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Decision support system for determining capital investment value in biodiesel production using the net present value method

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Abstract: Biodiesel is a renewable alternative that is a biofuel for diesel engine/motor applications. It is a fatty acid methyl ester (FAME) that is produced from vegetable oil or animal fat and can be renewed. The esterification/ transesterification process results in low CO2/CO2 emissions. Indonesia's energy consumption has increased by 7% annually in recent years, while the global energy consumption has only increased by 2% annually. This condition accelerates the rate of exploitation of fossil resources, including oil, natural gas, and coal, in comparison to the discovery of new reserves (replace reserves ratio). Economic calculations are conducted during the pre-design phase of a biodiesel chemical plant to ascertain the viability of investing in a biodiesel plant. The feasibility of capital investment in a factory production activity is estimated through the use of economic analysis, which involves the evaluation of capital requirements, predicted profits, payback period, taxes imposed, and break-even point. Furthermore, economic analysis is also used to ascertain the profitability of a factory that has been designed. The net present value (NPV) method is employed to develop a decision support system that simplifies the investment calculation process. In the present era of globalization, a company or investor must act promptly to make decisions and take action. The Net Present Value (NPV) method is used to assist in decision-making. The NPV method is a decision-making process that evaluates the feasibility of whether an investment is worthwhile. The value of an asset is determined by the initial purchase price and the time value of money, which are combined to calculate Net Present Value. The investment value of the SPK that has been designed is determined using the NVP procedure.

Keywords: *Biodiesel, Data analysis, Decision support system, Investment, Net present value.*

1. Introduction

Energy is a fundamental requirement for society. The function of non-renewable energy is rendered vulnerable as a result of the high energy consumption that is a consequence of the growing population. Consequently, it is imperative to optimize the potential of renewable power capabilities in Indonesia, including bioenergy (bioethanol, biodiesel, and biomass).[1]. Biodiesel is a renewable energy alternative that is a fatty acid methyl ester (FAME) made from vegetable oil or animal fat. It is a vegetable fuel for diesel engine/motor applications that can be renewed and produces low CO and CO2 gas emissions through the esterification/transesterification process.[2].

Indonesia's energy consumption growth exceeds that of the broader global energy consumption growth. Indonesia has experienced a 7% annual increase in energy consumption in recent years, while the global average is only 2%. This condition accelerates the rate of exploitation of fossil resources, including oil, natural gas, and coal, in comparison to the discovery of new reserves (replace reserves ratio). Indonesia's crude oil production has decreased by 5% to 6% per year, while the country's national energy consumption has increased by 7% annually due to the country's economic and population growth rates. [3].

Economic calculations are conducted during the pre-design phase of a biodiesel chemical facility to ascertain the feasibility of its establishment. Economic analysis is employed to determine the feasibility

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of capital investment in a factory production activity by examining the break-even point, predicted profits, repayment period, taxes imposed, and capital requirements. In addition, economic analysis is employed to ascertain the profitability of a factory that has been designed.[4]. The anticipated prices of equipment, raw materials, and requirements for 2024, the year in which the factory is scheduled to be established, are the primary focus of this literature review.

In a study conducted by Hernawan and Zuhri [5] The economic analysis of a biodiesel factory with a capacity of 360,000 tons/year, which is based on coconut oil and methanol, has yielded the following results. The net profit is Rp 472,492,397,094. The ROI before and after tax in previous investigations is 25.32% and 18.99%, respectively. The results of the POT before and after tax are 2.8 years and 3.4 years, respectively. The BEP score is 49.23%. This investigation determines the necessity for precise capital calculations, apparatus, and raw materials.

The development of contemporary business industries is significantly influenced by information technology (IT). IT facilitates the automation of general administration, inventory management, supply chain management, and business processes. Companies can enhance employee productivity and decrease operational expenses by implementing appropriate IT systems. Additionally, information technology facilitates organizations' ability to promptly adapt to market fluctuations. Integrated information systems facilitate the development of more effective production, distribution, and marketing strategies by allowing companies to make decisions based on real-time data. The data required for a comprehensive business analysis is provided by IT. Companies can make more informed and expeditious strategic decisions by employing business intelligence and data analytics techniques.[6] .

