

# Analysis of green supply chain of coffee Lindu Biosphere reserve at Pipikoro Coffee Company

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## Abstract

This study aims to analyze green supply chain activities within the Lore Lindu Biosphere Reserve and the Pipikoro Coffee company. Observations in the reserve area reveal extensive community farming activities, including within conservation zones, yet academic studies on such practices remain limited. At Pipikoro Coffee, the researcher identified a lack of comprehensive analysis regarding the involvement of key supply chain actors—farmers, processors, and consumers—in supporting sustainability initiatives. Using a phenomenological paradigm and a qualitative descriptive approach, this research was conducted at Pipikoro Coffee in South Lolu Village, South Palu District, Palu City, involving 10 informants. Data were analyzed using triangulation techniques and the NVivo 12 Plus software. The findings indicate that Pipikoro Coffee's green supply chain relies on five interrelated components: suppliers, manufacturers, distributors, retailers, and customers. Each component functions through inbound, operational, and outbound processes that collectively support sustainable practices. Key elements identified include farmer education, the adoption of eco-friendly roasting technology, and consumer participation in promoting sustainable local products. Overall, this study highlights the importance of deeper exploration into how green supply chain practices are implemented in biosphere reserves and local enterprises, emphasizing their role in aligning conservation goals with sustainable business operations.

**Keywords:** *Green Supply Chain, Upstream, Internal, Downstream*

## Introduction

Central Sulawesi has great potential in the coffee industry, this region offers supportive geographical conditions, with fertile volcanic soil, tropical climate, and ideal altitude for cultivating quality coffee, especially Arabica and Robusta types. Coffee industry companies in Central Sulawesi, especially in Palu City in this study are companies engaged in the agro-industry sector, companies that process agricultural commodities in the form of raw coffee beans or what are commonly called green beans and produced into roasted beans and/or ground coffee and sell them. We can also find these coffee plants in the Biosphere Reserve area, Central Sulawesi itself has a Biosphere Reserve, namely in the Sigi Regency area, which also has several suppliers who plant coffee in the area. The Lore Lindu Biosphere Reserve in Central Sulawesi is an area that has a complete type of land ecosystem ranging from lowland ecosystem types to mountainous ecosystems. The Biosphere Reserve is a concept for managing an area and at the same time an area of land and coastal/ocean ecosystems or both that are recognized internationally as part of the UNESCO Man and the Biosphere (MAB) Program.

The purpose of implementing the Biosphere Reserve concept is to harmonize the

interests of natural resource conservation with sustainable development whose implementation is based on scientific studies (Purwanto et al., 2016). This Biosphere Reserve is protected by the Government and its use is permitted through the Government Regulation on Biosphere Reserve Management which is a derivative regulation of Law Number 5 of 1990 concerning Conservation of Natural Resources and Ecosystems, Law Number 41 of 1999 concerning Forestry, and Government Regulation Number 28 of 2011 concerning Management of Nature Reserve Areas and Nature Conservation Areas. The existence of the Green Supply Chain concept began with concerns in line with environmental sustainability due to economic and industrial activities. Supply Chain Management is an activity to manage or organize goods or services starting from suppliers, warehousing, production, to distribution to consumers. According to Heizer et al. (2017), supply chain management (SCM) is concerned with the management of the flow of raw materials and services, the production process, and their delivery throughout the supply chain. Supply chain management can also be defined as the process of material flow from the beginning to the end consumer, with attention to timeliness, cost, and production volume, all carried out efficiently to reduce potential costs (Mirus et al., 2019).

According to Petljak (2019) Green Supply Chain Practices are very broad green chain activities, generally covering warehousing to transportation, green procurement activities, environmentally friendly products, and cooperation with green suppliers. Green supply chain management is a concept that integrates environmental and social principles into the company's activity process, from purchasing raw materials to shipping products to customers. By implementing green supply chain management, companies can reduce negative environmental impacts and improve product quality and customer satisfaction. Currently, the concept of Green Supply Chain Management is being implemented by organizations as a form of environmental awareness through green manufacturing, green distribution, and logistics practices that focus on efficiency and minimize environmental impact. Various studies have shown that green manufacturing facilitates waste reduction and production process efficiency, while green distribution and reverse logistics play a crucial role in building a greener supply chain (Syahfitria et al., 2022). The concept of Green Supply Chain Management (GSCM) or green supply chain management refers to efforts to minimize the negative impacts of an organization and its supply chain on the environment related to climate change, pollution and non-renewable resources (Heriyanto & Noviardi, 2019). In its application, GSCM adopts environmental management principles in all its activities, such as the procurement process, manufacturing process, to logistics and distribution processes (Brilliana et al., 2020).

