



Sustainable Supply Chain Management of Cocoa Beans in Indonesia: A Review

Noer Novijanto¹, Dyah Ayu Savitri², Setiyono², Gatot Subroto², Herlina³

¹Agroindustrial Technology Department, Faculty of Agricultural Technology, University of Jember

²Agricultural Science Department, Faculty of Agriculture, University of Jember

³Agricultural Product Technology Department, Faculty of Agricultural Technology, University of Jember

*Corresponding Author: Dyah Ayu Savitri

Email: dyahayusavitri@unej.ac.id



Article Info

Article history:

Received 11 May 2023

Received in revised form 10 September 2023

Accepted 21 September 2023

Keywords:

Cocoa Bean

Indonesia

Supply Chain

Sustainable

Abstract

This review describes the sustainable supply chain management of cocoa beans in Indonesia. Cocoa beans are produced in some areas in Indonesia such as Central Sulawesi Province, Southeast Sulawesi, South Sulawesi, West Sulawesi, Lampung and other provinces. Indonesian cocoa beans performing special characteristic that is having higher melting point therefore it does not easily melt in higher temperature. So, Indonesian cocoa are commonly used for blending materials. In order to support the strength value of Indonesian cocoa beans, the sustainable supply chain management should also be considered. The sustainable supply chain management of cocoa beans will support the management system prioritizing balance and sustainability so that the business system is maintained. In addition, this will support increased effectiveness, efficiency and competitiveness of Indonesian cocoa beans globally.

Introduction

Indonesia nowadays becoming the world's third largest producer of cocoa beans, after Ivory Coast and Ghana (Duron et al., 2022). Cocoa bean commodity has contributed to the country's foreign activity, besides other plantation commodities such as palm oil, coffee, tobacco, tea, vanilla etc (Wardhany & Adzim, 2018; Wulandari & Widjojoko, 2021). In 2020, cocoa plantations managed by the people were estimated to be 1.49 million hectares (98.92%), while those managed by large private plantations are 11.56 thousand hectares (0.77%), and those managed by large plantations the state by 4.81 thousand hectares (0.32%) (Ibnu, 2022). Production of cocoa bean in Indonesia reported by FAO World Cocoa Production Data 2018 Indonesia was amounted to 593,832 tons (number three) after Ivory Coast 1,963,949 tons (first place) and Ghana 947,632 tons (second place) (Budihardjo, 2022). Since, the cocoa production of Indonesia taking a big proportion to the country income, the availability of cocoa beans are being taken seriously (Dewanta, 2019; Wijayati & Haqqi, 2022).

East Java is one of the biggest producer of cocoa beans in Indonesia. It was reported that in 2021 the total production of cocoa in East Java was 34.683 ton. From twenty regencies producing cocoa in East Java, Banyuwangi contributed to the largest production (7800 ton), followed by Blitar (3290 ton) and Jember (2993 ton) (Badan Pusat Statistik, 2020). However, the production of cocoa are still challenging due to the presence of many factors. The factor that influence the fruitfulness production of cocoa are availability of land, capital, labor, fertilizers, seeds, and pesticides. Likewise, plant cultivation techniques are still low, such as fertilizing, pruning, sanitation and control of plant pests. Among the types of pests and diseases

that often attack cocoa plants include cocoa pod borer, cacao pod-sucking ladybugs and pod rot diseases (Ananda et al., 2019).

In running a business, companies engaged in cocoa business need to use various strategies to dominate the target market. In particular, the increasing number of competitors engaged in the same field requires companies to constantly innovate and act quickly to respond to the latest market situations (Calystania et al., 2022; Sucahyowati, 2011). Supply chain management (SCM) is part of a crucial business process in which there is a mix of material procurement activities, the conversion process from semi-finished products to final products, and continues with the delivery process to the final consumer followed by other processes such as supplying raw materials, tracking orders, dissemination of information, measurement of a performance, and new product development (Calystania et al., 2022).

The application of SCM in business organizations is a form of business partnership where there is a condition of mutual need between business units. SCM is a business control model that refers to the certainty of the supply of raw materials from suppliers to the certainty of receipt of finished goods by consumers. As a logistics reference model, SCM refers to the 5 (five) rules, namely the right type, right amount, right quality, right time and right price/cost (Nining Purwatmini, 2015). There were studies reported the application of SCM in cocoa beans industries such as the supply chain analysis of dry and wet cocoa beans (Saing et al., 2019), agriculture supply chain performance and added value of cocoa: a study in Kare Village, Indonesia (Indah et al., 2021), study on stakeholders position and role in supply chain of cocoa commodities (Muhammad Asir et al., 2019), the role of smallholder human resources on the performance of the supply chain of cocoa beans in Central Sulawesi Indonesia (Hattab et al., 2021) and so on.

Nowadays, the concept of sustainability in supply chain management has become a serious concern (Saeed et al., 2017; Tundys, 2020). A sustainable supply chain management aims to increase profits by always considering relevant economic, social and environmental management in making decisions faced by supply chain management actors (Septarianes et al., 2020). There were several studies discussing sustainability in supply chain management of agricultural products (Grumiller & Grohs, 2022; Nguyen & Sarker, 2018; Proença et al., 2022; Syahrudin & Kalchschmidt, 2012). This literature review describes the sustainable chain management of cocoa beans in Indonesia. This review is expected to provide a reference for readers who want to know the current practice of sustainable supply chain management of cocoa beans in Indonesia.

Cocoa Beans Production

Production includes efforts to produce or increase the use of goods. Production uses resources to create goods or services suitable for use. In production theory, production is an activity to add value to an item. Production is measured as the rate of production (output) per time period because it is a flow concept (Sholiha, 2018). Production is a process of combining inputs and turning them into outputs (Arzia, 2019).

Regarding the production of cocoa beans, it was reported that the Indonesian cocoa bean production in 2021 was 688.210 ton. The biggest producer of cocoa beans was Central Sulawesi Province (19%), followed by Southeast Sulawesi (16%), South Sulawesi (14%), West Sulawesi (10%), Lampung (8%) and other provinces (34%). Among all the producers, Central Sulawesi Province is the province with the largest cocoa plantation area in Indonesia, namely 278.3 thousand hectares in 2020 or 18.44 percent of the total cocoa plantation area in Indonesia (BPS Statistics Indonesia, 2021).

The cocoa bean producers in East Java are Pacitan, Ponorogo, Trenggalek, Tulungagung, Blitar, Kediri, Malang, Lumajang, Jember, Banyuwangi, Bondowoso, Mojokerto, Jombang, Nganjuk, Madiun, Magetan, Ngawi, and Sumenep with total production of 34.683 ton in 2021 (BPS Statistics East Java, 2023). However, the main problem faced in improving the quality of cocoa bean produced is the lack of fermentation implementation by farmers. Fermentation can increase the quality of cocoa beans. Fermentation of cocoa beans aims to form a distinctive chocolate flavor, hollow bean chips and reduce the bitter and astringent taste in cocoa beans so as to produce beans with good quality and aroma, as well as bright and clean brown color (Hartuti et al., 2020).

By practicing fermentation, the cocoa bean will perform a good characteristics that expected from the traders (Miguel et al., 2017). However, the farmers are less concerned with fermentation process due to the longer duration needed to prepare the fermented cocoa beans (4-5 days), the small price gap between unfermented and fermented cocoa beans (the price is only about Rp 3.000-5.000 per kg higher in fermented cocoa beans) and economical needs in farmers (Hartuti et al., 2020; Koffi et al., 2017; Saunshia et al., 2018). In a study regarding the priority models for cocoa supply chain performance, it was reported that the good quality of cocoa beans obtained from fermentation affected the successful supply chain of cocoa beans (materials) (Harya et al., 2020). The availability of material is important to be concerned in order to support the smooth running of the production process (Alonso et al., 2007; Suudi & S, 2021). The implementation of supply chain management has an impact on sufficient and quality raw material supplies, raw material supplies and their freshness are always maintained so that they can meet the needs and requests when needed (Talumewo et al., 2014).

Cocoa Beans Demand

Demand is the relationship between the amount of goods and services demanded in a certain market at a certain price level in a certain period of time. The nature of the relationship between the quantity of goods demanded can be explained by the law of demand. The law of demand is a hypothesis which states that the lower the price of a commodity, the greater the quantity of the commodity demanded, conversely, the higher the price of a commodity, the less quantity of the commodity requested (assuming other factors are constant or *ceteris paribus*) (Elvira, 2016).

The demand for cocoa beans currently were increased (2010-2018) although the production of Indonesia cocoa beans declined. Whereas, the price of domestic cocoa beans has grown by 8.95% (Zakiah et al., 2022). The level of demand for domestic cocoa is still relatively small compared to the total production of cocoa. The demand for cocoa can be seen based on the level of consumption and the needs of the people in a country. Indonesia's total cocoa production is high when compared to the low domestic demand for cocoa, so most of the cocoa production is intended for export (Hanifawati et al., 2018).

