Analysis of Costs of Inputs for Sunflower Production at Mkalama District in Tanzania

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Abstract
The paper analysed the input costs on the sunflower production at Mkalama district in Singida region using variables prices of fertilizer, plough, pesticide, land hired per acre, labour hired, hoe, improved seed (50kg) and Local seed (50kg). For this aim, descriptive statistics and an econometric analysis was conducted in 120 randomly selected sunflower farmers in Mkalama district. Descriptive statistics and OLS regression model were used to analyze the extent of input costs on the sunflower production by respondents. The results revealed that fertilizer, plough, labour hired and Local seed (50kg) inputs had the highest average total cost of inputs. The results of econometric model showed that fertilizers, ploughs, pesticides, land hired per acre, hoes and improved seed (50kg) were the most important inputs, significantly contributed to total production of sunflower seeds; While, the use of labour hired and Local seed (50kg) has negative relationship with output of sunflower. The paper found out that price per bag of fertilizer, price per plough, price per pesticide and price per acre of land hired are positive and statistically significant influence on the sunflower production (Beta= 0.535, 0.302, 0.502, 0.197, P>0.001). The paper concluded that major problems confronting sunflower production were found to be inputs cost which always affects the yield of sunflower. This paper recommended that the Government of Tanzania should enhance the productivity of the agricultural sector through the subsidies provision of the required inputs, which would minimize the total cost of production and speed up the productivity process of sunflower in Tanzania.

Keywords: *Costs of Inputs, Economical analysis, Econometric model, Sunflower production,*

INTRODUCTION

Worldwide, the sunflower is an important agricultural cash crop grown for its edible oil and fruits both for human and livestock consumption in most of the sunflower growing countries like Ukraine, Germany, Russia, European Union and Argentina (Marinda, 2022). In the world, 11% of crude vegetable oil production is supplied by sunflowers (Marinda, 2022). In Ukraine, sunflower is the second crop followed by wheat in sowing area with more than 6 million ha. It is sown through all 25 regions with the mottles distribution mainly influenced by relief, rainfall and crop rotation (Zymaroieva et al., 2021). According to the data shown in 2018, the major sunflower-producing countries in 2020 include Ukraine (576,0000 ha), the Russian Federation (6,942,000 ha), Argentina (1,426,000 ha), China (957,000 ha), Romania (1,025,000 ha), Bulgaria (842,000 ha), Turkey (689,000 ha), Hungary (625,000 ha), France (634,000 ha), and the United States (618,000 ha). Global oil production and consumption, both for food and non-food uses, are expected to double over the next two decades. Specifically, there is an anticipated threefold increase for oil palm, a 2.2-fold increase for sunflower, a doubling for soybean, and a 1.8-fold increase for canola Pilorge, (2020).

During the COVID-19 outbreak, various factors such as; labor shortages, lockdown restrictions, disrupted transportation, and supply-chain issues occurred and thus led to a decline in demand and production. However, global growth is projected to resume in the medium term, with consumption predicted to be 16% higher by 2030 compared to the base period of 2018–2020, (SAGL, 2023). The global pandemic has also heightened consumer awareness of health concerns, leading to a growing preference for healthy cuisine worldwide (FBI, 2023). Sunflower products play a vital role in the food industry as they can be processed into cooking oil, cereal, confections, and more. Notably, sunflower products, especially those rich in linoleic acid, are favored in most of Europe, the Asia-Pacific region, and South America. Confections and food-grade sunflower seeds are widely used as ingredients. The consumer retail sector, which dominates the food-grade seed market, is expected to expand both domestically and internationally due to increased demand for processed foods made with sunflower oil and other seeds (MI, 2023).