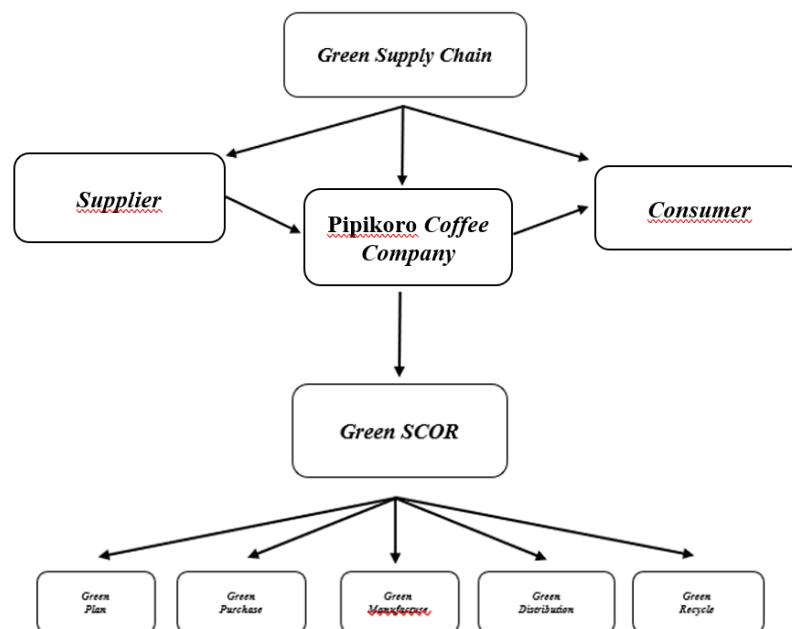
Green SCOR is also a modification that integrates environmental aspects into processes, metrics, and best practices in the SCM process, while considering the impact of operations at each stage of the product life cycle (Ahista et al., 2024). The Green SCOR concept aims to create an analytical tool that provides a clear view of the relationship between supply chain functions and environmental issues so that it can be used to improve an organization's management of both (Rosyidah et al., 2022).

The Green SCOR model can be viewed as consisting of three layers. The first layer encompasses the scope of the SCOR (Plan, Source, Make, Deliver, Return) process, expanded with green objectives. The second layer focuses on analyzing stakeholder behavior—from material suppliers to consumers—with environmental criteria in mind. The third layer

relates to the implementation and measurement of green KPIs based on these functions, as well as performance benchmarking (Suryaningrat et al., 2021).

The green supply chain activity at Pipikoro Coffee begins with the supply of raw coffee materials, the company orders and buys it from coffee farmer suppliers in Sigi Regency, especially in the Lindu Biosphere Reserve area. When the raw materials arrive at the company, they are then processed using a coffee roasting machine, no longer boiling coffee using a furnace because this method is quite conventional and can produce smoke and pollution. The use of this machine goes through the roasting stages in its production process, namely pouring raw coffee into the machine's storage container which will automatically enter the inside to be roasted, the raw coffee will be roasted at a hot temperature that has become the company's regulation, then cooling in the bottom container of the machine, resting, to grinding for ground coffee. It takes approximately 1 hour to process raw materials from raw coffee to roasted coffee that is ready to be marketed. After the raw coffee is processed, the roasted coffee is finally ready to be marketed.

Based on the initial observations above, it is not yet clear whether the coffee plantations in the Lindu Biosphere Reserve and Pipikoro Coffee Company have implemented a Green Supply Chain approach to coffee cultivation, raw material selection, production, and distribution. Based on the aforementioned description, the conceptual framework for this study is as follows:



**Figure 1. Framework of Thought**

Based on the explanation above, the purpose of this research is to determine and analyze the green supply chain activities of coffee plants at the Pipikoro Coffee Company.

## **Methods**

This study uses a qualitative approach conducted in the Lindu Biosphere Reserve and Pipikoro Coffee Company. The informant selection technique in this study employed a purposive sampling approach, selecting informants based on specific criteria established by the researcher in accordance with the study's objectives. Furthermore, snowball sampling was used, where several initial informants referred others, increasing the sample size over time (Lenaini, 2021). The determination of informants in this study was based on several criteria, namely local coffee farmers in the Lindu Biosphere Reserve, Lindu Forestry Extension Workers, Company Leaders, Company Production Managers, Company Marketing Managers and Consumers. Data analysis in this study was carried out interactively and continuously until complete, so that the data was full. In qualitative research, data analysis is conducted interactively and continuously during data collection and thereafter until information saturation is reached. Miles et al. (2020) explain that this model consists of three main activity streams: data condensation, data display, and conclusion drawing and verification, which are carried out in parallel and interrelated, namely:

Data processing is an activity carried out to process data into an informative form or convert data using a sequence of operations that have been determined either manually or automatically. In this study, the information obtained or the results of interviews from informants were processed using the NVivo 12 Plus software tool.

