Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

Mapping Priority of Policy Program in Value Chain Operation for Sustainability Indonesia Palm Oil Industry

Heri Fathurahman[1], Veera Pandiyan Kaliani Sundram[2], Bernardus Yuliarto Nugroho[3], Ariff Azly Muhamed[4]

Abstract

One of the problems faced by Indonesia as the main exporter of palm oil today is that most of Indonesia's palm oil exports are still in the form of raw materials with low selling value. In facing these various challenges, various policy supports are needed, including (1) increasing the productivity of people's oil palm plantations through a replanting program, (2) providing certified oil palm seeds, (3) increasing financial access for people's farmers through a people's land certification program, (4) increasing added value through downstream, (5) price stabilization through increasing domestic and regional markets, (6) investment and trade diplomacy and cooperation, (7) improving infrastructure and trade facilitation, (8) data and information, and (9) strengthening farmer and business actor organizations. This dynamic situation also causes system variations over time. Therefore, a study is needed regarding Mapping Priority of Policy Program in Value Chain Operation for Sustainability of the Indonesian Palm Oil Industry. The research method used is a quantitative method with data collection by distributing web-based questionnaires to experts in the palm oil industry in Indonesia with samples that are adjusted and match the Fuzzy VIKOR technique and Fuzzy TOPSIS technique. A web-based questionnaire was developed for data collection, which was then distributed to thirty experts. From the comparison results between Fuzzy VIKOR and Fuzzy TOPSIS, there are almost similarities in determining the priority of policy program in upstream operations value chain, midstream operations value chain and downstream operations value chain as follows. As for in upstream operations value chain namely the first rank of Fuzzy VIKOR and Fuzzy TOPSIS is the same, namely the priority of policy program is Environment. As for in midstream operations value chain namely the first rank of Fuzzy VIKOR is Governance whereas the first rank Fuzzy TOPSIS is Environment. As for in downstream operations value chain namely the first rank of Fuzzy VIKOR is Economics and the first rank of Fuzzy TOPSIS is Social.

Keywords: *Palm Oil Industry, Sustainability, Policy Program, Upstream Operations, Midstream Operations, Downstream Operations, Fuzzy VIKOR, Fuzzy TOPSIS.*

Introduction

Palm oil is a mainstay commodity with one of the largest foreign exchange contributors to Indonesia. The Indonesian palm oil plantation industry is classified into three types, namely private, community plantations, and government. Citing data from the National Superior Plantation Statistics in 2022, the largest palm oil landowners are still controlled by the private sector with an area of 8.4 million hectares (ha). The next position is community plantations (6.3 million ha) and the government (597.7 thousand ha) is in last place. However, the level of palm oil productivity in Indonesia is still quite low due to several factors such as land legality, seed quality, and the availability of fertilizers, which are some of the reasons for the low productivity of palm oil in the country (https://www.cnbcindonesia.com/research/).

Palm oil is one of the agricultural commodities that contributes greatly to the country's foreign exchange earnings, amounting to USD 25.61 billion with an export volume of 38.23 million tons in 2023, when compared to 2022 the trade volume balance increased by 4.68%, while the palm oil trade value balance decreased by 18.67%, the surplus value of the palm oil trade balance in 2023 reached USD 25.61 billion. Based on average production data per province in 2019-2023, there are nine palm oil center provinces with a cumulative contribution of 87.82% to Indonesia's total palm oil production. Indonesia's palm oil production in 2023 in the form of palm oil (provisional figures) is 46.99 million tons, an increase of 0.36%

[1] Department of Business Admnistration, University of Indonesia (Indonesia), Email: heri.fathurahman09@ui.ac.id, (Corresponding Author)
[2] Fakulty Business & Management, Universiti Teknologi MARA (Malaysia), Shah Alam, Shah Alam, Malaysia.
[3] Department of Business Admnistration, University of Indonesia (Indonesia).
[4] Fakulty Business & Management, Universiti Teknologi MARA (Malaysia) Shah Alam, Shah Alam, Malaysia

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

compared to the previous year. The difference between crude palm oil (CPO) and palm cooking oil price data is the price margin from the original form to the manufactured form. In general, the monthly period of 2021-June 2024, the price margin of bulk cooking oil against crude palm oil (CPO) price is relatively large, ranging from IDR 4,229/kg to IDR 15,118/kg. In 2023, the destination countries for Indonesian palm oil exports are still predominantly ten countries, the share of export volume to these ten countries reaches 68.40%. India is the main destination country for Indonesian palm oil exports in 2023 with a value of USD 4.52 billion, its share reaches 17.66% of the total value of Indonesian palm oil exports, followed by China with a total export value of USD 4.25 billion (16.60%), Pakistan at USD 2.18 billion (8.50%), the United States at USD 1.76 billion (6.87%) and other countries with export values below USD 2 billion. Meanwhile, the countries of origin of Indonesian palm oil imports in 2023 are predominantly from three countries. Vietnam is the first country of origin for Indonesian palm oil imports in 2023, reaching 4.26 thousand tons with an import value of USD 853 thousand (23.48%), second place is Malaysia with an import value of USD 779 thousand (21.44%), and followed by China with USD 577 thousand (15.87%) (Kementan, 2024).

Based on Trade map data in 2019 and 2023 HS code 1511, there are five largest palm oil exporting countries that cumulatively contribute 87% to the total value of palm oil exports in the world. Indonesia and Malaysia are the first and second largest palm oil exporting countries in the world (dominating the world's palm oil market share) in 2023, contributing 52.55% and 27.60% respectively. Meanwhile, the largest palm oil importing countries in the world are dominated by more than 10 countries, but with an import value above USD 1 billion, there are eight countries that cumulatively contribute 52.74% to the total value of palm oil imports in the world. These countries are India, China, Pakistan, the United States, the Netherlands, Italy, Bangladesh and Egypt. The results of the Import Dependency Ratio (IDR) analysis from 2019 - 2023 show that Indonesia only relies on palm oil imports of 0.02% to 1.09%. Meanwhile, the Self Sufficiency Ratio (SSR) value of Indonesian palm oil ranges from 453.29% to 541.81%, which means that domestic palm oil needs can be met by domestic production, even most of which is for export/surplus. The Trade Specialization Index (TSI) value of palm oil calculated based on the value of exports and imports in both primary and manufactured forms shows a positive value ranging from 0.994 to 1.00. This means that Indonesian palm oil commodities in primary and manufactured forms in world trade have reached the export maturity stage or have high competitiveness as a world palm oil exporting country. Based on the results of the Revealed Symmetric Comparative Advantage (RSCA) value calculation, it shows that Indonesian palm oil commodities have a fairly large comparative advantage in the world market. This is shown by the Revealed Symmetric Comparative Advantage (RSCA) value for 2019 - 2023 of 0.96 to 0.97. The penetration of the Indonesian palm oil market to the world's largest importing countries with HS code 1511 for the period 2019-2023, namely India, China and the United States, the average growth for the 5 years has increased, while when compared to 2023 to 2022, market penetration to India has decreased by 15.13% and to the United States it has decreased by 13.584%, while to the Chinese market there has been a slight increase of 1.13% (Kementan, 2024).