Furthermore, drought due to water shortage affects crop productivity as sunflower survive more in stress environments than other cereal crops. Sunflower crops are commonly found growing in a limited water environment in such a situation, it is expected that making water available through irrigation would drastically increase soil water content with expected increase as situations may warrant. In most cases, the sunflower is often restricted to marginal soil or low water land as compared to maize or soybean that prefer a high moisture environment. Hence, the effects of climate change on sunflower production in most regions of the world could offer new cropping opportunities. In Europe, growing of oilseed sunflowers using chemical fertilizers and pesticides is currently practiced. The less adaptation of some major crops like maize, rice, and wheat in the tropical and temperate regions due to climate change has influenced their yields (Konyalı, 2017).

In sub – Saharan Africa, sunflower is one of the important oilseed crops grown throughout the world as a source of premium oil and dietary fiber that significantly contributes to human health (Khan, Choudhary, Pandey, Khan, & Thomas, 2015). In some countries like South Africa, growing of sunflowers might be more competitive to other crops like maize, soybean, and sorghum (Vijayakumar et al., 2016). Due to the continuous increase in the human population, the demand for edible sunflower seeds, oil, and by-products has also increased, and to meet the demand, there is a need to intensify efforts to expand sunflower output (Taher, Javani, Beyaz, & Yildiz, 2017). Today, the international oilseed market is dominated mainly by sunflowers and other oilseed crops such as soybean, rapeseed, peanut, cottonseed, etc.

In Africa tropical countries, Tanzania production stands at 108 000 MT per annum, Sudan (18 000 MT), Kenya (12 000 MT), Angola, Mozambique, and Zambia (each about 11 000 MT). Most of the sunflower oil is consumed in these countries of origin and less than 30% reaches the international markets. Low exports of sunflower oil are attributed to high demand in domestic markets, low quality and standards which restrict entrant to international markets, and low output of most small-scale processors (Berglund, 2015). In Tanzania, agriculture continues to be the main backbone of the economy of most of the rural population. According to URT (2008) over 80% Tanzanians live in rural areas where agriculture and the use of natural resources are crucial to their livelihoods. Sunflower represents one of the key sub-sectors of agriculture in Tanzania (RLDC 2008). In world, the leading commercial producer of sunflower seeds includes Russia, Peru, Argentina, Spain, France and China (The George Mateljan Foundation, 2001-2010). In Iran, the economical and energy analysis as well as environmental analysis are important necessities in agricultural production (Mobtaker et al., 2010).

The Government of the United Republic Tanzania (URT) assigns a particular importance to agricultural development because; agriculture and particularly farm activities still constitute the major component of the Tanzanian economy. It provides livelihood to more than 70% of all the population. It accounts for about 24% of the GDP, 30% of total exports and about 65% of raw materials for domestic industries. It provides significant linkages, both backward and forward linkages with other nonfarm sectors. Furthermore, it accounts for the national inflation since; about 50% of the inflation basket is related to food availability (URT, 2021). Agriculture thus, constitutes the back born of the Tanzanian economy, and agricultural sector advancement remains a key task the nation government has to achieve.

Sunflower is one of Tanzania's most important cash crops grown mostly within the central regions of Tanzania. The country ranks 11th in the world for largest sunflower seed production and is the 2nd largest producer in Africa behind South Africa, accounting for 35% of the continent's total production yet the country imports nearly 50% of edible oil, African countries account for 5.5 per cent of the world's production (FAOSTAT, 2018). Furthermore, the statistics shows that local production of both factory and home extracted sunflower seed oil in Tanzania contributes about 40% of edible oil requirement of 330,000 tonnes, on which the 60% gap is filled by imports.

Sunflower oil is one of the most popular oils in the world, in Tanzania sunflower production offers multiple livelihood opportunities, as it produces important and valuable vegetable oils and animal feeds that are sold to internal and external markets (Ugulumu et al., 2014). It is estimated that about 4 million smallholder farmers engage in sunflower production (URT, 2013). Sunflower is grown in most regions across Tanzania as the crop is drought resistant and less susceptible to diseases; consequently, the semi-arid areas of the central zone and the southern coast of Tanzania are favorable for sunflower production (Kajimbwa et al., 2010).

