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Agroecological Practices' Influence on Social-Economic Development of Farmers in Makueni County, Kenya

Mwasezi Martha Majina[1*], John Musau[2], Andrew Kwonyike[3]

[1]Postgraduate student, Machakos University, Kenya

[2,3]Lecturer, Department of Environmental Sciences, Machakos University, Kenya

https://orcid.org/0009-0003-7904-3918

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ABSTRACT

Purpose: The purpose of this study was to investigate the influence of agro-ecological practices (AGP) on socioeconomic development (SED) of farmers in Makueni County, Kenya. The study specifically determined the relationship between agro-ecological practices and social-economic development of farmers.

Methodology: The study utilized quantitative research approach and descriptive cross-sectional design. The population of study consisted crop growing farmers of 30 self-help groups. Stratification and proportionate sampling technique was utilized to obtain a sample size from 280 targeted farmers of self-help groups. 163 respondents were the sample selected through proportionate sampling as a representative of the whole population.

Findings: Study findings' revealed that agro-ecological practices significantly influence social-economic development of farmers at about 15.5%. The findings revealed a link between agro-ecological practices and social-economic development of farmers.

Unique Contribution to Theory, Policy and Practice: The findings of this study aim to contribute to the growing concerns regarding population growth, climate change, rural-urban mobility, growing demand on natural resources and food crisis caused by the perennial and costly drought. Further, contribute to the application of agroecological practices by farmers in arid and semi-arid areas in order to enhance their social-economic development status with the aim to enhance food security in arid and semi-arid areas.

Keywords: *Agro-Ecological practices, Farmers, Social-Economic Development, Sustainability, Kenya*

INTRODUCTION

It is estimated that the global population will reach 9.1 billion people by 2050 (United Nations, 2009), indicating the need to increase food production. This exponential growth in world population would require an additional 30% of food and thus the agricultural sector throughout the world ought to transform to produce this extra food (Kinnunen et al., 2020). For example, there is an increasing demand for farmers to produce not only in large quantities, but also in environmentally friendly, economically beneficial, and socially equitable ways (Lajoie-O'Malley, 2020). Climate change effects are also visible, as evidenced by prolonged droughts and flooding. Social-economic development status of people across the world continue to decline as food insecurity continue to rise. The decline in social-economic status of people in arid and semi-arid land (ASAL) areas is worse in comparison to other areas, as these areas are naturally disadvantaged (Hag Husein, et al., 2021). Although social development has been defined differently in many contexts, in this context, social development refers to the capacity to ensure market accessibility, enhance inclusivity in crop production, improve security, education, health, and welfare, and ensure that all of these are provided equally regardless of social class or gender of the farmer. On other hand, economic development in this context refers to farmer's ability to generate income, employment opportunities, develop agri-infrastructure and increase crop yields for the population's long-term survival. ASAL areas can make significant contributions to development despite their contribution being overlooked (Hag Husein et al., 2021). Climate change, food insecurity, droughts, and floods are the most severe threats to the success of development initiatives in ASAL areas (Kogo, et al., 2021).

Famine has been identified as a major cause of death in ASAL areas, and various research studies have indicated that if nothing is done, many people are likely to continue dying from hunger (Mansoor, et al., 2022; Muthamilarasan & Prasad, 2021). According to FAO et al. (2018), 821 million people are facing hunger in the world. This indicates that the food systems and agricultural activities in the world are not able to achieve food demands. Furthermore, contemporary food systems have had a significant impact on nutrition and food security through their health and economic implications (Myers et al., 2017). For example, many food producers are struggling to make ends meet due to poor income, and small and medium-sized food businesses are experiencing economic insecurity.

In ASAL areas, agroecology has become a major factor in transforming food systems and minimizing the effects of climate change. Agroecology enables farmers, particularly in ASAL areas, to adapt and develop resilience to many challenges posed by climate change, while also making nutritious food available to the region's entire population (Bryan, et al., 2013). Agroecological practices are not new in ASAL areas such as Kenya's Makueni County. These practices are ingrained in traditional practices such as traditional water-harvesting systems, small-scale and family farming, and so on (Githunguri & Njiru, 2020). Agro-ecological practices (AGP), according to researchers Chable, (2020), González-Chang et al. (2020), Schoonhoven and Runhaar

