

# WAQF BASED WASTE ENERGY MANAGEMENT: CASE STUDY ON PLTS

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## **Keywords:**

*Garbage, PLTS, Waqf Waste; Energy;*

## **ABSTRACT**

Garbage is a classic and unsolved problem in Indonesia. According to data from the Ministry of Environment and Forestry (KLHK), Indonesia's amount of waste reaches 67.8 million tons consisting of 57% organic, 15% plastic, 11% paper, and 17 other waste. However, a garbage bank has established, even though its role still minimal compared to the City Waste Power Electric (PLTSa). By using ANP (Analytic Network Process) this qualitatively descriptive paper shows that the essential aspects from PLTSa are Institution and community. The problem of PLTSa is divided into three aspects such as expensive, 3T, and environment. In this case Waqf institutions such as education, socialization and cost. The issues of society are literacy, habits, lazy. Mapping solutions, in-depth studies, collaborations, webinars. Strategies in improving the environment security, among others, are the synergy of waqf institutions with the government, BOT system between Waqf Institutions and private businesses, and the last collaboration between waqf institutions and

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waste banks.

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## **INTRODUCTION**

Waste is currently a significant problem in the world and Indonesia, how the impact of waste is very influential on the environment, health and life (Islam, 2020). According to data from the Ministry of Environment and Forestry (KLHK), Indonesia's waste reached 67.8 million tons consisting of 57% organic waste, 15% plastic waste, 11% paper waste, and 17 other waste. The presence of waste banks brings new energy related to the problem of waste in Indonesia, but the results have not been optimal. PLTS or Municipal Garbage Power Plant is a solution to reduce the impact of the waste because it can produce electricity of 500 KW to 10 MW compare to the air power plant, which only produces 40MW to 100 MW while the Nuclear Power Plant can produce 100MW to 1200 MW of power (Abd Mutalib, 2018).

This research is descriptive qualitative with primary and secondary data. Primary data in the form of interviews via zoom with waste Waqf experts and distributing questionnaires to experts and practitioners. While secondary data is from websites related to the problem of waste Waqf and its problems, as well as from related journals and books. The analytical tool used is ANP, where this study will map the most important aspects of the problem as well as its solutions and strategies. This study uses 7 experts/practitioners who are experts in the field of Waqf and waste (Ali, 2021). This study discusses several important issues including the concept of the Waste Bank, the PLTS process into energy, the integration of waste Waqf with PLTS and the role of waste Waqf in strengthening the people's economy and improving the environment (Islam, 2020).

## **GARBAGE BANK**

What is meant by Banks in this study are Waste Banks, namely: waste that is managed similar to services in banking. Based on Law no. 18 of 2008 concerning Waste Management, states that waste is the remains of human daily activities and/or natural processes in solid form. The types of waste include, among others: household waste and similar waste originating from commercial areas and industrial areas, special areas, social facilities, public facilities and other facilities as well as specific waste. In the 1990 SKSNI, emphasized that waste must be managed properly so that it does not harm the environment and is able to maintain development investment. The Waste Management Model can be done through three approaches, namely: reduce, reuse, and recycle or often known as 3R. The problem with this 3R approach is that public awareness is still low on sorting waste. Therefore, it is necessary to process waste management using the 4R system: First, (Reduce) to reduce waste and save on the use of goods so as not to cause excessive waste. The current practice is the reduction and even elimination of the use of plastic waste. In daily shopping activities

that have been using plastic bags, are now starting to be eliminated. The implication is that consumers bring their own shopping bags made of reusable materials. Second, (Reuse) by reusing waste that can still be used. In practice, reuse of waste to be used productively is able to provide added value economically to the community. Likewise, in the environmental aspect

Third, (Recycle) by recycling waste that can still be recycled. For example, by making compost, various bags from used plastic, etc. Especially for composting waste management, according to Sulistyorini, it is necessary to go through the stages of sorting. Because what is used is a type of garbage called garbage (Wied, 2004). Fourth, (Replace) by urging residents to minimize plastic bag waste. This can be done by replacing plastic bags with everyday shopping baskets and stereo foam trash because these wastes cannot be degraded naturally. To realize this optimally, of course it takes time, resources, education and socialization to the community.