The current production from Singida region shows that there is low productivity as the average smallholder yields are only 240kg/acre, which is only 33% of their potential. Similarly, smallholder farmers in Mkalama district have a productivity of 454kg/acre which is only 47% of the potential productivity which could be achieve by cultivating high-yielding and drought tolerant hybrid seeds. Poor production attributed to poor seed selection, low planting density, and poor crop management (URT, 2021).

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) .

Many challenges facing the agricultural sector are known to have an influenced crop yield and their product, can vary from one country to another due to different weather conditions in season and time. The major constraints affecting sunflower production in Tanzania and other countries can be attributed to the shortage of improved seeds varieties to farmers for planting, harsh weather conditions, erratic/low rainfall, unreliable markets, and price fluctuations. Others include; high cost of farm input, disease attack, insect-pest infestation on the plant-crop, birds attack, lack of farm machinery, unpredictable rainfall, ignorance/lack of awareness, poor extension services, and stiff competition from edible oil imports. As farmers continue planting on farmland in and out of season, this could lead to problems of disease build-up such as leaf spot and head-rots, which can easily be controlled by crop rotation, irrigation methods, and the use of biopesticides (Ebrahimian, et al., 2019).

In this paper the main objective was to analyse the costs of inputs for sunflower production of smallholder farmers in Mkalama district at Singida region. Furthermore, sunflower is grown highly in district by small-scale farmers and has a great potential for improving welfare in household. So, there is wide gap between the potential yield of sunflower and inputs actual costs obtained in the field to the farmers. Therefore, the analysis of this paper is to figure out those productions input costs which are limiting the production of sunflower in the Mkalama district.

Theory of the Firm and its Application

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).

Literature Review

Sav, *et al.*, 2016, examined production potential of oil seeds, its development, the position of sector in economy, problems in sector within the foreign trade and applied politics in their study of improved crop varieties is related to various socioeconomic and institutional factors, the relationship between contract farming and the seed improved crop varieties has not been examined yet. Furthermore, studies on the adoption of improved crop varieties have largely ignored the relationship between farmers' adoption decisions, and risk aversion and their liquidity constraints as well as the availability of seeds of improved varieties and they suggested recommendations in regard to these problems.

Hamad et al. (2002) studied the production and marketing constraint of sunflower in Pakistan in which the study was divided into production factors and marketing factors. The production factors included yield of sunflower as the dependent variable and, number of ploughs, seed rate, number of irrigations, and number of bags of urea, sowing methods, pests attack as independent variables. The marketing constraints examined were non-existence of proper markets for sunflower producers and absence of a government procurement centers. The study used a sample of 70 farmers whose responses were analyzed using regression analysis. The study revealed that ploughings, irrigation, urea and the use of drill sowing contributed positively to the per acre yield of sunflower in the study area. The results on the marketing constraints indicated that government procurement system was found completely lacking. The study showed that this lead to farmers dispose of their produce to both villages, oil mills and private companies which exploited farmers by paying low price for their produce.

Studies in other countries with similar results include the one done by Nwachukwu (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.

Baloyi (2010) conducted a study on analysis of constraints facing smallholder farmers in the agribusiness value chain in Tanzania; the study discussed the factors such as lack of human capital, high transaction cost, lack of information on markets, transport problems, technological barriers. The study discovered that many smallholder farmers were illiterate, with poor technological skills, which seemed to be obstacles in accessing useful formal institutions that can disseminate technological knowledge. It shows that majority of emerging producers lack knowledge on financial and marketing skills and it was found that producers were not able to meet the quality standards set by fresh produce markets and food processors.

Mazibuko, *et al* 2018 conducted study on influencing smallholder farmers agricultural infrastructure availability, accessibility and satisfaction in Tanzania which in turn influence them to consider short term off-farm sources of household income which are not sustainable. The study emphased that despite the increasing demand for sunflower and production potentials, a multitude of challenges and risks at times pose obstacles towards successful participation of households in sunflower value chain activities particularly in the nodes relating to cultivation, storage and processing before marketing. Therefore, the study concluded that the socio-economic determinants influencing participation of smallholder farmers in sunflower value chain activities. Towards operationalising the study objective, it was hypothesised that socio-economic factors do not influence smallholder farmers' decision to participate in sunflower value chain activities. The study recommended that aforementioned production related factors sometimes contribute as barriers towards effective production and market participation by smallholder farmers.