One of the advantages of Indonesian cocoa is that it does not melt easily, so it is suitable for blending. These advantages support Indonesia's cocoa market opportunities for both export and domestic needs, so that the cocoa industry has the potential to be used as one of the drivers of growth and income distribution. Farmers can sell cocoa beans both domestically and abroad at quite promising prices. If farmers sell cocoa beans domestically, sales results will be obtained faster within 1-2 days. In contrast to the sale of cocoa beans abroad, for example the United States, sales results are only obtained two months later (Komisi Pengawas Persaingan Usaha, 2009). Cocoa beans purchased by domestic companies are used for purchasing purposes and then exported to other countries, the production process is carried out to market the products

themselves both within and outside the country, promotions, market research and other similar activities (Neilson et al., 2020).

In 2015 Indonesia exported 355,321 tons of cocoa beans or US\$ 1,307,771. The five export destination countries for Indonesian cocoa beans are China, Germany, Malaysia, Singapore and the USA. Some of the commodities exported include Indonesian cocoa beans, cocoa butter, cocoa paste and cocoa powder (Augustin et al., 2022). Another study reported that among the nine destination countries for Indonesian cocoa exports (namely Malaysia, the United States, Singapore, Brazil, China, Spain, Germany, Thailand, and the Philippines) Indonesian processed cocoa has a high comparative advantage in Spain, while Singapore has a lowest comparative advantage (Maulana & Kartiasih, 2017).

Ideally, any number of request should be fulfilled by company. Thus, the company can provide a fast response and maximize the profit. However, the company facing another obstacles in predicting the exact amount of products must be generated in order to avoid excess or shortage supply. In supply chain management demand forecasting is often carried out. Demand forecasting is an activity to estimate the amount of demand for certain goods or services in a certain period and marketing area (Saptaria, 2016).

The Impact of Production Challenges on The Cocoa Beans Industry

As the demand of cocoa beans and its products increasing (Gu et al., 2011), it is impacted to the challenges coped by cocoa beans industry to boost production (Akinlabi et al., 2019). Limited supply and inconsistent production of cocoa beans becoming challenge for the cocoa industry (Gavrilova, 2021; Geo & Saediman, 2019). Several factors that cause these are low quality of human resources, lack of access to finance and inadequate infrastructure (Indah et al., 2018), pest and disease attacks (EU et al., 2022), deforestation and loss of biodiversity (Renier et al., 2023), the threat of climate change (Igawa et al., 2022) and fairness in the cocoa supply chain (Krauss & Barrientos, 2021).

Farmers need ongoing assistance and guidance to continue to maintain cocoa production both in quantity and quality. Training to the farmers are required such as cocoa plants rejuvenation to the unproductive cocoa, maintenance and harvesting of cocoa including fermentation practices (Indah et al., 2018). This routine training program will provide support to farmers in spurring production and encourage farmers to maximize the processing of their crops. So that the cocoa beans produced also provide the best quality (Schaad & Fromm, 2017).

Besides the knowledge and skill required by farmers, the adequate access to finance and infrastructure are also need to be supported (Indah et al., 2018). Farmers can be equipped with alternative business models and implement promising practices for increasing climate resilience and household incomes. These efforts are executed in order to increasing farmers' income and reducing the number of farmers living below the standard of decent living income (Stringer et al., 2020). Some institutions that concentrated on the farmers' prosperity giving guidances such as providing farmers easy access to digital financing (Agyekumhene et al., 2018) and crop insurance solutions to help finance the transition to a diversified cocoa farming ecosystem (Alam et al., 2020). Another effort is bringing together key government, industry, and farmer groups (Lowitt et al., 2015) to help create the markets and rules necessary for a successful, diversified cocoa farming ecosystem (Schaad & Fromm, 2017).

Pest and disease attacks has becoming a major problem in cocoa plantation. Single pest control in cocoa can be done by several efforts such as Eradication of cocoa pod borer, technical culture, biological control, use of resistant clones, vegetable insecticides and synthetic insecticides (Grace Engka et al., 2019). The integrated pest control system is commonly

implemented. The integrated pest control system aims to limiting the use of synthetic insecticides by introducing the concept of an economic threshold as the basis for determining pest control. The approach used is a comprehensive approach that emphasizes existing ecosystems in a particular environment, seeks to integrate various compatible control techniques so that pest and plant disease populations can be maintained below a threshold that is not economically detrimental as well as preserving the environment and profitable for farmers (Meilin, 2011). Integrated control of cocoa pod borer can be carried out by pruning cocoa trees, appropriate fertilization, sanitation and application of vegetable insecticides (Grace Engka et al., 2019).

Deforestation and loss of biodiversity. Deforestation causes the conversion of forests into pastures, food crops, and plantations in which cocoa becoming one of the seven commodities being commercialized (Renier et al., 2023). The main causes of loss of biodiversity are habitat destruction, climate change (global warming), over-exploitation, environmental pollution, accidents/accidents, and emergence of alien species. Causal factors, drivers and stresses directly contribute to the degradation of global biodiversity and ecosystem services (Sutarno & Setyawan, 2015).

The threat of climate change. Climate change will change the characteristics and conditions of the cultivation area for many crops and the requirements for *Theobroma cocoa*. Climate change, primarily through water availability, CO₂ elevation, and high elevation temperatures, will cause important changes in tree function and consequently phenology and physiological properties such as water use efficiency, gas exchange, carbohydrate metabolism, and assimilation and nutrient translocation (Cilas & Bastide, 2020).

Fairness in the cocoa supply chain. Cocoa plants were grown in developing country, in which the farmers mostly obtain a relatively low profit from cocoa selling (Renier et al., 2023). In the cocoa supply chain, there are many actors involved. However, cocoa supply chain fairness may not apply to all actors including farmers. Many farmers are trapped in extreme poverty, unable to pay for their daily needs, let alone invest in new equipment or methods that may be better able to respond to the effects of the climate crisis (Okpratiwi et al., 2018). In coping this problems, the roles of government, traders or industrial companies and community around cocoa farming are important to helping a decent life for cocoa farmers (Iskandar et al., 2022).

Supply Chain Management of Cocoa Beans

Supply chain defined as “A life cycle process consisting of physical, information, financial and knowledge flows whose purpose is to satisfy end user requirements with the products and services of multiple linked suppliers” (Felea & Albastroiu, 2013). Supply chain management is designed in such detail to be used by both small and large organizations to deliver products to consumers, starting from the process of sourcing raw materials, manufacturing, and shipping the final product to customers. Organizing a supply chain management system properly will optimize the operations function so that it works quickly and efficiently (Kleab Candidate, 2017).

The product supply chain is an activity that starts from raw materials to after-sales handling. This supply chain includes activities that occur due to relationships with producers, suppliers and relationships with consumers. These activities are separate but highly dependent on one another (Aini et al., 2014). Cocoa commodity supply chain in Indonesia can be simply described in Figure 1.

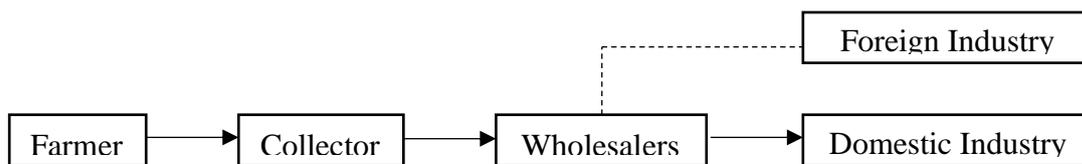


Figure 1. Supply Chain of Indonesian Cocoa (Aini et al., 2014)

Analysis of the supply chain of cocoa beans is useful for managing the supply chain of cocoa beans. Supply chain analysis of cocoa beans can provide an overview of chain structure, chain management, chain resources, chain business processes and supply chain performance. The measurement of supply chain performance will support steps to optimize marketing activities carried out by members of the supply chain. In addition, it can be studied the dominance of marketing agency actors in the supply chain of cocoa beans which play a role in the distribution of products in the supply chain (Sherina et al., 2020).

Characteristic of Supply Chain Management of Cocoa Beans

Along with the development of the times, the supply chain has also changed as a result of the industrial revolution. The industrial revolution 1.0 was marked by the existence of a steam engine. In the supply chain, the industrial revolution affected the transportation sector and the chocolate production process. The industrial revolution 2.0 was marked by the emergence of production lines and electricity. The supply chain affects the process of cultivating plants and the use of electricity for coanching machines in the chocolate production process. The industrial revolution 3.0 was marked by the entry of the digitalization era. The supply chain influences the field of detecting rainfall for handling cocoa plants, automatic production machines for processing chocolate, using computers to archive sales and production data. At this time, namely the era of the industrial revolution 4.0 which was marked by an intelligent system. In the 4.0 era supply chain has a goal to bring consumers closer to farmers or agricultural companies (Iswari et al., 2019).

The study about characteristic of cocoa commodity supply chain in West Sulawesi reported that the farmers sell cocoa beans mostly to the village collector traders due to quite small quantity of cocoa beans production, the easiness of access of trading activity, and strong commitment between farmers and traders. However, there is still a tendency for farmers to sell cocoa beans to sub-district collector traders, and to wholesalers, although only in special occasion. The study also reported the obstacles coped by farmers such as pest attack, lack of capital for cocoa cultivation and maintenance, lack of cooperation in obtaining mutual benefit between farmers and wholesalers, industries or exporters and lack of support from government (M. Asir et al., 2017).