(2018), are farming systems that aim to improve ecosystem sustainability while also providing economic, social, and environmental benefits to farmers and communities. Localized, diversified, and resource-efficient farming systems which form agroecological practices offer a pathway to sustainable food security (Michael et. al, (2022). The adoption of AGP in agriculture has recently increased (González-Chang et al, 2020). However, there is little literature in Kenya on the incorporation of AGP in farming, particularly in semi-arid and arid areas. Although previous research has supported the existence of a link between agro-ecology and farmer development (Bellocchi et al., 2015; Nicholls & Altieri, 2012), few empirical studies have examined the impact of AGP on farmers' social and economic development. Most of the previous studies on this subject have focused more on the contribution of AGP to agricultural sustainability. For instance, Wezel et al. (2014) classified agroecological cropping practices in terms of substitution, redesign, and efficiency, but left out the relationship between AGP and farmer social and economic development. Furthermore, Maitra et al. (2021) suggested that intercropping practices use relatively low input and improve agro-ecology quality. It is against this background that this research sought to fill the gaps and add information to the literature by providing empirical data regarding the influence of agro-ecological practices on the social-economic development of farmers in Makueni County, Kenya.

Water scarcity, frequent drought, extreme heat, erosive rain, and wind all have a significant impact on farming in Makueni County. These factors have reduced crop yields, exacerbated food insecurity, and increased poverty in the county (Mdemu, 2021). Furthermore, soil fertility has declined, and there is no longer enough food to feed the families. Although much research has been conducted on how AGP influence farmers' social-economic development, the resulting factors from these studies are mostly biased towards wetlands, leaving dryland areas such as Makueni County in Kenya without a proper guide to adopting agro-ecological practices (Bey, 2021; Rettberg et al., 2017). The models that have been proposed by researchers' lean towards fish farming and make it too wide for crop farming in dryland to fit because these practices differ from one farming practice to another (Ahmad et al., 2022). Consequently, crop farming in drylands has been purely driven by culture. The recent private and non-governmental organization's crop farming initiatives have not been able to fully improve the situation, as they are inadequate. Also, the proposed initiatives overlook water limitation and crop complete chain processes, which are the key components and linkages in enhancing food security. Currently, climate change is posing several challenges to the Makueni population regarding the use of land. Poverty, family conflicts and recurrent food insecurity are just few symptoms of the major problem. The type of mitigation required in this case should be able to respond to scientific research and agricultural practices that improve optimal crop yields and community members' living standards.

Kiswii et al. (2022) conducted a study in Makueni County to determine how land sizes affect agricultural produce produced by farmers. The study found that there was a small difference in land size between households that were food secure and those that were food insecure, so p=0.021

is less than a=0.05. Furthermore, there is a link between household land size and livelihood security. According to the study, culture, farm income, topography, and land quality are some of the major factors influencing household land sizes. The study also suggests that farmers be educated on the effects of additional land subdivisions, land curb selling, and land consolidation. The minimum land size proposed for sustainable food production was 10 acres. Scholarly research demonstrates that understanding farmers' crop selection decisions is critical (Yuan et al., 2021). Yuan et al. (2021) further claim that farmers are more sensitive to climate change, which influences their crop selection decisions. Crop rotation, on the other hand, is seen as the process of sequentially planting different crops on the same plot of land to optimize nutrients and improve soil health (Pehlivan et al., 2021). Farmers have adapted crop rotation to reduce insect, weed, and pathogen pressure and increase crop diversity (Zhao et al., 2020). However, while crop choice and rotation are beneficial to farmers, researchers Selim et al (2019) suggested that crop choice and rotation are risky, do not allow farmers to focus on a single crop for high yield, and require a lot of knowledge and skills that many farmers lack.

Crop selection and rotation aid in minimizing food contamination, increasing soil microbial structure, high land use efficiency, and superior yield. Farmers are thus encouraged to adopt this agro-ecological practice for the benefit of social and economic development. Organic fertilization critical to the global food supply chain and is required to sustain crop production for the growing population (Avery, 2021). However, while organic fertilization practices may be beneficial to product production, scholars Keel et al. (2019) argue that there is still a difference between organic and inorganic fertilizers and that organic fertilizers may not be environmentally friendly. Organic fertilization practices are pivotal contributors in increasing crop yields as they improve the soil aeration and microbial nature. Therefore, the goal of this research was to investigate the influence of agro-ecological practices on the social-economic development of farmers in Makueni County, Kenya (Figure 1). The study attempted to suggest intervention measures that would help optimize crop yields and improve the living standards of the local community.

