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Research Article

Multi-stakeholder Platform as a Tool for Information Sharing and Innovation Adoption in Avocado Farming

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Abstract

Avocado farming faces numerous challenges including inadequate crop management, climate fluctuations, market uncertainty, and a lack of value addition. Multi-stakeholder platforms offer a promising space to tackle these issues collectively. This research aims to assess how interactions within such platforms influence smallholder avocado farming. Employing a participatory action design and mixed-method approach, data was collected via questionnaires and focus group discussions. The study adopts an innovation systems perspective, using information sharing and stakeholder roles as indicators of communication. It highlights the platform's role in providing access to information, knowledge, and resources. Results emphasize the need to empower stakeholders for inclusive innovation adoption, ensuring comprehensive access to tools promoting avocado yield for food, industry, and climate resilience. The study underscores the positive impact of multi-stakeholder platforms in fostering collaboration, networking, and capabilities to integrate climate-smart avocado practices, revealing farmers' innovative potential. It recommends promoting community-based platforms in extension services for increased productivity, income, and positive changes in farming systems. Ultimately, this research contributes to understanding agricultural innovation diffusion through a multi-stakeholder approach within the agricultural innovation system.

Keywords: Avocado; Contract farming; Multistakeholder; Platform; Smallholder farmer; Value chain

Introduction

Avocado holds immense significance for East African rural communities and economies, with Kenya boasting a wide array of over 40 avocado varieties, including Hass as the primary export variety [1, 2]. While Hass and Fuerte dominate the export market, other local varieties like Pueble, Duke, and G6 cater to domestic consumption. More than 70% of Kenya's avocado production comes from smallholder farmers, leading to increased county government investments aimed at reducing losses, notably through contract farming [3 4]. However, solely relying on contract farming might not significantly enhance smallholder incomes [5] To address this, farmer organizations have intervened, though sustained external support is often necessary [6; 7].

In this context, the study adopts a multi-stakeholder approach to integrate avocado farmers with stakeholders across the value chain, such as exporters and government agencies. Emphasizing innovations in contract design, including third-party certification and R&D approaches, becomes pivotal to rebalancing power dynamics between smallholders and contracting entities [8, 9].

The research investigates the efficacy of multi-stakeholder initiatives in tackling challenges like farmers' acceptance of avocado farming and climate change. It underscores the necessity for collaborative efforts among diverse stakeholders in the agricultural value chain to address socioeconomic and ecological concerns (9). Evaluating the convergence of information-sharing pathways through multi-stakeholder initiatives highlights the need for a holistic approach to address vulnerabilities in avocado farming.

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Partnerships within agriculture involve diverse stakeholders collaborating across value chains [10]. For smallholders to integrate into these chains, specialized partnerships are crucial, employing varying competencies to address challenges and improve the entire chain [11].

These agricultural partnerships encompass players with differing interests and interaction styles, such as smallholders and commercially focused entities like financial organizations or retailers [11]. However, ensuring inclusivity in such collaborations can be challenging, often favoring those with more authority or stronger links in the chain (12). This highlights the necessity to reevaluate the inclusiveness of these arrangements, particularly in providing equitable outcomes for less empowered groups [13].

Agyekumhene et al. [11] outline criteria to assess the inclusivity of these collaborations: ownership, voice, risk, and reward [14]. Ownership pertains to control over project assets, while voice focuses on the ability of farmers to influence decisions. Risk-taking and corresponding returns are also pivotal indicators. Enhancing inclusivity means bolstering smallholder ownership, voice, risk-sharing, and rewards, thereby empowering them to leverage these connections [15].

Over time, agricultural platforms and collaborations have evolved, aiming to empower stakeholders and communities to harness their research potential [16]. Many of these platforms focus on specific issues identified by external experts, engaging the public in scientific activities directed by scientists and researchers. However, alternative approaches aim to capture communities' knowledge, practices, and understanding of their issues, providing insights for or against specific courses of action [17].

Improved communication methods, as highlighted by [11], can empower actors within value chains, particularly smallholders who are diverse and heterogeneous [18]. Facilitating farm-specific communication allows partners to better comprehend farmers' contexts and provide timely support services, fostering transparency and trust within partnerships [19]. However, excessive monitoring for information symmetry might inadvertently disempower farmers, leading to their increased control and scrutiny (20). To counter this, involving smallholders in monitoring and communication processes empowers them within partnerships, allowing them to influence their environment [19].

