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Evaluation of technical efficiency of edible oil production: The case of canola production in Kieni West Constituency, Kenya

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Globally, the vegetable oil demand is growing due to rising food consumption in emerging countries such as China and due to the high demand for biofuels. The current world vegetable production estimates stand at 187 million tons for the year 2016/2017. Of the estimated vegetable oil production, 70.3 million tons (37.6%) comes from palm and palm kernel, 55 million tons (30%) arise from soybean while the remaining 32.5% are supplied by canola, sunflower, peanut and cottonseed oils. Canola production is becoming an important crop in Kenya due to the high demand for edible oils, with the current production not meeting the current demand. This study evaluates canola production efficiency in Kieni West Constituency and its determinants using a stochastic production frontier approach and a sample of randomly selected 46 canola farmers. The output and input variables measured included the total amount of canola produced, land size under canola production, quantity of canola seeds, labour quantity engaged, and fertilizer quantity. The total input costs and income from canola farming were also evaluated. The mean technical efficiency score was 0.97 with 50% of the farms being efficient. The determinants of canola production included gender of the farmer, age of the farmer, years of schooling of the farmer and number of household members. Canola production was found profitable with the farmers earning an average income of Kshs. 96532.61 (965.32 US$) and a profit of Kshs. 76413.04 (764.13 US$) per season. Thus, the study recommends that there is need for policy makers to promote the crop as an alternative to other crops grown commonly in the area such as maize and coffee which have less return than canola. Measures should specifically be put in place to popularize the crop especially among the younger canola farmers who were found to be more efficient than the older farmers. Seed is also not readily available in Kenya, hence measures that would help farmers' access high quality canola seeds should be put in place.

Key words: Canola, technical efficiency, determinants, Kieni West Constituency.

INTRODUCTION

Globally, the vegetable oil demand is growing due to rising food consumption in emerging countries such as China and due to the high demand for biofuels. The current world vegetable production estimates stand at187 million tons for the year 2016/2017. Of the estimated vegetable oil production, 70.3 million tons (37.6%) comes from palm and palm kernel and 30% (55 million tons) arise from soybean while the remaining 32.5% are supplied by canola, sunflower, peanut and cottonseed oils (USDA, 2017). Canadian Oil which is often referred to as CANOLA originated from Canada which was the first country to produce canola for commercial purposes. The term canola is an abbreviation of two words, that is, "CAN" for Canada and "OLA" for oil and it originated from the Rapeseed Association of Canada (Wrigley et al., 2016). Canola has since been grown worldwide; ranks only second to soybeans in world oilseed crop production, constitute an important source of edible oil, source of biodiesel and are processed into feed for livestock (USDA, 2012). United States Development Agency estimates indicate that production of canola remains high with about 68 million tonnes of canola were produced in 2016/2017. Canola is a preferred source of oil due to its high oil content which is extracted from its seed with some varieties yielding between 35 and 50% of oil (Daun, 2011; Zum Felde et al., 2007). The seed remains the principal source of oil accounting for close to 65 to 80% of the oil produced while the remaining 20-35% is processed into canola meal. The canola meal is an important source of livestock and fish feed due to its high protein content of 35 to 50% (Tan et al., 2011; Enami, 2011).

In Kenya, canola farming is characterized by small-scale farming and it was first introduced in Nyeri County in the past two decades and later spread to other counties especially within the Rift Valley part of Kenya. Kenya's demand for oil crops such as sunflower, canola, soybean and linseed remains high with the country producing only 50% of its needs. Most of the edible oils produced in Kenya face a huge gap between production and consumption, a gap that is filled by imports from neighboring countries such as Uganda and Tanzania. For example, the demand for sunflower is about 10,000 metric tons while the country produces only 5,000 metric tons. Kenya has high potential to grow the oilseed crops since most of them grow well in poor soils, they are drought resistant and adapt well to diverse agro-ecological zones. The Government of Kenya's (GOK) general agricultural policy calls for food self-sufficiency by 2030, but so far that has been difficult to achieve in the vegetable-oil sector.