Data reduction is the main element in analyzing data, namely the process of selecting, focusing, simplifying and summarizing data from field notes. When data collection takes place, data reduction is carried out by making a summary of the data records obtained in the field (Sutopo, 2020).

Data presentation is a collection of information organization, description in narrative form so that research conclusions can be drawn. This presentation is a collection of sentences that are arranged logically and systematically, so that when read it will be easy to understand (Bungin, 2021).

Conclusions need to be verified to be sufficiently solid and truly accountable. Therefore, repetition activities can be carried out for the purpose of consolidation, quick data retrieval, perhaps as a second thought that crosses the researcher's mind when writing the data presentation by looking back briefly at the field notes (Saldana, 2021).

## **Results and Discussions**

The data obtained from the results of field research, then selected and identified to find words or sentences that contain meaning. The use of NVivo 12 Plus software aims to be a tool to help the coding process that will narrow down into various collections of meanings recorded in Nodes. Based on the text of the interview results in the field which were then processed using NVivo 12 Plus, important words implied in the word cloud of this study were found as follows:



## Figure 2. Word Cloud Interview Results

Figure 2 above shows a set of words that have a strong or dominant influence based on the results of interviews with informants in the field. These words are then used as a reference for discussing the formulation of research problems. Then forming the sub-themes of this research: coffee seeds, planting, care, and harvesting processes, suppliers, checking raw materials, raw material prices, waste utilization, production processes, environmentally friendly machines, special materials, production quality, coffee sales, coffee selling prices, consumers, product delivery, product returns, and subscriptions.

Based on Figure 2, the mind mapping of the research results shows that the scheme consisting of 16 keywords used as references in this research is:

1. Coffee Seedlings, which provide coffee seedlings to Farmers, namely the Sigi Regency Government. Farmers also obtain coffee seedlings from their parents' hereditary garden activities.
2. The Process of Planting, Caring for, and Harvesting Coffee Plants, this process is carried out by local coffee farmers who refer to the concept of sustainability.
3. Suppliers, who are suppliers of raw coffee raw materials at the Pipikoro Coffee company are local coffee farmers in the Lindu Biosphere Reserve area.
4. Checking Raw Materials, this raw material checking activity is carried out by the company before buying coffee harvests from farmers.
5. Price of Raw Materials, raw coffee from Farmers IDR 50,000/Kg - IDR 65,000/Kg, the price fluctuates.
6. Waste Utilization, efforts to make organic fertilizer from coffee skin waste.
7. Production Process, in the production process there are 6 stages carried out, namely peeling coffee skin, drying, sorting, roasting coffee, cooling coffee, and storage.
8. Environmentally Friendly Machine, the use of automatic coffee roasting machines that do not cause excessive smoke.
9. Special Ingredients, Pipikoro Coffee company does not use any special ingredients in the coffee roasting process.
10. Production Quality, the quality of coffee at Pipikoro Coffee company is very good, defective production results are rare.

11. Coffee Sales, sales had decreased due to the Covid-19 pandemic, but now it is running normally and stable.
12. Coffee Sales Price, varies according to type and size. For Arabica, 1 kg packaging costs 210 thousand. 500 gram packaging, 110 thousand. For Robusta, 1 kg costs 160 thousand, 500 grams costs 80 thousand.
13. Consumers, the consumers of Pipikoro Coffee company are intermediary and end consumers or households.
14. Product Delivery, local farmer suppliers deliver their own raw materials to the company, sometimes the company also picks them up directly. For coffee to consumers, the company implements a product delivery system in large quantities.
15. Product Returns, if there are raw material products or production results that are defective from suppliers and Pipikoro Coffee company, they will be returned.
16. Subscribe, consumers subscribe to the Pipikoro Coffee company because the price is ideal with good coffee quality and see the coffee production in an environmentally friendly company.

Upstream supply chain involves all activities related to sourcing and receiving raw materials from suppliers, including transportation, warehousing, and initial quality checks before entering the production process (Heizer et al., 2020). Upstream supply chain is the movement that enters the Pipikoro Coffee company as a coffee producer that the author studied which shows the flow of raw materials from the supplier, starting from ordering raw coffee beans to unloading raw materials to the Pipikoro Coffee company to be stored in the warehouse.