Smallholder populations vary significantly in constraints, capabilities, and attitudes, impacting their adoption of agricultural innovations. The focus here is on how farmer-oriented cooperative platforms, particularly in avocado farming, impact smallholder partnerships. Understanding farmers' use of agricultural monitoring and communication links helps assess their perspectives on ownership, voice, risk, and reward (21). Additionally, it emphasizes the challenges faced in altering institutional norms, hindering the implementation of new systems and agricultural value chain expansion strategies [22]. Multi-stakeholder platforms are collaborative governance mechanisms involving diverse stakeholders aiming to address common challenges [23]. They're pivotal in tackling agricultural, environmental, and social issues, often focusing on specific industries or regions [24]. These platforms not only foster dialogue but also establish norms influencing corporate behaviour [25].

Linked with the Agricultural Innovation Platform System (AIPS), they drive institutional and technical advancements in agriculture for sustainable rural development [27, 27]. AIPS fosters forums where stakeholders identify and resolve constraints, often transitioning into unified organizations coordinating activities, and forming multi-stakeholder platforms along the agricultural value chain [28].

Research methods such as innovation systems and value chain approaches analyze these platforms [29]. While the former delves into system components and innovative activities, the latter views these platforms as spaces for collaboration within economic units analyzing specific commodities [30,31]. However, understanding how activities unfold within an agricultural value chain through multi-stakeholder platforms remains relatively unexplored [32.33].

The study investigates the coordination of agricultural value chain stakeholders and innovation activities within an avocado multi-stakeholder platform in Kenya's Upper Mara Watershed, focusing on knowledge sharing and innovation potential to enhance outcomes and address policy gaps. The objectives of the study were:

(i) Assess the effectiveness of multi-stakeholder platforms in disseminating information related to avocado farming practices and innovations.

(ii) Measure and analyze the extent of adoption of innovative avocado farming practices facilitated by multi-stakeholder platforms among different stakeholders.

(iii) Investigate the role of multi-stakeholder platforms in facilitating information exchange among various actors involved in avocado farming.

Methodology

2.1. Context of the Study and Location

The research took place in the Upper Mara watershed of Kenya, positioned between specific coordinates of 0º45'S and 1ºS latitude and 35º and 35º15' E longitude and at an elevation above sea level [34]. This location was selected for its proximity to smallholder farmers engaged in avocado cultivation. Within the Upper Mara watershed, households primarily focus on agriculture, notably maize as a key food crop and increasingly, avocado as both a food source and an income generator. Notably, there are major maize trading centers in Bomet East and Narok West Sub- Counties.

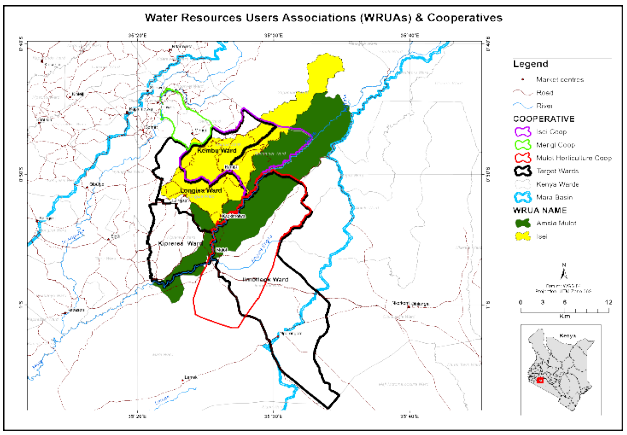

Figure 1: Map of Upper Mara Watershed in Bomet and Narok Counties of Kenya

Households in the Upper Mara watershed engage in agriculture, particularly maize as a staple food crop and increasingly, avocado as a valuable source of income. Also, the smallholder farmer belongs to the Water Users Association (WRUA) and horticultural cooperatives. Market centers in Bomet East and Narok West Sub County are significant hubs for maize trade in this region. However, smallholder farming here faces challenges like rain-fed production, limited storage, information gaps, dominance by traders, and weaker farmer groups. These issues lead to conflicts, unequal treatment, and mistrust among those involved in the value chain. Farmers' limited access to financial and material support puts them in vulnerable positions within partnerships, making them reliant on other value chain actors [35].