METHODOLOGY

Study Area and Data Collection

Data used in this study were obtained from 120 sunflower farmers from Mkalama district, Singida region, Tanzania. A survey approach was used to collect quantitative information on different inputs used for the production of sunflowers as well as the output and socio-economic structure of farms. For sampling, the population of the sunflower small farmers are unknown due to the nature of the sampling area. Tabachnick and Fidell (2007) suggest that a sample size of the unknown population is obtained using a formula: N>104 + m (where N is the sample size and m is the number of independent variables) for testing individual predictors. The simple random sampling method was used Tabachnick and Fidell (2007) suggest a sample size to adopt $N > 104 + m$ for multivariate data analysis for testing individual predictors.

Where;

N is the number of sunflower producers in unknown target population

m is the number of independent variables)

$N > 104 + 8$

$N > 112$

Therefore, the minimum sample size should be not less than 112, the sample size is 120.

The population of the Study

According to Kothari (2007), the term population means an entire group of individuals, events or objects that have common observable characteristics. It refers to all elements that meet certain criteria for inclusion in a given universe. The study used case study-based approach and targeted population was smallholder's farmers. According to the 2022 population and housing census (URT, 2022), the number of household's size of Mkalama District Council was 48,503 which is among are dealing with sunflower farming. The choice was on the fact that each respondent has different insights, information and experiences related to sunflower production in study area.

The Study Area

The study was conducted in Mkalama Districts, Mkalama district is one of the six districts of Singida Region of Tanzania. It is bordered to the East by the Manyara Region, to the South by the Iramba District, North by Singida rural district and to the West by the Meatu District. According to the 2012

Tanzania national census, the population of the Mkalama District was 188,733 (URT,2013). The study was carried out in four wards namely; Tumuli, Iguguno, Nduguti and Nkalankala where in each ward two villages were selected by considering the high volume of sunflower production.

Econometric Model of Sunflower Production

The costs of inputs used in the production of sunflower were specified in order to calculate the total production costs in the study. The inputs may be in the form of fertilizer, plough, pesticide, land hired per acre, labour hired, hoe, improved seed (50kg) and Local seed (50kg). The calculation of input costs, the relation between the costs of different inputs value was investigated using a prior mathematical function relation. In specifying a fit function relation, the Cobb Douglass production function was selected. The Cobb Douglass function has been used by several authors to investigate the relationship between various inputs and output of crops (Singh et al., 2004; Hatirli et al., 2006; Rafiee et al., 2010); it is a power function can be expressed in a mathematical form as follows (Singh et al., 2004):

$$Y_i = \alpha_0 \prod_{j=1}^{k} \chi_{ij}^{\alpha j} \ell^{\mu i} \quad \text{.....(1)}$$

$$(i = 1,2.....n;\ j = 1,2.........k)$$

Using a linear presentation, the function can be rewritten as:

$$\ln Y_i = \alpha_0 + \sum_{j=1}^{k} \alpha_j \ln(\chi_{ij}) + \mu_i \quad \text{.....(2)}$$

where: Yi, denotes the yield of the i^{th} farmer, X_{ij}, is the j th cost input used by the i th farmer for the cultivation of crop, α_0, is a constant term, α_j, represent the regression coefficients of j th input, which is estimated from the model and u_i, is the error term. Assuming that when the input costs are zero, the crop production is also zero (Singh et al., 2002; Hatirli et al., 2006):, then equation (1) reduces to a form presented in equation 2.

$$\ln Y_i = \sum_{j=1}^{k} \alpha_j \ln(\chi_{ij}) + \mu_i \quad \text{.....(3)}$$

In this functional form the parameters to be estimated, αi, represent the elasticity of output with respect to each input i which implies the percent change in output augmentation from a 1% increase in the i^{th} input cost.

