International Journal of Research in Education Humanities and Commerce

Volume 05, Issue 03 "May - June 2024"

ISSN 2583-0333

SOCIO-ECONOMIC FACTORS INFLUENCING FOOD CROPS DIVERSIFICATION AMONG SMALLHOLDER SUGARCANE FARMERS IN MUMIAS EAST SUB-COUNTY, KENYA

[1]*MADAPHINE MALALA, [2]ELIJAH K. NG'ENO & [3]NAOMI RIOBA

[1]Department of Agricultural Biosystems, Economics and Horticulture, University of Kabianga

[2]Department of Applied Economics, University of Eldoret, Kenya

[3]Department of Agricultural Biosystems and Economics, University of Kabianga

*University of Kabianga, P.O Box 2030-20200, Kericho, Kenya

Corresponding Author: 1* Madaphine Malala

https://doi.org/10.37602/IJREHC.2024.5307

ABSTRACT

Crop diversification is a predominantly important coping mechanism for agriculture's income, production and marketing risks. It is a key strategy for mitigating food insecurity among small-scale farmers in Kenya. It enables them to spread production and income risk, reducing livelihood vulnerability to weather or market shocks. Crop diversification among sugarcane farmers has been on the rise over time due to risks associated with sugarcane production and marketing and declining sugarcane productivity. Consequently, this has led to impaired sugarcane farmer households' goals of improving food, income and nutrition security. Therefore, the objectives of the study was to determine the socio-economic factors affecting food crop diversification among smallholder sugarcane farmers in Mumias East Sub County. The study was guided by Random Utility Maximization (RUM) theory and descriptive and cross-sectional research designs were adopted. Multistage sampling whereby purposive, stratified and simple random sampling techniques were employed in the study to select 155 farmers from a target population of 11,885 smallholder sugarcane farmer households. A questionnaire was used to collect data and data was analysed multivariate regression model with the help of STATA version 16 software. The analysed data was presented in the form of tables, bar charts and graphs. Descriptive results revealed that the mean age and farming experience of the farmers was 55.72 and 22.76 years respectively and owned on average 4.33 hectares of land. Multivariate linear regression results indicated that age, household income level, education level, land size and household size were all statistically significant and had an influence on food crop diversification among smallholder sugarcane farmers. Binary logistic regression results indicated that a unit increase in age, level of education, land size, membership to a farmers' group and market price positively influenced farmer participation in diversified cropping system by 117%, 81.7%, 745.5%, 228.2% and 117.3% respectively. Therefore, from the results of this study, relevant stakeholders, county and national governments should come up with an agricultural policy that supports the shift from non-diversification to crop diversification through the development of guaranteed access and subsidies to farm inputs resources that will help boost farm production among smallholder sugarcane farmer households. This will help to solve the issues of food insecurity and also help farmers to realize high-profit margins from their farm output.

Keywords: Socioeconomic, Smallholder farmer, Food Crop Diversification.

1.0 INTRODUCTION

Crop diversification is increasing across the world in favour of more competitive and high-value crops. It has enabled farmers to spread production and income risk; and therefore, reduced livelihood vulnerability to weather or market shocks (FAO, 2018; Mango et al., 2018). Nguyen (2014) defines crop diversification as the strategy of shifting from less profitable crops, changing of variety and cropping system, increasing exports and competitiveness in both domestic and international markets. Clements et al., (2011) and Feliciano (2019) relates crop diversification to the replacement of low-value commodities by high-value commodities, usually fruits and vegetables for the export market.

In Africa, 20.4 percent of the continent's population that is approximately 257 million people are undernourished, up from 19.7 in 2016 that is approximately 241 million people. In sub–Saharan Africa, there are 237 million undernourished in 2017, up from 222 million in 2016 (FAO, 2018). The worsening situation in Africa is due to difficult global in economic conditions and, in many countries, conflict and climate-related disasters, sometimes in combination. Economic growth slowed in 2016 due to weak commodity prices, in particular for oil and minerals. Food insecurity has worsened in countries affected by conflict, often exacerbated by drought or floods, and in Southern and Eastern Africa many countries have been adversely affected by prolonged drought. Notably, several countries have achieved sustained progress in reducing food insecurity in the face of challenging circumstances.

In recognizing that agriculture is key to her development towards global goals of ending hunger and poverty, and reducing food insecurity in the face of challenging circumstances, Africa developed a comprehensive policy framework for transformation of the sector; Agenda 2063. Agenda 2063 is a strategic framework for the socio-economic transformation of the continent over the next 50 years. It builds on, and seeks to accelerate the implementation of past and existing continental initiatives for growth and sustainable development (African Union Commission, 2015). Reforms in the sector are advocated for in the framework, important ones being a growth of 6% annually in Agricultural GDP and at least 10% allocation from the public expenditure to agriculture sector. Africa acknowledges that enhanced performance of the agricultural sector is strategic to economic development and poverty reduction by directly contributing to job creation, increasing opportunities for women and youth, enhancing food and nutrition security and resilience (UN-OSAA 2015). In addition, he acknowledged agriculture as a significant driver of economic growth whose power is also accredited by economists and political leaders since it is the sector has enormous potential for reduction poverty and inequality (NEPAD, 2003).

