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The Socio-Economic Factors Affecting Dry Maize Grain Output on Household Income Among Small-Scale Maize Farmers in Keiyo North, Elgeyo Marakwet County

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ABSTRACT

The growth rate in the agricultural sector has been slow in recent times as captured in the national governments' bulletins on performances by various agricultural sub-sectors. Farm gate maize prices have been unstable and sometimes fluctuating to levels too low to cover farmers' production costs, eliciting much debate. This has exposed maize farmers in Keiyo North Sub-County to skewed pricing mechanisms which sometimes work to their disadvantage. Therefore, this study was carried out in Keiyo North Sub-County, Elgeyo Marakwet County with the objective of analysing the Socio-Economic Factors Affecting Dry Maize Grain Output on Household Income Among Small-Scale Maize Farmers in Keiyo North, Elgeyo Marakwet County. The study was guided by Random Utility Maximization (RUM) theory and descriptive and cross-sectional research designs were adopted. Data was collected from a sample of 232 small-scale maize farmers from a target population of 4,107 farmers using multi-stage sampling technique. Data for the study was collected using a questionnaire and analysed using descriptive and inferential statistics. Multiple Linear Regression model was used to analyse objectives one to four with the help of the Stata software. Descriptive results revealed that 46.9% of the small-scale maize farmers were aged 41 to 50 years. 31.13% of the small-scale maize farmers had attained primary-level education. Further, results showed that 41.51% of the small-scale maize farmers had between 5 to 10 years in maize farming. The mean land size under maize farming was 2 acres. Results further, revealed that the average annual maize output per acre was 41 21 bags, the average number of bags sold was 33, while the mean price of a 90 kg bag of maize was Ksh 2,993. Moreover, 57.55% of the small-scale maize farmers belonged to groups, 50.47% of the farmers had access to extension services, 67.92 did not access credits, and 78.77%accessed market information. Multiple Linear Regression estimates on the effects of socio-economic determinants on household income results revealed that age, education level, and land size were statistically significant at 1% level with 0.604, 0.782, and 0.308 positive coefficients, respectively. Farming experience statistically significant at 5% level with 0.329 positive coefficient. However, marital status, and family size were significant at 5% and 1% level with 0.281 and 0.098 negative coefficients, respectively. Additionally, results on the estimates of the effects of marketing factors on household income revealed that maize output and maize price were statistically significant at 1% level with 0.003 and 0.015 positive coefficients, respectively. Further, results on the estimated effect of institutional factors on household income results revealed that group membership, credit access, and extension access were statistically significant at 1% level with 2.723, 2.999, and 1.595 positive coefficients, respectively. Results of the estimates of pricing factors on household income revealed that maize sales and maize price were statistically significant at 1% level with 0.001, and 0.018 positive coefficients, respectively. Market information access was statistically significant at 5% level with 0.282 positive coefficient. Therefore, the researcher concluded the results of estimates of the effect of socio-economic factors on household income revealed that age, education level, and land size were statistically significant at 1% level with 0.604, 0.782, and 0.308 positive coefficients, respectively. Farming experience statistically significant at 5% level with 0.329 positive coefficient. However, marital status and family size negatively determined small-scale maize farmer household income in the study area. Marital status, and family size were significant at 5% and 1% level with 0.281 and 0.098 negative coefficients, respectively. This study recommends the need for policy makers both at the national and county governments to formulate or review

agricultural land use policies. There is need to regulate land fragmentation since land size under crops is reducing every season for other purposes, yet increasing land acreage improves household income. There is also need to improve transport infrastructure to movement of maize output to the nearest markets and outlets.

Key words: ***Dry Maize Grain Output, Household Income, Small-Scale Maize Farmers***

1.0 INTRODUCTION

Agriculture remains the backbone of Kenya's economy, employing about 70% of the rural population and contributing significantly to national food security and household livelihoods. Among the staple crops grown in the country, maize occupies a central position as both a food and cash crop. It is the main source of calories for most Kenyan households and plays a vital role in the rural economy through employment creation, income generation, and as a raw material for agro-based industries. Maize production is, therefore, not only a subsistence activity but also a key driver of rural development and poverty reduction.

In Elgeyo Marakwet County, particularly in Keiyo North Sub-County, maize is the dominant crop grown by small-scale farmers for both domestic consumption and sale. The region's favorable climatic conditions, fertile soils, and long farming tradition provide great potential for maize production. However, despite this potential, maize yields in Keiyo North remain relatively low compared to the national and regional benchmarks. The majority of smallholder farmers harvest less than 10 bags per acre, far below the potential yield of 25–30 bags per acre under optimal conditions. This low productivity has resulted in reduced household income, high poverty levels, and increased food insecurity within the region.

The performance of small-scale maize farmers is influenced by a variety of socio-economic factors such as education level, access to credit, land size, availability of farm inputs, extension services, household labour, and market accessibility. These factors collectively determine the level of maize output and the ability of households to generate income from their farming activities. For instance, farmers with higher education and access to agricultural information are more likely to adopt improved farming practices that enhance productivity. Similarly, those with access to credit can invest in quality seeds, fertilizers, and modern farming equipment, thereby improving output and income. Conversely, farmers with limited access to such resources often experience low yields and reduced profitability.