The partial view by separating upstream, midstream and downstream activities is no longer acceptable from a sustainable business perspective. On the downstream side, the sustainability of products marketed to customers will be questioned even though the product is not produced by the seller. Responsibility throughout the supply chain from raw materials to products received by consumers is shared. This means that each stream has the same responsibility for each other. Consumer rejection of a particular product will result in economic losses for all agents involved in the supply chain of that product. In general, the supply chain consists of three stages, namely procurement, production and distribution. Supply chain management is part of modern management practices that companies need to improve their competitiveness. Various industrial sectors have become the focus of researchers in the field of supply chain management. The demands of sustainability issues are driving the development of sustainable supply chain management (Hadiguna, 2016).

One of the problems faced by Indonesia as the main exporter of palm oil today is that most of Indonesia's palm oil exports are still in the form of raw materials with low selling value. Although Indonesia is the main producer of palm oil, Indonesia has not been able to form world palm oil prices. The formation of palm

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

oil prices in the international market is more influenced by several factors, namely the supply and demand of palm oil, the price of other vegetable oils (especially soybeans), weather, and import policies of palm oil importing countries. Domestically, there are still problems faced by palm oil commodities, especially the status of land ownership of plantations, people's palm oil land currently does not have clean and clear status, both in terms of legal status of ownership and land use. Approximately 13.5 percent (1.5 million ha) of palm oil land is currently located in peatland locations. Deforestation due to palm oil expansion cannot be ignored either. In facing these various challenges, various policy supports are needed, including (1) increasing the productivity of people's oil palm plantations through a replanting program, (2) providing certified oil palm seeds, (3) increasing financial access for people's farmers through a people's land certification program, (4) increasing added value through downstream, (5) price stabilization through increasing domestic and regional markets, (6) investment and trade diplomacy and cooperation, (7) improving infrastructure and trade facilitation, (8) data and information, and (9) strengthening farmer and business actor organizations (Kementan, 2024).

The resolution of several important issues of sustainable supply chain management should not be done partially. Global optimization is a must in sustainable supply chain management decision making. The reason why global optimization needs to be done is because the network is complex, objective conflicts, dynamic systems, variations over time. The network is complex because supply chain facilities are located in geographically dispersed locations. Objective conflicts can occur due to differences in objectives, for example, the amount of production in the factory causes an increase in inventory levels at the distributor level. Fluctuations in demand and supplier capabilities that change over time cause the supply chain to develop over time and be dynamic. This dynamic situation also causes system variations over time. Therefore, a study is needed regarding Mapping Priority of Policy Program in Value Chain Operation for Sustainability of the Indonesian Palm Oil Industry.

Literature Review

Supply chain management is a competitive strategy for companies involved in the system to maximize economic benefits. All activities in the supply chain are directed to achieve the desired goals. Achievement of goals is done by using various available resources. Limited resources require management to monitor and control activities. Target achievement is monitored and controlled based on indicators. The definition of an indicator is a marker that is used as a reference to assess a situation. The nature of the indicator can be quantitative and qualitative. Quantitative means that the indicator gives a sign to the decision maker in the form of numbers, while qualitative gives a sign in the form of a signal. The term indicator is used to apply the concept of performance measurement and supply chain risk assessment. Indicators in performance measurement are known as key performance indicators. Indicators in this case act as markers to determine the level of achievement of supply chain operations. Each indicator in performance measurement aims to achieve achievements that are measured quantitatively or qualitatively. For example, performance indicators of inventory can be measured quantitatively based on inventory costs, while qualitatively based on perceived values, for example, are very large (Hadiguna, 2016).

Sustainable supply chain management cannot be separated from three types of key processes, namely performance measurement, risk assessment and decision making. Sustainability indicators are markers needed to be able to carry out the three key processes properly and correctly. Sustainability indicators are markers used to evaluate, analyze and plan sustainable supply chain activities. The generation of sustainability indicators cannot be separated from the pillars of sustainability, namely economic, environmental, social (Hadiguna, 2016) and governance (Teoh, Cheng Hai, 2010). Considering that sustainable production and use of palm oil should be based on a framework for sustainable development and good governance, the challenges and opportunities will be discussed under the broad headings covering economic, environmental and social aspects and governance. However, it should be clear that these issues are highly interrelated, and solutions must address the linkages among them. Effective policies, governance structures and management systems relating to environmental and social performance are perhaps one of the major opportunities to sustainable development, at various levels, from governments, international institutions and industry bodies down to individual companies (Teoh, Cheng Hai, 2010).

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

Formulation of indicators for risk assessment is done by considering products, processes, and information flows as elements that interact with each other. First, the economic aspect aims to manage the supply chain to maximize profits. This has become the most prioritized aspect in managing the supply chain. Economic motives will be the mainstay for the survival of the company. Indicators from the economic aspect are as follows (Hadiguna, 2016):

- Demand volume is a situation that triggers demand that exceeds or is smaller than the forecast;
- Product price is the economic value of the product set by the company but can be perceived as more expensive or cheaper by consumers;
- Finished product quality is a product attribute perceived by consumers;
- Production flow is the process of producing and distributing products to customers;
- Delivery schedule is the fulfillment of product delivery to customers on time;
- Stock out is a lack of product availability when there is demand resulting in backorders or shortages.
- Inventory costs are limited information or data that trigger excess or lack of inventory costs.
- Production costs are costs incurred to produce products
- The bullwhip effect is a distortion in the flow of information along the supply chain.

The second aspect is the environment in the physical sense. The environmental aspect is the company's effort to create a balance between economic profit and environmental concern through effective consumption of natural resources. The indicators of this aspect are as follows: (Hadiguna, 2016):

- Energy consumption is the use of energy for various types of activities along the supply chain;
- Waste volume is all unwanted output of production activities;
- Recycle and reuse of materials is the utilization of used materials;
- Natural disasters are natural events that damage and disrupt the smooth operation of the supply chain;
- Remanufacturing is the activity of reproducing defective products so that they meet quality standards;
- Environmental damage is an action that directly damages the physical environment;
- Technological changes are those that have the potential to damage the environment.

The third aspect is the socio-political impact of regulations and legislation issued by the government or other public decisions. The indicators are as follows: (Hadiguna, 2016):

- Labor strikes in companies are a threat to the smooth running of production activities;
- Demonstrations in public spaces can disrupt transportation and product distribution to customers;

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

- Environmental regulations that trigger increased production costs;
- Local culture is the belief of local people that has the potential for restrictions or resistance in the use of resources;
- The location of factory facilities or warehouses in public areas sometimes has the potential for clashes between the social interests of the surrounding community and the company's economic motivations.
- The threat of crime is a condition that threatens the smooth running of supply and distribution of goods.

The fourth aspect is governance of the palm oil industry in Indonesia. Efforts to improve the governance of palm oil plantations are carried out by the Government by implementing a sustainable palm oil certification system. This ISPO (Indonesian Sustainable Palm Oil) certification is intended to ensure that palm oil plantation companies have implemented sustainable principles in their business activities. The objectives of implementing ISPO in the palm oil industry in Indonesia are (Tropenbos Indonesia 2020):

- Ensure and improve the management and development of Oil Palm Plantations in accordance with ISPO principles and criteria;
- Increase the acceptability and competitiveness of Indonesian Oil Palm Plantation Products in national and international markets; and
- Increase efforts to accelerate the reduction of greenhouse gas emissions.

