
Challenges and opportunities for upgrading the avocado value chain in East Africa

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Avocado hanging on the branch with green leaves, Kiambu, Kenya
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Key messages

- The avocado value chain in East Africa plays a key role in driving economic growth, rural development, and foreign exchange earnings.
 - A growing emphasis on and need for sustainability has led to a re-evaluation of avocado value chains in the region and a shift towards adopting sustainable practices.
 - Sustainability in the avocado value chain offers the potential to not only conserve the environment but also enhance the livelihoods of smallholder farmers, facilitate market entry, and uphold the integrity of avocado products in the context of global trade.
 - Increased access to affordable finance, training and capacity building for climate-smart avocado farming, and development of market-focused policy can help smallholder farmers and producers overcome barriers to sustainable transitions.
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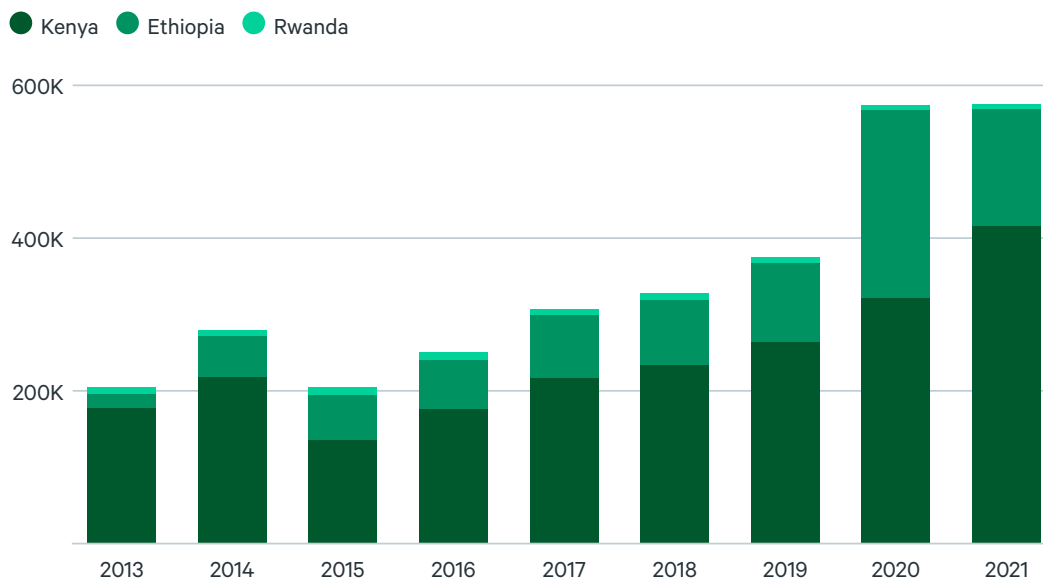
Introduction

In this report, we explore the sustainability and viability of the avocado value chain that brings avocados from production in East Africa to consumption worldwide, with an emphasis on export to the EU as the largest market for the commodity's export from East Africa. Our analysis is based on a systematic literature review that integrates findings from a large body of academic and grey literature. The review highlights challenges and opportunities for enhancing sustainability in the value chain to meet stringent EU market requirements on imported products imposed by trade agreements and other policy measures.

1. Background

Avocado has emerged as a significant agricultural export and means of sustenance for numerous small-scale producers in East Africa (Shivachi et al., 2023). Avocado production has experienced notable growth in the region (Wangithi et al., 2022), specifically in countries such as Kenya, Tanzania, and Uganda (see Figure 1). The region's wide range of climatic conditions, encompassing both cool highland areas and warmer coastal parts, create favourable conditions for producing the fruit (Odong, 2022).

Figure 1: Avocado production in East Africa in metric tonnes, by year



Source: FAOSTAT (2023)

Various stakeholders in East Africa contribute to the production, processing, and marketing of avocados. These include smallholder farmers who form the backbone of avocado farming in the region (Rop et al., 2023), as well as medium- and large-scale commercial producers. Micro, small and medium-sized enterprises (MSMEs) play a

vital role, particularly in the processing and marketing segments of the value chain (Rop et al., 2022). In the East African avocado value chain, MSMEs play a critical role in adding value, creating employment opportunities and facilitating market access for smallholder farmers (Lambri et al., 2013). Their involvement helps bridge the gap between production and consumption, ultimately fostering economic growth and rural development in the region.