Farmers in Africa have long adapted to climatic and other risks by diversifying their farming activities (Ebi et al., 2011), which may increase their ability to cope with change. This can happen by spreading the risk among different crop and livestock types (Antwi-Agyei, Stringer, & Dougill, 2014), income diversification (Block and Webb, 2001) or by increasing the range of agricultural products for markets or subsistence (McCord, Cox, Schmitt-Harsh, & Evans, 2015). Selling own products is also very important for overall food security outcomes for farmers in sub-Saharan Africa. Eighty-three percent of farm households in sub-Saharan Africa sell part of their crop produce, sometimes even before they produce enough to be self-sufficient (Frelat et al., 2016). Also, many African farmers own livestock as an insurance during periods

of drought (Kazianga & Udry, 2006). One way of measuring agricultural diversity is to assess the crop and farming diversity, that is, the number of crops grown and the number of overall farming activities including livestock husbandry (Frelat et al., 2016).

In East Africa, many communities depend largely on agricultural products for their livelihoods (Altieri, 1999). The majority of farmers here are smallholders owning less than 5 acres (2 hectares) of land (which is likely to be further reduced due to current land fragmentation and unregulated urban center expansion) and practicing "low-resource" agriculture (Altieri, Funes-Monzote, & Petersen, 2012). These farmers are more vulnerable to the overall effects of climate change since they have limited resources to invest in expensive coping strategies (Lin, 2011). Crop diversification is seen as one of the most ecologically feasible, cost-effective, and rational ways of reducing uncertainties in agriculture especially among small-scale farmers. This strategy is based on cultivating more than one variety of crops belonging to the same or different species in a given area. Crop diversification brings about higher spatial and temporal biodiversity on the farm and increases resilience, for example the ability of an agro-ecosystem to return to its original productive state after being perturbed (Holling, 1973).

The East Africa region has been ravaged by perennial food insecurity. The governments in the region, the donor community, regional economic blocks and the Farmer Organizations (FOs) have been putting a lot of effort and resources to address this issue. One of the main objectives of the East Africa Community (EAC) as set out in the treaty is the achievement of food security and rational agricultural production (EAC food policy, 2005). In order to meet the global food human needs by 2050, Roberto, et al (2013) note that the world's agricultural system must simultaneously produce far more food for a growing population, provide economic opportunities for the rural poor who depend on agriculture for their livelihoods. The only way to solve the above is through the food crop diversification.

The government of Kenya has emphasized on crop diversification and value addition in agriculture. Key areas of policy concern and strategy highlighted in Kenya Vision 2030 include catalysing enhanced agricultural productivity, food security and income growth through crop diversification. In line with government policy, Kakamega County has developed a strategic plan on promoting diversification of crop and livestock enterprise (County Integrated Development Plan 2017-2022, (2018). Agriculture is one of the key sectors targeted to bring out development in the county as documented in the County Integrated Development Plan 2017-2022 (2018). Poverty and food insecurity however, still remains a foremost challenge in the County (County Government of Kakamega, 2017). Agriculture can alleviate poverty by enhancing food security, creating employment and generating income to the County's population. According to Waswa, et al., (2012), results of their findings from Lurambi, Koyonzo and Chemelil areas in western Kenya show that on average, farmers retained only 31, 32 and 34% respectively of the gross income from contract sugarcane farming. Although net income was influenced differently by conventional input costs, yield appears to be a key determinant of gross income across the sites. Net income was significantly depressed by company-driven deductions for which farmers had no control. Such skewed sharing of income, where the sugar companies retain at least 60% of the gross income raises sustainability concerns that need to be addressed through a participatory approach involving all key stakeholders.

The smallholder sugarcane farmers in the study area continue to suffer largely owing to production and marketing risks associated with sugarcane production. Declining sugarcane production has impaired smallholder sugarcane farmer's goals of improving food, income and nutrition security especially in the study area. Cropping system diversification is one of the potential strategies in sustaining agricultural productivity, and copping with marketing risks. It is also a transitional step from subsistence to commercial agriculture (Rehima et al., 2013). It reduces uncertainties in agricultural productivity and income among smallholder farmers (Joshi et al., 2007; Feliciano, 2019), production stability and marketing (Makate et al., 2016). Empirical findings reveal that those engaged in diversified cropping systems are more likely to experience increased agricultural productivity (FAO, 2018), yield stability, nutrition diversity and food security (Mango et al., 2018). Mehta (2005) and Behera et al., (2007) observed that crop diversification leads to comparatively high net return from crops, optimization of resource use and high land utilization efficiency. Li et al., (2009) observed that farmers with diversified cropping realized increased yields between 33.2% and 84.7% in Yunnan province of China.