Moreover, challenges such as fluctuating market prices, poor storage facilities, post-harvest losses, and inadequate infrastructure further constrain the profitability of maize farming. Even when production levels are adequate, many farmers fail to realize substantial income due to poor market linkages and exploitative middlemen. Consequently, the contribution of maize farming to household income remains low, undermining the economic well-being of smallholder farmers in Keiyo North.

Although various initiatives by the national and county governments, as well as development partners, have sought to improve maize productivity, there is still inadequate empirical

understanding of the specific socio-economic factors that significantly influence dry maize grain output and household income in Keiyo North. Most studies conducted in Kenya have focused on other regions or have examined maize production in general without distinguishing between green and dry maize production or analyzing the direct link to household income. This knowledge gap necessitates a localized, evidence-based investigation into the socio-economic determinants of dry maize grain output and their implications for household income among small-scale farmers in Keiyo North Sub-County.

1.1 Statement of the Problem

Maize is a critical staple food and income-generating crop for most rural households in Kenya. In Keiyo North Sub-County of Elgeyo Marakwet County, small-scale farmers depend heavily on dry maize grain production as their main source of livelihood. However, despite the favorable agro-climatic conditions and long history of maize cultivation in the region, productivity and household income levels among these farmers remain low and inconsistent. Reports from the County Department of Agriculture indicate that average maize yields per hectare in Keiyo North fall below the national potential, and many households continue to face food insecurity and poverty.

Several socio-economic factors have been identified as potential contributors to this situation, including limited access to credit, low levels of education and agricultural training, small land sizes, inadequate extension services, poor market access, and high post-harvest losses. These constraints not only affect the quantity of maize produced but also determine how much income farmers earn from their produce. The challenge is compounded by fluctuating maize prices, high input costs, and limited opportunities for value addition, which further reduce the profitability of maize farming.

Although various government and non-governmental programs have aimed at improving maize productivity and farmers' welfare, there is limited empirical evidence on which specific socio-economic factors significantly influence dry maize grain output and how output levels translate into household income within Keiyo North. Without such localized data, interventions risk being generalized and ineffective. Therefore, there is a need to systematically analyze the socio-economic determinants of dry maize grain output and to establish the relationship between maize output and household income among small-scale maize farmers in Keiyo North Sub-County. The findings will provide evidence-based insights to inform targeted policies and development strategies aimed at improving both maize productivity and rural household welfare.

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1.2 Objective of the Study

The main objective of the study was to investigate the Socio-Economic Factors Affecting Dry Maize Grain Output on Household Income Among Small-Scale Maize Farmers in Keiyo North, Elgeyo Marakwet County

1.3 Value of the study

The study will provide empirical evidence on the socio-economic factors influencing dry maize grain output and household income among small-scale farmers in Keiyo North. Such localized information will help to fill existing knowledge gaps and guide policymakers, researchers, and development practitioners in designing data-driven interventions tailored to the unique socio-economic conditions of the area.

Secondly, the findings will assist the County Government of Elgeyo Marakwet and other relevant agencies, such as the Ministry of Agriculture and the Agricultural Finance Corporation, in formulating and implementing effective agricultural policies and programs. By identifying which socio-economic factors have the greatest impact on maize productivity and income, the county can prioritize investments in areas such as credit access, extension services, and market infrastructure to enhance farmer performance and welfare.

Thirdly, the study will benefit small-scale maize farmers themselves. Through dissemination of the findings, farmers will gain a better understanding of how various socio-economic and management factors influence their maize output and household earnings. This awareness can encourage them to adopt better farming practices, seek appropriate support services, and make informed production and marketing decisions that improve their productivity and profitability.

11: LITERATURE REVIEW

In a study of factors influencing adoption of protected tomato farming practices, Shadiadeh et al (2012) used multiple regression analysis to examine socio-economic characteristics of the farmers. The study established that family size, farming experience and level of education influenced adoption of protected tomato farming practices. Similarly, Singha et al. (2012) used multiple regression analysis to determine the socioeconomic factors influencing technology adoption of different land-based enterprises by farmers. Land size, education level and annual income were found to influence adoption of technologies and practices by vegetable and rice farmers. Xaba and Masuku (2013) also used multiple regression analysis in a study in Swaziland to determine factors affecting the productivity and profitability of vegetables production. The study found that productivity of vegetable farmers was significantly and positively related to selling price and gender. Agwu et al (2012) used multiple regression analysis in a study in Nigeria to estimate the socio-economic determinants of commercialization among smallholder farmers. The study established that household size, income, farming experience, farm size, distance to market and membership in associations significantly influenced commercialization among the smallholder farmers.

Ngozi et al. (2009) while using multiple regression analysis in a study of diversity and production methods of fluted pumpkin by vegetable farmers in Nigeria found that plot size had positive relationship with pumpkin yields. Adebisi-Adelani and Oyesola (2013) used linear regression analysis to investigate socio-economic factors influencing adaptation strategies of horticultural farmers in Nigeria. Income and age were found to be significant. Sani et al. (2014) also used multiple regression analysis to determine socio-economic factors influencing farmers' adoption of dual-purpose cowpea production technologies. Education level, household size, farming experience and social participation were found to be significant.

