

Waste Potential Analysis As a Source Of Electrical Power Plant And Creative Product To Support Tourism (Case Study in Kepulauan Seribu)

Resa Taruna Suhada^{a,*} and Indra Al-Mahdy^a

^aIndustrial Engineering Department, Mercu Buana University Jakarta 11650

Abstract

Waste can be used for energy sources from waste gas or composting. Energy can also be obtained from burning waste that can not be processed by incineration for power plants (PLTSa). Besides, garbage can also be used for the manufacture of creative products such as bags, bags or wallets from used coffee wrappers or also the use of waste paper for the manufacture of containers and invitations or paper ornamental paper. The waste in the Kepulauan Seribu is numerous and consists of two types of garbage: household and industrial waste and waste from the sea. Considering the condition of garbage in Kepulauan Seribu it needs to be analyzed about the potential of garbage as the fuel of garbage power plant and creative product to support tourism in Kepulauan Seribu District Administration. The steps taken are calculating the volume and types of waste in the Kepulauan Seribu, then calculating the energy owned by garbage and calculating the economic potential for the creative product from the waste. After that it will analyze energy potential and economic potential of waste. The final result of this research is expected to know the potential of garbage for the fuel of garbage power plants and creative products. In 2016, with a population of 4745 people, there is a potential power generated of 30.46kW, or simply can be used for about 40KK with 900VA installed power. For 2016, with a population of 4,745, or equivalent to 1,000 households, the economic potential of around Rp 3,000,000 / day or 90,000,000 / month can be utilized as an additional source of income of Rp 90,000 / month / kk. When looking at a limited segment of 20% or 200 families from the community in need, then the value of Rp 450,000 / month can be an additional income for them.

Keywords: Waste, Waste Energy Potential, Wasted Economic Potential

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1. Introduction

As the population grows, the waste problem becomes a very important thing to overcome. DKI Jakarta as the capital of the Republic of Indonesia has not been able to overcome the waste as a whole. In 2014, 3% of waste in DKI Jakarta was sorted and partially utilized, 7% sorted and then disposed and 80% not sorted. (Indonesian Central Bureau of Statistics 2014)

Law No. 18 of 2008 on Waste Management and Government Regulation No. 81 of 2012 mandates the need for a fundamental paradigm shift in waste management from the collecting paradigm - transport - dispose into processing which relies on waste reduction and waste management. Waste reduction activities are aimed to ensure that all levels of society, both government, businesses and the wider community carry out waste limitation activities, recycling and reuse of waste or better known as Reduce, Reuse and Recycle (3R). However, this

3R activity still faces major obstacles, namely the low awareness of the community to sort waste. One solution to overcome the problem is through the development of Bank Trash which is a social engineering activity that teaches the community to sort waste and raises public awareness in waste processing wisely and in turn, will reduce waste transported to the landfill. In some areas, there have been community members who built garbage banks. This activity is the beginning of fostering the collective consciousness of the community to start sorting, recycling, and utilizing the waste because the waste has a good selling value, so that environmentally sound waste management becomes a new culture of Indonesia.

Previous research mentioned that waste can be used for various things, including for economy, environment and energy. One of the utilization of waste is to use it for Power Plant [1]. This power plant can be by burning gas produced by organic waste (National Standardization Body - BSN, 1994) or from landfill gas [2].

Kepulauan Seribu District Administration is an administrative district in the Special Capital Region of

* Corresponding author. Tel.: +60 19-285-0467

E-mail address: resatarunas03@gmail.com

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Jakarta, Indonesia. Its territory includes a group of islands in the Bay of Jakarta.

The district already has an incinerator but the heat from the incinerator has not been utilized for power generation. For certain garbage such as packets of coffee, paper or plastic then there is the opportunity to create a creative production activities center that can be used as a typical product of tourism in Kepulauan Seribu.

Based on the above background, this research will analyze the potential of waste as a fuel of waste power generation and creative product.