Identification of Supply Chain Member

Supply chain members include all companies and organizations related to the core company either directly or indirectly through their suppliers and customers from point of origin to point consumption Primary members (primary members) are all companies or strategic business units that actually carry out operational activities and managerial in business processes that are planned to produce specific outputs for customers or markets. Secondary members are companies that provide resources, knowledge, utilities or assets for primary members (Ansar, 2019).

There are several main players who are actors who have the same interests, namely: 1) Suppliers, are sources that provide the first material, where the chain of distribution of goods

will begin. This first material can be in the form of raw materials, raw materials, auxiliary materials, merchandise, subassemblies, spare parts, and so on. 2) Manufacturers, suppliers as the first link in the chain are connected with manufacturers or assemblers or fabricators or other forms that do the work of making, fabricating, assembling, converting, or finishing goods (finishing). 3) Distributor, finished goods produced by the manufacturer can begin to be distributed to customers. 4) Retailers, the supply chain will completely stop after the goods in question arrive at the actual users of the goods or services in question (Ansar, 2019).

The cocoa bean supply chain is composed of several parties that work in a stream and support each other to achieve goals and maintain the sustainability of cocoa bean production. Each member of the supply chain has its own role. The member of cocoa supply chain including farmers, village level traders, district traders, wholesalers, cocoa processing factories. Farmers play an important role in the supply of main raw materials or suppliers. Village-level traders play the role of collecting cocoa beans for farmers at the village level or distributors. District traders act as collectors of cocoa beans from several sub-districts or distributors. Wholesalers act as distributors on a large scale and sell cocoa beans outside the region. The cocoa processing factory acts as a manufacturer that processes cocoa beans into cocoa bean derivative products as well as a retailer that sells these products (Sherina et al., 2020).

Flow Patterns of the Main Components of the Cocoa Bean Supply Chain

In the Supply Chain there are various flows managed by actors. These flows include the flow of materials, the flow of money (financial flow) and the flow of information (Madenas et al., 2014; Mizani & Azis, 2021; Shoffiyati et al., 2019; Yusuf & Soediantono, 2022).

Material Flow

This flow will move from upstream side to downstream side. One example of the flow of goods is the flow of raw materials sent from suppliers to processing plants. Furthermore, after going through the production process, the goods will be sent to the distributors who are forwarded to the delivery of goods to the retailers and finally the goods will move from the hands of the retailers to the end consumers. Material flow pattern of cocoa in East Selamadeg District, Tabanan Regency are including farmers, wholesaler, district collector, regency collector, province collector and cocoa manufacturers (Negara et al., 2017).

Financial Flow

The flow of money will move flowing from the downstream side to the upstream side. Money flows can take the form of invoices, payment agreements, checks, and more. Financial flow pattern of cocoa in East Selamadeg District, Tabanan Regency are including farmers, wholesaler, district collector, regency collector, province collector and cocoa manufacturers (Negara et al., 2017). In another study, the flow of cocoa beans is started from: 1) farmers to mobile collector traders, village gathering merchant, district collector traders, provincial traders/exporters, and industry (domestic/foreign); 2) farmers to cooperative, secondary cooperative, provincial traders/exporters, and industry (domestic/foreign); 3) farmers to village wholesaler, district merchant, provincial traders/exporters, and industry (domestic/foreign); 4) farmers to district merchant, provincial traders/exporters, and industry (domestic/foreign). In each terminal or temporary stop of traders will provide different value of cocoa beans depend on the postharvest handling, marketing process and marketing line. However, the value of cocoa is most affected by the length and shortness of the marketing channels and the prices imposed by collection agents (Baihaqi et al., 2014).

Information Flow

The flow of information is different from the flow of goods and money. If the flow of goods flows from upstream to downstream and the flow of money flows from downstream to upstream, then the flow of information moves from upstream to downstream and downstream to upstream. The flow of information needed from downstream to upstream, for example, is inventory information at a number of distributors or supermarkets, while the party that needs the information is the factory. Information from upstream to downstream as an example is a distributor who wants to obtain information regarding factory production capacity (S. Sharma & Modgil, 2013).

Information flow includes, for example, information on product availability and prices, information on the availability of production capacity, and information on the status of raw material shipments. By achieving coordination from the supply chain between actors, then each supply chain actor will not experience a shortage of goods and also will not have too many excess goods (Shoffiyati et al., 2019).

In the study of supply chain integration to cocoa performance and competitiveness, it was reported that several variables related to information flow included in the integration of cocoa beans supply chain were sharing technical information on cocoa cultivation with every farmer, Easily obtain information between farmer, merchants and farmers mutually share the required information, traders and farmers share information about supply of cocoa beans, traders and farmers carry out transparent information about prices to each other (Adha, 2017).

In another study in Pasaman District, it was reported that the flow of information is an important component to expedite product and financial flows that occur throughout the marketing of cocoa beans. To maintain the trust of each marketing member, clear information is conveyed regarding price and quality where the flow of information flows in two directions, namely from farmers to exporters and vice versa (Herawati et al., 2015).

The Effectiveness of Current Supply Chain Management Practices

Effectiveness and efficiency affect the decision-making process by ensuring the objectives set in supply chain management can be achieved (Hadiguna, 2017). Effectiveness is the achievement of success in meeting consumer expectations or satisfaction. By improving quality and service through the integration of supply chain structures in the form of cooperation and information sharing (Putri, 2020). The supply chain is efficient when in the process of delivering products to consumers at the lowest possible cost and is able to provide fair value sharing to all the links involved in it (Analia, 2017).

The benefits of effectiveness and efficiency in supply chain management include reducing total cycle time, better service, higher responsiveness to consumer needs, speeding up delivery, improving product quality, selecting more cooperative suppliers, managing resources well, minimizing costs, increase profitability, improve product design, increase competitiveness, and can make mid-term or long-term planning. Factors that affect the effectiveness and efficiency of supply chain management which have been summarized from several literatures, consist of knowledge sharing, information and information sharing, coordination, flexibility, as well as visibility and transparency (Putri, 2020).

Sustainable Supply Chain Management of Cocoa Beans

Concept of Sustainable Supply Chain Management

The application of the concept of supply chain management is needed to meet consumer demand for agricultural products, both as raw materials for agro-industry and for fresh products

that are directly consumed, so that supply chain actors can benefit from farmers to end consumers. Supply chain management is seen as a method, tool or approach to managing, integrating planning, implementing, coordinating and controlling all processes and business activities to efficiently produce and deliver products to meet market needs, and efficiently integrate suppliers, manufacturers, warehousing and storage, so that goods are produced and distributed in the right quantity, in the right location, and at the right time in order to minimize costs, the system as a whole, while meeting all needs at every level. Management of supply chain management is the management of the entire process of production, distribution and marketing that can be measured through supply chain performance measurement (Shoffiyati et al., 2019).

Sustainable supply chain management is important to be maintained in organizing agricultural commodities. There are several analyses in sustainable supply chain management such as development strategy of sustainable potato supply chain in Magetan regency. In this study, strengthening the supply chain is the key to accelerating and stabilizing production. In developing a sustainable supply chain, the economic dimension has the highest priority. However, the social and environmental dimensions also need to be considered equally important (Hidayati et al., 2019). In another study on sustainable supply chain management report that it is necessary to pay attention that increased attention to social and environmental aspects must be able to increase benefits from a business perspective (Hisjam, 2019).

In a study related to the sustainability of the robusta coffee supply chain in the Tanggamus Regency, there are two sensitive indicators on the sustainability of the economic dimension, namely responsiveness to customers and cost efficiency. Two social indicators that are sensitive, namely law enforcement on land and labor disputes. Two environmental indicators, namely waste management and energy consumption. Six technological indicators namely cultivation technology, standard for use of harvest technology, standard for use of post-harvest technology, standard for use of industrial processing technology, quality standard technology, waste management technology which are sensitive to the sustainability of the supply chain (Septarianes et al., 2020).

Sustainability in the cocoa agro-industry commodity is also highly expected to be maintained because it has an impact on the sustainability of the supply chain. The global market demands sustainable cocoa products, namely products that not only have good quality but also meet sustainable criteria, namely environmentally friendly, socially friendly and fair in the trade chain. Some of the key elements for cocoa sustainability are transparency, compliance with applicable laws and regulations, remuneration for cocoa quality, cocoa productivity, increased farmer income, access to credit, services for village development and diversification, market access, access to information, appropriate working conditions, support farmer organizations, planned land clearing and utilization as well as proper infrastructure, good and economical management of natural resources (Sriwana et al., 2021).

Specific strategies or initiatives implemented in the cocoa bean industry to promote sustainable supply chain management

In recent years, issues related to sustainable supply chains have increased significantly. Practitioners and researchers discuss the efforts of producers, retailers and operators to achieve sustainable goals from supply chains where the desire aspect is a benchmark for evaluating the performance of an industry (Pereseina et al., 2014). The supply chain is a network of companies that work together to create and deliver a product to the end user (Shoffiyati et al., 2019). In contrast to traditional supply chain management, sustainable supply chain management pays attention to environmental, social and economic aspects in its implementation (Khokhar et al.,

2020). In a review of supply chain management, increasingly advanced economic developments can have a positive impact on people's welfare. However, if examined further, it turns out that there are side effects resulting from this rapid economic growth, namely causing environmental problems which then affect social conditions in (Sharma et al., 2021) so that special attention is needed on aspects of sustainable supply chain management. It is these three factors (economic, social and environmental) that differentiate traditional supply chain management and sustainable supply chain management (Peng, 2023). Below were explained the specific strategies or initiatives implemented in order to promote sustainable supply chain management.

