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MORALITY BEFORE KNOWLEDGE

Strategies for strengthening partnerships in circular economy-based plastic waste management

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ABSTRACT

Background: Asian nations like China, Indonesia, the Philippines, Thailand, and Vietnam account for 60% of the estimated 4.8–12.7 million metric tons of marine plastic trash produced year worldwide. The majority of the marine trash off the north coast of Jakarta is made of plastic, at 59%. Because it offers financial advantages and fosters partner collaboration, the circular economy is a novel strategy for managing plastic trash. Regretfully, there remains a dearth of information regarding the entities engaged in the management of plastic garbage in Central Jakarta. In light of a circular economy, this research attempts to create methods for bolstering collaborations in the management of plastic trash. **Methods:** In this study, a hybrid strategy using a quantitative approach was employed. The best and most practical type of partnership in Central Jakarta was identified through the use of the Analytical Hierarchy Process (AHP) in this study. **Findings:** The study's findings indicate that the greatest plan for Central Jakarta is a collaboration with the government since it promotes both well-managed plastic waste management and economic gains. **Conclusion:** The best partnership model based on AHP analysis is the Government-Private sector partnership. This form of partnership can drive increased economic benefits and improve the performance of plastic waste management. **Novelty/Originality of this article:** This study integrates a circular economy approach with the Analytic Hierarchy Process (AHP) to determine the most effective partnership model for plastic waste management in Central Jakarta.

KEYWORDS: analitycal hierarchy process (AHP); circular economy; Central Jakarta; partnership; plastic waste.

1. Introduction

Human civilization is now supported by advancements in science and technology, reaching unprecedented progress. This advancement has also facilitated humanity's ability to manage natural resources on a large scale through industrialization, enabling people to sustain their lives. Inevitably, this technological progress and high population density exert significant anthropogenic pressure on the environment. Environmental issues such as pollution—affecting soil, water, and air—and ecosystem degradation, both terrestrial and aquatic, are worsening. Additionally, humans face meteorological disasters due to the climate crisis (WCED, 1987). Ecosystem damage to both land and sea is partly caused by plastic waste in the environment. Plastic waste pollution has garnered attention from the public, governments, and businesses worldwide. Plastic waste leakage also affects the health of freshwater and marine ecosystems, with 80% of marine debris originating from land (Jambeck et al., 2015; Sequeira et al., 2020). Plastics also come from maritime activities,

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mostly from ship operations and fishing. The impact of marine plastic waste includes harm to aquaculture, fisheries, beach aesthetics, and tourism services, resulting in economic losses (Truong, 2019). Out of the approximately 4.8-12.7 million metric tons of global waste generated each year, 60% comes from Asian countries such as China, Indonesia, the Philippines, Thailand, and Vietnam. The imbalance in recycling management and plastic production results in only 9% of global plastic waste being recycled (Brooks et al., 2018). The rest, around 40% of plastic waste, ends up in landfills, and 32% enters ecosystems, particularly marine ecosystems (Cordova et al., 2020; Jambeck et al., 2015). By 2030, plastic leakage emissions are predicted to reach 53 million metric tons per year if no serious action is taken (Clayton et al., 2021).

Plastic production based on fossil fuels has increased over the past 50 years, from 1964 to 2014, and is predicted to double in the next 20 years (Ellen MacArthur Foundation, 2016). This growth has risen from 2 metric tons to 380 metric tons, with a compound annual growth rate (CAGR) of 8.4%, approximately 2.5 times the global gross domestic product during that period. Of this amount, around 30% or 2,500 metric tons are currently in use (Geyer et al., 2017). Plastic production in China has increased nearly 100-fold since 1978, while plastic production in Europe has tripled over the same period (Jiang et al., 2020; Reinales et al., 2020). From 1978 to 2017, China imported a total of 322 metric tons of five major plastics, leading to an import dependency of 34%. On the other hand, the cumulative amount of plastic waste is 684 metric tons from 1978 to 2017, with 26% of total plastic production used for packaging. The most common use of plastic is for single-use packaging, for example, the majority of single-use plastic bags provided for free at shopping centers (Wang & Li, 2021). Plastic packaging offers benefits such as reducing food waste by extending food shelf life and its lightweight nature, which facilitates transportation and saves fuel (Matthews et al., 2021). However, despite the convenience it provides, plastic is harmful to the environment due to its chemical stability in nature. Currently, 95% of the value of plastic packaging is lost after its first use, known as single-use plastic. This value amounts to 80-120 million dollars per year. Beyond economic concerns, plastic also impacts health. Microplastics, even at the nano size, are found in the atmosphere, freshwater, drinking water sources, wastewater, soil, plants, marine ecosystems, human and animal bodies, and even in Arctic and Antarctic waters (Dabrowska et al., 2021).