A growing emphasis on sustainability in recent years, particularly in Europe, has led to a re-evaluation of value chains in developing countries and a shift towards adopting sustainable practices (Meemken, 2020). Considering the pressing issues of climate change, soil degradation and economic inequities, Africa is confronted with unprecedented challenges in the entire agricultural sector which affect avocado farming (Bender, 2019). As such, it is imperative that conventional practices within the avocado value chain undergo a transformation to protect the livelihoods of those who rely on them.

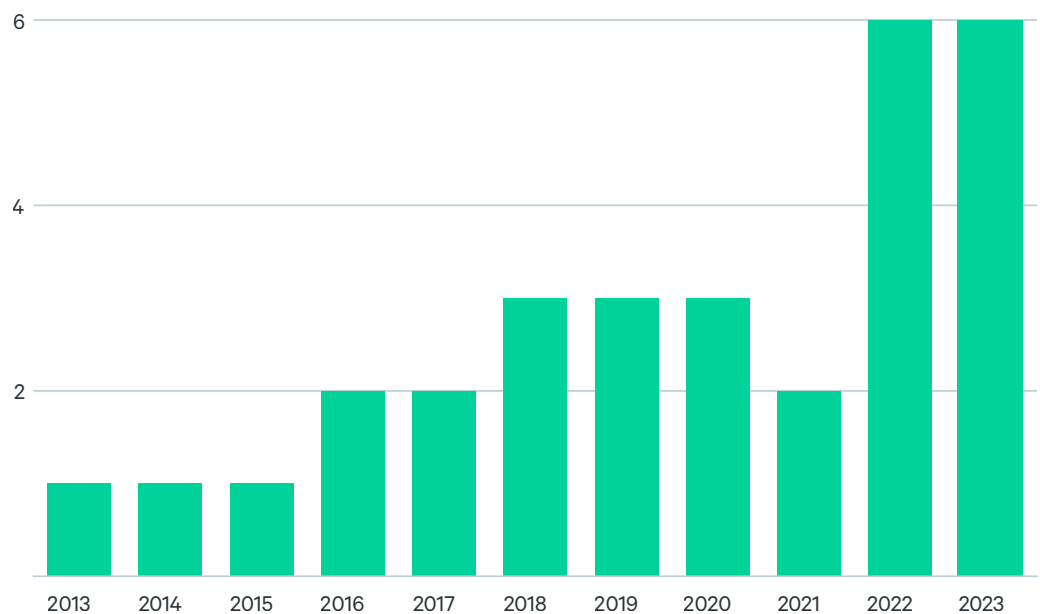
This necessitates a shift towards more sustainable production practices throughout the avocado value chain by transitioning from conventional farming methods to more sustainable agricultural practices that prioritize environmental conservation, soil health, and biodiversity. This may involve reducing the use of chemical pesticides and fertilizers, adopting integrated pest management approaches, promoting organic farming practices, and implementing agroecological principles. The imperative of sustainability has transitioned from being a mere choice to becoming an essential requirement for all East African avocado farmers, particularly those who want to access the European market (Bhore et al., 2021).

In a global context that prioritizes climate resilience, resource conservation and ethical practices, the avocado value chain must adopt innovative approaches to conducting business (Grüter et al., 2022). Sustainable methods offer the potential to not only conserve the environment, but also enhance the livelihoods of smallholder farmers and uphold the integrity of these commodities in the context of global trade. The alignment of these value chains with sustainable practices also provides opportunities for accessing premium markets and gaining international reputation (Gaspard et al., 2021).