The environmental aspects of sustainable supply chain management, including: 1) green logistics, 2) waste reduction and recycling, and 3) circular economy practices. Green logistics allows companies to reduce costs, service reliability, including flexibility, and efficiency of the right inventory. Companies involved in distribution enable implementation on an ongoing basis (Indrasari & Komari, 2021). Companies optimizing transportation routes, reducing emissions and adopting energy-efficient practices to minimize their carbon emission (Herold & Lee, 2017; Su et al., 2017). Frequent logistics activities increase fuel consumption, air pollution, and waste of resources, thus negatively impacting sustainable economic development. Quantitative studies of environmentally friendly transportation have two main aspects. The first aspect involves applying relevant knowledge, such as econometrics and statistics, to analyze green transportation. The second aspect is to develop an environmentally friendly transportation model using intelligent optimization algorithms to solve it (Lu & Li, 2023).

Waste Reduction and Recycling. Strategies for minimizing waste generation and maximizing recycling within supply chains. In an integrated supply chain network design, it is possible to process all types of waste according to the desired waste hierarchy level. The main objective of this strategy is to change the “production-consumption-waste” paradigm to a “circular economy” that promotes “reduction, reuse and recycling,” saves energy and raw materials, and reduces greenhouse gas emissions (Eghbali et al., 2022).

Circular Economy Practices. Circular economy principles are applied to extend product lifecycles and reduce resource consumption. Circular economy is a concept that does not only manage waste into items that can be recycled. However, it also emphasizes changes in society in deciding to buy goods, how they are used and when the goods are decided not to be used according to their original function. Circular economy emphasizes changes in paradigm and behavior of society, industry and government. The government began to apply regulations to the industry to utilize its waste products as raw materials again. Efforts are made to reuse production waste for products such as plastic and clothing that have a production process that produces large carbon emissions. Technology and regulations are being pursued to support the implementation of this circular economy. Meanwhile, people are required to change their consumption/usage behavior of goods (Handawati & Mataburu, 2020).

Social Sustainability. The social dimensions of sustainable supply chains, including: 1) ethical sourcing, 2) community engagement, 3) diversity and inclusion. In ethical sourcing there are the importance of sourcing materials from suppliers who adhere to fair labor practices, respect human rights, and provide safe working conditions. An ethical resource that manages all processes of providing the materials and services a company requires from a group of suppliers in an ethical and socially responsible manner. An ethical sourcing code of conduct is also needed so that workers can work for good wages and be safe in the workplace (Kim et al., 2018). In community engagement companies can engage with local communities to create positive social impacts, such as supporting education and healthcare initiatives.

Implementation of corporate social responsibility (CSR) programs can reduce the potential for conflict in a society, both vertically and horizontally. At the same time, it can improve the company's reputation and increase its productivity by gaining the trust of stakeholders (Budiani, 2020). In diversity and inclusion there are such efforts to promote diversity and inclusion among supply chain partners, fostering equitable opportunities. Equality, Diversity and Inclusion is a social project to ensure fair treatment and opportunities for all parties due to differences in race, gender, location, geography, culture, physical abilities, etc. It aims to eliminate prejudice and discrimination based on the characteristics of individuals or protected groups. This project works with the assumption that the community has the same ability/empowerment and they can access benefits under the same conditions. Universal concepts cannot be assumed with the term “personal”. Hence, equality emerged as an important element to add as organizations seek to adhere to diversity and inclusion (D&I) initiatives (Vargas-Solar et al., 2022).

Economic Sustainability. The economic considerations within sustainable supply chain management, including: 1) long-term value, 2) cost-effective solutions. In long-term value sustainable practices contribute to long-term business viability and profitability by reducing risks and enhancing brand reputation. In particular, for an organization to be sustainable, it must be financially secure to create long-term value, it must be able to reduce its impact on the environment through product innovation and its activities, and it must adopt strategies to generate competitive advantages in line with societal expectations. . Due to a lack of proper monitoring of agents, management incentives and activities often focus on short-term earnings, which are usually associated with executive compensation rather than (long-term) sustainable performance for shareholders and other stakeholders. To create sustainable corporate value in the long term, companies must consider all stakeholders, including shareholders, investors, consumers, customers, communities and other interest groups that may affect company performance or those affected by organizational achievements (Alsayegh et al., 2020). In cost-effective solutions, efficiency gains achieved through sustainable practices can lead to cost savings in the long run. Cost efficiency is an important and critical aspect, especially when it becomes more basic and significant to avoid cases of financial uncertainty. Cost and resource productivity are very important for organizations to control in order to ensure the continuity of their development (Narawish et al., 2022).

Case Studies and Examples. Some organizations such as Nestle’, Unilever, The Coca Cola Co, Pepsi Co, Adidas and many more has implemented sustainable supply chain management. Nestlé has a specific plan to build a more sustainable cocoa supply chain, where this program is called the Nestlé Cocoa Plan. In this case, Nestlé collaborates with local and international farmers, communities and organizations to develop and implement solutions to various challenges faced by cocoa farming communities. Then Nestlé also ensures that cocoa suppliers comply with the Responsible Sourcing Standards. Income accelerator program by Nestlé Cocoa Plan provide an assistant to close the living income gap and reduce the number of children at risk. By implementing this program, some incentives could be rewarded to school enrollment, good agricultural practices, agroforestry activities, diversified incomes and bonus for completing incomes. Nestlé provides incentives for families to engage in this practice, to earn up to €500 per year for the first two years and €250 per year thereafter: 1) reduce the risk of child labor by assisting with school attendance and monitoring, 2) help farmers increase cocoa production by training and subsidizing pruning groups, 3) increase agricultural resilience by providing forests and fruit trees, 4) reduce dependence on cocoa by supporting families to grow other crops and raise livestock, and 5) €100 for each target-based practice and an additional bonus of €100 for engagement in all four incentivized practices. In the future Nestlé

committed to always effectively integrated sustainability principles into their supply chain operations (Nestlé, 2023).

There are key performance indicators (KPIs) and metrics used to measure the effectiveness of sustainable supply chain practices. This could include tracking carbon emissions reductions (Huisinigh et al., 2015; Lu & Li, 2023; Su et al., 2017), waste reduction percentages (Johannes, 2018; Widiyanto et al., 2023), supplier compliance scores (Asif et al., 2019; Er Kara & Oktay Firat, 2018), and more. Sustainability KPIs and metrics are benchmarks that businesses set to measure the sustainability of their supply chain, employees, partners and suppliers. This ensures that businesses have a positive impact on the environment, rather than harming it (Tundys & Yudi, 2019).

Technology and innovation play a role in advancing sustainable supply chain management. Some technologies like blockchain for transparency (Xu et al., 2021), data analytics for identifying inefficiencies (Kumar et al., 2023; P & M. Patil, 2018), and IoT for real-time tracking of goods and resources (De Vass et al., 2021) may help the development of sustainable supply chain management. The application of technology in sustainable supply chain management will provide many benefits, such as: 1) increasing efficiency and reducing costs through better supply chain intensification, 2) companies could identify areas that require sustainability improvements by increasing supply chain transparency, 3) by identifying potential environmental and social risks in the supply chain companies can also achieve better risk management and 4) implementing sustainable practices can increase stakeholder involvement and improve reputation (Lodin et al., 2020; Thöni & Tjoa, 2017).

When implementing sustainable supply chain practices, organizations may face some challenges (Menon & Ravi, 2021). This could include resistance from suppliers (New, 2014), initial investment costs (Pettersson & Segerstedt, 2014), regulatory hurdles (Sospeter & Li, 2018), and the complexities of coordinating a multi-tier supply chain (Gong et al., 2023). Therefore in achieving sustainable supply chain goals, it is important to build collaboration and partnerships. The collaboration among suppliers, manufacturers, retailers, and other stakeholders can lead to more effective sustainability initiatives (Andalib Ardakani et al., 2022; Brun et al., 2020; Chauhan et al., 2022; Siems et al., 2023).

In the future there will be some emerging trends and future directions in sustainable supply chain management, such as the rise of ethical consumerism (Lambrechts, 2020), increased emphasis on supply chain transparency (Kauppila et al., 2020), and the integration of sustainability into corporate strategies (Oertwig et al., 2017). In the near future, more technology will emerge in the supply chain industry followed by new challenges. Companies must have the resilience to overcome unexpected disruptions by utilizing the latest supply chain management methods and emerging supply chain software trends that will help companies develop, become flexible and mobile (Dubey et al., 2023; Kazancoglu et al., 2023)

Conclusion

Nowadays, the study of supply chain management is growing rapidly. However the sustainability of supply chain management should also be considered due to the recent concern on global demand such as environmentally friendly, socially friendly and fair in the trade chain. A sustainable supply chain involves the integration of economic, social, technological and environmental aspects towards supply chain sustainability by an organization. Cocoa beans are Indonesian agroindustrial commodities which playing important role in global trading. Understanding the sustainable supply chain management of cocoa beans will provide some benefit such as providing customer satisfaction, increasing revenue, lowering costs, higher

asset utilization, increased profits and a bigger company. In the future, it is hoped that the challenges or risk of business uncertainty could be solved easily by managing and reducing risk in supply chain. Therefore, a strong and sustainable cocoa bean supply chain can be generated.