### **THE ENERGY PROCESS OF PLTS**

A waste biomass power plant or waste biomass power plant also known as PLTS is a thermal power plant based on supercritical steam and fueled by garbage or waste methane gas. Garbage and waste methane gas are burned to produce heat that heats steam in a supercritical steam boiler (Khan, 2019). The high compression steam then drives a steam turbine and a flywheel which is connected to a generator by means of a transmission gear to generate electricity (Suwandi, 2020). The power generated at this plant varies between 500 KW to 10 MW. Compare this with coal-fired power plants with a power of 40 MW to 100 MW per unit or nuclear power plants with a power of 300 MW to 1200 MW per unit (Salim, 2019).

The combustion process uses a Thermal conversion process in processing waste into energy. The work process is carried out in four stages as follow:

- (i) Waste sorting and storage. City waste amounting to  $\pm$  500-700 tons will be collected in a place called Final Processing Site (TPA), waste sorting according to the criteria needed by PLTS, this waste is then stored in a bunker that uses RDF (Refused Derived Fuel) technology. This RDF technology is useful in converting municipal waste into solid waste so that it has a high calorific value. Storage is carried out for five days until the water content is 45%, which is then followed by burning.
- (ii) Burning waste with a PLTS furnace at the beginning of its operation will use fuel oil, after the temperature reaches 850 °C – 900 °C, the waste will be put in an incinerator. The results of burning waste will produce exhaust gases containing CO, CO<sub>2</sub>, O<sub>2</sub>, NO<sub>x</sub>, and Sox. However, in the process there is also a decrease in O<sub>2</sub> levels. The decrease in O<sub>2</sub> levels at the furnace output causes the heat carried out to be reduced and this greatly affects the efficiency of the power plant

(iii) Boiler heating. The heat used in heating the boiler comes from burning waste. This heat will heat the boiler and turn the water in the boiler into steam.

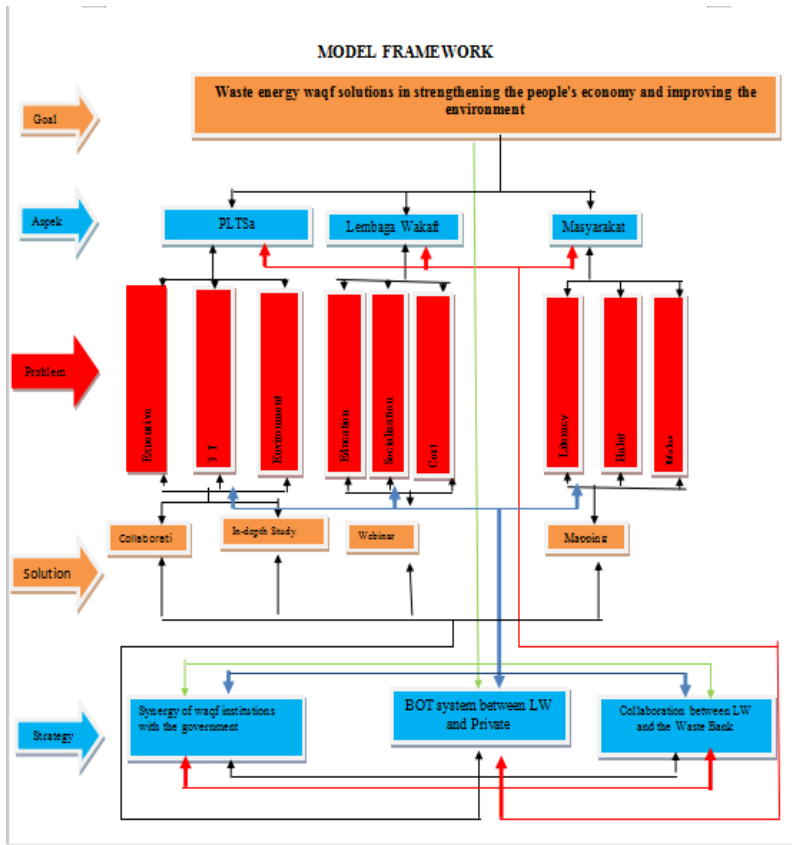
(iv) The movement of the turbine and generator and the steam created will be channeled to the steam turbine so that the turbine will rotate. Because the turbine is connected to a generator, when the turbine rotates the generator will also rotate. The rotating generator will produce electric power which will be channeled to the PLN electricity network. From the above process, the amount of waste that ranges from 500-700 tons per day can be processed into an energy source in the form of 7 Megawatts of electricity.