Previous research has detected high concentrations of microplastics in tempeh, table salt, and toothpaste (Wibowo et al., 2021). Nearly 74,000 to 121,000 microplastic particles enter the human body each year through consumption and inhalation (Luqman et al., 2021). These findings indicate the danger of plastic to wildlife, causing accumulation and contamination, as well as global environmental changes (Filella et al., 2021; Mao et al., 2020a; Mao et al., 2020b; Ying et al., 2020). Microplastics have also been found in zooplankton. Zooplankton and benthos are aquatic fauna that serve as crucial links in the food chain connecting producers to organisms at higher trophic levels. They are nutritious food sources for fish and other species due to their high energy content (Kuncoro et al., 2022). Therefore, microplastics in zooplankton can accumulate in higher trophic organisms, such as in the digestive systems of 323 fish species. This accumulation can reduce survival rates, and additionally, seabirds, 100,000 turtles, and marine mammals die each year due to ingesting plastic or getting entangled in discarded fishing nets and hooks (Abalansa et al., 2020; Chen et al., 2019; Sequeira et al., 2020). Plastic production and pollution are also correlated with other serious issues, such as climate change, species loss, oceanic dead zones, coral disease, pathogens and parasites, and antibiotic resistance (Bank & Hansson, 2019). If the current waste plastic processing practices continue (business as usual, BaU), it is predicted that by 2050, the amount of plastic waste will exceed the number of fish in the oceans (Ellen MacArthur Foundation, 2016).

In DKI Jakarta Province, plastic mass flows in river bodies transport significant amounts of plastic material to the sea. These plastic mass flows are heavily influenced by seasonal patterns of rainfall and drought (Van Emmerik et al., 2019). Indonesia is working to reduce the amount of waste entering the sea carried by water flows. This effort is aimed at achieving the objectives of Jakstranas as well as SDG14 Life Below Water (Stucki et al.,

2021; Sharifi, 2020). Anthropogenic pressure leads to high plastic contamination, especially in river and coastal areas. The global population is increasing and has surpassed seven and a half billion people (UN DESA, 2017). Like other cities around the world, DKI Jakarta is experiencing population growth due to urbanization. The resulting waste will continue to grow alongside increased per capita consumption associated with economic growth in highly urbanized cities (Abdoli et al., 2016; Jambeck et al., 2015; Singh et al., 2014). Other factors, such as consumption preferences, local customs and culture, and lifestyle also influence the amount of waste generated (Gu et al., 2021).

Public awareness and concern about environmental health through plastic waste management activities are starting to increase. Individual participation in Jakarta in implementing waste management is influenced by 1) their frequency of involvement in community social activities, 2) education level, and 3) per capita expenditure (Brotosusilo et al., 2020). Household waste sorting behavior reflects a commitment to environmental health and encourages more eco-friendly consumption patterns at the household level (Ma et al., 2020; Wang et al., 2020). When applied collectively as community actions on a smaller scale, this individual participation can still have a significant impact on a larger population (Oh & Hettiarachchi, 2020). Reducing marine plastic pollution requires the involvement of all parties through activities that promote recycling, reduce consumption and production of low-recyclability products, and improve waste disposal efficiency (Tyllianakis & Ferrini, 2021). Several actions that can be taken to increase recycling rates in Jakarta include separating waste at the source, integrating scavenger activities with waste banks and municipal collection, providing material management facilities at landfills with sorting and recovery technologies for plastic waste, and implementing alternative technologies such as chemical recycling and thermal treatment for plastics that cannot be mechanically recycled (Putri et al., 2018).

Indonesia is one of the largest producers of plastic waste globally, with a significant portion of this plastic waste ending up in the ocean. Jakarta, being the city with the highest population density in Indonesia, is also a major contributor to plastic waste. The anthropogenic pressure and economic development are proportional to the amount of waste generated. Waste from DKI Jakarta eventually ends up at the Bantar Gebang landfill, which is increasingly reaching its capacity. Improving plastic waste management infrastructure is urgent, requiring both resources and time, alongside limiting waste generation and reducing plastic waste. DKI Jakarta has implemented Governor Regulation (Pergub) No. 108 of 2019, or Jakstrada, with targets to reduce plastic waste by 30% and manage 70% of plastic waste by 2025. The objective of this research is to develop strategies for strengthening partnerships in plastic waste management based on a circular economy.