Examining the oilseed sector, some studies exist in the literature that tackles oilseed production. For example, Mruthyunjaya et al. (2005) investigated the Indian edible oilseed production and processing efficiency. The study evaluated the four major edible oilseeds of India namely groundnut, rapeseed and mustard, soybean and sunflower. The study used both primary and secondary data for the years 2002-03/2003-04 for 690, 240, 270 and 510 samples for groundnut, rapeseed and mustard, soybean, and sunflower farmers respectively. The study used the stochastic production frontier model to estimate the technical and allocative efficiencies of oilseed production and processing. The results indicated that oilseed production experienced inefficiency ranging from ¼ to 1/3 on average with greater technical, allocative and scale inefficiency being observed at the farm/processing unit level. Külekçi (2010) evaluated the technical efficiency and the socio-economic determinants of efficiency of sunflower farms in Erzurum, Turkey. The study used a stochastic production frontier analysis and a sample of 117 randomly selected sunflower farms. The results exhibited a mean technical efficiency for the sunflower farms of 64%. The inefficiency parameter estimates showed that older farmers, farmers with a higher level of education, the number of years of experience, farm size and higher access to information reduced inefficiency, while a larger family size and more credit usage resulted in increased inefficiency. Otitoju and Arene (2010) investigated the factors that constrained and determined the technical efficiency of 64 medium-sized scale soybean producers in Benue State of Nigeria. The study used mean and standard deviation and translog stochastic frontier. The results indicated that lack of adequate processing facilities (X = 3.42) and mechanical services (X = 3.41) were the major constraints of soybean production. The mean technical efficiency of the soybean farmers was found to be 73% on average. The determinants of technical efficiency of soybean production was gender, age and farming experience. Similarly, Taphee and Jongur (2014) investigated the productivity and efficiency of groundnut cultivation in Northern Taraba State of Nigeria. The study interviewed 150 randomly selected farmers in the study area. Estimates from the frontier production function found that the gamma (γ) and sigma-squared (δ2) variance was statistically significant at 1% significance level. The average technical efficiency score was 0.97, with the minimum and maximum technical efficiency being 0.63 and 0.99 respectively. The determinants of efficiency were seed, fertilizer, farm size and family labour.

Few studies exist in the literature focus on canola production. Dolatabadi and Ghahremanzadeh (2016) investigated the technical efficiency of canola farmers in Tabriz County, Iran and its determinants. The study used a sample of 157 canola farmers and a stochastic production frontier approach for analysis. The results of the study indicated an average technical efficiency of 0.8(80%) with a low of 0.25 (25%) and the highest of 0.95

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(95%). The differences in input production elasticities were found to emanate from water consumption and education level. The socio-economic determinants of efficiency of this study were found to be education level, training course number, and the cultivated area which were found to be positively associated with technical efficiency while the age of the farmer negatively affected technical efficiency. Unakitan and Lorcu (2011) evaluated the technical efficiency of canola production in Turkey. The study used a sample of 100 canola producers and the input-oriented data envelopment analysis technique for analysis. The mean technical efficiency of the canola farmers was 0.754 with the technical and scale efficiency being 0.812 and 0.927 respectively. The study found that on average, canola farmers obtained a yield of 310 kg/da with the 14 farmers operating on the frontier attaining an average yield of 382 kg/da. Similarly, Mousavi-Ayyal et al. (2011) used the data envelopment technique to evaluate the energy use pattern for canola production in Golestan province of Iran. The data used a sample of 130 canola farms that were randomly selected. The production inputs considered were human labour, diesel, machinery, fertilizers, agrochemicals, irrigation water, seeds and electrical energy with canola yield value being modelled as the output variable. The results indicated that the mean technical efficiency was 0.74 and 0.88 under constant and variable returns to scale respectively. The study found that majority of the canola farmers (85%) were inefficient with only 15% of farmers being fully technically efficient. The study found that on average 17,786 MJ ha^{-1} of energy was used in the canola production process. The results suggested that, on average, a potential of 9.5% (1696 MJ ha^{-1}) reduction in total energy input was likely if the canola farmers were to achieve full technical efficiency.

So far none of the studies that exist in the literature tackle canola production in Africa and more so in Kenya. To fill the above gap, the goal of this study was to investigate the technical efficiency of canola farming and its determinants in Kenya using Kieni West constituency as the case study. The specific objectives were three-fold. First, the study measured the technical efficiency of canola farming in the region. Second, the study investigated the determinants of canola production in the study area. Last, the study investigated the profitability of canola production in the study region. The findings of the study provide useful insights on canola production to farmers and policy-makers and spells out measures that will help boost canola production.

