Feasibility analysis of technical and environmental aspects of establishing an oil palm empty fruit bunch waste processing business unit

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Abstract. The purpose of this study was to analyze the feasibility of the plan to establish a business unit for processing OPEFB waste into briquettes and liquid smoke products based on technical and environmental aspects. The establishment of an OPEFB processing business unit will be established in the Sei Galuh PKS area, with a production capacity of 3000 kg/day and capable of producing charcoal briquette products of 644.25 kg/day and liquid smoke products of 314.11 kg/day. The business unit will be built on an area of ±767.5911 m² and consists of 12 facilities. The environmental impact caused by the establishment of this business unit can be reviewed from the physical development period of the project including land acquisition and the project operation period including waste and pollution that can be handled properly and does not cause adverse impacts on the environment around the business unit area. So that based on the technical and environmental aspects of this OPEFB processing business unit is feasible to establish.

1 Introduction

Palm oil is one of the most important commodities in the agriculture and plantation sector because of its role as the largest foreign exchange contributor commodity from the non-oil and gas sector. Palm oil is the most exported commodity, making it the largest foreign exchange contributor from the non-oil and gas sector with an export value in 2022 reaching US$ 39.26 billion. The high demand for crude palm oil (CPO) causes the expansion of the area to increase, as evidenced by the increase in export demand reaching 30.80 million tons in 2022 [1].

The high demand for CPO will cause the expansion of oil palm plantation areas to increase and the high amount of CPO processing waste produced. The processing of fresh fruit bunches (FFB) into CPO will produce gas waste in the form of methane gas (CH_4),

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liquid waste in the form of palm oil mill effluent (POME), and solid waste in the form of oil palm empty fruit bunches (OPEFB), shells, cake, fronds, and trunks that have not been optimally utilized, one of the wastes that has not been widely processed is OPEFB.

Oil palm empty fruit bunches is a solid waste that has the largest composition among other palm oil waste, which ranges from 21-23% [2]. So that in one ton of processing fresh fruit bunches into CPO will produce 210-230 kg of OPEFB. OPEFB are abundant in lignocellulosic biomass, including 66.97% holocellulose and 24.45% lignin [3]. These contents make OPEFB can be processed into charcoal briquettes and liquid smoke and PTPN V Sei Galuh which is a palm oil mill with a capacity of 14-15 thousand tons per month is able to produce 2,940-3,450 tons of OPEFB waste every month.

Briquettes are solid alternative fuels that have a certain shape and size, composed of fine charcoal particles that have been glued together with an adhesive in the form of starch [4]. Briquette products in Indonesia have long been the prima donna of exports to several countries, this is evidenced by the number of briquette exports reaching 527,514 tons in 2022 [5]. The use of the pyrolysis method in the charcoal combustion process will produce a by-product in the form of liquid smoke which has chemical content in the form of phenols, aldehydes, ketones, and organic acids that function as antioxidants and antimicrobials that can be used as preservatives, insecticides, and disinfectants [6].

The processing of OPEFB components into briquettes and liquid smoke products is very prospective to provide added value to commodities and become a solution to the handling of palm oil waste which continues to increase along with the increase in CPO production in Indonesia. Riau Province is the province with the largest CPO production in Indonesia so that it has the potential for abundant availability of raw materials, making the business very potential to be developed [7]. The establishment of a business processing OPEFB waste into briquettes and liquid smoke products requires a business feasibility analysis consisting of several aspects, to decide whether the business can be established and run properly, so that it can provide benefits as expected. One of the aspects used in analyzing business feasibility is technical and environmental aspects.

The technical aspect analysis is carried out to determine the project location, production capacity, production process, determination of technology and equipment, and project layout planning. While the environmental aspect is carried out to analyze the environmental impact caused and how to overcome it. This study was conducted to analyze the feasibility of establishing an OPEFB processing business unit into charcoal briquettes and liquid smoke in terms of technical and environmental aspects.