References

- Adha, W. M. (2017). Integrasi rantai pasok terhadap kinerja dan daya saing kakao. *Jurnal Bisnis Darmajaya*, 3(2), 146–162.
- Agyekumhene, C., de Vries, J. R., van Paassen, A., Macnaghten, P., Schut, M., & Bregt, A. (2018). Digital platforms for smallholder credit access: The mediation of trust for cooperation in maize value chain financing. *NJAS - Wageningen Journal of Life Sciences*, 86–87, 77–88. <https://doi.org/10.1016/j.njas.2018.06.001>
- Aini, H., Syamsun, M., & Slamet, A. S. (2014). Risiko Rantai Pasok Kakao di Indonesia dengan metode Analytic Network Process dan Failure Mode Effect Analysis Terintegrasi. *Jurnal Manajemen & Agribisnis*, 11(3), 209–219.
- Akinlabi, E. T., Adelakun, O. J., Okokpujie, I. P., & Akinlabi, S. A. (2019). Processing and Marketing Risk Factor of Cocoa Industry in Nigeria. *Journal of Physics: Conference Series*, 1378(2). <https://doi.org/10.1088/1742-6596/1378/2/022056>
- Alam, A. S. A. F., Begum, H., Masud, M. M., Al-Amin, A. Q., & Filho, W. L. (2020). Agriculture insurance for disaster risk reduction: A case study of Malaysia. *International Journal of Disaster Risk Reduction*, 47, 101626. <https://doi.org/10.1016/j.ijdr.2020.101626>
- Alonso, E., Gregory, J., Field, F., & Kirchain, R. (2007). Material availability and the supply chain: Risks, effects, and responses. *Environmental Science and Technology*, 41(19), 6649–6656. <https://doi.org/10.1021/es070159c>
- Alsayegh, M. F., Abdul Rahman, R., & Homayoun, S. (2020). Corporate Economic, Environmental, and Social Sustainability Performance Transformation through ESG Disclosure. *Sustainability*, 12(9), 3910. <https://doi.org/10.3390/su12093910>
- Analia, D. (2017). Structure Of Supply Chain, Institution Cluster And Industrial Commodities Red Chili : A Literature Review. *Sosial, Jurusan Fakultas, Ekonomi Universitas, Pertanian Padang, Andalas*, 1(1), 21–30.
- Ananda, S., Syahni, R., & Khairati, R. (2019). Faktor-Faktor Yang Mempengaruhi Produksi Kakao Rakyat di Kabupaten Tanah Datar (Studi Kasus di Nagari Balimbing Kecamatan Rambatan, Kabupaten Tanah Datar). *JOSETA: Journal of Socio-Economics on Tropical Agriculture*, 1(1), 97–103. <https://doi.org/10.25077/joseta.v1i1.13>
- Andalib Ardakani, D., Soltanmohammadi, A., & Seuring, S. (2022). The impact of customer and supplier collaboration on green supply chain performance. *Benchmarking*, 30(7), 2248–2274. <https://doi.org/10.1108/BIJ-12-2020-0655>
- Ansar, M. (2019). *Analisis Rantai Pasok Pemasaran Komoditas Biji Kakao di Desa Mattampa Walie Kecamatan Lamuru Kabupaten Bone*. Universitas Muhammadiyah Makassar.
- Arzia, F. S. (2019). Faktor-Faktor yang Mempengaruhi Produksi Industri Manufaktur di Indonesia. *Jurnal Kajian Ekonomi Dan Pembangunan*, 1(2), 365–374.
- Asif, M., Jajja, M. S. S., & Searcy, C. (2019). Social compliance standards: Re-evaluating the

- buyer and supplier perspectives. In *Journal of Cleaner Production* (Vol. 227, pp. 457–471). Elsevier Ltd. <https://doi.org/10.1016/j.jclepro.2019.04.157>
- Asir, M., Darma, R., Mahyuddin, & Arsyad, M. (2017). Characteristic of Cocoa Commodity Supply Chain in West Sulawesi. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, 36(4), 275–285. <https://doi.org/10.13140/RG.2.2.20122.54721>. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, 36(4).
- Asir, Muhammad, Darma, R., Mahyuddin, & Arsyad, M. (2019). Study on stakeholders position and role in supply chain of cocoa commodities. *International Journal of Supply Chain Management*, 8(1), 1–9.
- Augustin, N. P., Prasetyo, E., & Santoso, S. (2022). Analisis Daya Saing dan Trend Ekspor Kakao Indonesia ke Lima Negara Tujuan Tahun 2010-2019. *Jurnal Ekonomi Pertanian Dan Agribisnis*, 6(2), 442. <https://doi.org/10.21776/ub.jepa.2022.006.02.10>
- Badan Pusat Statistik. (2020). *Produksi Tanaman Perkebunan 2018-2020*. <https://www.bps.go.id/indicator/54/132/1/produksi-tanaman-perkebunan.html>
- Baihaqi, A., Hamid, A. H., Romano, & Yulianda, A. (2014). Analisis Rantai Nilai Dan Nilai Tambah Kakao Petani Di Kecamatan Paya Bakong Dan Geurudong Pase Kabupaten Aceh Utara. *AGRISEP*, 15(2), 28–35.
- BPS Statistics East Java. (2023). *Produksi Perkebunan Kakao dan Tebu Menurut Kabupaten/Kota dan Jenis Tanaman di Provinsi Jawa Timur*. Produksi Perkebunan Kakao Dan Tebu Menurut Kabupaten/Kota Dan Jenis Tanaman Di Provinsi Jawa Timur. <https://jatim.bps.go.id/statictable/2023/03/21/2582/produksi-perkebunan-kakao-dan-tebu-menurut-kabupaten-kota-dan-jenis-tanaman-di-provinsi-jawa-timur-ton-2021-dan-2022.html>
- BPS Statistics Indonesia. (2021). *Statistik Kakao Indonesia 2021*.
- Brun, A., Karaosman, H., & Barresi, T. (2020). Supply Chain Collaboration for Transparency. *Sustainability*, 12(11), 4429. <https://doi.org/10.3390/su12114429>
- Budiani, I. (2020). Enhancing the community engagement of Indonesian Palm Oil Companies through the implementation of the Social Life Cycle Assessment (SLCA). *ASEAN Journal of Community Engagement*, 4(1). <https://doi.org/10.7454/ajce.v4i1.1050>
- Budihardjo, K. (2022). Upaya Peningkatan Produktivitas Kakao (Theobroma Cacao L.) Guna Menunjang Hasil Olahannya Dalam Rangka Memperbaiki Perekonomian Warga Di Kabupaten Gunung Kidul. *Jurnal Agribisnis*, 24(1), 159–172.
- Calystania, V., Hasvia, T. G., Jones, J. H., Bhuan, S., & Valentino, J. (2022). Analisis manfaat penerapan manajemen rantai pasok dan ERP. *Jurnal Manajemen*, 14(2), 479–486. <https://doi.org/10.30872/jmmn.v14i2.11161>
- Chauhan, C., Kaur, P., Arrawatia, R., Ractham, P., & Dhir, A. (2022). Supply chain collaboration and sustainable development goals (SDGs). Teamwork makes achieving SDGs dream work. *Journal of Business Research*, 147, 290–307. <https://doi.org/10.1016/j.jbusres.2022.03.044>
- Cilas, C., & Bastide, P. (2020). Challenges to Cocoa Production in the Face of Climate Change and the Spread of Pests and Diseases. *Agronomy*, 10(1232), 1–8. <https://doi.org/10.3390/agronomy10091232>
- De Vass, T., Shee, H., & Miah, S. J. (2021). IoT in supply chain management: Opportunities

and challenges for businesses in early industry 4.0 context. *Operations and Supply Chain Management*, 14(2), 148–161. <https://doi.org/10.31387/oscm0450293>