Model Specification

The total production of sunflower is affected by average costs of inputs. Data was analyzed with Cobb-Douglas function to observe the effects of different capital input on sunflower yield. Following equation was formed for input costs affecting the production of sunflower in Mkalama district as under assuming that total production is a function of input costs, for analysing the impact of each input cost on sunflower yield. This paper regards the production of sunflower inputs costs in a given area of study. Given that these measurements will be made on each observation, a bivariate probit model will be adopted. Using a probit regression model the dependent variables took values: l if individual input went for pricing and 0 if the individuals input did not go for pricing. This model assumed that the error is normally distributed. A probit regression model is adopted to show whether there will be positive, negative or no association between sunflower production and the independent variables. Based on the theoretical framework, factors that determined uptake of sunflower production in Tanzania were explored using binary probit regression model that lies on an interval of between 0 and 1.

This relationship is being expressed as:

$$Yi = \begin{cases} 1 \text{ if the event takes place (an individual uses inputs costs for production)} \\ 0 \text{ otherwise} \end{cases}$$

Equation (1) expressing the prices for production can then be rewritten as:

$y^*_i = x_i\,'\beta + \varepsilon_i$

Where: y^*_i is variable showing the sunflower production,
$x_i\,'$ is a vector of variables related to the individual inputs costs
β is a vector of parameters and
εi error term

$Y = 1$ if $y^*_i > 0$ i.e $(x_i\,'\beta + \varepsilon_i) > 0$ and
$Y = 1$ if $y^*_i < 0$ i.e $(x_i\,'\beta + \varepsilon_i) < 0$

The values 0 and 1 are used in order to allow the definition of probability of occurrence of an event as a mathematical expectation of the variable Y.
This study aims to establish the relationship between the independent variables and the outcome variables for differences models, the Eq. (3) can be expanded in the following form;

$$\ln Y_i = \alpha_0 + \alpha_1 \ln x_1 + \alpha_2 \ln x_2 + \alpha_3 \ln x_3 + \alpha_4 \ln x_4 + \alpha_5 \ln x_5 + \alpha_6 \ln x_6 + \alpha_7 \ln x_7 + \alpha_8 \ln x_8 + \mu_i \text{......(4)}$$

Where X_i $(i = 1,2,3,.......8)$ stand for input costs of sunflower production X_i ;

Fertilizer	=	(χ_1)	1 if access, otherwise 0	Dummy
Plough	=	(χ_2)	1 if access, otherwise 0	Dummy
Pesticide	=	(χ_3)	1 if access, otherwise 0	Dummy
Land hired per acre	=	(χ_4)	number of acres	Continuous
Labour hired	=	(χ_5)	number of people	Continuous
Hoe	=	(χ_6)	1 if access, otherwise 0	Dummy
Improved seed (50kg)	=	(χ_7)	number bags	Continuous
Local seed (50kg)	=	(χ_8)	number bags	Continuous

Basic information on the costs of inputs and output were entered into Excel's spreadsheet and simulated using SPSS 23.0 software programs.

Analytical Tools of Sunflower Production

In this paper, the economic analysis of sunflower production was carried out by considering the costs of various inputs. The descriptive statistical and econometric methods were used to analyze the primary data collected from smallholder household heads using structured questionnaire. Descriptive methods such as measures of averages and percentages; and statistical methods such as one-way ANOVA tests and two-sample t-test was used to describe and analyze the costs of inputs per season of the sunflower production of the sample households. The probit regression analysis was used to answer the first research question. Multivariate linear regression analysis used to analyse the level of inputs costs of the farmers. SPSS software package was used to run the probit regression and multivariate linear regression models, and to analyze the quantitative data. Quantitative data were entered in Microsoft excel were all necessary arithmetic conducted for estimation of costs.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