The adoption of Food Crop Diversification in Kakamega began in 2015. In the study area, horticultural farming as well as commercial farming are carried out (such as Maize, beans, potatoes, cabbages, passion fruits, millet, etc). According to a study by Kibet et al., (2011) on the role of extraneous incentives and drivers in farm enterprise diversification in Uasin Gishu county found out that when the profitability of passion fruit and maize is compared, passion fruit earns Ksh. 195,167 per acre as compared to Ksh. 27,328 per acre that of maize. Millet and sorghum farming is another economic activity that is considered to be the most important enterprise in the agricultural sector in Mumias East Sub-County. In Mumias East Sub-County Millet and Sorghum farming is this below the level of production. However, these farmers are faced with a myriad of risks including price fluctuation which raises the cost of production and hence leading to low profits.

Mumias East Sub-County is a major Sugarcane producing sub-county in Kakamega County, Kenya. It produces sugarcane of the total 192, 532 metric tons in the country (CIDP, 2018). In 2015, Mumias East Sub-County produced 632,000 metric tons of sugarcane (Ministry of Agriculture Livestock and Fishery (MoALF), 2020). However, the smallholder sugarcane farmers continue to suffer largely owing to production and marketing risks. Although sugarcane production is the most important in terms of economic contribution and livelihood generation, its productivity in the sub-county has largely declined from 632,000 in 2015 to 193,532 metric tons in 2020 (MoALF, 2020). These problems lead to the perennial sugarcane decline in the sub-country and consequently, farmers are forced to diversify into other more profitable cropping systems. As the sub-country struggles with persistent sugarcane problems of poor returns, unpredictable prices, post-harvest losses, among other issues, farmers are moving away from the production of this crop and diversifying into other agricultural ventures.

1.1 The Problem Statement

In Mumias East Sub-County, about 11,885 farmers practice sugarcane farming whereby 191.2 thousand-hectare of land is put into sugarcane farming than the rest of crops (Kenya National Bureau of Statistics (KNBS), 2019). Sugarcane farming in the Sub-County is dominated by smallholders who account for about 75 per cent. The Sub-County hoped that sugarcane farming would raise farmers' incomes and somehow help reduce poverty, but the farmers are still

among the poorest and are also food insecure in Kenya (MoALF, 2018). Although sugarcane production is the most important in terms of economic contribution and livelihood generation, its productivity in the sub-county has largely declined from 632,000 in 2015 to 193,532 metric tons in 2020 (MoALF, 2020). Declining sugarcane productivity has impaired the household goals of improving food, income and nutrition security especially in the study area. Such impediments call for immediate measures to ameliorate the situation through diversification of the cropping system as a strategy to sustaining agricultural productivity and copping with marketing risks among smallholder sugarcane farmers in the study area. Food crop diversification in the study area is gaining ground because of these sugarcane problems. Smallholder sugarcane farmers in the study area have to diversify from sugarcane farming to other crops in order to alleviate household incomes and for food insecurity. It is on the basis of this that this study attempted to fill this research gap by analysing some selected economic determinants that affect participation in food crop diversification among smallholder sugarcane farmers in Mumias East Sub-County, Kakamega County, Kenya.

2.0 LITERATURE REVIEW

Determinants of people's decision on adoption of new technologies or practices like diversification have been studied by different scholars over time. The classic theory of diffusion of innovations considers the impact of social norms and values, individual characteristics, traits of the concerned technology as well as other external factors such as infrastructure and the policy environment. Ellis, (2000) also indicates that the decision to adopt an innovation is determined by a risk minimizing strategy as they are quite vulnerable to a risk arising out of natural and anthropogenic uncertainties. Due to such uncertainties, farmers in developing countries are vulnerable to various risks that the severity leads to the eventual loss of assets and income.

A number of scholars have carried out studies on crop diversification in many places such as India, China, Pakistan and many African countries like Nigeria, Malawi, Zambia, Ethiopia, Zimbabwe and Kenya among others. Most of these studies identified the role of socioeconomic, demographic and institutional factors in crops diversification. For example, Kumar, Kumar & Sharma, (2012), sought to establish the position of crop diversification and identify its determinants in Eastern India. The kind of determinants they evaluated were age and education of the household leader, agriculture as the main occupation, household size, credit access, farm assets, and operated area, use of technology components, infrastructure and caste. Three stage and stratified sampling was used in this study where 2885 farmers were studied. They used Herfindahl Index to establish the extent to which farmers have diversified their crop production while Tobit regression model was applied in identifying elements of diversification towards vegetable cultivation in the study area. They established that the crop sector in the eastern region was moderately diversified. The study also showed that education, size of the household, value of productive assets and the primary household head's occupation had very significant influence on diversification. Age and gender however did not have a substantial influence on farmers' decision to diversify in favour of vegetables. While seeking to identify factors which guide household decision to diversification of crop production in Ukhonul District, Manipur, Aheibam, Singh, Feroze & Singh, (2017) adopted Heckman's two-stage model to evaluate the determinants of household diversification and its intensity. The results showed that education of the head of the household had a positive association with the level of crop diversification

which is similar to Kumar et al, (2012), Mithiya, Mandal & Datta, (2018) and Shabzah et al, (2017). Other factors with positive influence are access to fertilizer, access to plough, availability of irrigation, exposure to farming information regularly, distance to the nearest market and experience of the farmer.