Coffee Seedlings, based on the results of the study, it is shown that local farmers who are suppliers receive the coffee seedlings they plant, namely from the Sigi Regency Government in its first period, namely in 2014-2019. From the provision of coffee seedlings, farmers plant them until they enjoy the results now. There are also local farmers who care for coffee passed down from their parents who have been planting coffee for a long time. Based on the researcher's observations, there are shortcomings in the limited number of coffee seedlings, the advantage is that farmers can get them for free.

Coffee Planting, Care, and Harvesting Process, the research results demonstrate a high level of awareness among farmers regarding regulations governing land management in the Biosphere Reserve area. During land clearing and planting, farmers refrain from felling trees due to prohibitions from extension workers and village heads. This demonstrates that the village government and relevant parties play a crucial role in overseeing and ensuring that community agricultural practices remain within permitted limits, without damaging the forest or the existing ecosystem. This prohibition demonstrates that land management adheres to the principles of sustainability and maintains the integrity of the conservation area, a crucial component of green supply chain management. During the maintenance process, farmers use organic fertilizer derived from processed coffee skins, which the company utilizes as organic fertilizer. During the harvesting process, farmers are not permitted to harvest unripe or under-red coffee beans; they are encouraged to harvest fully ripe, red coffee beans.

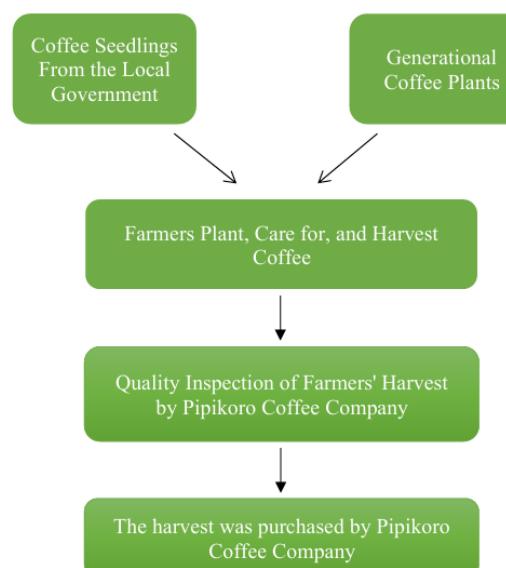
Supplier, based on the results of the study, it is described that local farmers who are suppliers in terms of distributing raw materials to the company, namely there are two models, first; the company that comes directly to pick up the local farmers' area to buy and

take coffee, second; farmers sometimes also deliver it directly to the Pipikoro Coffee company in Palu City.

Checking Raw Materials, based on the results of the study, it is described that there is a strict implementation of quality selection in the coffee post-harvest process. Coffee beans that do not meet quality standards are not sold, but are used for personal consumption. This shows an awareness of the importance of maintaining the reputation of the products sold to the company, as well as an understanding of the applicable quality standards. Farmers also explained that the quality checking process is carried out before the purchase by the company. Only coffee beans that meet the standards, especially those harvested in ripe conditions on the tree, will be accepted. Damaged or unsaleable beans are not taken by the company. However, the occurrence of damaged coffee beans is very rare because farmers have implemented the right harvesting techniques and have been provided with previous education. This practice reflects the principle of quality control in the green supply chain, where only products that meet certain criteria are continued to the next stage in the supply chain. In addition, the attitude of farmers who do not force the sale of low-quality products shows ethical awareness and responsibility towards quality standards and sustainability.

Raw Material Prices, based on the results of the study, it is described that coffee purchases by companies are made directly at the farmer's location, but in some cases, farmers also deliver coffee to companies in Palu. The price received from the company is around IDR 65,000 per kilogram. Farmers also explained that prices range from IDR 50,000 to IDR 60,000 per kilogram, depending on the quality of the coffee, and that companies usually come directly by vehicle to weigh and purchase on site.

From the description of the informant's statement above, the researcher knows and finds the green supply chain activity path (upstream supply chain) at the Pipikoro Coffee company as follows:



**Figure 4. Pipikoro Coffee Company's (Upstream Supply Chain) Activities**

Based on Figure 4, it explains that suppliers play a very significant role in upstream supply chain activities, all raw material flows (coffee beans) start from suppliers. Local