Conceptual Framework

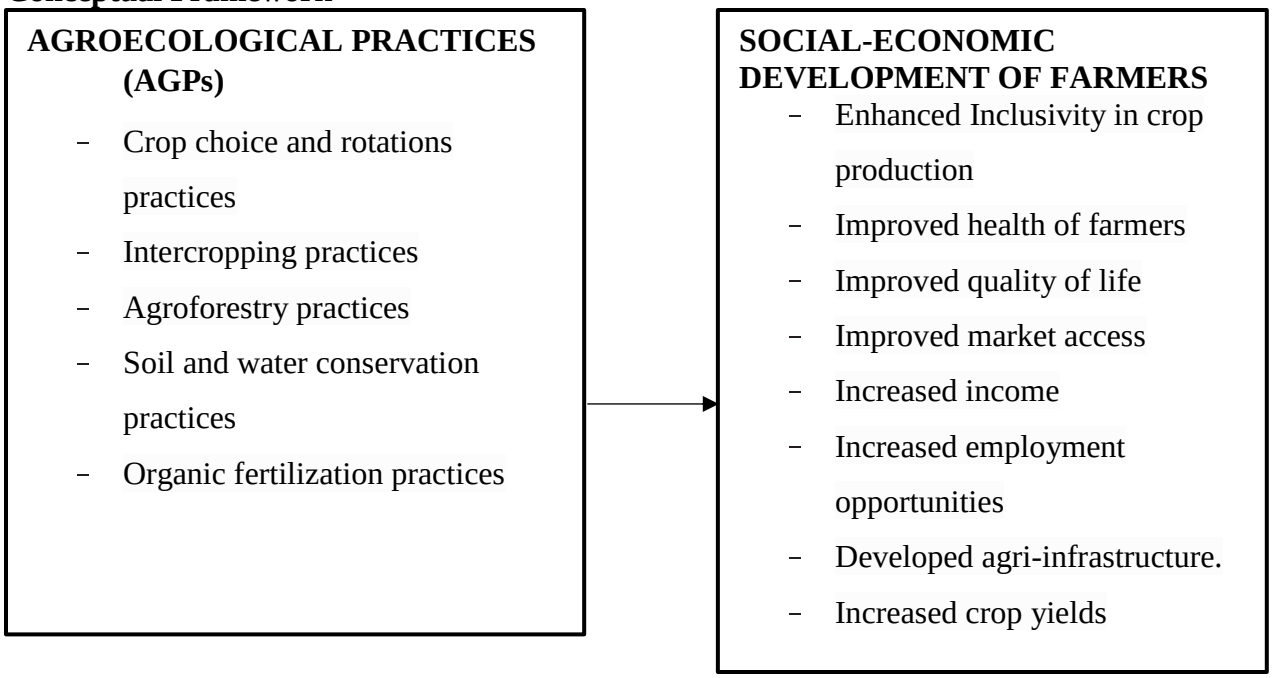

Figure 1 Conceptual Framework (Authors, 2025)

METHODOLOGY

Description of the study area

The study targeted crop growing farmers operating within Makueni sub-county and Kibwezi East sub-county in Makueni County, Kenya. Makueni County has six sub-counties. According to 2019 census, the population for Makueni County is 987,653 consisting of 497, 942 females and 489,691 males (KNBS, 2019). Kibwezi East sub-county one of the Makueni sub-counties under study covers an area of 1,209.6 square kilometres and has a population of 132,199 while Makueni sub-county that covers area of 1,571.9 square kilometres has a population of 193,802 (KNBS, 2019). Kibwezi East and Makueni sub-counties lies in the arid and semi-arid zones of the county. The terrain lies low from 600m above sea level. The area is great in terms of its natural diversity and geography and a good representation of semi-arid and arid areas and thus its selection for this study. Also, with rising agro-ecology awareness in the agriculture sector and farmers in the agro-ecology being relatively new to the farming practice, it was assumed that farmers had mainstreamed Agro-ecological practices in their farming.

Sampling design

The study utilized quantitative research approach and descriptive cross-sectional design. The design was selected because it enables data collection on a sample of cases at a single point in time (Bryman, 2016; Bell et al., 2019). This enables variables to maintain their characteristics within

the short period of collection of data, hence allowing suggestions to be made regarding relationships between variables as per the data collected via the survey (Saunders et al., 2009). The study targeted crop growing farmers operating within Makueni sub-county and Kibwezi East sub-county in Makueni County, Kenya. The area is great in terms of its natural diversity and geography and a good representation of semi-arid and arid areas and thus its selection for this study. The population of study consisted crop growing farmers of 30 self-help group, with approximately 280 farmers in total to be selected based on list of groups by the Makueni Department of Social Development as at January 2023. These farmers from self-help groups were selected because they greatly get engaged in farming practices. The study selected a sample size of 163 farmers from 280 farmers belonging to self-help groups, using a statistical formula for calculating the sample from a larger population. The farmers were stratified based on their sub-county locations, and a proportionate sampling technique was employed to determine the number of respondents from each sub-county. The 163 farmers from the 30 self-help groups were reached and asked to take part in the survey. Van Dalen's formula was used to draw proportionate samples from each sub-county. A researcher-guided questionnaire was used as a data collection instrument to enable collection of quantitative data.

