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EMBRACING AVOCADO (*PERSEA AMERICANA*) FARMING AMONG SMALLHOLDER FARMERS IN RURAL HOUSEHOLDS IN KENYA: CHALLENGES, OPPORTUNITIES AND STRATEGIES FOR SUSTAINABLE GROWTH

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Abstract. Avocado farming in Kenya has become both a vital livelihood source and a thriving agricultural enterprise, driven by rising global demand and government initiatives to boost exports (Suljada, 2024; Shivachi et al., 2023). This study examines the challenges and opportunities in avocado farming, with a focus on smallholder farmers in Kiambu County. Employing a mixed-methods approach, the study collected primary data through surveys, key informant interviews, and focus group discussions, while secondary data from publications, policy documents, and agricultural reports provided additional insights. The research was guided by the *Adoption and Diffusion of Innovations* theory, and the *Theory of Planned Behavior*. The findings reveal that avocado farming has significant potential to enhance farmers' livelihoods, particularly by generating employment opportunities for youth. The sector benefits from expanding local and international markets, opportunities for value addition, and income diversification. Farmers can leverage technological advancements, favorable climatic conditions, and climate adaptation programs. Additionally, forming cooperatives can improve market access, enabling farmers to secure contracts with premium buyers. Training programs, knowledge-sharing initiatives, and agricultural extension services further support the sector's growth. Despite these opportunities, several challenges persist, including exploitation of farmers by brokers, low youth participation, price volatility, limited local consumption, restricted access to quality inputs, and inadequate extension services. To address these barriers, the study recommends strengthening agricultural extension services, enhancing access to affordable inputs, promoting farmers' cooperatives, investing in infrastructure and market linkages, encouraging sustainable farming practices, and increasing youth engagement in the sector. This paper underscores the need for robust institutional frameworks and inclusive policies to promote sustainable avocado farming. By addressing existing challenges and fostering collaboration among communities and stakeholders, the paper offers insights into transforming avocado farming into a resilient and profitable venture for smallholder farmers in rural Kenya.

Keywords: avocado farming, smallholder farmers, agricultural cooperatives, sustainable farming, agricultural extension services

INTRODUCTION

Agriculture remains the backbone of Kenya's economy, contributing approximately 33% of the country's Gross Domestic Product (GDP) and employing over 40% of the total population (USAID, 2023). Smallholder farmers, who represent about 78% of agricultural producers, are central to this sector (Wahome et al., 2024). Despite their significance, small-scale farming in Kenya has traditionally been marked by low productivity, reliance on rain-fed systems, and a focus on subsistence crops (World Bank and CIAT, 2015). These challenges have hindered farmers' ability to achieve economic resilience,

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especially in the face of issues like fluctuating weather patterns, land fragmentation, and volatile market prices (FAO 2017; Kariuki, 2013).

In response to these constraints, there has been growing interest in diversifying into high-value crops, such as avocados. Avocado farming presents a promising opportunity, driven by rising demand both locally and globally. The global avocado trade has seen exponential growth, particularly in Europe, where demand is surging in countries like the Netherlands, the United Kingdom, France, Italy, Germany and the Scandinavian region (CBI, 2024). Demand is also increasing in Asia and North America, where avocados are highly valued for their nutritional and health benefits. Kenya, as one of Africa's leading avocado exporters, has significant potential to increase its market share, providing smallholder farmers with a unique opportunity to shift from subsistence to more commercially viable agricultural practices.

Avocado farming is practiced in 42 of Kenya's 47 counties, with production spanning from March to October (Ramirez, 2024). Smallholder farmers account for approximately 70% of avocado production, growing the fruit both for subsistence and commercial purposes, including local markets and exports. Five key exporters dominate the avocado export market: Sunripe, Kenya Horticultural Exporters, Vegpro, East African Growers, and Kakuzi, with most of their avocados sourced from smallholder farmers (Amare and Wilson, 2020).

East Africa's diverse climatic conditions create favorable environments for avocado cultivation (Odong, 2022). Kiambu County, situated in central Kenya, is particularly well-positioned to capitalize on the benefits of avocado farming. The region boasts fertile soils, a favorable climate, and proximity to Nairobi, ensuring easy access to both local and international markets. Furthermore, Kiambu's primarily small-scale farmers have demonstrated considerable adaptability, embracing horticulture as a means of improving their livelihoods. Over the past decade, avocado farming has gained traction in Kiambu, as farmers recognize its potential to create employment, increase incomes, and enhance food security (Kariuki, 2020).

Avocado farming has emerged as a key agricultural activity in Kiambu County, with smallholder farmers playing a dominant role in production. Micro, Small, and Medium Enterprises (MSMEs) are also vital to the sector, contributing to value addition, employment creation, and market facilitation (Rop et al., 2023). However, the sector faces a range of challenges, including limited resources, market inefficiencies, and environmental concerns. This paper emphasizes the need to leverage available opportunities to enhance avocado farming and improve the economic well-being of smallholder farmers in Kiambu County.

Origins and History of Avocado Farming in Kenya

The botanical name for avocado is *Persea americana*. The term *avocado* is thought to have come from the Aztec word *ahuacatl*, which means "testicle," likely due to the fruit's shape. From the Aztec language, the word evolved into *aguacate* in Spanish, *avocat* in French, and *abacate* in Portuguese. The avocado tree, an evergreen plant, is considered to have first appeared in southern Mexico, Central America, and northwestern South America (Griesbach, 2005). Avocados are believed to have been introduced into Africa, specifically South Africa, by settlers from the West Indies and other Dutch colonies between 1652 and 1700 (Witney, 2002).

