

Analysis of Operational Planning and Supply Chain of Used Cooking Oil to Support the Export of Biofuel Raw Materials: A Case Study of PT Biofuel Unggul Lestari

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Abstrak

Pemanfaatan Used Cooking Oil (UCO) sebagai bahan baku biofuel memiliki peluang untuk dikembangkan sebagai bagian dari rantai pasok energi terbarukan. Namun, pengembangan bisnis UCO menghadapi tantangan berupa ketersediaan pasokan, konsistensi kualitas, efisiensi operasional, pengendalian persediaan, serta kebutuhan ketertelusuran produk. Penelitian ini bertujuan menganalisis perencanaan operasional dan rantai pasok PT Biofuel Unggul Lestari (PT BUL) dalam mendukung kegiatan ekspor UCO sebagai bahan baku biofuel. Penelitian menggunakan pendekatan deskriptif dengan metode studi kasus berdasarkan rancangan business plan PT BUL. Analisis dilakukan terhadap desain operasi, strategi cost focus, manajemen rantai pasok, pengendalian persediaan, manajemen kualitas, pemanfaatan teknologi digital, serta proyeksi biaya operasional dan investasi. Hasil analisis menunjukkan bahwa PT BUL merancang rantai pasok yang terdiri atas mitra pengumpul, pengambilan UCO, pemrosesan dan penyimpanan, ekspor, serta buyer internasional. Strategi cost focus diterapkan melalui kemitraan dengan pengepul, efisiensi fasilitas, pengendalian logistik, pembayaran transparan, serta pemanfaatan teknologi digital. Standar kualitas yang ditetapkan meliputi FFA $\leq 3\%$, moisture $\leq 0,5\%$, dan impurities $\leq 0,1\%$, sedangkan target kesiapan pasokan ditetapkan minimal 70% dari kebutuhan buyer. Sistem persediaan menggunakan FIFO dan JIT secara selektif dengan waktu penyimpanan maksimal 7 hari untuk UCO mentah, 14 hari untuk UCO pra-olah, dan 30 hari untuk UCO siap kirim. Proyeksi menunjukkan volume UCO meningkat dari 800 ton pada tahun pertama menjadi 1.800 ton pada tahun kelima, sedangkan biaya operasional meningkat dari Rp9,96 miliar menjadi Rp22,18 miliar. Kebutuhan investasi awal sebesar Rp3,04 miliar. Hasil tersebut menunjukkan bahwa integrasi pengadaan, kualitas, persediaan, logistik, dan digitalisasi menjadi faktor penting dalam mendukung kesiapan operasional PT BUL untuk pasar ekspor.

Kata Kunci: Used Cooking Oil, Perencanaan Operasional, Rantai Pasok, Cost Focus, Biofuel, Traceability.

Abstract

Utilizing Used Cooking Oil (UCO) as a biofuel feedstock offers significant potential for development within the renewable energy supply chain. However, the UCO business faces challenges regarding supply availability, quality consistency, operational efficiency, inventory control, and the need for product traceability. This study aims to analyze the operational planning and supply chain of PT Biofuel Unggul Lestari (PT BUL) in supporting UCO exports for biofuel production. A descriptive approach using a case study method based on PT BUL's business plan was employed. The analysis covered operational design, cost-focus strategy, supply chain management, inventory control, quality management, digital technology utilization, and projections for operational costs and investment. The analysis revealed that PT BUL designed a supply chain comprising collection partners, UCO pickup, processing and storage, export operations, and international buyers. A cost-focus strategy is implemented through partnerships with collectors, facility efficiency, logistics control, transparent payment systems, and the use of digital technology. Established quality standards include FFA $\leq 3\%$, moisture $\leq 0.5\%$, and impurities $\leq 0.1\%$, while the supply readiness target is set at a minimum of 70% of buyer requirements. The inventory system selectively utilizes FIFO and JIT methods, with maximum storage periods of 7 days for raw UCO, 14 days for pre-processed UCO, and 30 days for ready-to-ship UCO. Projections indicate that UCO volume will rise from 800 tons in the first year to 1,800 tons in the fifth year, while operational costs will increase from IDR 9.96 billion to IDR 22.18 billion. The initial investment requirement is IDR 3.04 billion. These results demonstrate that the integration of procurement, quality, inventory, logistics, and digitalization is crucial for supporting PT BUL's operational readiness for the export market.