2. Methodology

To understand the challenges and opportunities along the avocado value chain, a systematic quantitative literature review was conducted, using the stage flow methodology recommended by the Preferred Reporting Items for Systematic Review Recommendations (Moher et al., 2010). This approach ensured the inclusion of quantitative, qualitative and mixed methods studies, allowing for a thorough assessment of avocado-related research. The review focused on various aspects of avocado production in East Africa, including management practices, constraints, the roles of value chain actors, value addition strategies, and avenues for value chain enhancement. Primary data acquisition involved an exhaustive search across multiple scientific and educational databases such as AgEcon, National Agricultural Library Search, PubAg, Science Direct, Jstor, Scopus, and ERIC (ProQuest), with an emphasis on peer-reviewed journal articles. Initially broad in scope, the search was gradually refined to specifically target Eastern African avocado value chains. Following a systematic screening process – which included duplicate removal and thorough examination of titles, abstracts and full texts – only articles addressing challenges and opportunities associated with scaling up avocado value chains were included for analysis. Importantly, the review focused exclusively on articles published between 2013 and 2023 within the Eastern African context. The review was conducted to analyse various aspects of the avocado value chain, at different stages including production, processing, transport, storage and marketing. From an initial pool of relevant literature, 30 articles were selected for the final analysis. These articles were then categorized based on their primary focus areas and the subtotals were calculated. Specifically, the categories included sustainability opportunities, as well as production,

Figure 2. Number of studies on avocado production in East Africa, by year of publication. The frequency of articles published has dramatically increased in recent years.



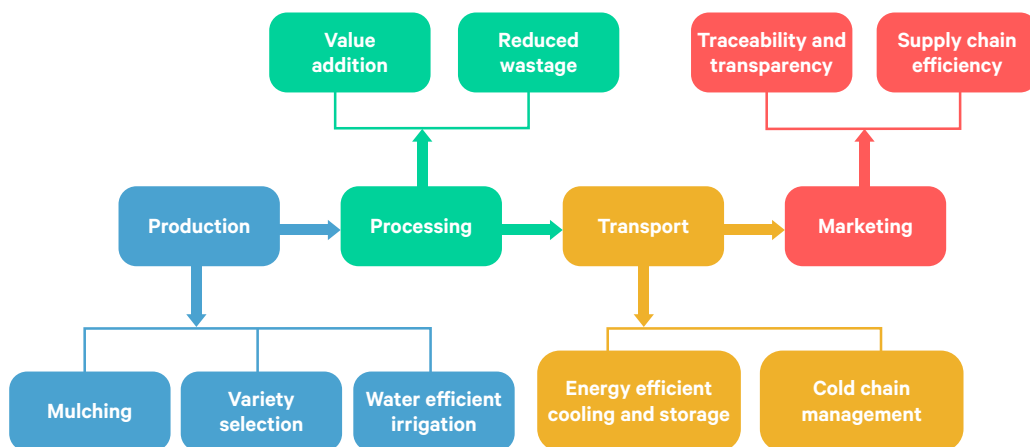
Source: Authors' own

processing, transport, storage, institutional, marketing and processing challenges and their opportunities. The percentages for challenges or opportunities for each category were then determined by calculating the proportion of articles that mentioned the specific challenge or opportunity within these primary focus areas. This provided a clear quantification of the focus areas within the avocado value chain literature, highlighting key trends and priorities within the field. The results are tabulated to quantify the attributes of the reviewed papers, with Figure 2 providing an overview of the publications reviewed. The highest number of articles was from Kenya (10) followed by Ethiopia (5), Tanzania (5), Uganda (4), Burundi (3), and Rwanda (3), with some location overlap.

3. Sustainability and productivity opportunities across the avocado value chain

Sustainable practices, combined with productivity-enhancing measures, can promote economic growth, support livelihoods and meet the increasing global demand for avocados while preserving the environment. Out of the 30 articles, 18 articles focused on sustainability opportunities. The review of sustainability opportunities across the avocado value chain in East Africa sheds light on key initiatives vital for enhancing productivity and environmental stewardship (see Figure 3). Traceability was significantly emphasized in around 78% (n=14) of the 18 articles as crucial tools for ensuring transparency and accountability in avocado production, supporting food safety standards, and minimizing risks associated with contamination and fraud. Cold chain management was also highlighted by 78% (n=14) of these articles as essential for minimizing post-harvest losses, optimizing resource utilization, and maintaining product quality throughout the value chain.

Figure 3. Identified sustainable practices along the East African avocado value chain



Source: Authors' own

Reducing wastage was cited by 50% (n=9) of the articles as a critical sustainability initiative that can be achieved through improved post-harvest management practices. By implementing efficient cold chain management systems and innovative packaging solutions, stakeholders can mitigate losses and promote sustainable resource utilization. Additionally, water use efficiency measures, such as drip irrigation systems and rainwater harvesting, was also highlighted by nine of the articles as crucial for conserving water resources, mitigating drought risks, and promoting sustainable avocado production practices.