The results of this research are expected to contribute to the development of knowledge regarding sustainable development and provide input for stakeholders related to plastic waste management based on a circular economy, particularly in Kemayoran District, Central Jakarta Administrative City. Practically, this research encourages the active participation of the community, government, and private sector in efforts to manage plastic waste through a circular economy in a sustainable manner to address plastic waste entering the environment. This expectation naturally requires support from all parties. The research results are expected to provide a comprehensive overview of the multidimensional benefits that stem from sustainable plastic waste management. Thus, it is hoped that best practices can be implemented across all community units to effectively reduce plastic waste in the environment. In Law No. 32 of 2009 on Environmental Protection and Management, the environment is defined as a unified space with all objects, forces, conditions, and living beings, including humans and their behavior, which affect nature itself, the continuity of life, and the well-being of humans and other living creatures. This aligns with Otto Soemarwoto's (1998) view that the environment is a space where living beings coexist with other organisms and interact with non-living components. In managing the environment, several approaches can be implemented. However, humans have tended to rely on an anthropocentric approach, often neglecting ecological aspects (Keraf, 2005). A relatively new approach to holistic environmental management considers three interrelated aspects:

human, social, and environmental. Managing these aspects together is known as the sustainability theory.

Environmental science is an interdisciplinary field that studies how the Earth functions, encompassing living beings, including humans, and their interactions with the Earth itself, as well as how humans and other living beings can address environmental problems (Miller & Spoolman, 2015). Interactions on the planet occur when humans engage with both living organisms and non-living elements that are part of their environment. This interaction integrates several natural sciences, such as chemistry, biology, and geology, along with social sciences, including economics, geography, and political science (Miller & Spoolman, 2018). Human demands on nature are expected to increase exponentially in the future due to population growth. Environmental degradation, such as deforestation, will lead to the loss of biodiversity. The broader impact includes threats to human food supply, wood reserves, and natural medicinal resources. These effects will also influence economic opportunities, recreation, and disrupt ecological functions (Salim et al., 1999). The word "plastic" is derived from the Greek "plastikos," which meaning "something that can hold its shape under different conditions." Long-chain polymer molecules, which are produced as byproducts during the extraction of natural gas, coal, and petroleum, make up the majority of plastic (Rajmohan et al., 2019). Dioxins and other hazardous substances are present in plastic, which is not inert. Dioxins are lethal organic pollutants that are emitted by plastic polymers and interfere with reproductive system development, cancer, and nerve damage.

Consumer goods with plastic components are known as plastic products. According to Reinales et al. (2020), the most widely used plastics are polystyrene (PS), polypropylene (PP), and polyvinyl chloride (PVC), which together make up 36%, 21%, and 12% of all non-fiber plastic manufacture. According to Liu et al. (2021; UNEP, 2018), plastic products fall into the following categories: packaging (36%), building and construction materials (16%), textiles (14%), consumer and institutional products (10%), transportation materials (7%), industrial machinery (1%), and others (12%). Additional plastic goods are used in main industries, scientific research, and building construction (Landon-lane, 2018). Because they are robust, flexible, waterproof, and simple to mold, plastics and their derivatives are highly useful in the industrial, agricultural, and daily sectors (Mao et al., 2020b).

Single-use plastics are plastic products designed for one-time use and disposal. On the other hand, sustainable plastics refer to plastics created with minimal resources and waste, posing minimal risks to environmental and social systems (Landon-lane, 2018). The Marine Stewardship Council (MSC) has established plastic certification focusing on sustainability. This certification began in 1996 along with growing awareness of global fishery overfishing. Well-designed agreements encourage stakeholder participation in compliance. The certification aims to eradicate single-use plastics, make plastics easier to recycle, increase the percentage of recycled materials in plastic production, and design plastic products using resources as efficiently as possible while minimizing environmental damage (Landon-lane, 2018; Wysocki & Billon, 2019). The most important parameters for measuring plastic film degradation are the strength and density of the polymers. Plastic polymers have durability due to their high hydrocarbon (CH) bonds, making them difficult to degrade naturally and contributing to plastic pollution (Beaumont et al., 2019; Rajmohan et al., 2019). Plastic pollution is a transboundary issue that affects biodiversity, coastal communities, and poses risks to food security and human health (Roebroek et al., 2021; Wysocki & Billon, 2019). Plastic waste production in Jakarta is approximately 2.9×105 tons per year, with around 25% not properly managed.

