African Phytosanitary Journal
ISSN 2617-1856 (Paper) DOI: 10.52855/UTKZ8404
https://www.africanphytosanitaryjournal.go.ke
Volume 5, Issue 1, 2025

Assessing macadamia value chain gaps in Kenya: A case of Murang'a, Embu and Bungoma Counties

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Abstract

Macadamia (*Macadamia* spp.) is an important high value cash crop in Kenya. This study sought to understand the existing gaps in the macadamia value chain in Kenya with a view of informing policy on how to enhance the value chain performance. The study was carried out in Murang'a, Embu, and Bungoma counties representing macadamia growing areas in Kenya. Data was collected from different value chain actors using a semi-structured questionnaire on various aspects of the value chain. The results show that macadamia crop is grown by both men and women farmers. The crop is becoming popular and has overtaken coffee in Murang'a and Embu Counties and maize in Bungoma County as a cash crop or source of household income. Farmers mainly plant macadamia as an intercrop (76.2%) with fruit trees, coffee, tea, bananas and miraa among other tree crops. Most farmers (65.5%) have planted grafted macadamia. Seedlings are sourced from KALRO, macadamia buying/processing company nurseries, roadside nurseries and individual farmer nurseries. Farmers' reported yields of 67-179 kg per tree/year with Murang'a having the highest average yield of 82 kg/tree per year. Farmers sell mainly to brokers (middlemen) but they are also selling to macadamia buying or processing companies within or outside the counties. Farmers reported being exploited by the brokers and companies who were the main decision makers on the price setting of the nuts. Most farmers (72%) were aware of the opening dates for harvesting of macadamia nuts but this was not keenly being followed. The key challenges to macadamia crop included theft of the nuts, non-involvement of farmers in setting of the nuts prices, poor market prices, lack of policy guidelines on the production and marketing systems, unstructured and unregulated markets and marketing systems. These challenges if managed are expected to enhance the value chain performance, which will improve livelihood of the actors. It is therefore recommended that stakeholders should work

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together to resolve the identified challenges for the benefit of the value chain. A market-based solution that can resolve the identified challenges is encouraged.

Keywords: Macadamia, varieties, seed type, seedling, yields, marketing, challenges, information

Introduction

Macadamia is increasingly becoming an important cash crop and foreign income earner in Kenya, having expanded from a crop grown as a shade crop for coffee in 1940s, to currently being a main crop with a record of more than 40,000 metric tons annual production of nuts in shell in 2018 (Quiroz *et al.*, 2019). At the same period, the country was ranked 3rd among the global macadamia producers, with a kilogram of kernel exported at KES 1,380 (Quiroz *et al.*, 2019). The crop is mainly produced by smallholder farmers in eastern, central, coast, rift valley and western regions of Kenya (Muthoka *et al.*, 2008). The crop has a record of about 200,000 smallholder farmers involved in its production and average of about 30 active nut processing companies (Quiroz et al., 2019). The annual production of macadamia in 2022 was estimated at 42,562 MT valued at KES 2.4 billion at the farm gate, which was an increase from a recorded 40,903 MT valued at 2.5 billion reported in 2021 (AFA, 2024).

Macadamia has been grown mainly in Mount Kenya region where it started as a coffee shade crop. It is mainly found in coffee growing areas of Meru, Tharaka Nithi, Embu, Kirinyaga, Nyeri, Muranga and Kiambu (AFA, 2024). It is also grown in Machakos, Taita Taveta, and Bungoma counties and has been expanding to other counties such as Uasin Gichu, Trans Nzoia, Elgeyo Marakwet, Baringo, Nyandarua and Busia (AFA, 2024).

The government of Kenya over the years has developed the macadamia value chain to reflect on the industry needs. The Nut and Oil Crops Directorate (NOCD) of the Agriculture and Food Authority (AFA) is responsible for overseeing the industry regulations (AFA, 2024). The Directorate was established with a mandate to develop, promote and regulate the Nuts & Oil Crops sub-sector in Kenya based on the Crops (Nuts & Oil

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Crops) Regulations, 2020. It is responsible for developing policies and strategies that promote macadamia nut production, processing and marketing.

This study was carried out to identify existing gaps in the macadamia value chain that, if managed, can contribute to enhancing the sub sector development. While macadamia is a high value crop, there is minimal research publications and thus the current study looks to unlock the potential of the subsector.