2. Literature Review

• Definitions

Waste is all waste produced by human and animal activities in the form of solid, sludge (sludge), liquid or gas discharged because it is not needed or unwanted things. Although they are deemed to be useless and unwanted, the material can sometimes still be recovered and used as raw materials [3].

Waste management: Waste management as a whole is the waste that does not interfere with health, aesthetics, and the environment. Handling includes how to move from source, process, and recycle again [3].

Waste Management [3]: Is a systematic, comprehensive, and continuous activity that includes waste reduction and handling

1. Garbage is regulated in Constitution No.18/2008
2. Household waste
3. Household waste
4. Specific waste

Household waste (Constitution No.-18/2008): Garbage derived from daily household activities, excluding stools and specific waste.

Waste management has several objectives:

1. Improve environmental health and community
2. Protecting natural resources (water)
3. Protecting socio-economic facilities
4. Supporting the development of strategic sectors.

Community participation: Without the participation of waste generating communities, all planned waste management programs will be in vain. One approach to the community is able to assist government programs in cleanliness of how to familiarize the community with the behavior that is in line with the goals of the program. These include:

1. How to change people's perception of orderly and orderly waste management
2. Social factors, structures, and local culture
3. Habit in waste management during this time.

Trash divided by source, such as:

- a. Trash settlement
- b. Garbage commercial area
- c. School waste
- d. Garbage construction and dismantling of buildings
- e. Garbage public facilities
- f. Domestic waste processing waste

- g. Industrial waste industry
- h. Agricultural waste

Some researcher like Y. Sukarmawati, et al. used Traveling Salesman Problem to waste collection route and show that it can reduce the distance from 3 km to 2.4km and travel time from 3.6 hours to 2.8 hours.[4]

I. Surjandari, et al. research that the phase of waste management in Jakarta based on Analytic Hierarchy Process (AHP) and Benefit-Cost ratio (B / C) is first with composting and then with incinerator.

• Trash

As the population grows, the waste problem becomes a very important thing to overcome.

• Waste Utilization

Previous research mentioned that waste can be used for various things, including for economy, environment and energy.

The results of research in Samarinda city showed that theoretically the potential utilization of organic waste is become bioethanol for 5,976.82 kL / year [5].

The results of waste management, such as Styrofoam waste, rice husks, paper, plastics and wood powder can be used as an alternative building material, and have tested the advantages, both physically and mechanically [6].

T. Oswari et al. [7] show that the economic value of waste in Depok city is Rp 187,951,800 per day. Ratnaningsih, et al. used fresh organic waste as a mixture of cow dung for biogas production. [8], Ruslan, et.al. Using trembesi leaf litter, leaves sono and alang-alang to making bokashi fertilizer [9].

• Management and Modeling of Waste Management

Law No. 18 of 2008 on Waste Management and Government Regulation No. 81 of 2012 mandates the need for a fundamental paradigm shift in waste management from the collecting paradigm - transport - dispose into processing which relies on waste reduction and waste management. Waste reduction activities are aimed to ensure that all levels of society, both government, businesses and the wider community carry out waste limitation activities, recycling and reuse of waste or better known as Reduce, Reuse and Recycle (3R).

However, this 3R activity still faces major obstacles, namely the low awareness of the community to sort waste.

It is necessary to build energy management institution from garbage in sub-district level or sub-district level so that waste generation can be reduced and pushed into minimal energy self-sufficient kelurahan for office operation (lighting) and or public facility of kelurahan (park).

Integrated Settlement Management Model:

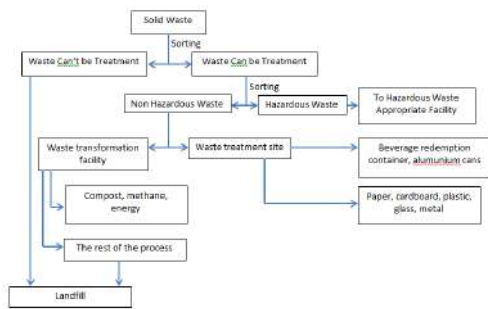


Figure 1 Integrated settlement waste management
Source: Modified based on [10]

• Garbage power plant

One of the utilization of waste is to use for Power Plant [1]. This power plant can be by burning gas produced by organic waste (National Standardization Agency - BSN, 1994) or from landfill gas [2].