Mithiya et al., (2018), while seeking to establish trends of crop production and identify factors of their diversification by smallholders in West Bengal, used secondary data from different districts. Using Simpson Index (SI) which was also used by Aheibam, (2017), the results showed that every district in Western region of Bengal and the whole state demonstrated higher crop diversification levels during new millennium in relation the nineties. The factors analysed include level of literacy, urban population percentage of the district, comparative earnings from high value crops compared to cereals, regional market density, smallholders' percentage and area under high yielding food grain varieties. Education, land size, distance from the market as well as income from other sources had a significant influence. In addition, Huang', Jiang', Wang' & Hou, (2014) also investigated how crop diversification is used as a coping mechanism against extreme weather occurrences in China. They used multiple stage sampling to obtain 3330 smallholder farmers. It was established that age had an undesirable effect on diversification where aged farmers did not implement crop diversification compared to young farmers. Young farmers had less experience hence more likely to adopt crop diversification as a means to avoid production risks. Young people were also more willing to try new things. This is in line with Aheibam et al, (2017), Dube, Numbwa & Guveya, (2016) and Ojo et al, (2014). Huang' however noted that farmers with lower education level are more vulnerable and are likely to use crop diversification in order to mitigate the threats of extreme weather event. In addition, Huang' found out that farmers with larger farming fields are more willing to diversify their crop types. A household with more access to land was expected to grow more crops since more arable land is available, better enabling them to plat more crops.

While seeking to identify determinants of crop diversification in mixed cropping zone of Punjab in Pakistan, Shahbaz, Boz & Ul Haz, (2017) used multiple stage sampling to select 100 growers for the study. They applied Herfindahl index to calculate the farmer's level of diversification which has been used by many other scholars such as Kumar et al, (2012), Ojo et al, (2014) and Kanyua, Ithinji, Maluvi & Gido, (2013). The expected elements of crop diversification were analysed using Tobit model which was also used by Kumar et al, (2012), Ojo et al, (2014) and Kanyua et al, (2013). It was established that level of education and farm size positively and significantly influence how farmers vary crop production. A more educated farmer would understand the market condition better thus resolves impact of the uncertain events in an appropriate manner. Similarly, ownership of farm machinery enhanced the levels of diversification in crop cultivation. The study nevertheless indicates an undesirable relationship between age and diversification in crop production. This is possibly because younger farmers have the ability to innovate, take risk and are physically strong in farming activities unlike old people. The study also revealed that self - owned operated farms were less diversified in crop production compared to other tenures like rented or shareholder.

Sichoongwe (2014), also carried out a study to identify the determinants and establish the extent of crop diversification in smallholder farming in the Southern Province of Zambia. He analysed gender, age, education level of the head of the household including size of household, land holding size, number of fields or land plots, hired labour, tillage time, plough tillage,

fertilizer quantity and distance from the market for 1,555 farmers. Sichoongwe established that crop diversification in smallholder farming was relatively low. In his study, size of land holding, quantity of fertilizer, distance to the commodity market, time of tillage including tillage were established to significantly impact on crop diversification.

A study was also undertaken by Dude, et al, (2016) to identify factors influencing smallholder crop diversification among 479 smallholder farming households in Zambian provinces of Manicaland and Masvingo. They used Herfindahl Index to assess diversification level and Tobit regression model to evaluate factors associated with it. This study revealed that male headed households were marginally more diversified in comparison to households headed by female farmers. Tobit regression model also revealed that education, number of livestock units, access to irrigation, membership of a farmers' group, access to markets, farming experience, farms of flat terrain, farmer to farmer extension, agro-ecological zone and household income were the weightiest factors in crop diversification.

Ojo et al, (2013) in addition examined the factors that influence diversification of small-scale food crop farming in North Central Nigeria. Multiple stage sampling was used to obtain a sample of 300 respondents. Using Herfindahl Index, their study revealed that North central Nigrian smallholders were less diversified. The study also showed that experience, extension contacts as well as land size positively influenced diversification. Age and income from other sources however had no influence. In another study investigating profitability of food crop diversity and its determinants in south-eastern part of Nigeria, Rahman and Chima, (2015) used Multivariate Tobit approach. Their analysis revealed that farm size is the foremost determinant of diversity compared to profitability. Other factors that vary in their influence include; proximity to the market and extension office, extension contact, training, agricultural credit and subsistence. The study covered a total of 450 households.

A significant positive association between crop diversification and farm income was found by Makate et al., (2016) in Zimbabwe, by Bravo-Ureta et al., (2006) in El Salvador and Honduras, and by Perz (2004) in the Brazilian Amazon. Bravo-Ureta et al., (2006) estimated a 21% average increase in farm income of the entire sample in the analysis, whereas Perz (2004) found a very strong positive relationship between diversification and income. Makate et al., (2016) observed that increased production from diversified cropping systems (crop rotations, intercropping) resulted in higher income for farmers.

