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ORGANIC FARMING AND THEIR EFFECTS ON HOUSEHOLD FOOD SECURITY IN MANDERA EAST SUB COUNTY

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ABSTRACT

Purpose of the study: The objective of this study was to determine the effects of organic farming practices on household food security in Mandera East Sub-County, Kenya.

Statement of the problem: Despite Mandera East Sub-County's arid and semi-arid climatic conditions with erratic rainfall and scarce water sources limiting agricultural activity, the specific impact of organic farming practices on household food security in this context remained insufficiently understood.

Methodology: This study adopted a cross-sectional research design. The target population was 14,170 farm families in Mandera East Sub-County, from which a sample of 389 farm families was selected using stratified random sampling across three wards. Data were collected through questionnaires, focusing on quantitative information.Descriptive and inferential statistics were used for data analysis.

Findings: The study revealed that maize and sorghum are the primary and secondary crops, cultivated by 61.1% and 38.9% of respondents respectively. However, yields are generally low, with 80.2% of farmers harvesting only 15 to 50 kilograms of maize. A significant 94.6% of farmers reported harvests lasting less than four months, indicating a precarious food security situation. The

adoption of organic farming practices, particularly crop rotation and diversification, showed potential in promoting agricultural resilience.

Conclusion: The study concludes that while organic farming practices demonstrate potential for enhancing agricultural resilience, current adoption rates and yield levels are insufficient to ensure food security in Mandera East Sub-County.

Recommendations: The study recommends increased efforts to promote and support the adoption of organic farming practices, with a focus on improving crop yields and extending harvest longevity. Further research should explore barriers to adoption and strategies to enhance the effectiveness of organic farming in arid and semi-arid conditions.

Keywords: *Organic Farming Practices, Crop Rotation, Household Food Security, Mandera East Sub-County, Kenya.*

INTRODUCTION

The United Nations, through the Sustainable Development Goals (SDGs), emphasizes ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture by 2030. Food insecurity is the lack of access to adequate, safe, and nutritious food due to poor physical, social, and economic factors. The global population growth poses a potential crisis in terms of food security. The current objective is to ensure a sustainable and secure supply of safe, nutritious, and affordable high-quality food to meet the needs of the growing population. This must be achieved while using less land, reducing inputs, and considering the challenges posed by global climate change, environmental changes, and declining resources. Many developing countries continue to struggle with maintaining food security at both national and household levels. According to a report by FAO (2010), approximately 870 million individuals experienced undernourishment in terms of dietary energy supply between 2015 and 2016. This represents over 12.5% of the global population, with the majority, 852 million, residing in developing countries where the prevalence of undernourishment is estimated to be over 14.9% of the population.

The concept of food security includes the guarantee of universal and continuous availability of sufficient food, together with the ability of individuals to obtain it both physically and economically. It refers to ensuring that all individuals have consistent and unrestricted access to an adequate quantity of food, enabling them to maintain an active and healthy lifestyle. The World

Food Summit in 1996 defined food security as the condition in which individuals possess both physical and economic means to consistently get enough, secure, and nourishing food that satisfies their dietary requirements and preferences, enabling them to lead a healthy and active lifestyle. Based on the findings of the World Bank Report (2019), food security can be assessed through three key indicators: food availability, which pertains to sufficient food production; economic access to food, ensuring individuals have the means to obtain available food; and nutritional security, which is influenced by the presence of nonfood resources like childcare, healthcare, clean water, and sanitation. Women have a substantial, if not prevailing, role in providing all three essential components required to attain food security in underdeveloped nations.

The Government of Kenya (GOK) has repeatedly prioritized local food production as a strategy for addressing household food insecurity, as outlined in the Kenya Vision 2030 and the National Food Security and Nutrition Policy (NFSNP). Nevertheless, despite the development of strategic plans, the issue of household food insecurity remains prevalent due to the significant dependence on relief supplies among impoverished individuals, other vulnerable segments of the population, and brokers. In rural areas of Kenya, approximately 53% of the population is considered to be living in poverty, while 51% are classified as experiencing food poverty. Across Kenya, acute food insecurity remains elevated due to the impacts of drought on multiple below-average crop and livestock production, ineffective crop diversification, poor soil management, and ineffective water management practices. Kenya has favorable climate and soil conditions for agriculture. However, unsustainable farming practices have resulted in soil degradation, water pollution, and food insecurity. Sustainable agriculture is a key strategy for addressing these challenges and promoting economic growth and attaining food security.