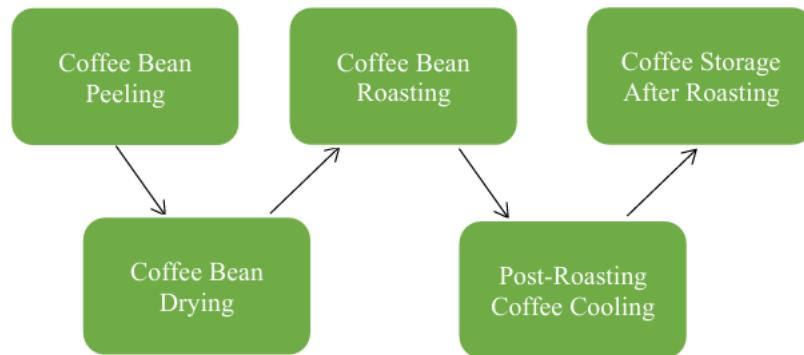
farmers in the Biosphere Reserve area who in this case become suppliers of coffee beans to the Pipikoro Coffee company. Local farmers are suppliers of coffee beans located in the Biosphere Reserve area of Anca Village, Lindu District, Sigi Regency, where the Pipikoro Coffee company picks up the coffee beans they buy. Sometimes local farmers also bring their coffee harvest directly to the company. After the raw materials arrive at the Pipikoro Coffee company, the quantity and quality of the coffee beans will be checked first, then the company's inventory section will check and when it has been checked, the raw materials will be stored in the company's warehouse. This aligns with Rendon et. al (2019) explanation, which states that received coffee beans must undergo a quality inspection, including visual inspection, moisture testing, and defect sorting. Once approved, the inventory department officially receives the beans and stores them in a warehouse with controlled environmental conditions to maintain product quality and stability.

Internal Supply Chain includes the entire series of processes within a company that transform raw materials into finished products through manufacturing, quality inspection, and packaging activities, before the product is distributed to consumers (Heizer et al., 2020). This activity is the processing of input into output goods in which there is a coffee bean production process carried out by manufacturers in this case the Pipikoro Coffee company. The coffee bean production process must have stages of procedures for a good and smooth production process.

Waste Utilization, research shows that the main waste from coffee processing is the coffee husks, which are peeled from the beans. After the husks are separated from the beans, they are dried in the sun for days until they dry. Once dry, these husks become an ingredient in organic fertilizer. However, this waste is not discarded carelessly but is managed and reused by farmers. The husks are returned to farmers to be used as organic fertilizer, which is then reused on the coffee trees. This practice demonstrates a circular economy within the coffee supply chain, where waste is not considered as waste but as a resource with reusable value for agriculture. The use of coffee husks as organic fertilizer not only helps reduce farmers' dependence on chemical fertilizers but also strengthens the sustainability of the agricultural ecosystem. The organic content of coffee husks can improve soil fertility and maintain plant health naturally. This aligns with the principles of green supply chain management, which emphasize waste reduction and the reuse of local resources. This aligns with Hadi et al. (2024) explanation that using coffee husks as organic fertilizer has a dual positive impact: reducing dependence on chemical fertilizers and strengthening agricultural sustainability by improving soil fertility and ecological structure. Coffee husks are rich in nitrogen, potassium, and magnesium, and their high organic content improves soil texture, retains moisture, and stabilizes pH—marked by the effective growth of coffee seedlings and other plants.

Production Process, based on the research results, it is described that in detail the stages of post-harvest coffee processing, starting from the process of peeling the coffee skin using a pulper machine. This process is the initial step in changing fresh coffee beans into green beans, namely coffee beans that have been cleaned of the outer skin and are ready for the next process. After being peeled, the coffee beans are dried in the sun to reduce the water content until they reach a standard level of dryness. After the drying process, the coffee beans enter the roasting stage using a special machine. The informant stated that the roasting temperature is adjusted to the type of coffee: for robusta it is done up to a temperature of 215 ° C, while for arabica it is sufficient at a temperature of 175 ° C. This temperature difference reflects the characteristics and special treatment required for each type of coffee to produce optimal flavor. After the roasting process is complete, the coffee beans are transferred to a cooling container (cooler) for approximately 30 minutes. This

cooling is important to stop the roasting process and maintain the final quality of the coffee beans. The final stage is storing the roasted coffee beans in a special box that maintains the freshness and quality of the product before distribution.



**Figure 5. Activities (Internal Supply Chain) of Pipikoro Coffee Company**

Environmentally friendly machine, based on the results of the study, it is illustrated that the use of modern coffee roasting machines is part of a commitment to more environmentally friendly production practices. This machine is used as an alternative to the manual roasting method which generally uses a wood-fired stove and produces large amounts of smoke. Although the roasting machine still produces smoke, the amount is much less than the traditional method, so it has a smaller impact on the surrounding environment. The use of this technology reflects an effort to reduce emissions and air pollution caused by the production process, as well as improve energy efficiency in coffee processing activities. This is a concrete step in integrating the principle of sustainability into the coffee supply chain, especially at the processing stage. In addition, this practice also shows that business actors have realized the importance of clean technology as a solution to maintain environmental quality and support the green supply chain management program. This aligns with Leister (2025) explanation that, as a concrete step toward integrating sustainability into the coffee supply chain, modern electric roasting machines, or eco-roasters, are used as an alternative to traditional wood- or gas-fired methods. While they still produce smoke, the volume is significantly lower—with an 80–90% reduction in emissions and higher energy efficiency. This reflects the implementation of clean technology and supports the principles of green supply chain management in reducing emissions and energy use.