Mesfin et al, (2011) studied the pattern and trend of crop diversification identifying its determinants among 167 small scale farming households in the Eastern region of Ethiopia. Tobit regression model was used to analyse covariates of crop diversification and its intensity. Among the determinants under scrutiny were; farm size, age of the household head, household size, distance to the market, number of extension contacts, farm machinery (tractor and water pump), off/non-farm income, number of farm plots, access to market information, irrigation intensity and sex of the household. They used modified Entropy Index to measure crop diversification. Mesfin, established that farmers with a greater number of plots are more likely to diversify by growing different crops on each plot of land which is similar to the findings of Mussema et al, (2015) and Ogutu and Obare, (2015). It was also established that with access to market information, irrigation and machinery, farmers were likely to diversify. The findings however established that there was a negative relationship between extension contacts and

diversification since extension was advocating for productivity and profitability which favored specialization at micro level and overlook the role of diversification in risk minimization.

In another study seeking to identify determinants of diversification of crop production in Oromia region, Ethiopia, Mussema et al, (2015) used Margalef's Index (MI) to analyse determinants of crop diversification. The results suggested that asset ownership, soil quality, agricultural extension and level of infrastructure development are significant drivers of crop diversification. Three-stage sampling model was used to arrive at 382 households. The results revealed that land size and number of plots affected crop diversification decision positively and significantly. In the same way, Extension services, market information and access to all-weather roads had positive and significant impact. Their findings on access to market were in line with those of Kumar et al, (2012), Aheibam et al, (2017), Mithiya et al, (2018), Sichoongwe et al, (2014), Dube et al, (2016) and Kanyua et al, (2013).

Furthermore, Kanyua et al, (2013), investigated factors influencing diversification and the intensification of horticultural production among smallholder tea farmers in Gatanga District, Kenya. They analysed participation in diversified cash crop farming, occupation, age and education level of the household head, tools, credit, distance from the market, contract among others. Heckman two-step model was used to establish the determinants and it was found out that farm size and value of farm tools to be the most significant in crop diversification. Heckman two stage model was also used by Aheibam et al, (2017). The study also established that the amount of land owned by a farmer has a very significant effect on the degree of diversification; with an increase in the farm size leading to a rise in the crop diversification index. From their study, it was established that the amount of free land owned by the farmer had a very significant effect on diversification to horticulture production. Other farmers with big lands however had little crop diversity since more land had been allocated to tea. Gender was a very significant factor in diversification into horticulture by tea farmers; male headed households were more diversified than female headed households. This was similar with the findings of Dube et al, (2016) that male headed households were more diversified. Experience of the household head had a significant effect on degree of diversification possibly due to the learning curve effects.

Finally, Ogutu and Obare, (2015) compared crop choice and adoption of sustainable agricultural intensification practices in Eastern and Western Kenya among 532 randomly sampled smallholder households. They used stochastic production function model which established that gender played an important role in adoption of sustainable agricultural intensification (SAI) innovation and cropping choices. Female decision makers were seen to practice more intercropping in their plots. Land size and number of plots also had a positive influence. Education however did not have any influence on SAI practice and crop choice while income from other sources had a negative influence.

None of the above studies however focused on diversification within the food crops sub-sector among smallholder farmers. This study thus backs the knowledge gap concerning this aspect of diversification by the smallholder households.

3.0 RESEARCH METHODOLOGY

This study adopted descriptive and cross-sectional survey designs. These were used to target smallholder sugarcane farmers for the purpose of analysing economic determinants affecting participation in food crop diversification in Mumias East Sub-County. The designs are more appropriate because they can give provisions for the comparison research findings. Furthermore, they are exploratory and allows the researcher to collect, sum up, evaluate, analyse, present and interpret the data in a simpler and more understandable manner (Kothari, 2008).

The study targeted 11,885 small-holder sugarcane farmers in Mumias East Sub County, Kenya Nassiuma (2003) sample size formula was used to calculate the desired sample size and a sample of 154 respondents was used for data analysis. According to Brenda (2009), the target population for a survey is the entire set of units for which the survey data are to be used to make inferences. Thus, the target population defines those units for which the findings of the survey are meant to generalize. According to the IEBC (2017) register, Mumias East Sub-County has three wards namely; Lusheya-Lubinu, Malaha-Isongo-Makunga and Wanga. This study employed multistage sampling procedure whereby purposive, stratified and simple random sampling techniques were used. In the first stage Purposive sampling was used to select the study area since the study area lead in terms of sugarcane production in Kakamega County. Thereafter, stratified random sampling procedure was used to obtain the sample of small-scale sugarcane farmers in the whole Sub County. The area under study has three administrative wards, which formed the three strata for this study. In each of the ward, a proportionate size sampling procedure was used to pick respondents for the study. Thereafter, a list of smallholder sugarcane farmer households from each ward was obtained from the sub-county Agricultural Office. The names of the farmers in the lists was first serially numbered and then randomly ordered and picked using a simple random sampling technique. This technique gave each farmer an equal opportunity of being selected and therefore, this increased the chances of obtaining an appropriate and representative sample size. This was advantageous in the sense that the sample frame was already available in the form of a list (Kothari, 2004).

Descriptive statistics was presented using frequencies and percentages. A multivariate linear regression model was used to analyze the socio-economic factors on food crop diversification among small scale sugarcane farmer in Mumias East Sub-County, Kenya and the significance of relationship between the variables in respect to the dependent variable. The results was analyzed and then presented in tables.