Mandera East Sub-County is semi-arid and receives an average annual rainfall below 250mm. The area is vulnerable to droughts, solar heat from three directions, and moisture stress that affect the production, storage, and sale of agricultural harvest. Recurring flash floods affect crop production and restrict access to markets to sell produce. Occasional flooding of the Dawa River during long rains sometimes sweeps away crops, leaving farmers with massive losses. Therefore, Mandera East Sub-County, like any other county, has been under the intense influence of climate change. Some of the sustainable farming strategies and practices used in Mandera East Sub-County include farming systems based on conservation agricultural practices, the use of good seed of high-yielding

adapted varieties, integrated pest management, plant nutrition based on healthy soils, efficient water management, and the integration of crops, pastures, trees, and livestock.

Crop diversity involves the cultivation of a wider range of plant species in associations, sequences, and rotations that may include trees, shrubs, and pasture. The study, therefore, sought to establish the influence of sustainable farming strategies on household food security in Mandera East Sub-County in Kenya.

STATEMENT OF THE PROBLEM

Mandera East Sub-County is characterized by arid and semi-arid climatic conditions with very erratic and unreliable rainfall and scarce water sources, which limit agricultural activity in the region (FAO, 2001). While the county is putting efforts to increase the area under irrigation by developing solar irrigation infrastructure and exploiting groundwater sources, a large segment of the population in Mandera East Sub-County is unable to meet basic needs due to high poverty levels. This is occasioned by limited alternative economic activities, dependence on subsistence farming, unreliable weather patterns, low agricultural productivity, high economic dependency, and unemployment, among other factors (Grafton et al., 2015). Despite the fact that the region has fertile soils, only 4,000 ha is exploited against the potential area of 15,000-20,000 ha, whereas under rainfed agriculture, the exploited area is very low considering that the reliability of rainfall is below 30% (Matson et al., 1997). The region's main economic activity is agro-pastoral, which is limited by unreliable and erratic rainfalls that characterize the region, leaving the community unable to produce enough food to feed their families throughout the year.

OBJECTIVES OF THE STUDY

To establish the influence of organic farming on household food security in Mandera East Sub-County.

RESEARCH HYPOTHESIS

H_0: Organic farming does not have a significant effect on household food security

LITERATURE REVIEW

The literature included theoretical and empirical review.

Theoretical Review

The theoretical framework of this study was guided by two models: the Sustainable Livelihoods Framework Model and the Conservation Model. These models provide a philosophical basis for the research and link theory to practical components, as suggested by Kothari (2014).

The use of these models allows for a comprehensive understanding of the complex relationships between farming practices, environmental factors, and food security in Mandera East Sub-County. The Sustainable Livelihoods Framework Model, developed by the British Department for International Development (DFID), depicts stakeholders operating in a context of vulnerability with access to certain assets (Kollmair et al., 2002). This framework is highly relevant to the study as it helps understand the capabilities, assets, and activities that households in Mandera East Sub-County require for sustaining their livelihoods. It addresses the effects of organic farming practices, soil management, and irrigation on household food security by considering five types of capital: human, social, natural, physical, and financial (De Stagé et al., 2002). The model's emphasis on the interplay between assets, vulnerability context, and livelihood strategies provides a valuable lens through which to analyze the impact of sustainable farming practices on food security outcomes in the region.

The Conservation Model of agricultural development emphasizes the evolution of complex land and labor-intensive cropping systems, the use of organic manures, and effective use of land and water resources. This model has emerged as an alternative to conventional agriculture, aiming to reduce soil degradation through practices that minimize alterations to soil composition and structure (ECAF, 2001). It maintains a permanent or semi-permanent organic soil cover, which is crucial for protecting soil from environmental factors and maintaining soil fertility. The Conservation Model is particularly relevant to this study as it aligns with the principles of organic farming and sustainable soil management practices being investigated in Mandera East Sub-County. It provides a framework for understanding how these practices can contribute to improved agricultural productivity and environmental conservation (FAO, 2001; Fox et al., 1991).

Both theories are instrumental for this study as they provide practical perspectives on reducing poverty and making better use of agricultural resources. The Sustainable Livelihoods Framework offers an analytical tool to identify development priorities and new activities, placing focus on the poor people themselves by involving them in all planning processes (DFID, 2000).

The Conservation Model explains the relationship between organic farming practices, soil management, irrigation, and household food security in Mandera East Sub-County. These theories support the study's objectives of determining the effects of sustainable farming strategies on food security in the region, providing a robust theoretical foundation for analyzing the complex interactions between agricultural practices, environmental factors, and food security outcomes.