In a study in Nigeria, Nwaiwu et al. (2012) used multiple regression analysis to assess socio-economic determinants of the productivity of garden egg producers. Age of the farmer and farm size were major determinants of garden egg productivity. Ayoola et al. (2011) used regression to investigate the socio-economic factors influencing rice production among farmers in Nigeria. Land, farmers' experience and age were found to influence rice productivity. Wambugu et al. (2010) using regression model in a study in Western Kenya found that social capital had a positive effect on the performance of rural producer organizations.

Gender equity is one of the priority areas identified in the Sustainable Development Goals (SDGs). Meinzen-Dick et al. (2011) observed that if gender is not considered in agricultural extension,researchanddevelopmentsystems,itwillbehardtoincreaseproduction so as to meet demands of the future generations. Gender equity in agriculture is a development issue that will benefit men, women and society at large. Gender differences are important factors for agricultural production where management and ownership rights are definedby culture

According to a study by Ndinomupya (2010), educational level of the farmer was found to be significant and positively influencing market choice and participation. This is attributed to the roles such as enhancement of managerial competencies and successful implementation of improved marketing practices that education plays (Marenya and Barret, 2009). The more the education level achieved, the higher the chances of choosing a more paying marketing channel due to knowledge exposure. Vijay et al. (2009) observed a significant and positive relationship between education and choice of modern milk channels.

Ndinomupya (2010) deduced that farm size determines the quantity of the produce and therefore choice of the marketing channel. Large farm size increases farmers‟ propensity to participate in modern markets and avails more grazing land (Hangaraet al., 2011). This because, large farm size is considered to be an indicator of wealthier farmers that produce large volumes of milk implying lower risks in modern market participation (Wollniet al., 2008).

III: RESEARCH METHODOLOGY

3.1 The Study Area

The study was conducted in Keiyo North Sub-County, Elgeyo Marakwet County, Kenya as shown in Figure 2.2. The Sub-County is situated at a latitude and longitude between 0.5248°N to 0.6437°N and 35.5057°E to 35.5924°E, respectively. The altitude ranges between 1500 and 2000 meters above the sea level and is characterized by distinct ecological zones of highlands and

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valleys with an annual mean temperature of 18°C – 22°C on the highland and 25°C- 28°C down in the valley. The area receives a mean annual rainfall of between 700 and 1700 mm from the months of March to October of the year. According to the Census of 2019, the sub county's population was 107,109 with a population density of 198 square Kms (KNBS, 2019).

The sub county is subdivided into four wards, namely Kapchemutwa, Tambach, Kamariny and Emsoo. The study area is 80 percent arable with many areas having fertile black cotton soil.The Sub-County produces both food and cash crops that vary with the agro-ecological zones. The major food crops include maize, beans, wheat, bananas, green grams, groundnuts, sorghum, millet and cowpeas. Horticultural and industrial crops include Irish potatoes, avocado, passion, mangoes, tea, coffee and pyrethrum (CIDP 2018-2022). Livestock farming is also practiced in the study area. Cattle (both dairy and beef), goats (Small East African goats, toggenburgs and alpine dairy goats), sheep (Dorper and local breeds), and poultry are the main livestock found in the Sub-County.

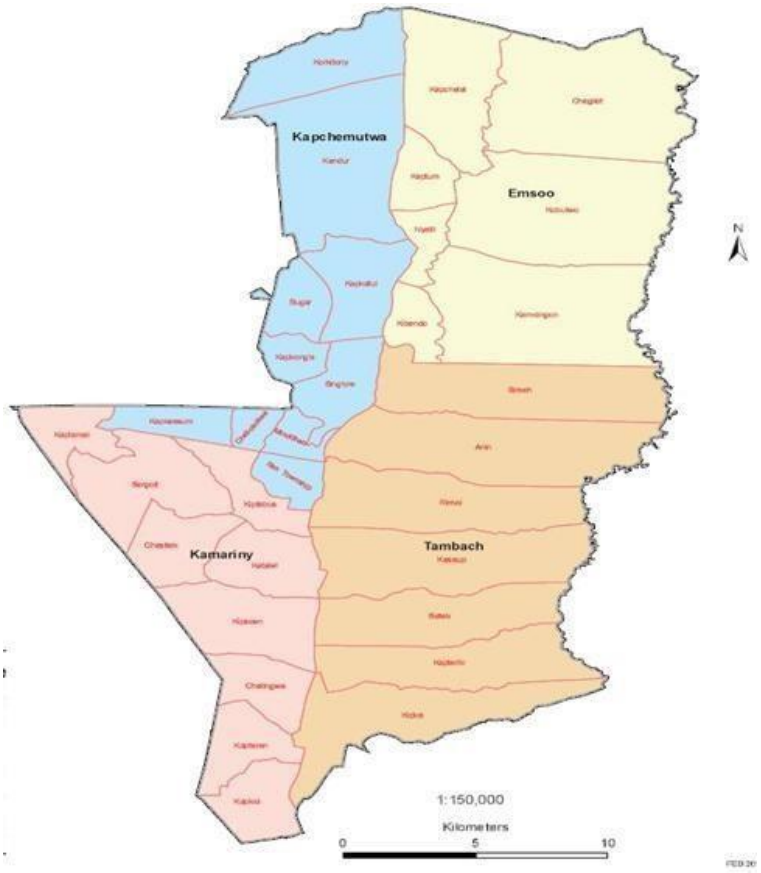


Figure 3.1Map of Keiyo North Sub-County

Sources: Elgeyo Marakwet (CIDP, 2018).