The avocado is thought to have been introduced to Kenya by the Portuguese during the 16th and 18th centuries (Griesbach, 2005). The tree can reach heights of 30 to 60 feet, but grafted varieties such as Hass and Fuerte typically mature at around 20 feet. Each avocado contains a large central seed, made up primarily of two cotyledons, surrounded by a creamy, buttery pulp. The fruit is rich in proteins, vitamins, antioxidants, and monounsaturated fats, all of which contribute to its health benefits. The oil content of avocados is particularly high, reaching up to 30%, making them a nutrient-dense fruit (Griesbach, 2005).

Although technically a fruit, avocados are often used as a vegetable in salads and as a spread on bread, serving as a substitute for margarine. They are also used in soups, ice creams, and milkshakes. Avocados are recommended as a high-energy food for people with diabetes and are believed to enhance sexual vitality. Avocado is easily digestible, low in sugar, and widely used in cosmetics (Griesbach, 2005).

For many years, avocados in Kenya were grown exclusively by smallholder farmers for subsistence, with most farmers having fewer than five trees. The crop was often viewed as a "white man's crop." In central Kenya, avocados were not considered a fruit for adults. Among the Kikuyu people, the fruit was known as *manoria ngui* or *maguna ngui*, which loosely translates to "fattener of

dogs," because dogs would gather around the tree waiting for the ripe fruit to fall.

There are many avocado varieties grown in Kenya including Fuerte, Hass, Bacon, Hardy, Linda Lula, Nabal, Sama, Simmonds, Puebla, Ettinger, Reed, and Tambarina. The export of avocados began on a small scale, with only 23 tonnes being exported in 1970. By 1984, exports had grown to 1,400 tonnes, and by 2003, avocados had become a significant commercial fruit, with 30% of production being exported (Griesbach, 2005).

Avocados currently represent 17% of the total value of Kenya's horticultural exports, making them the fourth most important fruit after bananas, mangoes, and pineapples (Muma, 2024). The export market is dominated by two primary avocado varieties: Fuerte and Hass. Over time, the Hass variety has gained prominence due to its high export value and long shelf life, gradually replacing traditional varieties. Between 2018 and 2022, avocado production in Kenya increased from 317,000 tonnes to over 632,000 tonnes, with Hass accounting for more than 70% of total production (Ramirez, 2024). In 2020, Kenya produced approximately 322,600 thousand metric tonnes of avocados (Cowling, 2023).

Kenya's avocado export value rose from around $1.02 million in 2019 to about $1.16 million in 2020. By 2023, the country exported around 114,000 tonnes of avocados (Ramirez, 2024). Today, Kenya leads Africa in avocado production, with an output of 417,000 metric tonnes, followed by Ethiopia (Mureithi, 2023). The country is home to more than 150,000 avocado farmers, accounting for nearly 50% of Africa's total production. Key export markets for Kenyan avocados include Europe, the Middle East, China and Asia. In 2023, the value of Kenya's avocado market reached $428 million.

Avocado farming has become a key pillar of Kenya's agricultural sector, driven by government policies, private sector investment, and strong international partnerships. Today, it plays a vital role in supporting rural livelihoods and generating significant foreign exchange for the country.

THEORETICAL FRAMEWORK

This study is informed by the *Adoption and Diffusion of Innovations* theory and the *Theory of Planned Behavior* to examine how smallholder farmers in Kiambu County adopt avocado farming, while also exploring the associated challenges and opportunities.

Adoption and Diffusion of Innovations Theory

The *Adoption and Diffusion of Innovations* theory, formulated by Everett Rogers, provides a framework for understanding how new ideas, practices, or technologies spread within a social system over time (Rogers, 1995). The theory identifies five key factors that determine the rate and success of innovation diffusion: relative advantage, complexity, trialability, compatibility, and observability (Rogers, 1983). These factors explain why some innovations are rapidly adopted, while others face resistance.

The theory asserts that adoption is driven by the perceived attributes of an innovation. Farmers are more likely to adopt avocado farming if they perceive it to be advantageous and compatible with their existing farming practices. Additionally, the perceived ease of incorporating avocado farming into their systems – without abandoning their traditional crops – affects their willingness to adopt.

The theory also recognizes that adoption rates are influenced by adopter categories within the farming community. Rogers classifies individuals into five groups: innovators, early adopters, early majority, late majority, and laggards. These categories represent different stages of adoption, which can affect the overall spread of innovations in a community (Murwanashyaka et al., 2021).

The role of communication channels is also critical in the adoption process. These channels, such as community meetings (*barazas*), media, agricultural extension services, and cooperatives, are vital in disseminating information and encouraging the adoption of innovations. Peer influence and social networks also play a crucial role in shaping the adoption of new practices.

Finally, the social system in which farmers operate– including community norms, cultural practices, and social networks – shapes the diffusion of innovations. As Rogers (2003) emphasizes, the adoption of innovations is a social process, with information and experiences shared among farmers. This underscores the importance of community engagement in fostering the widespread adoption of practices like avocado farming.

The Theory of Planned Behavior (TPB)

The *Theory of Planned Behavior* (TPB), developed by Ajzen (1988), provides a psychological framework for understanding the individual psychological factors that

influence smallholder farmers' intentions to adopt or reject avocado farming. The theory posits that an individual's subjective preferences and perceptions of a product significantly influence its demand (Hattam, 2006).