Keywords: *Used Cooking Oil, Operational Planning, Supply Chain, Cost Focus, Biofuel, Traceability.*

BACKGROUND

The development of renewable energy needs has encouraged the emergence of various alternative raw materials that can be used in the biofuel industry. One of the raw materials that has the potential to be used is Used Cooking Oil (UCO) or used cooking oil. UCO is oil waste that comes from cooking activities and can be recollected to be used as raw materials in the renewable energy industry.

The utilization of UCO not only has economic potential, but is also related to waste management and the application of sustainability principles. However, UCO business development requires an operational system that is able to effectively connect raw material sources with end users. Problems that can arise include scattered supply sources, variations in UCO quality, collection and transportation costs, inventory management, and documentation and traceability needs. Moreover, improving business performance also depends heavily on the extent to which supply chain management, environmental innovation, and competitive advantage can be properly integrated (Angelia, Puspitasari, Syah, & Alhabsyi, 2021). In the context of UCO business for export markets, quality and traceability are important aspects. PT

Biofuel Unggul Lestari (PT BUL) is designed as a company that procures and collects UCO from a network of collectors, followed by quality control, storage, and trade for export purposes as raw materials for the biofuel industry. The business model used is Business to Business (B2B), with local collectors as the main distribution partners.

PT BUL is planned to be located in North Bekasi because it considers its proximity to the collector's network and UCO sources in Jakarta, Tangerang, and Cikarang. Transportation accessibility is also one of the considerations in choosing the location. In its business planning, PT BUL uses a cost focus strategy. This strategy is translated into operations through cooperation with collectors, the use of simple and semi-manual facilities, logistics efficiency, and the use of digital technology.

The main problem that is of concern in PT BUL's operational planning is how to build a supply chain system that is able to maintain the availability of UCOs, meet quality standards, control costs, and support product traceability to export processes. Based on these problems, this study aims to analyze PT BUL's operational and supply chain planning, including operation design, raw material procurement, inventory management, quality control, digitalization, operational cost projections, and investment needs.

The development of renewable energy needs has encouraged the emergence of various alternative raw materials that can be used in the biofuel industry. One of the raw materials with potential is used cooking oil (UCO), an oil waste from cooking activities that can be recollected and used as raw material in the renewable energy industry. The utilization of UCO not only has economic potential but is also related to waste management and the application of sustainability principles. However, UCO business development requires an operational system that is able to effectively connect raw material sources with end users. Problems that can arise include scattered supply sources, variations in UCO quality, collection and transportation costs, inventory management, and documentation and traceability needs. In Bogotá, for example, household and hotel, restaurant, and catering (HORECA) segments were identified as major UCO generators, and the physicochemical properties of collected UCO varied widely even among samples from the same type of source, indicating the need for pretreatment before reuse (Rincón, Cadavid, & Orjuela, 2019). Collection is also a cost-sensitive stage, as it depends on site characteristics, visit frequency, and routing, which makes the optimization of collection routes important for controlling costs and emissions (Rodríguez, Orjuela, & Cadavid, 2022). Moreover, improving business performance depends heavily on the extent to which supply chain management, environmental innovation, and competitive advantage can be properly integrated (Angelia, Puspitasari, Syah, & Alhabsyi, 2021). In the context of UCO business for export markets, quality and traceability are important aspects, since final users are increasingly aware of the sustainability and traceability of waste feedstocks within supply chains (Casas, Orjuela, & Poganietz, 2024). PT Biofuel Unggul Lestari (PT BUL) is designed as a company that procures and collects UCO from a network of collectors, followed by quality control, storage, and trade for export as raw material for the biofuel industry. The business model used is Business to Business (B2B), with local collectors as the main distribution partners. PT BUL is planned to be located in North Bekasi because of its proximity to the collector network and UCO sources in Jakarta, Tangerang, and Cikarang, as well as its transportation accessibility. In its business planning, PT BUL uses a cost focus

strategy, translated into operations through cooperation with collectors, the use of simple and semi-manual facilities, logistics efficiency, and the use of digital technology. The main problem in PT BUL's operational planning is how to build a supply chain system that is able to maintain UCO availability, meet quality standards, control costs, and support product traceability through to the export process. Accordingly, this study aims to analyze PT BUL's operational and supply chain planning, including operation design, raw material procurement, inventory management, quality control, digitalization, operational cost projections, and investment needs. The results are expected to provide an overview of the readiness of PT BUL's operational design and become the basis for developing an efficient and integrated UCO business operational system