Empirical Literature

Nelson, Mapemba and Mathinda (2018) found that crop diversification is a viable option in smallholder farming that can ensure resilient agricultural systems contributing significantly to household food security. The results implied that government efforts to promote crop diversification should remain a priority policy direction due to continued malnutrition and food insecurity threats. Eva-Marie and Matin (2018) reported that organic farming, accounting for only 1% of global agricultural land, is lower yielding on average. They concluded that smart combinations of organic and conventional methods could contribute to sustainable productivity increases in global agriculture. Makate, Makate and Mango (2017) established that farmer perceptions significantly influence the use of sustainable agricultural practices. The results highlight the need for consideration of farmer perceptions in climate change adaptation policies.

Dereje, Degefa, and Seyoum (2021) found that factors such as education level, irrigation farming, and farm size positively affected Household Dietary Diversity. They recommended that stakeholders promote crop diversification strategies and expand access to irrigation to boost rural household incomes. Falco (2009) found that crop diversification can be a substitute for financial insurance in hedging against risk exposure. The study indicated that cultivating several crop species can help smallholder farmers manage price and production risks. Smithson (2016) concluded that yields from intra-specific crop mixtures were often slightly higher compared to pure stands. The study suggested developing strategies to make food and farming systems more resilient to climate change challenges.

Appiah and Maxwell (2022) revealed that crop diversification increased food access and reduced food insecurity experiences of households. They recommended policies promoting diversified crop production and sustainable soil management practices. Ali, Muturi, and Mberia (2018) found that low food production in Mandera East sub-County was caused by limited farm inputs and lack of crop diversification. Their findings suggest the need for customized interventions to solve food

insecurity in the region. Masuku and Selepe (2017) reported that Local Economic Development initiatives did not create job opportunities for local community members. They recommended creating a specific budget for implementing LED projects. Ballard (2011) reported that crop diversification contributes significantly to livelihoods, improved health, and household food security. The study emphasized the importance of including a broader range of crop species in production and consumption habits.

Gilbert and Tsey (2018) found that crop diversification has a positive effect on household food security status. They noted that factors such as access to extension services and storage facilities also affect food security. Gideon, Obedy, and Akelo (2022) suggested that efforts to promote crop diversification should focus on minimizing its effect on production costs. They recommended policies addressing labor constraints associated with crop diversification. Evans, Kavoi, and Collins (2020) reported that factors influencing crop diversification included age, education, and irrigation facilities. They recommended strengthening extension services and improving access to credit and irrigation facilities. These findings collectively emphasize the importance of crop diversification in enhancing food security, particularly for smallholder farmers. They suggest that policies should prioritize promoting crop diversity, especially in areas facing climatic variability and limited access to resources.

RESEARCH METHODOLOGY

The study employed a cross-sectional research design to examine the relationship between organic farming and food security in Mandera East Sub-County. The target population consisted of 14,170 farm families across three wards: Township, Khalalio, and Neboi. A sample size of 389 farm families was selected using stratified random sampling. Data collection utilized a structured questionnaire with both open-ended and close-ended questions, designed to capture demographic information and insights into organic farming practices. To ensure validity and reliability, a pilot test was conducted with 40 respondents, and Cronbach's Alpha was used to measure internal consistency. Data analysis was performed using SPSS version 36.0, employing descriptive statistics and binomial logistic regression to examine the relationship between organic farming and food security. This methodology allowed for a comprehensive assessment of organic farming's impact on food security in the region, providing valuable insights for addressing food shortages through sustainable farming practices.

RESEARCH FINDINGS AND DISCUSSIONS

The section presents the response rate and results were interpreted based on the data in Table 1.

Table 1: Response Rate

		Frequency	Percent
Valid	Filled Questionnaire	293	75.3
	Unfilled Questionnaire	96	24.7
	Total	389	100.0

The study achieved a highly satisfactory response rate of 75.3%, which is considered excellent for survey-based research. This rate exceeds the 70% threshold recommended by Fincham (2008) for reducing response bias and ensuring sample representativeness. Compared to similar studies in agricultural practices and food security, such as Ndambiri et al. (2012) and Kivuva et al. (2019), which reported response rates of 68% and 73% respectively, this study's response rate is notably strong. The high participation rate may be attributed to effective data collection strategies, including follow-up reminders and engagement with local agricultural officers. This approach aligns with Dillman et al.'s (2014) findings on the importance of personalized follow-ups and community involvement in survey research. The robust response rate enhances the reliability and validity of the study's findings, providing a solid foundation for analysis and inference in the context of organic farming and food security in Mandera East Sub-County.