The research on garbage-fueled boilers has been done by Ahsonul Anam of the Energy Technology Center - BPPT, PUSPIPTEK in 2008 with waste as fuel and kerosene as comparative fuel. Experiments with fuel waste in a result are a steady, odorless fire and time for steam formation faster than kerosene stoves [11].

Research conducted in Malaysia by Kathirvale, S., et al. [12] shows that the energy potential of an incineration plant operating with 1,500 tons of municipal waste / day with an average caloric value of 2200 kcal / kg is 640 kW / day.

From the calculation, large electric power can be generated, with an average thermal converter technology of 6 MW per unit or equal to 144 MWh and with gasification technology can generate electricity of 4,128 MW per unit or equal to 99,072 MWh, with generation efficiency equal to 30% [13].

Monice and Syafi'i research showed that in West Sumatra the use of PLTSa can save fossil energy by 7,242,000 kW per year and can be used in peak load conditions [14].

Another researcher was M. Purwaningsih showed that Waste Power Generation in Gedebage, Bandung, Indonesia if using incinerator has negative NPV value, IRR 5.22% and PBP 62.3 years [15].

Last research by D. Eko Budi Santoso and Gunawan results that the energy potential of the Waste Power Generator with Dry Anaerobic Conversion Technology is 572,910 kWh [16].

• Kepulauan Seribu

Kepulauan Seribu District Administration is an administrative district in the Special Capital Region of Jakarta, Indonesia. Its territory includes a group of islands in the Bay of Jakarta.

This district government center is located on Pramuka Island which has been functioned as the center of district

government since 2003. There are two sub districts in Kepulauan Seribu District. Administration District of Kepulauan Seribu Selatan and Administration District of Kepulauan Seribu Utara.

Kepulauan Seribu Selatan District oversees three urban villages namely Tidung Island, Pari Island Village, and Kelurahan Pulau Untung Jawa Island. North Kepulauan Seribu District oversees three kelurahan also Kelapa Kelurahan Island, Harapan Island Village, and Kelurahan Pulau Panggang.

Kepulauan Seribu District Administration has a population of approximately 21,082 people spread over eleven small islands inhabited. (BPS, 2010). The 11 islands include the Untung Jawa Island, Pari Island, Lancang Island, Pulau Tidung Besar, Pulau Tidung Kecil, Pramuka Island, Panggang Island, Harapan Island, Kelapa Island and Sebira Island. In addition to the inhabited islands, there are also some islands that serve as a tourist island, such as Bidadari Island, Onrust Island, Kotok Besar Island, Puteri Island, Matahari Island, Sapa Island, and so on.

The waste in Kepulauan Seribu consists of two types of garbage: household waste and rubbish from the sea around the thousand islands. The Kepulauan Seribu District Administration has also provided 11 (eleven) incinerators to reduce waste generation. The waste management in the Kepulauan Seribus currently not integrated and the heat from the incinerator has not been utilized as a source of energy.

Based on the above background, this research will make an analysis of the potential waste for waste generating fuel and creative products in Kepulauan Seribu District Administration.

3. Research Methods

• Research Stages

First Three Months Research

Identify the garbage problem faced by the people of Kepulauan Seribu District Administration. It also conducts literature study activities to determine methods of waste management.

Second Months Research

Map mapping and collecting data on garbage volume, waste type and waste management in Kepulauan Seribu.

Third Month Research

Analysis of potential waste for fuel power generation and creative products.

Fourth Month Research

Validation of analysis results with other references. And the creation of reports.