Special Ingredients, based on the results of the study, it is shown that the coffee roasting process is completely free from the use of additional chemicals. This process is purely a dry roasting process that only relies on heat without a mixture of oil or other ingredients. This shows that the processing method used not only maintains the natural taste of coffee, but is also in line with the principle of clean production, namely minimizing the use of hazardous chemicals and reducing the potential for residues that have a negative impact on the environment and consumer health.

Production Quality, based on the results of the study, it is illustrated that so far no significant problems have been found related to the quality of coffee production, because since the beginning strict quality standards have been applied, where farmers are encouraged to only submit the best quality coffee. Education and assistance provided to

farmers regarding the correct harvesting process also contribute to the high quality of raw materials received. This condition indicates the existence of an effective quality control system at the initial level of the supply chain. This aligns with Prathita et al. (2023) explanation that farmer education and mentoring on proper harvesting and sorting techniques significantly impact the quality of the coffee raw materials received. This demonstrates that the quality control system at the initial level of the supply chain is effective, based on training and integrated quality standards.

Downstream supply chain is defined as all process activities related to the flow of finished products from manufacturers to end consumers, encompassing distribution, warehousing, and after-sales services (Heizer et al., 2020). In general, the activity of moving coffee products that leave the Pipikoro Coffee company to customers, which play an important role are the distribution, retail outlets, and customers. Coffee Sales, based on the results of the study, it is shown that demand for coffee products is generally stable throughout the year. However, there is a seasonal decrease in demand, especially during the month of Ramadan. This is due to changes in people's consumption patterns during the fasting month, where coffee drinking activities during the day tend to decrease. This phenomenon indicates the existence of external factors such as religious times that can affect fluctuations in product demand, although in general consumption trends remain consistent. For coffee business actors, this condition is a consideration in planning production and distribution so that it remains efficient and does not cause excess stock during periods of low demand.

**Selling Price of Coffee**, based on the results of the study, it is shown that the price of coffee products offered is highly dependent on the type and size of the packaging. Arabica coffee, which is generally known to have a more complex and high-quality taste, is sold at a higher price than Robusta. For Arabica, a 1-kilogram package is priced at IDR 210,000, while a 500-gram package is sold for IDR 110,000. Meanwhile, for Robusta coffee, a 1-kilogram package is sold for IDR 160,000, and a 500-gram package for IDR 80,000. This price difference reflects the existence of product segmentation based on quality, taste characteristics, and consumer purchasing power. In addition, the provision of various packaging sizes shows a marketing strategy that is adaptive to market needs, both for individual consumers who want to buy in small quantities and business actors who need large stocks. This price information also shows transparency and a clear price structure, which supports consumer confidence in local products.

Customers, based on the research results, it is described that coffee product consumers come from various segments. Most of them are coffee shop owners who buy coffee in the form of roasted beans to be processed and served as drinks at their outlets. Several outlets mentioned routinely become regular customers, such as Kedai Excited, Gerai KPH, Summer, and Tanah Kaili. In addition, there are also individual consumers who come directly to the production location to enjoy coffee on the spot or buy packaged ground coffee, to be consumed at home. This condition shows that the distribution model applied is direct and flexible, serving both business segments (B2B) and end consumers (B2C). The existence of regular customers from coffee shops indicates a sustainable business relationship, while direct sales to consumers reflect the openness of market access to the general public.

**Product Delivery**, based on the results of the study, it is illustrated that one form of service provided by coffee producers is direct product delivery to consumers, especially coffee shop owners (warkop). This type of consumer generally makes purchases in large quantities, because their needs are aimed at maintaining the availability of coffee drink stocks that will be resold in their coffee shop businesses. This statement shows an active distribution pattern from local coffee business actors in meeting the demands of medium-

scale consumers such as warkop owners. In addition, delivery activities also reflect a responsive service approach and support the smooth operation of business partners. This relationship strengthens the role of local producers in the coffee supply chain, and shows that coffee products are not only consumed individually, but also become an important part of economic activities and service provision at the local level.

