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ENHANCING GREEN WAQF FOR CARBONIZATION TECHNOLOGY: OPPORTUNITIES FOR SUSTAINABLE DEVELOPMENT GOALS (SDGs) IN INDONESIA

Nurul Fatma Hasan[1], Syahruddin[2]
[1]Sunan Ampel State Islamic University Surabaya, Indonesia
nurul.fatma.hasan@uinsby.ac.id
[2]Faculty of Business Administration, Karabük üniversitesi, Türkiye
shaheeda@karabuk.edu.tr

Abstract: Introduction/Main Objectives: Green economy, a new concept of combating global warming and climate change through economic activities, becomes a prominent theme for politicians, scientists, activists, and businessmen. The main purpose of this research is to propose green economy by enhancing green waqf for Carbonization Technology. **Background Problems:** Waste countinuos to be one of the major problems facing the stable development of the economy and society. Managing waste is needed to reduce environmental damage and provide benefits for all. **Novelty:** Proposing green waqf for carbonization technology is a new concept. **Research Methods:** This research used qualitative approach by studying related literatures. **Finding/Results:** The results show that green waqf is strongly recommended to support green economy. Waqf as a charitable institution in Islam is expected to play its significant role to carry out environmental protection. Environmental protection could be achieved by waste management. Waste management by Carbonization Technology could supply renewable power and plays a crucial role in preserving the environment, improving living standards, and accelerating economic power. **Conclusion:** Enhanching green waqf for Carbonization Technology should be a prioritized program to support green economy. Hopefully, this is in line with SDG 7 (sustainable

energy), SDG 11 (sustainable cities and communities), and SDG 13 (climate action).

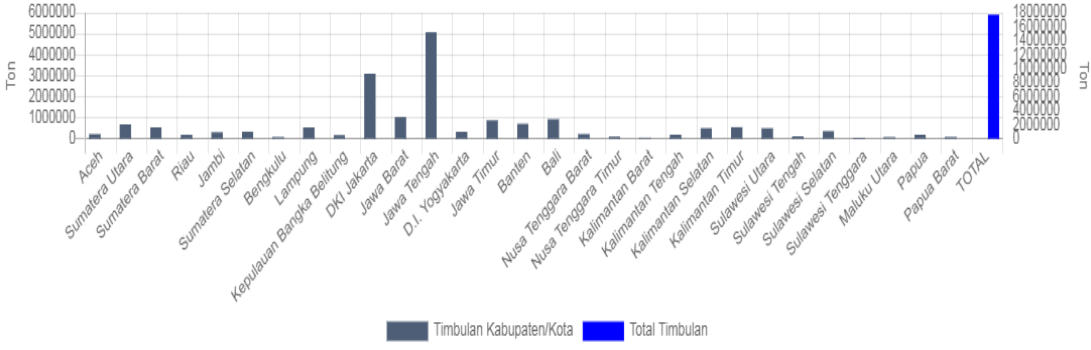
Keywords: Green economy, green waqf, carbonization technology, SDGs

INTRODUCTION

Waste countinuos to be one of the major problems facing the stable development of the economy and society. Though the development of agriculture, science, and technology plays a major role in raising living standards, but rapid urbanizations, increasing population, and industrialization also play a significant role in producing a large quantity of wastes globally. About 4 billion tons of various kinds of worldwide waste is produced every year, 1.6-2 bilion tons being municipal solid waste (Vlaskin & Vladimirov, 2018). Unfortunately, most of them are dumped untreated, which causes serious environmental and health issues (Gupta & Nguyen, 2022).

