

Review on Supply Chain Management of Avocado Fruits in Ethiopia

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ABSTRACT

This review article examines the supply chain management of avocado fruits in Ethiopia, providing a comprehensive analysis of the current status, challenges, and opportunities within the sector. The study explores the stages of the supply chain, from production and post-harvest handling to transportation and market access. This review article utilized electronic databases such as PubMed, Google Scholar, Scopus, and Agricola, with a publication period between 2010 and 2024. The search was limited to articles written in English that focused on the avocado supply chain management in Ethiopia. Additionally, relevant grey literature and reports from agricultural organizations were included. A total of 29 articles and reports were selected and thoroughly examined. Key findings reveal that challenges identified included inadequate infrastructure, limited technological adoption, and insufficient farmer support. The review concludes with Recommendations include investing in better infrastructure, providing training and support to farmers, and adopting advanced technologies for post-harvest processing. By addressing these issues, Ethiopia can strengthen its position in the global avocado market, thereby boosting the incomes of local farmers and contributing to the country's economic development.

Keywords: Avocado, Supply Chain Management, Post- Harvest.

Introduction

The Ethiopian economy is built around agriculture, which accounts for roughly half of the country's gross domestic product (GDP) and more than 80% of its exports (Stellmacher, T.; Kelboro, G. (2019). Furthermore, it is one of the main employment sectors, with around 80% of the population relying on the agricultural sector for their livelihood (Njeru, E.; Grey, S.; Kilawe, E. (2016). Smallholder farming, in which farms are defined as being less than 2 hectares and are primarily run using family labour, is the dominant form of agriculture in Ethiopia (Aweke, M. Gelaw. (2017). However, in Ethiopia, there are fewer Sustainable Supply Chain Management Practices, which have a negative impact on the performance of agricultural sectors. Ethiopia is employing several key tactics to achieve food security, such as encouraging the cultivation of high-yielding, early-maturing crops in various agro ecologies of the nation, diversifying crops, and enhancing the availability of food production (CSA, 2009). For the rural people of Ethiopia, whose lives rely almost entirely on agriculture, food security is one of the most critical issues.

The avocado (*Persea americana*), which is native to Mexico, is now grown commercially in tropical and subtropical regions all over the world (Shaffer et al., 2013). One of the most economically significant fruits in the world is the avocado (Bost et al., 2013). Although there are three subspecies of avocado—Guatemalan, Mexican, and West Indian—the varieties that are grown nowadays are hybrids between these. Due to its high oil content and high concentration of essential vitamins and minerals, avocado fruit is exceptionally nutritious (Shaffer et al., 2013). Avocado trees can be grafted or planted from seed (pers. com., Chaka, 1, 2014). The most popular method of propagation is grafting, which yields fruit in only two years. In contrast, seeded trees don't bear fruit for around eight years. The planted trees are also more vulnerable to yield and quality losses, in addition to the extended juvenile phase. During rainy seasons, avocado trees do not require irrigation, but they may do so during dry spells. Too much

irrigation is one of the factors contributing to root rot, the most frequent failure in avocado farming. The tree may benefit from fertilizer application in late winter and early summer, even though there are no guidelines for fertilizer application in Ethiopia (pers. com. Chaka, 1, 2014).

In recent years, Ethiopian avocado production has picked up steam as a result of rising domestic and worldwide demand. Given the advantageous weather circumstances in several areas of the nation and the economic value of avocados, it is a feasible farming endeavour. However, there are numerous issues with avocado supply chain management in Ethiopia that impede the industry's expansion and profitability. The goal of this review article is to thoroughly examine these issues and suggest practical remedies for improving Ethiopia's avocado supply chain.

Objectives

General Objectives

The main objective of this article was to review the supply chain management of avocado fruits in Ethiopia.

Specific Objectives

- To provide an overview of the current status of avocado supply chain management in Ethiopia.
- To identify the key challenges and bottlenecks in the avocado supply chain.