Methodology

This study was conducted in 6 sub-Counties; Murang'a (Gatanga and Kandara), Embu (Runyenjes and Manyatta) and Bungoma (Bungoma North and Tongaren). The sub-counties were selected on the basis of macadamia production, regional balance and presence of various industry players. Both qualitative and quantitative data was collected in the study using various data collection tools such as literature review, interviews, observations and photography. The literature review was used to inform the study of the areas with the highest macadamia production (acreage) as per the selected study counties. The literature was sourced from the Ministry of Agriculture Reports from the study Counties, technical reports, from other organisations, journal papers and online publications. The interviews were conducted with key informants and individual macadamia farmers. The key informants included; County and sub-Counties Crops Officers in the Ministry of Agriculture in the specific study areas (sub-County), processors/exporters and brokers. The individual farmers included male and female farmers who had more than five macadamia trees. Out of these farmers, a study sample was randomly identified in each sub-County with the help of sub-County agricultural extension agents and/or farmer leaders to participate in the study. The key informants included extension service providers, individual nurseries manager and macadamia buying/processing companies where possible in each County. The key informant interviews were guided by a checklist with open ended questions while individual farmers' interviews were

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conducted using a semi-structured questionnaire. Farmers consent to participate in the study was sought before commencing the interviews. The questionnaire was loaded into the open data kit (ODK) tool. Enumerators were recruited and trained on how to use ODK and to conduct the individual farmers' interviews. As part of the training, the enumerators pre-tested the questionnaires which was revised based on the pre-testing experiences before commencing on data collection. Observations of the crop on individual farm were made to establish the status of the macadamia crop in the study unit. Photographs were taken to help in visualising the crop and the nuts. The data collected was exported to Microsoft excel then to Statistical Package for Social Sciences (SPSS) for analysis. Descriptive statistics (means, counts, percentages, standard deviations), relationships between variables were established through cross tabulations. The results were disaggregated by gender where appropriate and presented in narrative, tables, pie charts and graphs. The results were supported by the information from key informants, field observation and photographs.

Results

Demographic description

A total of 148 individual macadamia farmers (93 male and 55 female) participated in the study; 65 were from Murang'a, 63 from Embu and 20 from Bungoma. For household evaluation, overall, the interviewed households were categorized as; male headed and managed (54.1%), female-headed and managed (32.4%), male headed but female and managed (13.5%) (Table 1). In all counties, male headed and managed households were the majority followed by female headed and managed.

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Table 1: Types of households by County

Type of Household	Murang'a (n=65)	Embu (n=63)	Bungoma (n=20)	Overall sample (n=148)
Male-headed and managed	58.7	49.2	55	54.1
Female-headed and managed	25.4	38.5	35	32.4
Male-headed, female managed	15.9	12.3	10	13.5

Most (80%) of the interviewed macadamia farmers were aged between 46 and 65 years while 16% were above 65 years of age and the rest 4% were youth aged between 18 and 35 years. Among the respondents, there was no difference in the percent number of males and females who had no primary education as well as those qualified with primary level education. However, male respondents were significantly ($P<0.05$) more in terms of secondary and tertiary level education compared to the female respondents. The average land size per household for macadamia production differed by County with Bungoma County leading with 13 acres per household 13 acres of land per household followed by Embu (2.8 acres) and Murang'a (2.4 acres).