A core element of this theory is that human behavior is shaped by attitudes. In this context, smallholder farmers' decisions to adopt avocado farming are influenced by their perceptions of its potential benefits and challenges. Additionally, subjective norms – such as the influence of peers, family, and community – also play a crucial role in shaping their decision to embrace avocado farming. This suggests that farmers' attitudes alone may not fully determine their adoption; rather, social pressures and the perceived difficulty of cultivating the crop also factor into their decision-making process.

A third key element is perceived behavioral control, which refers to farmers' confidence in their ability to adopt and sustain avocado farming. This confidence is shaped by the resources at their disposal and their knowledge of the crop.

STUDY AREA AND METHODOLOGY

Study Area

The empirical study was conducted in Kiambu County between October and November 2024. Kiambu is one of Kenya's leading avocado-growing regions and a significant hub for smallholder farming. According to the 2019 census, the county had a population of 2,417,735, projected to reach 2.8 million by 2025. It covers 2,538.7 square kilometers, with an average population density of 1,065 people per square kilometer and 795,241 households (KNBS, 2019; Stats Kenya, 2025; County Government of Kiambu 2023–2027). As Kenya's second most populous county, Kiambu had 1,187,146 males, 1,230,454 females, and 135 intersex individuals recorded in the 2019 census (KNBS, 2019).

Agriculture is the backbone of Kiambu's economy, with most households engaged in smallholder farming, primarily relying on rain-fed agriculture for crop and dairy farming. The county has 214,052 farming households, of which 173,960 practice subsistence farming, while 35,169 engage in commercial agriculture (Stats Kenya, 2025). Permanent crop cultivation is widespread, with 20,958 households growing tea, 9,855 cultivating mangoes, 11,748 producing macadamia, 31,152 growing coffee, and 31,392 farming avocados (Stats Kenya, 2025).

Kiambu County is classified as a high-potential agricultural region due to its fertile soils and favorable climate for food production. The county experiences a bimodal rainfall pattern, with long rains occurring from March to May and short rains from October to December. Annual rainfall ranges between 600 mm and 1,200 mm, supporting the cultivation of a variety of crops (County Government of Kiambu 2023–2027).

Although Kiambu has better infrastructure than many other parts of the country, much of the road network consists of feeder roads that become impassable during the rainy season. As a result, transporting farm produce can be both difficult and costly for businesses.

Methodology

This study employed a mixed-methods approach, integrating both qualitative and quantitative methodologies to provide a comprehensive understanding of the challenges and opportunities in avocado farming.

Target Population and Sampling

The primary target population consisted of small-scale avocado farmers in the selected region. A list of avocado farmers, obtained from local agricultural offices, served as the sampling frame. A total of 144 smallholder farmers were interviewed. Secondary respondents included representatives of agricultural cooperatives, county government agricultural officers, and NGOs supporting avocado farming.

Data Collection Methods

Primary data were collected through surveys, key informant interviews (KIIs), and focus group discussions (FGDS):

- Surveys: A structured questionnaire was used to collect quantitative data on farmers' demographic characteristics, farming practices, opportunities in avocado farming, and challenges faced.
- Key Informant Interviews (KIIs): Semi-structured interviews were conducted with *Nyumba Kumi* elders, cooperative leaders, local administrators, and NGO representatives to gain expert insights.
- Focus Group Discussions (FGDs): Six FGDs, each consisting of 8-12 farmers, were conducted to explore diverse perspectives on the opportunities and challenges of avocado farming.

Secondary data was obtained through a review of reports, policy documents, and agricultural extension records, which provided contextual background and complemented primary data findings.

Data Analysis

- Quantitative data were analyzed using descriptive statistics such as frequencies and percentages.
- Qualitative data from KIIs and FGDs were analyzed thematically, allowing the researcher to identify recurring themes related to opportunities and challenges in avocado farming among smallholder farmers in Kiambu County.

Ethical Considerations

The study adhered to ethical research principles:

- Informed consent was obtained from all participants, who were provided with detailed information about the study.
- Confidentiality was ensured by anonymizing respondents to protect their identities.

Voluntary participation was emphasized, and respondents were informed of their right to withdraw from the study at any stage if they felt uncomfortable.

RESULTS AND DISCUSSION

Table 1 presents the demographic characteristics of the 144 smallholder avocado farmers interviewed in this study. The majority (72.9%) were male, while females accounted for 27.1% of the respondents. Most farmers (68.8%) were over 50 years old, indicating that avocado farming is predominantly practiced by older farmers.

In terms of education levels, 37.5% had completed primary education, followed by 31.3% who had attained secondary education. Regarding land ownership, 41.7% of the farmers cultivated 1–2 acres, while 33.3% had larger farms exceeding two acres.

Regarding farming experience, over half (52.1%) had been engaged in farming for more than 10 years. Additionally, farming was the main source of income for 83.3% of the farmers, highlighting a strong dependence on agriculture for their livelihoods.

However, access to agricultural training was low, with only 18.8% of farmers having received some form of training. Similarly, only 22.9% were members of farmer groups, pointing to potential gaps in collaboration and knowledge sharing.