Variety selection, underscored in 44% (n=8) of the articles, is a key opportunity for enhancing sustainability and resilience within the avocado sector. By cultivating diverse avocado varieties suited to different agroclimatic conditions, growers can mitigate risks associated with climate change and market fluctuations while promoting genetic diversity and ecosystem resilience. Mulching, as indicated by 28% (n=5) of the articles, plays a pivotal role in soil conservation and moisture retention, promoting sustainable agricultural practices and enhancing overall ecosystem health within avocado orchards. In the next sub-section, the secondary findings on the challenges and opportunities for upgrading the East African avocado value chain are discussed.

4. Challenges impacting the East African avocado value chain

4.1 Marketing and institutional challenges

East African avocados are gaining recognition in the EU market, driven by their exceptional quality and growing market demand. However, several marketing and institutional challenges hinder value chain performance in this dynamic marketplace, as illustrated in Figure 4. Marketing and institutional challenges were addressed in 17 and 12 articles, respectively.

Of the marketing challenges, the issue of limited market access and information came up as a significant concern in the review, with 76% (n=13) of the 17 articles emphasizing its impact. This highlights the need for improved market intelligence systems and enhanced access to global markets. Inconsistent product quality was another prominent challenge, mentioned in around 82% (n=14) of the articles, indicating the necessity for stringent quality control measures and standardized practices. Export barriers and regulations, noted in 71% (n=12) of the articles, underscore the importance of addressing regulatory hurdles to facilitate smoother international trade.

The EU and the UK serve as significant consumers of avocados originating from East Africa. Nevertheless, to enter these markets, it is imperative to adhere to rigorous quality and food safety regulations (Amare et al., 2019). Therefore, the implementation of contemporary packhouses, strict compliance with certifications such as GlobalG.A.P. (Good Agricultural Practices), and the development of connections

Figure 4: Marketing and institutional challenges for East African avocados (Marketing, N=17; Institution N=12)



Source: Authors' own

with global purchasers have emerged as crucial elements for the avocado value chain in East Africa.

Several factors limit the export of avocados from East Africa. These include: a) delays in transportation; b) excessive certification requirements; c) bureaucratic processes in the registration system; d) the seasonal nature of crop production; and e) the need to ensure both quantity and quality standards for avocados sourced from small-scale farmers (Karing'u et al., 2021).

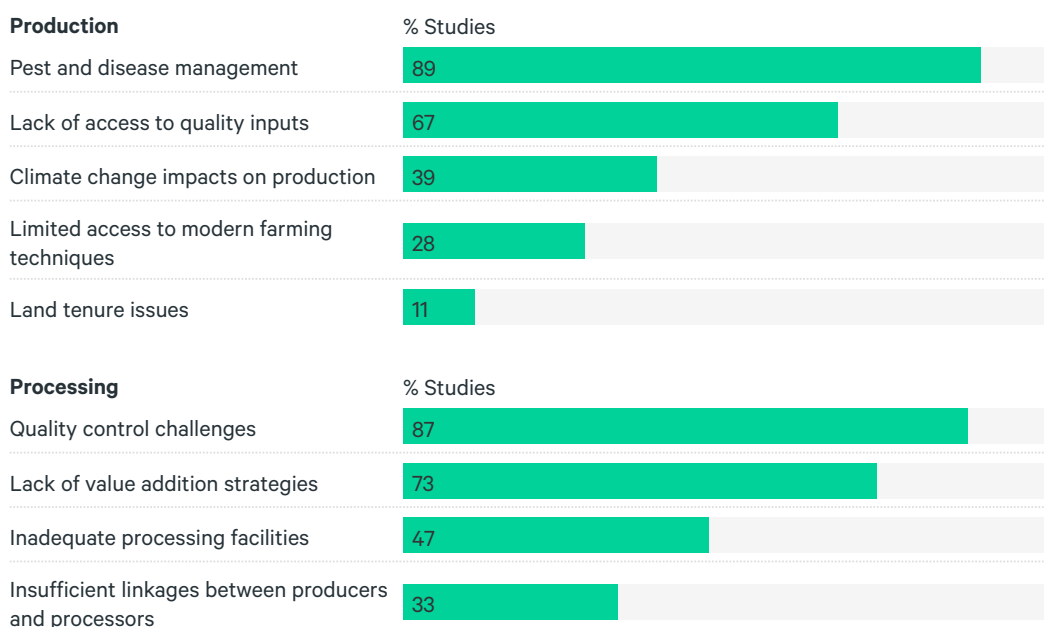
Many individual farmers and producer organizations fail to adhere to minimum harvesting quality standards. For example, the practice of harvesting immature fruits results in the production of uneven and low-quality produce. Additionally, there are issues with inadequate grading and packaging, as well as a lack of adoption of post-harvest management technologies for sea transportation. Furthermore, there is a slow response to changes in export market preferences and policy matters concerning specific export countries or destinations (Kamonde, 2021).

