important to understand their intention (Isinika and Mwanjombe, 2018). In agriculture, the aim of every farmer is to minimize cost and increase profit.

Studies in other countries with similar results include the one done by Nwa-

chukwu (2017) in Nigeria that strongly suggests that the main factors significantly affecting adoption of good agriculture practices include cultural values, institutionalized land tenures, cropland size, poverty, literacy level, technology complexity, agricultural extension services, age and sex. On the other hand, the study of Katungi et al. (2016) suggests that adoption of climbing beans in Rwanda depends on elevation, rainfall, and cropping systems.

Another study done in Nigeria by Fadare et al. (2015) reports that the farm size, access to extension services, education level, marital status, access of the household head influence adoption decision of maize farmers in the country. Other adoption studies with results in line with those reviewed in this study include the one done by Mlenga and Maseko (2015) in Swaziland, Beshir (2014) in Ethiopia, Wossen et al. (2017) in Nigeria, Mwangi and Kariuki (2015) and Abebe and Bekele (2015) in Ethiopia.

Generally, factors such as education level, age, years of experience in farming, access to extension services and access to credit have been recorded to have a positive relationship with adoption of good agricultural practices. Educated farmers are said to be knowledgeable enough to understand the importance of adopting improved agriculture practices. The influence of age has been controversial. Age can be related with experience and record a positive influence, while on the other hand, the higher the age the higher can be the reluctance to accept change. The current study suggests that there is some missing information in the literature regarding the factors influencing adoption of good agricultural practices, and argues that probably these might account for the persisted low adoption rate among farmers. The profitability impacts of the good agriculture practices in production are important to be taken into consideration.

4. Methodology

4.1. Study Area

The study was conducted in two districts namely Dodoma City and Kongwa in Dodoma Region. Dodoma region was purposely selected for the study based on the implementation of various interventions by the GoT and other stakeholder such as Development Partners in revamping the sunflower processing firms in the region. Dodoma is one of the regions selected in the edible oil strategies to make a major production of sunflower oil (URT, 2020). Dodoma Region is located between 60˚ South and 360˚ East of the Equator. The region lies at the heart of Tanzania in the Eastern-central part of the country, covering an area of 41,311 sqkm with a population of about 2,642,287 (The Region consists of seven districts namely Bahi, Chamwino, Chemba, Dodoma City, Kondoa, Kongwa and Mpwapwa (Iringo, 2013).

4.2. Research Design

This study used a cross-sectional research design in which data were collected at one point in time from a selected sample of respondents (Kothari, 2004). This

design is relatively cheap, quick and effective since it utilizes limited resources in terms of funds, labor, transport and time. In a cross-sectional study, the investigator measures the outcome and exposures of participants at the same time (Setia, 2016). It is also very useful for descriptive purposes and the data that was collected using this design was used to determine relationships between different variables focused on this study.

4.3. Sampling Procedure and Data Collection

The sampling frame consists of sunflower producers in Kongwa and Dodoma City. A multistage sampling method was employed in the study to obtain the required sample of 138 respondents. Both quantitative and qualitative data were collected. Quantitative data was collected through a survey using a structured questionnaire from 138 respondents. That is 138 small-scale sunflower farmers, whereby 79 were from Kongwa and 59 from Dodoma City. The questionnaires contained both open-ended and closed-ended questions. The questionnaire was used to collect information on the background information of the respondents.

4.4. Data Analyses

Descriptive statistics were used to discuss the small-scale sunflower producers in Kongwa and Dodoma city Gross Margin analysis was used to estimate profit obtained by small-scale producers, and then linear regression was used to analyze the factors influencing profitability of sunflower producers using good agricultural practices in their farming process. A descriptive analysis was done using excel, while Statistical Package for Social Science (SPSS) was employed to carry out different analyses on variables that were generated from the study.