Table 1. Demographic Characteristics of Smallholder Avocado Farmers

Demographic characteristic	Category	Frequency	Percentage (%)
Gender	Male	105	72.9
	Female	39	27.1
	Total	144	100
Age (years)	40–50	45	31.2
	51–60	60	41.7
	61 and above	39	27.1
	Total	144	100
Education level	Lower primary	15	10.4
	Primary	54	37.5
	Secondary	45	31.3
	Tertiary	30	20.8
	Total	144	100
Farm size (acres)	Less than 1	36	25.0
	1–2	60	41.7
	More than 2	48	33.3
	Total	144	100.0
Farming experience (years)	Less than 5	24	16.7
	5–10	45	31.3
	More than 10	75	52.1
	Total	144	100
Main source of income	Farming	120	83.3
	Non-farming activities	24	16.7
	Total	144	100
Access to agricultural training	Yes	27	18.8
	No	117	81.2
	Total	144	100.0
Membership in farmer groups	Yes	33	22.9
	No	111	77.1
	Total	144	100.0

Source: own elaboration based on survey data.

Challenges Experienced by Smallholder Avocado Farmers in Kenya

Despite the potential of avocado farming, smallholder farmers in Kenya face several significant challenges. These obstacles are discussed in the following section.

Perishability of Avocado Fruits

The perishability of avocados presents a significant challenge, as they are highly perishable with a limited post-harvest shelf life. Proper handling, storage, and timely transportation are therefore critical to minimizing losses. However, many farmers lack access to cold storage facilities and reliable transportation networks, resulting in significant post-harvest losses.

Approximately 83% of farmers reported that poor road conditions made transportation a major issue. Additionally, unpredictable market demand and limited access to dependable buyers caused delays in selling the produce, leading to further spoilage. This finding is consistent with Mbogo (2023), who noted that fresh produce farmers in Kenya lose up to 45% of their crops due to poor transportation infrastructure. Similarly, Githumbi (2022) found that inadequate transport and storage contribute to 40-50% of post-harvest losses in mango farming.

In Kiambu County, poor transportation not only reduces farmers' income but also discourages them from expanding their production, thus hindering the sustainable growth of avocado farming. One farmer with just 12 avocado trees shared the following:

> Why should I plant more avocados when I am not able to sell the ones I already have? Those people who come to buy our avocados knows that we cannot store them for long. They therefore buy them when they want and at the price they want. Avocados are not like maize which I can store for a longer period. As a farmer, the earlier I sell and get whatever I get the better before they ripen, or they over-mature.

To address the issue of perishability, significant investments in post-harvest infrastructure, training on best practices, and enhanced market access are needed.

Theft of Avocado Fruits and Seedlings

Theft of both avocado seedlings and fruits was identified as a major challenge for smallholder farmers in Kiambu County. This issue poses a significant threat to the farmers' investments and livelihoods. Many farmers reported that they either planted avocado seeds directly on their farms and then grafted the trees, or purchased grafted seedlings from established nurseries such as Jomo Kenyatta University of Agriculture and Technology (JKUAT) and Kakuzi Limited, or from experienced farmers with grafting expertise. These high-quality seedlings were expensive, ranging from Ksh 150 to Ksh 200 each. However, thieves frequently targeted these seedlings, especially in the early stages when they are easier to uproot. As a result, farmers faced direct financial losses, and the establishment of their trees was delayed.

Similarly, a significant 97.5% of farmers reported that theft of mature fruits during harvest season posed a serious challenge to avocado farming in the region. One key informant, an area assistant chief, shared the following:

> The demand for avocados in the local and export market is high. This has led to the emergence of many thieves in this area who steal fruits directly from our farms. We are forced to keep vigil, especially at night. Tracking the stolen avocados is difficult because there are many *boda bodas* (motorbikes) which are used to transport them to the nearest town particularly late at night.

This study aligns with previous reports that have highlighted theft as a significant challenge for avocado farmers in Kenya (Kinyua, 2024). The theft of fruits had severely disrupted market supply chains, as stolen avocados were often sold at lower prices in local markets.

To address this issue, farmers could adopt enhanced security measures and consider forming cooperative groups for shared surveillance. Additionally, local authorities should work towards preventing theft by introducing stricter penalties for those caught stealing avocados.

Low Local Consumption of Avocado Fruits and Stringent Quality Standards for Exports

Despite the high nutritional value and health benefits of avocados, the local community – particularly the older generation – has viewed avocados as a non-essential food item. As a result, their focus has remained on staples like maize and beans, as well as cash crops such as tea and coffee. The older generation has not fully embraced avocados as an important part of their diet. Consequently, farmers were often left with surplus produce that could not be absorbed by the local market, thus

increasing the risk of post-harvest losses. In addition, the low local demand has forced farmers to rely heavily on export markets, which are subject to strict quality standards and logistical challenges. This dependence on external markets has created vulnerabilities, as farmers have faced significant losses when export opportunities have not been well tapped.

One of the farmers who had about 50 trees of the Fuerte and Hass varieties reported:

> People here do not think that avocados are supposed to be eaten by adults. The older generation sell them but they rarely eat the fruit. Traditionally, people have seen avocados as being meant for the dogs, as some people here still call them *manoria ngui* or *maguna ngui*. Nobody wants to be seen as if he is competing with the dogs. Dogs like eating avocados that ripen after they drop down the trees. Fortunately, the younger people have now totally embraced avocado and they like eating them with ugali, rice and *githeri*.

Studies examining avocado consumption patterns in Kenya have found that domestic consumption accounts for only 47% of the country's avocado production (Kimitei and Tate, 2025; Mwangi, 2021). To encourage local consumption, public awareness campaigns, nutrition education programs and value-addition initiatives can help diversify market opportunities. Increased local demand would not only stabilize prices for farmers but also improve food security and health outcomes for the local population.