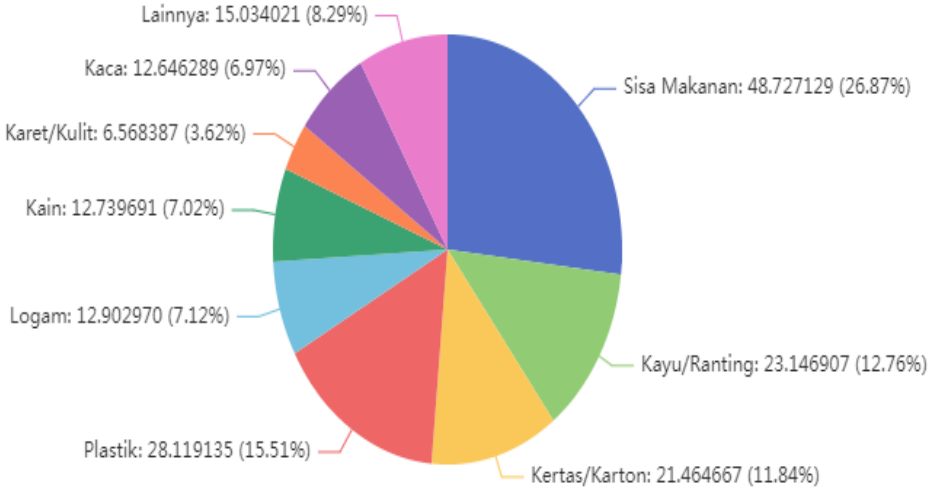
In Indonesia, the developing country, the massive amounts of waste do become a severe problem. Indonesia produces up to 50 thousand tons of waste every day or more than 18 million tons of waste every year (figure 1, 2, and 3). This reality ofcourse impacts negatively on Indonesian environment. It causes the depletion of natural resources, outbreaks of vector-borne diseases, atmospheric pollution, and climate change phenomenon. The domino effect, it also causes social and economical trouble.

Figure 1. Waste Generation in Indonesia in 2021



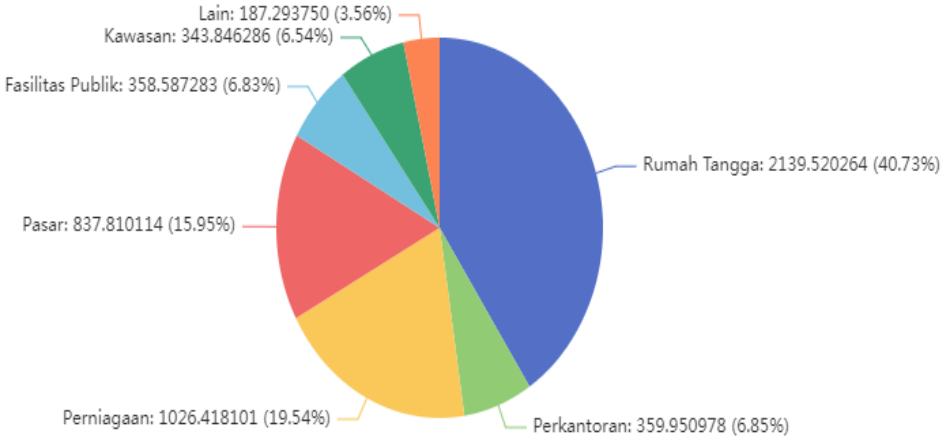
Source: Direktorat Penanganan Sampah, 2022

Figure 2. Waste Composition Based on Type - 2021



Source: Direktorat Penanganan Sampah, 2022

Figure 3. Waste Composition Based on Source - 2021



Source: Direktorat Penanganan Sampah, 2022

Thus, waste management has become an economic approach that plays a crucial role in preserving the environment and improving living standards. Waste management/treatment can be integrated alongside energy-generating technologies as a solution to handling waste as well as producing chemicals and energy. Among the treatment options available, the Hydrothermal Carbonization (HTC) method, which can process not only solid but also wet waste, has become the most preferred choice among researcher recently. The HTC eliminates energy-intensive pre-drying process needed for other treatment methods such as pyrolysis, dry torrefaction and incineration (Sharma, Sarmah & Dubey, 2020). As a magic box, during Carbonization process, the waste input become the source of energy, which the potential energy in the process is converted into heat energy. In other word, waste comes in,

activated carbon plus other organic and safe products comes out (sampangan.id, 2022).