4.5. Gross Margin Analysis

According to Mpogole et al. (2012), many studies employ gross margin (GM) to analyze the profitability of enterprises. Although GM is not a profit since it does not include the depreciation costs, fixed costs and management costs in its cost outlay, however, the study has used gross margin since it tells what the business made after paying for the direct cost of doing business. Therefore, GM is a proxy for profit and it only helps to show the financial direction of the enterprise. For this study, GM is as shown in Equation (1).

$$\mathrm{CM} = \sum_{i=1}^{n} \left(\mathrm{TR} - \mathrm{TVC}\right) = \sum p_y y - \sum p_x x \tag{1}$$

where GM is the gross margin and is used as a proxy for sunflower profit, TR is the Total Revenue of selling sunflowers, TVC is the Total Variable Costs of producing sunflowers and p_y and p_x are prices of sunflowers and inputs while Y and X are quantities of sunflowers sold and inputs used respectively. Examples of studies used GM as a proxy for profit to analyze the profitability of agricultural enterprises includes; Mpogole et al. (2012); and Song et al. (2006).

Linear Regression Analysis

The regression modal provides a function that describes the relationship between one or more independent variables and a response, dependent, or target variable. It allows obtaining predicted values for specific variables under certain condition (Baum, 2013; Fernando, 2011). Such as level of profit on sunflower production, while controlling for the influence of other factors, such as the use of improved seeds, land preparation, proper weeding, use of fertilizer, proper spacing, use of pest sides. The regression modal can be used to forecasting the production of sunflower seed/oil in the study area. The modal assumes the following: Linearity, homoscedasticity, no or little multicollinearity, no auto-correlation and multivariate normality. The linear regression equation adopted in this study is presented in Equation (2).

$$\begin{aligned}\text{Profit}(\pi) = {} & \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_4 X_4 + \beta_5 X_5 \\ & + \delta_6 X_6 + \delta_1 D_1 + \delta_2 D_2 + \delta_3 D_3 + \delta_4 D_4 + \delta_5 D_5 + \delta_6 D_6 + \mu\end{aligned} \tag{2}$$

Whereby; β_0 = intercept β_0 = coefficient parameters, δ_i = Coefficient parameters, X_1 = Educational level (in years), X_2 = Experience of the farmer in years, X_3 = Farm size in acres, X_4 = household size, D_1 = Gender of the farmer, D_2 = Use of improved seeds, D_3 = Pests and disease control, D_4 = Use of irrigation, D_5 = Use of tillage services, use of proper weeding, D_6 = Use of improved seeds, D_6 = Use of irrigation services. π = the observed dependent variable defined as the profit of a sunflower producer, e_i = Error terms that was assumed to be independently and normally distributed with zero mean and constant variance and $I = 1, 2 \ldots n$ (n is the number of Observations). Examples of the study that has used liner regression on their study are such as Lotto (2019), Lubua (2019) and Mboya et al. (2020).

5. Results and Discussion

5.1. Cost Estimation in Sunflower Production

The total production cost of sunflower oil and sunflower seeds are the essential component of the whole process of sunflower production; Sunflower seeds used by farmers can be either recycled seeds or improved seeds. The cost involved in the purchasing of sunflower seeds includes the cost of seeds per bag which could fluctuate depending on forces of demand and supply and environmental factors such as weather conditions and government policies. Other costs which are included in sunflower cultivation include farming equipment such as a hoe, tractor and transportation costs from the market to the farm, land preparation cost, wedding cost, seed cost and harvesting cost. Other indirect costs include the cost of the search for sellers and dealers, especially in the low season which involve communication costs, re-planting due to failure of some seeds to grow, travelling costs by farmers to search for raw materials especially in long-distance areas to obtain the best seeds for the upcoming season.

