International Journal of Renewable Energy Research-IJRER

Financial Analysis of Establishing Small-Scale Industry of Corn Cobs Briquettes in Majalengka Regency

Tjutju Tarliah Dimyati, Dedeh Kurniasih

Abstract

Since the kerosene is no longer produced in Indonesia and the price of LPG is quite expensive, people in some villages of Majalengka Regency are using wood as fuel, both for household and business activities. Whereas, as an agricultural area, there are abundant of agricultural wastes in this area which are not yet utilized. Some studies showed that the agricultural wastes can serve as an alternative renewable raw material for the production of energy, either used directly as solid fuel for cooking, or converted into charcoal briquettes. Therefore, it is necessary to consider establishing small scale biomass briquette industry in this regency, so that the abundant waste can be utilized and the energy needs of the community can be fulfilled without damaging the environment. The issue is whether the establishment of this briquette industry will be profitable for the local community? This problem is discussed in this research using several financial indicators.

Keywords

Small scale industry; briquettes; agricultural wastes; financial analysis

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Impact Factor=(649+1206+725)/(225+229+204)=3.92

International Journal of Renewable Energy Research-IJRER

Vol 10, No 1 (2020)

March

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Articles

Financial Analysis of Establishing Micro Industry of Corn Cobs Briquettes in Majalengka Regency

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Received: 09.01.2020 Accepted:19.02.2020

Abstract- Since the kerosene is no longer produced in Indonesia around 2010 and the price of LPG is quite expensive, people in some villages of Majalengka Regency are using wood as fuel, both for household and business activities. Whereas, as an agricultural area, there are abundant of agricultural wastes in this area which are not yet utilized. Some studies showed that the agricultural wastes can serve as an alternative renewable raw material for the production of energy, either used directly as solid fuel for cooking, or converted into charcoal briquettes. Therefore, it is necessary to consider establishing micro biomass briquette industry in this regency, so that the abundant waste can be utilized and the energy needs of the community can be fulfilled without damaging the environment. The issue is whether the establishment of this briquette micro industry will be profitable for the local community? This problem is discussed in this research using several financial indicators

Keywords Small scale industry**;** briquettes; agricultural wastes; financial analysis.

1. Introduction

Majalengka regency is geographically located in the eastern part of West Java, Indonesia, with the latitude of -6° 49' 59.99" S and longitude 108° 12' 60.00" E. It consists of 26 sub-districts and 343 villages, where only 47 villages (13.7%) are considered as the fast growing villages and the rest are considered as growing villages. Majalengka Regency is known as an agricultural area, with paddy and corn as its main plant. The Central Bureau of Statistics of Majalengka Regency [1] showed that during the year of 2018, the width harvested of paddy in this regency was 89,660 acres with the production of 556,315 tons, while the width harvested of dry land paddy was 1,818 acres with the production of 7,510 tons. In the same time, the land area of corn was 21,054 acres, spread over 24 of the 26 sub-districts, with the harvest area of 19,075 acres and the yield as much as 151,646 tons. This condition has made Majalengka Regency as one of the largest corn producers in the Province of West Java. Obviously, the width of the planting acreage and its productivity in this area will increase the amount of its waste, i.e. parts of the plant that are usually abandoned or discarded at the time of harvest. The wastes are usually burnt in the field, or they are left to decompose or utilized to produce livestock feed.

Due to the limitations in the availability of fossil fuel, there is a need for seeking the alternative energy source, especially on renewable basis [2,3]. One of the renewable energy source is biomass, i.e. an organic compound derived from plants, animals or microorganisms as biological material [4,5]. It also includes products and residues/waste from agriculture, forestry, industry and municipalities [6-9]. Therefore, biomass is recognized as one of the major potential sources for energy production. It is a renewable energy as it is replenished on a shorter timescale than fossil fuels [10]. As an energy resource, biomass may be used directly as solid fuel for cooking, or converted into charcoal briquettes, which are a form of solid fuel that can be burned for energy. As an alternative to charcoal, biomass briquette production relies on unused agricultural or industrial wastes, and therefore does not contribute to deforestation.

A number of studies have been conducted to make briquettes from various agricultural wastes, including sugarcane bagasse [11], Durian peel [12], corn cobs [13], and jackfruit peel [14]. The results of their research show that the type of waste and the composition of the binder material used will affect the quality of the briquette, such as easiness of ignition, the strength of flame, and the ash content.