Management waste by Carbonization Technology is an initiative startegies that supply renewable power from waste and thus mitigate climate change. It could be a valuable opportunity to achive SDG 7 – ensure eccess to affordable, reliable, sustainable and modern energy for all. Ultimately, it could create job opportunities and promote growth in Gross Domestic Product (GDP). In other word, it could be a solution for pandemic recovery. Taken from greenwaqf.org, economic growth is the impact of effort in healing and saving nature, not the other way around, economic growth that is pursued by destroying nature. This is so called green economy.

How to realize it? Carbonization Technology for waste management toward SDGs in Indonesia. Where the funds from? In Islam, the development of renewable energy based on SDG 7 and environmental conservation based on SDG 13 - take urgent action to combat climate and its impact - are God's mandate for humans as caliphs on earth according to Q.S. al-Baqarah (2) verse 30. Thus, renewable energy development and environmental presevation are suitable for investment objects with waqf schemes, called green waqf.

The green waqf itself was actually the idea of Mr. Muhaimin Iqbal who is motivated to reduce environmental damage due to global warming and carbon emissions by planting trees. Another way to reduce environmental damage and provide benefits for all is to manage sustainable waste. The most preferred sustainable waste management is Carbonization Technology. Thus, the main purpose of this research is to propose green economy by enhancing green waqf

for Carbonization Technology. Hopefully it could disclose opportunities toward Sustaianble Development Goals (SDGs) in Indonesia.

LITERATURE REVIEW

Green Waqf

The Green Waqf Project initiated by Mr. Muhaimin Iqbal is facilitating the collaboration of activists in the field of waqf, environmental, and renewable energy. It is strategic: locally, nationally, and globally. This project is very much in line with most Sustainable Development Goals. The orientation of the Green Waqf is to answer today's global issue, including climate change and energy security (WaCIDS, 2021).

Sustainable Waste Management and Carbonization Technology

Sustainable waste management refers to the collection, transportation, valorization, and disposal of the various types of waste, in a manner that does not jeopardize the environment, human health or future generations. Fundamentally, sustainable waste management entails developing a circular economy of waste, as opposed to the make-use-dispose model. In a sustainable model, waste returns as a new product or form of energy - a cyclical model rather than a linear one (Seadon, 2010).

In term of sustainable waste management, researchers have introduced carbonization technology. Carbonization technology is the heat-treatment process which combine pyrolysis and gasifaction. This is called decomposition, using heat radiation without the presence of oxygen (without burning) - thus, this process has no pollution. In a

simple term, this concept is similiar to an oven or rice cooker: no fire but heat radiation. Carbonization Technology operates at 100 to 400 ^{o}C (for comparation, traditional process needs 700 to 1200 ^{o}C). Carbonization converts organic precursors like plastics to carbon materials. It could produce hydrochar, activated carbon, carbon nanotube, graphene, carbon fibers, and carbon spheres. In general, carbonization is classified into four types: anoxic carbonization, catalytic carbonization, direct pressure carbonization, and hydrothermal carbonization (HTC) (Ardhistira, et.el, 2020).

Previous Studies

Many researchers have focused on the concept of cash waqf and its allocation for combating global warming and climate change, called green waqf. For example, research tittled "Enhancing Waqf Forest Sustainability through Agroforesty" by Jannah et.al. They said that based on Sustainable Forest Management (SFM) goals, agroforesty practices in waqf forest are estimated to extend forest resources, increase biodiversity, forest health, forest production, and protection functions, and contribute to social and economic development benefits (Jannah, et.al., 2021). Jannah's research focused on examining green waqf for agroforesty to achieve Sustainable Forest Management. On the other hand, this research focused on proposing the concept green waqf for carbonization technology to achieve Sustainable Waste Management.