Plastic leakage or emissions through water bodies such as rivers and canals are estimated at 2.1×103 tons per year, equivalent to 3% of the total unmanaged plastic waste in Jakarta annually (Van Emmerik et al., 2019). Microplastics are defined as plastic fragments/particles smaller than <5 mm, while particles <1 μm are referred to as nanoplastics (Dabrowska et al., 2021). In Jakarta's northern coast, plastic waste is found in various sizes and shapes, in river streams (9.37 ± 1.37 particles/m^3), along the coast (8.48 ± 9.43 particles/m^3), and even within aquatic organisms in the form of microplastics (Cordova et al., 2020).

Marine litter has been identified as a global environmental and economic concern. It is described as continually created or processed solid materials that are thrown, abandoned, or left in the marine and coastal environment. According to Agamuthu et al. (2019), there are five primary types of marine litter: plastic, paper, metal, textiles, glass, and rubber. Plastic fragments or particles less than 5 mm are referred to as microplastics, while particles smaller than 100 μm are referred to as nanoplastics (Dabrowska et al., 2021; Wysocki & Billon, 2019). In addition to the atmosphere, freshwater, drinking water sources, wastewater, soil, plants, marine ecosystems, and even human and animal bodies, microplastics and nanoplastics have also been found in the waters of the Arctic and Antarctic. Microplastics enter the environment through primary and secondary sources. Primary microplastics consist of beads, pellets, fibers, powders, and nurdles.

The primary sources include industrial materials, personal care products like exfoliants in facial cleansers, and vectors for certain drugs. Typically, these primary microplastics are polyethylene (PE), polypropylene (PP), and polystyrene (PS). Secondary microplastics result from the breakdown of large plastic debris/macroplastics due to weathering or aging (Dabrowska et al., 2021). These secondary microplastics are marine plastic waste (macroplastics) that break down into smaller pieces due to physical, chemical, or biological reactions, such as UVB radiation under sunlight, the oxidative properties of the atmosphere, and the hydrolytic nature of seawater (Setyaningsih et al., 2022; Wysocki & Billon, 2019).

Waste management to handle plastic after use includes incineration, landfilling, reuse and recycling, and improper disposal, such as leakage into the environment (Liu et al., 2021; Payne et al., 2019). Plastic waste also becomes a commodity for export and import, particularly between developed countries like the United States and recycling countries like China (Brooks et al., 2018; He et al., 2018; Jiang et al., 2020; Wang & Li, 2021). China has since imposed a ban on plastic waste imports. The impact of this ban has subsequently been felt by neighboring developing countries, which have become new destinations for the world's plastic waste (Brooks et al., 2018; He et al., 2018). Strategies are a group of actions taken by the company with the goal of lessening the environmental effect of different operations through products and regulations that fall under the waste management framework. These consist of lowering energy use, managing and processing waste, consuming water and its impact on the environment, cutting back on energy use, and altering social norms and behavior. According to Zorpas (2020), this entails putting initiatives into action, assessing their social impact, and utilizing environmentally friendly, sustainable resources and environmental management systems.

Waste management options, according to Payne et al. (2019), cover a wide range of techniques, including the most recent circular economy model, linear economy approaches, incineration and composting, and classic techniques like landfills. The lack of long-term waste strategies, unskilled staff, inadequate coordination between authorities and employees, lack of infrastructure or excessive distances, involvement of parties other than stakeholders in planning and decision-making processes, and financial resource challenges to handle increasing waste, particularly in rapidly growing cities, are some of the issues related to waste management strategies (Zorpas, 2020).

According to a prior study, the circular economy can lessen the amount of plastic garbage that is improperly treated, which will lessen the strain that humans place on environmental systems. According to Elgie et al. (2021), circular measuring techniques can be used to reduce waste output. Additionally, Asteria & Haryanto (2021) contend that the involvement of women in trash management in Jakarta depends on empowerment initiatives that make use of user-friendly technologies. Furthermore, Syakti et al. (2019) recommend that local actors and activities be the main focus of plastic trash management. When externality taxes are set by political and economic processes, opportunities for waste trade can affect equilibrium results (Cassing & Long, 2021).