The study found that the average cost of sunflower seed in Kongwa District was 3000 TZS per bag of 2 kg for recycled seeds and 8000 TZS per bag of 2 kg for the modified seeds while in Dodoma City it was 2500 TZS per bag of 2 kg for

recycled seeds and 8000 TZS per bag of 2 kg for modified seeds. Kibaigwa town had the lowest average in Kongwa district of 2000 TZS per bag of 2 kg for recycled seeds and 7500 TZS per bag of 2 kg for modified seeds, followed by Hembahemba (2200 TZS) and Pandambili (2400 TZS) (Table 1). Kibaigwa in Kongwa District had the lowest prices of sunflowers since the town acts as an agricultural market centre where different agricultural products are marketed. Thus, it is an easy fetching point for farmers to procure the seeds at lower prices by arranging with other farmers in the market. In Dodoma city the study found that the Manchali ward had the lowest average cost of 2600 TZS per bag of 2 kg for recycled seeds and 7800 TZS for modified seeds compared to 3000 TZS for the total average recycled seeds and 8000 TZS for modified seeds the whole district. Additionally, farmers still prefer recycling local breeds of sunflower seeds.

On the one hand, farmers preferring recycling seeds in belief that they are reliable more than modern seeds that are claimed not to grow properly in the study area. However, recycling reduces the quality of seed kernels which eventually reduces the oil content of seed kernels. On the other hand, these years, there was a critical shortage of sunflower kernels, which led to uncontrollable price fluctuations. Processors claim that there was an invasion of big-scale sunflowers oil processors such as Murza Oil, Mount Meru, East Coast Millers and a new Chinese factory in Kahama ward in Dodoma (Iringo, 2013). The reason behind farmers preferring recycling local seeds is the belief that local seeds are more reliable than modern seeds that are said not to grow properly in the study area.

The study also found that the total cost of farm preparation on average was 27,000 TZS sq·m in Kongwa and 30,000 TZS sq·m in Dodoma City (Table 1). This includes clearing the farms by hoe or tractor before starting seedlings, the cost of weeding on average is 21,000 TZS sq·m in Kongwa and 20,000 TZS sq·m in Dodoma City (Table 1). This includes both wedding, the first one just after emerges of seeds and the second one after a sunflower plant has started to carry the caps. The cost of harvesting sunflower seeds including cutting caps, removing seeds from the cap, and removing dirt from the sunflower seeds on average is 1000 TZS per 1 bag of 70 kg in both Kongwa and Dodoma City (Table 3). Generally, on average, the total production cost of sunflowers in Dodoma region per 1 acre is TSZ 74,000/ = for the farmers using recycled seeds and TSZ 114,500/ = for the improved seed varieties.

Table 1. Cost incurred in production processes.

Input factor	Average cost per acre (TZS)	% Total Cost
Seeds	8000	6.98
Farm preparation	20,000	24.89
Weeding	20,500	17.90
Planting seeds	30,000	26.21
Fertilizer/manure	8000	6.98
Harvesting	10,000	17.04
Total production cost	114,500	100

5.2. Gross Margin Analysis Results

The study results (Table 2) show that the total revenue for both Kongwa and Dodoma City settled at 200,000 TZS per 1 acre on average in one season, while the average number of sunflower bags produced per season was 5 bags of 70 kg per acre on average. The minimum bags produced by the farmer were 2 bags of 70 kg and the maximum was 8 bags per month. The maximum price per bag was 90,000 TZS during the dry season thus from October-June and the minimum was 55,000 TZS during the surplus season, that is from July-September. The maximum total revenue of sunflower produced was 720,000 TZS per 1 acre while the minimum revenue was 110,000 TZS per 1 acre. The total revenue for farmers using recycled seeds on average is 145,000 TZS per 1 acre and 580,000 TZS for farmers using improved seeds. Due to this price variation among seasons, most sunflower farmers tend to store their yields up to the season when the price of sunflower seeds increases to the maximum and then start to sell at high prices.