Price Volatility and Exploitation of Avocado Farmers by Intermediaries/Brokers

Price volatility further exacerbates smallholder farmers' vulnerability and significantly impacts their incomes and long-term sustainability. Avocado prices frequently fluctuate due to seasonal variations in supply and demand, with peak harvest periods flooding the market and causing sharp price declines. Since smallholder farmers lack cold storage facilities and urgently need to sell their produce to meet their immediate needs, they are often forced to sell at drastically low prices. The oversupply seasons contrast with periods of scarcity when prices rise but farmers do not have enough produce to take advantage of the higher market prices. The unpredictable nature of avocado prices makes it difficult for farmers to plan their production and finances effectively.

Smallholder farmers also lack direct access to lucrative export markets, which forces them to depend largely on intermediaries who dictate prices. The fluctuation in the prices, combined with manipulation by brokers, makes it difficult for farmers to predict their returns. This uncertainty discourages them from investing in avocado farming.

One farmer in a FGD shared the following:

> Last season, they bought my Hass avocados at Ksh 15, and this year, they have bought at only Ksh 10. The buyers told me that people in China are not buying our avocados at good prices because our avocados are not of good quality. Yet, my neighbor has sold his avocado at Ksh 20. I know they just exploited me because I am old, and my children are not here to help me negotiate with them. Even when they were counting the number of pieces, they counted very fast. I called the son of my neighbor to help me, but they bought him alcohol as they harvested. When he came back, they had already counted the produce and gave me only Ksh 14,000 for avocados that, in my estimate, were worth more than Ksh 40,000.

The findings of this study support those of Mwangi et al. (2024), who examined marketing dynamics in Kenya and found that 99% of farmers sold most of their produce through brokers, who were often exploitative. Despite feeling exploited, farmers continued selling to brokers because they provided immediate payment and a ready market.

According to the theory of reasoned action, many farmers continue to sell to brokers despite price exploitation because of subjective norms and perceived behavioral control. They believe they lack direct market access. This behavior persists even when they recognize that they are being exploited.

Addressing price volatility requires strengthening market linkages and promoting farmer cooperatives to negotiate better prices. Additionally, implementing policies that stabilize the avocado market and encourage value addition would reduce farmers' dependence on the sale of raw fruits.

The Cobweb Effect and Long Gestation Periods in Avocado Farming

The cobweb theorem, combined with the long gestation period of avocado farming, presents a significant

challenge for smallholder farmers in Kiambu County. The cobweb theorem illustrates how farmers' production decisions, based on past prices, can lead to cycles of oversupply and scarcity in the market. When avocado prices are high due to scarcity, farmers are motivated to plant and nurture trees to capitalize on future profits. However, the long gestation period of avocados, which typically takes 3–5 years to mature and bear fruit, creates a lag between the decision to increase production and the actual market supply.

The transition from traditional crops to avocados requires a considerable time investment. By the time increased production reaches the market, prices may have dropped significantly, leading to reduced profits or even financial losses for farmers. The delayed response not only disrupts the market but also discourages farmers from consistently investing in avocado farming. Conversely, when prices are low, many farmers reduce their investment or abandon avocado farming altogether, leading to future scarcity and subsequent rise in prices. This cyclical price volatility, combined with the long gestation period of avocados, makes it difficult for farmers to predict returns or to maintain stable incomes. Consequently, avocado farmers in Kiambu find it challenging to rely on the sale of the fruit.

One farmer in an FGD shared how he struggled to adjust to changes in the prices:

> You can never be sure that you will sell avocado at a good price. Three years ago, the price was very good at Ksh 20, but the last two seasons, the price was very low at Ksh 10 per fruit. I had to cut down my trees and used the wood to make charcoal, and then I planted maize on the farm. In some section of my land, I started taking care of coffee. Now I hear avocado prices will be good, and I have started taking care of them and I have applied manure. I have recently planted twenty new trees.

To overcome the challenges posed by the Cobweb effect and the long gestation periods in avocado farming, coordinated production planning and value addition are essential to reduce reliance on volatile avocado sales.

Limited Access to Resources

Limited access to resources is a significant challenge for smallholder avocado farmers, restricting their ability to capitalize on the growing demand for avocados. Farmers struggle to obtain essential agricultural inputs such as high-quality seedlings, fertilizers, pesticides, farm manure, and irrigation facilities, all of which directly impact productivity and profitability.

Financial constraints further exacerbate the problem. Most smallholder farmers lack collateral, making it difficult to secure loans. As a result, they are unable to invest in improved farming techniques, irrigation systems and storage facilities, limiting their capacity to enhance yields and quality.

In Kiambu, access to extension services is notably low. Only 18.8% of farmers have received training, while the majority (81.2%) lack the technical knowledge necessary for sustainable avocado farming practices and meeting export quality standards. For instance, the researcher found that farmers do not know how to protect young avocado trees from *dik-diks* – small antelopes that feed on tender shoots and leaves, damaging saplings and stunting tree growth. Additionally, the absence of technical knowledge led to inefficient avocado harvesting methods further reducing yields and farmers' income.

Resource limitations also expose farmers to exploitation by predatory avocado brokers, who take advantage of their financial struggles and lack of market access. Another major constraint is land size; 66.7% of smallholder farmers operate on two acres or less. These fragmented land holdings make it difficult to scale up production or implement efficient farming practices.

Addressing these challenges requires targeted interventions to equip smallholder avocado farmers with the necessary resources, training and financial support. By overcoming these barriers, farmers can improve productivity, enhance profitability and contribute more effectively to the agricultural sector.