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3.2 Research Design

The study adopted descriptive and cross-sectional survey designs.The major purpose of descriptive research design is to provide information on characteristics of a population or phenomenon (Mugenda & Mugenda, 2003). The descriptive research design was preferred because it is concerned with determining the frequency with which a factor determines an outcome or the relationship between variables (Bryman& Bell, 2011). A cross-section survey was used for this study because it employs a single point of data collection for each participant, it is cheaper to undertake compared to longitudinal survey and the results from the sample are inferred to the larger population.

3.3 Target Population

A target population is a group of individuals taken from the general population sharing a common characteristic, such as age, sex, or health condition (Kombo and Tromp, 2006). According to MOA (2020), Keiyo North Sub-County has a total of 4,107 small scale maize farmers within the four wards. The respondents for this study were the small-scale maize farmers, particularly those who plant maize and sell dry maize grains at farm gate. Therefore, the distribution of the 4,107 small scale maize farmers in the four wards of Kamariny, Emsoo, Tambach and Kapchemutwo of the sub-county were as shown in table 3.1.

Table 3.1: Population of small-scale maize farmers in Keiyo North Sub-County

S/NO	Ward	Target Population
1	Kapchemutwa	1074
2	Tambach	969
3	Kamariny	1144
4	Emsoo	920
Total		**4,107**

Source; MOA, Elgeyo Marakwet County, (2020).

3.4 Sample Size Determination

The sample size used in this study was determined by the Mugenda and Mugenda (2003) formula as shown in equation 3.1.

$$n = \frac{Z^2 pq}{d^2} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3.1)$$

Where: n = desired sample size (if the target population is over 10,000),

Z = the standard normal deviation at the required confidence level,

d = the level of statistical significance set,

p = the proportion in target population estimated to have characteristics being measured,

q = 1 – p.

The proportion in the target population assumed to have the characteristics of interest as recommended by Fisher et al is = 50%. However, for our case we considered 80% proportion of the target population. The z-statistic is 1.96 and the desired accuracy level is = 0.05.

Therefore using the formula we obtain a sample size of 384 respondents.

$$n = \frac{1.96^2(0.8)(0.2)}{(0.05)^2}$$

$$n \cong 246$$

Given that the target population is less than 10,000. Therefore the actual sample size will be;

$$n_f = \frac{n}{1 + \frac{n}{N}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

Where: n_f = desired sample size (when population is less than 10,000), n = desired sample size (when population is more than 10,000), N = the estimate of population size.

$$n_f = \frac{246}{1 + \frac{246}{4107}}$$

$$n_f \cong 232$$

Therefore, from the above calculations, a total of 232 small-scale maize farmers formed the required sample size and was used for data analysis in this study.

3.5 Sampling Procedure

The study employed a multi-stage sampling technique which combined purposive, stratified, proportionate and simple random sampling techniques. In the first stage, Keiyo North Sub-County was purposively selected as the study area due to its dominance in terms of maize production in Elgeyo Marakwet County. In the second stage, stratified random sampling procedure was used to obtain the sample of small-scale maize farmers in the whole Sub County. The area under study has four administrative wards, which formed the three strata for this study. In the third stage, proportionate size sampling procedure was used to pick respondents for the study from each wardas shown in Table 3.2. Thereafter, lists of smallholder maize farmer households from each ward were 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.

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Table 3.2: Proportionate Distribution of small-scale maize farmers

S/NO	Ward	Target Population	Proportion (%)	Proportionate size sample	Target Sample
1	Kapchemutwa	1074	26%	0.26	60
2	Tambach	969	24%	0.24	56
3	Kamariny	1144	28%	0.28	65
4	Emsoo	920	22%	0.22	51
Total		**4,107**			**232**

Source: Author's Computation, (2024)

Random sampling was required to ensure that the sample is representative of a larger underlying population. To select small-scale farmers using this method, the study generated randomnumbers within the range 1 – 351 in Excel using the formula; =rand between (351). A farmer was then selected when the random number falls within its cumulative sample range, thus making the probability of his/her selection proportionate to the sample size of the ward. Continuous generation of random numbers by (pressing the F9 key) until the desired numbers of farmers were selected from each ward. If a random number fell within an already selected farmer, it was simply continued pressing F9 until a random number that falls for another farmer in a village within the sample range was found.

Table 3.3: Table of Probability of Small-Scale Farmers' Selection

Ward	Cumulative Sample	Target Sample
Kapchemutwa	60	60
Tambach	116	56
Kamariny	181	65
Emsoo	232	51
Total		**232**

Source: Author's Computation, (2024)

3.6 Data Types and Sources

Primary and secondary data was used in this study. Primary data was collected directly from the small-scale maize farmer household heads through self-administered questionnaires by enumerators. Primary data that was collected included small scale maize farmer's socio-economic characteristics, pricing factors, marketing and institutional factors that contribute to the incomes earned by the households.

Secondary data was collected through literature review. A review of books, journal articles, unpublished study documents, ministry of agriculture databases, the National Cereals and Produce Board (NCPB) databases, other official reports of relevant quality, and internet sources economic journals, statistical abstracts, conference reviews, books, magazines, national and county development and strategic plans, National Bureau of Statistics publications, desktop literature, and the internet sources.