The success of implementing governance in the palm oil industry in Indonesia is determined by several factors, namely (Tropenbos Indonesia 2020):

- Availability of palm oil land rights status that has an ISPO certificate;
- Traceability of palm oil harvests from palm oil farmers and palm oil companies;
- Public participation, especially in monitoring environmental damage caused by palm oil plantations;
- Simplification of procedures for palm oil farmers and palm oil companies in obtaining ISPO;
- Collaboration between stakeholders in the palm oil industry, namely between the government, palm oil companies, palm oil farmers, civil society organizations, and environmental observers, especially in palm oil plantations.

Indicators for sustainable palm oil supply chains that must be adjusted to be easily understood and in accordance with the real situation of sustainable palm oil supply chains. Indicators that have been adjusted for the case of sustainable palm oil supply chains can be seen in Table 1.

Table 1. Risk Indicators in the Palm Oil Supply Chain

Aspect	Indicators
Economy	Demand volume Price of crude palm oil Price of fresh fruit bunches Quality of crude palm oil

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

(Hadiguna, 2016)	Price timeliness of palm oil delivery Availability of crude palm oil Losses Processing costs Distortion of demand information
Environment (Hadiguna, 2016)	Energy consumption Value added waste processing Reuse and recycle material Natural disaster threats Remanufacturing Land quality Application of environmentally friendly technology
Social (Hadiguna, 2016)	Labor strikes Community demonstrations Environmental legislation Local culture Criminal attacks
Governance (Tropenbos Indonesia 2020)	Availability of palm oil land rights status Traceability of palm oil harvests Public participation Simplification of procedures Collaboration between stakeholders

One of the most interesting issues to formulate sustainability indicators is the palm oil supply chain which still needs to be elaborated so that indicators are found that are in accordance with the Roundtable on Sustainable Palm Oil (RSPO). In addition, sustainability indicators must also have a dual role, namely performance markers and risk triggers. Proof that these indicators are dual-functioning can be done by testing the level of conflict between indicators. The rule is that there is a conflict of interest from each indicator either at the upstream or midstream or downstream level. The indicators formulated above have met the requirements as dual-functioning indicators because each has a conflict with at least one of the others (Hadiguna, 2016).

Research Method

The research method used is a quantitative method with data collection through the distribution of web-based questionnaires to experts in the palm oil industry in Indonesia with samples adjusted to the Fuzzy VIKOR technique and the Fuzzy TOPSIS technique. A web-based questionnaire was developed for data collection, which was distributed to thirty-six experts. The first part of the questionnaire consisted of demographic questions and the second part consisted of giving weights to various criteria for mapping value chain operations in the palm oil industry in Indonesia. The final part of the questionnaire consisted of ranking various alternatives against the proposed criteria with a five-point scale of linguistic variables used for evaluation of the criteria. Experts were asked to choose the most important alternative to implement and have the lowest execution barriers. A total of four alternatives in determining policy and program priorities, namely economic, social, governance and environmental based on criteria for: a) Downstream Operation Value Chain, b) Midstream Operation Value Chain, c) Upstream Operation Value Chain. The thirty-six experts consisted of: a) supply chain and logistics managers in palm oil companies with a minimum of five years of professional experience; b) Lecturers from reputable academic institutions, with the criteria for each academic expert being determined to have at least five years of teaching experience and have three international publications, c) Practitioners from members of the Indonesian Palm Oil Entrepreneurs Association; d) Professionals from bureaucratic circles at the Palm Oil Plantation Fund Management Agency.

A five-point scale of linguistic variables was used for the evaluation of the criteria, namely:

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

Value	Linguistic Variables
1	Very Low
2	Low
3	Medium
4	High
5	Very High

The alternative decision choices taken by the experts are:

Value	Alternative
A1	Economics
A2	Social
A3	Governance
A4	Environment

There are several criteria or indicators of Upstream Operations Value Chain determined by experts based on linguistic variables (Hadiguna, Rika Ampuh & Tjahjono, Benny. 2017):

Value	Criteria
C1	Availability of material
C2	Crop productivity
C3	Land
C4	Local culture
C5	Criminal attact
C6	Material price
C7	Quality of material
C8	Transportation security
C9	Transportation reliability
C10	Complaints
C11	Hazards
C12	Labor safety and security
C13	Unit cost of tranportation
C14	Harvest cost
C15	Harvest labor wage

There are several criteria or indicators of Midstream Operations Value Chain that are determined by experts based on linguistic variables (Hadiguna, Rika Ampuh & Tjahjono, Benny. 2017):

C1	Manufacturing cost
C2	Energy consumption cost
C3	Cost of waste treatment
C4	Labor cost and rewards
C5	Storage cost
C6	Maintenance cost
C7	Energy utilization
C8	Water utilization
C9	Waste reduction
C10	Government regulations
C11	Complaints of the sewage plant
C12	Health and safety labor
C13	Reuse and recycle
C14	Remanufacturing cycle time
C15	Material Handling cost (Reid & Sanders, 2023)

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

There are several criteria or indicators of Downstream Operations Value Chain that are determined by experts based on linguistic variables (Hadiguna, Rika Ampuh & Tjahjono, Benny. 2017):

C1	Demand
C2	Transportation schedule
C3	Delivery reliability
C4	Product warranty and quality
C5	Responsiveness to meet demand
C6	Forecasting accuracy of demand
C7	Customer complaints
C8	Transportation security
C9	Product inventory in port
C10	Reliability of shipping
C11	Accuracy of shipping documents
C12	Security of shipping to customers
C13	Transportation cost from plant to port
C14	Shipping cost to destination port
C15	Product price

Fuzzy VIKOR (Vise Kriterijumska Optimizajica I Kompromiso Resenje)

VIKOR is a multi-criteria decision-making method from a decision support system that can select from one criterion. The use of VIKOR for automatic summarization is done by simulating a case to be processed, to produce a ranking order based on alternative rankings. The following are the working steps of the VIKOR method (Siregar, V. & Rochmawati, N. 2023):

Convert data into numeric form and arrange it in matrix form. The converted data is arranged into matrix X with equation (1) below:

$$X = \begin{array}{c} \\ A1 \\ A2 \\ \vdots \\ Am \end{array} \begin{bmatrix} C1 & C2 & & Cn \\ x11 & x12 & & x1n \\ a21 & 122 & \cdots & x2n \\ \vdots & \vdots & \ddots & \vdots \\ xm1 & am2 & \ldots & xmn \end{bmatrix} \qquad (1)$$

Where Am is the m-th decision matrix, M = 1,2,3 …m, Cn is the n-th criterion, N = 1,2,3….,n and mn indicates the performance level of the m-th alternative.

Determining the Normalization Matrix

The following is the formula for determining the normalization matrix with equations (2), (3) below:

The X matrix is then normalized using the following equation (4):

$$f^{+}_{j} = \max(f_{1j}, f_{2j}, f_{3j}..., f_{mj}) \qquad (2)$$

$$f_{ij} = \min(f_{1j}, f_{2j}, f_{3j}..., f_{mj}) \qquad (3)$$

$$N_{ij} = \left(\frac{f^{+}j - fij}{f^{+}j - f^{-}j}\right) \qquad (4)$$

$$fij$$

Where N is a normalized matrix, is the response value of sample i in one criterion, f+ j is the maximum value of a criterion and f- j is the minimum value of a criterion.

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

Determining the Weight of Each Criterion

The formula for determining the weight is shown in equation (5) below:

$$Wj = \sum_{j=1}^{n} wj = 1 \qquad (5)$$

Where Wj is the criteria weight of j. While j = 1,2,3 …n is the order of the criteria.

Determining the weighted normalization matrix.

