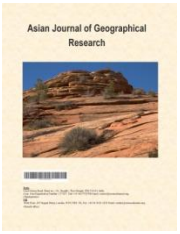

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Examination of the Socio-Economic Factors Influencing Sustainable Food Production in Arid and Semi-Arid Lands of Elgeyo Marakwet County, Kenya

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Food insecurity has remained a major challenge to many developing countries. The Food and Agricultural Organization, estimates that 842 million people have suffered from lack of food access, resulting in undernourishment. Kenya's rural and urban areas, have been suffering from food insecurity since independence. Previous case-studies have shown that, although various governments and donor agencies' have attempted to sponsor food-production programs, execution has remained a challenge. Elgeyo Marakwet has previously been experiencing famine intervention projects from World Vision Kenya, Community Agricultural Development for Semi-Arid Lands, National Agriculture and Livestock Extension Program and Njaa Marufuku Kenya. The aim of this research was to examine the, organizational structure, socio-economic and capacity-building factors that contribute to sustainable food production in semi-arid and arid areas. The study used a descriptive survey research design to guide in the collection of data from a sample of 136 households using structured questionnaire. Data was analysed through cross-tabulation using Chi-square, ANOVA and percentages. In conclusion the research has revealed that organizational, demographic and capacity building factors are important in the improvement of food production. It is recommended that sustainable food security depends on developing sustainable local food production policy.

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Keywords: Arid and semi-arid land; climate change; food and agricultural organization; food security; food production; population; poverty.

1. INTRODUCTION

Globally, more than 870 million individuals are chronically hungry. The largest number of malnourished people lives in Pacific and Asian areas, while Sub-Saharan Africa's (SSA) population remains the largest concentration block of hungry people globally [1]. According to Food and Agriculture Organization (FAO) [2], food security is explained as a scenario existing where individuals have efficient access to socio-economic and physical needs, such as, sufficient nutritious and safe food which meets individuals' dietary needs and food preferences for an active and healthy life [3].

Hunger in SSA is dominant within the African narrative [4]. Further [4] has reported that hunger cases in Democratic Republic of Congo, Chad, Eritrea and Burundi as "alarming" based on the Global hunger index score [5]. Other Sub-Saharan African parts such as the Horn of Africa or southern Madagascar, have reached catastrophic dimensions [6]. Development indicator reports show that Sub-saharan Africa has been the second-most region to be affected severely by climatological disasters amongst the world's developing regions due to high temperatures where most inhabitants in the region are dependent on rain-fed agricultural production [7].

According to [8], about one hundred and twenty-one individuals living in Sub-Saharan Africa survived on less than 0.50 US dollars on daily basis and the decreasing rates in the production of food crops do not meet current population growth [8]. As [9,10] reports, undernourishment in Africa rose from 17.6% of the population in 2014 to 19.1% in 2019, more than twice the world average and highest of all regions of the world.

The large gaps between current food productivity in Africa and the yields that farmers harvest point to a major opportunity to increase food production [3]. For instance, the decreasing crop production per capita has been experienced in Kenya where crop on-farm agricultural production is lagging annually thus leading to food insecurity in the country [5]. [11] suggest that the solution for food insecurity is to increase food crop production that surpasses population growth.

The Kenyan government has put in place initiatives and implementation mechanisms to mitigate the current food situation, broadly described as formulated policies and programs that favour individuals' needs and influence food security within the country. Some of the long-term interventions include targeted food security programs such as National Accelerated Agriculture Input Access Programme [12], Orphaned Crop Programme [13], Njaa Marufuku Kenya [5], and Traditional High-Value Crop (THVC) Programme [14].

The larger part of Elgeyo Marakwet County which is classified as Arid and Semi-arid Land (ASAL), has on several occasions, been hampered by extreme weather conditions leaving the residents vulnerable to hunger [15]. In response to this, the Government of Kenya and other stakeholders have initiated several food security programs in the region such as furrow irrigation and Community Agricultural Development Project in Semi-Arid Lands (CADSAL), to attain food sufficiency [15]. Thus this study aimed at, examining the socio-economic factors influencing sustainable food production in arid and semi-arid lands of Elgeyo Marakwet County, Kenya using CADSAL as a case study. The study was guide by three questions (1) how does the CADSAL organizational structure influence the communities in implementing sustainable food production in Elgeyo Marakwet? (2) to what extent do demographic factors affect the implementation of sustainable food production programs in Elgeyo Marakwet? and (3) how does capacity building affect the implementation of sustainable food production programs in Elgeyo Marakwet