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3.7 Data Collection Instruments

Primary data was obtained using questionnaires. The questionnaire was made up of closed-ended questions. The closed ended questions were preferred because of the listed options that were to measure the socio-economic, pricing factors, and institutional factors. According to Saunders et al., (2012), the closed or structured questions provide simple results and are generally easier to evaluate. Well-trained enumerators were employed to help administer the questionnaires to the farmers through interviews.

3.7.1 Validity of Research Instruments

Validity refers to the extent to which a research tool measures what it is expected to measure (Kimberlin and Winterstein, 2008). It is the degree to which the outcomes of a test are acceptable. To ensure that the results obtained from this study meets all the credentials of a scientific research, the instruments were presented to experts from the department of Agriculture Economics and Rural Development at the University of Eldoret. They were able to ascertain the validity by the clarity of wording and whether the respondents were able to interpret all questions in a similar way. Their comments were incorporated into the instrument.

3.7.2 Reliability of Research Instruments

Kothari, (2008), refers reliability as the degree to which scores obtained with an instrument are consistent. The instrument should return the same measurements when it is used at different times. Therefore, for this study, the reliability of the instrument was determined by pre-testing the instrument with a sample of 9 respondents in Metkei ward and in Keiyo South Sub-county. Data from the pilot study was analysed using Cronbach's Alpha coefficient, mathematically expressed as shown in equation 3.3. Adjustments were then made where necessary on the questionnaire to increase on its reliability.

$$a = \frac{N\bar{c}}{v+(n-1)\bar{c}} \quad (3.3)$$

Where $a$is the Cronbach's Alpha coefficient, $\bar{c}$is the average inter-item covariance among the items, is the average variance and N is equal to the number of items/observations.

After calculating the Cronbach's Alpha coefficient for this study, the reliability coefficient results are as shown in table 3.4 using the questionnaire. A coefficient of 0.724 was found which showed that the data collection instruments were reliable.

Table 3.4: Interview Schedule Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
0.724	0.737	9

Source: Author's Computation, (2024)

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3.8 Data Collection Procedures

The researcher sought a letter from the directorate of postgraduate studies, University of Eldoret to conduct the study. The enumerator-administered questionnaires were preferred over questionnaire administration to give respondents enough time to seek clarification and guidance in responding to questions. The researcher sought the help of research assistants, well conversant with the four wards to help with the administration of questionnaires.

3.9 Data Analysis and Presentation

Before processing the responses, the completed questionnaires were edited for completeness and consistency. The data was then coded to enable the responses to be grouped into various categories and corresponding tables. Data was then analysed with the help of STATA software. Descriptive statistics, such as frequencies, percentages, mean score and standard deviation was computed for all the quantitative variables and information presented in the form of tables and graphs. Regression analysis was used to establish the existence of significant relationships among variables in the study area.

3.10 Specifications of Empirical Models

3.10.1 Estimates of Socio-Economic Factors Affecting Household Income

Objective (i) of the study was analysed using multiple linear regression model. This model presumes the existence of a linear relationship between the dependent variable, independent variables, and latent variable. It was modelled as shown in Equation 3.4 and as adopted from Brown (2009).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon \quad \text{..... (3.4)}$$

Where Y is the household income,

X_1= Age,

X_2= Gender,

X_3= Education Level,

X_4= Marital status,

X_5= Family Size

X_6= Years of experience,

X_7= Land size

$\beta_0$to$\beta_7$are the regression coefficients and ε is the error term that is normally distributed with a mean of zero and constant variance of sigma squared, ~N (0, σ2).

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3.10.2 Estimate of Marketing Factors Affecting Household Income

A multiple regression model did also apply for this case as it entailed estimating the effect of market knowledge on household income (multiple independent variables verses a single dependent variable). The dependent variable was household income while the independent variable was marketing factors with the following measurable: Maize Price, Maize Volumes, Market outlets, Road type. The regression model was:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$... (3.5)

Where Y is the household income,

X_1 = Maize price,

X_2 = Maize Volumes,

X_3 = Market Outlets,

X_4 = Road type.

$\beta_0$to $\beta_4$were the regression coefficients and $\varepsilon$is the error term that is normally distributed with a mean of zero and constant variance of sigma squared, ~N (0, σ2).

3.10.3 Estimate of Institutional Factors Affecting Household Income

A multiple regression model also applied for this case as it entailed estimating the effect of institutional factors on household income (multiple independent variables vs a single dependent variable). The dependent variable is household income while the independent variable is institutional factors with the following measurables: Farmer Groups (Membership to cooperative society), Access to credit, and Access to Extension service. The regression model will thus be:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$..(3.6)

Where Y is the household income,

X_1= Farmer Groups,

X_2= Access to credit,

X_3= Access to Extension service

$\beta_0$to$\beta_3$are the regression coefficients and ε is the error term that is normally distributed with a mean of zero and constant variance of sigma squared, ~N (0, σ2).