The presence of inadequate storage facilities, specifically cold rooms, at seaports, along with shipment cancellations or delays resulting from reduced shipping capacity and elevated insurance prices due to associated shipping risks, have collectively impeded the ability to access export markets.

4.2 Production and processing challenges

Our systematic review highlighted critical challenges faced by farmers and the East African avocado industry. Notably, pest and disease management emerged as one of the most pervasive issues, with 89% (n=16) of the 18 articles that focused on production challenges underscoring its impact. This signifies a need for robust strategies to address and mitigate pest and disease threats. Limited access to modern farming techniques was identified in 28% (n=5) of the articles, indicating a gap in the adoption of contemporary agricultural practices that could enhance productivity. Climate change, mentioned in 39% (n=7) of the articles, was recognized as a significant factor affecting avocado production, emphasizing the necessity of climate-resilient strategies (see Figure 5).

Figure 5: Avocado production and processing challenges in East Africa (Production N=18; Processing N=15)



Source: Authors' own

Fifteen articles noted challenges facing the processing of avocados. Quality control challenges emerged prominently, with 87% (n=13) of the articles emphasizing the critical need for stringent quality measures to ensure that processed avocado products meet international standards. The lack of value-addition strategies was mentioned in 73% (n=11) of the articles, indicating a gap in initiatives that could enhance the value and marketability of processed avocado products. Inadequate processing facilities, identified in 47% (n=7) of the articles, signal a need for investment in modern and efficient processing infrastructure. Additionally, insufficient linkages between producers and processors, mentioned in 33% (n=5) of the articles, highlight the importance of fostering stronger connections in the supply chain for a more seamless and efficient avocado processing industry in East Africa.

4.3 Storage and transportation challenges

From our review, 75% (n=9) of the 12 articles that mentioned storage challenges emphasize post-harvest losses due to poor storage practices (see Figure 6). This highlights a critical need for improved storage protocols and training for stakeholders in the avocado value chain. Inadequate cold storage facilities are mentioned in 58% (n=7) of the articles, suggesting a need for investments in infrastructure to ensure optimal storage conditions. Additionally, limited awareness of proper storage techniques was identified in 42% (n=5) of the articles, indicating a communication gap that needs to be addressed through educational initiatives.

The lack of access to efficient packaging materials, mentioned in 67% (n=8) of the articles, also underscores the importance of ensuring the availability of suitable materials to prevent spoilage and extend the shelf life of stored avocados.

Of the 16 articles discussing transportation challenges, two primary challenges that consistently emerged were high transport costs and limited access to reliable logistics, each appearing in 69% (n=11) of the articles. The economic viability of avocado transportation is evidently impacted, necessitating strategies to mitigate these costs, such as optimizing transport routes or exploring collaborative shipping solutions. This also suggests a critical need for improvements in the transport infrastructure and coordination between stakeholders.

Figure 6. Avocado storage and transportation challenges in East Africa (Storage N=12; Transport N=16)



Source: Authors' own

5. Opportunities for upgrading the East African avocado value chain

The EU's increasing demand for avocados presents an opening for East African producers to secure a significant market share (Amare et al., 2019). The rise of sustainability and fair-trade awareness among EU consumers also aligns with East African avocado production methods, which emphasize ethical and environmentally responsible practices. Acquiring recognized certifications like organic, Fair Trade or Rainforest Alliance enhances market access by signalling to consumers that the avocados are responsibly produced. Collaborating with European retailers who directly source from East African producers can also streamline market access, eliminating intermediaries and ensuring fresher avocados reach the market (Karing'u et al., 2021). Furthermore, regional integration efforts among East African countries, which involve uniform standards and cooperative marketing strategies, can enhance their collective position in the EU market. By actively addressing these challenges and harnessing these opportunities, East African avocados have the potential to establish a more robust presence in the highly competitive EU market.