Collection of Data

The respondents were guided in filling in the questionnaire to enable in-depth insights. Using a 5-point Likert scales, questions addressing objective were quantified. Likert scales was utilized to enable data be collected from large respondents' number and allow establishment of interpretation validity through numerous means (Nemoto & Beglar, 2014). For AGP, the respondents were required to score on a 5-point Likert scale the prevalence of the AGP in their farms as per the measurement items. The measurement continuum was as follows. 1 -less than 20% prevalence; 2-between 21% - 40% prevalence; 3 -between 41% - 60% prevalence; 4 - between 61% - 80% prevalence 5 – between 81% - 100% prevalence. For socio-economic development, the respondents were needed to mark on a 5-point Likert scale the socio-economic development indicators linked with AGP. The measurement continuum was as indicated below; 1 – less than 20% linked with AGP;2 – 21% - 40% linked with AGP;3 – 41% - 60% linked with AGP; 4 – 61% - 80% linked with AGP;5 – 81% - 100% linked with AGP.

A pilot study was conducted involving 20 respondents, which is 10 percent of the main sample size (Connelly, 2008). The primary objective of the pilot study was to test the validity and reliability of the questionnaires. Feedback from the respondents was sought to assess the clarity and comprehensibility of the questionnaire's content. Any errors or issues identified were corrected based on the findings from the piloting study. The questionnaires were distributed to the pilot respondents, and their filled responses were collected for analysis. The data collected during the piloting phase was carefully analyzed, and necessary adjustments was made to ensure the effectiveness and accuracy of the questionnaires for the main study.

Data Analysis

The data analysis involved quantitative analysis of the collected data. The data was edited, coded, and entered in IBM SPSS 22. Linear regression analysis was conducted to determine the influence of AGP on social-economic development of farmers in the study areas. The regression equation was expressed as follows:

$$Y = \alpha + \beta_1 X_1 + \cdots + \beta_n X_n + \varepsilon$$

Where, Y was the dependent variable (social-economic development of farmers), X_n were the independent variables (different AGPs).

Results and Discussion

Social-economic development

The study investigated social-economic development measures of farmers using a scale ranging from less than 20% indication, between 21% – 40% indication, between 41 – 60% indication, between 61 – 80% indication to between 81% – 100% indication. The results were as shown in table 1;

Table 1: Social-economic development

				Valid	Cumulative
Improved health		Frequency	Percent	Percent	Percent
Valid	less than 20% indication	21	12.8	12.8	12.8
	between 21% – 40% indication	32	19.5	19.5	32.3
	between 41 – 60% indication	42	25.6	25.6	57.9
	between 61 – 80% indication	40	24.4	24.4	82.3
	between 81% – 100% indication	29	17.7	17.7	100.0
	Total	164	100.0	100.0	
				Valid	Cumulative
Improved quality of life		Frequency	Percent	Percent	Percent
Valid	less than 20% indication	21	12.8	12.8	12.8
	between 21% – 40% indication	27	16.5	16.5	29.3
	between 41 – 60% indication	45	27.4	27.4	56.7
	between 61 – 80% indication	39	23.8	23.8	80.5
	between 81% – 100% indication	32	19.5	19.5	100.0
	Total	164	100.0	100.0	
				Valid	Cumulative
Enhanced market access		Frequency	Percent	Percent	Percent
Valid	less than 20% indication	20	12.2	12.2	12.2
	between 21% – 40% indication	35	21.3	21.3	33.5
	between 41 – 60% indication	44	26.8	26.8	60.4
	between 61 – 80% indication	35	21.3	21.3	81.7
	between 81% – 100% indication	30	18.3	18.3	100.0
	Total	164	100.0	100.0	
				Valid	Cumulative
Inclusivity in crop production		Frequency	Percent	Percent	Percent
Valid	less than 20% indication	20	12.2	12.2	12.2
	between 21% – 40% indication	37	22.6	22.6	34.8
	between 41 – 60% indication	42	25.6	25.6	60.4
	between 61 – 80% indication	33	20.1	20.1	80.5
	between 81% – 100% indication	32	19.5	19.5	100.0
	Total	164	100.0	100.0	
				Valid	Cumulative
Income from the farm has increased		Frequency	Percent	Percent	Percent
Valid	less than 20% indication	19	11.6	11.6	11.6
	between 21% – 40% indication	34	20.7	20.7	32.3
	between 41 – 60% indication	44	26.8	26.8	59.1
	between 61 – 80% indication	40	24.4	24.4	83.5
	between 81% – 100% indication	27	16.5	16.5	100.0
	Total	164	100.0	100.0	
				Valid	Cumulative
Agri-infrastructural development		Frequency	Percent	Percent	Percent