Information technology is also necessary for decision support systems. In the current era of globalization, it is imperative for a company or investor to act promptly in order to make decisions and take action. The Net Present Value (NPV) method is used to assist in decision-making. The NPV method is a decision-making process that evaluates the feasibility of whether an investment is worthwhile. [7]. The present value of a project, asset, or investment is estimated by NPV, which is based on the anticipated future cash inflows and cash expenditures, adjusted for interest rates and the initial purchase price. The value of an asset is determined by the initial purchase price and the time value of money, which are combined to calculate Net Present Value.

2. Related Literature

The potential for the widespread adoption of biodiesel to effectively reduce detrimental emissions is present; however, external influences such as unstable oil prices, limited availability of raw materials, and insufficient government support present obstacles.[8]. Addressing concerns regarding feedstock availability, pricing stability, and policy support can facilitate the widespread adoption of biodiesel. This will facilitate the realization of substantial environmental benefits and contribute to the development of a more sustainable and environmentally benign biofuel.[9].

Malaysia has implemented a biodiesel mandate program to further the development of the palm oil-based biodiesel industry, which has become increasingly significant in response to the global demand for alternative fuels. Nevertheless, the industry's expansion has not been as robust as anticipated as a result of a variety of obstacles, such as fluctuations in the prices of crude oil and palm oil, modifications to subsidy policies, and increased scrutiny of sustainability concerns. Consequently, these have become impediments to any prospective new investments in the biodiesel industry. It is crucial for neophyte investors to have a tool that can virtually experiment with various economic scenarios in order to ascertain their impact on the industry, particularly in terms of investment value.[10].

Adiwidya Muhammad Sofwan, Dendy Pramana Putra, and Lukman Efendi have conducted numerous successful studies in the field of SPK for investment value. [11] The NPV method was successfully implemented as a financial analysis of the feasibility of the Mixue franchise business. This method provides a net financial assessment of the company after deducting other costs, allowing the value of the increase or lack of existing company money to be used as a reference for evaluating the company's financial feasibility.

NPV (Net Present Value) is the methodology employed in SPK. This investigation [12] Develop and evaluate the outcomes of the NPV method on the decision support system for the assessment of the

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feasibility of micro, small, and medium-sized enterprises (MSMEs). The Waterfall Method is in use in the system development process. The data employed is from the fashion sector's MSME data. The outcome is that the NPV method can be implemented on the DSS, resulting in an NPV value of 2156862.745098. This indicates that the NPV value is either positive or greater than zero. Consequently, the MSME can be executed and the feasibility test can be successfully completed.

The Decision Support System for Determining the Feasibility of Secondary Crop Farming Businesses was developed to facilitate the rapid and effortless feasibility analysis of farming enterprises by farmers. [13]. The Break Even Point (BEP), Return Cost Ratio (R/C), Net Present Value (NPV), and Internal Rate of Return (IRR) are the four components of a farming business analysis. Frequently, farmers are uncertain about the profitability of their agricultural operations and the potential revenue they can generate. This is due to the fact that farmers do not initially conduct a business investment analysis, or in this instance, a farming business analysis, to ascertain the viability of their farming business. Frequently, this is not performed because farmers are unaware of how to conduct an agricultural business feasibility analysis, or if they are aware of the process, manual calculations will require an extended period of time. The Decision Support System for Determining the Feasibility of Secondary Crop Cultivation Business was developed to facilitate the rapid and effortless analysis of the feasibility of agricultural businesses by farmers.

3. Research Methodology

This flowchart delineates the research stages that will be implemented and provides a comprehensive overview of the research. Stages of research that will be implemented include:

3.1. Preparation

During this phase, three activities are implemented: literature studies, research objectives, and problem formulation. I am in search of references regarding the concept of investment in biodiesel production. I am in search of references in periodicals that pertain to the biodiesel production process and the utilization of the Net Present Value method in decision support systems. The research proposal contains problem data that is the output of this activity.