### **INTEGRATION OF ENERGY WASTE WAQF AND PLTS**

If the energy waste waqf is integrated with PLTS, it will encourage the community's economy to be more advanced and improve the environment. It can even make Indonesia's electricity needs in 3T (Outermost, innermost, remote) overcome by PLTSa. The electricity demand per capita in 2025 will reach 2,030 kWh/capita (BaU), 1,892 kWh/capita (PB), and 1,834 kWh/capita (RK). Meanwhile, electricity demand per capita in 2050 will reach 6,723 kWh/capita (BaU), 5,824 kWh/capita (PB), and 4,935 kWh/capita (RK). This condition is still below the electricity target per capita contained in the KEN, which is 2,500 kWh/capita in 2025 and 7,500 kWh/capita in 2050 (Sanyinna, 2017).

The number of PLTSa currently projected is 12, including in Surabaya 10 MW with 1,500 tons of waste investment 49.86 million USD, Bekasi 9 MW with a total investment of 120 million USD, Surakarta 3 locations with 10 MW, Palembang 20 MW, Denpasar 20 MW total investment 297.82 million USD with 2,800 tons of waste per day. Jakarta 38 MW with an investment of 345.8 million USD, Bandung 20 MW with an investment of 245 USD, Makassar, Manado, South Tangerang only 20 MW with a total investment of 120 million USD. 12 PLTS is capable of generating electricity of 234 MW with 16 thousand tons of waste per day. The currently operating PLTS are PLTSa Benowo (Surabaya) and PLTSa Merah Putih Bantar Gebang (Bekasi), this is in accordance with Presidential Regulation Number 35 of 2018 concerning Acceleration of Construction of Waste Processing Installations into Electrical Energy Based on Environmentally Friendly Technology (Yahya, 2008).

**Waste energy waqf strengthens the people's economy and improves the environment**

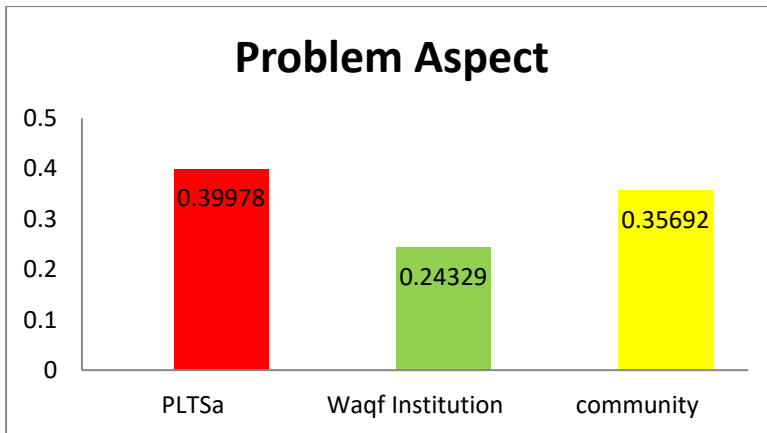


**Diagram 1 Research Framework**

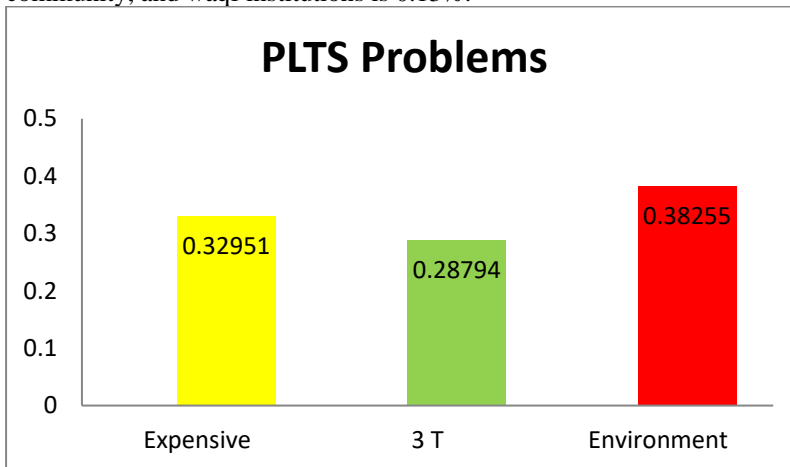
*This is the result of the energy waqf model of the waste energy waqf solution in strengthening the people's economy and improving the environment due to interviews with experts and practitioners in waste banks and waqf. The aspects obtained are PLTSA, Waqf Institutions, the community, and solutions from the three. There are also three strategies needed to strengthen the people's economy and improve the environment.*

### ANALYSIS AND DISCUSSION

In this discussion, what will describe the synthesis results in the aspect cluster to determine the solution for waste energy waqf in strengthening the people's economy and improving the environment.