Environmental Sustainability Concerns in Avocado Farming

Environmental concerns pose a significant challenge to smallholder avocado farming in Kiambu County. Similar challenges have been observed in Mexico, where intensive avocado production has been linked to biodiversity loss, extreme weather conditions, extensive soil degradation, and irreversible environmental damage (Ayala, 2020). Avocado cultivation, if not managed sustainably, can have detrimental effects on local ecosystems worldwide, including in Kiambu County. Avocados have high water demand, which can strain limited water resources, particularly during the dry season (Betz, 2021).

During a FGD, one participant highlighted the difficulties faced due to water shortages:

> Water is a big problem in this area. I planted my trees several times because only a few survived the dry seasons. There was a time I bought 40 trees from JKUAT and they all dried. It was difficult for me to fetch water from a nearby stream. I employed a young man to water the trees but they could not survive. I decided to plant the seeds directly into the farm and then later employed someone to graft the young trees. Fortunately, there was good rains in that season and that is when these trees you are seeing here survived. Those three trees you see over there have dried because of the dry spell we are currently experiencing.

More than 80% of surveyed farmers did not practice mulching to prevent water loss. Avocado farming has created competition for water among farmers, domestic users, and other agricultural activities such as cabbage, potato, carrot, and tomato farming. Over-extraction of water for irrigation risks depleting local rivers, threatening long-term agricultural sustainability. Additionally, in some cases, avocado farming in Kiambu has required the clearing of natural vegetation, leading to deforestation, biodiversity loss, soil erosion, and increased risks of land degradation and flooding.

Among the farmers interviewed, 13% had applied chemical fertilizers to their avocado trees, while only 9% had ever used some pesticides. The use of these agrochemicals poses a risk of soil and water contamination, which can harm both human and animal health.

To mitigate these challenges, sustainable farming practices such as water conservation and agroforestry should be promoted. There is also an urgent need to educate farmers on the benefits of using organic manure to reduce environmental impact and support the long-term sustainability of avocado farming in Kiambu County.

Policy Gaps in Avocado Farming

Avocado farming in Kiambu faces considerable obstacles due to the absence of comprehensive policy frameworks that address the needs of smallholder farmers, as well as weak enforcement mechanisms that hinder effective sector regulation. Although the crop has become an important export commodity, regulations and guidelines on production standards and marketing remain inadequate. As a result, farmers lack clear direction on sustainable farming practices and quality assurance measures needed to meet both local and international market demands.

One of the key informants noted:

> Farmers are on their own and nobody cares whether they are exploited by cartels and brokers. Recently some people who claimed they were sent by the government came here and asked farmers the number of trees they have. We hear that they want to tax the farmers. There has never been any government support in acquiring the seedlings, manure or fertilizers. Farmers deal directly with the brokers who most of the time dismiss the produce as being of poor quality. Fortunately, we have a few good people who come with pick-ups and Probox vehicles to buy avocados and sell in Thika, Ruiru and Juja towns.

Government support in the form of financial incentives remains limited, making it difficult for smallholder farmers to access high-quality seedlings, fertilizers and irrigation systems. This constraint reduces their productivity and competitiveness, as highlighted in FGDs. Additionally, the absence of strong market-support mechanisms means that farmers lack access to organized markets and structured value chains. Without policies to promote cooperative development, collective marketing, or contract farming, farmers struggle to secure fair prices for their produce (Muma, 2024).

Furthermore, there are no established policies to regulate pricing and ensure fair trade practices, leaving smallholder farmers vulnerable to exploitation by intermediaries. Investment in agricultural extension services and research is also insufficient, depriving farmers of the knowledge and skills necessary for sustainable avocado farming. The lack of coordinated policies to address these shortcomings continues to hinder the potential of avocado farming in Kiambu County as a driver of community development and economic growth.

Opportunities for Smallholder Farmers Embracing Avocado Farming in Kenya

Despite the challenges outlined above, avocado farming in Kiambu County has become a promising and profitable venture for smallholder farmers, thanks to the region's favorable climate and the increasing global demand for avocados. Several opportunities exist that

farmers can capitalize on to enhance their productivity, improve market access, and ultimately transform their livelihoods. This section explores these opportunities in detail.

A Growing Local and International Demand for Avocados

The demand for avocados has surged both locally and globally, particularly in Europe, the Middle East, and Asia, presenting a valuable opportunity for smallholder farmers in Kiambu County. In Kenya, domestic consumption is gradually increasing, providing farmers with a steady local market and reducing overreliance on exports. Meanwhile, global demand continues to rise, with Kenya emerging as a major supplier of Hass avocados, which command premium prices. However, as Griesbach (2005) notes:

> Even though the local and export marketing potential is there, this can be expected to become more competitive in the future and will require keeping abreast of developments affecting the sector especially when it comes to adhering to consumer needs, preferences, pesticide residue standards and traceability regulations.

The expansion of international sales has been facilitated by compliance with emerging export standards and certifications such as GlobalGAP and organic farming certifications. These certifications can open access to high-value markets, allowing smallholders to secure premium prices for their produce. (Mwangi et al., 2022). Additionally, the growing preference for organically grown avocados provides a niche for smallholder farmers willing to adopt organic practices. Organic farming not only reduces reliance on expensive chemical inputs but also enhances marketability in premium segments that prioritize sustainability and ethical production. Support from agricultural extension officers and training programs can help farmers achieve these certifications, strengthening their competitiveness in the global avocado market.

Furthermore, the expansion of international trade agreements and partnerships between Kenyan exporters and foreign buyers presents another promising avenue for smallholder farmers. Contract farming arrangements with exporters can offer technical support, guaranteed markets, and stable pricing, reducing uncertainties in the market. By securing such agreements, farmers in Kiambu can confidently invest in avocado cultivation, knowing they have assured income and access to broader market opportunities.