A number of economic analysis have also been conducted. Among others were Atif Khan [15] who studied the feasibility of biomass gasification for electricity generation, Pallav Purohit and Vaibhav Chaturvedi [16] who studied the financial viability of biomass pellet for power generation, Aries Roda D. Romallosa and Eckhard Kraft [17] who analyzed the profitability of briquette production by utilizing the municipal waste, and Y. Utsugi, S. Obara, Y. Ito and M. Okada [18] who discussed the economic aspects of installing renewable generator in Hokkaido, Japan. Their works revealed that the utilization of biomass would be beneficial if it meets certain conditions related to the population size, the industrial scale, the availability of raw materials etc.

The purpose of this research is to conduct the financial feasibility analysis of establishing a micro industry of corn cobs briquette in Majalengka Regency. Corn cobs are chosen as the raw material because they are available in abundance at this regency. This micro industry is intended to be performed by the local community whose most of them are farmers. Given the level of education and their economic is relatively low, the manufacture of briquette will be done using simple and low cost technology.

2. Materials and Methods

2.1 Materials and Equipment

The material used was corn cobs and cassava starch to be used as binder. Corn cobs were collected from the local farmland along Majalengka Regency, especially in the northern regions. For every 1 kg of dry corn produced, about 0.15 kg of cobs, 0.22 kg of leaves and 0.50 kg of stalks are produced [19]. With the average production rate of corn in Majalengka Regency as much as 151,646 tons/year [1], the corn cob that can be collected is about 22,746.9 tons/year. Cassava starch was obtained from the local market in a large amount, since the production of cassava in this area in the year 2018 is 4,101 tons [1].

The equipment consists of Carbonization kiln, which is a simple drum with perforated fire tube in the center, Grinding machine, Mixer, and Briquette press machine, as shown in Figure 1.

Fig. 1. The equipment used.

2.2 Briquetting Process

The corn cobs were sorted and dried to reduce the moisture content so that the carbonization will effectively run. This drying process causes a reduction in the weight of corn cobs around 5%. Dried corn cob was then carbonized for about 50 minutes to ensure it was completely carbonized, after which it was pulverized using grinding machine. This process generates powdered cobs as many as 1/3 parts of processed materials.

The powdered cobs was mixed with starch with a ratio of 90%:10% as it was suggested in [20]. Once cooled, the materials were then formed and compacted in the hot briquette press machine. To avoid cracking, the densified briquettes were sundried until the moisture content reached less than 10% as the wet basis. The mix of 9 kg powdered cobs and 1 kg starch produce 9 kg briquettes.

Dried briquettes were then burned to observe its properties, such as the easiness of ignition, the strength of flame, the volatile matter, and the time required to boil 250 mL of water, as shown in Figure 2.

3. Financial Projections

3.1 Basic Calculation

The establishment of the briquette industry in Majalengka Regency aimed to meet the needs of households and small businesses of local residents, so that the financial analysis will be done to fit the micro industry. Under the Republic of Indonesia Law number 20 year 2008 about micro, small, and medium enterprises, the criteria of micro enterprise are as follows [21]:

a. Has *net worth* at most IDR 50,000,000. 00 (fifty million Rupiah) excluding land and business premises; or
b. Have the *annual sales result* at most IDR 300,000,000.00 (three hundred million rupiah).

It is further explained that what is meant by "net worth" is the result of a total reduction in the value of business wealth (assets) with the total value of liabilities, excluding land and business premises, whereas the "annual sales result" is the result of net sales derived from the sale of goods and business services within a year of the book.

Currently, the currency conversion unit of 1 US $ = IDR 14,000. Therefore, the “net worth” for the micro industry is equivalent to US $3.572 and the “annual sales result” equivalent to US $21.428. The average current selling price of corn briquette is IDR 6,000 or US $0.428/kg. Therefore, to reach the *annual sales result* of US $21.248, the necessary production of briquette is 50,000 kg/year.

Fig. 2. The process of briquetting and testing.