The study focuses on collaboration within the avocado value chain, emphasizing value chain development and enhanced cooperation among various parties. It was conducted in proximity to smallholder avocado farmers, specifically in Bomet East and adjacent Narok West, chosen due to their proximity to these farmers and their active engagement in avocado harvesting.

2.2 Research design

The study employs Participatory Action Research (PAR) to establish a multi-stakeholder platform for avocado farming. This approach integrates three methodologies to tackle complex issues, find feasible solutions, and drive positive change. PAR aims to gather relevant information within an organizational context through planning, intervention, and reflection processes [36]. It emphasizes community involvement, empowering those directly impacted by the research outcomes.

By engaging participants as co-researchers, PAR ensures the research process is shaped by their insights and experiences. It highlights how interactions among stakeholders influence the exchange of information, capturing both researcher intentions and farmer impacts through interventions, implementation, and reflection. Understanding the context of information flow is deemed crucial.

The PAR approach involves three main steps: issue conceptualization, intervention, and assessment, followed by reflection and learning. Continuous reflection occurs at each stage, emphasizing the social and economic implications of implementing accepted farming information. In the multi-stakeholder platform, diverse groups participate, prompting the use of various communication strategies to bridge communication gaps between researchers and stakeholders [37].

2.3 The target population

The research encompassed various stakeholders across the nodes of the avocado value chain and distribution. It aimed to fortify smallholder farmer organizations by facilitating connections with markets, funding sources, inputs, and information. This involved a diverse range of individuals and entities engaged in research, advisory services, production (avocado growers), transportation, marketing, seedling suppliers (both external and local suppliers like Isinya Roses and local nurseries), and policy influencers. The selection of these stakeholders was based on their expertise and involvement within the avocado value chain. Identification of these key stakeholders was done in collaboration with the Departments of Agriculture, Livestock, Fisheries, and Cooperatives in Bomet and Narok Counties (MoALF), leaders from CFA and WRUA, village elders, and a local non-governmental organization (NGO) [36].

2.4. Sampling design

Twenty avocado farmers from three agroecological zones and two avocado farmer group leaders were chosen for interviews using a carefully stratified sampling method. Additionally, nineteen key informant stakeholders were purposively selected from the Cis Mara Avocado Farmer Cooperative Society (CMAF) in the study area [33]. Special attention was given to including women and youth representatives in the sample. The selection process was guided by the specific roles played by stakeholders within the avocado value chain, as detailed in Table 1. Descriptive analysis of the data delineated the various roles undertaken by stakeholders within the avocado value chain.

Table 1. The role and functions of key stakeholders in the avocado value chain

No.	Stakeholder	Position of Key informant	The Number Interviewed	Specific role
1.	Bio-farm	Research Manager	1	Traders/advisory service
2.	Ever-grow Research	Market researcher	1	Research/advisory/market
3.	Agri-Tech	Technical Officer	1	Input supplier-organic manure
4.	International partnership service (IPS)- fertisoils	IPS field officer	1	Input suppliers- organic manure/ferti-soils
5.	Sun culture irrigation	Programme Manager	1	Input suppliers/irrigation equipment
6.	Kenya biologics	Lead specialist	1	Input supply/pest and disease control
7.	Olivado	Agronomist	1	Market/input supply
8.	Cis-mara avocado cooperative society (CMAF)	Programmes Manager	1	Regulatory/research/advisory services/financial/market
9.	Water resource user's associations (WRUA)	Head of WRUA	1	Regulatory resource use water/ land conservation
10.	Horticultural Crops Directorate (HCD)	Regional director	1	Regulatory/policy on quality and export
11.	Ward Agricultural office	Extension officer	1	Advisory services
12.	Community Forest Association (CFA)/ SOCOFONA	CFA chair Avocado farmer	1	Advisory services/research/ traders
13	Sasini and Stabex Multi-National Company	Programme manager	1	Marketing avocado
14	Mara Farm	Avocado farmer	1	Research information/marketing
15	Water Resource Management Authority (WARMA)	Regional field officer	1	Regulatory on water provision
16	Kenya Plant Health Inspectorate (KEPHIS)	Regional Field officer	1	Regulatory to control pests/ diseases
17	Horticultural Crop Research Institute (KALRO)	Horticultural Research Institute Centre director	1	Agro-advisory / Research information
18	Avocado seedlings suppliers (Isinya roses, local)	Enterprise manager	1	Input supplier -seedling/ traders/
19	Avocado farmer	Household heads	20	Avocado grower/producer