Valid	less than 20% indication	10	6.1	6.1	6.1
	between 21% – 40% indication	32	19.5	19.5	25.6
	between 41 – 60% indication	73	44.5	44.5	70.1
	between 61 – 80% indication	39	23.8	23.8	93.9
	between 81% – 100% indication	10	6.1	6.1	100.0
	Total	164	100.0	100.0	

Increased crop yields		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 20% indication	1	.6	.6	.6
	between 21% – 40% indication	23	14.0	14.0	14.6
	between 41 – 60% indication	38	23.2	23.2	37.8
	between 61 – 80% indication	77	47.0	47.0	84.8
	between 81% – 100% indication	25	15.2	15.2	100.0
	Total	164	100.0	100.0	

Increased employment opportunities from farm		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 20% indication	6	3.7	3.7	3.7
	between 21% – 40% indication	24	14.6	14.6	18.3
	between 41 – 60% indication	57	34.8	34.8	53.0
	between 61 – 80% indication	67	40.9	40.9	93.9
	between 81% – 100% indication	10	6.1	6.1	100.0
	Total	164	100.0	100.0	

Source: (Authors, 2025)

Overall, the data from above table 1 suggests that agro-ecological practices contribute positively to socio-economic development, with a wide range of perceived effects across different indicators. For most indicators, a significant portion of respondents (over 50%) reported an effect of 41% or higher, indicating a moderate to high level of positive influence. The findings on the improved health, improved quality of life, enhanced market access, inclusivity in crop production, income from the farm, agri-infrastructural development, increased crop yields and increased employment opportunities measures of social-economic development ranged along the entire continuum of the scale; from less than 20% indication to between 81% -100% indication. This is attributed to the adoption and implementation of agro-ecological practices. As such the implementation of agro-ecological practices were determined on whether the farmers experienced social-economic development or not.

The majority of respondents (67.7%) indicated that agro-ecological practices led to an improvement in health of 41% or more, with 17.7% reporting an 81-100% indication of improvement. Similar to health, 70.7% of respondents perceived an improvement in quality of life of 41% or higher, and 19.5% saw an 81-100% indication. Over two-thirds of respondents (66.5%) reported enhanced market access at a 41% or higher indication. Inclusivity in Crop Production,

while still positive, showed a slightly lower perceived effect compared to others. 65.2% of respondents indicated inclusivity at 41% or higher, with 34.8% indicating between 21-40% or less. This suggests that while agro-ecological practices contribute, there might be persistent challenges in fully achieving inclusivity. A substantial 67.7% of respondents reported an increase in farm income of 41% or more, indicating a strong positive correlation between agro-ecological practices and financial benefits. Agri-infrastructural Development indicator had the highest proportion of responses in the middle range, with 44.5% of respondents indicating an impact between 41-60%. Overall, 74.4% reported an impact of 41% or higher, suggesting a notable contribution to infrastructural development. Increased Crop Yields was the most positively perceived indicator, with a striking 85.4% of respondents reporting increased crop yields at 41% or higher. A significant 47% indicated an increase between 61-80%. Over three-quarters of respondents (75.8%) reported increased employment opportunities at 41% or higher, with 40.9% falling into the 61-80% indication range.

This study corroborates with Mouratiadou and Wezel's (2024) study that indicated that agro-ecological practices are linked positively to social-economic outcomes across the broad range of assessed metrics (51% positive, 30% negative, 10% neutral, and 9% inconclusive outcomes). Similarly, this study supports the findings by Rudolph and Zenda (2025), who found out that agro-ecological framework can improve economical sustainability and ecological resilience. Furthermore, the study agrees with Kamau et al. (2024) who found out that households that applied a comprehensive package that consists of ecological practices had a significant positive effect on farm income, increasing it by 9.2%. The study supports Miraji Kibwana Suleiman and Nyakwana (n.d) who argued that improvements in infrastructure would result in positive agricultural outcomes. Previous study had revealed that agro-ecological practices significantly enhance crop yield (Akinola et al., 2024), so this study confirmed these findings by highlighting the importance of organic farming and crop rotation. Study confirms previous argument by Rana et al. (2024) on leveraging agro-ecology to create jobs for young people in Africa, both on farms and in supply chains.