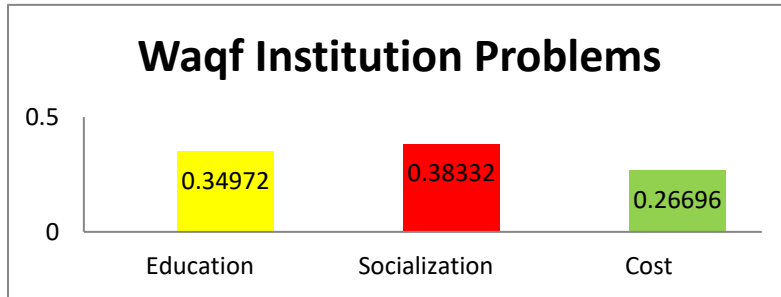
Graph 1.1 above shows that based on the combined opinion of the respondents, the most priority problem in determining the waste energy waqf solution in strengthening the people's economy and improving the environment is the PLTSa problem of 0.39, followed by the community at 0.35. Those who occupy the last order is the issue of waqf institutions of 0.24. The results of the acquisition of the rater agreement value of all respondents are 0.13%. This means that the respondents' level of agreement on the priority order of aspects of the problem in PLTSa, the community, and waqf institutions is 0.13%.



**Graph 1.2 Results of Priority Synthesis of PLTS Problems Based on the Value of Each Respondent**

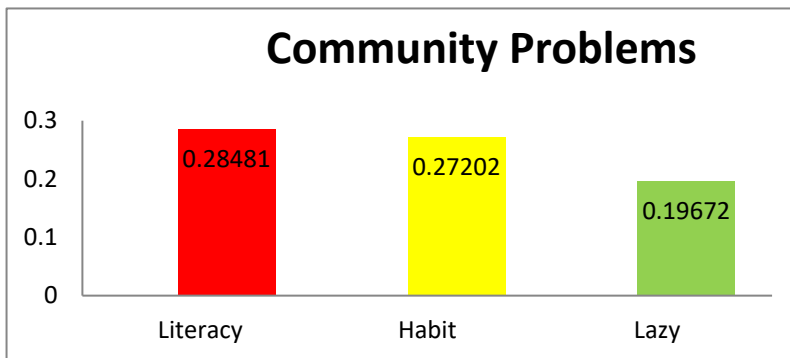
Graph 1.2. The above shows that based on the combined opinion of the respondents, the most priority PLTS problem in determining the waste energy waqf solution in strengthening the people's economy and improving the environment is the environmental problem at 0.38%, followed by the expensive problem at 0.32% and the most costly problem at 0.32%. The last place is the 3T problem of 0.28%, The result of the rater

agreement value of all respondents is 0.9%, which means that the respondents' level of agreement on the priority order of the common PLTS problem is 0.9%.



**Graph 1.3. Results of Synthesis Priority of Waqf Institution Problems Based on the Value of Each Respondent**

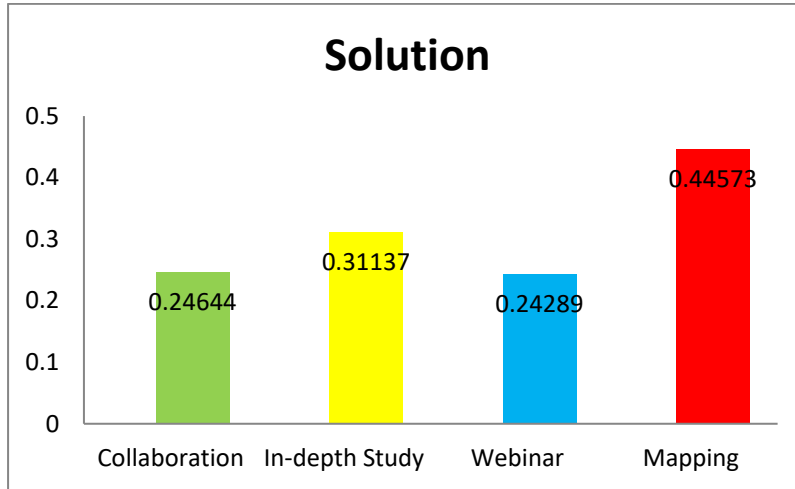
Graph 1.3 above shows that based on the combined opinion of the respondents, the most priority issue of waqf institutions in determining is the problem of socialization of 0.38, followed by the difficulty of education of 0.34, and the last place is the problem of cost at several 0.26. The result of the rater agreement value of all respondents is relatively low, namely 0.2. This means that respondents' level of agreement on the priority order of socialization, education, and cost issues is 0.2.