METHODOLOGY

Study area

This study was carried out in Kieni West Constituency which is one of the six constituencies of Nyeri County, Kenya. The constituency consists of Mwiyogo, Mugunda, Gatarakwa, Endashara and Mweiga locations with a population of about 68,861 residents. The main economic activity is agriculture. The area is home to several cottage industries including canola processing.

Sample size and procedure

Cross-sectional data obtained from a field survey of canola farmers was used in this study. Simple random sampling technique was used to get a sample of the canola farmers from the list provided by the County Ministry of Agriculture containing canola farmers in the county. A sample size of 50 canola farmers was randomly selected as an ideal representative of the entire population of canola farmers in Kieni West Constituency who are few in this area.

Data collection technique

Using a well-structured questionnaires and interview schedule, data was collected from the sample. The data collected was on canola output, inputs and socio-economic characteristics of the farmers. Data collection was done in January 2019. The data were coded, entered and edited in Microsoft Excel with four (4) respondents being dropped for being outliers. Frontier 4.1 version was used in data analysis.

Theoretical framework and analysis model

The technical efficiency of an individual firm/farm is defined simply as the ratio of the observed output of the corresponding frontier output given the level of inputs used by the firm/farm. Technical inefficiency is therefore defined as the ratio of the amount by which the level of production for the firm/farm is less to the frontier output. The popular approach to measure the technical efficiency component is the use of parametric methods such as stochastic frontier production function or non-parametric methods such as data envelopment analysis. The use of parametric methods has an advantage since it captures the stochastic measures. The Cobb Douglas production Frontier is one of the parametric ways of measuring efficiency. The Cobb Douglas function was used in this study to specify the stochastic production frontier, hence forming the basis for deriving the technical efficiency and its related efficiency measures. The stochastic Cobb Douglas production function was chosen because this functional form has been widely used in farm efficiency analyses for both developing and developed countries. The stochastic production frontier approach that was first independently proposed by Aigner et al. (1977) and Meeusen and Van den Broecl (1977) which is defined as follows was considered:

$$Y_i = f(x_i;\ \beta) + e_i \quad (1)$$

$$e_i = v_i - \mu_i$$

where i is the ith farm= 1, 2,……N. Y_i represents the amount of canola output, X_i is the vector of inputs used in canola production while β_i is the vector of parameters of production function to be estimated. The error-term $e_i = v_i - \mu_i$consists of two components; υ_i which represents the component beyond the control of the canola producers while μ_i represented the inefficiency components. υ_i is asymmetrical random-term which is assumed to be normally distributed [N(0, σ2, v)]. u_i is a firm-specific (non-negative) inefficiency effect assumed to follow a truncated (at zero) normal distribution, N (μ, σ^2 υ). υ_i and u_i are distributed independently of each other and of the inputs (X_i) used. Here, a canola farmer faces own stochastic production frontier f (X_i, β_i) exp (υ_i); a deterministic part f (X_i, β_i) common to all canola farmers and canola farmer specific part exp (υ_i) which contributes to the ith farm not reaching the frontier or maximum efficiency of production; its value ranges between zero and one and is thus associated with technical efficiency. The stochastic frontier production function used to analyze resource use efficiency in canola production is given by Equation:

$$y_i = \propto_0 + \sum_{k=1}^{4} \propto_k + ln x_{ki} + v_i - \mu_i \quad (2)$$

where, ln denotes natural logarithms, output y of canola production, x variables are the actual inputs used and $v_i - \mu_i$ is the error term. α's are parameters to be estimated from the production function.

The inefficiency model is estimated from the equation given below.

$$\mu_i = \delta_0 + \sum_{m=1}^{7} \delta_{m_i} z_i \quad (3)$$

where δ_0 and δ_m are parameters in the inefficiency model to be estimated together with the variance parameters which are expressed in terms of

$$\sigma^2 = \sigma_\mu^2 + \sigma_v^2$$

known as sigma squared and $\gamma = \sigma_\mu^2 / \sigma^2$ known as gamma which captures the total variation of observed output from its frontier output.