Government and Institutional Support

The Kenyan government, in collaboration with development agencies, provides valuable opportunities for smallholder avocado farmers, through various initiatives. Programs such as the Kenya Avocado Strategy (2020–2025) aim to support farmers by offering subsidies, training and export facilitation. These initiatives enhance farmers' access to extension services, improving productivity and market readiness.

Beyond government support, NGOs, research institutes, universities, and private sector actors play a crucial role in empowering farmers. They offer financial and technical assistance, educate farmers on modern agricultural techniques, supply high-quality seedlings, and create market linkages. Training programs help farmers develop essential skills in pest management, pruning, and harvesting, ensuring compliance with export standards. Additionally, farmers are encouraged to adopt innovative practices such as agroforestry and soil conservation, which not only boost avocado production but also promote environmental sustainability.

Institutional support also provides opportunities for farmers to participate in benchmarking field visits to learn from the most successful avocado farmers in the country. These visits enable knowledge-sharing and the adoption of best practices, ultimately strengthening the avocado farming sector in Kiambu County.

Formation of Cooperatives and Farmer Groups

Some farmers avoid cooperatives due to concerns about efficiency, the belief that individual marketing is more profitable, or doubts about cooperatives' effectiveness. According to the *theory of reasoned action*, their decision is shaped by their attitudes towards collective action and their perceived ability to navigate markets independently. However, smallholder farmers in Kiambu have the opportunity to form cooperatives to pool resources, share knowledge and negotiate better prices for their avocados.

Farmers' cooperatives and organizations such as Kenya Horticultural Exporters (KHE) provide collective marketing, giving members better bargaining power and reducing exploitation by middlemen. Additionally,

cooperatives allow farmers to purchase essential inputs such as fertilizers and pesticides in bulk, lowering costs and improving access to quality supplies.

Another key advantage of cooperatives is their role in group certification processes, making it easier for smallholder farmers to meet export requirements.

Value Addition and Income Diversification

Smallholder farmers in Kiambu can increase their profitability through value addition and income diversification. By processing avocados into products such as oil, cosmetics, juices and other by-products, farmers can add value to their produce, tapping into high-value markets. Support for small-scale cooperatives and agribusiness ventures could help establish local value-added enterprises.

Avocado farming also offers a complementary income source alongside traditional crops like tea, coffee and maize. Farmers can diversify their revenue by planting additional crops or practicing intercropping with nitrogen-fixing crops such as sweet potatoes or cassava, which improve soil fertility while boosting overall income. This approach not only enhances profitability but also supports sustainable agricultural practices.

Furthermore, avocado farming presents an opportunity for agri-tourism. Kiambu's proximity to Nairobi makes it an ideal location for farmers to attract visitors interested in learning about avocado farming. Farmers can organize farm tours, offer avocado product tastings, and showcase sustainable farming practices, providing an additional income stream and raising awareness about the benefits of avocado farming.

Improved Technology and Agronomic Practices

The adoption of modern agricultural technologies presents a significant opportunity for smallholder avocado farmers to enhance productivity and efficiency. Techniques such as drip irrigation and precision farming can significantly increase production. Additionally, weather forecasting apps and mobile platforms for market information enable farmers to make informed decisions, helping them to better manage resources and increase productivity.

Technology also plays a vital role in pest and disease management. Digital tools can provide farmers with timely guidance on controlling pests and diseases, ultimately improving the quality of their avocados and reducing post-harvest losses. Moreover, young farmers can leverage digital platforms to connect directly with buyers, bypassing brokers and securing better prices for their produce.

Favorable Climatic Conditions and Climate Adaptation Programs

Kiambu County benefits from moderate rainfall, fertile soils, and a favorable altitude, providing optimal conditions for avocado farming. These factors give farmers in Kiambu a comparative advantage, as avocado cultivation requires relatively minimal inputs for success. Additionally, avocados offer better climatic resilience compared to traditional crops, as they can withstand moderate drought conditions.

However, as global climate change continues to impact agriculture, farmers have the opportunity to embrace climate adaptation programs for sustainable avocado farming. With a growing focus on climate change, farmers can benefit from initiatives that promote climate-smart agriculture. These programs provide resources and support for adopting drought-tolerant avocado varieties, water-efficient irrigation systems, and sustainable land management practices.

Avocado farming also has environmental and soil benefits. The crop lends itself well to agroforestry practices, where avocado trees can be inter-planted with other crops and trees. These trees contribute to soil conservation by reducing erosion, providing shade to protect other crops from wind, and helping promote biodiversity. Additionally, avocado trees act as carbon sinks, aligning farming practices with global sustainable development goals.

Access to Financial Services

Microfinance institutions and commercial banks are increasingly offering affordable loans designed to meet the needs of horticultural farmers, providing avocado farmers with valuable financial support. Farmers organized into groups can also access grants and funding from international organizations that focus on supporting agri-business. The growth of microfinance institutions presents more opportunities for smallholder avocado farmers to secure credit and loans specifically tailored to their needs, enabling them to invest in high-quality seedlings, advanced irrigation systems, and other critical farming inputs.

When farmers are financially empowered, they can not only improve their avocado production but also diversify their farming activities. For example, dairy

farming, which is highly profitable in Kiambu County, can provide additional income while supporting organic avocado farming through the availability of manure for soil fertility.