2.5. Data collection approaches

The study utilized stakeholder interviews as a primary data collection method. Participants unfamiliar with the concept of a multistakeholder platform were briefed before the interviews. Farmer interviews involved individuals across different levels of influence to ensure a balanced representation and enhance the study's credibility. Employing a mixed-method approach, the study combined key informant interviews for qualitative insights, categorizing stakeholders based on their roles, with the use of the Sapelli mobile application for data collection from the multi- stakeholder platform interactions [24].

The Sapelli application, an open-source software, employs an icon-based interface to overcome literacy and language barriers during data collection. This user-friendly approach allows the customization of symbols to match local preferences, facilitating citizen science research using smartphones. Utilizing features like cameras, microphones, and GPS, Sapelli automatically generates and stores data in formats like XML or CSV, offering easy download or transmission via SMS [17]. These attributes make Sapelli an apt tool for comprehensive data collection in multi- stakeholder avocado platform contexts.

2.6. Data analysis

Descriptive analyses were conducted to calculate the percentages of stakeholders responding to specific interview questions regarding avocado production land allocation. Key variables for both descriptive and inferential analyses included avocado production and market prices. Additional factors such as farm size dedicated to avocado production, achievements within the value chain, and attributes of information exchange in the multi-stakeholder platform were considered. Mean values derived from these analyses were further examined through a paired samples t-test. This test aimed to assess the statistical significance associated with the avocado multi-stakeholder platform's performance and the engagement processes involving stakeholders within the value chain.

Results and Discussion

3.1 Increased dissemination of information about avocado farming practices and innovations

3.1.1 Increase production information

The study indicates a substantial increase in household avocado production, from 49.99 kg in 2018 to 1678.00 kg in 2022, largely attributed to information exchange facilitated by multi-stakeholder platforms (Figure 2). Notably, avocado yields in the Upper Mara watershed fluctuated significantly between 2018 and 2022, mainly attributed to adverse weather conditions and limited farmer revenue.

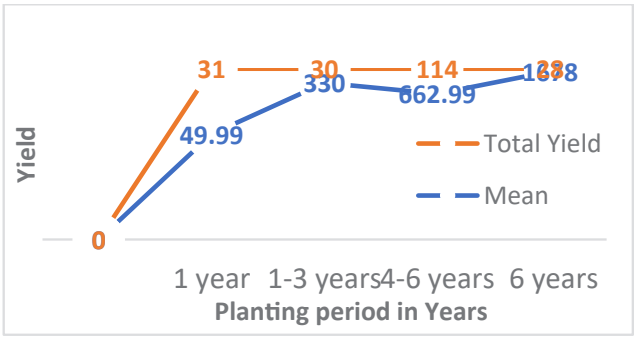

Figure 2: Avocado production in the Upper Mara region

Contract farming emerged as a primary strategy in the region following the assessment of avocado production and marketing operations through multi-stakeholder platforms. Contract farming aimed to bolster avocado output and availability, involving collaboration between farmers and export companies. Farmers focused on increasing production and sales, supported by seedlings, inputs, or loans from export companies [2], a strategy resonating with studies on public-private partnerships [3]. Contract farming and capacity-building initiatives effectively increased avocado quantities, enhancing availability and income for both farmers and exporters [4]. The scaling activities aimed to facilitate market connections between producer farmers, domestic traders, exporters, and consumers, aligning with previous research on Kenyan agrifood chains [5]. To improve market access, avocado farmers were linked to markets through mobile phone-based information systems, a strategy in line with other studies focusing on enhancing market access for smallholder farmers [16, 17]. Contract farming's potential to integrate smallholder farmers into controlled agri-food value chains addresses issues like limited credit availability, market inefficiencies, and high transaction costs, especially in developing countries [38]. It grants farmers access to technology, quality assurance, and marketing support, correlating positively with household income, agricultural production, and food security [35]. However, conflicting data exist, with concerns raised about the exploitation of labor, increased regional inequality, and potential income sacrifices from nonfarm enterprises and labor markets [39].