Equation 4 below shows a joint estimate equation of a stochastic frontier production function in Frontier 4.1 software:

$$\ln Y_i = \beta_0 + \beta_1 Land + \beta_2 Seed + \beta_3 Labour + \beta_4 Fertilizer + \delta_0 + \delta_1 Gender + \delta_2 Age + \delta_3 Years\ of\ schooling + \delta_4 Household\ members + \delta_5 Market\ distance + \delta_6 Farming\ experience + \delta_7 Training + v_i - u_i \quad (4)$$

where:

Y_i = Canola production in Kgs;

Land size= number of acres of land under canola
Seed = Quantity of canola seeds in Kgs;
Labor = labor quantity in number
Fertilizer = Quantity of fertilizer in Kgs
Gender = dummy for Male=1 Female = 0;
Age = Number of years of canola farmer
Household members = Number of household members
Market distance = Distance to canola market in Kilometres
Canola experience = Years of experience as canola farmer
Trainings = Number of trainings attended on canola farming
$v_i - u_i$= error terms

This study employed the single stage maximum likelihood estimation method to estimate the technical efficiency levels and the inefficiency determinants simultaneously using the frontier version 4.1 software.

RESULTS

Summary statistics of canola farmers

The summary statistics of the canola production variables and socio-economic determinants of the farmers are provided in Table 1. Examining the output and inputs, the output was measured by the amount of canola harvested. The average output of canola was 1930.65 kg with the minimum being 430 kg and the maximum was 4900 kg. On-farm inputs, majority of the canola farmers farmed on 1.69 acres of land with the minimum being 0.5 acres and the maximum being 4 acres which strongly suggests that canola farmers were mostly small scale producers. On labour, the number of people used in canola farming is on average three (3) people with a minimum of one (1) person and a maximum of 7 people providing labour for canola farming. The amount of fertilizer used for canola farming was on average 40.2 kg with a minimum of 10 kg and a maximum of 90 kg being applied.

Examining the socio-economic characteristics of the canola farmers, the results indicate that male canola farmers were 54.3% while the female was 45.7%. The age of the canola farmer ranged between 35 to 68 years with the mean age of the canola farmers being 43 years. The average number of years of schooling of canola farmers was 11 years with the minimum and maximum being 7 and 15 years respectively. The number of household members ranged from five to nine with the average number of household members is three (3). Most of the farmers in this region had a maximum of 6 years in canola farming with 65.2% of the farmers having an experience of 3 years in farming canola. Canola farming in Kenya and specifically in Kieni West Constituency was a recent venture in agriculture. The average number of trainings attended on canola production was found to be 2 which were mostly carried out by the canola output buyer.

Stochastic production frontier results

The maximum likelihood estimate results of the stochastic production frontier function with the inefficiency model is as shown in Table 2. The mean technical efficiency of the canola farmers was 97.9%. This implies that given the same level of inputs and technology, there is potential to increase canola output by a further 2.1% keeping all the other factors constant. The highest efficient score was 1.00 (100%), the lowest being 0.821 (82.1%) with half (50%) of the farms being fully efficient. Thus, it is observed that canola production in this region is highly efficient.

Examining the input variables of canola production, all the inputs mainly land, labour, seed and fertilizer were found to positively affect technical efficiency. Land size coefficient had a positive elasticity and was statistically significant at 1% significance level. This implies one unit

Table 1. Summary statistics of canola farmers.

Parameter	Variable	Mean	Min	Max	Std Dev
Y_i	Canola output (Kg)	1930.65	430	4900	1001.24
X_1	Land size (Ha)	1.685	0.5	4	0.796
X_2	Seeds (Kg)	7.207	3	17	3.509
X_3	Labour (No)	2.870	1	7	1.191
X_4	Fertilizer (Kg)	40.217	10	90	19.42
Socio-economic variables					
δ_1	Gender (Dummy: 1=Male; 0=Female)	0.543	0	1	0.498
δ_2	Age (Years)	43.609	35	68	6.489
δ_3	Years of schooling (Years)	11.435	7	15	1.814
δ_4	H/Members (No)	5.000	3	9	1.251
δ_5	Market distance (Km)	3.848	1	6	1.122
δ_6	Canola experience (Years)	3.000	1	6	1.216
δ_7	Trainings Attended (No)	2.109	0	6	1.323

Table 2. Maximum likelihood estimate for the parameters of the stochastic frontier production function and technical inefficiency effect model for canola production.