Demographic Characteristics

The study revealed significant demographic patterns among farmers in Mandera East Sub County: Gender distribution showed a notable imbalance, with 86.3% male and 13.7% female respondents, indicating that farming in the region is predominantly male dominated. Age distribution highlighted an aging farming population, with 58.0% of farmers above 50 years old, 29.4% between 41-50 years, and 12.6% aged 35-40 years. Educational attainment was low, with 82.6% of respondents having no formal schooling, 11.6% completing primary education, and only 5.8% achieving secondary education. This suggests significant challenges in accessing education in the region. However, farming experience was extensive, with 43.0% having over 15 years of experience, 32.1% having 11-15 years, and 24.9% having 5-10 years. This high level of experience indicates a long-standing agricultural tradition, which could positively influence the adoption of sustainable farming practices.

These demographic characteristics provide important context for understanding the agricultural landscape and potential challenges in implementing new farming practices in Mandera East Sub County.

Descriptive Results on HouseHold Food Security

This section provides a comprehensive analysis of household food security among farmers in Mandera East Sub County. It examines primary and secondary crops (mainly maize and sorghum), seed sources, harvest quantities, and post-harvest losses. The analysis assesses crop yields, farming efficiency, and factors affecting food availability. It also estimates the duration of household food sufficiency based on harvested quantities and consumption rates. The utilization of harvests, including household consumption and market sales, is examined to evaluate economic impacts on food security. The study found that 61.1% of respondents identified maize as their primary crop, while 38.9% indicated sorghum as their secondary crop. This detailed analysis offers insights into the food security status of farming households and the effectiveness of their agricultural strategies in enhancing food availability and economic stability in Mandera East Sub County.

Table 2: First and Second Main Crop Frequencies

		Responses		Percent of Cases
		N	Percent	
First and Second Main Crop[a]	What has been your 1st [main] crop (Maize) during the last [season/harvest]?	264	61.1%	90.1%
	What has been your 2nd [main] crop (Sorghum) during the last [season/harvest]?	168	38.9%	57.3%
Total		**432**	**100.0%**	**147.4%**

a. Dichotomy group tabulated at value 1.

The "Percent of Cases" column reveals that 61.1% of respondents identified maize as their primary crop, while 38.9% indicated sorghum as their secondary crop. The total cumulative percentage of 147.4% implies that many respondents cultivate both a first and second main crop, a strategy commonly employed in mixed cropping systems to enhance overall yield and reduce agricultural risk. The higher percentage for maize as the primary crop (61.1%) highlights its significance among farmers, who likely favor it due to its reliability, yield potential, and market demand.

In Mandera East Sub County, maize and sorghum are integral staples, recognized for their resilience and vital role in household food security. This trend underscores the farmers' strategic decisions to prioritize crops that ensure sustenance and economic stability.

Comparing with other studies, Ndambiri et al. (2012) observed similar cropping patterns in semi-arid regions of Kenya, where farmers often rely on a primary staple crop complemented by a secondary crop to diversify their sources of food and income. Additionally, Kivuva et al. (2019) reported that the adoption of diverse cropping systems contributes to enhanced food security and resilience against climate variability. The lower frequency of second main crops (38.9%) indicates that not all farmers engage in substantial secondary crop cultivation, possibly due to limited resources, labor, or suitable land. However, those who do cultivate a second crop benefit from diversified production, which can buffer against crop failure and market fluctuations, as noted by Rutto et al. (2020) in their study on crop diversification strategies. The findings are consistent with other empirical studies, reinforcing the value of crop diversification in enhancing agricultural sustainability and resilience in semi-arid regions. These insights are crucial for developing policies and interventions aimed at supporting sustainable farming practices and improving food security in similar contexts

Harvest from the Main Crop (Maize)

The data highlights the diversity in harvest outcomes among farmers in Mandera East Sub County.