The following formula determines the weighted normalization matrix with equation (6) below:

$$F^{*}ij = WjxNij \qquad (6)$$

Where F*ij is the multiplication of W= weight and N= normalization matrix.

Calculating the Utility Measure (S) and Regret Measure (R) values:

The following formula determines the Utility Measure (S) and Regret Measure (R) values shown in equation (7) below:

$$Si = \sum_{j=1}^{n} Wij \left(\frac{f^{+}j - fij}{f^{+}j - f^{-}j}\right) \qquad (7)$$

dan

$$Ri = \text{Max j}\left[\left(\frac{f^{+}j - fij}{f^{+}j - f^{-}j}\right)\right] \qquad (8)$$

Where Si is the utility measure value which is the value of the 1st to the nth alternative in the i-th alternative. The Ri value is the maximum value based on the comparison of the 1st to the nth criterion values in the I-th alternative.

Calculating the Vikor Index (Q).

The following is the formula for calculating the Vikor index (Q) in equation (9) below:

$$Qi = v\left[\left(\frac{Sj - S^{-}}{S^{-} - S^{-}}\right) + (1 - v)\left[\left(\frac{Rj - R^{-}}{R^{+} - R^{-}}\right)\right]\right] \qquad (9)$$

Where S- is the minimum value of Si, S+ is the maximum value of Si, R is the minimum Ri, R+ is the maximum n value of Ri, v = 0.5. The ranking result is the ordering of S, R and Q.

The best recommendation is identified based on the alternative with the minimum Vikor Index (Q).

Fuzzy TOPSIS (Technique for Others Preference by Similarity to Ideal Solution)

Fuzzy TOPSIS according to Hwang and Zeleny is based on the concept that a good selected alternative not only has the shortest distance from the positive ideal solution, but also has the longest distance from the negative ideal solution. This concept is widely used in several MADM (Multi Attribute Decision Making) models to solve decision problems practically. This is because the concept is simple and easy to understand, the computation is efficient, and it has the ability to measure the relative performance of decision alternatives in a simple mathematical form. In general, the TOPSIS procedure follows the following steps (in Sukerti, Ni Kadek. 2015):

- Determine the normalized decision matrix.
- Calculate the weighted normalized decision matrix
- Calculate the positive ideal solution matrix and the negative ideal solution matrix

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

- Calculate the distance between the value of each alternative with the positive ideal solution matrix and the negative ideal solution matrix
- Calculate the preference value for each alternative
- The largest preference value indicates that the alternative has the greatest chance of being selected.

TOPSIS requires a performance rating of each alternative on each normalized criterion. Shown in equation 1.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (1)$$

The positive ideal solution and the negative ideal solution can be determined based on the normalized weight ratings, shown in equations (2) and (3):

$$Yij = Wj\ rij. \quad (2)$$

$$A+ = (y1+, y2+, \ldots, yn+) \quad (3)$$

$$A- = (y1-, y2-, \ldots., yn-)$$

With the provision of:

Yj+ = (max yij; if j is a benefit attribute)

(min yij; if j is a cost attribute)

Yj- = (min yij; if j is a benefit attribute)

(max yij; if j is a cost attribute)

The distance between the alternative and the positive ideal solution is formulated in equation 4:

$$Di+ = \sqrt{\sum_{j=1}^{n} (y_j^+ - y_{ij})\,2} \quad (4)$$

The distance between the alternative and the negative ideal solution is formulated in equation 5:

$$Di- = \sqrt{\sum_{j=1}^{n} (y_{ij} - y_j^-)\,2} \quad (5)$$

The preference values for each alternative are shown in equation 6:

$$Vi = \frac{D_i^-}{D_i^- + D_i^+} \quad (6)$$

Results and Discussion

From the results of the distribution of web-based questionnaires made for data collection, which were then distributed among thirty-six experts, validity and reliability tests were carried out. The following are the test results:

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

Table 2. Results of Validity Test and Reliability Test of the Criteria/Indicators

Using IBM SPSS Statistics Version 26

Alternative	Key Person:	CRITERIA C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
A4	Expert3	4	4	4	5	5	4	5	5	5	5	5	5	5	4	4
A2	Expert5	3	3	4	3	3	3	4	4	3	3	3	3	3	3	3
A3	Expert7	5	5	5	5	5	4	4	4	4	4	3	4	4	4	5
A3	Expert10	4	5	5	5	5	5	5	4	4	4	3	3	4	3	4
A4	Expert14	4	5	5	5	5	5	5	3	4	4	4	3	3	3	5
A1	Expert18	5	5	5	4	4	5	3	5	5	5	5	5	5	5	3
A2	Expert21	4	4	4	4	4	5	4	4	5	5	5	5	5	5	4
A3	Expert23	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
A1	Expert26	3	4	3	4	4	4	4	4	4	4	5	5	4	5	5
A2	Expert29	5	5	4	4	5	5	5	5	5	5	5	5	4	4	4
A1	Expert32	4	3	4	4	5	5	4	4	5	5	5	5	5	5	3
A4	Expert35	5	5	5	5	5	5	5	3	5	3	4	3	2	3	5
A4	Expert2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
A1	Expert6	4	5	5	5	5	5	4	5	3	5	5	5	3	5	5
A2	Expert8	5	4	4	4	4	3	4	3	4	3	4	3	4	3	4
A3	Expert11	5	5	5	5	5	5	5	4	4	4	4	4	4	4	5
A2	Expert13	4	3	5	5	4	3	4	5	3	4	4	4	4	4	4
A4	Expert16	4	4	4	4	4	4	4	4	4	4	3	4	4	3	4
A1	Expert19	3	4	4	4	3	3	4	4	4	3	3	4	4	4	4
A2	Expert22	4	5	5	5	5	5	5	5	4	4	4	5	4	5	5
A3	Expert27	5	5	5	5	5	5	5	5	5	4	2	3	3	4	5
A1	Expert30	5	5	5	5	3	4	5	4	5	4	4	4	4	4	5
A3	Expert33	3	3	4	4	3	4	4	3	4	4	3	4	4	3	4
A4	Expert36	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A4	Expert1	4	5	5	5	5	4	5	4	4	4	4	4	3	4	4
A3	Expert4	4	4	4	4	4	4	4	3	3	4	4	4	4	4	4
A2	Expert9	5	5	5	5	5	4	4	4	4	3	3	3	3	3	5
A1	Expert12	4	3	5	5	4	3	5	1	3	2	4	1	2	1	4
A4	Expert15	3	2	2	3	3	3	2	3	4	3	3	4	2	3	3
A1	Expert17	4	5	5	5	5	4	5	4	5	5	5	5	4	4	5
A3	Expert20	5	5	5	5	5	5	4	5	5	5	4	4	4	5	5
A2	Expert24	4	5	5	5	5	4	4	4	4	3	4	3	4	4	5
A4	Expert25	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
A1	Expert28	4	5	5	5	4	5	5	5	5	5	5	5	5	5	5
A3	Expert31	3	3	3	4	4	3	4	3	4	4	3	3	3	3	4
A2	Expert34	3	4	3	3	4	3	4	3	4	4	3	4	4	4	4
Anti-image Correlation		.833a	.830a	.713a	.715a	.830a	.908a	.838a	.824a	.826a	.910a	.784a	.834a	.871a	.808a	.688a
Validity Test																
KMO and Bartlett's Test																
Kaiser-Meyer-Olkin Measure of Sampling						.810										