2. METHODOLOGY

The study was conducted at Elgeyo Marakwet County which borders West Pokot County on the Northern side, Baringo County on the Eastern side, Trans Nzoia County on the Northwest side and Uasin Gishu County on the Western side (Fig. 1). Elgeyo Marakwet County is divided into three topographic zones such as; the escarpments, Kerio Valley, the Highlands. The study area covered divisions of Tot,Tunyo,Soy and Tambach which lie in the Kerio Valley. There is a known rainfall variation within the three topographic zonations where, escarpments and Kerio valley receive rainfall range of 1000 mm to 1400 mm annually while the highlands receive a

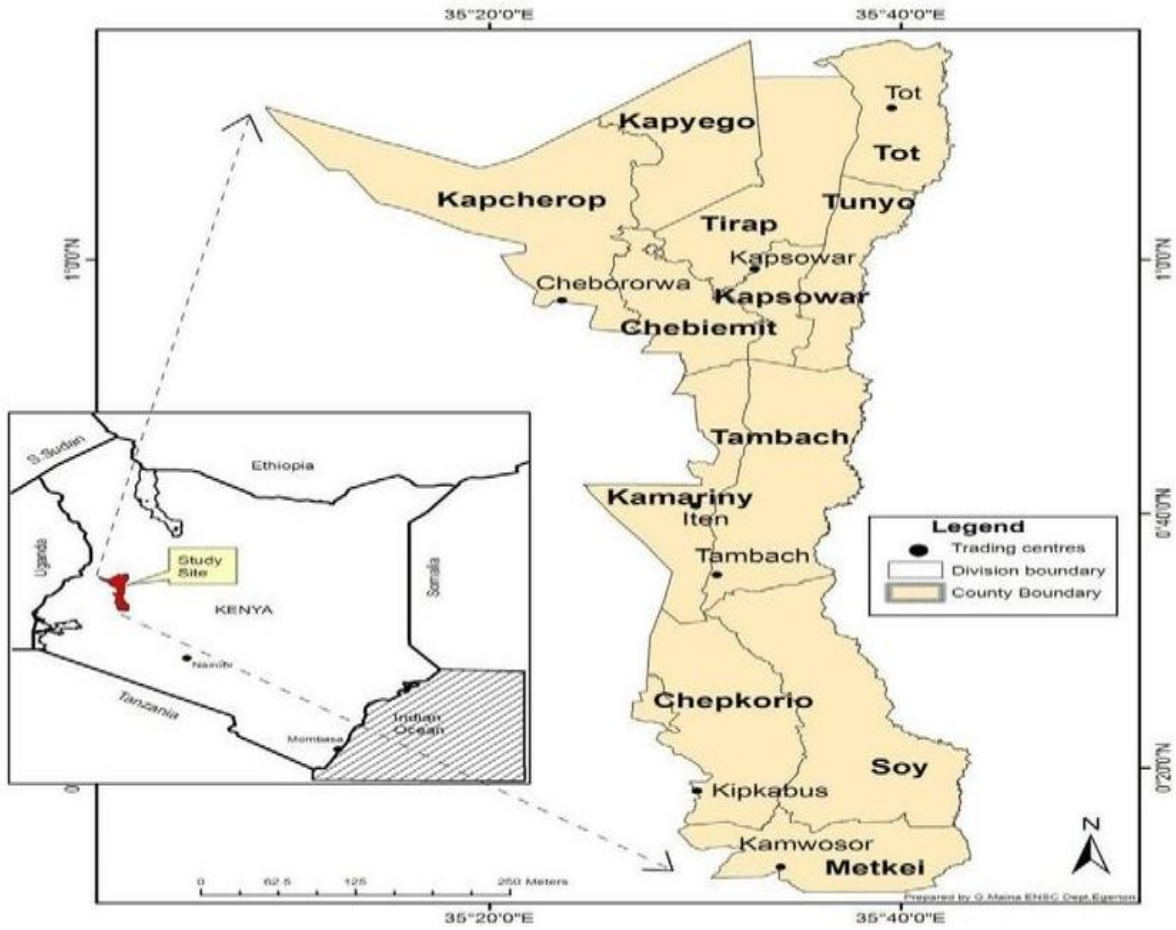

Fig. 1. Study area

rainfall range of 1200 mm to 1500 mm annually. Also, economically, the county depends on agriculture (crop production and livestock rearing) [16].