Employment Creation for Youth

Avocado farming offers a promising avenue for employment creation, especially for the youth in Kiambu County. Young people can be encouraged to participate in the sector, helping to diversify employment opportunities across the various stages of the avocado value chain, from production to processing and marketing. The youth can contribute to tasks such as land preparation, planting, watering, pest control, pruning, and harvesting.

The growth of the avocado sector also creates opportunities in agro-processing, where young people can get involved in producing avocado oil, packaging for export, and other value-added products, fostering entrepreneurship and skill development. Additionally, the increasing integration of technology in avocado farming offers roles for tech-savvy youth, including digital marketing, data management, and operating agricultural machinery.

With the right training and resources, young people can also venture into related businesses such as supplying farm inputs, offering transport services, or acting as intermediaries between farmers and markets. These opportunities not only address unemployment but also enhance the efficiency and competitiveness of the avocado industry.

CONCLUSION AND RECOMMENDATIONS

Avocado farming in Kenya holds immense potential for economic growth and rural development. However, the long-term sustainability of the sector depends on effectively addressing the challenges faced by smallholder farmers and promoting strong collaboration among all stakeholders. Community participation, supported by robust partnerships across multiple sectors, is key to realizing the full potential of avocado farming. By investing in infrastructure, capacity building, and sustainable farming practices, Kenya can position itself as a global leader in avocado production while empowering smallholder farmers economically.

Based on the study's findings, the following recommendations are proposed to address the challenges faced by avocado farmers in Kiambu County:

Address Price Volatility and Market Exploitation through the Promotion of Farmers' Cooperatives

The study found that only 22.9% of farmers belong to farmers' groups or cooperatives, but these groups are primarily focused on tea, milk and coffee, rather than avocados. To address price volatility and market exploitation, avocado farmers in Kiambu County should form or strengthen cooperatives that promote collective bargaining, bulk selling, and direct market linkages. These cooperatives could provide a platform for collective marketing, bulk selling, certification, and access to international markets, helping farmers secure better deals while complying with GlobalGAP standards. Additionally, cooperatives can reduce exploitation by intermediaries and enable farmers to benefit from economies of scale (Chitere and Kariuki, 2022). They can also facilitate access to credit, subsidies and training, enabling farmers to invest in better seedlings and improve post-harvest handling practices.

Beyond economic benefits, cooperatives can foster knowledge-sharing on sustainable farming practices, such as organic farming and agroforestry. According to the *Diffusion of Innovations* theory, farmers who are innovators and early adopters will be quick to embrace these sustainable practices. Finally, since agriculture is a devolved function in Kenya, cooperatives can offer farmers a platform to engage with policymakers in the Kiambu County government, advocating for favorable agricultural policies and securing support from both the government and the private sector.

Strengthen Agricultural Extension Services

Regular access to agricultural extension services is essential for building knowledge and technical gaps among farmers. Extension officers can train smallholder farmers in sustainable farming practices, pest control, and disease management. Additionally, they can provide guidance on meeting export quality standards through various extension channels (Mwangi et al., 2023).

Enhance Farmers' Access to Affordable Inputs and Credit

Improving farmers' access to affordable inputs, such as high-quality seedlings and fertilizers, is crucial for increasing avocado yields. Additionally, financial institutions can support farmers by offering credit facilities and low-interest loans. Microfinance institutions can

also partner with agricultural cooperatives to enhance farmers' access to financial resources.

Invest in Infrastructure and Market Access

Improving rural feeder roads, improving storage facilities, and establishing value-addition processing plants are essential to reducing post-harvest losses and ensuring efficient avocado transportation to urban centers. Additionally, creating platforms that enable farmers to engage directly with buyers can enhance market access, promote fair pricing, and eliminate predatory middlemen.

Encourage Sustainable Farming Practices

Climate change poses significant threats to avocado farming in Kiambu County, with rising temperatures, unpredictable rainfall, and prolonged droughts affecting yields. To address environmental concerns and ensure sustainability, farmers should be trained and encouraged to adopt sustainable farming techniques such as agroforestry, mulching, drip irrigation for efficient water use, and organic farming. Additionally, training in crop diversification and natural pest control methods can further enhance resilience.

Supporting farmers in adopting climate-smart agricultural practices is essential for mitigating the impacts of climate change. These practices not only improve adaptation to erratic weather, soil degradation, and water scarcity but also enhance market competitiveness. Encouraging sustainable avocado farming is key to building long-term resilience in the sector.

Support Research and Innovation in Avocado Farming

Investing in research and innovation is vital for addressing challenges faced by smallholder avocado farmers, not only in Kiambu County but also across the country. Research institutions can develop drought-tolerant and disease-resistant varieties of avocados while also guiding farmers in adopting sustainable farming technologies. Additionally, advancements in processing and value addition can help boost farmers' incomes.

Stronger collaboration among researchers, NGOs, policymakers, and smallholder farmers is urgently needed to develop practical solutions for the avocado sector. Establishing well-defined policies and regulations tailored to avocado farming can further support smallholder farmers and enhance the industry's resilience.

Encourage Youth Participation in Avocado Farming

The study revealed that avocado farming is predominantly dominated by older farmers, with 68.8% being aged 50 years and above. There is a need for initiatives that encourage youth involvement in avocado farming, such as training programs and access to modern farming technologies. Young people are more likely to understand the importance of meeting global GAP requirements and organic certifications.

Increasing youth participation in avocado farming will not only create employment opportunities but also inject innovation and energy into the sector, ultimately boosting productivity and ensuring the long-term sustainability of avocado farming.

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