- Dewanta, A. S. (2019). Demand for Indonesian cocoa beans in a dilemma: Case study Malaysian market. *Economic Journal of Emerging Markets*, 11(1), 59–72. <https://doi.org/10.20885/ejem.vol11.iss1.art6>
- Dubey, R., Bryde, D. J., Dwivedi, Y. K., Graham, G., Foropon, C., & Papadopoulos, T. (2023). Dynamic digital capabilities and supply chain resilience: The role of government effectiveness. *International Journal of Production Economics*, 258, 108790. <https://doi.org/10.1016/j.ijpe.2023.108790>
- Duron, M., Justin, J. U., Manalo, M., Patricia, I. S., Reyes, M. C., Rosete, M., & Antoinette, L. (2022). Trading Policy Analysis of the Cocoa Industry in Indonesia. *International Journal Of Social and Management Studies*, 3(No.1), 32–62.
- Eghbali, H., Arkat, J., & Tavakkoli-Moghaddam, R. (2022). Sustainable supply chain network design for municipal solid waste management: A case study. *Journal of Cleaner Production*, 381(1). https://www-sciencedirect-com.translate.google.com/science/article/abs/pii/S0959652622047850?_x_tr_sl=en&_x_tr_tl=id&_x_tr_hl=id&_x_tr_pto=tc
- Elvira, R. (2016). TEORI PERMINTAAN (Komparasi Dalam Perspektif Ekonomi Konvensional Dengan Ekonomi Islam). *Islamika : Jurnal Ilmu-Ilmu Keislaman*, 15(1), 47–60. <https://doi.org/10.32939/islamika.v15i1.35>
- Er Kara, M., & Oktay Firat, S. (2018). Supplier Risk Assessment Based on Best-Worst Method and K-Means Clustering: A Case Study. *Sustainability*, 10(4), 1066. <https://doi.org/10.3390/su10041066>
- EU, A., EB, K. U., & AH, O. (2022). Assessment of the incidence and intensity of major cocoa insect pest and Disease in southwest region of Nigeria. *Journal of Entomology and Zoology Studies*, 10(2), 206–211. <https://doi.org/10.22271/j.ento.2022.v10.i2c.8990>
- Felea, M., & Albastroiu, I. (2013). Defining The Concept of Supply Chain Management and Its Relevance to Romanian Academics and Practitioners. *Amfiteatru Economic*, XV(33), 75–88. <https://doi.org/10.1142/P894>
- Finance, A., & Process, M. (2017). *The Role of Digital Payments*. October.
- Gavrilova, N. G. (2021). Contemporary global production and consumption of cocoa: An assessment. *IOP Conference Series: Earth and Environmental Science*, 839(2). <https://doi.org/10.1088/1755-1315/839/2/022095>
- Geo, L., & Saediman, H. (2019). Analysis of Factors Affecting Cocoa Development in Southeast Sulawesi. *Pakistan Journal of Nutrition*, 18(5), 479–490. <https://doi.org/10.3923/pjn.2019.479.490>
- Gong, Y., Jiang, Y., & Jia, F. (2023). Multiple multi-tier sustainable supply chain management: a social system theory perspective. *International Journal of Production Research*, 61(14), 4684–4701. <https://doi.org/10.1080/00207543.2021.1930238>
- Grace Engka, R. A., Rimbing, J., & Wanta, N. (2019). Penerapan Penerapan Pengendalian Hama Secara Terpadu Pada Tanaman Kakao. *Journal of Chemical Information and Modeling*, 1(9), 18–24.
- Grumiller, J., & Grohs, H. (2022). Sustainability in the cocoa-chocolate global value chain:

- From voluntary initiatives to binding rules? *Austrian Foundation for Development Research (ÖFSE)*, 1(39), 39–55. <http://hdl.handle.net/10419/251779>
- Gu, F., Tan, L., Wu, H., Fang, Y., Xu, F., Chu, Z., & Wang, Q. (2011). *Comparison of Cocoa Beans from China, Indonesia and Papua New Guinea*. 2, 183–197. <https://doi.org/10.3390/foods2020183>
- Hadiguna, R. A. (2017). *Manajemen rantai pasok agroindustri: pendekatan berkelanjutan untuk pengukuran kinerja dan analisis risiko*. Andalas University Press.
- Handawati, R., & Mataburu, I. (2020). Mengenalkan Kegiatan Ekonomi Sirkular Personal Sekolah Dasar. *Prosiding Seminar Nasional Pengabdian Kepada Masyarakat 2020*, 8, 71–82. <http://journal.unj.ac.id/unj/index.php/snppm>
- Hanifawati, T., Suryantini, A., & Mulyo, J. H. (2018). Jurnal Sosial Ekonomi dan Kebijakan Pertanian. *Jurnal Sosial Ekonomi Dan Kebijakan Pertanian*, 7(1), 30–36. <http://dx.doi.org/10.21107/agriekonomika.v7i1.2513%0AABSTRACT>
- Hartuti, S., Juanda, & Khathir, R. (2020). Upaya Peningkatan Kualitas Biji Kakao (*Theobroma Cacao L.*) Melalui Tahap Penanganan Pascapanen (Ulasan). *Jurnal Industri Hasil Perkebunan*, 15(2), 38–52.
- Harya, G. I., Sudiyarto, & Santoso, W. (2020). MODEL PRIORITAS UNTUK KINERJA RANTAI PASOK KAKAO DI JAWA TIMUR, INDONESIA. *Jurnal Ilmiah Sosio AGRIBIS*, 20(1), 67–85.
- Hattab, S., Daswati, Effendy, Antara, M., Hanani, N., Darmawan, D. P., Basir-Cyio, M., Mahfudz, & Muhardi. (2021). The role of smallholder human resources on the performance of the supply chain of cocoa beans in central sulawesi indonesia: A structural equation modeling analysis. *Songklanakarinn Journal of Science and Technology*, 43(3), 847–854. <https://doi.org/10.14456/sjst-psu.2021.112>
- Herawati, Rifin, A., & Tinaprilla, N. (2015). Kinerja Dan Efisiensi Rantai Pasok Biji Kakao Di Kabupaten Pasaman, Sumatera Barat. *J. TIDP*, 2(1), 43–50.
- Herold, D. M., & Lee, K.-H. (2017). Carbon management in the logistics and transportation sector: an overview and new research directions. *Carbon Management*, 8(1), 79–97. <https://doi.org/10.1080/17583004.2017.1283923>
- Hidayati, A., Irianto, H., & Kusnandar, N. (2019). Strategi Pengembangan Rantai Pasok Kentang Berkelanjutan Di Kabupaten Magetan. *Jurnal Agro Ekonomi*, 36(2), 163. <https://doi.org/10.21082/jae.v36n2.2018.163-182>
- Hisjam, M. (2019). Perkembangan Riset Bidang Manajemen Rantai Pasok Berkelanjutan. *PERFORMA Media Ilmiah Teknik Industri*, 17(2), 103–110. <https://doi.org/10.20961/performa.17.2.20390>
- Huisinigh, D., Zhang, Z., Moore, J. C., Qiao, Q., & Li, Q. (2015). Recent advances in carbon emissions reduction: Policies, technologies, monitoring, assessment and modeling. *Journal of Cleaner Production*, 103, 1–12. <https://doi.org/10.1016/j.jclepro.2015.04.098>
- Ibnu, M. (2022). Mencapai Produksi Kakao Berkelanjutan di Indonesia. *AgribiSains*, 8(2), 22–33.
- Igawa, T. K., de Toledo, P. M., & Anjos, L. J. S. (2022). Climate change could reduce and spatially reconfigure cocoa cultivation in the Brazilian Amazon by 2050. *PLoS ONE*,

17(1 January), 1–14. <https://doi.org/10.1371/journal.pone.0262729>

- Indah, P. N., Harya, G. I., Pratiwi, L. F. L., & Widayanti, S. (2018). Analysis of Factors Influencing Processed Cocoa Industry in East Java Indonesia. *International Conference on Science and Technology*, 1(January 2018), 652–656. <https://doi.org/10.2991/icst-18.2018.133>
- Indah, P. N., Setiawan, R. F., Hendrarini, H., Yektingsih, E., & Sunarsono, R. J. (2021). Agriculture supply chain performance and added value of cocoa: A study in kare village, Indonesia. *Bulgarian Journal of Agricultural Science*, 27(3), 487–497.
- Indrasari, L. D., & Komari, A. (2021). Usulan Kinerja Green Logistic dengan Pendekatan Root Cause Analysis guna Meningkatkan Re- Order Point yang Efektif terintegrasi dengan FMEA dan Fishbone Diagram (Waisul et al ., 2017). (Prokop , 2011). Pertumbuhan ekonomi mengakibatkan perusahaan manu. *Seminar Nasional 2021: Universitas Ma Chung*, 44–58.
- Iskandar, E., Amanah, S., Hubeis, A. V. S., Sadono, D., Ginting, L. N., & Mujiburrahmad. (2022). Improving the sustainability of cocoa smallholders farming in Aceh, Indonesia. *IOP Conference Series: Earth and Environmental Science*, 951(1). <https://doi.org/10.1088/1755-1315/951/1/012036>
- Iswari, D. A., Arkeman, Y., & Muslich. (2019). Analisis Dan Desain Rantai Pasok Kakao Berbasis Blockchain. *AGRI-TEK: Jurnal Ilmu Pertanian, Kehutanan Dan Agroteknologi*, 20(2), 41–47.
- Johannes, H. P. (2018). Waste Reduction Through Integrated Waste Management Modeling At Mustika Residence (Tangerang). *Journal of Environmental Science and Sustainable Development*, 1(1), 12–24. <https://doi.org/10.7454/jessd.v1i1.15>
- Kauppila, O., Valikangas, K., & Majava, J. (2020). Improving supply chain transparency between a manufacturer and suppliers: A triadic case study. *Management and Production Engineering Review*, 11(3), 84–91. <https://doi.org/10.24425/mper.2020.134935>
- Kazancoglu, I., Ozbiltekin-Pala, M., Mangla, S. K., Kumar, A., & Kazancoglu, Y. (2023). Using emerging technologies to improve the sustainability and resilience of supply chains in a fuzzy environment in the context of COVID-19. *Annals of Operations Research*, 322(1), 217–240. <https://doi.org/10.1007/s10479-022-04775-4>
- Khokhar, M., Hou, Y., Rafique, M. A., & Iqbal, W. (2020). Evaluating the social sustainability criteria of supply chain management in manufacturing industries: A role of BWM in MCDM. *Problemy Ekorozwoju*, 15(2), 185–194. <https://doi.org/10.35784/pe.2020.2.18>
- Kim, S., Colicchia, C., & Menachof, D. (2018). Ethical Sourcing: An Analysis of the Literature and Implications for Future Research. *Journal of Business Ethics*, 152(4), 1033–1052. <https://doi.org/10.1007/s10551-016-3266-8>
- Kleab Candidate, K. (2017). Important of Supply Chain Management. *International Journal of Scientific and Research Publications*, 7(9), 397. www.ijsrp.org
- Koffi, A., Yao, N., Bastide, P., Bruneau, D., & Kadjo, D. (2017). Homogenization of cocoa beans fermentation to upgrade quality using an original improved fermenter. *International Journal of Nutrition and Food Engineering*, 11(7), 558–563.