3.10.4 Estimate of Pricing Factors Affecting Household Income

For the fourth objective, a multiple regression model as specified in Equation 3.3 was also used to estimate the effect of pricing factors on household income. As such, household income forms

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the dependent variable as it is responsive to farm gate pricing factors. Therefore, the regression model assumed the form as shown in Equation 3.6:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon \quad \text{..... (3.7)}$$

Where Y is the household income

X_1= Price,

X_2= Distance to the market,

X_3= Access to market information

X_4= Sales volume,

X_5= Aggregators

$\beta_0$to $\beta_5$are the regression coefficients and $\varepsilon$is the error term that is normally distributed with a mean of zero and constant variance of sigma squared, ~N (0, σ2).

3.11 Ethical Considerations

A research permit was obtained from the National Commission for Science Technology and Innovation (NACOSTI) through an introductory letter from the Board of Post Graduate Studies, University of Eldoret. The permit was then presented to the Sub-County Agricultural Officer in the Ministry of Agriculture, Livestock and Cooperative Management, and the Sub-County Commissioner responsible for data collection in the Sub-County for permission to collect data from the small-scale maize farmers. The small-scale maize farmers were fully informed about the procedures involved in the process and they were assured of the confidentiality of the information they provided, including their personal information. They were to remain anonymous throughout the study and even to the researcher himself to guarantee the needed privacy. The small-scale maize farmers were guaranteed that the provided information would not be made available to anyone who was not taking part in the research project and that the information would remain confidential for the purposes it was intended for.

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IV: RESULTS

4.1 Estimates of Socio-economic Factors on Household Income Variability

Table 4.15 of results shows the coefficient of determination (adjusted R-squared) that was computed to determine the degree to which the independent variables explain the variation of the dependent variable in the multiple linear regression model. Results revealed that the R-squared (R2) value to be 0.9676. This indicates that 96.8% of the variation in household income is explained by the independent variables.

Table 4.1: Estimates of Socioeconomic Determinants on Household Income

Source	SS	Df	MS
Model	24387.094	6	4064.51566
Residual	807.865711	206	3.92167821
Total	25194.9597	212	118.844149

No of Obs = 212
F (6, 206) = 1036.42
Prob > F = 0.0000
R-squared = 0.9679
Adj R-squared = 0.9670
Root MSE = 1.9803

lnnetincome	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
Age	0.604	0.135	4.46	0.000	0.337	0.871
Gender	0.126	0.1	1.26	0.208	-0.071	0.323
Marital status	-0.281	0.128	-2.19	0.030	-0.534	-0.028
Education level	0.782	0.077	10.15	0.000	0.63	0.934
Family size	-0.098	0.027	-3.63	0.000	-0.152	-0.045
Experience	0.329	0.13	2.52	0.012	0.072	0.587
Land size	0.308	0.064	4.84	0.000	0.183	0.433
Constant	10.928	0.38	28.75	0.000	10.179	11.678

Source: Author's Computation from Survey Data (2024)

Table 4.15 of results further shows that six out seven variables considered and analysed were significant in the study. Age, marital status, education level, family size, farming experience, and land size, were found to be statistically significant. Results from the table reveal that age was statistically significant at 1% ($p<0.01$) with a positive coefficient of 0.604 on small-scale maize farmer household income. This mean that a one year increase age of the farmer is likely to increase household income by approximately 60.4%. This can be attributed to the fact that an additional year in age translates to an increase in experience in maize farming. The current finding is consistent to that by Omotayo et al. (2021) who reported that age had a positive and significant impact on household income in South Africa. The current is divergent to the findings by Chukwuemeka et al. (2011) on the determinants of income among poor farm households in Nigeria who reported that age of the household head negatively influenced farm income. Similarly, Agbenyo et al. (2022) established a negative effect of age of cocoa farmer on the farmer's income in Ghana.

Results also revealed that marital status was negative and statistically significant at 5% ($p<0.05$) with a coefficient of -0.281 on small-scale maize farmer household income. This implies that being married is associated with a decrease in household income by approximately 28.1%. This could be attributed to the fact that being married comes with increased expenses on household consumption as such farmers will have to dispose less of the output as compared to individuals who are single. The current findings is convergent to that of Ojo and Baiyegunhi (2021) on climate change perceptions and its impact on net farm income of smallholder rice farmers in South-West, Nigeria who reported that the coefficient of being single was negative and statistically significant in explaining the variation of rice farmers' net income. The current result is inconsistent to that by Agbenyo et al. (2022) on the impact of crop insurance on cocoa farmers' income who reported a positive and significant of marital status on their incomes in Ghana. Similarly, Omotayo et al. (2021) established a positive and significant relation between marital status and household income in South Africa.

Results as shown in the table of results show that education level was statistically significant at 1% ($p<0.01$) with a positive coefficient of 0.782 on small-scale maize farmer household income. This implies that the higher the education levels of the small-scale maize farmer household head, the more he/she is likely to increase household income by approximately 78.2%. Individuals who increase their education level acquire more skills and knowledge about the market and are likely to make proper decisions with regards to maize marketing. A high level of education exposes farmers to innovative practices which make rural households head to improve and increase their agricultural productivity which will result in more inflow of income to the households (Egwue et al., 2020; Obeta et al., 2020). The current finding is line with that of Serin et al. (2009) on the effects of formal education and training on farmers' income in Turkey, who found a positive and significant association between education level and farmer income. They established that education level had a 24% influence on farmers income levels. The current finding is also consistent to the findings by Kwaghe et al. (2009) who found out that education level was a positive and significant determinant of income among cowpea farmers in Nigeria. Mukaila et al. (2021) also identified education level as one of the socio-economic factors enhancing yearly income of rural women in Enugu State, Nigeria.