The study used a descriptive research design [17]. Descriptive research entails the identification of attributes based on observation of specified phenomena and conducting a correlation analysis between two or more phenomena [18, 19].

The sample population for this study was drawn from a list of direct beneficiaries of CADSAL implemented projects in Elgeyo Marakwet County who were one thousand eight hundred and sixty-six farmers (1,866). Thus using [20]'s method a total of 136 respondents were sampled for the study using random sampling approach. The survey questionnaire was used as the main research instrument for data collection. The quantitative data from questionnaires were analysed following both descriptive and inferential analyses using the Statistical Package for Social Sciences (SPSS). The descriptive analyses involved the tabulation of the sample distribution and presentation of the percentages for the responses to the Likert scale on the scale of 1 strongly disagree to 5 strongly agree. Also statistical correlation analysis to know the relationships between different study variables was done.

3. RESULTS AND DISCUSSIONS

3.1 CADSAL Organization Structure

CADSAL programs were funded by Japan International Cooperation Agency (JICA) through the support of the Japanese government and implemented in Keiyo and Marakwet districts in collaboration with the Government of Kenya ministry of agriculture by working with the communities (Fig. 2). The programs used two approaches as follows (i) Community Initiative Project (CIP), which assists community groups in formulating and implementing a plan and, (ii) community participatory technology

development, which allows communities to introduce better techniques, varieties, and breeds, e.g., (New Rice for Africa) NERICA rice and dairy goats both of which contribute directly to food security demands of the community. Communities were able to own the projects because, under CIP, CADSAL supported the initiated project at about 80% of the project unit, while the beneficiaries provided 20%. To grow the knowledge and skill of CIPs groups, members were given opportunities of training in these activities, which also encompassed other community members of Kerio Valley. The following (Fig. 1) shows the project organizational organogram.

The organizational structure included the Ministry of Agriculture which developed the Bilateral Agreement with JICA and which provided overall policy direction during the entire project. JICA provided financial and technical support to the project. Relevant Government Agencies responsible for agricultural production at the inter-ministerial levels and county levels were involved in the development of project document with all its structures and institutions to enable implementation of CADSAL project, including monitoring and evaluation at both National and County levels. The purpose of Kenya Agricultural and Livestock Research Organizations (KARLO) in the project was to development innovations and technologies for improving food security in ASAL. CADSAL involved the project team tasked with the implementation of the project through two initiatives that included top down approach that transferred technologies and innovations to the farmers' groups under Community Participatory Technology Development (CPTD) and bottom up approach that assisted farmers' initiated projects aimed at increasing food production under the CIPs (Table 1).