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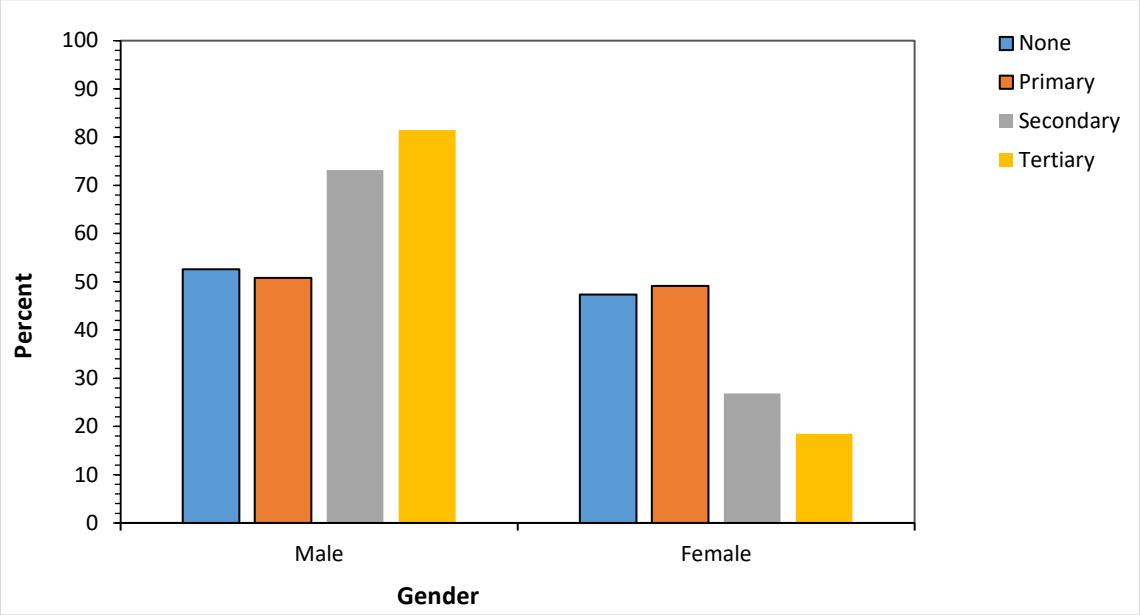

Figure 1: Farmers' level of education by gender

Social Capital

There was no farmer belonging to macadamia group in Embu. However, 15.9% of the farmers in Murang'a and 8.3% in Bungoma belonged to such a group of macadamia producers. Overall, most (65.1%) of the farmers belonged to different types of social welfare groups while 17.4% reported being members of farmer groups, 14.0% religious groups, 9.3% macadamia farmer groups, 9.3% cooperative societies and 7% agricultural marketing group (Table 2).

Table 2: Farmers membership in social groups

Type of social group	County			Average Scores (%)
	Murang'a	Embu	Bungoma	
Welfare	54.5	76.7	75	65.1
Farmer groups	20.5	16.7	8.3	17.4
Religious	13.6	16.7	8.3	14.0
Macadamia	15.9	0	8.3	9.3
Cooperative society	6.8	13.3	8.3	9.3
Agricultural marketing	6.8	3.3	16.7	7.0

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Sources of household income

Crop and crop products were identified as the main source of household income by 43% of the respondents followed by livestock and livestock products reported by 31% of the respondents (Figure 2).