5.1 Marketing and institutional opportunities

A predominant theme, highlighted in 76% (n=13) of the 17 articles that mentioned marketing opportunities, is the imperative need for the development of robust marketing and branding strategies (see Figure 7). This underscores the importance of creating a distinctive identity for East African avocados in the global market. Additionally, there is a recognized opportunity, mentioned in 47% (n=8) of the articles, for exploring international markets, emphasizing the potential for expanding avocado sales beyond regional borders.

Establishing direct relationships with retailers emerged as a focal point in the review, as noted in 53% (n=9) of the articles, indicating the significance of creating efficient distribution channels. Compliance with global quality and safety standards is a priority, as indicated by 71% (n=12) of the articles, underlining the necessity of meeting international benchmarks to enhance market access. Though consumer awareness campaigns were the least mentioned opportunity, appearing in 18% (n=3) of the articles, this is a potential area for growth in elevating consumer knowledge and demand for East African avocados.

Figure 7. Avocado marketing and institutional opportunities in East Africa (Marketing N=17; Institutional N=19)



Source: authors' own

5.2 Production and processing opportunities

An overview of the publications that analysed avocado production and processing opportunities is shown in Figure 8. Improved access to finance was reported by 86% (n=12) of the 14 articles that mentioned production opportunities as a key option for upgrading the avocado value chain. The next most frequently reported opportunity in the articles for upgrading avocado production in the region was training and capacity building (79%, n=11), followed by the adoption of sustainable farming practices (57%, n=8) and the use of technology for precision agriculture (50%, n=7).

The least frequently cited opportunity was the formation of farmer groups in 29% (n=4) of the articles. For the processing of avocados, 86% (n=12) of the 14 articles identified research and innovation as the major opportunity for upscaling processing in the region. This was followed by investment in modern processing infrastructure, which was noted by 57% (n=8) of the articles. Development of value-added products for export and training on post-harvest handling and processing were reported by 50% (n=7) and 43% (n=6) of the articles, respectively, as an opportunity for scaling the processing of avocados in East Africa.

As Otles and Kartal (2018) states, waste generated from avocados can be transformed into value-added bioproducts through waste valorization. For instance, avocado wastewater, which accounts for 45% of the total waste produced from cold pressed avocado oil, can be transformed into avocado wastewater powder. This powder can then be used as a bio-antioxidant (Permal et al., 2020). Avocado peels and seeds, on the other hand, which make up approximately 27% of the waste produced during avocado processing, contain valuable components that can be extracted and utilized as bioactive compounds like catechin and quercetin. Alternatively, they can be processed into other products such as bioethanol, which can serve as an environmentally friendly fuel source (Restrepo-Serna et al., 2022).

Figure 8. Avocado production and processing opportunities in East Africa (Production N = 14; Processing N =14)