Product Returns, based on the research results, it illustrates that there is a commitment to quality and consumer satisfaction in the coffee distribution process. If damaged or substandard coffee is found, the company is ready to provide a refund to consumers. However, the company emphasized that such cases are very rare because the coffee received from farmers and then processed by them generally has good quality. This illustrates that the coffee selection and processing process is carried out carefully and controlled from the start. Accuracy in selecting coffee beans from farmers, as well as the implementation of a processing process that meets standards, are the main factors that ensure product quality is maintained until it reaches consumers.

Subscribe, based on the results of the study, it is shown that the reason consumers subscribe to this company is because they observe that the coffee production process that is carried out has implemented environmentally friendly principles. This can be seen from the use of a coffee roasting machine, which replaces the traditional method with a stove and burning wood. Based on his own experience when he tried to roast coffee manually, he realized that this method produced a lot of smoke, which had a negative impact on the environment. This statement shows an awareness of the importance of using cleaner technology in the coffee production process. By switching to a roasting machine, in addition to increasing process efficiency, it also reduces smoke emissions that can pollute the air. This reflects the commitment of business actors to supporting more sustainable and environmentally friendly coffee production practices.

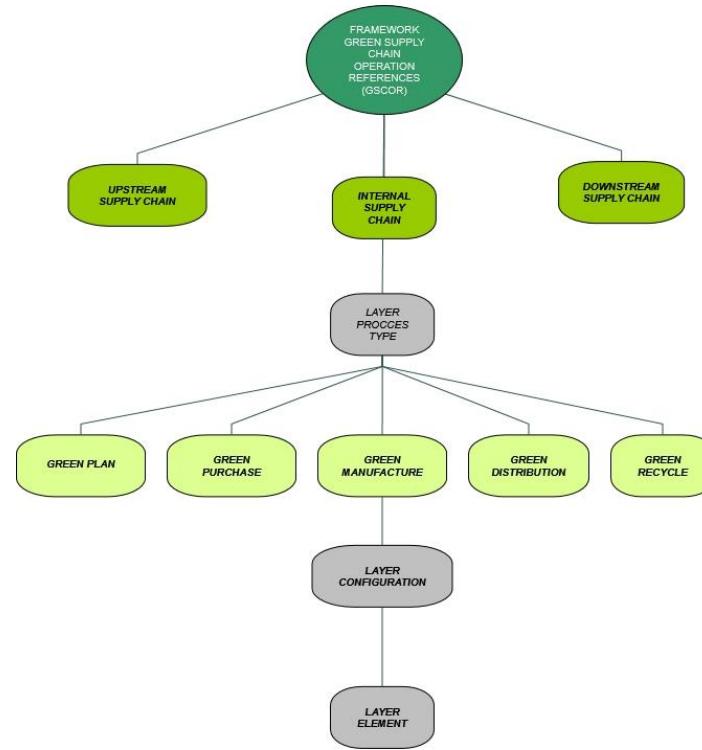


**Figure 6. Activities (Downstream 1) of Pipikoro Coffee Company**

Based on Figure 8 which explains the downstream supply chain activities on the first path from the Pipikoro Coffee company as a coffee producer who then sells or distributes it to Intermediary Consumers who have coffee shops, then Intermediary Consumers who process it into drinks in their shops until it can be purchased and enjoyed by End Consumers. In this first path downstream supply chain activity, there are three parties involved, namely the Pipikoro Coffee company, Intermediary Consumers and End Consumers. The downstream supply chain activities on the second path of the Pipikoro Coffee company, this path occurs because the end consumer has ordered and purchased the company's coffee directly from Pipikoro Coffee as a coffee producer. In this second path downstream supply chain activity, there are two parties involved, namely the Pipikoro Coffee company and the end consumer.

Qianhan et al (2010), divides the Green SCOR Model into three layers. The first layer, process type, is the topmost layer in the Green SCOR Model, which explains the general scope and strategic objectives of the entire environmentally friendly supply chain system. This layer is used to analyze the behavior of supply chain actors such as farmers (suppliers), processing companies, and consumers. The second layer, configuration, shows how

companies select and organize specific processes from the Green SCOR Model to suit their operational strategies. The third layer, element, is the most detailed technical layer, describing each process selected in the second layer in more detail.



**Figure 11. Green Supply Chain Operations References (GSCOR) Framework Mapping**

The top layer in the Green SCOR Model, which explains the general scope and strategic objectives of the entire green supply chain system. This layer is used to analyze the behavior of supply chain actors such as farmers (suppliers), processing companies, and consumers. Green Plan, researchers found upstream supply chain activities, especially green plans, in farmers who never cut, burn, and damage other plants when planting coffee, implementing organic plantations is also an appeal from the forestry extension workers on duty. Farmers also receive education on the use of coffee skin waste as fertilizer. Farmers also receive education on environmentally friendly planting, maintenance and harvesting techniques from the company.