3.1.2 Increased information on adoption and investment in avocado production by farmers

The study observed a 2.1% increase in individual avocado production in the Upper Mara watershed since 2016. Notably, there's been substantial growth in avocado planting on various farm sizes, ranging from 7.5% to 40.7%, as depicted in Figure 3. About 55.6% of farmers in the study region cultivated avocados across diverse land sizes, with household production ranging from 49.99 kg to 1678.00 kg per hectare in 2022. However, these figures fall below the average means of avocado production based on FAO statistics from 2018.

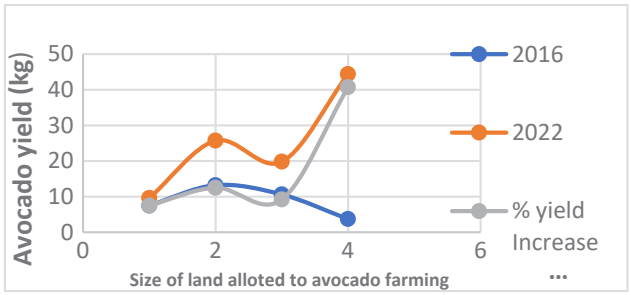

Figure 3: Avocado production increases per hectare in the Upper Mara region. (Source: Author, 2022).

In line with this research, increased farmer involvement and information exchange via multi- stakeholder platforms have spurred a surge in avocado farming across Kenya [33]. Smallholder farmers initially lacked exposure to commercial avocado cultivation until initiatives like Marafarm stepped in. Assessments from the Solidaridad NGO in the Netherlands highlighted a lack of knowledge about avocado crops as a barrier to earlier, limited adoption among farmers [40]. Efforts to scale up avocado production aimed to raise yields per hectare, presenting lucrative opportunities for farmers to bolster profits [36].

The dissemination of avocado farming information through the multi-stakeholder platform, combined with proximity to the Trans Mara Forest Block and the implementation of climate-smart practices, empowered farmers to boost avocado output despite challenges like irregular rainfall, drought, and pests. Despite these constraints, farmers in the study area see avocado cultivation as a promising alternative income source. The limited yet tangible benefits experienced by farmers from avocado farming have spurred increased investment in avocado production, leading to expanded farm sizes dedicated to avocados. This trend aligns with the positive economic impact farmers associate with avocados, influencing their farm income and access to financial services through cooperative engagements—a sentiment echoed in work on agricultural innovation sustainability [41].

The establishment of a farmers' cooperative society in the Upper Mara region significantly boosted smallholder farmers' income through collective marketing, encouraging greater involvement in avocado production and marketing activities [33]. Despite disparities between optimal and average production levels,

avocado stakeholders successfully addressed value chain constraints, resulting in increased avocado production. Similarly, a study on stakeholder participation in Ghana's cocoa industry mirrors the use of multi-stakeholder platforms to elevates output through various interactions, including training, improved linkages, and financial support [42].

Platform respondents highlighted key achievements attributable to multi-stakeholder platform interactions. A majority supported technical information dissemination (86%), marketing (93%), credit access (79%), expanded input availability (85%), nursery establishment (78%), watershed conservation through avocado planting (82%), and participation in avocado planting training (89%) (Figure 4) [36]. Farmers are expected to learn about climate-smart soil management through platform engagement, potentially mitigating climate change effects.

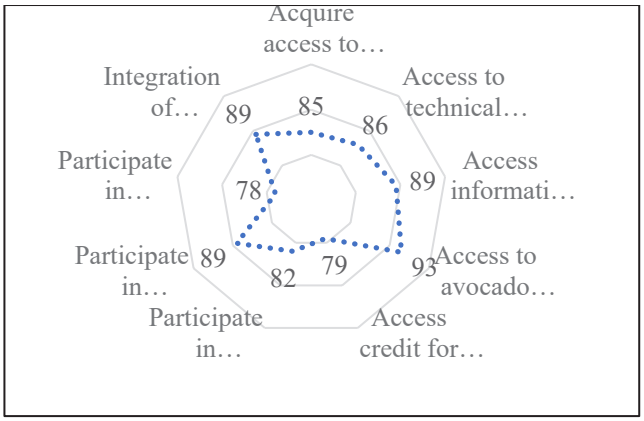

Figure 4: The percent achievements attributed to the multi-stakeholder platform for avocado information exchange in the Upper Mara watershed (n=80)
(Source: Author, 2022).