- Komisi Pengawas Persaingan Usaha. (2009). *Kajian Industri dan Perdagangan Kakao*. 1–61.
- Krauss, J. E., & Barrientos, S. (2021). Fairtrade and beyond: Shifting dynamics in cocoa sustainability production networks. *Geoforum*, *120*, 186–197. <https://doi.org/10.1016/j.geoforum.2021.02.002>
- Kumar, D., Singh, R. K., Mishra, R., & Vlachos, I. (2023). Big data analytics in supply chain decarbonisation: a systematic literature review and future research directions. *International Journal of Production Research*. <https://doi.org/10.1080/00207543.2023.2179346>
- Lambrechts, W. (2020). *Ethical and Sustainable Sourcing: Towards Strategic and Holistic Sustainable Supply Chain Management* (pp. 1–13). https://doi.org/10.1007/978-3-319-71058-7_11-1
- Lodin, G., Supervisor, R. S., Examiner, V. K., & Term, M. T. (2020). *Sustainable Innovation in Supply Chain Management within the Food Industry*.
- Lowitt, K., Hickey, G. M., Ganpat, W., & Phillip, L. (2015). Linking Communities of Practice with Value Chain Development in Smallholder Farming Systems. *World Development*, *74*, 363–373. <https://doi.org/10.1016/j.worlddev.2015.05.014>
- Lu, Y., & Li, S. (2023). Green Transportation Model in Logistics Considering the Carbon Emissions Costs Based on Improved Grey Wolf Algorithm. *Sustainability (Switzerland)*, *15*(14). <https://doi.org/10.3390/su151411090>
- Madenas, N., Tiwari, A., Turner, C. J., & Woodward, J. (2014). Information flow in supply chain management : A review across the product lifecycle. *Journal of Manufacturing Science and Technology*, *7*(4), 335–346. <https://doi.org/10.1016/j.cirpj.2014.07.002>
- Maulana, A., & Kartiasih, F. (2017). Analisis Ekspor Kakao Olahan Indonesia ke Sembilan Negara Tujuan Tahun 2000–2014. *Jurnal Ekonomi Dan Pembangunan Indonesia*, *17*(2), 103–117. <https://doi.org/10.21002/jepi.v17i2.664>
- Meilin, A. (2011). Perkembangan Implementasi dan Teknologi Pengendalian Hama Terpadu pada Tanaman Kakao di Indonesia. *Jurnal Llmiah Universftas Batanghari Jamb*, *11*(3), 1–11.
- Menon, R. R., & Ravi, V. (2021). Analysis of barriers of sustainable supply chain management in electronics industry: An interpretive structural modelling approach. *Cleaner and Responsible Consumption*, *3*, 100026. <https://doi.org/10.1016/j.clrc.2021.100026>
- Miguel, M. G. da C. P., Reis, L. V. de C., Efraim, P., Santos, C., Lima, N., & Schwan, R. F. (2017). Cocoa fermentation: Microbial identification by MALDI-TOF MS, and sensory evaluation of produced chocolate. *Lwt*, *77*, 362–369. <https://doi.org/10.1016/j.lwt.2016.11.076>
- Mizani, T. T., & Azis, A. M. (2021). Analisis kerangka kerja, aliran, dan hambatan rantai pasokan. *Jurnal Manajemen Maranatha*, *21*(November), 17–24.
- Narawish, C., Sharma, D. K., Suman Rajest, S., & Regin, R. (2022). Importance of Cost Efficiency in Critical Aspect of Influences the Decision-Making Process in Banks. *Turkish Journal of Physiotherapy and Rehabilitation*, *32*(3), 47184–47212. www.turkjphysiotherrehabil.org47184
- Negara, I. P. A. S., Aviantara, I. G. N. A., & Yulianti, N. L. (2017). Sistem Manajemen Rantai Pasokan terhadap Nilai Tambah dan Kelembagaan Biji Kakao (*Theobroma Cacao* L.)

- di Kecamatan Selemadeg Timur Kabupaten Tabanan. *Jurnal BETA (Biosistem Dan Teknik Pertanian)*, 5(Vol 6 No 1 (2018): Maret), 1–9. <https://ojs.unud.ac.id/index.php/beta/article/view/35411/21390>
- Neilson, J., Dwiartama, A., Fold, N., & Permadi, D. (2020). Resource-based industrial policy in an era of global production networks: Strategic coupling in the Indonesian cocoa sector. *World Development*, 135, 105045. <https://doi.org/10.1016/j.worlddev.2020.105045>
- Nestlé. (2023). *Income accelerator program* (Issue July 2023).
- New, S. (2014). Understanding Supplier Resistance - Overcoming Obstacles to Supply Innovation. *Nang Yan Business Journal*, 2(1), 168–173. <https://doi.org/10.2478/nybj-2014-0037>
- Nguyen, G. N. T., & Sarker, T. (2018). Sustainable coffee supply chain management: a case study in Buon Me Thuot City, Daklak, Vietnam. *International Journal of Corporate Social Responsibility*, 3(1), 1–18. <https://doi.org/10.1186/s40991-017-0024-x>
- Nining Purwatmini. (2015). PERAN MANAJEMEN RANTAI PASOKAN (“SUPPLY CHAIN MANAGEMENT”) bagi INDUSTRI KREATIF BERBASIS INDUSTRI KERAMIK. *Jurnal Administrasi Kantor Vol 3 No 2 Agustus 2015*, 03(02), 525–538. <https://core.ac.uk/download/pdf/268190071.pdf>
- Oertwig, N., Galeitzke, M., Schmiege, H.-G., Kohl, H., Jochem, R., Orth, R., & Knothe, T. (2017). *Integration of Sustainability into the Corporate Strategy*. 175–200. https://doi.org/10.1007/978-3-319-48514-0_12
- Okpratiwi, S., Haryono, D., & Adawiyah, R. (2018). Analysis of Household Income and Poverty Level of Cocoa Farmers in Sungai Langka Village, Gedong Tataan Subdistrict, Pesawaran Regency. *JIIA*, 6(1), 9–16.
- P, A., & M. Patil, M. (2018). A Review on Data Analytics for Supply Chain Management: A Case study. *International Journal of Information Engineering and Electronic Business*, 10(5), 30–39. <https://doi.org/10.5815/ijieeb.2018.05.05>
- Peng, S. (2023). Sharing economy and sustainable supply chain perspective the role of environmental, economic and social pillar of supply chain in customer intention and sustainable development. *Journal of Innovation and Knowledge*, 8(1), 100316. <https://doi.org/10.1016/j.jik.2023.100316>
- Pereseina, V., Jensen, L. M., Hertz, S., & Cui, L. (2014). Challenges and conflicts in sustainable supply chain management: Evidence from the heavy vehicle industry. *Supply Chain Forum*, 15(1), 22–32. <https://doi.org/10.1080/16258312.2014.11517331>
- Pettersson, A. I., & Segerstedt, A. (2014). To Evaluate Cost Savings in a Supply Chain : Two Examples from Ericsson in the Telecom Industry. *Operations and Supply Chain Management: An International Journal*, 6(3), 94–102. <https://doi.org/10.31387/oscm0150094>
- Proença, J. F., Torres, A. C., Marta, B., Silva, D. S., Fuly, G., & Pinto, H. L. (2022). Sustainability in the Coffee Supply Chain and Purchasing Policies: A Case Study Research. *Sustainability (Switzerland)*, 14(1), 1–17.
- Putri, F. P. (2020). Peningkatan Efektivitas Dan Efisiensi Manajemen Rantai Pasok