Table 3: Harvest from the Main Crop (Maize)

		Frequency	Percent
Valid	Below 15 Kgs	41	14.0
	15 to 30 KGs	116	39.6
	31 to 50Kgs	119	40.6
	More than 50 Kgs	17	5.8
	Total	293	100.0

The findings from Table 3 reveal significant challenges in maize production among farmers in Mandera East Sub-County. The majority of farmers (80.2%) reported harvesting between 15 to 50 kilograms of maize, indicating low to moderate productivity levels. Only 5.8% of farmers harvested more than 50 kilograms, while 14.0% harvested below 15 kilograms, highlighting substantial variability in yields. These results suggest that many households may face food insecurity due to inadequate crop production, emphasizing the need for improved agricultural

practices and support systems. These findings align with broader trends observed in smallholder farming systems in semi-arid regions. Studies by Ng'endo et al. (2013) and Wekesa et al. (2018) have noted similar fluctuations in crop yields among smallholder farmers in Kenya, attributing them to environmental and socio-economic factors. Critical determinants of harvest success include access to quality seeds, effective pest management, and favorable weather conditions. The results underscore the necessity for targeted interventions to enhance maize productivity, improve access to quality agricultural inputs, and support farmers facing adverse conditions to achieve sufficient yields for household food security and economic stability.

Harvest from the Second Main Crop (Soghurm)

The table below summarizes the harvest quantities from the second main crop (Soghurm) during the last season or harvest, providing insights into the distribution and success of secondary crop production among the surveyed farmers.

Table 4: Harvest from the Second Main Crop (Soghurm)

		Frequency	Percent
Valid	Below 15 Kgs	41	14.0
	15 to 30 KGs	17	5.8
	31 to 50Kgs	148	50.5
	More than 50 Kgs	87	29.7
	Total	293	100.0

The table indicates the distribution of sorghum harvest quantities among the farmers surveyed. The majority of the farmers harvested between 31 to 50 kilograms, representing 50.5% of the respondents. This is followed by 29.7% of the farmers who harvested more than 50 kilograms. A smaller proportion of the farmers harvested below 15 kilograms (14.0%) and between 15 to 30 kilograms (5.8%). The distribution of sorghum harvest quantities shows a significant concentration of farmers achieving very low yields. Specifically, 70.3% of the farmers harvested less than 50 kilograms, indicating poor seasons for the majority. This low yield distribution could be attributed to several factors, including unfavorable weather conditions, ineffective farming techniques, or in access to necessary resources such as seeds and fertilizers, inadequate rainfall or irrigation, pest infestations, and limited access to agricultural inputs. These findings highlight the variability in sorghum production success among the surveyed population, pointing to potential areas for intervention to support lower-yield farmers.

The distribution of sorghum harvest quantities shows a significant concentration of farmers achieving very low yields. Specifically, 70.3% of the farmers harvested less than 50 kilograms, indicating poor seasons for the majority. This low yield distribution could be attributed to several factors, including unfavorable weather conditions, ineffective farming techniques, or inaccess to necessary resources such as seeds and fertilizers, inadequate rainfall or irrigation, pest infestations, and limited access to agricultural inputs. These findings highlight the variability in sorghum production success among the surveyed population, pointing to potential areas for intervention to support lower-yield farmers. The results also suggest a notable high percentage struggling with lower production levels. Further research could explore the specific factors contributing to these lower yields and develop strategies to address them, ensuring more uniform success across the farming community. The table below summarizes the estimated duration for which farmers can utilize the crop harvests from their main crops for their own consumption

Table 5: Months for Utilizing the Crop Harvests

		Frequency	Percent
Valid	Less than 2 Months	147	50.2
	2 to 4 Months	130	44.4
	5 to 7 Months	12	4.1
	More 7 Months	4	1.3
	Total	293	100.0

Source: Researcher (2024)

The data reveals that a significant proportion of the farmers, 50.2%, can utilize their crop harvests for less than 2 months. Another 44.4% of the respondents reported that their harvests last between 2 to 4 months. A small fraction, 4.1%, indicated that their crop harvests last for 5 to 7 months, and only 1.3% of the farmers can utilize their harvests for more than 7 months. The utilization period for crop harvests among the surveyed farmers in Mandera East Sub County indicates a relatively very short duration of food security. The majority of the farmers (94.6%) have harvests that last for less than 4 months, highlighting the precarious nature of their food supply and the need for interventions to extend this period. These findings are consistent with other empirical studies on smallholder farming systems in semi-arid regions. For example, a study by Omoyo et al. (2015) found that farmers in semi-arid areas of Kenya often experience short periods of food sufficiency due to the variability in crop yields and limited storage capacities. Additionally, research by

Ayanlade et al. (2017) reported that climatic factors, such as irregular rainfall patterns and drought, significantly impact the duration for which harvested crops can sustain households in these regions.