Proposing green waqf for carbonization technology is a new concept. This is in line with the research tittled "Waqf and Waste: An Unexplored Potential" by Wildana & Manzilati. They said that its is

possible for waqf institutions, either privately or publicly managed, to ease the burden of government in managing waste generated by society, from both obligation and budget perspectives. The ultimate goal for their concept is to preserve the environment and life as one of the obligations stipulated in *maqasid shariah* to achieve *falah* (Wildana & Manzilati, 2021). However, their concept did not speak up about carbonization technology, they spoke only about the potential of waqf for waste management.

METHODS

This study adopts a qualitative method. Secondary data is collected from the secondary sources such as literature, reports, and documents related to green waqf and carbonization technology (sustainable waste management).

RESULT AND DISCUSSION

Green Waqf for Sustainable Waste Management (Carbonization Technology)

In Islam, protecting the environment is strongly encouraged. On the contrary, destroying the environment and not participating in its protection is considered as an abuse of the orders of God and Prophet Mohammad. It is because of a number of reasons. *First*, the environment is God's creation and to protect it is to preserve its values as a sign of the Creator. *Second*, the component parts of nature are entities in continuos praise of their Creator. *Third*, all the laws of nature are laws made by the Creator and based on the concept of the

absolte continuity of existence. *Fourth*, the Quran's acknowledgment that human-kind is not the only community to live in this world. *Fifth*, Islamic environmental ethics is based on the concept that all human relationships are established on justice *('adl)* and equity *(ihsan)*. *Sixth*, the balance of the universe created by God must also be preserved. *Seventh*, the environment is not in the service of the present generation alone. Rather, it is the gift of God to all ages, past, present and future. *Finally*, God entrusted humans with the duty of vicegerency (Budiman, 2011).

Waqf as a charitable institution in Islam is expected to play its significant role to carry out environmental protection and therefore to ensure a more sustainable development in the country. This is basically not a new idea. It is developed on the back of the acceptance of cash *waqf* and *istibdal* by the early jurists. In this regard, Kuwait Awkaf Public Foundation (KAPF) has played a major role in pulling the public attention to the importance of environmental waqf. In 1992, KAPF established a waqf company, Kuwaiti Company for the Environmental Services, which mainly focused on the cleaning services. This is to assure that waqf property put environmental protection as a priority. KAPF has also established an Environmental Fund with the mission to protect and maintain the environment in 1995. Moreover, KAPF is preparing a project to treat mosques sewer in view to use it in watering the mosques plants. Finally, KAPF is charged, beside building and maintaining mosques, to make green their yards as well (Budiman, 2011).

In Indonesia, waqf which is intentionally meant for the purpose

of environmental protection and recovery is a relatively new. In fact, waqf for the purpose of environmental protection has been much less popular than any other form of waqf, such as for religious, education, health, and poverty alleviation purposes. There are some pioneering programs introduced by waqf institutions and others. Most of the programs take the form of tree planting or cultivating, making well and building clean water installation. We have not found waqf for waste management yet.

Environmental waqf or waqf for environmental protection (more specifically waqf for sustainable waste management) is one of such Islamic prescriptions that can be optimized in this regard. Since waqf is a voluntary action from community, it would not take any portion of government expenditure. The most important job for government is just to boost awareness of the people and to provide some necessary supports in terms of land management, legal affairs, and incentives to those who involve in this noble action. To increase the probability of successful such waqf development, waqf institutions could apply cash-waqf and self-managed model first, while other models could be applied in staged in line with waqf institution experience (Ascarya, Hosen & Rahmawati, 2022).