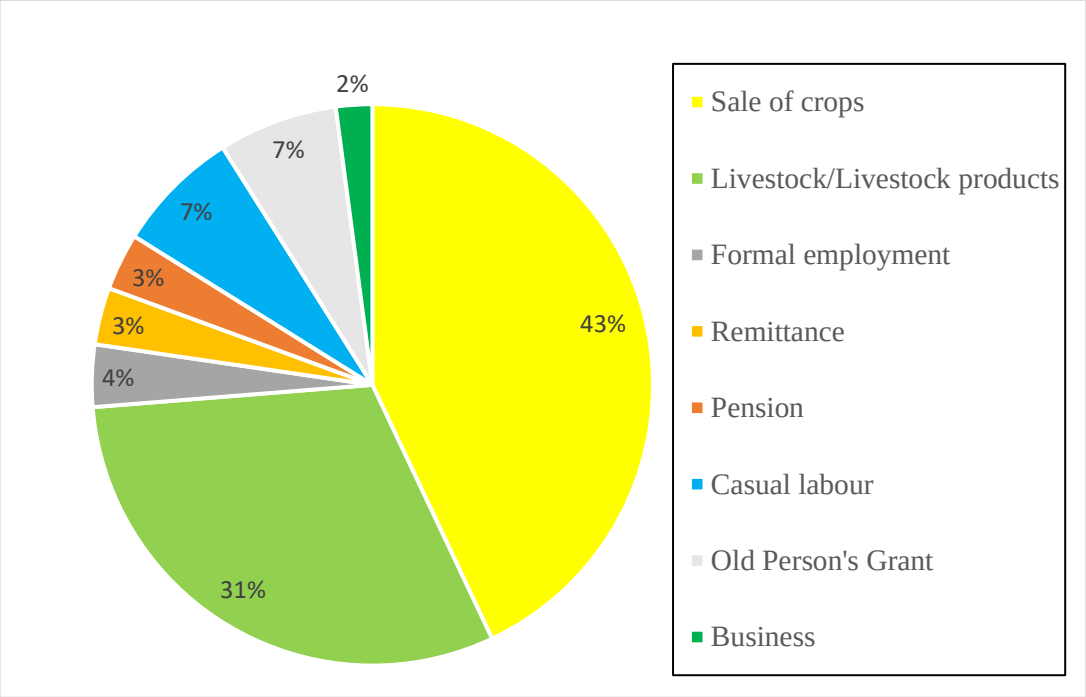

Figure 2: Sources of household income

Among the crops, macadamia was identified as the leading household income generator followed by coffee in Murang'a, bananas in Embu and maize in Bungoma Counties (Table 3).

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Table 3: Main income generating crops

Crop	Murang'a (n=62)	Embu (n=64)	Bungoma (n=20)	Overall sample (n=146)
Macadamia	98.4	96.9	100.0	97.9
Coffee	50.0	43.8	30.0	44.5
Banana	24.2	45.3	30.0	34.2
Maize	11.3	6.3	65.0	16.4
Fruit trees	22.6	9.4	0.0	13.7
Local vegetables	6.5	9.4	10.0	8.2
Beans	6.5	1.6	15.0	5.5
Tea	0.0	14.1	0.0	6.2
Potato	3.2	3.1	0.0	2.7
Sweetpotato	1.6	0.0	5.0	1.4
Cassava	0.0	1.6	0.0	0.7

Macadamia Production

Majority of the respondents reported having 21-30 years of growing of macadamia across all the three counties (Figure 2). However, there was still a large population who had 11-20 years of growing the crop. The average number of trees per household differed by County with Murang'a leading with 39, Embu (38) and Bungoma (30) trees.

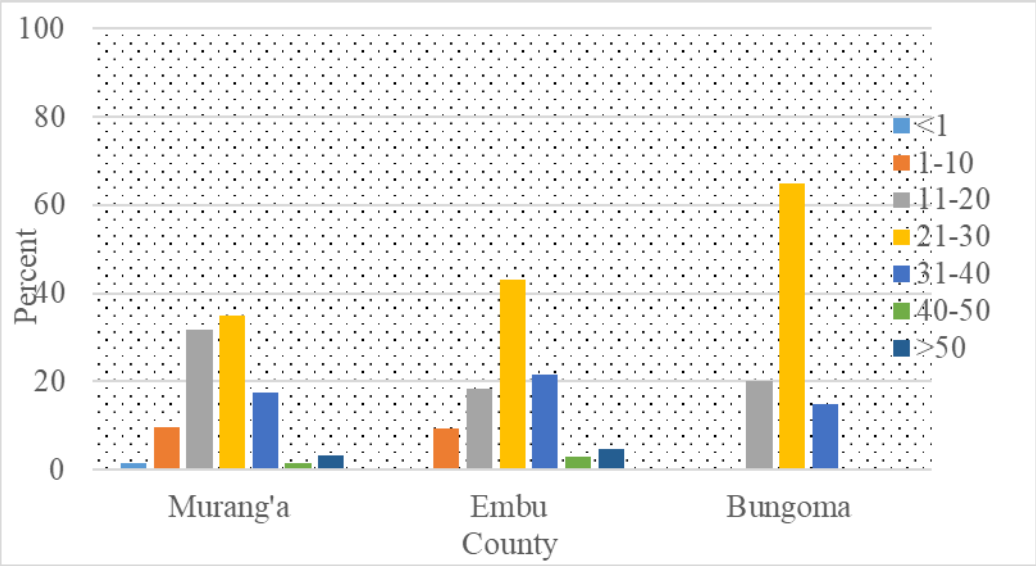

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Figure 2: Number of years farmers have practiced macadamia farming in Embu, Murang'a and Bungoma counties, Kenya

Most (75%) of the farmers planted macadamia as an intercrop with 31.8% planting it as pure stand, 4% along the hedge and 2% as shade trees. Intercropping was mainly with fruit trees (33.5%), food crops (26.7%) and banana crop (22.7%) respectively, among others. In Embu the crop was also planted together with Miraa and tea (Table 4). The farmers nut in-shell yields ranged from 68-175 kgs/tree per year with Murang'a County leading with an average of 175kg/tree per year.