When compared to the harvest quantities of maize and sorghum presented, it becomes evident that the yield levels are insufficient to ensure long-term household food security. For instance, while a significant proportion of farmers achieved moderate to low yields, the quantities are not enough to sustain them beyond a few months. This disparity underscores the challenges faced by farmers in ensuring continuous food availability throughout the year. To address this issue, several strategies can be implemented. Enhancing storage facilities and techniques can help in preserving crop harvests for longer periods, reducing post-harvest losses. Moreover, diversifying crops and integrating drought-resistant varieties can improve overall yield stability. Training on effective farm management practices and access to financial services for purchasing inputs are also critical for increasing productivity and extending the utilization period of crop harvests.

Interpretation and Discussion of Income from Selling Main Crops

The table below summarizes the income obtained from selling the main crops after the last season or harvest among farmers in Mandera East Sub County. The data provides insights into the distribution and financial outcomes from agricultural sales.

Table 6: Average Income from selling the Main Crops (KES)

		Frequency	**Percent**
Valid	Less than 5000	189	64.5
	5000 to 10,000	100	34.1
	More than 10,000	4	1.4
	Total	293	100.0

The study reveals that farmers in Mandera East Sub County face significant financial challenges, with 64.5% earning less than KES 5,000 from crop sales, 34.1% earning between KES 5,000 to 10,000, and only 1.4% earning more than KES 10,000. These low income levels correlate with the predominantly subsistence nature of farming in the region, characterized by low yields and limited market access. Most farmers harvested between 15 to 50 kilograms of maize, insufficient for generating significant income. These findings align with studies by Kiprop et al. (2016) and Njuki et al. (2011), which highlighted similar challenges faced by smallholder farmers in Kenya.

The results underscore the need for interventions to improve financial outcomes, such as enhancing market access, providing training on commercial farming practices, and supporting the adoption of improved agricultural technologies to increase productivity and enable surplus production for sale.

Descriptive Analysis Results on Organic Farming Practices

This section examines the adoption of organic farming practices, soil management techniques, and irrigation methods among farmers in Mandera East Sub County. It assesses the extent of engagement in organic farming methods such as using organic fertilizers, crop rotation, and intercropping, analyzing their contribution to reducing chemical inputs and fostering biodiversity. The study evaluates soil management practices like composting, cover cropping, and conservation tillage, exploring their impact on soil health and crop yields. Additionally, it investigates irrigation methods and their efficiency in optimizing water use and ensuring consistent crop growth. The research aims to understand how these sustainable agricultural practices enhance overall farm productivity and contribute to food security. Table 7 presents data on farming practices and the adoption of crop rotation, providing insights into the methods used by farmers and the associated benefits, offering a comprehensive view of sustainable farming practices in the region.

Table 7: Farming and Crop Rotation

		Responses		Percent of Cases
		N	Percent	
Organic farming and crop rotation Benefit[a]	What farming method do you use?	293	16.4%	100.0%
	Do you apply crop rotation?	252	14.1%	86.0%
	Manages soil fertility	206	11.6%	70.3%
	Reduces soil Erosion	204	11.4%	69.6%
	Improves soil Health	235	13.2%	80.2%
	Increases nutrients for crops	199	11.2%	67.9%
	Contains the spread of pests and diseases	189	10.6%	64.5%
	Improves weed management	204	11.4%	69.6%
Total		1782	100.0%	608.2%

a. Dichotomy group tabulated at value 1.

The data indicates that 16.4% of respondents practice organic farming, with 14.1% applying crop rotation. Among those who practice crop rotation, the reported benefits include managing soil fertility (11.6%), reducing soil erosion (11.4%), improving soil health (13.2%), increasing

nutrients for crops (11.2%), containing the spread of pests and diseases (10.6%), and improving weed management (11.4%). The cumulative percent exceeds 100.0%, suggesting that many farmers reported multiple benefits associated with crop rotation.

This underscores the integrated nature of these agricultural practices and their potential to enhance agricultural sustainability and productivity.

Comparing these results with literature, studies by Gathuru *et al.,* (2018) and Muchiri *et al.*, (2020) highlight similar benefits of crop rotation in improving soil health, nutrient availability, and pest management. These findings support the importance of adopting sustainable farming practices to mitigate environmental impacts and ensure long-term agricultural productivity. The findings underscore the benefits of organic farming and crop rotation in Mandera East Sub County, emphasizing the need for continued support and promotion of these practices to enhance agricultural resilience and sustainability in the region.

Crop Diversifications and Its Benefits

Table 8 provides insights into crop diversification practices and the associated benefits among farmers in Mandera East Sub County. The table highlights the adoption rates and perceived benefits of crop diversification in enhancing agricultural productivity and sustainability.