The socio-economic characteristics assessment for the farmers is shown in Table 1. The gender distribution of the sunflower farmers revealed that majority 75.0% of the respondents in the study area were male, and 25.0% of the respondents were female. The result shows that sunflower productions are practised and dominated mainly by male farmers compared to female, this is agreed with Ruhangawebare (2010) observed that men are the ones involved in daily management of farming activities and thus they have more power upon making the decision on agricultural output. The age distribution of the respondents showed that the majority of the sunflower farmers in Mkalama district were in age group of 31 – 45 years which represented 34.2%. This implies that most of the sunflower farmers were in their economically active and productive ages. The study agrees with Anwasia (2015), whose findings revealed that 69% of sunflower farmers felt within the productive age range. The educational status of the respondents showed that a large proportion of respondents (80.8%) had acquired primary school level of education. This implies that a large proportion of households' heads were primary education leavers.

The results generally concurred with the findings of agricultural marketing information study which reported that a large number of people in the country that are involved in agricultural production and marketing are primary education leavers (URT, 2021). The farming experience of the respondents, majority showed that had experience of 60.0% for more than 10 years. This implies that sunflower farmers in the study areas had more experience and hence improving managerial capabilities for higher productivity is needed. Furthermore, the farmers with more years of experience likely had a better understanding and know how to appropriately manage the farming system of sunflower under tough climatic and economic conditions than less experienced farmers.

Table 1: Socio-economic Characteristics of the Farmer

Variable	Variable category	Frequency	Percentage
Sex			
	Male	90	75.0
	Female	30	25.0
Age of Respondent			
	18-30 yrs	24	20.0
	31-45 yrs	41	34.2
	46-60 yrs	39	32.5
	60+ yrs	16	13.3
Educational Level			
	Informal education	0	0.0
	Primary school	97	80.8
	Secondary school	23	19.2
Farming experience of respondent			
	Less than 1 Yr	0	0.0
	2-10 Yrs	48	40.0
	More than 10 Yrs	72	60.0

Source: Field data (2023)

Descriptive Statistical of Sunflower Production

In this study economic analysis of sunflower production was carried out by considering the costs of various inputs. The results obtained from the economic analysis are presented in Table 2, the average costs and sum of inputs per season of the sunflower production were considered. Accordingly, the total cost value per household in the season was calculated as input costs had a sum of Tshs. 264,585.53, the highest average and maximum cost per season is Tshs 121,052.63 for buying ploughs while pesticides had a minimum cost of Tshs 3,539.47 per season. There were different inputs which enabled households to purchase for farming such as fertilizers, ploughs, pesticides, land hired per acre, labour hired, hoes, improved seed (50kg) and local seeds. It is, therefore, logical to assess the costs affecting agricultural production and associated activities of off-farm participation of farm operation in the study areas. The results implying that the application of capital inputs in the sunflower production is considered a value-added goods and products.

Table 2: Inputs Cost in Sunflower Production

Costs for the capital inputs in TSHS per season in household at Mkalama district				
Type of input	Min	Max	Average	Sum
Fertilizer	5,000.00	240,000.00	27,236.84	2,070,000.00
Plough	45,000.00	450,000.00	121,052.63	9,200,000.00
Pesticide	10,000.00	50,000.00	3,539.47	269,000.00
Land hired per acre	30,000.00	280,000.00	14,605.26	1,110,000.00
Labour hired	6,000.00	210,000.00	38,822.37	2,950,000.00
Hoes	2,000.00	50,000.00	17,789.47	1,352,000.00
Improved seed(50kg)	6,000.00	300,000.00	16,500.00	1,254,000.00
Local seed (50kg)	5,000.00	80,000.00	25,046.05	1,903,500.00
TOTAL			**264,592.09**	**20,108,500.00**
COST PER HOUSEHOLD			**3,481.47**	**264,585.53**

Source: Field data (2023)

Income Earned

The findings in Table 3 indicates that the sunflower agricultural activity was performed in Mkalama District in season 2020/2021 and 2021/2022 had the mean income per annual of Tshs 857,763.16 and 794,440.00, respectively with mean income of household farmer. This indicates that sunflower production stands a better chance of improving community livelihoods at Mkalama district.