To assess the effects of socio-economic factors on food crop diversification among small scale sugarcane farmer in Mumias East Sub-County, Kenya, a multivariate linear regression model, which describes the relationship between the dependent variable and the independent variables, was used. This model presumes the existence of a linear relationship between the dependent variable, independent variables, and latent variable. It can be modelled as shown in Equation 3.3 and as adopted from Brown (2009).

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + e \quad \text{..... (3.3)}$$

Where Y = food crop diversification,

X1 = Age,

X2 = Gender
X3 = Income level,
X4 = Education level,
X5 = Years of experience,
X6 = Household size,
X7 = Land size,
X8 = Income level,
X9 = Occupation of farmer,

b0 to b9 are the regression coefficients and e is the error term that is normally distributed with a mean of zero and constant variance of sigma squared, e~N (0, σ2).

4.0 RESEARCH FINDINGS AND DISCUSSIONS

As shown in the Table 1 of results, the value of R-Square indicates the goodness of fit of the linear regression. R-square is at 0.709 which means that 70.9% of the total variation in the dependent variable (food crop diversification) is attributed to the socio-economic factors and variables and the remaining 29.1 lies within the error term in the regression model for this study. According to Wooldridge (1991), adjusted R-squared ranges from 0 to 1, and a coefficient of determination of 0.7 to 1 is acceptable.

Table 1: Model Summary Results

R	(R^2)	Adjusted *R* Square	Std. Error of the Estimate
0.842[a]	0.709	0.692	0.219

	Sum of Squares	Df	Mean Square	*F*	*P*-value (Sig.)
Regression	16.11	5	3.22	63.89	0.000[b]
Residual	7.36	146	0.05		
Total	23.47	151			

Source: Survey Data (2023)

The overall significance of the regression model (ANOVA) was generated which yielded the results as shown in Table 1. The findings indicated that the p-value is less than the level of significance, i.e., P<0.05. Thus, the sample data provide sufficient evidence to conclude that the regression model fits the data which shows that the independent variables in the model improve the model fit. The F-value (63.885) is calculated from the data and was compared to F critical value, Fα=0.05 (5, 146) = 2.276. The calculated F value is larger than the critical F value (63.885>2.276). In this regard, the null hypothesis (H01) was rejected. Hence conclude that socio-economic factors have significant effect on food crop diversification among smallholder sugarcane farmers in Mumias East Sub-County.

The individual regression results are shown in Table 2 of results. The result of the multiple linear regression analysis showed that household income level, education level, land size and

household size were all statistically significant at a 1% level and influenced crop diversification positively except the variable age of the household head.

From Table 2 of results, age of the smallholder sugarcane farmer households head was significant at a 1% level with a negative coefficient (-0.150). The negative sign of the coefficient shows that as the age of the household head increases by one year, there is a probability of a decrease/reduction in crop diversification among smallholder sugarcane farmer by 15% when other factors are kept constant. This implies that as the age of the farmer increases, crop diversification reduces. This is because an older farmer is considered less energetic to supply labour to the farm. The results differ from that of Wiredu et al., (2010), who showed that in rice cultivation in Ghana, age had a positive effect on yield meaning experience in rice cultivation implied accumulated knowledge in rice production. The study is almost similar to the findings in the study done by Von Braun, Hazell, Hoddinot and Babu (2003), on achieving long-term food security in southern Africa, which found out that in terms of labour supply, the age of the household head has a negative effect on the amount of maize crop production in the sense that young people in the family households are labour providers on the farm activities and are expected to cultivate large tracts of land as compared to the older people. These findings are also consistent with the outcomes by Makate et al. (2016), who discovered that crop diversification has shown a positive relationship with the farm household's annual income.

Table 2: Estimates of Effects of Socio-economic Factors on Food Crop Diversification

Variables	Unstandardized β	Std. Error	Standardized B	*t*	Sig. (*P*-value)
(Constant)	-0.625	0.164		-3.820	0.001*
Age	-0.150	0.048	-0.188	-3.116	0.002*
Gender	0.091	0.008	-0.013	11.517	0.773
Income level	0.064	0.016	0.346	4.047	0.001*
Education level	1.877	0.486	0.231	3.860	0.000*
Years of experience	-0.14	0.002	0.031	-6.374	0.432
Household size	0.053	0.009	0.402	5.072	0.001*
Marital status	-0.596	0.962	-0.036	-0.620	0.537
Land size in acres	0.237	0.080	0.588	4.872	0.000*
Occupation	-4.094	5.3760	0.580	6.443	0.446

Legend
Number of observations = 152
LR Chi^2 (9) = 148.9
R^2 = 0.709
Prob >Chi^2 = 148.9
Log likelihood = 0.00
* = significant at 1% level and **=significant at 5%

Source: Survey Data (2023)

Results also revealed that education level was statistically significant at a 1% level with a positive coefficient of 1.877. This implies that with an increase in the educational level of the smallholder sugarcane farmer household head, food crop diversification also increases by 187.7%. The current study result on education level is convergent to those of Ekou (2015) who did a study on the effects of education level on farm production in the Ivory Coast and found out that education level was significant at 1% level with a coefficient of 0.1630. Nyemeck et al., (2004) in Cameroun found that literacy level has an important effect on technical efficiency in the single-crop system of maize, but it has no impact on groundnuts production and in the associate production of groundnuts. These results show that a farmer, whose literacy number exceeds or is equal to four years, is technically more effective. These findings are similar to those of Weir (1999) who found out that in Ethiopia, that literacy level has a positive effect on cereals but it is only noticeable after a minimum of four years of training. However, the current study results differ with the findings by Obierio, (2013) who found out that there is a negative correlation of -0.075 between education and maize yield in Siaya County, meaning education is negatively correlated with farm yield.