• The measured variable

1. Overall garbage volume
2. Volume of each type of garbage

• *Research sites*

The location of research conducted:
 Province: DKI Jakarta
 District Administration: Kepulauan Seribu
 District: Kepulauan Seribu Selatan
 Village: Pulau Tidung

4. Results And Discussion

• *General description*

1. Kepulauan Seribu

Kepulauan Seribu District Administration Government is one of the administrative areas under the Provincial Government of DKI Jakarta. Geographically, the Kepulauan Seribu District Administration is located between 106°19'30 " - 106°44'50" East Longitude and 5°10'00 " - 5°57'00" South Latitude. The total area of Kepulauan Seribu District Administration is 4,745.62 km², which consists of 8.76 km² of land, 4,690.85 km² and 46 km², comprising more than 110 islands.

Based on census data from Kepulauan Seribu Statistics 2016, the population in Kepulauan Seribu District Administration is 23,639 inhabitants, consisting of 11,816 men and 11,823 women. The rate of population growth also increased from 1.74% in 2014-2015 spread over eleven small islands inhabited. In this regency area there is also a conservation zone in the form of a national marine park called Kepulauan Seribu Marine National Park. As a region where most of the area is water and there is also a conservation zone, it is not surprising when the development of the district is more emphasized on the development of marine cultivation and tourism. These two sectors are expected to be the prime-mover of community development and the Kepulauan Seribu District Administrative Region.

Table 1

Tourist Visiting Data in Kepulauan Seribu 2010 – 2013

Year	Domestic Travelers	Abroad Traveler	Quantity
2010	226.234	4.786	231.020
2011	552.306	6.692	558.998
2012	651.237	8.422	659.659
2013	1.482.949	15.521	1.498.470

2. Sources of Waste in Kepulauan Seribu

Source of waste in the Kepulauan Seribu in general from housing, industry and from the sea. The amount of garbage that stranded on the coast has increased in line with the development in Jakarta area either in Kota / Kabupaten around the Kepulauan Seribu.



Figure 2. Garbage stranded on the beach
 Source: Photo of Kominfo and Kepulauan Seribu Statistics

The solid waste derived from household waste and industrial waste is usually inorganic waste such as bottled water bottles, plastic bags, used plastic packaging, plastic bowls, spray cans, drink cans, bottles of glass, cardboard, plastic sandals, and light bulbs. Medium organic waste in the form of wood pieces, water hyacinth, leaves, banana trees, used baskets, and others.

3. Waste Utilization

Waste handling activities (according to Law No. 18 Year 2008 on Waste Management), include: a. segregation in the form of grouping and segregation of waste in accordance with type, quantity, and / or trash nature; b. collection in the form of taking and removing waste from waste sources to temporary shelters or integrated waste treatment sites; c. transport in the form of carrying waste from a source and / or from a temporary garbage collection or from an integrated waste treatment site to the final processing site; d. processing in the form of changing the characteristics, composition, and amount of waste, and / or e. final processing of waste in the form of return of waste and / or residue of the previous processing to the environment medium safely.

4. Garbage Generation

Unit Permanent Household Permanent / person / day = 2.25 - 2.5 liters / day
 (Source: SNI 19-3983-1995)

In this research, the unit of waste generation is 2,25 liter / day.

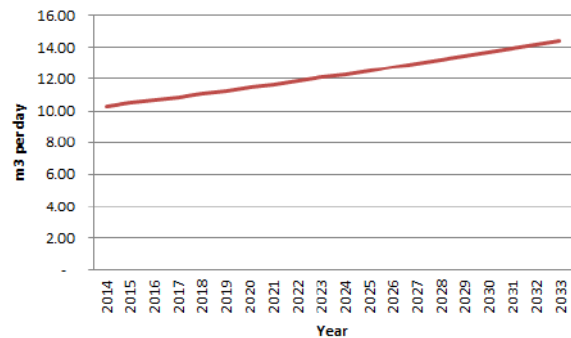


Figure 3 Graph of Waste Generation
 Source: Data Processing, 2016

5. Energy Potential

Analysis can be done on the potential energy generated if the waste is burned on the incinerator. The assumption of 95% waste is it can be burned on the incinerator. It is estimated that from 500 to 700 tons of waste or 2,000 - 3,000 m³ of waste per day will generate electricity with a power of 7 Megawatts. Using similar calculations, it is assumed that every 1 m³ of waste can produce 3 kW. So the potential energy produced is as follows:

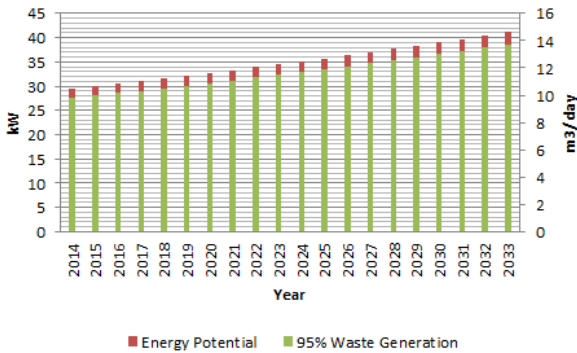


Figure 4 Graph of Waste Potential
Source: Data Processing, 2016

In 2016, with a population of 4745 people, there is a potential power generated of 30.46kW, or simply can be used for about 40KK with 900VA installed power.



Figure 5 Waste Incinerator in Kepulauan Seribu
Source: Photo of Kominfo and Kepulauan Seribu Statistics

6. The Potential of Creative Products

The economic potential of creating creative products from waste can be analyzed as follows. The waste assumption processed into creative products is 5% of waste generation and from every kilogram of waste can produce creative products such as paper bags, miniature monas / mascot thousand islands, women's handbags, or schoolboy bags from coffee packets and so on, which can be sold for Rp 20,000 for each type of product.

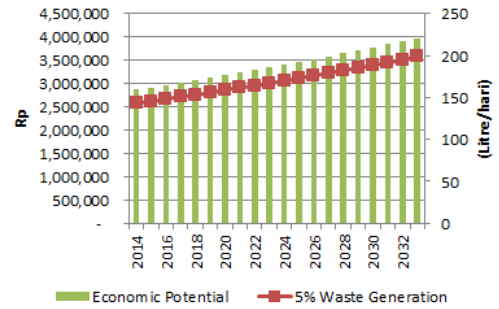


Figure 6 Graph of Economic Potential
Source: Data Processing, 2016

For 2016, with a population of 4,745, or equivalent to 1,000 households, the economic potential of around Rp 3,000,000 / day or 90,000,000 / month can be used as an additional source of income of Rp 90,000 per month. When looking at a limited segment of 20% or 200KK from the community in need, then the value of Rp 450,000 / month can be an additional income for them.

Examples of creative products from coffee wrap.



Figure 7 Creative Product from Coffee Pack Waste

5. Conclusion

Potential waste generation of more than 11.000L equivalent of 3 tons per day, 95% can be used as fuel for power plants that can be utilized for the community.

The waste power plant can supply about 4% of the community's electricity needs or 40 homes for 900kVA power capacity. Therefore, the waste power plant can be an alternative source of electrical energy.

If the waste generation of about 5% can be utilized for creative product, then there is potential economic value of creative product that can be produced by about 20% segment of society Rp 450.000 / bulan / KK. Thus the segments of the needy can earn additional income.

By utilizing the waste that is not valuable as raw material, the segment of society involved in making these creative products can further grow the creative village settlements with other products that characterize

6. Suggestion

Required studies of waste power generation are needed on a relatively small scale according to the availability of raw materials waste.

In line with the rising standard of living, it is necessary to research the form of specific creative products and the appropriate price to adjust the visitor's expectations in the developed tourism industry.

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