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Analysis on the Use of Bioenergy from Corncob Waste to Increase People's Economic Condition in Tantom Angkola Subdristrict Tapanuli Selatan Regency

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Abstract. *The increase production of corn (Zea Mays L.) with an average was 9.192.22 tons/year and potential waste reached 130.95 tons/year causes the amount of corncob waste to be abundant in Tantom Angkola Subdistrict, Tapanuli Selatan Regency, in general farmers immediately dispose and accumulate waste only. Seeing the opportunity of waste that can be used as bioenergy raw materials, has useful value and can help people's economic. The existence of technology can produce briquettes, gas and bioethanol. Based on the results of this research corncob waste can produce briquette mass of 52.38 tons/year, gas of 94.91 tons/year and bioethanol of 18.62 liters/year. In the prospect of potential bioenergy by developing business in the use of waste, its applicable technology is corncened with briquette and bioethanol.*

Keywords: *bioenergy, corncob waste, people's economic condition, regional development*

Abstrak. Peningkatan produksi jagung (Zea Mays L.) dengan rata-rata sebesar 9.192,22 ton/tahun dan potensi limbah mencapai 130.95 ton/tahun menyebabkan jumlah limbah tongkol jagung melimpah di Kecamatan Tantom Angkola, Kabupaten Tapanuli Selatan. Pada umumnya masyarakat langsung membuang dan menumpukkan limbah saja. Melihat peluang limbah yang bisa dipergunakan sebagai bahan baku bioenergi, memiliki nilai guna dan dapat membantu perekonomian masyarakat dengan adanya teknologi dapat menghasilkan briket, gas dan bioetanol. Maka berdasarkan hasil penelitian limbah tongkol jagung dapat menghasilkan massa briket sebesar 52.38 ton/tahun, gas sebesar 94.91 ton/tahun dan bioetanol 18.62 liter/tahun. Prospek potensi bioenergi dengan pengembangan usaha pemanfaatan limbah, teknologi yang layak untuk dijalankan adalah briket dan bioetanol.

Kata Kunci: Bioenergi, limbah tongkol jagung, pengembangan wilayah, perekonomian masyarakat

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1. Introduction

Corn waste includes straw and cobs. The use of corn straw is increasingly popular for animal feed, while for cobs there is no use of economic value. Corn waste contains lignocellulosic material which has potential for future products development. Estimating the real potential of corn waste energy, the use of corncobs for fuel purposes is about 90% while stem and leaf waste is about 30& of the existing potential.

Often, untreated waste will cause environmental pollution. The potential for waste energy in corn is very large and is expected to continue to increase in line with the government's program to increase corn production nationally

Rios et al, in [1] optimization of the utilization of corn waste is needed to open up new economic opportunities so as to provide added value for farmers and help improve energy security, especially in developing countries. Utilization of waste as raw material for bioenergy such as palm shells, corn cobs, wood powder, according to Djafar et al, [2] rice husk is carried out using technology to produce products such as briquettes, gas and bioethanol.

Bioenergy is a component key and strategic path in the struggle to achieve Sustainable Development Goals (SDGs) which are the development and application of renewable energy must be in accordance with the sustainable development goals of realizing clean and affordable energy. Consumption development renewable energy in 2017 to 2023 it is predicted that bioenergy consumption will be the most widely used.

Processing alternative energy sources has benefits for human and has many advantages, including unlimited sources, economical, efficient, environmentally friendly and renewable. We should start to think from now on to make our lives and future generations will be better off. It is necessary to provide education, counseling, guidance and cooperation from all parties in the development and implementation this alternative energy source.

This study was conducted to analyze the potential of corncobs waste as a bioenergy raw material, the potential for bioenergy produced and the prospects for the potential of bioenergy on the economy of the community in Tantom Angkola Subdistrict, Tapanuli Selatan Regency. The data from this study can be used as a basis for research studies on the concept of using bioenergy with corncob waste and community guidelines for utilizing small scale energy.

2. Method

The basic method used in this research is descriptive research method with a quantitative approach. Secondary data in the form of written references, and data sources of this study were

obtained from Badan Pusat Statistik (BPS) Tapanuli Selatan Regency which consisted of data on harvested area and corn production in the last 5 years, books and journals related to the research.

2.1 Waste Availability Analysis

The method used to calculate the total waste of corn plants that can be used as raw material is by calculating:

$$W = pi \times ha \times dmi \quad (1)$$

Where pi = production index (0.1), ha= harvest area, dmi= dry material index (0.9)

2.2 Potential Energy Analysis

Measuring the amount of energy contained in the results of utilizing corncob waste as briquettes [3], gasification and bioethanol are:

$$P\ briquett = briquett\ mass \times energy \quad (2)$$

The amount of syngas obtained is based on

$$m_{syngas} = \frac{\eta_{gasification} \times m_{biomess} \times HHV_{biomess}}{100\%\ x\ LHV_{syngas}} \quad (3)$$

Bioethanol produced by corncob waste can be calculated using the equation

$$P\ bio-ethanol = waste\ corncob \times yield\ ethanol \times energy \quad (4)$$

2.3 Economic Analysis

Economic analysis is useful to know the feasibility of a business that consist of calculation are production cost, Benefit/Cost (B/C) ratio and Return of Invesment (ROI), thus impacting the economy of the people in Tantom Angkola Subdistrict, Tapanuli Selatan Regency.