Table 4: Macadamia production system in Embu, Murang'a and Bungoma counties

Intercropping crops/trees	**% of farmers intercropping the macadamia tree**			
	Murang'a (n=63)	Embu (n=65)	Bungoma (n=20)	Overall score (%)
Fruit trees	43.8	27.1	21.4	33.5
Bananas	21.9	30.5	28.6	26.7
Food crops and vegetables	21.0	22.9	28.6	22.7
Trees	0.0	2.5	10.7	13.3
Miraa	0.0	0.8	0.0	0.4
Coffee	25.7	15.3	10.7	19.1
Tea	0.0	2.5	0.0	1.2

Varieties grown and seedling sources

The farmers planted several macadamia varieties namely; Embu 1(EMB1), Kiambu 3 (KMB3), Kirinyaga 15 (KRG 15), Murang'a 20 (MRG 20) and Tetraphylla. Most farmers (65%) did not know the variety they had planted. The main sources of seedlings were the Kenya Agricultural and Livestock Research

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Organisation (KALRO), private nurseries, roadside nurseries, individual farmer nurseries, buying from neighbours and market places. The results further indicate that based on specific varieties, 56.3% of the unknown varieties were sourced from roadside nurseries. The most common source of "Tetraphylla" variety was from farmer owned nurseries (Table 5).

Table 5: Varieties and where their planting materials are sourced

Variety	% Responses				
	KALRO	Private nurseries	Roadside nurseries	Farmer own seedlings	Other sources
MRG 20	33.3	28.1	34.4	14.3	38.1
Unknown	18.8	34.4	56.3	14.3	35.7
EMB 1	14.6	9.4	3.1	14.3	4.8
KMB 3	12.5	9.4	3.1	0.0	7.1
KRG 15	12.5	3.1	0.0	0.0	0.0
Tetraphylla	8.3	15.6	3.1	57.1	14.3
Total	100	100	100	100	100

Types of macadamia seed/planting materials

Farmers from all the counties planted three types of planting materials: grafted seedlings, non-grafted seedlings and a mix of both grafted and non-grafted seedlings. About 46.6% of all farmers planted grafted seedlings with majority of them coming from Murang'a (57.8%) and Bungoma 50%) counties. Out of the 22.3% who had planted both grafted and non-grafted seedlings, majority (30.2%) were from Embu County. However, non-grafted seedlings were highly reported in Embu County compared to Murang'a and Bungoma Counties. Some farmers (10.8%) did not know the type of seedlings (Table 6). From the interviews, it was noted that education was a major determinant of the choice of the planting material. About 68,3% of the farmers with secondary level education used grafted seedlings compared with 40.7% who had tertiary education, 37.7% primary education and 36.8% with no formal education.

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Table 6: Type of macadamia planting materials used by farmers

Type of seedlings	% Responses by County			
	Murang'a (n=63)	Embu (n=65)	Bungoma (n=20)	Overall score (n=148)
Grafted	58.7	33.8	50.0	46.6
Grafted and non-grafted	17.5	30.8	10.0	22.3
Non-grafted	12.7	29.2	15.0	20.3
I don't know	11.1	6.2	25.0	10.8

Marketing

Out of the 148 farmers, about 72% were aware of the opening and closing dates for macadamia harvesting. However, these dates were not being observed as a result of various reasons such as to avoid loss of nuts in shell through theft.

Macadamia challenges and constraints

Farmers practice macadamia growing with minimal challenges on agronomic practices such as fertilizer and manure applications, weeding, pruning and pest management. About 79.5% of the farmers apply manure just before the onset of rainfall. They do not manage pollination in any way though they confirmed observing bees visiting macadamia flowers. About 66% of the farmers were not pruning their trees and only 12% of farmers were not carrying out regular weeding.

The main challenges for macadamia growing were theft, poor nut in-shell prices, non-involvement of the farmers in setting of the prices, emerging crop pests, (insects, monkeys, rodents), lack of structured markets leading to exploitation by brokers and buying/processing among many other as shown in Table 7.

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Table 7: Challenges and constraints in macadamia growing.