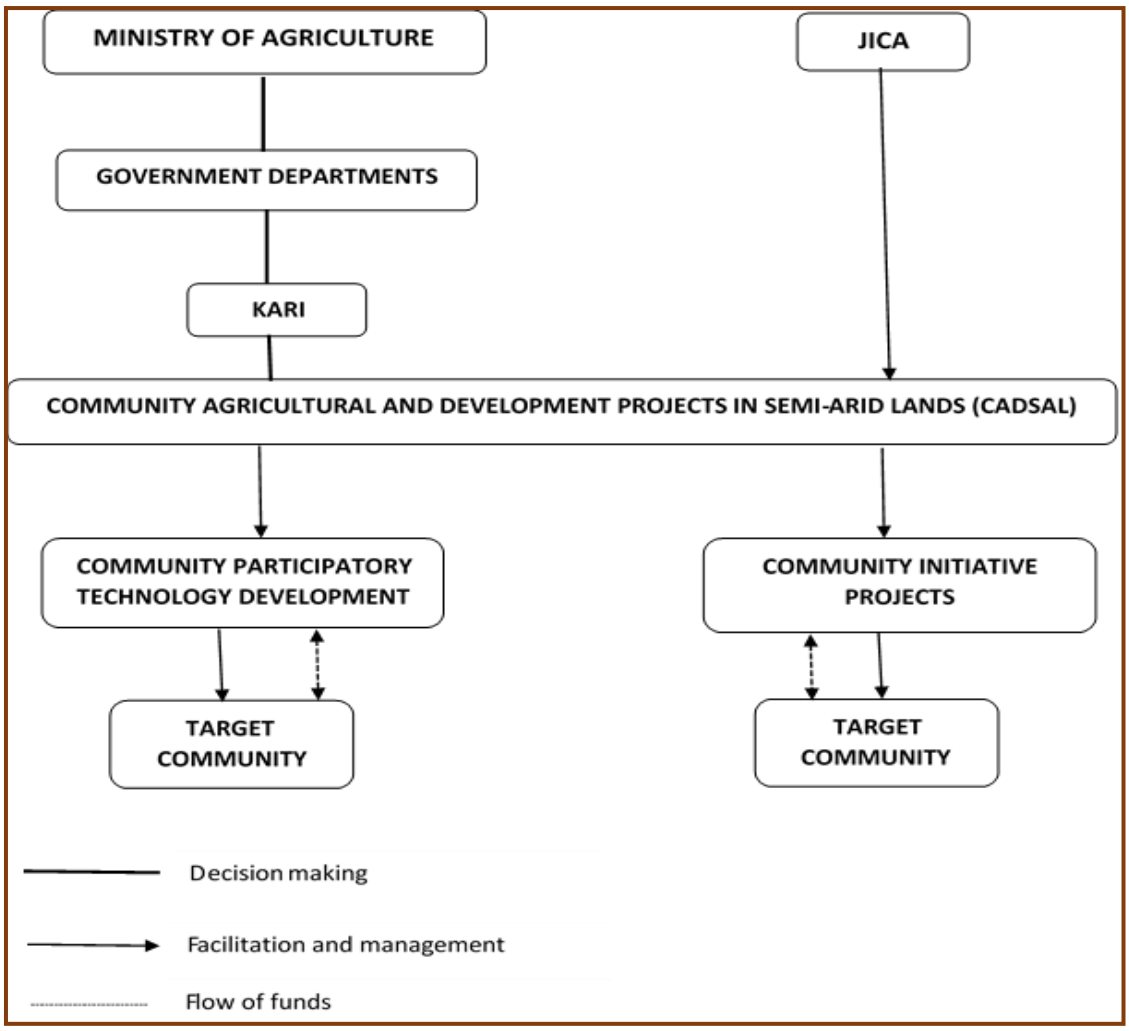

Fig. 2. Community agricultural development project in semi-arid lands (CADSAL) organogram

Table 1. Summary of the roles of the participants in the project

Institution	Roles in the Project
Ministry of Agriculture	Policy formulation/ direction Deployment/secondment of personnel to the project
Japan International Cooperation Agency (JICA)	Financial and technical assistance.
Relevant government department's e.g. Livestock, Irrigation, Environment, Social services.	Project development Project monitoring and evaluation
Community Agricultural Development project in Semi-Arid lands (CADSAL)	Project implementation Technical backstopping Project reporting
Target communities and groups	Project implementation at grass roots (both through CIPs and CPTDs) Mobilize local resources for the implementation of project such as land and locally available resources. Farmer to farmer extension.

3.2 Influence of Demographic Factors on Food Sustainability

The study also wanted to establish the demographic factors that influence sustainable food production such as gender, age, marital status, family type, family size, and level of education on overall food sustainability. This was achieved through cross-tabulations of the various demographic variables and then the Chi-Square results provided.

In the case of gender, Table 2 shows that the Pearson chi-square p-value is greater than 0.05, thus indicating that there is no association between gender and sustainable food production $(X^2(3) = 1.674, p = 0.643)$.

In the case of age, Table 3 shows that the Pearson's Chi-Square P-Value is greater than 0.05, thus there is no association between age and sustainable food production $(X^2(9) = 12.272, p=0.198.$

When marital status was tabulated, in Table 3 the Pearson chi-square p-value was found to be less than 0.05 thus showing an association between marital status and sustainable food production. This was confirmed from the study due to the fact that those in marriage and not widowed were more sustainable in food production compared to those widowed.

In the case of family type, Table 4, the Pearson's Chi-Square P-Value was found to be less than 0.05, which was a clear indication that there is an association between family type and overall food production sustainability $(X^2(6) = 13.331, p = 0.038)$. In fact the research found that female-headed houses (FHH) were more food insecure than male-headed homes (MHH).

In the case of family size Table 6 results show that Pearson's Chi-Square P-Value is less than 0.05, thus indicating that there is an association between family size and food sustainability

Table 2. Gender and sustainable food production

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	1.674[a]	3	.643
Likelihood Ratio	2.067	3	.559
Linear-by-Linear Association	1.392	1	.238
N of Valid Cases	136		

a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .49.