Review of Related Literature

Supply Chain Management

According to Sivaramane Dr. N and Reddy Dr. GP (2014), supply chain management research examines the flow of goods and information between supply chain enablers, their operating procedures, their strengths and weaknesses, and how they distribute those products to end users. Generally speaking, the supply chains are more efficient on the input side due to the fact that seeds, fertilizers, plant protection chemicals, and other inputs are produced and marketed by professionally managed organizations and institutions. However, on the output side, supply chain management must connect small, geographically dispersed production units with widely dispersed consumers who are offering value. This is fraught with significant risks, such as high transfer costs, high perishability, prevalent traditional preferences and tastes, inadequate storage, and a lack of knowledge about grades and standards.

Supply chain management involves coordinating the processes that acquire goods and services, convert them into finished and intermediate products, and distribute them. Marketing of goods and services depends heavily on supply chain management. Every organization intends to reduce expenditures, which do not contribute to the maintenance or enhancement of the quality of its products and services. In this path, the supply chain has been a significant factor in a variety of industries worldwide. In addition to lowering expenses, SCM contributes to maintaining and raising the quality of the products and services provided. In this regard, the supply chain has played a significant role in many industries worldwide (Daliya et al. 2011).

Effective supply chain management necessitates optimizing the value inside the supply chain and managing the expenses associated with the flow of goods and information throughout the chain (Chopra & Meindl, 2013). According to Lambert & Cooper (2000, p. 70), "Supply Chain Management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders." Different definitions of supply chain management can be found; the goal is to strike a balance between supply and demand throughout the supply chain, from the producer to the end user.

One of the key metrics for assessing the performance of supply and logistics chains is the efficient distribution of goods to markets. It's crucial to reference supply chain management ideas at this juncture. "A supply chain is a network of suppliers, manufacturers, transporters, warehouses, retailers, and customers, systematized in such a way that it transforms raw materials into finished products and distributes the final products among customers through retailers," according to Khatami et al. (2015). The priorities for supply chains in developing nations are to enhance and modernize distribution, quality, and procedures. There is a need for greater understanding of supply chain management and the adoption of better postharvest technologies in many developing nations (Kitinoja et al., 2011). The sequential arrangement of several chain players who are involved in the flow of avocado products from producers to end consumers is what we mean by supply chain in the current study.

Supply Chains in Agriculture

Bailey (2001) argues that the primary distinction between the food and agricultural product supply chain and other industry supply chains is that agricultural supply chains are both demand and supply driven. The capacity of members of the agricultural supply chain to regulate supply is constrained, even though demand and supply forecasts are equally crucial. These supply chains cannot be entirely customer-driven because of factors unique to agricultural supply chains. Neither a company nor its chain members can influence the seasonal production patterns or other elements, such as weather and diseases. Because customers are often at the far end of the chain and have highly specific needs that agricultural production cannot respond to or meet, they are frequently in the far end of the chain. As production-adjusted, customer-driven systems, agricultural supply chains may be thought of.

Supply Chain for Avocado in Ethiopia

In Ethiopia, avocado (*Persea americana* Miller.) is one of the main fruit crops in terms of land area, total output, and export value, next to banana, according to CSA (2017). Their main production area is in the southwest region of Ethiopia. Avocado production accounts for 10% of the nation's total fruit output and covers around 15% of the country's harvested fruit crop area. The main producing regions for edible fruits are the Amhara, Oromia, and South Nation and Nationalities (SNNPR) regional states. These areas offer the greatest opportunity for boosting production through both rain fed and irrigated commercial farming practices. Following the growing demand for the fruit in both domestic and international markets, there has been a considerable increase in the demand for avocado seedlings, and more Ethiopians are also switching to avocado farming.