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

Adequacy.																
Bartlett's Test of Sphericity																
Approx. Chi-Square		437.447														
	df	105														
	Sig.	.000														
Reliability Statistics																
Cronbach's Alpha	N of Items															
.922	15															
Cronbach's Alpha if Item Deleted		.919	.912	.917	.917	.916	.912	.920	.915	.917	.914	.919	.919	.920	.916	.919

Validity Test using Kaiser-Mayer-Olkin Measure of Sampling Adequacy (KMO MSA) Value and KMO and Bartlett's Test output table is useful to know the feasibility of a variable, whether it can be further processed using this factor analysis technique or not. The method is to look at the KMO MSA (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) value. If the KMO MSA value is greater than 0.50, then the factor analysis technique can be continued. Based on the output above, it is known that the KMO MSA value of the fifteen's criteria/indicators of upstream operations value chain, midstream operations value chain and downstream operations value chain is 0.810> 0.50 and the Bartlett's Test of Sphericity (Sig.) Value is 0.00 <0.05, then the factor analysis in this study can be continued because it has met the requirements. There is a strong relationship or correlation between the criteria/indicators. This is indicated by the Anti-image Correlation value between the criteria/indicators being greater than 0.50. Thus, fifteens criteria/indicators of upstream operations value chain, midstream operations value chain and downstream operations value chain can be declared valid.

From the output table above, it is known that there are N of Items (the number of items or questionnaire questions) there are 15 items/criteria/indicators of upstream operations value chain, midstream operations value chain and downstream operations value chain with a Cronbach's Alpha value of 0.922. Because the Cronbach's Alpha value of 0.993> 0.60, then as the basis for decision making in the reliability test above, it can be concluded that the 15 or all questionnaire question items for the criteria/indicators of upstream operations value chain, midstream operations value chain and downstream operations value chain are reliable or consistent. The output table above provides an overview of the statistical values for the 15 questionnaire question items. Note in the "Cronbach's Alpha if Item Deleted" column in this table, the Cronbach's Alpha value for the seven question items is> 0.60, so it can be concluded that the 15 questionnaire question items related to criteria/indicators of upstream operations value chain, midstream operations value chain and downstream operations value chain are reliable.

Fuzzy VIKOR Upstream Operations

The Fuzzy VIKOR method is used to determine the priority of policy program in upstream operations value chain for sustainability Indonesia Palm Oil Industry. To facilitate the analysis, the Fuzzy VIKOR calculation uses Microsoft Excel (Indonesian version). The steps taken in calculating Fuzzy VIKOR are determining the weight, creating a normalization table R, calculating the S value, calculating the R value, comparing the S value and the R value, determining the index value and the last step is determining the ranking value.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
VIKOR METHOD																
Upstream Operations	CRITERIA															
ALTERNATIVE	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	SUM
Economics	4,00	4,00	4,00	4,00	4,33	4,67	3,67	4,33	4,6	4,6	5,0	5,0	4,6	5,0	3,67	65,68

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

									7	7	0	0	7	0		
Social	4,00	4,00	4,00	3,67	4,00	4,33	4,33	4,33	4,33	4,33	4,33	4,33	4,00	4,00	3,67	61,65
Governance	4,33	4,33	4,33	4,33	4,33	4,00	4,00	3,67	3,67	3,67	3,00	3,33	3,67	3,33	4,00	57,99
Environment	4,33	4,67	4,67	5,00	5,00	4,67	5,00	3,67	4,67	4,00	4,33	3,67	3,33	3,33	4,67	65,01
WEIGHT	2	1	3	1	2	2	2	2	2	1	1	2	2	1	1	25,00
W=1	0,08	0,04	0,12	0,04	0,08	0,08	0,08	0,08	0,08	0,04	0,04	0,08	0,08	0,04	*0,04	1,00
NORMALIZATION															*=+P9/$Q$9	
	*=((MAX(B$5:B$8)-B5))/((MAX(B$5:B$8)-MIN(B$5:B$8)))															
	*1,00	1,00	1,00	0,75	0,67	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,00	
	1,00	1,00	1,00	1,00	1,00	0,51	0,50	0,00	0,34	0,34	0,34	0,40	0,50	0,60	1,00	
R	0,00	0,51	0,51	0,50	0,67	1,00	0,75	1,00	1,00	1,00	1,00	1,00	0,75	1,00	0,67	
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,00	0,00	0,67	0,34	0,80	1,00	1,00	0,00	
CALCULATING THE VALUE OF S																
	*=B$10*B13													*=SUM(B19:P19)		
	*0,08	0,04	0,12	0,03	0,05	0,00	0,08	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,04	*0,44
	0,08	0,04	0,12	0,04	0,08	0,04	0,04	0,00	0,03	0,01	0,01	0,03	0,04	0,02	0,04	0,63
S	0,00	0,02	0,06	0,02	0,05	0,08	0,06	0,08	0,08	0,04	0,04	0,08	0,06	0,04	0,03	0,74
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,08	0,00	0,03	0,01	0,06	0,08	0,04	0,00	0,30
CALCULATING THE VALUE OF R																
		*=MAX(B19:P19)														
	*0,12															
	0,12															
R	0,08															
	0,08															
		*+Q19														
ALTERNATIVE	VALUE OF S	VALUE OF R														
A1	*0,44	**0,12	**+B25													
A2	0,63	0,12														
A3	0,74	0,08														
A4	0,30	0,08														
MIN	0,30	*0,08	*=MIN(C31:C34)													
MAX	0,74	**0,12	**=MAX(C31:C34)													
DETERMINING INDEX																

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

	VALUE															
	*=((B31-$B$35)/($B$36-$B$35)*0,5)+((C31-$C$35)/($C$36-$C$35)*0,5)															
		RANKING														
	*0,660	**3	**=RANK(B40;$B$40:$B$43;1)													
	0,874	4														
Q	0,500	2														
	0,000	1														
Rank:																
1. Environment																
2. Governance																
3. Economics																
4. Social																

Based on Fuzzy VIKOR calculations to determine the priority of policy program in upstream operations value chain for sustainability Indonesia Palm Oil Industry, the results obtained are that the first rank is Environment, second: Governance, third: Economics, fourth: Social.

Fuzzy TOPSIS Upstream Operations

In addition, this study aims to determine the priority of policy program in upstream operations value chain for sustainability Indonesia Palm Oil Industry using the Fuzzy TOPSIS method. The steps taken in calculating Fuzzy TOPSIS are determining the cost or benefit for 15 criteria of value chain from upstream operations, creating a normalized matrix R, creating a weighted normalized matrix Y, determining the positive ideal solution (A+), determining the negative ideal solution (A-), determining the distance between weighted values of positive and negative ideal solutions, determining the preference value and determining the ranking value.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
TOPSIS METHOD															
Upstream Operations															
	CRITERIA														
ALTERNATIVE	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Economics	4,00	4,00	4,00	4,00	4,33	4,67	3,67	4,33	4,67	4,67	5,00	5,00	4,67	5,00	3,67
Social	4,00	4,00	4,00	3,67	4,00	4,33	4,33	4,33	4,33	4,33	4,33	4,33	4,00	4,00	3,67
Governance	4,33	4,33	4,33	4,33	4,33	4,00	4,00	3,67	3,67	3,67	3,00	3,33	3,67	3,33	4,00
Environment	4,33	4,67	4,67	5,00	5,00	4,67	5,00	3,67	4,67	4,00	4,33	3,67	3,33	3,33	4,67
	BENEFIT	BENEFIT	BENEFIT	BENEFIT	COST	COST	BENEFIT	COST	BENEFIT	COST	COST	COST	COST	COST	COST
WEIGHT	2	1	3	1	2	2	2	2	2	1	1	2	2	1	1
CREATING A NOMALIZED MATRIX -R-															
	=SQRT((B6^2)+(B7^2)+(B8^2)+(B9^2))													=P6/P$14	
DIVIDER	8,337	8,518	8,518	8,557	8,860	8,852	8,557	8,027	8,708	8,368	8,456	8,265	7,897	7,948	8,047
	0,480	0,470	0,470	0,467	0,48	0,52	0,429	0,53	0,536	0,55	0,59	0,60	0,59	0,62	0,45