Table 8: Crop Diversifications and Benefits

		Responses		Percent of Cases
		N	Percent	
Crop Diversifications and Its Benefits[a]	Do you apply crop diversification?	173	14.0%	68.4%
	Enhances beneficial pollinator populations	144	11.7%	56.9%
	Alternative means of generating income	144	11.7%	56.9%
	Improves soil quality	132	10.7%	52.2%
	Improves soil Health	173	14.0%	68.4%
	Increases nutrients for crops	161	13.0%	63.6%
	Improves weed management	132	10.7%	52.2%
	Improves the crop yield	177	14.3%	70.0%
Total		1236	100.0%	488.5%

a. Dichotomy group tabulated at value 1.

The study reveals that 14.0% of respondents in Mandera East Sub County practice crop diversification, with farmers reporting multiple benefits such as enhanced pollinator populations

(11.7%), alternative income generation (11.7%), improved soil quality (10.7%) and health (14.0%), increased crop nutrients (13.0%), better weed management (10.7%), and improved crop yields (14.3%). These findings align with studies by Muriuki et al. (2019) and Mugo et al. (2021), which highlight similar benefits in enhancing soil health, biodiversity, and agricultural sustainability. The cumulative percentage exceeding 100% indicates that farmers perceive crop diversification as a valuable strategy for improving agricultural resilience and productivity. These results underscore the importance of promoting crop diversification as a key approach for sustainable agriculture in semi-arid regions, emphasizing the need for continued support to build resilient agricultural systems that can adapt to environmental challenges and improve farmers' livelihoods.

Organic Fertilizer and Its Benefits

Table 9 presents data on the adoption and benefits of organic fertilizer among farmers in Mandera East Sub County. The table provides insights into the perceived benefits of using organic fertilizer and its role in enhancing agricultural sustainability.

Table 9: Organic Fertilizer and Its Benefits

		Responses		Percent of Cases
		N	Percent	
Organic Fertilizer and Its Benefits[a]	Balances soil ecosystem	107	12.7%	60.5%
	Boosts plant health naturally	143	16.9%	80.8%
	They’re all natural	107	12.7%	60.5%
	Prevents over-fertilization	136	16.1%	76.8%
	No artificial compounds left in the soil	102	12.1%	57.6%
	Don’t upset the soil balance	131	15.5%	74.0%
	Delivers nutrients sustainably	119	14.1%	67.2%
Total		845	100.0%	477.4%

a. Dichotomy group tabulated at value 1.

The findings from Table 9 reveal a strong appreciation among farmers in Mandera East Sub County for the benefits of organic fertilizers in sustainable agriculture. Respondents identified multiple advantages, including balancing the soil ecosystem (12.7%), naturally boosting plant health (16.9%), preventing over-fertilization (16.1%), and delivering nutrients sustainably (14.1%). The high cumulative percentage (477.4%) indicates that farmers recognize multiple benefits, suggesting a growing awareness of sustainable agricultural methods.

This appreciation for organic fertilizers aligns with their potential to enhance both productivity and environmental stewardship in farming practices. These results are consistent with studies by Karanja et al. (2017) and Onguso et al. (2020), which highlight similar benefits of organic fertilizers in improving soil health, reducing environmental impact, and promoting sustainable agriculture. The findings underscore the importance of promoting organic fertilizer use as a key strategy for sustainable agriculture in semi-arid regions like Mandera East Sub County. Continued support and education about these practices are essential for building resilient agricultural systems that can adapt to environmental challenges and improve farmers' livelihoods.

Animal Manure and Its Benefits

Table 10 provides insights into the adoption and benefits of animal manure among farmers in Mandera East Sub County. The table outlines the reported benefits associated with using animal manure in agricultural practices.

Table 10: Animal Manure and Its Benefits

		Responses		Percent of Cases
		N	Percent	
Animal Manure and Its benefits[a]	Do you apply animal manure	185	15.1%	100.0%
	Reducing soil bulk density	168	13.7%	90.8%
	Compaction	185	15.1%	100.0%
	Increasing soil aggregate stability	168	13.7%	90.8%
	Water infiltration	168	13.7%	90.8%
	Water retention	185	15.1%	100.0%
	Any other....	168	13.7%	90.8%
Total		1227	100.0%	663.2%

a. Dichotomy group tabulated at value 1.