For those working along the value chain, avocado manufacturing has grown to be a larger source of revenue (Haile A, Megerssa B, Negash R (2020). Fruit cultivation in gardens lowers families' expenses on fruit purchases while also providing a stable income for farmers. The fruit industry generates jobs, especially in agricultural communities, and fruit production is very intensive. Both fresh and processed fruits have large potential markets for both exports and domestic use. Avocado, apple, banana, citrus, grape, guava, mango, passion fruit, pineapple, papaya, and strawberry are among the fruits that have a great potential for export markets (Kemper N, Czura K, Schumacher H, 2018). Additionally, there is a strong demand for Ethiopian wine in both domestic and foreign markets. Ethiopia's main export markets for fruits are its neighbouring nations, such as Djibouti, Sudan, and Somalia. The main export market destinations are the United Arab Emirates, the United Kingdom, the Netherlands, Belgium, Yemen, Saudi Arabia, and the Russian Federation (Nabuuma D, Ekesa B, Faber M, Mbhenyane X (2021).

Limitations and Advantages of Sustainable Supply Chain Management Practices in the Agriculture Sector of Ethiopia

Challenges with Implementation

The potential advantages of SSCM practices can only be fully realized with their effective implementation. However, studies have revealed several barriers to the adoption of these methods in Ethiopian agriculture. SCM managers deal with particular difficulties in integrating supply chain-specific tactics with the overall corporate business strategy, which is why flawless coordination is seldom seen in reality (Otchere et al, 2013). Most issues related to scientific cooperation arise from either unanticipated events or a lack of coordination among many stakeholders and actions. At the same time, customers are becoming more selective and demanding higher quality goods, improved customer service, and lower prices (Sweeney, 2013).

Sustainable Supply Chain Management Practices

Although some authors divide SSCM practices into two general categories—sustainable purchasing practices and sustainable manufacturing and logistics practices—the primary SSCM practices were grouped into four subcategories based on their role throughout the supply chain, as stated by various scholars in the numerous works of literature reviewed in this study.

- **Eco-Friendly Buying Practices**

The adoption of eco-friendly procurement methods is one of the most important components of a sustainable and green supply chain. The buying habits of raw materials that are recycled or reusable have an impact on the sustainable supply chain (Rasool, Y., Ahmad, W., & Nazam, M. (2016).

- **Designing Sustainable Products and Processes**

Integrating life cycle assessment (LCA) principles into the supply chain/process maximizes the design phase for long-term sustainability, according to Chaabane, A., Ramudhin, A., & Paquet, M. (2012).

- **Packaging that is sustainable**

Resources are scarce in society today, and access to those resources for utilization has become increasingly difficult. However, the majority of packing products are intended for single use, and after use, they swing to squander. Furthermore, the product has a limited lifespan, which results in excessive resource usage for packaging, posing a serious risk to the environment.

- **Sustainable Logistics**

Transportation has a variety of possible adverse effects on the environmental, economic, and social elements of SSCM. By estimating and summing all direct, indirect, and avoidance costs, these effects can be expressed in monetary values (Chiu, S. C. and Sharfman, M. (2011)).

- **Management of Supply Chains for Sustainability**

Increased environmental and social issues have made industries and regulatory agencies more aware of sustainability (Govindan, K., Kaliyan, M., Kannan, D., & Haq, A. N. (2014)). The concept of sustainability in a SC is regarded as a crucial business issue that affects the organization's performance in terms of financial, social, and environmental risk (Majumdar, A., & Sinha, S. (2018)). It aims to improve the long-term performance of individual enterprises and the entire supply chain as a unified whole (P. J. M. P. & S. S. Beske Janssen, (2015)). Supply Chain Management (SCM): SCM mandates that previously distinct material functions report to an executive who is in charge of managing the entire materials process. Additionally, it calls for shared connections with vendors across several tiers (S. R. P. a. G. M. Croom, (2000)). Governmental forces may push the implementation of environmental management throughout business (Tian, Y., Govindan, K., & Zhu, Q. (2014)). According to (Sarkis, J., Helms, M. M., & Hervani, A. A. (2010)). sustainability has been attracting attention from both academia and industry.