The multi-stakeholder platform served as a conduit for delivering climate-smart avocado practices and information, leading to increased purchase and planting of avocado seedlings among farmers.

This, in turn, improved household food availability. Enhanced access to advisory services facilitated the adoption of climate-smart practices, aligning with efforts to address conservation challenges in different agricultural settings [43].

Improved marketing access through the multi-stakeholder platform positively impacted farmers' decision-making, enabling strategic investments in land management practices and soil productivity. The linkage between access to farm inputs, marketing information, and climate-smart practice adoption justified farmers' investments in land management for better yields and land conservation using avocados [44].

Avocado production and marketing emerged as a lucrative opportunity for income generation, fostering resilience against climate change shocks. The multi-stakeholder platform functioned as an innovative mechanism for collaborative problem-solving, garnering attention from stakeholders to engage further in avocado activities [45].

A significant relationship emerged between farmers' interaction with extension agents and the adoption of climate-smart practices, highlighting the crucial role of improved information access and demonstration of new technologies [46].

Access to inputs like improved seedlings and fertilizers significantly predicted the adoption of climate-smart practices, as smallholder farmers opted for these inputs to boost productivity. Technical information access and social cooperation further facilitated technology adoption by raising awareness and fostering an enabling environment for knowledge dissemination [47].

These findings underscore the importance of multi-stakeholder platforms in enhancing knowledge dissemination, fostering collaboration, and promoting the adoption of climate-smart practices among smallholder farmers, ultimately contributing to improved agricultural productivity and resilience [35, 38].

3.2 Adoption of innovative avocado farming practices through a multi-stakeholder platform

The study uncovers significant improvements in the accessibility of avocado seedlings in the Upper Mara region, driven by learning exchanges facilitated by NGOs and farmers' cooperative organizations. Notably, the average price of avocado seedlings dropped from Ksh 329.94 to Ksh 249.93 per seedling between 2018 and 2022, making them more affordable for farmers. However, local dealers dominated the market, restricting farmers' ability to negotiate lower prices.

Employing a paired-sample t-test revealed substantial variations in seedling prices between 2018 and 2022 (Figure 5), signifying the impact of multi-stakeholder platform activities on market connections, seedling quality, and pricing. This echoes findings in Ethiopia where such platforms bolstered agricultural innovation [48].

Figure 5: The cost of avocado seedlings in the Upper Mara region over six years.

The study shows how these initiatives enhanced market connections, benefiting both production actors and farmers. Improved access to advisory services and inputs contributed to the increased adoption of climate-smart practices and better pricing for avocados. Similar measures across Africa

aim to bolster avocado production, including farmer capacity-building and technology integration [4].

Efforts in the avocado value chain focused on quality management training and aligning produce with national and global standards. Cooperative interventions strengthened links to financial institutions, empowering farmers to secure loans against their avocado harvest. These collaborations led to improved financial access and better economic conditions for farmers, echoing findings on agricultural innovation sustainability [41].

However, challenges persist regarding the adequacy of financial support for capital-intensive climate-smart practices. While access to credit via savings and lending institutions helps finance labor-intensive methods, it falls short of technology-

intensive practices. To bridge this gap, farmers resort to accessing credit in-kind for seedlings and fertilizers through various local sources and government extension programs [40].

Moreover, the findings showcase the transformative impact of multi-stakeholder platforms and cooperative interventions in enhancing access to seedlings, market connections, and financial services for avocado farmers in the Upper Mara region. The findings align with efforts to boost agricultural innovation and improve smallholder farmers' livelihoods across Africa [33].

3.3 Increased promotion and dissemination of climate-smart practices

The study highlights the adoption of climate-smart practices among smallholder farmers in the Upper Mara watershed, focusing on avocado cultivation and soil management techniques. The research indicates a consistent adoption rate, averaging between 3.7 to 4.1 across practices (Figure 6, Source: Author). Notably, mulching emerges as a preferred method for soil health management, while recycling avocado waste via composting and mulching enhances soil fertility [42, 49].