5.3. Analysis of Factors Influencing Sunflower Profitability

From the profitability analysis, the F statistics were statistically significant at 1% indicating that the independent variable can explain the variation in the dependent variable. The model satisfies the assumptions of linear regression as the R square indicates the Goodness of Fit since the independent variable can explain the variation in the dependent variable by 76.1%. The result indicates that experience, land size, household size, use of improved seeds, pests and disease control, land preparation, use of fertilizer, and use of irrigation were significant in explaining the variation in profit level among sunflower producers in Dodoma region. The coefficient for gender, educational level and use of proper weeding was insignificant even at 10%.

The coefficient for the experience of sunflower farmers was negative and statistically significant at 10% (Table 3). The negative coefficient indicates that an increase of 1 year of experience for sunflower producers will increase the level of profit by 0.2002 TZS. Years of experience play a little significance role in the sunflower production, since the sector is characterized by newer people who are trying to find opportunity in sunflower production based on the expected high profits. Thus, experience of the farmer has little or no contribution to the profits obtained. The results are similar to those of Salisali (2012) who argues that entrant of newer and younger farmers in recent years have been incentivized by interventions by government and other development stakeholders to boost sunflower

Table 2. Gross margin analysis (Per one acre).

Variable	Minimum (TZS)	Maximum (TZS)	Average (TZS)
Total revenue	145,000	580,400	362,700
Total cost	74,000	114,500	94,250
Gross Margin	71,000	465,900	268,450

Table 3. Analysis of factors influencing profitability of sunflower production in Dodoma region.

Variable	Coefficient	SD error	t ratio
Gender	0.12348	0.1362	0.91
District Dummy	−0.1228	0.1464	−0.84
Experience	−0.2002	0.1053	−1.90*
Education level	0.3134	0.1635	1.92*
Land preparation	0.4249	0.11523	2.79***
Farm size	0.0482	0.00394	12.24***
Use of Improved seed	0.7779	0.1403	5.54***
Pests and disease control	0.1818	0.1414	1.29
Use of proper weeding	0.3702	0.1486	2.49**
Proper spacing	0.6516	0.1381	4.72***
Use of fertilizer	0.1794	0.1473	1.22
Constant	13.2462	0.3746	35.36***
Statistics	Value		
R square	72.73		

* = 10%, ** = 05% and *** = 01%.

production and productivity in the central corridor of Tanzania, high demand for sunflower oil for its nutritional contents, access of loans from CRDB Bank and training and extension services. This shows that the newer and younger farmers' dominance shows that the sector has fewer barriers in terms of regulations which could deter the entrant and participation of newer and younger producers in the market. Newer and younger producers offer competition to the market in terms of innovation and better output which encourages production efficiency and increases output. The entrants of newer and younger farmers in recent years have been incentivized by interventions by the government and other development stakeholders to boost sunflower production in the central corridor of Tanzania, high demand for sunflower oil for its nutritional contents, access to loans from CRDB Bank and training and extension services (Salisali, 2012).

The results show that the coefficient for land preparation was positive and statistically significant at 1% (Table 3). The positive coefficient indicates that with an increase in land preparations for one 1 acre, the profit efficiency level will increase by 0.4249 TZS. This is mainly attributed to the fact that most sunflower farmers prepare farms during the early rains which includes clearing of bushes, weeds and other unwanted plants in the farms in order to allow new seeds to grow easily. However, some farmers use tractors to mix the soil with plant remains so as to add nutrients into the soil. The result is similar to those of Massawe et al. (2005) who argue that land preparation leads to reduction of rodent

population size in crop fields.

The coefficient for farm size was positive and statistically significant at 1% (**Table 3**). The positive coefficient indicates that with an increase in 1 acre of sunflower cultivation, the profit level will increase by 0.0482. An increase in the area under cultivation is the leading way to increasing output and maximizing profit for many farmers in Tanzania, especially the small-scale ones. The increase in profit can be attributed to the fact that when a farmer increases the size of production he/she experiences economies of scale and economies of size. In the case of sunflower farmers, they might experience economies of size in input purchase and the utilization of fixed inputs such as a tractor. This implies that a farmer can produce more sunflowers by using the same set of fixed inputs hence reducing the cost of production. The results are similar to those of Gumbau-Albert and Maudos (2002) and Alveraz and Crespi (2003) who explicitly showed that there is a positive relationship between a firm's size and production efficiency.