**Graph 1.4. Results of Synthesis of Community Priority Problems Based on Average Scores**

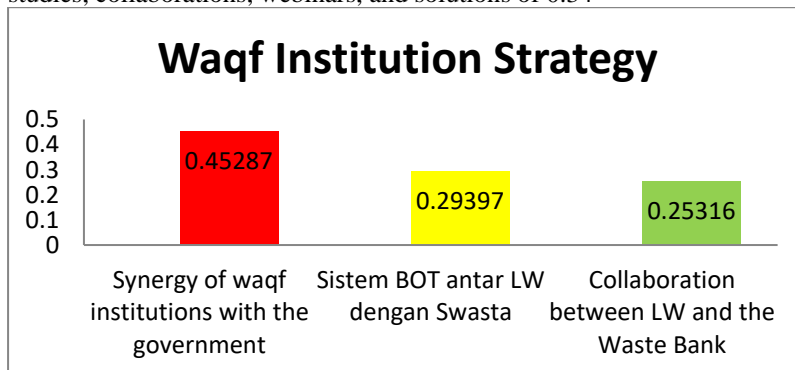
Graph 1.4 above shows that based on the combined opinion of the respondents, the most priority community problem in determining waste energy waqf solutions in strengthening the people's economy and improving the environment is literacy at 0.28, followed by habit problems at 0.27. ranks third with a small portion is the lazy problem of 0.19, the result of the rater agreement value of all respondents is 0.10, this means

that the level of agreement of respondents to the priority order of the community problems in the form of literacy, habit, lazy are low because the value reaches 0.10.



**Graph 1.5. Results of Synthesis of Priority Solutions Based on Average Values**

Graph 1.5 above shows that based on the combined opinion of the respondents, the most priority solution in determining the waste energy waqf solution in strengthening the people's economy and improving the environment is the mapping solution, which is 0.44. The second priority is occupied by an in-depth study solution of 0, 31 and the third is the collaboration solution of 0.24, and the last is the webinar solution of 0.24%. The result of the rater agreement value of all respondents is 0.34. This means that the level of agreement of the respondents is moderate to the order of priority solutions in the form of mapping solutions, in-depth studies, collaborations, webinars, and solutions of 0.34



**Graph 1.6. Results of Synthesis of Priorities Strategic Based on Average Scores**



Graph 1.6 above shows that based on the combined opinion of respondents about the most priority strategy in determining waste energy waqf solutions in strengthening the people's economy and improving the environment, namely the synergy between waqf institutions and the government of 0.45, followed by the inter-institutional BOT system. Waqf with the private sector is 0.29, and which ranks last for the collaboration strategy between waqf institutions and waste banks is 0.25. The result of the later agreement value of all respondents is 0.19. This indicates respondents' agreement on the importance of energy waqf solutions in strengthening the people's economy and improving the environment, such as the synergy between waqf institutions and the government, the BOT system between waqf institutions, and collaboration between waqf institutions and waste banks.

### CONCLUSION

It can be concluded that if waste is managed properly and properly, it will bring tremendous benefits. There are only 2 PLTS operating in Surabaya and Bantar Gebang. The results of this study indicate the importance of synergies between waqf institutions, waste banks and the government to create greater benefits for society and the environment. The most important aspects are waqf institutions, the community and PLTS with a Rather Agreement of 13 percent. The problem of PLTS is divided into three, namely expensive 3 T, the environment with a Rather Agreement of 9 percent. Problems with waqf institutions include education, socialization, costs with a Rather Agreement of 2 percent. Community problems are literacy, habit, lazy with a Rather Agreement of 10 percent.

The solutions resulting from mapping, in-depth studies, collaborations, webinars and solutions are 0.34. The strategies found included improving the environment, synergies between waqf institutions and the government, the BOT system between waqf institutions. Collaboration between waqf institutions and waste banks improves the environment, among others, by synergizing waqf institutions with the government, the BOT system between waqf institutions, and collaboration between waqf institutions and waste banks with a Rather Agreement of 19 percent.

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