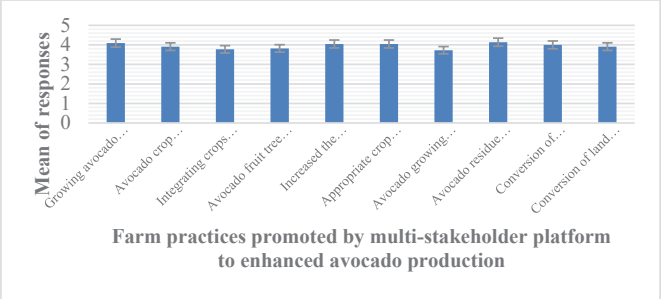

Figure 6: Mean responses on the adoption of climate-smart avocado production practices among smallholder farmers. n = 80. **(Source: Author).**

Agroforestry incorporating avocado crops proves effective in transitioning land to natural cover, supporting crop variety, and promoting climate-smart practices within the avocado value chain [50]. Multi-stakeholder platform activities, including training, seminars, and coordination meetings, facilitate knowledge exchange and engagement among value chain stakeholders [51].

Capacity-building training sessions conducted by ward extension officers and NGOs emphasize climate-smart techniques like soil conservation, early weeding, and effective harvest management for avocado growers [52]. These initiatives aim to spread awareness and demonstrate resilient agricultural methods within the community.

Successful implementation of such strategies relies on inclusive approaches, enabling actor-led changes and entrepreneurship [51]. Farmer networks play a crucial role, as larger networks correlate with higher adoption rates of climate-smart practices [36]. Interactions across multi- stakeholder platforms enhance farmers' access to resources and diverse knowledge [33].

The multi-stakeholder platform serves as a bridge for various value chain actors, strengthening connections and facilitating access to essential resources and information [29, 53]. It fosters capacity-building among farmers for climate-smart avocado production through workshops, meetings, and exchange visits [52].

Ultimately, an inclusive strategy, incorporating diverse stakeholder participation and strengthening collaborative networks, is vital for the successful implementation and scaling of climate-smart innovations within the avocado value chain [38]. Comprehensive support mechanisms, coupled with active engagement across all levels, are crucial for achieving these goals [51,54].

Conclusion

The research findings underscore the pivotal role of enhanced communication facilitated by a multi-stakeholder platform in strengthening relationships within the smallholder value chain. By implementing a participatory, user-friendly platform, farmers exhibited improved awareness and adoption of avocado farming, leading to advancements in their livelihoods and farm conditions. Farmers utilized this platform to draw attention to their farms' status, seek specialized extension assistance, and demonstrate personal responsibility, fostering confidence along the value chain.

Moreover, the study highlights that a multi-stakeholder platform significantly amplifies networking, cooperation, and interactions among stakeholders, thereby enhancing the integration of climate-smart avocado farming practices. This not only boosts production and farm resilience but also promotes sustainable farming approaches. The platform significantly impacts smallholder avocado farmers' innovation capacity, positively influencing their practices, costs, productivity, and income levels. Notably, the study emphasizes the potential for setting up nurseries as a strategy to enhance avocado production for watershed protection and productivity while reducing seedling costs.

In terms of contributions to knowledge, the research establishes the agricultural innovation system approach as a crucial mechanism for disseminating agricultural innovation through a multi- stakeholder platform. Furthermore, it highlights the potential of value chain efforts to influence policy changes supporting avocado farming and providing farmers with agricultural science training. Ultimately, the study underscores the effectiveness of a community-based multi- stakeholder platform as an extension method, fostering interactive learning and enabling more effective demand-driven research and extension feedback interventions in avocado farming systems.

Recommendations and policy implications

The study suggests a multi-stakeholder platform production strategy for the avocado value chain, emphasizing the importance of local knowledge and practice in agricultural innovation for enhanced productivity. The multistakeholder approach to sharing agricultural information and data collection should be refined and scaled, with appropriate techniques and technology like Sapelli software being implemented to enhance knowledge-sharing potential. Further refinement and scaling are needed.

The policy implication is that engaging farmers and value chain stakeholders in policymaking creates an accessible interface, empowering their futures and advocating for better-informed policymaking and crisis management.

Author Contributions

The main author SCKR contributed all: Conceptualization; methodology; software; validation; investigation; data curation; writing—original draft preparation; writing—review and editing and funding acquisition. The author has read and agreed to the published version of the manuscript.

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Ethics approval and consent to participate.

The research was conducted following Egerton University's research ethics committee and the National Commission for Science, Technology, and Innovation (NACOSTI) approval.

Conflicts of Interest

The authors have no conflict of financial interest.

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