3.2 Basic Assumptions

Financial projections were conducted to evaluate the economic and financial viability of the business. Some basic assumptions are set to be used in the calculation. The underlying assumptions are:

a. The project takes 10 years
b. Building lifetime is 10 years
c. The value of the factory land is fixed
d. Equipment lifetime is 10 years
e. Auxiliary tools lifetime is 3 years
f. The salvage value of the equipment is zero
g. The selling price of briquettes on the market is fixed, i.e. IDR 6,000 or US $0.428/kg
h. The production rate during the first year is 80% of the production capacity
i. The interest rate is 14% /year
j. Business license fee is IDR 500,000 or US $35.8

3.3 Estimated Costs and Incomes

To perform the briquette production in the capacity of 50,000 kg/year, the estimated investments are as follows:

a. 1 unit of grinding machine for US $1,428
b. 1 unit of mixer for US $1,428
c. 1 unit of briquette press for US $1,285
The total equipment's cost is then US $4,141

d. Auxiliary tools (carbonization kiln and briquette stove) for US $357
e. Factory building of 30 m2 for US $5,357
f. 100 m2 of land for US $2,143

The carbonization process generates powdered cobs as many as 1/3 parts of processed materials (see section 2.2). That is, as many as 150,000 kg of corn cobs are needed to produce 50,000 kg briquetts/year. However, since corn cobs are still considered garbage that has no selling value, then the procurement cost of the corn cobs comprise only the transportation costs from the plantation to the location of the factory. It is assumed that the carriage of cob from the plantation to the factory will be done using trucks with a capacity of 3 tons, and the transportation costs is IDR 200,000 per shipment. Then the procurement cost of corn cob is IDR 10 million or US $714,3/year. The quantity of cassava starch needed to produce 1 kg of briquettes is 1/9 kg. Currently, the price of the starch is IDR 10,000/kg. Thus, to produce 50,000 kg of briquettes will cost IDR 55,555,556 or US $3,968/year. These estimations result in the total materials cost of US $4,682.3/year.

This micro industry is planned to be run by 5 people with average monthly income of IDR 2 million. Thus, the labor cost is IDR 120 million/year or US $8,571.5/year. Another operational cost is the cost of electricity. For the electricity power of 4400 volts, the cost is IDR 12 million/year or US $857/year. Miscellaneous expenses, such as occupational safety and health, office stationery, security, and cleaning service are estimated at IDR 1 million/month or US $857 per year.

As the selling price of briquette is US $0.428/kg and the production output in the first year is 80% of the capacity, then the sales income in the first year is US $17,120. Starting the second year, the sales income will be US $21,400.

3.3 The Cash Flow

Based on the above data, the cash flow for micro industry briquette is as shown in Table 1, while the net cash flow diagram is shown in Figure 3.

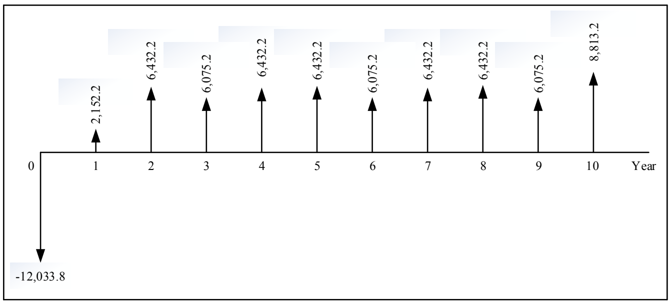

Fig. 3. Net cash flow diagram

Table 1. Cash flow for 10 years' production (in US $)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Business Licensing fee	35,8										
Factory Building	5357										
Factory Land	2143										
Equipment	4141										
Auxiliary tools	357			357			357			357	
Raw materials		4682,3	4682,3	4682,3	4682,3	4682,3	4682,3	4682,3	4682,3	4682,3	4682,3
Labor cost		8571,5	8571,5	8571,5	8571,5	8571,5	8571,5	8571,5	8571,5	8571,5	8571,5
Energy		857	857	857	857	857	857	857	857	857	857
Miscellaneous expenses		857	857	857	857	857	857	857	857	857	857
Total Out Cashflow	12033,8	14967,8	14967,8	15324,8	14967,8	14967,8	15324,8	14967,8	14967,8	15324,8	14967,8
Sales		17120	21400	21400	21400	21400	21400	21400	21400	21400	21400
Salvage value											2381
Net Cash Flow	-12033,8	2152,2	6432,2	6075,2	6432,2	6432,2	6075,2	6432,2	6432,2	6075,2	8813,2