Agro-ecological practices influence on social-economic development

The study sought to determine the influence of agro-ecological practices on social-economic development in Makueni County, Kenya. The study's objective was achieved by regressing agro-ecological practices against the social-economic development factors. Agro-ecological practices under study were transformed to reduce the variables into one construct and the factor score was saved as a variable for subsequent regression analysis. The resulting factor score for agro-ecological practices was regressed against social-economic development factors to answer the question summarized below.

Is there a relationship between agro-ecological practices and social-economic development in Makueni County, Kenya?

Table 2 below indicates the analysis of variance (ANOVA) for social-economic development regressed against agro-ecological practices.

Table 2 Analysis of variance (ANOVA) for social-economic development factors

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	21.664	1	21.664	29.430	.000[b]
	Residual	118.514	161	.736		
	Total	140.178	162			

a. Dependent Variable: Social-economic development factors
b. Predictors: (Constant), Agro-ecological practices

Regression findings in table 2 show that regression model with agro-ecological practices as the predictors and social-economic development factors as the dependent variable was fit with F value (1, 161) = 29.43, p=.001

Table 3 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.393[a]	.155	.149	.85797

a. Predictors: (Constant), Agro-ecological practices

The model results shown in Table 3 above indicate that R^2 was 15.5%. This implied that agro-ecological practices (Crop choice and rotations practices, intercropping practices, Agroforestry practices, Organic fertilization practices, and Soil and water conservation practices) explain 15.5% of the variance in social-economic development. Agro-ecological practices emerged as significant influencers of social-economic development.

Existing literature reveals similar conclusions regarding the influence of agroecological practices on the social-economic development of farmers. For instance, Mutui et al. (2022) found out that applying agricultural technology in farming influenced the livelihood of farmers. Similarly, Chatterjee et al. (2021) revealed that agro-ecology has a significant effect on the development of farmers. Khan et al. (2024) in their study reported that organic fertilization was a critical factor in the global food supply chain and recommended that it should be embraced to sustain crop production for the growing population. Therefore, these results affirm and give further evidence that agro-ecological practices positively and significantly influence the social-economic development of farmers. However, these results contradict Keel et al. (2019) who argued that organic fertilizers may not be environmentally friendly, hence farmers do not utilize it as a sustainable practice. Farmers have applied many ways to increase their crop yields and enhance

their social-economic development. These ways include using animal manure, agroforestry, and intercropping and thus this explains the effect of agro-ecological practices on the social-economic development of farmers under study. In Kenya, most of the current studies are inclined to the relationship between agricultural technology and firm yields and not agro-ecological practices for the social-economic development of farmers, hence this study will fill this gap both theoretically and practically.

CONCLUSIONS

This study aimed at investigating the influence of agro-ecological practices on the social-economic development of farmers in Makueni County, Kenya. The agricultural industry largely depends on the environment to survive. This makes the management of the environment a critical aspect in all sectors of the economy. Throughout the world, farmers have developed agro-ecological practices to sustainably utilize the environment in their daily operations. To achieve the study's objective, a factor score was generated for agro-ecological practices from the observed variables, and the same was done for social-economic development factors. Linear regression was done to answer the research question coinciding with the objective and the findings show that agro-ecological practices significantly influenced the social-economic development of farmers. Social-development of farmers continues to be an essential issue in Kenya. A good understanding of the social-economic development of farmers is key in daily farming activities, policy formulations, and to agricultural stakeholders as a whole. Therefore, with the increasing population seeking food supply, there will be increased pressure on Makueni County land. The quality of soil for growing crops cannot be guaranteed in this case, hence the need to embrace agroecological practices to ensure quality of soil and continuity to yield more for sustained livelihood. Although the study showed that agro-ecological practices significantly influence the social-economic development of farmers, there is need for further studies to be conducted on many attributes utilized to measure agro-ecological practices and determine their influence on the social-economic development of farmers individually. Also, further investigation need to be done to determine how the influence of social development of farmers by agro-ecological practices complements economic development and vice versa.

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