Green Waqf for Carbonization Technology towards SDGs in Indonesia

Many researchers have proven that Carbonization Technology can be successfully applied to sustainable waste management. Carbonization can effectively convert medical waste into valuable products, specifically char, with an estimated Higher Heating Value

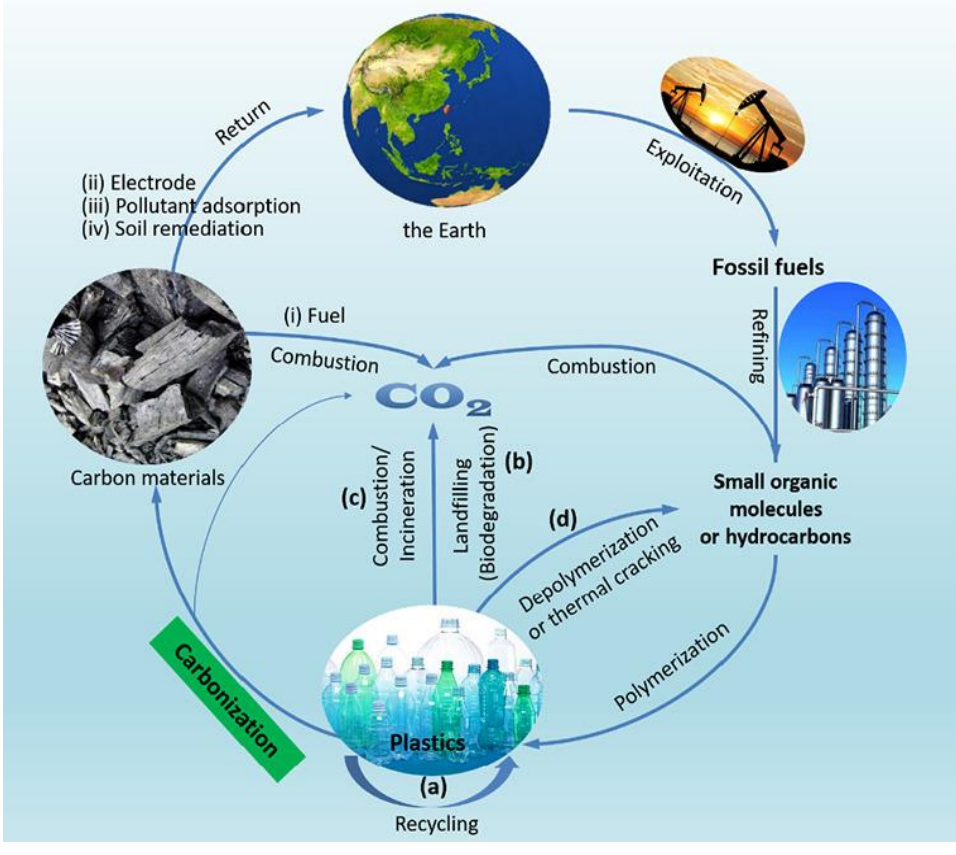
(HHV) up to 25 MJ/kg, similiar with that of sub-bituminous coal, while operating under mild conditions. In the absence of oxygen, over 50% of the carbon is recovered as solid product, therefore decreasing the emitted gaseous carbons (Ardhistira, et.al., 2020).

In addition, carbonization is an effective way of converting polymer precursors to valuable carbon materials for use in fields of energy conversion and storage, environmental protection and restoration (Cheng, et.al., 2020). Hence, they proposed the feasibility, application prospect and challenge of carbonization as one method of reutilization of plastic wastes. It is because the debris of plastics have high calorific value which makes it suitable to use as fuel (Iñiguez, Conesa & Fullana, 2019).

Based on simple weighted analysis, Hydrothermal Carbonization (HTC) is the most recommended carbonization method as a sustainable waste treatment to energy conversion in Indonesia. Hydrothermal carbonization is a thermochemical conversion process that is used as an opportunity to convert biomass and organic waste in the presence of water into solid biofuel, liquid, and gaseous products. It is a low-energy alternative for transforming waste of different origins: sewage sludge, lignocellulosic biomass, algae, and other types of waste (Czerwińska, Ślize & Wilk, 2022). Hydrothermal Carbonization (HTC) is a promising thermochemical process which can convert organic solid wastes (e.g. bimass, plastics) into valuable products (i.e. hydrochar) at relatively low temperatures (180-250 ^{o}C) and saturated pressures (2-10 MPa). The carbon materials derived from hydrochar have high potential in various applications, such as

solid fuel, supercapacitor, fuel cell, and sorbent (Shen, et.al., 2020).