Table 3. Age and sustainable food production

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	12.272[a]	9	.198
Likelihood Ratio	13.697	9	.134
Linear-by-Linear Association	.064	1	.800
N of Valid Cases	136		

a. 8 cells (50.0%) have expected count less than 5. The minimum expected count is .21.

Table 4. Marital status and sustainable food production

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	18.266[a]	6	.006
Likelihood Ratio	20.793	6	.002
Linear-by-Linear Association	.405	1	.525
N of Valid Cases	136		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .05.

Table 5. Family type and sustainable food production

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	13.331[a]	6	.038
Likelihood Ratio	15.551	6	.016
Linear-by-Linear Association	.724	1	.395
N of Valid Cases	136		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .06.

Table 6. Family size and sustainable food production

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	15.356[a]	6	.018
Likelihood Ratio	18.796	6	.005
Linear-by-Linear Association	.427	1	.513
N of Valid Cases	136		

a. 8 cells (66.7%) have expected count less than 5. The minimum expected count is .04.

$(X^2(6) = 15.356, p = 0.018)$. However, the relationship might be influenced by other factors such as land size under production and occupation of household breadwinners. Also a negative and significant relationship between food security and family size was observed. Therefore, we can conclude that the size of the family negatively impacts on food sufficiency.

Finally the results on the level of education Table 7 shows that the Pearson's Chi-Square P-Value is greater than 0.05, thus there is no association between educational level and overall food sustainability $(X^2(12) = 11.470, p = 0.489)$. Even though this results do not concur with GOK [21] research that found a significant relationship between education and food production.

3.3 Capacity Building and Sustainable Food Production

The study sought to determine how capacity building influenced sustainable food production in Elgeyo-Marakwet County. The R-value (0.95) from the model summary table designates a high correlation between capacity building and sustainable food production. Additionally, 90.2%

Table 7. Educational level and sustainable food production

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	11.470[a]	12	.489
Likelihood Ratio	11.366	12	.498
Linear-by-Linear Association	1.011	1	.315
N of Valid Cases	136		

a. 12 cells (60.0%) have expected count less than 5. The minimum expected count is .18.

Table 8. Capacity building and sustainable food production

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.950[a]	.902	.902	.08410	.902	1239.909	1	134	.000	.369

a. Predictors: (Constant), CB_Overall
b. Dependent Variable: SFP_Overall

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.770	1	8.770	1239.909	.000[b]
	Residual	.948	134	.007		
	Total	9.717	135			

a. Dependent Variable: SFP_Overall
b. Predictors: (Constant), CB_Overall

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.608	.106		5.719	.000		
	CB_Overall	.828	.024	.950	35.212	.000	1.000	1.000

a. Dependent Variable: SFP_Overall

of sustainable food production can be explained by capacity building. The ANOVA table illustrates capacity building to be statistically significantly in predicting sustainable food production $(F(1,134) = 1239.91, p < 0.0005)$ and $(t = 35.212, p < 0.0005)$ respectively. Capacity-building initiatives have existed in Kenya ever since colonial governments, the ministry of agriculture is mandated by law to carry out capacity-building programs to assist farmers in acquiring skills and knowledge about food production.

4. CONCLUSION, POLICY OPTIONS AND RECOMMENDATIONS

The study answered three questions in sustainable food production using CADSAL case study, (1) how does the CADSAL organizational structure influence the communities in implementing sustainable food production in Elgeyo Marakwet? (2) to what extent does demographic factors affect the implementation of sustainable food production programs in Elgeyo Marakwet? and; (3) how does capacity building affect the implementation of sustainable food production programs in Elgeyo Marakwet? It is concluded that the organizational structure plays a significant role in sustainable food production. Also there is no association between gender and education levels to sustainable for production, but there is an association between age, marital status and family size to sustainable food production. Finally it can be concluded that capacity building is statistically significantly in predicting sustainable food production. In terms

of policy, in order donors and host governments implanting projects on sustainable food production to succeed, they have to understand the operation structure of food production, demographic and the capacity building factors affecting the local communities. They have to strengthen the process of building local capacities over a long period of time so that the communities can internalize the sustainable food processing techniques. It is recommended that sustainable food security depends on developing sustainable local food production policy. There is also a huge demand for assistance of the local communities in developing food production policy and programs aimed at sustainable food production so as to reduce poverty and hunger.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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