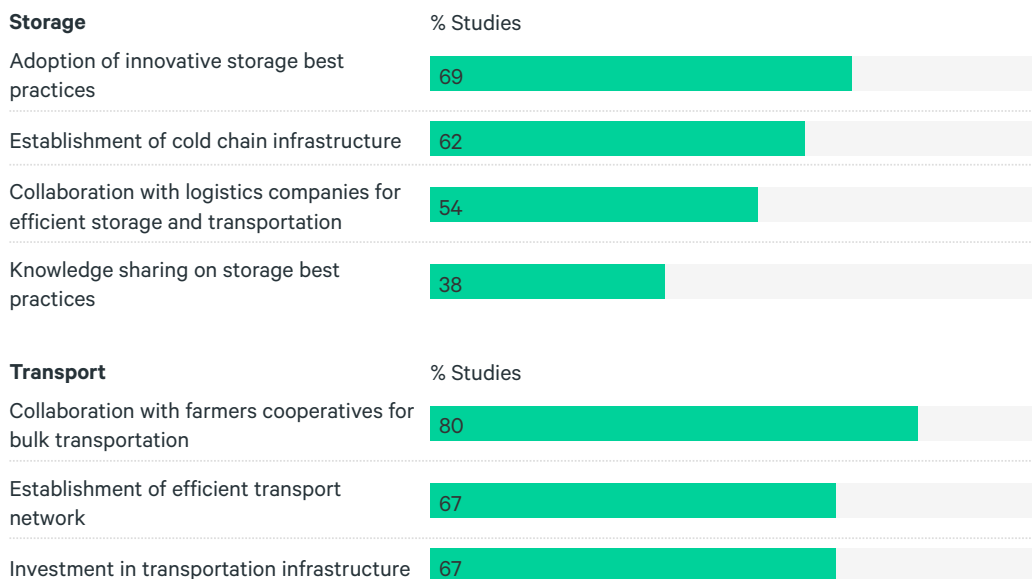
Source: authors' own

5.3 Storage and transport opportunities

Our review of publications revealed several key opportunities for upgrading the storage of avocados in East Africa. 69% (n=9) of the 13 articles on storage opportunities pointed to the adoption of innovative storage systems, such as solar powered storage facilities, as the main opportunity for reducing post-harvest losses (see Figure 9). Additionally, 62% (n=8) of the articles highlighted the critical need for establishing a robust cold chain infrastructure to prolong shelf life and maintain the quality of avocados.

Knowledge sharing on storage best practices emerged as a focal point, with 38% (n=5) of the articles underscoring the significance of disseminating information and expertise in avocado storage. Collaboration with logistics companies for efficient storage and transportation featured prominently in 47% (n=7) of the 15 articles discussing transport opportunities, acknowledging the interconnectedness of storage and transportation in ensuring the overall quality and market readiness of avocados in the region.

Figure 9. Avocado storage and transport opportunities in East Africa (Storage N = 13; Transport N = 15)



Source: authors' own

A significant focus, reflected in 67% (n=10) of the articles, is the need for substantial investment in transport infrastructure. This underscores the critical need for well-maintained roads, reliable vehicles and supporting facilities to ensure the smooth movement of avocados from farms to markets. Simultaneously, 67% (n=10) of the articles stressed the establishment of an efficient transport network, emphasizing the importance of well-connected and streamlined routes to optimize the transportation process. Collaboration with farmers' cooperatives for bulk transportation emerged as a prominent strategy mentioned by 80% (n=12) of the articles, indicating a strong consensus on the benefits of collective efforts in transporting avocados.

6. Costs and challenges for transitioning to sustainability in the avocado value chain

Transitioning to more sustainable practices in the avocado value chain comes with various costs and challenges for the actors involved. Smallholder farmers, who make up a significant portion (85%) of avocado producers (Johnny et al., 2019), face financial constraints in implementing sustainable farming methods such as high-yield organic farming, agroforestry, or obtaining eco-certifications (Meemken, 2020). These changes often require investments in training, infrastructure and resources, which can be challenging for smallholders with limited access to capital. Larger commercial producers and agribusinesses also encounter costs associated with the transition to sustainability, including investments in equipment for eco-friendly processing and storage, as well as adapting their supply chains to meet eco-certification standards (Meemken et al., 2021).

The adaptation process may involve changing existing practices and purchasing new technologies, which can be financially burdensome. Barriers to adopting sustainable practices in the avocado value chain can also include limited technical capacity and knowledge among farmers and other actors (Rop et al., 2023). The transition to sustainability requires new skills and training, which can be a constraint, particularly for small-scale farmers with limited access to educational resources. Overcoming these barriers often requires capacity-building initiatives, technical assistance, and raising awareness about the advantages of adopting sustainable practices in the avocado value chain.

7. Policies to promote sustainable climate-resilient agriculture

The East African Community (EAC) has been increasingly recognizing the importance of climate-smart agriculture (CSA) and its potential application to the avocado sector (Rop et al., 2023). While policies and institutions have historically focused on broader agricultural initiatives, there is a growing shift toward climate-smart practices (Faling and Biesbroek, 2019). Weak policies and legislations, lack of enforcement, and overlap of mandates among institutions involved in compliance—coupled with poor coordination and collaboration among institutions and stakeholders in CSA—have contributed to the region’s inability to effectively address vulnerability and maintain climate-resilient agriculture.