3.2. Data Acquisition

Interviews and direct observations are implemented to ascertain the data requirements for biodiesel investment in this investigation, which pertains to a biodiesel production facility. Beginning with the initial capital, equipment, basic materials, employee salaries, taxes, and profits of a single production. In order to acquire data regarding investment value and profit. This activity yielded primary and secondary research data.

3.3. Data Analysis

Upon the acquisition of primary and secondary data, the net present value method is employed to conduct multiple analyses in order to determine the bias and truth values in the calculation using the formula.

3.4. System Design

In order to establish a decision support system, the numerical results of the net present value formula are incorporated into the Python programming code. Calculations are implemented to evaluate the system's suitability. The investment value of biodiesel production is determined by a decision support system, which generates the results of this activity.

3.5. Documentation

A report is generated to document and record all activities..

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3.6. System Development Methods

The present value of the income stream generated by an investment is known as Net Present Value (NPV). NPV is the outcome of subtracting discounted costs. [14]. This NPV analysis is employed to determine the extent to which the investment value considers the currency value and illustrates the disparity between the present value of profits and expenditures. [15]. The following equation illustrates the net present value (NPV) formula [16]:

$$NPV = \sum_{t-1}^{t} \frac{C_t}{(1+r)^t} - C_0$$

Information:
NPV = Net Present Value (Rp)
CFt = Cash flow each year in period t
K = Interest rate (discount rate)
I0 = Initial investment
t = years t
n = number of years

The System Development Life Cycle (SDLC) method with the Rapid Application Development (RAD) paradigm is employed in the development of a decision support system for determining the investment value of biodiesel production.

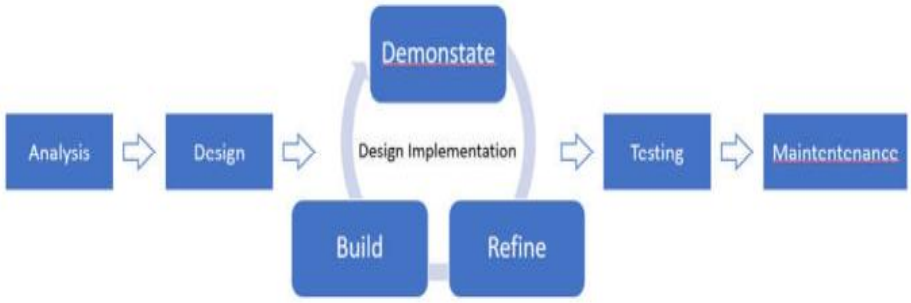

Figure 1.
Rapid application development (RAD) model.

The rationale for employing this approach is that the system project must be constructed with minimal risk. Initially, developers construct a system prototype and evaluate its functionality prior to its release in the RAD methodology. This assists developers in the early identification of issues and errors, thereby minimizing the likelihood of the system malfunctioning during operation.

3.7. System Design

The data processing sequence shown in the process diagram is used to determine investment data using the NPV method in a decision support system. The software development tools are employed to design the decision support system. Visual Studio Code is employed to generate the implementation results (Coding) of the PHP programming language. The subsequent Figure illustrates the process diagram.:

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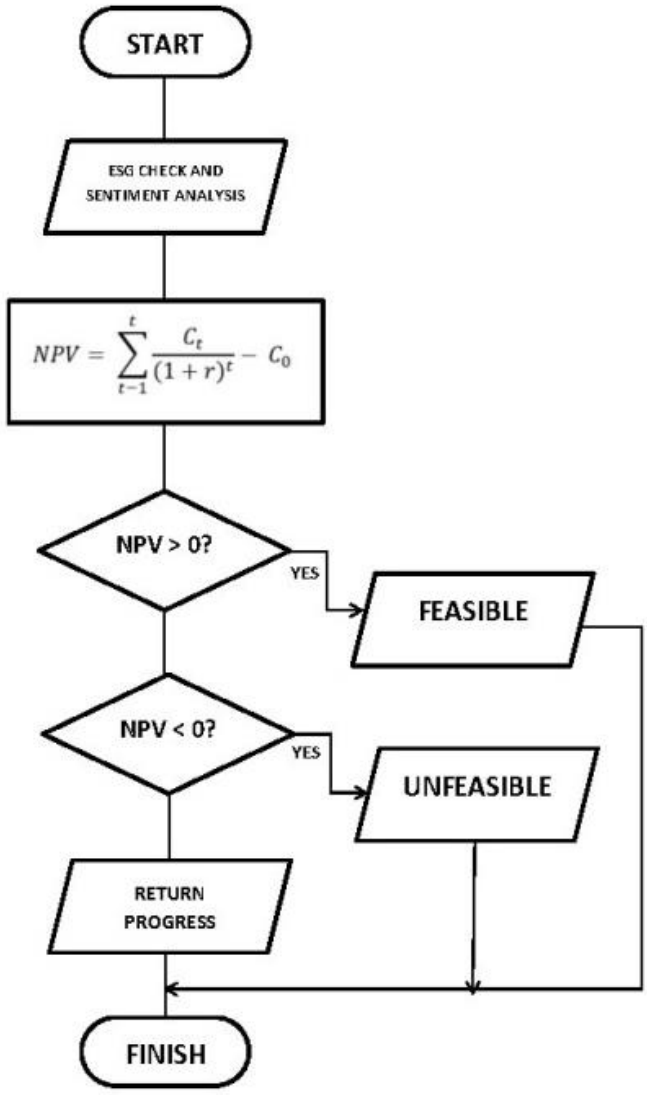

Figure 2.
Process diagram and flowchart of SPK investment value in biodiesel production.

4. Results of the Study

The preparation, data acquisition, and analysis stages are the initial phases of the research process. There is a strong and consistent synchronization among these three phases. The Decision Support System for the Assessment of the Investment Value (feasibility) of Capital in Biodiesel Production The Net Present Value (NPV) Method is employed to facilitate decision-making by utilizing sentiment data for the 2022-2023 period. The initial data sources were obtained from the Ministry of Energy and Mineral Resources (ESDM) and https://palmoilina.asia/. The initial data collected included the investment value (in USD) and capacity (in kiloliters) of all biodiesel companies in Indonesia. The data depicted in the accompanying image:

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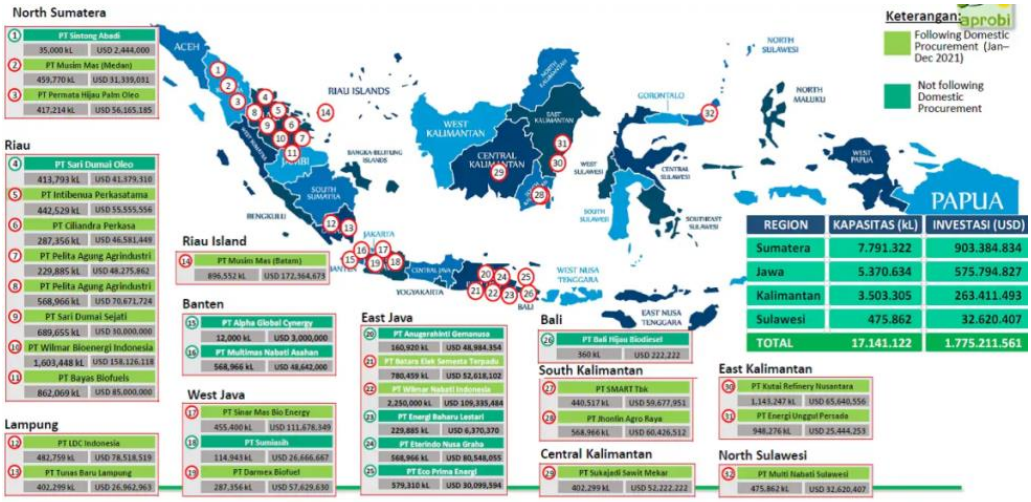

Figure 3.
The distribution of PT biodiesel in Indonesia.
Source: https://palmoilina.asia/wp-content/uploads/2023/02/Distribusi-Produsen-Biodiesel-di-Indonesia.webp.