Methodology

This review is based on an extensive analysis of existing literature, including academic articles, industry reports, and government publications related to the avocado supply chain in Ethiopia. This review article encompasses a thorough examination of peer-reviewed studies, and relevant literature published from 2010 to 2024. The search strategy involved electronic databases, academic repositories, and reputable sources, yielding a diverse range of literature on various aspects of the Ethiopian avocado value chain. Additionally, grey literature and reports from relevant agricultural organizations were included. The review synthesizes information from these sources to provide a comprehensive understanding of the supply chain dynamics and challenges.

Results and Discussion

Current Status of Avocado Supply Chain Management

- **Production**

According to the FAOSTAT database (2024), the global production volume of avocados amounted to 39,819,656 tons over the 5 years from 2018 – 2022. This gives an average of 7,963,931 tons of avocado production per year during the same period. The data also indicates an upward trend in avocado production during the same period (2018 – 2022) from the lowest production of 6,842,058 tons in 2018 to 8,978,275 tons in 2022. According to FAOSTAT (2024) Mexico was the world's top producer of avocado having produced 2,5 million tons in 2022 and therefore accounting for 28% of the world's avocado production. Mexico is followed by Colombia with 1,0 million tons (12%) and thereafter Peru with 866 hundred thousand tons (10%) respectively. In the year 2022, at least 40% of the world's avocado production totalling over 3,6 million tons was produced by Mexico and Colombia alone.

According to the FAOSTAT database avocado production in Africa has contributed an average of 13% (average 1.05 million tons) to the overall global production over the last 5-year period between 2018 and 2022. Production in Africa has also been on an increasing trend with the highest production of 1.2 million tons being recorded in 2022 from a low production of 882 thousand tons that was recorded in 2018. The yield has also increased from 7 tons/ha in 2018 to 8.1 tons/ha in 2022.

The majority of the 13% avocados produced in Africa is mostly concentrated or produced in Kenya whereby the country was responsible for 38% (458,439 tons) of Africa's avocado production in

2022. The second largest avocado producer in Africa in 2022 was Ethiopia whereby 14% (167,884 tons) was produced. In Ethiopia, the production of avocado was estimated at 167,884.1 tons from 28,759.0 ha of land in the 2022 spring seasons. In the same year, the national average yield was estimated at approximately 4.2 tons per hectare, which is far lower than the global average and potential yield of avocado 7.2 tons per hectare. Ethiopia is followed by South Africa with a total production of 103,602 tons (9%), FAOSTAT (2024). Avocado production is primarily conducted by smallholder farmers using traditional methods. The supply chain involves several stages: cultivation, harvesting, post-harvest handling, transportation, and market access.

- **Harvest and Post harvest Losses of Avocado Fruits**

Knowledge of the postharvest physiology of avocado and sound harvest and postharvest procedures are essential for maintaining good fruit quality. In addition, efficient methods are crucial because the harvest and postharvest stages of avocado production and marketing account for about 60% of the expenditures. Manual harvesting of avocado is done by clipping or plucking (Hofman et al., 2013). The most significant post harvesting losses of avocado are caused by the cracking down during harvesting, according to Humble and Reneby (2014). Jute bags are used as packing materials for fruits such as mangoes and avocados in certain areas of the nation because they have little ventilation and do not protect the fruits from mechanical harm or compression (Humble & Reneby 2014). Fruits like mango, banana, papaya, avocado, sweet orange, and certain vegetables are particularly vulnerable to significant postharvest losses (Emana et al. 2017). The preharvesting causes of fruit and vegetable loss were also said to include subpar cultural practices such as farmland selection, crop and cultivar selection, seeding, weeding, the use of traditional tools for crop harvesting, and crop rotation, diseases and pests at a critical time (Bantayehu et al. 2018). Additionally, changes in production and pricing must be taken into account as preharvesting causes of fruit and vegetable PHL (Alamerie et al. 2014).