The study found that the total revenue of sunflower seed sold in Mkalama district was Tshs 65,190,000.00 per bag of 70 kg in production season. Mkalama district whereby the research was conducted in Tumuli, Iguguno, Nduguti and Nkalankala wards had the highest prices of sunflower since the refining industry is built at Singida town close to Mkalama as the sunflower market, processors, procurement of seeds at high prices through making arrangement with farmers and middlemen in advance.

Currently, many farmers have pressing machine in different centres in Mkalama district operated manually or by using electric power. The pressing machines in the sunflower chain act as market place for all forms of sunflower products. Privately owned processing machines are buying places for sunflower seeds and selling points from farmers, for sunflower oil pressed. In addition farmers and traders who pressed their seed into sunflower oil also sell their oil in these premises especially when there was a ready buyer. Seed cakes which are retained by the processor are sold to, traders dealing with livestock food tuff, livestock farms and individual households who keep livestock. Apart from the above-mentioned buyers, there are also some traders who bought sunflower seed cakes and sell them to industries that make animal feeds in other parts of the country and outside, particularly Dar es Salaam, Arusha, Kilimanjaro, Tanga and Kenya.

Table 3: *Revenue from Sunflower Value in Mkalama District*

District	Season	N	Min (Tshs)	Max (Tshs)	Average Revenue (Tshs)	Total Revenue (Tshs)
Mkalama District	2021	120	70,000.00	4,500,000.00	857,763.16	65,190,000.00
	2022	120	35,000.00	5,200,000.00	794,440.00	59,583,000.00

Source: Field data (2023)

Econometric Model Analysis of Input Costs

To analysis the input costs of sunflower production, Cobb-Douglas type of model was considered appropriate. The results of economic model estimation of sunflower production are show in Table 4. For the data used in this study presence of autocorrelation in the residuals from the regression analysis was tested using the Durbin–Watson statistical test (Hatirli et al., 2006; Rafiee et al.,2010). The test result revealed that Durbin–Watson value was as 1.75 for Eq. (4); indicating that there was no autocorrelation at the 5% significance level in the estimated model. The R^2 (coefficient of determination) was as 0.88 for this linear regression model.

This implies that all the explanatory variables included in the regression equation had contributed to the total production of sunflower by 88%.

The estimated regression coefficients for the model (Eq. (4) are presented in the standardized coefficients of Table 4. The results revealed that, fertilizers, ploughs, pesticides, land hired per acre, hoes and improved seed (50kg) were the most important inputs, significantly contributed to total production; while, the use of labour hired and local seed was indicating that coefficient for sunflower production had negative sign indicating that the relationship has negative influence. The value of coefficient of labour hired for cultivation was - 0.085. The coefficient was significant at one per cent. The coefficient indicates that by one per cent increase in labour hired of sunflower farm cultivation beyond recommended costs, the yield of sunflowers decreases by 0.085 Tshs per acre. The coefficient for local seed prices is negative and is - 0.127. It is significant at a one per cent level. This means that pest attack negatively affects the yield of sunflowers as significant portion of the yield per acre of the sunflower. The coefficient shows local seed cost decreases the yield of sunflowers by 0.127%. Therefore, yield loss due to poor seeds is one of the major problems in the production of sunflowers. Also, all of the statistically significant inputs showed positive relationships with output. Moreover, chemical fertilizer input cost had the highest coefficient on output (0.535). The second and third important input costs were pesticides and ploughs with the coefficient values of 0.502 and 0.302, respectively. Based on the obtained results, increasing 1% in the input costs from chemical fertilizer, pesticides and ploughs would have led to 0.535%, 0.502% and 0.302%, increases in sunflower seed total production, respectively. Mobtaker et al. (2010) developed an econometric model for inputs costs of production. the results imply that prices of fertilizers, ploughs, pesticides, land hired per acre, hoes and improved seed (50kg) were the important expenditures significantly contributed to the total production of sunflower; while the impacts of labour hired and local seeds costs were inconsistent with output.