3.4 The Financial Indicators

To analyze the profitability of the project, three indicators of financial analysis were evaluated, i.e. NPV, IRR, and the Payback Period [22] [23]. Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. It is used in capital budgeting and investment planning to analyze the profitability of a projected investment, and is calculated by:

$$NPV = \sum_{t=1}^{n} \frac{R_t}{(1+i)^2} \quad (1)$$

where
R_t = Net cash inflow – outflow during single period
i = Discount rate of return that could be earned in alternative investment
t = Number of time period

The internal rate of return is a discount rate that makes the net present value (NPV) of all cash flows from a particular project equal to zero. IRR calculations rely on the same formula as NPV does. The formula is:

$$0 = NPV = \sum_{t=1}^{T} \frac{C_1}{(1+IRR)^t} - C_0 \quad (2)$$

where
C_t = Net cash inflow during the period t
C_0 = Total initial investment costs
IRR = The internal rate of return
T = The number of time period

The payback period refers to the amount of time it takes to recover the cost of an investment. The desirability of an investment is directly related to its payback period. Shorter paybacks mean more attractive investments. The formula is:

$$Payback\ Period = \frac{Initial\ Investment}{Net\ Cash\ Flow\ per\ period} \quad (3)$$

4. Result and Discussions

4.1 The characteristics of the briquette

To determine the characteristics of the briquette produced, some tests have been done to measure some physical properties, after which they were compared to the Indonesian National Standard requirements for briquette fuel (SNI 01-6235-2000) [24]. The result is shown in Table 2.

Table 2. The characterization of briquette produced

Properties	Content	Units	SNI 01-6235-2000
Moisture content	3.68	%	Less than 8
Volatile matter	11.04	%	Less than 15
Ash content	4.15	%	Less than 8
Fixed carbon	80.21	%	Not listed
Calorific value	5663.5	Cal/g	At least 5000
Ignition time	30.20	Seconds	-
Burning time	16.56	Minutes	-
Water boiling time	5.14	Minutes	-

The moisture content is calculated as the ratio of evaporated water's mass compared with sample's mass before heating. It affects the quality of briquette, where the lower the moisture content the higher the heat value and the combustion power. The formula is:

$$MC = \frac{W_1 - W_2}{W_1}\ x\ 100\% \quad (4)$$

Where: W_1 = initial weight
W_2 = weight after drying

The volatile matter or often called a flying substance, affect the combustion of briquettes, i.e., the perfection of combustion and intensity of fire. The assessment is based at the ratio or comparison between the carbon content (fixed carbon) with flying substances, which is called the fuel ratio. The higher value of the fuel ratio will reduce the amount of carbon burned in briquettes. The formula is:

$$VM = \frac{W_1 - W_2}{W_1}\ x\ 100\% \quad (5)$$

Where: W_1 = original weight of the sample
W_2 = weight of sample after cooling

The ash content of the briquette is determined by burning the briquette sample till all the sample become ash. The ash was then cooled and weighted. The ash content is determined as percentage of the resulted ashes compared with the original sample. The higher the ash content, the lower the quality briquette because high ash content can reduce the value of the heat of the briquette. The formula is:

$$AC\ (\%) = \frac{W_2}{W_1}\ x\ 100 \quad (6)$$

Where: W_2 = weight of ash after cooling
W_1 = original weight of dry sample

The fixed carbon is the solid combustible residue that remains after briquette has been heated and the volatile matter is expelled. The fixed carbon provides is an indication of solid fuel heating value. Lower content of carbon in solid fuel results into longer cooking time due minimal release of heat energy. The formula is:

$$FC\ (\%) = 100 - (\%\ VM + \%\ AC + \%\ MC \quad (7)$$

Where: VM = initial weight
AC = weight after drying
MC = Moisture Content

The calorific value (or heating value) is the standard measure of the energy content of a fuel. It is defined as the amount of heat released when a unit weight of fuel is completely burnt and the combustion products are cooled. The ignition time is the time taken for briquette to catch fire. It was recorded using a stopwatch. The burning time is the time taken for briquette to burn completely to ashes, while the water boiling time is the time taken for 100 gr of briquette to boil 250 mL of water using small stainless cups and domestic briquette stove.