- **Key Challenges**

Infrastructure Deficiencies: The inadequate infrastructure for transportation, cold-storage and processing are some of the greatest reasons for waste in the agri-fresh supply chains in developing countries (Viswanadham, 2006; Shukla & Jharkharia, 2013). Poor road conditions, lack of cold storage facilities, and inadequate transportation networks lead to high post-harvest losses and reduced fruit quality. According to Trienekens (2011) there are four main constraints regarding resources and infrastructure faced by markets in developing countries. The first constraint regards little access to input resources, in other words physical resources. The second constraint is the geographic position of many producers where they face long distances to central and valuable markets. Thirdly, lack of human resources in form of educated labour and knowledge is a restraint for markets to advance in developing countries. The last constrain concerns lack of technology, both for production and distribution purposes. Besides from these four constraints there is a lack of adequate infrastructure, both regarding information and distribution. Products distributed in an efficient way and information flow are elementary conditions for a chain to develop.

- **Technological Gaps:** Limited access to modern agricultural technologies and practices results in lower yields and suboptimal fruit quality. Using information technology has the potential of developing supply chain partners in order to work together for efficient delivery of products to consumers (Harnowo, 2015). Information technology allows the supply chain partners act as a single entity. According to Harnowo, (2015) information technology is a mixture of telecommunications achievements, methods and strategies for problem solving and leadership skills using computer knowledge and include issues related to advanced science and computer technology, computer design, information systems implementation and their applications.
- **Farmer Support:** One of the key challenges of farmer support in the supply chain management of avocado in Ethiopia is the lack of access to agricultural extension services and technical training. Many smallholder avocado farmers lack adequate knowledge about modern farming practices, disease and pest management, post-harvest handling, and quality standards required by the market. This knowledge gap significantly limits their productivity and the quality of their produce, making it difficult for them to meet market demands, especially for export. Additionally, the absence of farmer cooperatives or weak cooperative structures further isolates individual farmers, preventing them from accessing inputs, collective bargaining, and market information.

Another significant challenge is the limited access to credit and financial services tailored to the needs of avocado farmers. Most rural farmers face difficulties securing loans due to lack of collateral, poor financial literacy, and the absence of rural financial institutions that understand the seasonality and risks of avocado farming. Without adequate financial support, farmers struggle to invest in improved seedlings, irrigation systems, fertilizers, and packaging materials. These limitations not only reduce the volume and quality of avocado supplied to the market but also hinder farmers from integrating into high-value supply chains. This ultimately weakens the overall efficiency and competitiveness of Ethiopia's avocado supply chain.

- **Market Access:** Farmers face difficulties in accessing reliable market information and meeting international quality standards, limiting their ability to penetrate high-value export markets. In order for an individual actor or a chain to achieve market access it is essential with market knowledge and market orientation. Market orientation of a value chain is defined by (Grunert et al (2005)) as "chain members' generation of intelligence pertaining to current and future end-user needs, dissemination of this intelligence across chain members, and chain wide responsiveness to it". To clarify; this definition includes all undertakings of the actors in the chain concerning information about the end-consumer, all information exchange between the actors regarding the end-consumers and last activities by the actors with the goal to create added value for the end-consumer. How market oriented one actor in the chain is affects the rest of the actors, therefore the entire chain is affected by how well one actor serves the demand of the end-consumer.

Opportunities

There are several promising opportunities in the supply chain management of avocado in Ethiopia. One major opportunity is the growing international demand for avocados, particularly in Europe and the Middle East, where Ethiopian avocados are gaining attention due to their favourable agro-ecological conditions and organic nature. This rising demand creates the potential for farmers and exporters to expand market access, increase foreign exchange earnings, and attract investment in value addition and cold chain infrastructure. Additionally, Ethiopia's diverse climatic zones enable year-round production, offering a competitive advantage over other producing countries with limited harvest seasons.

Another opportunity lies in the development of organized farmer cooperatives and contract farming arrangements, which can help aggregate production, improve quality control, and ensure a consistent supply to local and export markets. Investments in rural infrastructure such as roads, cold storage facilities, and packhouses can reduce post-harvest losses and increase supply chain efficiency. Furthermore, the government's agricultural transformation plans and growing interest from NGOs and private investors present a favourable environment for capacity building, access to finance, and technology transfer. Government and international support further amplifies these opportunities. Initiatives by the Ethiopian government, in collaboration with organizations like USAID, FAO, and MASHAV, provide essential support to farmers through training, technical assistance, and improved farming inputs. Continued investment in research and development, infrastructure improvements, and capacity-building initiatives are crucial for maximizing the potential of avocado production in Ethiopia. By leveraging these opportunities, Ethiopia can build a robust avocado supply chain that benefits smallholder farmers, traders, and the national economy.