Results also revealed that family size was negative and statistically significant at 1% ($p<0.01$) with a coefficient of -0.098 on household income. This means that a one person increase in family size among small-scale maize farmers result in a decrease in household income by approximately 0.098 units. Families with large number of household members would need more food, thus making them to heavily invest in production in production in order to feed the large household size as compared to their counterparts with few members (Chune, 2022). This increased demand for food means that less will be sold so as to cater for household consumption. This in turn will negative influence household income. The current result is consistent with the findings of Mukaila, Falola, & Akanbi (2021) who reported a negative and significant relationship between household size and annual income among women in Nigeria. They found out that a 1% increase in household size would lead to a 0.030057% decrease in their annual income. Similarly, Purnamadewi and Firdaus (2018) while analyzing income determinants among households in Indonesia, reported a negative influence of household size on farm household income. However,the findings of this study are divergent with those of Chune (2022) who found a positive and significant association between household size and farm income. He established a unit increase in land size would result in an increase in farm income by 3.44%.

Results from the table further revealed that farming experience was positive and statistically significant at 5% ($p<0.05$) with a positive coefficient of 0.329. This implies that a one year increase in number of years of farming among small-scale maize farmers in the study area is likely to increase household income by approximately 32.9%. The current finding is consistent with that of Danso-Abbeam et al. (2018) who reported a positive influence of farming experience on household income in Ghana. A study by Nkari et al. (2016) on influence of farmer characteristics on performance of commercial farmers in Kenya reported that farming experience had a positive association with farm performance, a situation that increases farm income in the long run.

Land size was also a variable that determined household incomes among small-scale maize farmers in the study area. Land size was statistically significant at 1% ($p<0.01$) with a positive coefficient of 0.308. This implies that an increase in land size by an acre is likely to increase household income by approximately 30.8%. Land is a primary factor in production. Farmers who increase the size of land under maize farming are likely to increase their income due to increased output than farmers who cultivate small portions. The current finding is consistent with that of Chune (2022) on the determinants of maize production income in Western Uganda, who found that a unit increase in farm size would increase farm income by 5.97%. Additionally, Baidoo et al. (2016) reported a unit increase in farm size will increase household income by 38.9% among smallholder livestock farmers in Ghana. The current finding is also consistent with that of Doti (2017) reported that a unit increase in farm size would result in an increase in farm income by 19% among smallholder farmers in Ethiopia. However, the current result is inconsistent with that of Das and Ganesh-Kumar (2017) on the drivers of farmers' income in India, who reported that farm size has a significant negative impact on on-farm income per hectare.

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4.2 Estimates of Marketing Determinants on Household Income Variability

Table 4.16 of results shows the coefficient of determination (adjusted R-squared) that was computed to determine the degree to which the independent variables explain the variation of the dependent variable in the multiple linear regression model. Results revealed that the R-squared (R2) was 0.669. This means that 66.9% of the variation in household income is explained by the independent variables. The p-value (0.000) associated with the F-value is very small indicating the independent variables reliably predict the dependent variable.

Table 4.2: Estimates of Marketing Factors on Household Income

Source	SS	df	MS	No of Obs = 212
Model	105.927377	4	26.4818444	F (4, 207) = 104.62
Residual	52.3986315	207	.253133486	Prob > F = 0.0000
Total	158.326009	211	.750360232	R-squared = 0.6690
				Adj R-squared = 0.6627
				Root MSE = .50312

lnnetincome	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
Maize price	0.003	0.000	28.80	0.000	0.002	0.003
Yield (bags)	0.015	0.001	18.27	0.000	0.014	0.017
Market outlet	-0.022	0.042	-0.53	0.598	-0.104	0.06
Road type	0.049	0.05	0.99	0.326	-0.049	0.148
Constant	8.887	0.303	29.34	0.000	8.29	9.484

Source: Author's Computation from Survey Data (2024)

Table 4.16 of results shows that only two out the four variables considered and analysed were significant in this study. Maize price and maize output were found to be statistically significant with positive effects on small-scale maize farmer household income. Maize price was statistically significant at 1% ($p<0.01$) level with a positive coefficient of 0.003. This implies that a one shilling increase in price in Ksh is likely to increase small-scale maize farmer household income by approximately 0.3%. High maize prices fetch high incomes for the respective small-scale maize farmer households in Keiyo North Sub County while low price bring about low incomes. The current finding is consistent with that of Beckman and Schimmelpfennig (2015) who established that prices paid and received by farmers' influences farm income. Further, a study by Salam et al. (2019) established that selling price was among the significant factors affecting farmers' income of rice farming in Indonesia. In support to these findings is the argument that prices influences the decision to participate in markets. Maziku (2015) reported a significant positive relationship between price of maize and amount of maize sold in Tanzania. The findings by Ng'eno (2019) established a positive and significant impact of milk price received by the farmer on the amount of milk marketed.