Crop diversification and household family size results were also found to have a positive and significant relationship. Household family size of the smallholder sugarcane farmer households head was statistically significant at a 1% level with a positive coefficient of 0.053. With an increase in family size of the smallholder sugarcane farmer household head, food crop diversification also increases by 5.3%. This implies that with numerous agricultural husbandry practices, including land preparation, sowing of seeds, planting crops, and harvesting; homes with a large family size will tend to grow a bigger range of crops. The findings of the current study are comparable to study findings by Babatunde et al., (2007) in Nigeria who reported that in farming activities, households with larger labour supplies are better positioned to increase the production of their land. This is also consistent with the findings of Muyanga et al., (2008), who noted that relatively larger households tend to be labour suppliers. Increasing labour use in maize production by a single worker increases the mean household income by Kshs 3.517 per day, holding other factors constant.

Further, from the Table 2 of results, land size was also statistically significant at a 1% significance level with a positive coefficient of 0.237. The result of land size implies that an increase in land size by one acre leads to a 23.7% increase in food crop diversification among the smallholder sugarcane farmer households. This means that smallholder sugarcane farmers who had large fields/farms were seen as more likely to diversify crops in their farms. This could be attributed to the fact that households with large farm sizes may want to maximize the production from their farms as they may have to combine various crops. Similar results on farm size were realized by Chiona (2011) in his study on technical and allocative efficiency of smallholder farmers in Zambia, where she reported a positive relationship between farm size and efficiency. Increasing the size of the field by one hectare increased the level of technical efficiency by 3 percent and allocative efficiency by one percent. Idumah et al., (2013) in a study in Edo State, Nigeria found that farm size was significantly positive to yam production in the area. The results of the efficiency estimation, however, indicated that farm size (1.55) was underutilized. Further, Dom et al., (2003), in a study in Nigeria, found that farm size had a positive impact on the output of flutted pumpkin and was significant at one percent level and the elasticity of production with respect to farm size was 0.71. Therefore, the current study

findings are in convergence with that of Chiona (2011), Dom et al., (2003) and Idumah et al., (2013).

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

The first objective of the study sought to determine the socio-economic factors influencing food crops diversification among smallholder sugarcane farmers in Mumias East Sub-County, Kenya. Multivariate linear regression was used for data analysis and the results indicated that age, household income level, education level and family size influenced crop diversification. A one-year increase in the age of the household head was found to reduce food crop diversification by 15% when other factors are kept constant. Results also revealed that education level was statistically significant at 5% level with a positive coefficient of 1.877. Household income level, land size and household size were all statistically significant at a 1% level with positive coefficients of 0.064, 0.237 and 0.053. They all had a positive influenced on crop diversification among smallholder sugarcane farmers.

5.1 Acknowledgement

I thank God for the gift of life during this work. Special thanks to my supervisors Dr. Elijah Ng'eno and Dr. Naomi Rioba for their unreserved advice and guidance in this work. I also thank all people who have assisted me in one way or another during my research.

5.2 Conflict of Interests

The author has not declared any conflict of interests.

REFERENCES

Aheibam, M., Singh, R., Feroze, S. M., Singh, N. U., Singh, R. J., & Singh, A. K. (2017). Identifying the determinants and extent of crop diversification at household level: An evidence from Ukhrul District, Manipur. Economic Affairs, 62(1): 89.

Aheibam, M., Singh, R., Feroze, S. M., Singh, N. U., Singh, R. J., & Singh, A. K. (2017). Identifying the determinants and extent of crop diversification at household level: An evidence from Ukhrul District, Manipur. Economic Affairs, 62(1): 89.

Altieri, M. A. (1999). The ecological role of biodiversity in agroecosystems. In Invertebrate biodiversity as bioindicators of sustainable landscapes (pp. 19-31). Elsevier.

Antwi-Agyei, P., Stringer, L. C., & Dougill, A. J. (2014). Livelihood adaptations to climate variability: insights from farming households in Ghana. Regional environmental change, 14(4), 1615-1626.

Behera, U. K., Sharma, R., & Mahapatra, I. C. (2007). Crop diversification for efficient resource management in India: Problems, prospects, and policy. Journal of Sustainable Agriculture, 30(3), 97–127. https://doi.org/10.1300/J064v30n03_08. (accessed 20th april 2020)

Block, S., & Webb, P. (2001). The dynamics of livelihood diversification in post-famine Ethiopia. Food Policy, 26, 333– 350.