The distribution of 32 biodiesel enterprises in Indonesia is limited to only four regions/areas, as illustrated in the image above: Sumatra, Java, Kalimantan, and Sulawesi. Nevertheless, there is only one enterprise in the Sulawesi region. Therefore, this investigation exclusively employed data from three regions: Sumatra, Java, and Kalimantan. This is due to the fact that the data from the Sulawesi area is biased, which can affect the SPK value when determining the feasibility of an investment.

Tabel 1.
Illustrates the investment value and capacity.

Region	Capacity (Kl)	Investment (Usd)
Sumatra	7.791.322	903.354.834
Java	5.370.634	575.794.827
Kalimantan	3.503.305	263.411.493
Sulawesi	475.862	32.620.407
Total	17.141.122	32.620.407

The disparity between the capacity and investment values of the Sulawesi area is so significant that this study does not incorporate data from that region. The following data illustrates the distribution of each investment value within the company, as indicated by the summary of the data values:

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	CAPACITY (kl)		INVESTMENT (USD)
NORTHA SUMATRA			
PT Sintong Abadi	30,000	USD	2,440,000
PT Musim Mas	459,770	USD	31,339,031
PT Permata Hijau Palm Oreo	417,214	USD	56,165,185
RIAU			
PT Sari Dumai Oreo	413,793	USD	41,379,310
PT Inti Benua Perkasatama	442,529	USD	55,555,556
PT Celiandra Perkasa	287,356	USD	46,581,449
PT Pelita Agung Agrindustri	229,885	USD	48,275,862
PT Pelita Agung Agrindustri II	568,966	USD	70,671,724
PT Sari Dumai Sejati	689,655	USD	30,000,000
PT Wilmar Bioenergi Indonesia	1,603,448	USD	158,126,118
PT Bayas Biofuels	862,069	USD	85,000,000
LAMPUNG			
PT LDC Indonesia	482,759	USD	78,518,519
PT Tunas Baru Lampung	402,299	USD	26,962,963
RIAU ISLAND			
PT Musim Mas (Batam)	896,552	USD	172,364,673

	CAPACITY (kl)		INVESTMENT (USD)
EAST JAVA			
PT Anugerahinti Gemanusa	160,920	USD	48,984,354
PT Batara Elek Semesta Terpadu	780,459	USD	52,618,102
PT Wilmar Nabati Indonesia	2,250,000	USD	109,335,484
PT Enertgi Baharu Lestari	229,885	USD	6,370,370
PT Eterindo Nusa Graha	568,966	USD	80,548,055
PT Eco Prime Energi	579,310	USD	30,099,594
BALI			
PT Bali Hijau Biodiesel	360	USD	222,222

SOUTH KALIMANTAN			
PT Smart Tbk	440,517	USD	59,677,591
PT Jhonlin Argo Raya	568,966	USD	60,426,512
CENTRAL KALIMANTAN			
PT Sukajadi Sawit Mekar	402,299	USD	52,222,222
WEST KALIMANTAN			
PT Kutai Refinery Nusantara	1,143,247	USD	65,640,556
PT Energi Unggul Persada	948,276	USD	25,444,253

	CAPACITY (kl)		INVESTMENT (USD)
BANTEN			
PT Alpha Global Cynergy	12,000	USD	3,000,000
PT Multimas Nabati Asahan	568,996	USD	48,642,000
WEST JAVA			
PT Sinar Mas Bio Energy	455,400	USD	111,678,349
PT Sumiasih	114,943	USD	26,666,667
PT Darmex Biofuel	287,356	USD	576,299,630

REGION	CAPACITY (kl)		INVESTMENT (USD)
SUMATERA	7,791,322	USD	903,384,834
JAWA	5,370,634	USD	575,794,827
KALIMANTAN	3,503,305	USD	263,411,493
TOTAL	16,665,261	USD	1,742,591,154

Figure 4.
Illustrates the distribution of investment value and capacity data among all companies.