Table 4: Econometric Model Estimation of Input Costs for Sunflower Production

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
$\ln Y_i = \alpha_0 + \alpha_1 \ln x_1 + \alpha_2 \ln x_2 + \alpha_3 \ln x_3 + \alpha_4 \ln x_4 + \alpha_5 \ln x_5 + \alpha_6 \ln x_6 + \alpha_7 \ln x_7 + \alpha_8 \ln x_8$						
1	(Constant)	.392	6.620		.059	.953
	Price per bag of fertilizer	-1.149	.000	.535	-.350	.727
	Price per plough	7.055	.000	.302	3.094	.003
	Price per pesticide	.001	.000	.502	5.112	.000
	Price per acre of land hired	.000	.000	.197	1.939	.057
	Price per labour hired	.000	.000	-.085	-.756	.452
	Price per hoe	.001	.001	.082	.815	.418
	Price per KG of improved seed	5.554	.000	.214	1.967	.053
	Price per KG of local seed	-9.712	.000	-.127	-1.043	.301
DurbinWatson		1.75				
R^2		0.88				

a. Dependent Variable: Number of bags of sunflower produced
b. Significant at P = 0.05

Source: Field data (2023)

Therefore, R-value (.88) for input costs for sunflower production suggested that there was a strong relationship influence number of bags of sunflower produced per season. It can also be observed that the coefficient of determination, the R-square (R^2) value is 0.88, which represents 88.0% of the true relationship. While 12.0% variation of performance of sunflower production as a result of input costs for sunflower production.

CONCLUSIONS AND POLICY IMPLICATIONS

In this paper, considering the results and findings and in relation to the objective of the study, that is to analyse the input costs of production by smallholder sunflower farmers. According to results of this study, there were significant developments on the yield from unit area within the period of production for improving the production by smallholder sunflower farmers in Mkalama District. The descriptive statistical analysis of costs input sunflower production in Mkalama district of Tanzania was analysed and an econometric model between input costs and the total production of sunflower was developed using the CobbDouglass production function. For this purpose, data were collected from 120 randomly selected smallholder farmers in the wards. The results showed that total cost value per household in season were calculated as input costs had sum of Tshs. 264,585.53 and the econometric analysis of chemical fertilizer input cost had the highest coefficient on output (0.535). The second and third important input costs were pesticides and ploughs with the coefficient values of 0.502 and 0.302, respectively. Moreover, the results of econometric model development revealed that, prices of fertilizers, ploughs, pesticides, land hired per acre, hoes and improved seed (50kg) were the important expenditure significantly contributed to total production of sunflower and showed the positive relationships with output. While, inputs showed negative sign indicates that additional units of these inputs cost are contributing negatively to production, i.e. less production with more input.

The positive sign in the model can be the association of weakened and low capacity widened to reach majority into sunflower production, it could play a very crucial role in bridging the gap of information asymmetry exist especially on access to loans and type loan offered by banks and cost of borrowing which could help farmers to improve technologies and production facilities. Government of Tanzania should enhance the productivity of the agricultural sector through the subsidies provision of the required inputs, which would minimize the total cost of production and speed up the productivity process. In response to the challenge of strengthening the capability of farmers' will bridge the gap of inputs costs (prices) information exist between farmers and buyers by facilitating the development of an integrated marketing system for sunflower sub-sector with other stakeholders.

Policy implications of this paper, 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. The policy makers should be creating awareness on the use of improved seed, results show most of the farmers are not aware of the importance of improved sunflower seeds 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 results show significantly address effect of input costs among the sunflower seed smallholder farmers. On this basis, policies that can stimulate and enhance agricultural commercialization such as NAP (2013) and Agricultural Sector Development Strategy policy (ASPS) (2015/16 – 2024/25) are provided a framework for implementation of the agricultural sustainability. The mentioned policies are aimed at operationalizing transformation of the agricultural sector into modern, commercial, highly productive, resilient, and competitive in the national and international market which leads to achieving poverty reduction.

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