Figure 4. Carbonization Technology for Sustainable Waste Management



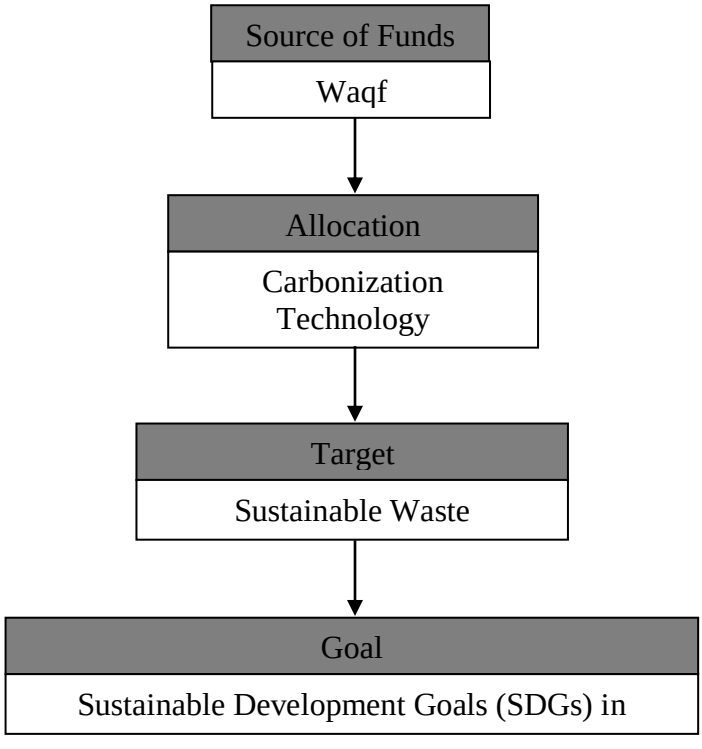
Source: Cheng, at.al. (2020)

Another research mentioned that HTC is also strongly recommended for sustainable medical waste treatment. Life Cycle Impact Analysis (LCIA) showed that HTC decrease damages of human health, ecosystem quality, climate change, and resources, all in comparison with incineration and landfill. HTC project as a mean for processing medical waste is deemed to be economically viable

compared to incinerator with a 10 years break-even selling price of 240 USD/ton hydrochar (Ardhistira, et.al., 2020).

Considering the benefits of Carbonization Technology for sustainable waste management, it raises an idea: allocate waqf for Carbonization Technology, called Green Waqf. Its scheme is as follows:

Figure 5. The scheme of Green Waqf for Carbonization Technology



Source: Researcher

Hence, the final goal of enhancing Green Waqf for Carbonization Technology is to achieve Sustainable Development Goals in Indonesia.

This idea is in line with SDG 7 (ensuring access to affordable, reliable, sustainable, and modern energy for all), SDG 11 (make cities or communities inclusive, safe, resilient, and sustainable), and SDG 13 (take urgent action to combat climate and its impact). Green Waqf for Carbonization Technology provides solutions and innvoations in handling climate change and at the same time minimize social injustice. It is potentially become a big part of green economy program: combating global warming and climate change through economic activities.

CONCLUSION

Based on the literatures reviewed, we got that Carbonization Technology is so far the best for sustainable waste management. Hence, it raises an idea: allocate waqf for Carbonization Technology, called Green Waqf. Thus, enhanching green waqf for Carbonization Technology should be a prioritized program for protecting environment and at the same time accelerating economic power. It is strongly recommended to support green economy. Hopefully it could disclose opportunities toward Sustaianble Development Goals (SDGs) in Indonesia.

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