3. Result and Discussion

Corn production in Tantom Angkola Subdistrict was fluctuated based on the results of data analysis. Production in the last 5 years can be seen in Table 1 below.

Table 1 Corncobs waste potential result

Year	Harvest area (ha)	Waste potential (tons/year)
2016	166.80	15.01
2017	1260.40	113.43
2018	2306.00	207.54
2019	1391.00	125.19
2020	2151.00	193.59
Average	1455.04	130.95

Based on Table 1 above, it can be seen that the average harvested area of corn in Tantom Angkola Subdistrict is 1455.04 ha with an average waste potential is 130.95 tons/year. The significant increase in maize production is due to easy techniques, easy cultivation methods and the increasing market demand for maize.

The amount of corn waste in this area is very potential for the development of the utilization of corncob waste to be used as alternative energy, this waste is generally used by farmers as a pest repellent by burning. In addition, farmers will dispose of the corn cobs after harvesting.this is in accordance with [4] who stated that agricultural waste is often disposed of through open burning or disposed of in a place that causes environmental problems.

Corns with a planting age of 140 days that has been harvested by farmers will usually be processed into dry shelled corn which is sold to farmers corn collector. In Tantom Angkola Subdistrict there are 3 corn collectors, which usually buyers who come from outside the city such as Padang city will come directly to the peeled corn collectors in Lumban Ratus, Purba Tua and Panabari. Price of dry shelled corn sold by farmers ranged from 3.500 – 4.000 IDR per kilograms.

3.2 Bioenergy Potential from Corncob Waste in Tantom Angkola Subdistrict

The average ratio of potential energy produced from each utilization with briquettes, gasification and bioethanol can be seen in Table 2 below.

Table 2 Energy potential result

Types of technology	Production (ton/year)	Energy (MJ/years)
Briquette	52.38	152.532,88
Gasification	94.91	268.899,06
Bioethanol	18.62	227.180,76

Based on Table 2 briquette which can be produced from corncob waste is 52.38 tons/year, while for the energy is 152.532,88 MJ/year. Potential of gas produced from corn crop waste using gasification produced is 94.91 of gas tons/year, with energy 268.899,06 MJ/year. Bioethanol 18.62 ton/year with an average calorific energy of 227.180,76 MJ/year.

One of the methods of processing biomass into fuel that can be applied is briquettes. By briquettes, smoke and soot forming elements can be minimized, better combustion quality and more practical application. In the gasification process, the result is gas that can be used to drive a motor and can be used as a generator electricity.

Research about gasification [5] use leather inside seeds that become waste from the process of grinding coffee, and cane pulp waste as raw material for gasification. The process of making bioethanol can through three ways, hydrolyzing lignocellulose into sugar, fermenting sugar into ethanol and ethanol purification with chemical hydrolysis process using dilute sulfuric acid.

Consumption of fuels such as gasoline or diesel used by people in Tantom Angkola Subdistrict everyday an average of 1 liter, where the energy demand of 4.234 households is 5.978,573,12 MJ/year. The energy produced by bioethanol cannot be meet the energy needs of this region, but can meet the energy of one village consisting of 156 households with a total need of 215.779,20 MJ/year, so it can be concluded that the use of waste corncobs in meeting energy needs in Tantom Angkola Subdistrict still not enough**.**

3.3 Prospects of Bioenergy Potential to Increase People's Economic

Utilization of this waste is expected to be able to improve the economy of the people's in Tantom Angkola Subdistrict. The results of the economic analysis of making bioenergy can be seen in Table 3 below.

Table 3 Economic Analysis Results

Descriptions	**Briquettes**	**Gasification**	**Bioethanol**
Invesment (IDR)	62.248.600	156.378.000	130.569.200
B/C Ratio (Ratio)	1.3	0.98	1.4
ROI (Percent)	27	0.47	38
Information	Feasible	Infeasible	Feasible

Based on Table 3 it can be seen that the development of the briquettes and bioethanol business is considered feasible because it can provide benefits for the people's and open new jobs in Tantom Angkola Subdistrict. Corn farmers in Tantom Angkola Subdistrict have a net income is 1.200.000 IDR with a land of 0.5 ha and corn production of 1.2 tons.

That income used for consumption households such as health, education, electricity, food and clothing of 1.050.000 IDR, so that remaining income is 150.000 IDR, it can be seen that the income earned during one planting period is spent on finance farmer households.

Utilization of corncob waste as bioenergy can increase Gross Domestic Regional Product (GDRP). Potential of existing agricultural sectors if managed properly and developed so as to reduce regional economic inequality. One of the steps of bioenergy development that can be used by utilizing Bumdes program, which this existence can create economic benefits. The contribution of Bumdes will usually be driven by the village government which will eventually provide welfare to the community [6]. BumDes can have function in accordance with Undang-Undang No. 6 Tahun 2014 concering of villages, with developing villages as partners [7].

4. Conclusion

Corncob waste potential in Tantom Angkola Subdistrict, Tapanuli Selatan Regency reaches 130.95 tons/year. Utilization of cob waste as an alternative with the use of technology obtained briquettes can produce briquettes of 52.38 tons/year and energy of 152.532,88 MJ/year, gasification produces 94.91 tons of gas/year and energy 268.899,06 MJ/year and bioethanol produces 18.62 tons/year and energy 227.180,76 MJ/year. Prospects of developing a bioenergy business from corncob waste that are feasible to run as a business are briquettes and bioethanol.

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