2. Methods

The approach used in this research is a quantitative approach. The mixed-method research method was selected for this study. The quantitative method is necessary to measure the research variables as input for developing a partnership model for plastic waste management. In this study, the population consists of two sample groups: the formal sector and the informal sector. The formal sector refers to formal bodies/institutions involved in urban plastic waste management. For the population from the formal sector, this study includes waste management facilities and institutions responsible for urban solid waste management. The informal sector is defined as the unofficial urban solid waste management sector located in Central Jakarta. According to data from SIPSN (2021), the informal sector in this study consists of scavengers and collectors. The calculation of secondary data from the informal sector population uses secondary data from the National Waste Management Information System (SIPSN).

To make the research more manageable in terms of time, cost, and effort, the researcher sets several limitations. First, the study focuses on the middle section of plastic waste management, as it is in this part that partners are actively involved in handling plastic waste and typically collaborate with other partners. The upstream or source of waste has been extensively studied and has received many interventions from previous research, so the researcher intends to avoid repetition. Furthermore, partnerships in plastic waste management require contributions from both the formal and informal sectors of urban waste management. The study by Aleluia & Ferrão (2016), which claims that the informal trash sector actively participates in places not served by the official urban garbage collection system, serves as the foundation for this examination. The second research restriction relates to the places that were chosen. The upstream and outstream of plastic garbage are defined as crowded places, which are also sources of waste. These locations include markets, modern commercial centers, and public facilities, as they generally have established waste management systems and responsible parties. Third, the researcher excludes scavengers from this study. Although scavengers do play a role, the researcher categorizes them as part of the upstream sector, given their close connection to waste sources. Additionally, scavengers are not accounted for in the informal sector data in SIPSN. Scavengers typically work individually, are unorganized, and lack strong partnerships with other stakeholders. Furthermore, the researcher found that the organization initially representing scavengers (the Indonesian Scavengers Association) is no longer active, leaving no strong reason to involve scavengers in this study. Fourth, neighborhood-scale composting facilities (RT/RW) focus on organic waste management and do not process solid waste, so these composting facilities are not included in the study population.

The researcher employed several stages of purposive sampling. A cross-sectional design was chosen to obtain data both quantitatively and qualitatively using questionnaires. By utilizing purposive sampling, the criteria for the samples in this study are restricted and further detailed in the selection process. The purposive sampling method was implemented under the following conditions: the participants are actively managing plastic waste up to the present, have members, employees, or laborers, and engage in partnerships with other parties such as individuals, the government, the private sector, or non-governmental organizations. The samples are geographically dispersed, with the researcher using administrative boundaries at the village or sub-district level, and the participants are willing to serve as respondents or informants. Analytical Hierarchy Process (AHP) data analysis is utilized to create a model for improving circular economy-based partnerships in plastic waste management in Central Jakarta. Developed by Saaty in the 1980s, the AHP model is a technique for managing both quantitative and qualitative multi-criteria aspects (Taherdoost, 2017). It provides a fundamental understanding of decision-making processes to generate appropriate choices. The decision-making process involves numerous criteria and sub-criteria that must be ranked as alternative decisions (Saaty, 2008). In this context, it pertains to sustainable waste management. After other study goals are accomplished, AHP can be used to determine a new strengthening model. In order to guarantee methodical

decision-making, the subsequent actions that must be taken include ascertaining the kind of knowledge required by defining the problem and the relevant knowledge, arranging the decision in a hierarchical structure with the overall goal at the top followed by broader objectives and then intermediate levels, creating a set of matrices for pairwise comparisons in which the elements at the level immediately below each higher-level element are compared, and weighing the priorities at the lower level using the priorities derived from these comparisons. These steps are repeated for each component (Saaty, 1994).