The data shows that 15.1% of respondents apply animal manure in their agricultural practices. Reported benefits include reducing soil bulk density (13.7%), increasing soil aggregate stability (13.7%), improving water infiltration (13.7%), and enhancing water retention (15.1%). The cumulative percent exceeds 100.0%, suggesting that many farmers reported multiple benefits associated with animal manure. This underscores the integrated nature of these agricultural practices and their potential to enhance agricultural sustainability and productivity. Comparing these results with existing literature, studies by Nyamai et al. (2018) and Gitari et al. (2021) have similarly highlighted the benefits of using animal manure in improving soil structure, water retention, and nutrient cycling.

These findings support the importance of promoting the use of animal manure as a key strategy for sustainable agriculture in semi-arid regions. The findings underscore the benefits of animal manure in enhancing agricultural productivity and sustainability in Mandera East Sub County. Continued support and promotion of these practices are essential for building resilient agricultural systems that can adapt to environmental challenges and improve farmers' livelihoods.

4.3 Variables in the Equation

Table 11 presents variables in the equation

Table 11: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Organic Farming Practices	.247	.044	32.107	1	.000	1.280	1.175	1.394
	Constant	-18.529	3.892	22.663	1	.000	.000		

a. Variable(s) entered on step 1: Organic Farming Practices

$$\text{Logit}\,[P(Y \leq j)] = -18.529 + 0.247X_1 + \varepsilon$$

The logistic regression analysis reveals a significant positive relationship between organic farming practices and household food security in Mandera East Sub County. The coefficient for organic farming practices (B = 0.247, SE = 0.044) is highly significant ($p < .001$), with an odds ratio of 1.280 (95% CI: 1.175 - 1.394). This indicates that for every unit increase in organic farming practices, the odds of achieving household food security increase by 28%, holding other variables constant. This finding underscores the importance of organic farming in promoting food security and suggests the need for policies and initiatives that encourage the adoption of these methods through education, resources, and support for farmers. The constant term in the model (B = -18.529, SE = 3.892) is also highly significant ($p < .001$), with an odds ratio effectively at 0. This indicates that in the absence of organic farming practices and other predictors, the baseline odds of achieving food security are extremely low. This reinforces the critical role of the predictor variables, particularly organic farming practices, in improving food security outcomes. The overall model highlights the positive impact of organic farming on household food security in Mandera East Sub County, providing valuable insights for developing targeted interventions and policies to enhance food security through sustainable farming practices.

CONCLUSIONS OF THE STUDY

The study concludes that smallholder farmers in Mandera East Sub County face significant challenges in agricultural productivity and post-harvest management, despite adopting organic farming practices and soil management techniques. In addition, it is concluded that crop yields are constrained by factors such as poor seed quality, inadequate pest management, and insufficient post-harvest infrastructure, which hinder the full potential of organic farming methods. Besides, the study concludes that the reliance on self-produced seeds and community support for seed acquisition demonstrates the resilience of local social networks, but also underscores the need for improved access to quality seeds and modern agricultural technologies. Moreover, the research findings highlight the positive impact of organic farming practices on household food security, with a 28% increase in the odds of achieving food security for every unit increase in organic farming practices. Likewise, the study reveals a strong appreciation among farmers for the benefits of organic fertilizers in sustainable agriculture, including improved soil health and crop vitality. The study further concludes that crop diversification, although practiced by only 14% of respondents, is perceived as a valuable strategy for improving agricultural resilience and productivity, with multiple benefits reported by farmers.

RECOMMENDATIONS

The study recommends that policy interventions be implemented to improve agricultural outcomes in Mandera East Sub County, with a particular focus on promoting organic farming and soil management practices. In addition, it is recommended that farmers be encouraged to adopt organic farming practices through comprehensive training programs on integrated pest management and soil conservation techniques. Besides, the study recommends that crop diversification and cover cropping be actively promoted to improve soil health and enhance agricultural productivity sustainably. Moreover, efforts should be made to improve irrigation and water management practices, given the arid and semi-arid conditions of the region. Likewise, the study suggests that initiatives be developed to improve access to quality seeds and modern agricultural technologies, addressing the current reliance on self-produced and community-sourced seeds.

The study further recommends that support be provided for post-harvest management, including the development of adequate storage facilities and training on proper handling techniques to reduce losses. Additionally, it is advised that policies be implemented to enhance market access for

smallholder farmers, potentially through the formation of cooperatives or the development of local value chains. Furthermore, the research suggests that educational programs be established to increase awareness about the benefits of organic fertilizers and sustainable farming practices among the farming community. Lastly, it is recommended that a comprehensive approach be adopted, combining these interventions with continued research and monitoring to ensure their effectiveness in improving food security and agricultural sustainability in Mandera East Sub County.

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