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

					9	8		9		8	1	5	1	9	6
R	0,480	0,470	0,470	0,429	0,451	0,489	0,506	0,539	0,497	0,517	0,512	0,524	0,507	0,503	0,456
	0,519	0,508	0,508	0,506	0,489	0,452	0,467	0,457	0,421	0,439	0,355	0,403	0,465	0,419	0,497
	0,519	0,548	0,548	0,584	0,564	0,528	0,584	0,457	0,536	0,478	0,512	0,444	0,422	0,419	0,580
CREATE A WEIGHTED NORMALIZED MATRIX (Y)															
	=B15*$B$11														
	0,960	0,470	1,409	0,467	0,977	1,055	0,858	1,079	1,073	0,558	0,591	1,210	1,183	0,629	0,456
Y	0,960	0,470	1,409	0,429	0,903	0,978	1,012	1,079	0,994	0,517	0,512	1,048	1,013	0,503	0,456
	1,039	0,508	1,525	0,506	0,977	0,904	0,935	0,914	0,843	0,439	0,355	0,806	0,929	0,419	0,497
	1,039	0,548	1,645	0,584	1,129	1,055	1,169	0,914	1,073	0,478	0,512	0,888	0,843	0,419	0,580
POSITIVE IDEAL SOLUTION															
	=IF(B$10="BENEFIT";MAX(B$21:B$24);(MIN(B$21:B$24)))														
A+	1,039	0,548	1,645	0,584	0,903	0,904	1,169	0,914	1,073	0,439	0,355	0,806	0,843	0,419	0,456
NEGATIVE IDEAL SOLUTION															
	=IF(B$10="BENEFIT";MIN(B$21:B$24);(MAX(B$21:B$24)))														
A-	0,960	0,470	1,409	0,429	1,129	1,055	0,858	1,079	0,843	0,558	0,591	1,210	1,183	0,629	0,580
DISTANCE BETWEEN THP WEIGHTED VALUES OF POSITIVE AND NEGATIVE IDEAL SOLUTIONS															
	=SQRT(((B$27-B21)^2+(C$27-C21)^2+(D$27-D21)^2+(E$27-E21)^2+(F$27-F21)^2+(G$27-G21)^2+(H$27-H21)^2+(I$27-I21)^2														
	+(J$27-J21)^2+(K$27-K21)^2+(L$27-L21)^2+(M$27-M21)^2+(N$27-N21)^2+(O$27-O21)^2))														
	D1+	0,792	D1-	0,278											
	D2+	0,530	D2-	0,427											
	D3+	0,377	D3-	0,669											
	D4+	0,327	D4-	0,738											
	=SQRT(((B21-B$30)^2+(C21-B$30)^2+(D21-D$30)^2+(E21-E$30)^2+(F21-F$30)^2+(G21-G$30)^2+(H21-H$30)^2+(I21-I$30)^2														
	+(J21-J$30)^2+(K21-K$30)^2+(L21-L$30)^2+(M21-M$30)^2+(N21-N$30)^2+(O21-O$30)^2))														
PREFERENCE VALUE			RANK												
	=E34/(E34+C34)														
		=RANK(C43;$C$43:$C$46;0)													
	V1	0,260	4												
	V2	0,446	3												
	V3	0,639	2												

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

	V4	0,693	1													
Rank:																
1. Environment																
2. Governance																
3. Social																
4. Economics																

Based on the Fuzzy TOPSIS calculation to determine the priority of policy program in upstream operations value chain for sustainability Indonesia Palm Oil Industry, the results obtained are that the first rank is Environment, second: Governance, third: Social, fourth: Economics. The following is a comparison table between Fuzzy VIKOR and Fuzzy TOPSIS to determine the priority of policy program in upstream operations value chain for sustainability Indonesia Palm Oil Industry:

Table 3. Comparison of Fuzzy VIKOR and Fuzzy TOPSIS Result from Upstream Operations

Ranking	Fuzzy VIKOR	Fuzzy TOPSIS
1	Environment	Environment
2	Governance	Governance
3	Economics	Social
4	Social	Economics

From the comparison results between Fuzzy VIKOR and Fuzzy TOPSIS, there are almost similarities in determining the priority of policy program in upstream operations value chain for sustainability Indonesia Palm Oil Industry, only different in the third and fourth options. The first rank of Fuzzy VIKOR and Fuzzy TOPSIS is the same, namely the priority of policy program is Environment. The second rank of Fuzzy VIKOR and Fuzzy TOPSIS is always the same, namely the priority of policy program is Government. The third rank of Fuzzy VIKOR is Economics and the third rank of Fuzzy TOPSIS is Social. The fourth rank of Fuzzy VIKOR is Social and the third rank of Fuzzy TOPSIS is Economics.

Fuzzy VIKOR and Fuzzy TOPSIS Midstream Operations

The Fuzzy VIKOR method is used to determine the priority of policy program in midstream operations value chain for sustainability Indonesia Palm Oil Industry. To facilitate the analysis, the Fuzzy VIKOR calculation uses Microsoft Excel (Indonesian version). The steps taken in calculating Fuzzy VIKOR are determining the weight, creating a normalization table R, calculating the S value, calculating the R value, comparing the S value and the R value, determining the index value and the last step is determining the ranking value.

To determine the priority of policy program in midstream operations value chain for sustainability Indonesia Palm Oil Industry using the Fuzzy TOPSIS method. The steps taken in calculating Fuzzy TOPSIS are determining the cost or benefit for 15 criteria of midstream operations value chain, creating a normalized matrix R, creating a weighted normalized matrix Y, determining the positive ideal solution (A+), determining the negative ideal solution (A-), determining the distance between weighted values of positive and negative ideal solutions, determining the preference value and determining the ranking value.

The Fuzzy VIKOR and Fuzzy TOPSIS calculations to determine the priority of policy program in midstream operations value chain for sustainability Indonesia Palm Oil Industry using MS Excel as exemplified in the Fuzzy VIKOR and Fuzzy TOPSIS calculations to determine the priority of policy program in upstream operations value chain for sustainability Indonesia Palm Oil Industry above.