Parameter	Variable	Coefficient	Standard-error	t-ratio
β_0	Constant	5.719	0.203	28.172***
β_1	Land size (Ha)	0.411	0.123	3.338***
β_2	Seeds (Kg)	0.245	0.083	2.949**
β_3	Labor (No)	0.216	0.122	1.777*
β_4	Fertilizer (Kg)	0.247	0.057	4.330***
Inefficiency model				
δ_0	Constant	0.013	0.164	0.081
δ_1	Gender (1=Male; 0=Female)	0.038	0.019	2.055**
δ_2	Age (Years)	0.007	0.002	2.933**
δ_3	Years of schooling (Years)	-0.015	0.006	-2.613**
δ_4	Household Members (No)	-0.026	0.009	-2.875**
δ_5	Market distance (Km)	0.003	0.020	0.170
δ_6	Canola experience (Years)	-0.006	0.010	-0.599
δ_7	Trainings Attended (No)	-0.008	0.006	-1.333
Sigma-squared	$\sigma^2 = \sigma_\mu^2 + \sigma_v^2$	0.005	0.001	7.449**
Gamma	$\gamma = \sigma_\mu^2/\sigma^2$	0.000	0.000	0.017
	Log likelihood function			58.33***
Technical efficiency scores				
	Mean efficiency	0.979		
	Maximum efficiency	1.000		
	Minimum efficiency	0.821		

*, **, *** Significant at 10, 5 and 1%, respectively.

increase in the amount of land under canola production will lead to canola output increasing by 0.411 units keeping all the other factors constant. This finding is consistent with a number of studies that find land to be positively influencing production (Abate et al., 2018; Bhatt and Bhat, 2014; Danquah et al., 2019; Dessale, 2019;

Table 3. Canola yield gap due to technical inefficiency.

Parameter	Min	Max	Mean	Std. Dev
Actual canola yield kg/ha	430	4900	1930.65	1001.24
Technical efficiency estimates	0.821	1	0.979	0.035
Potential/Frontier yield kg/ha	523.610	4900	1965.92	1012.17
Yield gap/loss kg/ha	93.610	0	35.27	10.93

Laha, 2013). The elasticity of the coefficient of the amount of canola seeds used for planting was positive and statistically significant at 5% level of significance. This implies that one unit increase in the amount of canola seed used increased canola output by a further 0.245 units keeping all the other factors constant. Canola seeds being small in size implies it is possible that canola are applying seeds at below optimum levels, hence increasing canola seed would increase canola output. The coefficient of labour was positive and statistically significant at 10% significance level meaning that labour responded positively with canola output. This implies that one unit increase in labor increased canola output by 0.216 units keeping all the other factors constant. This finding is consistent with that of Dessale (2019), who found wheat output to be positively associated with labor in Jamma district of Ethiopia. Labor for canola is critical especially during harvesting and packaging since ploughing is normally done by machinery. The elasticity of the coefficient of amount of fertilizer was positive and significant at 1% significance level implying that one unit increase in fertilizer will result to a change increase in canola output by 0.247 units keeping all other factors constant. This relation is very strong which suggests that increasing the fertilizer used, will have a huge impact on the yield of canola (Dessale, 2019; Wudineh and Enderias, 2016).

Examining the inefficiency model, the socio-economic determinants of canola production were found to be gender of the canola farmer, age of the canola farmer, years of schooling of the canola farmer and number of household members of the canola farmer. The coefficient of gender was positive and statistically significant at 5% significance level which implies that the male canola farmers were less efficient than the female canola farmers. This finding coincides with the findings of Yami et al., 2013 who found male wheat farmers to be less efficient than their female counterparts in selected waterlogged areas of Ethiopia. The finding however contradicts with some studies that exist in the literature which conclude that male farmers are more efficient than the female canola farmers (Ironkwe et al., 2014; Oladeebo, 2012). However, it may be assumed that given women play a critical role in canola farming by providing close to half of the total labour used in canola arming, then this finding holds. The age of the canola farmer was positive and statistically significant at 5% significance level which implies that the older farmers were less efficient than the younger farmers. The finding coincides with those of Mugera and Featherstone (2008) who found that age increased inefficiency among a sample of 126 Philippines hog keepers. The coefficient of years of schooling was negative and statistically significant at 5% significance level which implies that schooling reduced inefficiency. This can be interpreted that years in school helped the canola farmers to gain knowledge on efficient and accurate use of farm resources such as land, seed, labour and fertilizer. The number of household members was negative and statistically significant at 5% level of significance which implies that as the number of household members increased, the efficiency of canola farming increased holding all other factors constant. An increase in household members helps to reduce inefficiency by availing required labor at a low cost. This is because the family members are able to take care of farming activities without necessarily incurring additional costs. The coefficients of years of experience in canola farming and number of trainings had a negative coefficient although the variables were not significant. The coefficient of the distance to the market for canola inputs and outputs was positively associated with inefficiency although the variable was insignificant.