Impact on Quality and Marketability

The quality and marketability of avocados in Ethiopia are significantly influenced by inefficiencies and gaps within the supply chain management system. One major impact is the deterioration of fruit quality due to poor post-harvest handling practices, including inadequate harvesting techniques, lack of proper storage facilities, and transportation challenges. Many farmers harvest avocados before they fully mature or handle them roughly during collection and transport, leading to bruising and spoilage. These quality issues reduce the shelf life of the fruit and its appeal to both domestic and international buyers, ultimately affecting the price farmers receive and the competitiveness of Ethiopian avocados in the global market.

Moreover, the lack of standardization and grading systems further affects the marketability of Ethiopian avocados. Without clear quality standards and uniform packaging, it becomes difficult to meet the strict requirements of export markets or even higher-end local markets. Limited access to market information and weak linkages between producers and buyers also hinder effective price negotiation and demand forecasting. As a result, even when there is high demand, farmers may

struggle to meet market expectations. Improving supply chain coordination, training in quality standards, and investing in infrastructure are crucial steps to enhance the quality and marketability of avocados from Ethiopia.

Conclusion and Recommendations

Conclusions

The supply chain management of avocado in Ethiopia faces several challenges that hinder its efficiency, quality, and market competitiveness. Inadequate infrastructure, limited technological adoption, weak farmer support systems, and poor market access have collectively contributed to high post-harvest losses, low product quality, and underperformance in both domestic and international markets. Despite these challenges, Ethiopia holds immense potential to become a leading avocado producer and exporter, thanks to its favourable climate, growing global demand, and government interest in agricultural transformation. To capitalize on the increasing global demand, particularly in lucrative markets such as Europe and the Middle East, Ethiopia must continue to enhance its export capabilities. This involves not only meeting international quality standards but also establishing efficient logistics and marketing strategies. Additionally, fostering public-private partnerships and engaging in continuous research and development will be key to overcoming climatic and agronomic challenges. By addressing these issues and leveraging opportunities, Ethiopia can ensure the sustainable growth of its avocado industry, contributing significantly to income and food security of smallholder farmers. To fully harness this potential, strategic interventions are required across the supply chain.

Optimizing the supply chain management of avocados in Ethiopia requires addressing the identified challenges through targeted interventions. The following recommendations are proposed:

Recommendations

- **Infrastructure Development**
 - Invest in improving road networks and transportation systems to facilitate the efficient movement of avocados from farms to markets.
 - Develop cold storage facilities to reduce post-harvest losses and maintain fruit quality.
- **Technological Advancements**
 - Promote the adoption of modern agricultural technologies, such as improved seedlings, irrigation systems, and post-harvest processing techniques.
 - Provide training and support to farmers on advanced farming practices and technology use.
- **Strengthening Farmer Support**
 - Enhance access to credit, training, and extension services to empower farmers and improve their productivity.
 - Provide financial and technical assistance to farmers.
 - Support the formation and strengthening of farmer cooperatives to improve collective bargaining power and market access.
 - Training programs on farmer training centre (FTC), post-harvest handling, and quality management should be scaled up through extension services and farmer cooperatives.
- **Enhancing Market Access**
 - Facilitate better market linkages and provide farmers with reliable market information.
 - Support compliance with international quality standards and certifications to enable access to high-value export markets.

By implementing these recommendations, Ethiopia can enhance the efficiency and competitiveness of its avocado supply chain, benefiting both farmers and the broader economy. The future of avocado production in Ethiopia holds significant promise, provided that concerted efforts are made to address the existing challenges and capitalize on emerging opportunities.

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