Sentiment data for each company is also required for this study. This data is obtained through online data news monitoring. This procedure employs the Support Vector Machine (SVM) method of Neural Language Processing. This information is crucial for evaluating the company's positive and negative attributes. The information obtained is presented in the form of online news, as illustrated in the accompanying image:

Figure 5.
Sentiment analysis data sources.

Sentiment data is crucial for the system to substantiate the decision results it generates, enabling users to obtain a comprehensive understanding of the company's status through public information. Document filtering, a process that eliminates portions of unprocessed documents that are irrelevant or devoid of significance for the classification process, is one of the activities that are implemented during this phase. Therefore, in this section, researchers exclusively employ the headline (Main Title) of each online news article. Additionally, the process of correlating cases in a document is performed, which is known as case folding. This is implemented to simplify the process of conducting searches. Additionally, tokenization and word sorting are implemented to ascertain positive and negative values.

Decision Support System Developed with Python as the foundational programming language and VScode as the compiler text editor. The system's initial display necessitates that users select supporting

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data based on the current period. Then, choose the criteria that you wish to employ. There are three criteria that can be employed: environmental, social, and governance, or ESG. Companies that intend to invest must adhere to the ESG framework, which encompasses environmental, social, and governance factors. This concept is employed as a measurement instrument to assess the social and sustainability implications of the company's investments. Companies that adhere to this standard will incorporate these three criteria into their investment decision-making and business operations. In essence, this concept evolved as a consequence of the growing recognition among investors of the significance of a sustainable business model. The recognition of this concept as a critical guideline in the long-term business decision-making process is facilitated by this awareness. ESG is a critical factor in business and investment as it enables companies to mitigate risk, establish a positive reputation, and have a beneficial effect on society and the environment. It is essential to have a more profound comprehension of this concept in order to guarantee that companies and investors can make a meaningful contribution to a more sustainable world. By taking into account three primary factors: environmental, social, and governance, ESG criteria emphasize sustainable business practices. Each criterion is described below:

4.1. Environmental Criteria (Environmental)

The company's operations' impact on the natural environment is the subject of environmental criteria. This encompasses practices such as the conservation of natural resources, the reduction of pollution, the utilization of renewable energy sources, and the management of waste. The potential negative effects on the business are mitigated by incorporating environmental factors into the company's risk management. It also contributes to the evaluation of the company's operations by taking into account their dedication to environmentally favorable practices. The company benefits from environmental conservation by enabling sustainable business operations that are bolstered by a healthy environment in the long term.

4.2. Social Criteria (Social)

The company's interactions with external parties, such as communities, society, suppliers, consumers, the media, and other entities, are the primary focus of social criteria. This can have a direct impact on the financial performance of the company. The manner in which the organization addresses social issues can have an impact on its reputation. For instance, the organization must take a proactive approach to the challenges, rights, and concerns that employees and workers encounter. The standard's evaluation is significantly influenced by the organization's capacity to adapt and contribute positively to social issues.

4.3. Criteria for Corporate Governance (Governance)

This criterion accentuates the organization and management of the company internally, with a particular emphasis on external relations. Corporate Governance Criteria encompasses a variety of factors, such as compliance, audit processes, company ethos, company policies, and standards. These factors can enhance the company's value by fostering investor confidence, which is facilitated by robust and transparent governance. For instance, investors consistently prioritize financial governance that is transparent, legal, and ethical.

Users may select online reference sources that will serve as references for the assessment standards after establishing the criteria to be employed. Subsequently, they may establish the intended quantity of output.