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
VIKOR METHOD																
Midstream Operations		CRITERIA														
ALTERNATIVE	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	
Economics	4,00	4,67	4,67	4,67	3,67	4,00	4,33	4,33	4,00	4,00	4,00	4,33	3,67	4,33	4,67	63,34
Social	4,33	4,00	4,67	4,67	4,33	3,67	4,33	4,33	3,67	3,67	4,00	4,00	4,00	4,00	4,33	62,00
Governance	4,33	4,33	4,67	4,67	4,33	4,67	4,67	4,00	4,33	4,00	3,00	3,67	3,67	3,67	4,67	62,68
Environment	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	3,67	4,00	4,00	3,67	4,00	59,34
WEIGHT	2	1	3	1	2	2	2	2	2	1	1	2	2	1	1	25,00
W=1	0,08	0,04	0,12	0,04	0,08	0,08	0,08	0,08	0,08	0,04	0,04	0,08	0,08	0,04	0,04	1,00
DETERMINING INDEX VALUE																
		RANKING														
	0,045	3														
	0,027	2														
Q	0,000	1														
	1,000	4														
Rank:																
1. Governance																
2. Social																
3. Economics																
4. Environment																

Based on Fuzzy VIKOR calculations to determine the priority of policy program in midstream operations value chain for sustainability Indonesia Palm Oil Industry, the results obtained are that the first rank is Governance, second: Social, third: Economics, fourth: Environment.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
TOPSIS METHOD															
Midstream Operations															
	CRITERIA														
ALTERNATIVE	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Economics	4,00	4,67	4,67	4,67	3,67	4,00	4,33	4,33	4,00	4,00	4,00	4,33	3,67	4,33	4,67
Social	4,33	4,00	4,67	4,67	4,33	3,67	4,33	4,33	3,67	3,67	4,00	4,00	4,00	4,00	4,33
Governance	4,33	4,33	4,67	4,67	4,33	4,67	4,67	4,00	4,33	4,00	3,00	3,67	3,67	3,67	4,67
Environment	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	3,67	4,00	4,00	3,67	4,00
	COST	COST	COST	COST	COST	COST	BENEFIT	BENEFIT	BENEFIT	BENEFIT	COST	COST	BENEFIT	BENEFIT	COST
WEIGHT	2	1	3	1	2	2	2	2	2	1	1	2	2	1	1
PREFERENCE VALUE			RANK												
	V1	0,446	2												
	V2	0,442	3												
	V3	0,435	4												

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

	V4	0,569	1												
Rank:															
1. Environment															
2. Economics															
3. Social															
4. Governance															

Based on the Fuzzy TOPSIS calculation to determine the priority of policy program in midstream operations value chain for sustainability Indonesia Palm Oil Industry, the results obtained are that the first rank is Environment, second: Economics, third: Social, fourth: Governance. The following is a comparison table between Fuzzy VIKOR and Fuzzy TOPSIS to determine the priority of policy program in midstream operations value chain for sustainability Indonesia Palm Oil Industry:

Table 4. Comparison of Fuzzy VIKOR and Fuzzy TOPSIS Result from Midstream Operations

Ranking	Fuzzy VIKOR	Fuzzy TOPSIS
1	Governance	Environment
2	Social	Economics
3	Economics	Social
4	Environment	Governance

From the comparison results between Fuzzy VIKOR and Fuzzy TOPSIS, to determine the priority of policy program in midstream operations value chain for sustainability Indonesia Palm Oil Industry is difference. The first rank of Fuzzy VIKOR is Governance whereas the first rank Fuzzy TOPSIS is Environment. The second rank of Fuzzy VIKOR is Social whereas the first rank Fuzzy TOPSIS is Economics. The third rank of Fuzzy VIKOR is Economics whereas the first rank Fuzzy TOPSIS is Social. The fourth rank of Fuzzy VIKOR is Environment whereas the first rank Fuzzy TOPSIS is Governance.

Fuzzy VIKOR and Fuzzy TOPSIS Downstream Operations

The Fuzzy VIKOR method is used to determine the priority of policy program in downstream operations value chain for sustainability Indonesia Palm Oil Industry. To facilitate the analysis, the Fuzzy VIKOR calculation uses Microsoft Excel (Indonesian version). The steps taken in calculating Fuzzy VIKOR are determining the weight, creating a normalization table R, calculating the S value, calculating the R value, comparing the S value and the R value, determining the index value and the last step is determining the ranking value.

To determine the priority of policy program in downstream operations value chain for sustainability Indonesia Palm Oil Industry using the Fuzzy TOPSIS method. The steps taken in calculating Fuzzy TOPSIS are determining the cost or benefit for 15 criteria of downstream operations value chain, creating a normalized matrix R, creating a weighted normalized matrix Y, determining the positive ideal solution (A+), determining the negative ideal solution (A-), determining the distance between weighted values of positive and negative ideal solutions, determining the preference value and determining the ranking value.

The Fuzzy VIKOR and Fuzzy TOPSIS calculations to determine the priority of policy program in downstream operations value chain for sustainability Indonesia Palm Oil Industry using MS Excel as exemplified in the Fuzzy VIKOR and Fuzzy TOPSIS calculations to determine the priority of policy program in upstream operations value chain for sustainability Indonesia Palm Oil Industry above.

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
VIKOR METHOD																
Downstream Operations	CRITERIA															
ALTERNATIVE	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	
Economics	4,00	4,33	5,00	5,00	4,33	4,00	5,00	3,33	4,33	4,00	4,67	3,67	3,67	3,33	4,67	63,33
Social	4,00	4,67	4,33	4,33	4,67	3,67	4,00	3,67	4,00	3,33	3,33	3,33	3,67	3,67	4,67	59,34
Governance	4,00	4,00	4,00	4,33	4,33	4,00	4,00	3,67	4,00	4,33	3,67	3,67	3,67	4,00	4,33	60,00
Environment	3,67	3,67	3,67	4,00	4,00	3,67	3,67	3,67	4,00	3,67	3,67	4,00	3,00	3,67	3,67	55,70
WEIGHT	2	1	3	1	2	2	2	2	2	1	1	2	2	1	1	25,00
W=1	0,08	0,04	0,12	0,04	0,08	0,08	0,08	0,08	0,08	0,04	0,04	0,08	0,08	0,04	0,04	1,00
		RANKING														
	0,000	1														
	0,228	2														
Q	0,283	3														
	1,000	4														
Rank:																
1. Economics																
2. Social																
3. Governance																
4. Environment																

Based on Fuzzy VIKOR calculations to determine the priority of policy program in downstream operations value chain for sustainability Indonesia Palm Oil Industry, the results obtained are that the first rank is Economics, second: Social, third: Governance, fourth: Environment.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
TOPSIS METHOD															
Downstream Operations															
	CRITERIA														
ALTERNATIVE	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Economics	4,00	4,33	5,00	5,00	4,33	4,00	5,00	3,33	4,33	4,00	4,67	3,67	3,67	3,33	4,67
Social	4,00	4,67	4,33	4,33	4,67	3,67	4,00	3,67	4,00	3,33	3,33	3,33	3,67	3,67	4,67
Governance	4,00	4,00	4,00	4,33	4,33	4,00	4,00	3,67	4,00	4,33	3,67	3,67	3,67	4,00	4,33
Environment	3,67	3,67	3,67	4,00	4,00	3,67	3,67	3,67	4,00	3,67	3,67	4,00	3,00	3,67	3,67
	BENEFIT	BENEFIT	BENEFIT	BENEFIT	BENEFIT	BENEFIT	COST	COST	COST	BENEFIT	COST	COST	COST	COST	COST
WEIGHT	2	1	3	1	2	2	2	2	2	1	1	2	2	1	1
	V1	0,552	2												
	V2	0,562	1												
	V3	0,450	3												
	V4	0,411	4												
Rank:															
1. Social															
2. Economics															
3.															