Canola yield gap due to technical inefficiency

Table 3 provides the canola yield gap due to technical inefficiency. The results indicate that the mean technical efficiency was 0.978 with the actual canola output being 1930.65 kg/ha while the potential output was 1965.92 kg/ha. This indicates that there was a yield gap or loss of 35.26 kg/ha of canola which was caused by technical inefficiency.

Profitability of canola farming

Canola profitability was found to differ from one farmer to another. Canola is a plant that requires less attention from the time of planting to harvesting which has enabled

Table 4. Profitability of canola farming.

Variable (Kshs)	Average	Min	Max	Std Dev
Total seed costs	2882.61	1200.00	6800.00	1403.46
Total fertilizer costs	2010.87	500.00	4500.00	970.99
Labour costs	13282.61	5000.00	32000.00	6422.32
Other costs	1943.48	300.00	5800.00	1139.73
Total costs	20119.57	7900.00	45200.00	8603.55
Income	96532.61	21500.00	245000.00	50062.15
Profit	76413.04	11400.00	211000.00	45264.64

its farming to have a lower cost-revenue ratio. The average cost of canola production was 20119.57 (201.2 US$) while the total income was Kshs 96532.61 (965.32 US$). The profit from canola production was on average Kshs 76413.04 (764.13 US$). The cost/revenue ratio was found to be 0.208 which implies that canola production was a profitable venture in Kenya. The bulk of the cost emanates from labour which is required mainly during land preparation and harvesting. Canola production is profitable due to three main reasons. First, the canola produce is sold at stable prices, currently at 50 Kshs (0.5 US$) per kg regardless of the quality of seeds as compared to other crops such as maize or beans whose prices frequently fluctuate. Second, canola requires low investment costs and maintenance as confirmed by 89% (41) of the respondents who stated that was their main reason for farming canola (Table 4). Canola farming is a highly mechanized venture, and less labour is required. It's planted by drill method using planters since it has very tiny seeds which would take so long for human labour to plant one acre. Harvesting is also done by the use of combined harvesters which minimizes on wastage during harvesting. In canola land preparation, tractors are used for planting and harrowers for levelling and ensuring that the soil is fine enough. All these machines charge a fixed amount of fee usually based on the size of land and the area a farmer comes from. Third, canola farming also requires less labour and less monitoring between planting to harvesting time as confirmed by 34 of the respondents (74%) who said that their main work was to prepare the land and plant then wait for harvesting and then sell their produce.

Challenges faced by canola farmers

Despite canola farming being profitable, canola farmers face serious challenges. The first is bird infestation which reduces the level of yields hence lowering the income of the farmers'. Second, whiteflies being the only insect that attack this plant, it is common especially before rains falls. The farming system (broadcast) poses a challenge of spraying with the respective insecticide. This is represented by 93% of the respondents. It is a challenge to acquire loans to facilitate canola farming from various financial institutions. Some farmers were unable to acquire loans to invest in canola which was 29 (63%) of the total respondents. There is no government intervention, for example, supply of subsidized fertilizers, regulation of buyers and standards of output such as quality, and specific bodies to look into canola farming like in other farming activities such as coffee and tea. This was raised by 13 of the respondents (28%) who felt there was a need for government intervention.

CONCLUSION AND RECOMMENDATIONS

The study found that canola farming in the study area was efficient although the number of farmers growing the crop still remain low. Canola farming was also found to be a profitable venture since the investment costs of farming canola were quite low with less work required to be done after planting till the harvesting season. Furthermore, canola can do well in poor soils, is more resistant to a large number of weeds and field pests which further lowers the cost of investment in terms of labour and agrochemicals. Thus, the study recommends that there is need for policy makers to promote the crop as an alternative to other crops grown commonly in the area such as maize and coffee which have less return than canola. Measures should specifically be put in place to popularize the crop especially among the younger canola farmers who were found to be more efficient than the older farmers. Seed is also not readily available in Kenya, hence measures that would help farmers' access high quality canola seeds should be put in place.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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