Green Purchase, researchers found upstream supply chain activities, especially green purchases, at the Pipikoro Coffee company, which refers to purchasing decisions to consider the environmental and health impacts of the selected product or service. The company educates farmers about environmentally friendly planting, maintenance and harvesting techniques. This ripe harvest is when farmers harvest coffee beans that are truly ripe on the tree as an effort to maintain coffee plants and produce the best quality coffee harvest. Green Manufacture, researchers found internal supply chain activities, especially green manufacture, at the Pipikoro Coffee company, which in the coffee bean processing stage uses an environmentally friendly coffee roasting machine, which no longer emits excessive heat and smoke like manual coffee roasting.

Green Distribution, researchers found downstream supply chain activities, especially

green distribution, at the Pipikoro Coffee company at the stage of sending coffee production results, the company uses a packaging called Krafts Paper Bag for packaging roasted coffee beans. This packaging is environmentally friendly and easily biodegradable, also used to maintain the humidity of coffee beans, and has been equipped with a Zip Lock which functions to close the packaging tightly after being opened.

Green Recycle, researchers found green recycling activities at the Pipikoro Coffee company which implemented the utilization of peeled coffee bean skin waste into organic fertilizer that can be used for coffee plants themselves or other plants, this coffee skin is processed until it functions as a mixture for planting media in Polybags. Layer Configuration, Pipikoro Coffee Company in the configuration layer actively adopts and focuses on implementing all stages of the process type layer in the Green SCOR Model, which include: Green Plan, Green Purchase, Green Manufacture, Green Distribution, and Green Recycle. This choice shows the company's commitment to the integration of sustainability principles as a whole in its operational system. Layer Element, Pipikoro Coffee Company at the element level, technically and measurably pays close attention to input-output and sustainability.

**Table 1. Layer Element Green SCOR Pipikoro Coffee Company**

Type procces	Input	Output	Indicator
Green Plan	Coffee seeds	Coffee plants are planted, cared for and harvested without farmers burning, cutting or damaging other plants.	Sustainable Biosphere Reserve Land.
Green Purchase	Coffee beans from farmers that are harvested ripe. Quality.	High quality raw materials that meet company standards.	Low level of coffee bean defects and production yields.
Green Manufacture	Raw coffee beans (green beans).	Roasting high quality coffee and using environmentally friendly roasting machines.	Low smoke emissions and energy efficiency.
Green Distribution	Coffee bean/powder production results.	Environmentally friendly packaging.	The packaging can and does decompose easily.
Green Recycle	Coffee skin waste.	Organic fertilizer that can be used for coffee plants or other plants.	Functions as a mixture for planting media in polybags.

## Conclusion

Based on the results of the research and discussion on the analysis of the green supply chain at the Pipikoro Coffee company, the researcher concluded that in the upstream supply chain stage, the supplier of coffee raw materials to the Pipikoro Coffee company is a local coffee farmer in Sigi Regency, especially in the Biosphere Reserve area in Lindu District. The

researcher concluded that upstream supply chain green supply chain activities at the coffee farmer level have begun to show awareness of sustainability, such as the use of coffee skin waste as organic fertilizer, avoiding the use of chemicals, and prohibiting cutting down trees in the Biosphere Reserve area. However, this practice is still driven by the direction of the extension worker and has not yet fully become an independent initiative. In the internal supply chain stage, there are five important stages in the production process of raw coffee to coffee beans and powder at the Pipikoro Coffee company, namely peeling the skin, drying raw coffee, roasting coffee, cooling coffee, and storing coffee. Researchers concluded that internal supply chain activities at the Pipikoro Coffee company industry level have implemented green supply chain practices in a more structured manner, including the use of more environmentally friendly roasting machines, sorting coffee beans based on quality, using kraft paper packaging, and implementing a storage system that pays attention to material efficiency (FIFO). The company also plays an active role in providing education and training to coffee farmers so that the quality of raw materials is maintained. In the downstream stage, there are two downstream paths at the Pipikoro Coffee company, First, the Pipikoro Coffee company - intermediary consumers - end consumers. Second, the Pipikoro Coffee company - end consumers. This study has several limitations that should be considered when interpreting its results and developing further research. First, the study focused on only one company, Pipikoro Coffee in Palu City, so the findings cannot be generalized to the entire coffee industry in Central Sulawesi or other regions. Second, data collection was conducted over a specific time period and did not capture seasonality or fluctuations in the coffee market, which could significantly impact supply chain activities.

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