- Agroindustri Buah: Tinjauan Literatur Dan Riset Selanjutnya. *Jurnal Teknologi Industri Pertanian*, 30(3), 338–354. <https://doi.org/10.24961/j.tek.ind.pert.2020.30.3.338>
- Renier, C., Vandromme, M., Meyfroidt, P., Ribeiro, V., Kalischek, N., & Zu Ermgassen, E. K. H. J. (2023). Transparency, traceability and deforestation in the Ivorian cocoa supply chain. In *Environmental Research Letters* (Vol. 18, Issue 2). <https://doi.org/10.1088/1748-9326/acad8e>
- Saeed, M. A., Waseek, I., & Kersten, W. (2017). Literature review of drivers of sustainable supply chain management. *Digitalization in Maritime and Sustainable Logistic*, 1–28. <https://doi.org/10.15480/882.1488><https://creativecommons.org/licenses/by-sa/4.0/>
- Saing, M. M., Arsyad, M., Asrul, L., Mahyuddin, Munizu, M., Munir, A. R., Nuddin, A., & Jamaludin. (2019). Supply chain analysis of dry and wet cocoa beans. *IOP Conference Series: Earth and Environmental Science*, 343(1). <https://doi.org/10.1088/1755-1315/343/1/012113>
- Saptaria, L. (2016). Peramalan Permintaan Produk Cincou Hitam dalam Memaksimalkan SCM (Supply Chain Management). *Jurnal Manajemen Dan Kewirausahaan*, Vol. 3(1), 247–256.
- Saunshia, Y., Sandhya, M. K. V. S., Lingamallu, J. M. R., Padela, J., & Murthy, P. (2018). Improved Fermentation of Cocoa Beans with Enhanced Aroma Profiles. *Food Biotechnology*, 32(4), 257–272. <https://doi.org/10.1080/08905436.2018.1519444>
- Schaad, N., & Fromm, I. (2017). Sustainable Cocoa Production Program (SCPP): Analysis of cocoa beans processing and quality in post-harvest in South East Sulawesi in Indonesia. *Asia Pacific Journal of Sustainable Agriculture Food and Energy*, 6(1), 1–6.
- Septarianes, S., Marimin, & Raharja, S. (2020). Strategi Peningkatan Kinerja Dan Keberlanjutan Rantai Pasok Agroindustri Kopi Robusta Di Kabupaten Tanggamus. *Jurnal Teknologi Industri Pertanian*, 30(2), 207–220. <https://doi.org/10.24961/j.tek.ind.pert.2020.30.2.207>
- Sharma, S., & Modgil, S. (2013). Supply chain efforts among downstream and upstream : a developed view. *Int. J. Engineering Management and Economics*, 4(1), 54–71. <https://doi.org/10.1504/IJEME.2013.055986>
- Sharma, V. K., Sachdeva, A., & Singh, L. P. (2021). A meta analysis of sustainable supply chain management from different aspects. *International Journal of Supply and Operations Management*, 8(3), 289–313. <https://doi.org/10.22034/IJSOM.2021.3.4>
- Sherina, R., Maryadi, & Wildayana, E. (2020). Kajian Rantai Pasok Biji Kakao Rakyat di Nagari Sungai Talang Kecamatan Guguak Kabupaten Limapuluh Kota. *Jurnal Prodi Agribisnis*, 1(1), 41–52. <https://doi.org/10.56869/kaliagri.v1i1.28>
- Shoffiyati, P., Noer, M., Syahni, R., & Asrinaldi. (2019). Analisis Kinerja Rantai Pasok Agroindustri Kakao Di Kabupaten Lima Puluh Kota, Provinsi Sumatera Barat. *Jurnal Teknologi Industri Pertanian*, 29(1), 27–33. <https://doi.org/10.24961/j.tek.ind.pert.2019.29.1.27>
- Sholiha, I. (2018). Teori Produksi dalam Islam. *Iqtishodiyah : Jurnal Ekonomi Dan Bisnis Islam*, 4(2). <https://doi.org/10.36835/iqtishodiyah.v4i2.83>

- Siems, E., Seuring, S., & Schilling, L. (2023). Stakeholder roles in sustainable supply chain management: a literature review. *Journal of Business Economics*, 93(4), 747–775. <https://doi.org/10.1007/s11573-022-01117-5>
- Sospeter, M. J., & Li, W. (2018). The Impact of Regulations on Public Supply Chain Performance: Case of Tanzania. *Advances in Economics, Business and Management Research (AEBMR)*, 46(Ebic 2017), 214–228. <https://doi.org/10.2991/ebic-17.2018.34>
- Sriwana, I. K., Arkeman, Y., Marimin, & Assa, A. (2021). Analisis Keberlanjutan Rantai Pasok Agroindustri Kakao Menggunakan Multi Dimensional Scalling. *Jurnal Industri Hasil Perkebunan*, 16(1), 58–71.
- Stringer, L. C., Fraser, E. D. G., Harris, D., Lyon, C., Pereira, L., Ward, C. F. M., & Simelton, E. (2020). Adaptation and development pathways for different types of farmers. *Environmental Science and Policy*, 104(December 2019), 174–189. <https://doi.org/10.1016/j.envsci.2019.10.007>
- Su, Q., Yang, W., & Liu, Y. (2017). Optimization of carbon emission considering production planning at enterprise level. *Journal of Cleaner Production*, 162, 635–645. <https://doi.org/10.1016/j.jclepro.2017.06.092>
- Sucahyowati, H. (2011). Manajemen Rantai Pasokan (Supply Chain Management). *Majalah Ilmiah Gema Maritim*, 13(1), 20–28. <https://doi.org/10.37612/gema-maritim.v13i1.19>
- Sutarno, & Setyawan, A. D. (2015). Biodiversitas Indonesia: Penurunan dan upaya pengelolaan untuk menjamin kemandirian bangsa. *PROS SEM NAS MASY BIODIV INDON*, 1(1), 1–13. <https://doi.org/10.13057/psnmbi/m010101>
- Suudi, M. Y., & S, E. S. (2021). Pengaruh Bahan Baku Dan Manajeamen Rantai Pasokan Terhadap Proses Produksi Pt. Niro Ceramic Nasional Indonesia. *Jurnal Ekonomi Dan Industri*, 22(1). <https://doi.org/10.35137/jei.v22i1.528>
- Syahrudin, N., & Kalchschmidt, M. (2012). Sustainable supply chain management in the agricultural sector: a literature review. *International Journal of Engineering Management and Economics*, 3(3), 237. <https://doi.org/10.1504/ijeme.2012.049894>
- Talumewo, P. O. E., Kawet, L., & Pondaag, J. J. (2014). Analisis Rantai Pasok Ketersediaan Bahan Baku Di Industri Jasa Makanan Cepat Saji Pada Kfc Multimart Ranotana. *Jurnal Emba*, vol.2 no.3(1), 1584–1591.
- Thöni, A., & Tjoa, A. M. (2017). Information technology for sustainable supply chain management: a literature survey. *Enterprise Information Systems*, 11(6), 828–858. <https://doi.org/10.1080/17517575.2015.1091950>
- Tundys, B. (2020). Sustainable supply chain management – past, present and future. *Prace Naukowe Uniwersytetu Ekonomicznego We Wrocławiu*, 64(3), 187–207. <https://doi.org/10.15611/pn.2020.3.15>
- Tundys, B., & Yudi, F. (2019). Sustainable Supply Chain Management - Key Performance Indicators (KPI) as an Element for Measuring of Processes. *Transport Economics and Logistics*, 83, 31–50. <https://doi.org/10.26881/etil.2019.83.03>
- Vargas-Solar, G., Cerquitelli, T., Montorsi, A., Salvai, S., Sangineti, M. T., Darmont, J., & Favre, C. (2022). Promoting equity, diversity and inclusion: policies, strategies and future directions in higher education, research communities and business.

Proceedings - 2022 IEEE International Conference on Big Data, Big Data 2022, 4710–4718. <https://doi.org/10.1109/BigData55660.2022.10020621>

- Wardhany, M., & Adzim, F. (2018). Determinant of Cocoa Export in Indonesia. *Economics Development Analysis Journal*, 7(3), 286–293. <https://doi.org/10.15294/edaj.v7i3.25262>
- Widiyanto, B., Aji Fathurakhman, M., & Munadi. (2023). Calculation of Waste Generation and Composition in Tegal City as an Effort to Increase Waste Reduction. *IOP Conference Series: Earth and Environmental Science*, 1147(1). <https://doi.org/10.1088/1755-1315/1147/1/012022>
- Wijayati, H., & Haqqi, H. (2022). The Indonesian Global Cocoa Chain's Position in the Pandemic Era. *International Journal on Social Science, Economics and Art*, 12(1), 10–21. <https://doi.org/10.35335/ijosea.v12i1.75>
- Wulandari, W. A., & Widjojoko, T. (2021). Analysis of Export Competitiveness of Indonesian Cocoa Beans in the International Market. *Proceeding ICMA-SURE*. <http://jos.unsoed.ac.id/index.php/eprocicma/article/view/4436%0Ahttp://jos.unsoed.ac.id/index.php/eprocicma/article/download/4436/2829>
- Xu, P., Lee, J., Barth, J. R., & Richey, R. G. (2021). Blockchain as supply chain technology: considering transparency and security. *International Journal of Physical Distribution and Logistics Management*, 51(3), 305–324. <https://doi.org/10.1108/IJPDLM-08-2019-0234>
- Yusuf, A. M., & Soediantono, D. (2022). *Supply Chain Management and Recommendations for Implementation in the Defense Industry: A Literature Review Supply Chain Management dan Rekomendasi Penerapannya Pada Industri Pertahanan: A Literature Review*. 3(3), 63–77.
- Zakiah, Safrida, & Frastica, N. (2022). Performance of cocoa beans production modelling in Indonesia. *IOP Conference Series: Earth and Environmental Science*, 951(1). <https://doi.org/10.1088/1755-1315/951/1/012007>