2 Method

The data analysis method used in this research is a qualitative analysis method. Qualitative analysis was conducted to analyze technical aspects to determine project planning and environmental aspects to analyze environmental impacts. Analysis of technical aspects includes project location, production capacity, determination of technology and equipment, production process, and project layout planning. Analysis of environmental aspects of environmental impact itself can occur during the physical construction of the project and during the production period. Environmental impacts due to the physical development period of the project can be caused by land acquisition activities and construction activities, while the production period itself will produce one or all types of solid, liquid, and even gas waste. The flow of research methods carried out in this study can be seen in Figure 1.

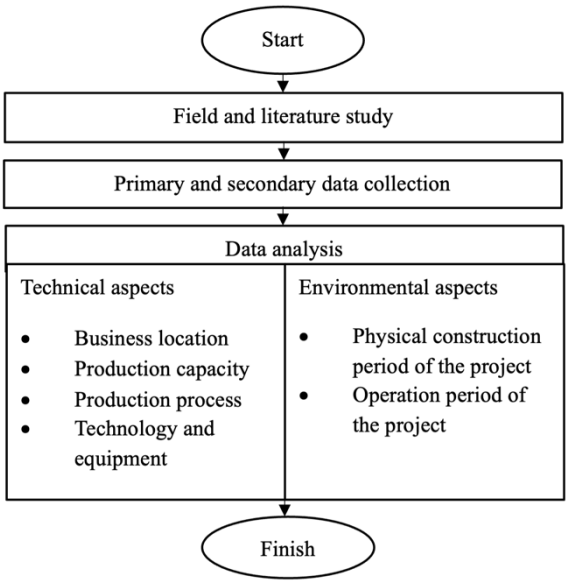

Fig 1. Flow of research implementation.

3 Result and discussion

Business location is one of the basic needs in business development that must be determined with various considerations so that when operating the business, it can run well and can survive in the long term. Some considerations that can be made in determining the location of the business are such as the distance of the business location to the available raw materials, the location of the intended market, the availability of electricity and water, labour supply, and transportation facilities with adequate roads [8]. The location of the oil palm empty bunch waste processing business unit to be built is within the Sei Galuh PKS area located on Jl. Garuda Sakti km. 19, Tapung District, Kampar Regency, Riau Province 28464.

The determination of production capacity can consider one of three things: the availability of raw materials and land, the ability of the market to absorb the product, and the technical capacity of production. Based on these considerations, the determination of the production capacity of the oil palm empty fruit bunch processing business unit can be determined from the availability of raw materials and technology. This is because the raw material used, namely OPEFB as much as 3000 kg, is the rest of the OPEFB which cannot be processed and resold by the Sei Galuh PKS and the process of burning raw materials to produce charcoal and liquid smoke is the pyrolysis method, where this method must use an indirect combustion device called a pyrolysis reactor.

A pyrolysis reactor is an indirect combustion device capable of producing two products, namely charcoal and liquid smoke. Currently, pyrolysis reactors with large capacity can only be purchased overseas. The production capacity of the business unit by considering the technical production capability is planned to produce only from raw materials of 3000 Kg per day which will be dried to leave 2,550 Kg per day of dry OPEFB. The production of 2,550 Kg of dried OPEFB per day will require two pyrolysis reactors with a capacity of 1,500 Kg which contains approximately 1,275 Kg of raw materials in one combustion for each pyrolysis reactor.

The charcoal briquette production process itself starts from sorting raw materials, drying raw materials, charring, cooling charcoal, separating, grinding, sieving, mixing, and kneading, molding/pressing, drying briquettes, and packaging. Meanwhile, the liquid smoke

production process starts with cooling, collecting, settling, separating, and packaging. The raw material for liquid smoke is the hot smoke produced during the combustion process. The hot smoke produced will be channelled through a smoke pipe that has been connected to the pyrolysis reactor and is ready to go through the process of the initial stage of liquid smoke production. The production process of charcoal briquettes and liquid smoke can be seen in Figure 2.