The results of the research are expected to provide an overview of the readiness of PT BUL's operational design and become the basis for the development of an efficient and integrated UCO business operational system.

LEGACY BOXING

Used Cooking Oil

Used cooking oil is cooking oil that is heated or used repeatedly and undergoes changes either physically or chemically, namely by changing color from clear to dark and rancid, as well as chemically undergoing changes in hydraulic reactions, thermal oxidation and thermal polymerization (Simatupang, 2019).

Supply Chain

The concept of supply chain management is a method used to integrate suppliers, distributors, warehouses, and stores effectively and efficiently so that stock goods can be produced, distributed in the right quantity, four, and time until the total cost can be reduced to benefit consumers (David, 2018). The integration of green supply chain management has been recognized as one of the keys in increasing the value and performance of environmentally friendly companies (Subhan, Siregar, Hamdi, & Syah, 2021).

Biofuel

Biofuel or biofuel is the final product of the transformation of plant materials produced from organic materials such as plants and animals (Ministry of Energy and Mineral Resources, 2019).

METHODS

This study uses a descriptive approach with a case study method on the business planning of PT Biofuel Unggul Lestari The object of the research is the operational design of PT BUL in carrying out the collection, management, storage, and export activities of UCO as a raw material for biofuels.

The data analyzed comes from PT BUL's business plan, especially the operational planning section which includes:

1. Operation Design;
2. supply chain;
3. Procurement Strategy;
4. Inventory Control;

5. Quality Control;
6. Process Technology;
7. Operational Cost Projections;
8. Capex projection.

The analysis is carried out through several stages as follows:

1. Analyze UCO's operating design and distribution flow from suppliers to international buyers.
2. Analyze the application of cost focus strategies to procurement, facilities, logistics, and technology.
3. Analyze inventory systems based on FIFO and JIT methods and storage time policies.
4. Analyze the quality control system based on the parameters of FFA, moisture, and impurities.
5. Analyze the use of digital technology designed to support transactions, supply monitoring, supplier coordination, and SCM integration.
6. Analyzed operational cost projections over five years by looking at the relationship between increased UCO volume and increased costs.
7. Analyze initial investment needs based on CAPEX projections.

RESULTS AND DISCUSSION

Operational Design Analysis

The results of the analysis show that PT BUL's operational design has been prepared in an integrated manner from the raw material procurement stage to export. The operational flow consists of UCO Collection, Initial Storage & Transportation, Pre-Purification, Quality Testing, Packaging and Export Preparation and finally the Export Process



Figure 1. Operational Design of PT BUL

The design supports a cost focus strategy because PT BUL uses simple and semi-manual facilities to avoid over-investment in automated machines. This approach also allows the facility to be easier to maintain and use energy more efficiently. Thus, the operation design can be assessed as aligned with the business strategy, as the focus on efficiency is applied to the use of facilities, human resources, and processing processes.

Supply Chain Analysis

In its business, PT BUL has a relatively simple supply chain, namely:

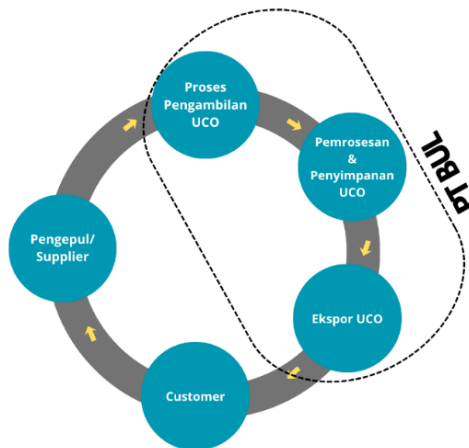


Figure 2. PT BUL Supply Chain

The purpose of PT BUL's supply chain management is to optimize the production, distribution and distribution process of used cooking oil to consumers. Some of the parties involved in supply chain management are described in the following table:

Table 1. Supply Chain Order

Yes	Supply Chain Sequence	Parties
1.	Supplier	UCO Collection Partners / Sources
2.	UCO Recruitment	PT BUL
3.	UCO Processing and Storage	PT BUL
4.	UCO Exports	PT BUL
5.	Customers	International Buyers who accept UCO

This structure has the advantage of easier process control because PT BUL is the center of coordination from collection to export activities. In terms of cost focus strategy, direct cooperation with collectors is one of the important factors. Long-term relationships with suppliers can support supply stability while facilitating quality control. The business plan sets a supply readiness target of at least 70% of buyer needs as well as the development of a network of collectors in West Java and DKI Jakarta. Thus, the success of PT BUL's supply chain is highly dependent on the company's ability to maintain active suppliers and maintain consistent supply quality.

Cost Focus Strategy Analysis

The implementation of the cost focus strategy at PT BUL can be seen in four main aspects, namely:

- Procurement: PT BUL builds partnerships with collectors to acquire directly and sustainably
- Facilities: PT BUL uses simple and semi-manual facilities so that investment needs and maintenance costs can be controlled.
- Logistics: Routine pick-ups are designed using a schedule agreed with the supplier and are supported by the availability of a pick-up fleet.
- Digitalization: Technology is used to speed up transactions and coordination while increasing transparency.

With this approach, the cost focus at PT BUL is not only applied to one activity, but becomes a principle that connects procurement, operations, logistics, and administration.

Inventory Control Analysis

PT BUL applies FIFO and JIT selectively. The storage policy is determined based on the following UCO conditions:

Table 2. Inventory Management				
Yes	Categories	Maximum Storage Time	Handling Procedure	
1.	Crude used cooking oil	7 days	Stored using a sealed jerry can in the refrigeration chamber	
2.	Pre-processed oil	14 days	Put into the sedimentation tank	
3.	Oil ready to ship	30 days	Stored in stainless steel tanks	

This policy suggests that inventory management considers not only the amount of stock, but also the condition and quality of the UCO. The use of relatively short storage times on raw UCO can also help reduce the risk of deterioration before entering the next stage of processing.

Quality Control Analysis

In the UCO collected, PT BUL sets the following quality standards:

Table 3. UCO Quality Standards		
Yes	Parameters	Maximum Standard
1.	FFA	$\leq 3\%$
2.	Moisture	$\leq 0.5\%$
3.	Impurities	$\leq 0.1\%$

These standards are part of the company's short-term goals. The QC process begins from the moment the UCO is received through sensory and physical examinations, then

continues with FFA, moisture, and MIU testing. Only UCOs that meet the standards are stored and prepared for export.

From an operational perspective, this system shows that quality is not placed just as a final inspection, but as part of the process of receiving raw materials. This is important because the quality of the incoming UCO will affect the subsequent process and conformity with the buyer's specifications.

Operational Digitalization Analysis

There are three main technologies in PT BUL's plan as follows:



Figure 3. PT BUL Technology

1. Automated Digital Payment Systems leveraging Fintech & IoT
The use of fintech-based payment systems can enable payment processes to collectors quickly, safely and transparently. This system can support digital transaction recording, speed up the payment process and reduce the risk of misadministration of using cash money.
2. Digital SCM Integration System for Volume Stabilization and Logistics Efficiency
Digital SCM systems can be used to integrate the procurement process, collection, quality control, preparation management, and delivery of UCOs. This system is used for real-time UCO supply monitoring, more accurate formulation of volume needs and increased operational efficiency.
3. WhatsApp Business for Collectors
This system is used as a means of communication and coordination between PT BUL and UCO collectors. Through this system, collectors can convey information on the availability of UCO volumes, submit pick-up requests and receive updated UCO selling price information. The use of this system helps accelerate the flow of information between PT BUL and Collectors.