The coefficient for use of improved seeds was positive and statistically significant at 1% (**Table 3**). The positive coefficient indicates that farmers who use the improved seeds are experiencing higher profit levels than their counterparts. This is because improved seeds are better and offer more quantity harvest than the recycled seeds. Although they are sold at a higher price, the benefits offset the difference in prices as they earn more harvest than the recycled seeds. However, most of the farmers in Dodoma region use the recycled seed in production thus leading to low production. This study is similar to that of Iringo (2013) who argue that farmers still prefer recycled breeds of sunflower seeds; He also explains that recycling reduces the quality of seed kernels which eventually reduces the oil content of seed kernel. The availability and reliability of sunflower oil kernels are also not in stable condition. However, the use of recycled seeds was perpetuated by a critical shortage of sunflower kernels during that framing season, which led to uncontrollable price fluctuations (Iringo, 2013).

The coefficient for the proper weeding services was positive and statistically significant at 1% (**Table 3**). The positive coefficient indicates that farmers that practices weeding services earn higher in profit level than those who do not, by 0.3702. This might be attributed to the fact that most of the sunflower producers in Dodoma are small-scale farmers and it is economical to do proper wedding services since most of the sunflower farmers conduct intercropping hence weeding is important since other crops such as groundnut to get space. These results are similar to those of Senthilkumar (2022) who argue that weeding is one way of crop protection against early diseases and helps the roots to easily penetrate to the soil hence increasing yields production.

6. Conclusion and Recommendations

From the result, the study concludes that the majority of the sunflower producers in the study are profit efficient with the mean gross of TZS 268,450/acre. The

standard deviation on profit was greater than the mean profit indicating greater variation among farmers. That can be attributed to the difference in factor endowment, size of production, resource management and technologies used in the production processes. Determination of factors influencing profitability indicates the profit of sunflower producers in the study area to be largely affected by the experience, land size, household size, use of improved seeds and land preparation. Further, the use of Good Agricultural Practices (GAP) seemed to have a significant impact on the profit of sunflower producers.

The study recommends policies that will enable farmers to easily access extension services since this will enhance intensification in agriculture to commercialize utilizing resources efficiently. Farmers should use different GAPs in the production process since they have proven to be significant in determining the level of profit of sunflower producers. This will increase the room to improve their productivity and profitability. Proper education like extension services, training and workshops should be in line with these GAPs. Further, farmers should consider increasing the scale of production efficiently to realize economies of scale since the sunflower-cropped area positively influences the level of profit among producers.

Policy Implications

Results of the present study have several policy implications. The first policy implication with regard to the seeds price is that, policy makers can use the own price of improved seeds as a tool to adjust quantity demand of the improved seeds because the actual profitability analysis has shown a relative highly responsiveness to change in own price of improved seeds. Results indicated that a 1% increase (decrease) of improved seed price results to 0.78 decrease (increase) of the quantity demanded of the improved seeds, therefore, for policy makers, the entry point of intervention should be provision of improved seeds. However, before implementation of any seeds, price adjustment schemes are required. It is important that an assessment of actual cost of the seeds production is considered along its whole value chain; this will enable the policy and decision makers to make decisions that consider the interests of both seed producers and consumers (farmers).

The second policy implication is that rural agricultural development interventions should promote adoption of improved agricultural technologies in order to improve the profitability to the farmers. Results of the current study indicates that adoption of improved sunflower seeds have improved the farmers' productivity and income thus, suggesting that in improving the profitability of sunflower farmers through agriculture, promoting adoption of GAPs is inevitable.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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