Several countries within the EAC, including Kenya and Tanzania, have developed policies and strategies that promote sustainable and climate-resilient agriculture. These policies emphasize the adoption of CSA techniques in the avocado sector, including practices that enhance water use efficiency, reduce carbon emissions, and increase resilience to climate change impacts (Rop et al., 2022). Kenya, for example, has developed a CSA strategy whose objective is to enable the country to adapt to climate change and build a resilient agricultural system while minimizing emissions

for enhanced food and nutritional security and improved livelihoods. However, national strategies and interventions, such as the Climate Change Action Plans, and the agriculture sector development strategy have not adequately mainstreamed adaptation, building resilience, and mitigation of greenhouse gases into the agricultural sector. Consequently, the sector needs sound and enabling climate-smart strategies that will simultaneously guarantee productivity and food security while addressing climate change adaptation and resilience.

Additionally, countries within the EAC, with support from various development partners, have initiated programs to provide technical and financial assistance to farmers and producers looking to implement climate-smart approaches (Turyasingura and Ayiga, 2022). These initiatives aim to bolster the adoption of sustainable practices in the avocado value chain, helping farmers mitigate and adapt to the effects of climate change while enhancing the sector's long-term sustainability. There is also ongoing work to further develop institutional frameworks and financing mechanisms tailored specifically to the avocado sector to better support CSA within the EAC (Nyasimi et al., 2017).

However, there remain crucial areas where policy and enabling conditions can be strengthened. These encompass improving access to financing for smallholder farmers and avocado producers, requiring tailored policies for the sector. Capacity-building programs are also necessary to equip farmers with the knowledge and skills for effective climate-smart techniques (Odong, 2022). Policies are also needed to enhance market linkages for sustainable avocados, ensuring their smoother entry into markets. Access to timely climate information is vital and can be improved through policy measures , adequate training and capacity building, and effective climate communication platforms. Clear environmental regulations that guide sustainable practices are crucial, as are increased investments in avocado-focused research and innovation.

Lastly, inclusivity within CSA policies and programs—considering the needs of women and marginalized groups along the avocado value chain—is essential. Addressing these gaps and improving enabling conditions will further bolster CSA in the avocado sector, promoting its long-term sustainability and resilience in the face of climate change.

8. Conclusions and recommendations

In conclusion, the avocado value chain in East Africa offers significant promise for sustainable economic development, improved livelihoods, and contributions to global food security. The avocado sector's growth potential is driven by increasing global demand, the fruit's nutritional qualities, and a growing appreciation for its taste and versatility. However, while opportunities abound, the avocado value chain in East Africa faces its fair share of challenges. These range from gaps in sustainable production practices to market access obstacles, including stringent EU-specific standards and competition with established producers.

For the avocado value chain in East Africa to enhance its productivity, sustainability and access to export markets, a multi-faceted approach is necessary. Based on our review and analysis, we have several key recommendations:

- Encourage the adoption of sustainable and more productive farming practices such as high-yielding organic production, agroforestry and efficient water management to reduce the environmental footprint of avocado production.
- Allocate resources to research and development to enhance disease resistance and climate resilience of avocado varieties. Support local research institutions to work on innovative solutions for the avocado sector.
- Facilitate access to affordable financing for smallholder farmers and producers to invest in sustainable practices and infrastructure.
- Explore opportunities for diversifying avocado products and value-added options, including avocado oil and processed avocado products from waste valorization .
- Develop policies and strategies that strengthen market linkages, especially for climate-smart and sustainably produced avocados.
- Support sustainable practices and improve local and international market access, including meeting EU-specific standards.
- Invest in training and capacity-building programs to equip farmers with the skills required for sustainable avocado production.
- Encourage the adoption of CSA practices that help mitigate the impacts of climate change and build resilience.
- Identify and engage in trade and sectoral dialogues between East African countries and major export markets, such as the EU, to design technical and financial support for actors and institutions with potential to enhance productivity and sustainability of the avocado value chain.
- Prioritize inclusivity and gender balance in all policies and practices within the avocado value chain, recognizing the critical role of women and marginalized groups.

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