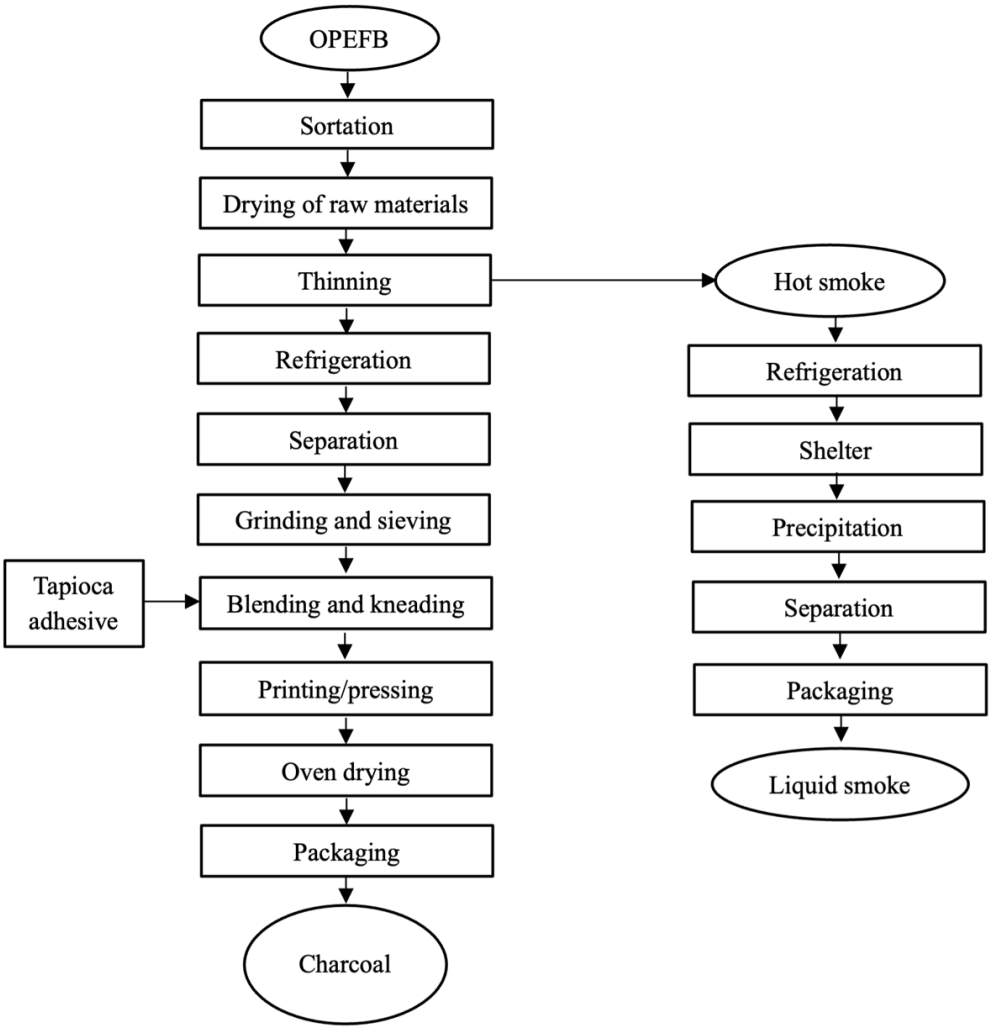

Fig 2. Production process of charcoal briquettes and liquid smoke.

The production process is carried out by preparing the available OPEFB raw material of 3 tons, through a series of production processes to produce charcoal briquettes and liquid smoke products. The net weight produced for charcoal briquette products is 644.25 kg/day or 193,275 kg/year. While the net weight produced for liquid smoke products is 314.11 kg/day or 93,233 kg/year.

The technology used to produce charcoal briquettes and liquid smoke are pyrolysis reactor, sieving machine, grinding machine, mixing machine, kneading machine, molding machine, cutting machine and conveyor, oven. While the equipment needed to support the production activities of charcoal briquettes and liquid smoke are *krisbow* trolleys, shovels, 20 kg table scales, 150 kg sitting scales, gallon taps, ear basins, 50 cm and 1 m wooden spatula and knives.

Layout is a description of all facilities that are placed as efficiently as possible with the aim of supporting each other so that the production process can run well. The empty bunch waste processing business unit project requires ±767.5911 m² with a total of 12 facilities. Planning in designing this layout is based on the type of layout determined, namely the process type or layout by process, so that the layout must be planned regarding the sequence of product processing. The design of this layout can be done using several stages such as making a chart of interrelationships between activities using an activity relationship chart (ARC) and creating an overview of proximity using an activity relationship diagram (ARD) which can be seen in Figure 3.