Clements, R., Haggar, J., Quezada, A., & Torres, J. (2011). Technologies for climate change adaptation: Agricultural sector. https://backend.orbit.dtu.dk/ws/ portal files/portal/5706575/Technologies for Climate Change Adaptation Agriculture sector. pdf. Accessed on 09/07/2020

Ebi, K., Padgham, J., Doumbia, M., Kergna, A., Smith, J., Butt, T., & McCarl, B. (2011). Smallholders adaptation to climate change in Mali. Climatic Change, 108(3), 423–436.

Ellis, F. (2000). The determinants of rural livelihood diversification in developing countries. Journal of Agricultural Economics, 51(2), 289-302.

Feliciano, D. (2019). A review on the contribution of crop diversification to sustainable development goal 1"no poverty" in different world regions. Sustainable Development, 27(4), 795–808. https://doi.org/10. 1002/sd.1923. January 01, 2020

Frelat, R., Lopez-Ridaura, S., Giller, K. E., Herrero, M., Douxchamps, S., Djurfeldt, A. A., van Wijk, M. T. (2016). Drivers of household food availability in sub-Saharan Africa based on big data from small farms. Proceedings of the National Academy of Sciences of the United States of America, 113(2), 458– 463.

Holling, C. S. (1973). Resilience and stability of ecological systems. Annual review of ecology and systematics, 1-23.

Huang, J. K., Jiang, J., Wang, J. X., & Hou, L. L. (2014), Crop diversification in coping with extreme weather events in China. Journal of Integrative Agriculture, 13(4):677-686.

Joshi, P., Gulati, A., Jr, & R., C. (2007). Agricultural diversification in South Asia: Beyond food security. Agricultural Diversification and Smallholders in South Asian. 47–81. Retrieved November 18, 2019, from http://www.ifpri.org/sites/default/files/pubs/pubs / other pubs/agdiversesach02.pdf.

Kanyua, M. J., Ithinji, G. K., Muluvi, A. S., Gido, O. E., & Waluse, S. K. (2013). Factors influencing diversification and intensification of horticultural production by smallholder tea farmers in Gatanga District, Kenya. Current Research Journal of Social Sciences, 5(4), 103-111.

Kibet, N., Lagat, J., & Obare, G. (2011). Identifying efficient and profitable farm enterpise in Uasin Gishu County in Kenya. Asian J Agric Sci, 37(5), 378-384.

Kothari, C. R. (2004). Research Methodology: Methods and Techniques, 2nd edition. New age International Publishers (P) Ltd., New Delhi, India.

Kumar, A., Kumar, P., & Sharma, A. N. (2012). Crop diversification in Eastern India: Status and determinants. Indian Journal of Agricultural Economics, 67(4), 600-616.

Makate, C., Wang, R., Makate, M., & Mango, N. (2016). Crop diversification and livelihoods of smallholder farmers in Zimbabwe: adaptive management for environmental change. SpringerPlus, 5, 1-18.

Mango, N., Makate, C., Mapemba, L., & Sopo, M. (2018). The role of crop diversification in improving household food security in central Malawi. Agriculture and Food Security, 7(1), 1–10. https://doi.org/10.1186/ s40066-018-0160-x

McCord, P. F., Cox, M., Schmitt-Harsh, M., & Evans, T. (2015). Crop diversification as a smallholder livelihood strategy within semi-arid agricultural systems near Mount Kenya. Land Use Policy, 42, 738– 750.

Mesfin, W., Fufa, B., & Haji, J. (2011). Pattern, trend and determinants of crop diversification: empirical evidence from smallholders in eastern Ethiopia. Journal of Economics and Sustainable Development, 2(8), 78-89.

Mithiya, D., Mandal, K., & Datta, L. (2018). Trend, pattern and determinants of crop diversification of small holders in West Bengal: A district-wise panel data analysis. Journal of Development and Agricultural Economics, 10(4): 110-119.

Mussema, R., Kassa, B., Alemu, D., & Shahidur, R. (2015). Determinants of crop diversification in Ethiopia: Evidence from Oromia region. Ethiopian Journal of Agricultural Sciences, 25(2): 65-76.

Nguyen, H. Q. (2014). Crop diversification, economic performance and household's behaviors: Evidence from Vietnam. SSRN Electronic Journal, 1–25.

Ojo, M. A., Ojo, A. O., Odine, A. I., & Ogaji, A. (2014). Determinants of crop diversification among small–scale food crop farmers in north central, Nigeria. Production Agriculture and Technology Journal, 10(2): 1-11.

Rehima, M., Belay, K., Dawit, A., & Rashid, S. (2013). Factors affecting farmers' crops d iversification: Evidence from SNNPR, Ethiopia. International Journal of Agricultural Sciences, 3(6), 558–565.

Sichoongwe, K., Mapemba, L., Ng'ong'ola, D., & Tembo, G. (2014). The determinants and extent of crop diversification among smallholder farmers: A case study of Southern Province, Zambia (Vol. 5). Intl Food Policy Res Inst.

Waswa, F., Gweyi-Onyango, J. P., & Mcharo, M. (2012). Contract sugarcane farming and farmers' incomes in the Lake Victoria basin, Kenya. Journal of applied Biosciences, 52, 3685-3695.