4.2 The Financial Indicators

Formula (1), (2), and (3) were used to calculate the three financial indicators, which gave the results as the Net Present Value (NPV) is US $17,891.8, the Internal Rate of Return (IRR) is 41%, and the Payback Period (PP) is 2.57 years.

4.3 Sensitivity Analysis

Sensitivity is an analysis to evaluate the change of investment parameters, which will affect the investment decision, so that the change can be anticipated. Sensitivity analysis is usually performed due to changes on one of the investment parameters, i.e. the amount of investment, the income, the expenditure, or the interest rate.

For the case where the amount of investment increase 50%, the net cash flow becomes as shown in Table 3. In this case the NPV becomes 11,874.9. That is, the project is still feasible.

For the case where the income decrease 15%, the net cash flow becomes as shown in Table 4. In this case the NPV becomes 1,711.21. That is, the project is still feasible.

For the case where the expenditure increase 20%, the net cash flow becomes as shown in Table 5. In this case the NPV becomes 2,277.03. That is, the project is still feasible.

For the case where the interest rate is 40%, the net cash flow becomes as shown in Table 6. In this case the NPV becomes 321.15. That is, the project is still feasible.

Table 3. Cash Flow after investment increase 50%

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total Out Cashflow	18050,7	14967,8	14967,8	15324,8	14967,8	14967,8	15324,8	14967,8	14967,8	15324,8	14967,8
Sales		17120,0	21400,0	21400,0	21400,0	21400,0	21400,0	21400,0	21400,0	21400,0	21400,0
Salvage value											2381,0
Net Cash Flow	-18050,7	2152,2	6432,2	6075,2	6432,2	6432,2	6075,2	6432,2	6432,2	6075,2	8813,2

Table 4. Cash Flow after the income decrease 15%

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total Out Cashflow	12033,8	14967,8	14967,8	15324,8	14967,8	14967,8	15324,8	14967,8	14967,8	15324,8	14967,8
Sales		14552	18190	18190	18190	18190	18190	18190	18190	18190	18190
Salvage value											2381
Net Cash Flow	-12033,8	-415,8	3222,2	2865,2	3222,2	3222,2	2865,2	3222,2	3222,2	2865,2	5603,2

Table 5. Cash Flow after the expenditure increase 20%

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total Out Cashflow	12033,8	17961,36	17961,4	18318,36	17961,36	17961,36	18318,36	17961,36	17961,36	18318,36	17961,36
Sales		17120	21400	21400	21400	21400	21400	21400	21400	21400	21400
Salvage value											2381
Net Cash Flow	-12033,8	-841,36	3438,64	3081,64	3438,64	3438,64	3081,64	3438,64	3438,64	3081,64	5819,64

Table 6. Cash Flow for the interest rate is 40%,

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total Out Cashflow	12033,8	14967,8	14967,8	15324,8	14967,8	14967,8	15324,8	14967,8	14967,8	15324,8	14967,8
Sales		17120	21400	21400	21400	21400	21400	21400	21400	21400	21400
Salvage value											2381
Net Cash Flow	-12033,8	2152,2	6432,2	6075,2	6432,2	6432,2	6075,2	6432,2	6432,2	6075,2	8813,2

5. Conclusions

There are two main conclusions of this research. The first is that the material composition and the process of briquetting conducted in this research has resulted in products that meet the Indonesian National Standard requirements.

The second, it is feasible to establish a micro briquette industry in Majalengka Regency, with the Net Present Value (NPV) US $17,891.8, the Internal Rate of Return (IRR) 41%, and the Payback Period (PP) 2.57 years. The sensitivity analysis showed that the project is remained feasible with the 50% increase of investment, or 15% decrease on the sales income, or 20% increase on the expenditure, or when the interest rate is 40%.

Establishing the micro corn cobs briquette industry in Majalengka Regency will not only improving the local community welfare but also will reducing the agricultural waste that cause environmental damage.

Acknowledgements

Acknowledgements are meant to the Indonesian Ministry of Research, Technology and Higher Education, Directorate General of Research and Development which has funded this research based on SK No. 7/E/KPT/2019 date 19 February 2019 and the contract agreements No. 2652/L4/PP/2019 dated 19 March 2019.

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