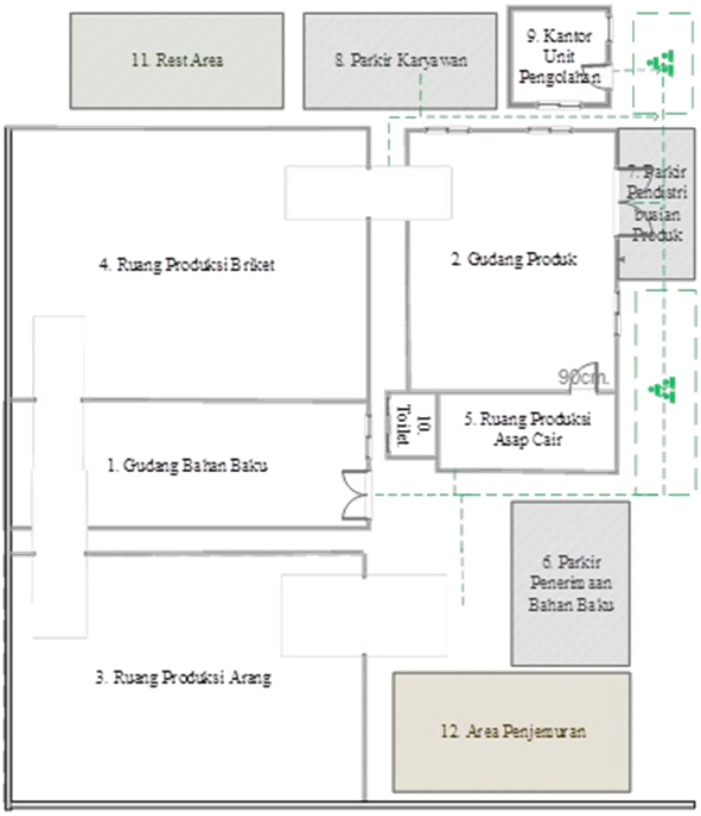

Fig 3. Layout plan.

Reviewing the environmental impact of the results of business activities carried out is one of the elements that must be considered. The environmental impact that will be caused by the OPEFB waste treatment business unit can be reviewed from the physical construction of the project and during the project operation period which can be seen in Figure 4.

The environmental impact that can occur during the physical development of the project is land acquisition to build an industrial area. The construction of the OPEFB waste treatment business unit in the Sei Galuh PKS area itself is not built on land that has trees or in residential areas but is built on vacant land which is the remaining land from the construction of the factory. The remaining vacant land will be utilized as a building for the operation of the business unit, so that the environmental impact of land acquisition does not occur.

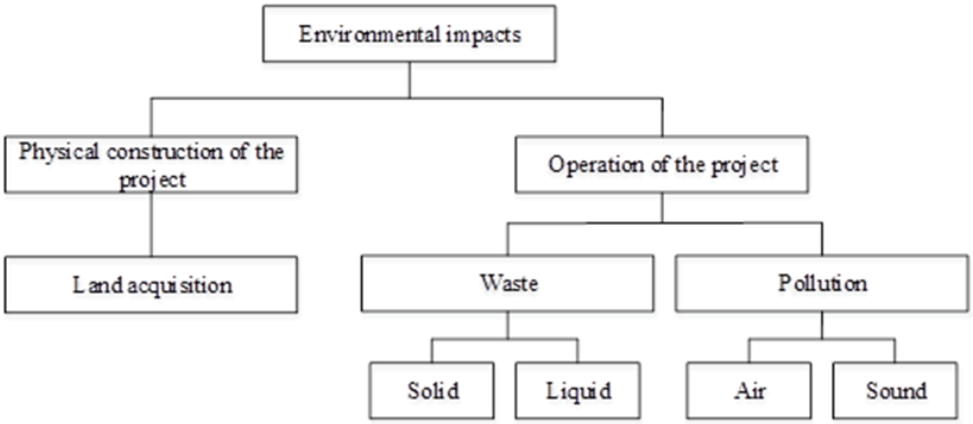

Fig 4. Environmental impact.

Solid waste generated in the operation of the business unit includes domestic waste from office activities, briquette production and liquid smoke. The following types of solid waste and how to deal with them can be seen in Table 1.