Users are obligated to identify the investment area they wish to participate in, as illustrated in the image above. Initially, there are only three areas that can be chosen: Sumatra, Java, and Kalimantan. Users have the option to select the intended company to invest in after determining the area. Then, the data will be processed by the system.

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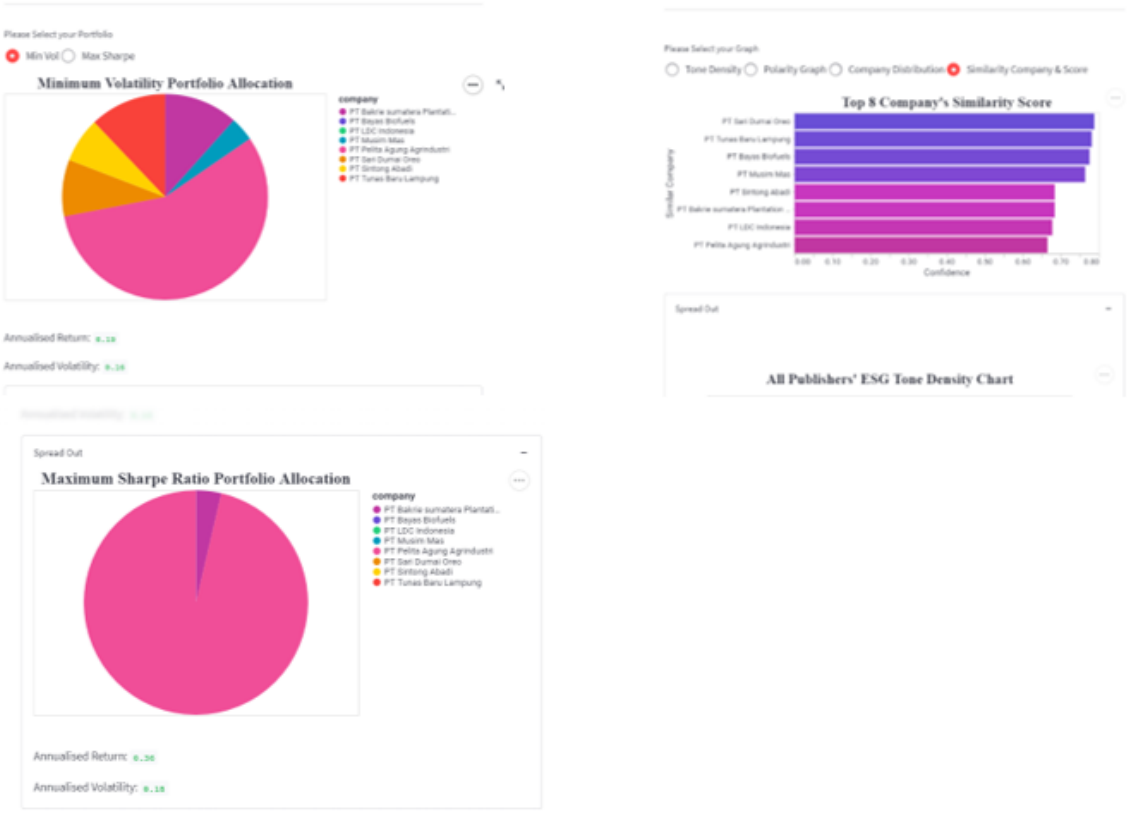

Figure 6.
Results of investment feasibility diagram.

The system will show the feasibility of investment (percentage) and offer recommendations for other companies that are also worth investing in (similarity score). Which companies are worth investing in due to their close score value.

5. Conclusion

The decision support system is developed using the Python programming language and can be implemented to assist in the assessment of the feasibility of investing in a biodiesel company in Indonesia. Stakeholders are engaged in the development of the application. Future development will incorporate additional information regarding investment-related variables, including financial standards, to ensure the acquisition of more accurate calculation data. Additionally, it is anticipated that the system will operate more efficiently and in real-time due to the modifications and enhancements.

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