Table 4.15 of results further shows that maize volumes/output is statistically significant at 1% ($p<0.01$) level with a positive coefficient of 0.015 on small-scale maize farmer household income in the study area. This means that a one 90kg bag increase in maize output is s likely to increase small-scale maize farmers' household income by approximately 1.5%. Households that produce many bags of maize output annually will sell more and thus realize high incomes as compared to those that produce less. These findings are convergent to those of Urgessa (2015) who reported that an increase in farm output by one percent is likely to increase rural household income by 0.15%. The findings by Mabe et al. (2010) that a unit increase in number of cattle leads to 74.3% increase in total farm revenue of farmers in South Africa is also in line with this current study. Additionally, Salam et al. (2019) found that productivity of rice was a significant factor affecting farmers' income in Indonesia. Moreover, the findings of Abu et al. (2016) who found a significant association between yield of maize and groundnuts and participation in the respective markets supports our findings that output determines income.

4.3 Estimates of Institutional Determinants on Household Income

Table 4.17 of results shows the coefficient of determination (adjusted R-squared) that was computed to determine

the degree to which the independent variables explain the variation of the dependent variable in the multiple linear regression model. Results revealed that the R-squared (R2) value is 0.9331. This means that 93.3% of the variation in household income is explained by the independent variables. The p-value associated with the F-value is very small (0.000) indicating the independent variables reliably predict the dependent variable.

Table 4.3: Estimates of Institutional Determinants on Household Income

Source	SS	df	MS		
Model	23508.8588	3	7836.28626	No of Obs	= 212
Residual	1686.10091	209	8.06746845	F (4, 207)	= 971.34
Total	25194.9597	212	118.844149	Prob > F	= 0.0000
				R-squared	= 0.9331
				Adj R-squared	= 0.9321
				Root MSE	= 2.8403

lnnetincome	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
Group membership	2.723	0.379	7.18	0.000	1.975	3.471
Credit access	2.999	0.387	7.74	0.000	2.235	3.762
Extension access	1.595	0.412	3.87	0.000	0.781	2.408
Constant	10.332	0.367	28.16	0.000	9.609	11.056

Source: Author's Compilation (2024)

Table 4.17 of results shows that all of the variables considered and analysed were significant in this study. Group membership, credit access, and extension access were found to be statistically significant with positive effects on small-scale maize farmer household income. Group membership was statistically significant at 1% ($p<0.01$) with a positive coefficient of 2.723. This implies that being a group member is likely to increase small-scale maize farmer household income by approximately 272.3%. Among the many advantages farmers receive from belonging to particular groups are trainings, extension services, loans, access to inputs, and marketing of outputs. The current findings is consistent with that of Vu et al. (2020) who conducted a study to determine the effects of farmers groups on household income for tea farmers in Vietnam. They reported that group membership influenced household income. Similarly, a study done by Tolno et al. (2015) in Guinea to determine the influence of group membership on smallholder sweet potatoes farm income reported a positive relationship between farm income and group membership.

Table of results also reveals that access to credit was statistically significant at 1% ($p<0.01$) with a positive coefficient of 2.999. This implies that access to credit is likely to boost small-scale maize farmer household income by approximately 299.9%. Credits facilitate farm operations especially in the acquisition of inputs including improved seed, fertilizer and pesticides, payment of labour services, purchasing of agricultural equipment, and increasing farm size which enhances maize productivity. Moreover, accessing agricultural market needs ready finance to transport the produce to the markets offering sustainable output price. As, such farmers who do not access credit are forced to local markets which offer low output prices. The current finding is consistent with a study by Danso-Abbeam et al. (2016) on agricultural extension and its effects on farm productivity and income who reported a positive association between farm income and access to credit in Ghana. Similarly, a study by Ogundeji et al. (2016) on the impacts of access to credit on farm income reported that access to credits increased farmers' income from 116.608 USD to 136.894 among farmers in Lesotho. Additionally, a study by Sedem et al. (2016) on the effects of access to agricultural credit on farm income in Ghana reported that access to credit had a positive association with farm income.

Access to extension services was statistically significant at 1% ($p<0.01$) with positive coefficient of 1.595. This means that access to extension services is likely to increase small-scale maize farmer household income by approximately 159.5%. Those farmers who had access to extension services improved their skills and knowledge on maize farming and hence realized more output and relatively high incomes as compared to those who did not. Similar findings were reported by Danso-Abbeam et al. (2018) who found that extension program led to an increase

in farm income by 11.3% to 111.3% in Ghana. Kwaghe et al. (2009) also reported that access to extension agents is likely to increase farmer income by 46.1% in Nigeria. Similar results were also reported by Omotayo et al. (2021) who found that extension visits to likely influence household income by approximately 114.3%. The findings by Ng'eno (2019), who established a positive and significant relationship between dairy extension services access and daily marketed milk output further supports these findings that extension influence income.

V: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The results of estimates of the effect of socio-economic factors on household income revealed that age, education level, and land size were statistically significant at 1% level with 0.604, 0.782, and 0.308 positive coefficients, respectively. Farming experience statistically significant at 5% level with 0.329 positive coefficient. However, marital status and family size negatively determined small-scale maize farmer household income in the study area. Marital status, and family size were significant at 5% and 1% level with 0.281 and 0.098 negative coefficients, respectively.

5.2 Recommendation

This study recommends the need for policy makers both at the national and county governments to formulate or review agricultural land use policies. There is need to regulate land fragmentation since land size under crops is reducing every season for other purposes, yet increasing land acreage improves household income. There is also need to improve transport infrastructure to movement of maize output to the nearest markets and outlets.

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