While the liquid waste generated during the operation of the OPEFB waste treatment business unit takes place such as tar produced together with liquid smoke obtained from the OPEFB pyrolysis process. The tar content will be separated from the liquid smoke in the precipitation process, so that tar sediment will be obtained which is a product of liquid waste.

Tar is a liquid waste resulting from the thermal decomposition of OPEFB from the pyrolysis process or also known as pyrolysis residue [9]. Tar is called liquid waste because it is a thick liquid that is blackish brown in color, has a very strong odor, and has a high boiling point. In addition, tar is also a hazardous liquid waste because it is carcinogenic which is harmful to the body. Waste from production process residues (tar) is considered hazardous waste [10]. Currently, tar that is recognized by the government as dangerous waste is only tar that comes from the residue of the production process of the petrochemical industry, aluminium smelting and coating, and coal processing by pyrolysis and coke production.

The handling of tar as liquid waste which is also categorised as dangerous waste is by storing tar in the dangerous Waste TPS (Temporary Storage Place) of Sei Galuh PKS. Before being stored in the Waste TPS, tar must be packaged in accordance with the applicable requirements referring Decree of the Head of the Environmental Control Agency number: Kep-01/Bapedal/09/1995. Tar packaging activities must be given symbols and labels that indicate the characteristics and types of waste and are packaged with packaging from materials that do not react with the stored waste, free from rust and leakage, and packed with a limited size of 50 kg / package. Tar that has been packaged and collected at the PKS Sei Galuh waste temporary storage place (TSP), will then be transported by waste transportation company that has collaborated with the PKS Sei Galuh.

The OPEFB waste treatment business unit in operation will produce two types of products, namely charcoal briquettes, and liquid smoke products. Charcoal briquettes are

produced from raw materials such as OPEFB charcoal and are produced by the processing unit itself. The charcoal production process produces air pollution in the form of smoke because the smoke is simply released into the air. The charcoal production process carried out by the processing unit will not produce air pollution in the form of smoke from combustion, because the hot smoke will be channelled through pipes and condensed to produce by-products in the form of liquid smoke. The process can be carried out with the help of a pyrolysis reactor machine, to realize an air pollution-free charcoal briquette industry.

Table 1. Identification of solid waste types and their countermeasures.

Type of waste	Activity	Countermeasures
Paper, organic waste, plastic	Office	Reuse, reduce, and recycle, and dispose of waste by type.
Burlap/sack	Raw materials (tapioca flour)	Can be reused as a container to place charcoal for easier transportation.
Latex masks and gloves	Liquid smoke production	Including medical waste will be disposed of in a special medical waste bin along with medical waste from the Sei Galuh PKS labor needs.

Sound pollution caused by production machine noise will certainly have the most impact on workers as operators, especially if the work is carried out with high intensity. The impact that will be caused to workers is of course hearing loss. Countermeasures that can be taken to avoid this impact are by providing safety equipment such as earplugs for workers who work as machine operators and workers who are very close to the position of the machine as a source of sound. In addition, shift changes can also be made for machine operators, to reduce the amount of time in contact with machines that are sources of noise.

Sound pollution that will affect the community itself still has a small potential, because the noise generated from machines, or all production activities is not able to reach residential areas around the industrial area. This is because the location of the guard post to the PKS Sei Galuh processing unit with residential areas is 1-2 km, so that sound pollution from all OPEFB waste processing production activities will not have an impact on the surrounding community.

4 Conclusions

Based on the feasibility analysis conducted, it can be concluded that the establishment of the OPEFB waste treatment business unit is feasible to be established in terms of technical and environmental aspects. Based on technical aspects, the establishment of an OPEFB processing business unit will be established in the Sei Galuh PKS area, Kampar Regency, Riau Province. The capacity of this OPEFB processing business unit is 3000 kg/day and through a series of product processes will produce charcoal briquettes of 644.25 kg/day and liquid smoke of 314.11 kg/day. The establishment of this OPEFB processing business unit is planned to be built on an area of ±767.5911 m². Based on environmental aspects, the establishment of this business unit does not result in land acquisition during the physical construction of the project, can cope with solid and liquid waste as well as air and noise pollution caused during the project operation period.

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