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

Governance															
4. Environment															

Based on the Fuzzy TOPSIS calculation to determine the priority of policy program in downstream operations value chain for sustainability Indonesia Palm Oil Industry, the results obtained are that the first rank is Social, second: Economics, third: Governance, fourth: Environment. The following is a comparison table between Fuzzy VIKOR and Fuzzy TOPSIS to determine the priority of policy program in downstream operations value chain for sustainability Indonesia Palm Oil Industry:

Table 5. Comparison of Fuzzy VIKOR and Fuzzy TOPSIS Result from Downstream Operations

Ranking	Fuzzy VIKOR	Fuzzy TOPSIS
1	Economics	Social
2	Social	Economics
3	Governance	Governance
4	Environment	Environment

From the comparison results between Fuzzy VIKOR and Fuzzy TOPSIS, there are almost similarities in determining the priority of policy program in downstream operations value chain for sustainability Indonesia Palm Oil Industry, only different in the first and second options. The first rank of Fuzzy VIKOR is Economics and the first rank of Fuzzy TOPSIS is Social. The second rank of Fuzzy VIKOR is Social and the third rank of Fuzzy TOPSIS is Economics. The third rank of Fuzzy VIKOR and Fuzzy TOPSIS is the same, namely the priority of policy program is Governance. The fourth rank of Fuzzy VIKOR and Fuzzy TOPSIS is always the same, namely the priority of policy program is Environment.

Conclusion

From the comparison results between Fuzzy VIKOR and Fuzzy TOPSIS, there are almost similarities in determining the priority of policy program in upstream operations value chain, midstream operations value chain and downstream operations value chain as follows. As for in upstream operations value chain namely the first rank of Fuzzy VIKOR and Fuzzy TOPSIS is the same, namely the priority of policy program is Environment. The second rank of Fuzzy VIKOR and Fuzzy TOPSIS is always the same, namely the priority of policy program is Government. The third rank of Fuzzy VIKOR is Economics and the third rank of Fuzzy TOPSIS is Social. The fourth rank of Fuzzy VIKOR is Social and the third rank of Fuzzy TOPSIS is Economics. As for in midstream operations value chain namely the first rank of Fuzzy VIKOR is Governance whereas the first rank Fuzzy TOPSIS is Environment. The second rank of Fuzzy VIKOR is Social whereas the first rank Fuzzy TOPSIS is Economics. The third rank of Fuzzy VIKOR is Economics whereas the first rank Fuzzy TOPSIS is Social. The fourth rank of Fuzzy VIKOR is Environment whereas the first rank Fuzzy TOPSIS is Governance. As for in downstream operations value chain namely the first rank of Fuzzy VIKOR is Economics and the first rank of Fuzzy TOPSIS is Social. The second rank of Fuzzy VIKOR is Social and the third rank of Fuzzy TOPSIS is Economics. The third rank of Fuzzy VIKOR and Fuzzy TOPSIS is the same, namely the priority of policy program is Governance. The fourth rank of Fuzzy VIKOR and Fuzzy TOPSIS is always the same, namely the priority of policy program is Environment.

Acknowledgement

This research was funded by the Directorate General of Development of the University of Indonesia in the framework of implementing the Bilateral Alliance (UI – BISA) Research Collaboration Agreement Matching Fund with Universitas Teknologi Mara (UiTM).

Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 368 – 388
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.6127

References

Abidin, Jamaludin Zainal. 2023. Tata Keloloa Industri Kelapa Sawit Berkelanjutan dalam Mendukung Ketahanan Energi Nasional. Journal of Agrosociology and Sustainability JASSU 1[1]: 59-74.

Adinugraha, A.G. 2018. Tata Kelola Perkebunan Sawit di Indonesia Studi Kasus di Provinsi Riau dan Kalimantan Barat. Bogor: Forci Development.

CPOCP (2021). Palm Oil Supply and Demand Outlook Report 2021.

Hasan, M.F., Reed, M.R., & Marchant, M.A. (2001). Effect of an Export Tax on Competitiveness: The Case of the Indonesian Palm Oil Industry. Journal of Economic Development, 26(2), 77-90.

Hadiguna, Rika Ampuh. 2016. Manajemen Rantai Pasok Agroindustri: Pendekatan Berkelanjutan untuk Pengukuran Kinerja dan Penilaian Resiko. Padang: Andalas University Press.

Hadiguna, Rika Ampuh & Tjahjono, Benny. 2017. A Framework for Managing Sustainable Palm Oil Supply Operations: a Case of Indonesia. Production Planning & Control, 28:13, 1093-1106, DOI: 10.1080/09537287.2017.1335900.

Kaplinsky, R., & Morris, M. (2001). A Handbook for Value Chain Research. IDRC. Lall, S. (2004). Reinventing Industrial Strategy: The Role of Government Policy in Building Industrial Competitiveness. United Nations Conference on Trade and Development, 28.

Kementerian Pertanian RI. (2024). Analisis Kinerja Perdagangan Kelapa Sawit. Jakarta: Pusat Data dan Sistem Informasi Pertanian.

Marks, S.V., Larson, D.F., & Pomeroy, J. (1998). Economic Effects of Taxes on Exports of Palm Oil Products. Bulletin of Indonesian Economic Studies, 34(3), 37-58. http://dx.doi.org/10.1080/00074919812331337410.

Rifin, A. (2009). Export Competitiveness of Indonesia's Palm Oil Product. Trends in Agricultural Economics, Asean Network for Scientific Information.

Rifin, A. (2010). The Effect of Export Tax on Indonesia's Crude Palm Oil (CPO) Export Competitiveness. Asean Economic Buletin, 27(2), 173-184. http://dx.doi.org/10.1355/ae27-2b.

Raid & Sanders. 2023. Operations Management: An Integrated Approach. New Jersey: John Wiley & Sons Inc.

Siregar, V. & Rochmawati, N. 2023. Penerapan Metode Vikor Dalam Penentuan Rekomendasi Objek Wisata Terbaik Surabaya Di Masa Pandemi COVID-19. Journal of Informatics and Computer Science: Volume 04 Nomor 04, ISSN: 2686-2220.

Sukerti, Ni Kadek. 2015. Penerapan Fuzzy TOPSIS untuk Seleksi Penerimaan Bantuan Kemiskinan. Jurnal Informatika, Vol. 15, No. 2.

Silitonga, R.Y.H., Siswanto, J., Simatupang, T., & Nur-Bahagia, S., (2016). Modeling Policy Mixed to Improve the Competitiveness of Indonesian Palm Oil Industry. Journal of Industrial Engineering and Management, 9(1): 231-253 – Online ISSN: 2013-0953 – Print ISSN: 2013-8423, http://dx.doi.org/10.3926/jiem.1582.

Teoh, Cheng Hai, 2010. Key Sustainability Issues in Palm Oil Sector. Washington DC: International Finance Corporation, World Bank Group.

Tropenbos Indonesia. 2020. ISPO Baru: Harapan Baru Bagi Penguatan Tata Kelola Sawit?. Bogor: Tropenbos Indonesia.

Tambunan, T. (2006). Indonesian Crude Palm Oil: Production, Export Performance and Competitiveness. Working Paper Series no. 8. Center for Industries and SME Studies, Faculty of Economics, University of Trisakti.

(https://gapki.id/en/news/21136/palm-oil-performance-in-2021-and-prospect-in-2022).

https://www.cnbcindonesia.com/research/20231117140611-128-489891/terkuak-ini-masalah-yang-gerogoti-produktivitas-sawit-ri