Operational Cost Projection Analysis

The following is the projected cost for 5 years of PT BUL:

Table 4. Operational Projections

No	BIAYA OPERASIONAL	Tahun ke 1	Tahun ke 2	Tahun ke 3	Tahun ke 4	Tahun ke 5
	Qty	800	1,000	1,200	1,600	1,800
	Raw Material Price per ton	9,552,000	9,838,560	10,133,717	10,437,728	10,750,860
1	Total Raw Material	7,641,600,000	9,838,560,000	12,160,460,160	16,700,365,286	19,351,548,276
2	Loss 2%	152,832,000	196,771,200	243,209,203	334,007,306	387,030,966
3	Rental Warehouse	250,000,000	257,500,000	265,225,000	273,181,750	281,377,203
4	ISCC Surveillance	40,000,000	41,200,000	42,436,000	43,709,080	45,020,352
5	Electricity	200,000,000	206,000,000	212,180,000	218,545,400	225,101,762
6	Flexy bag	216,000,000	222,480,000	229,154,400	236,029,032	243,109,903
7	Trucking and Loading	264,000,000	271,920,000	280,077,600	288,479,928	297,134,326
8	Gasoline	8,000,000	8,240,000	8,487,200	8,741,816	9,004,070
9	Export Quota	360,000,000	370,800,000	381,924,000	393,381,720	405,183,172
10	Levy	830,736,000	855,658,080	881,327,822	907,767,657	935,000,687
	TOTAL	9,963,168,000	12,269,129,280	14,704,481,386	19,404,208,975	22,179,510,716

The analysis of the cost per ton shows that although the total cost increased, the operating cost per ton was relatively stable in the range of Rp12.1-12.5 million per ton. This is a stronger finding for a journal article than simply stating that costs are increasing. In the fourth year, the cost per ton reached around Rp12.13 million, which is the lowest value in the five-year projection. However, in the fifth year, it increased to around Rp12.32 million per ton. This condition shows that the increase in volume has not consistently resulted in a decrease in cost per unit.

Thus, there is an opportunity for PT BUL to further evaluate the cost components that do not directly follow the volume, especially logistics, levies, export quotas, and facility costs.

CAPEX Analysis

From the table below the total initial investment needs of PT BUL is IDR 3,036,205,593 with the following details:

Table 5. CAPEX Fees

No	Description	Amount (IDR)	Qty	Total (IDR)
1	Company Establishment	50,000,000	1	50,000,000
2	Operational Car	265,000,000	1	265,000,000
3	ISO Tank (24kl)	350,000,000	4	1,400,000,000
4	Screener	10,000,000	2	20,000,000
5	IBC Tank	1,300,000	52	67,600,000
6	IBC Scales	10,200,000	1	10,200,000
7	Office equipment	65,634,245	1	65,634,245
8	Lab equipment	100,000,000	1	100,000,000
9	jerrycan (18 litres)	25,000	500	12,500,000
10	Pump	2,300,000	6	13,800,000
11	Risk Management	81,471,348	1	81,471,348
12	sistem pembayaran fintech	550,000,000	1	550,000,000
13	integrasi SCM digital	400,000,000	1	400,000,000
Total				3,036,205,593

The analysis shows that ISO tanks are the largest investment. On the other hand, digital investment is also relatively significant, namely IDR 950 million for fintech and SCM integration. This shows that PT BUL's design is not only oriented towards building physical capacity, but also building digital infrastructure as part of the operational system. Interestingly, the business plan stipulates that CAPEX is entirely realized in the first year and there are no additional assets in the second to fifth years because the available capacity is considered sufficient for operational targets.

CONCLUSION

The results of the analysis show that PT Biofuel Unggul Lestari's operational planning has been aligned with the cost focus strategy through strengthening supplier partnerships, quality control, logistics efficiency, inventory management, and supply chain digitalization. UCO quality standards are set at FFA $\leq 3\%$, moisture $\leq 0.5\%$, and impurities $\leq 0.1\%$, with a supply readiness target of at least 70% of buyer needs. The volume projection increases from 800 tons to 1,800 tons in five years, with operating costs per ton relatively stable in the range of Rp12.1 - 12.5 million and initial CAPEX needs of Rp3.04 billion. Overall, the design can be the basis for PT BUL's operational development to support the export of UCO as a biofuel raw material.

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