Challenges	% Responses
Theft	29.1
Poor prices including and non-involvement of farmers in setting nut market prices	25.7
Crop pest including diseases, insects, monkey, big rat (Bernard/ Kithanda)	17.6
Lack of structured macadamia nuts market	8.8
High cost of farm inputs	7.4
Flower and fruit abortion	5.4
Lack of technical knowhow and information on macadamia	3.4
Exploitation by brokers	2.7
Harvesting of immaturity of the nuts	2.7
Lack of superior varieties	2.0
Lack of extension services	1.4

Information and knowledge on macadamia

The results indicated that most (60%) farmers had not received any information about macadamia in the past one year (Table 8). Out the 40% who had received information, mainly on crop management and market, the main channel was radio, macadamia buying/processing companies and brokers. Few farmers (3.5%) in Murang'a County had received information through the mobile phone. The farmers further identified KALRO and government extension services as their most trusted source of information.

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Table 8: Source of information that macadamia farmers access

Source of information	% Responses			
	Murang'a	Embu	Bungoma	Total
Government extension services	5.5	9.1	3.6	18.2
Farmer Association	5.5	0.0	0.0	5.5
KALRO	1.8	3.6	5.5	10.9
Private Service provider	23.6	20.0	0.0	43.6
Neighbours	7.3	7.3	0.0	14.5
Relative	7.3	1.8	0.0	9.1
Newspaper	1.8	0.0	0.0	1.8
Radio	25.5	16.4	3.6	45.5
Brokers	23.6	14.5	1.8	40.0
Agro-dealers	3.6	0.0	0.0	3.6
Phone	3.6	0.0	0.0	3.6

Discussion

The macadamia sub-sector in Kenya has continued to grow and becoming popular owing to the ever-growing global market demand for the kernels. Farmers continue to join the industry annually, due to the promising income levels. The findings that most of the farmers are above 46 years of age agrees with previous report by Maina *et al.* (2021) who likewise noted that majority of growers are above 50 years of age. The current findings that majority of farmers have from 10-30 years of experience in macadamia production implies that they started at their youthful age. Maina *et al.* (2021) noted about 7% of the respondents being youth involved in macadamia production compared with current findings of 4%. Young people are reportedly impatient in farming due to waiting period of returns to investment, which could be the case of educated people not investing in macadamia production. Previous studies have reported that the reasons for low participation of youth in agriculture are due to lack of access to financial services and long waiting period for returns as well as fluctuation of market (Brooks *et al.,* 2013). Based on the findings, macadamia production can provide

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opportunities for youth to participate in economic activities. However, to do this, they need access to financial services which they can use to access production inputs, including leasing of land, where possible. The study revealed that most farmers were planting improved varieties. However, the source of those planting materials was diversified, and, has impact on quality of the materials. For example, unregistered nurseries pose threat to quality materials. Such nurseries have no reason to conform to regulations since they are not under any form of industry regulations and thus are likely to supply planting materials that do not conform to standards such as known varieties, and, free from diseases among others. The quality of the planting materials contribute significantly to crop growth and productivity (Zaimoglu *et al.*, 2004, Oxfam, 2019). A large number of farmers also did not know the varieties they were growing. Yet it is important particularly if the buying companies demand nuts of certain varieties. The biggest challenge that farmers reported was related to the marketing system. They reported theft of nuts in shell and price volatility. Farmers were left to depend on middle men as the main buyers. This has contributed to farmers being the lesser beneficiaries of the crop compared with other value chain players (Maigua *et al.*, 2017). Maina *et al.* (2021) noted the value of information sharing amongst macadamia value chain actors, which this study agrees with. Sharing of information is crucial in transforming the agricultural sector and improving household incomes, food security and reduced poverty. While co-existence of multiple sources of information, technologies and knowledge should be encouraged, such sources should be credible and affordable (Wanyama *et. al*, 2017).

Conclusion

This study reports a highly active macadamia farming community. It notes that production challenges are manageable. However, the main challenges are market based and are related to stealing of nuts-in-shell while on the trees, resulting to harvesting of premature nuts that get to the market,

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and also, reducing incomes of the farmers. Further, farmers are not involved in price determination and thus are just price takers, which make them disadvantageous of market offers.

Recommendations

This study recommends development of a market model that will guarantee farmers competitive edge in price setting, and, prevent stealing of nuts-in-shell in the orchards. A model that allows only macadamia farmers to participate in selling of the nuts-in-shell will prevent theft.

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