3. Results and Discussion

3.1 Strategies for strengthening partnerships in plastic waste management based on a circular economy

To enhance existing partnership schemes from the collaboration models currently in place, this research considers four criteria: the role of partnerships/collaborations, economic benefits, waste management performance, and infrastructure. Based on field research, each collaborator plays a distinct role, leading to various perspectives from different agencies regarding partnerships or collaborations. In order to manage urban plastic garbage, policies and regulations must be put into place, and here is where the government of Indonesia comes into play. Furthermore, through Jakarta Kota Kolaborasi, the Jakarta Provincial Government is stepping up joint efforts to build a livable city. Among the organizations that can take advantage of this situation to encourage cooperation in the management of plastic waste is the Environmental Agency. There is still a great chance to make plastic waste management a political priority, as Jakarta Kota Kolaborasi has not yet made it a priority. The Environmental Agency is the best organization to bring up this topic. The partnership between the government, specifically the Environmental Agency, and the private sector will support other partners at the grassroots level, facilitating and advancing their efforts. Thus, this partnership encourages community participation and expands waste management services through both the formal and informal sectors.

3.1.1 Analytical hierarchy process for plastic waste management systems in Central Jakarta

AHP is a methodology for modeling complex, multi-structured, and multi-criteria decision-making through a hierarchical system. This hierarchical system facilitates the structuring of multi-level decision-making. The first level of this structure is the determination of objectives, followed by the level of criteria and sub-criteria for evaluation, and finally the level of alternatives, which are the objects of assessment. The following is an illustration of the multi-level structure in AHP:

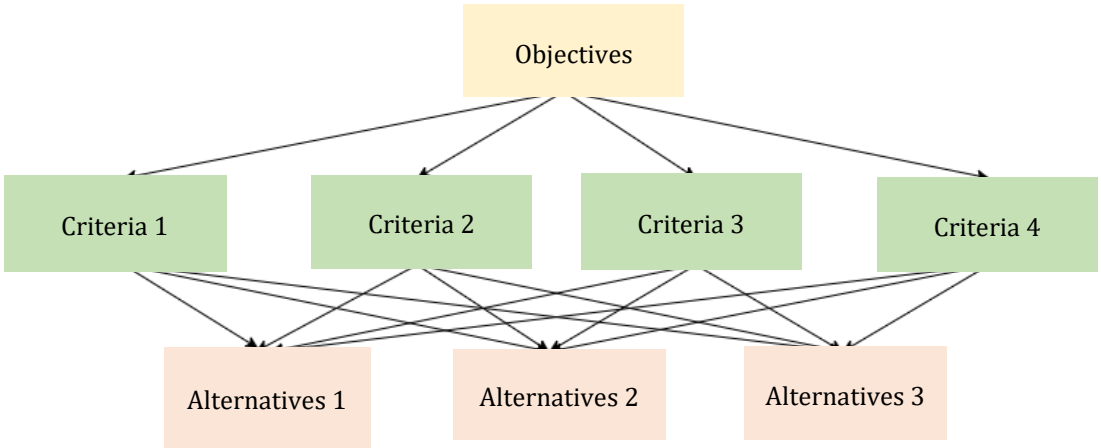

Fig. 1. Hierarchical scheme in AHP

In determining the form of partnership in the management of Plastic Waste in Central Jakarta that has the strongest value, interviews are needed with stakeholders involved in plastic waste management, ranging from the City Government to private parties. Based on the results of these interviews, it is known that the views on partnership from each stakeholder have varying answers that cannot be directly concluded qualitatively. Therefore, the AHP method will help examine the comparison of the respondents' views on the strongest form of partnership based on the evaluation of the established criteria. In comparing pairs of objects within criteria and alternatives, the AHP method uses standard values for comparing two quantified objects. The standard comparison table for two objects is as follows:

Table 1. Intensity of importance values

Intensity of importance value	Comparison syntax
1	Equally important compared to the other
3	Slightly more important compared to the other
5	Moderately more important compared to the other
7	Very important compared to the other
9	Extremely important compared to the other
2, 4, 6, 8	Values between two adjacent assessments
Reciprocal	If element 1 has one of the above values compared to element j, then j has the reciprocal value when compared to i

Establishing the hierarchy and values at the criteria level and choosing the substitute objects that will fulfill the AHP process's goals are the first steps in putting AHP into practice. Thus, the AHP hierarchy for identifying solid alliances in the management of plastic waste is established. Establishing the goals for the AHP process leads to the establishment of the hierarchy. The aim of the Analytic Hierarchy Process (AHP) is to determine the optimal form of cooperation for managing plastic trash by using predetermined criteria. Four factors make up the assessment at this level: partnership roles, infrastructure, waste management performance, and economic advantages. The compilation and evaluation of frequently studied waste management performance indicators produced these assessment criteria. Three items make up the options for evaluation at this level: private sector collaborations with the community, community and government relationships, and collaborations between the public and private sectors.

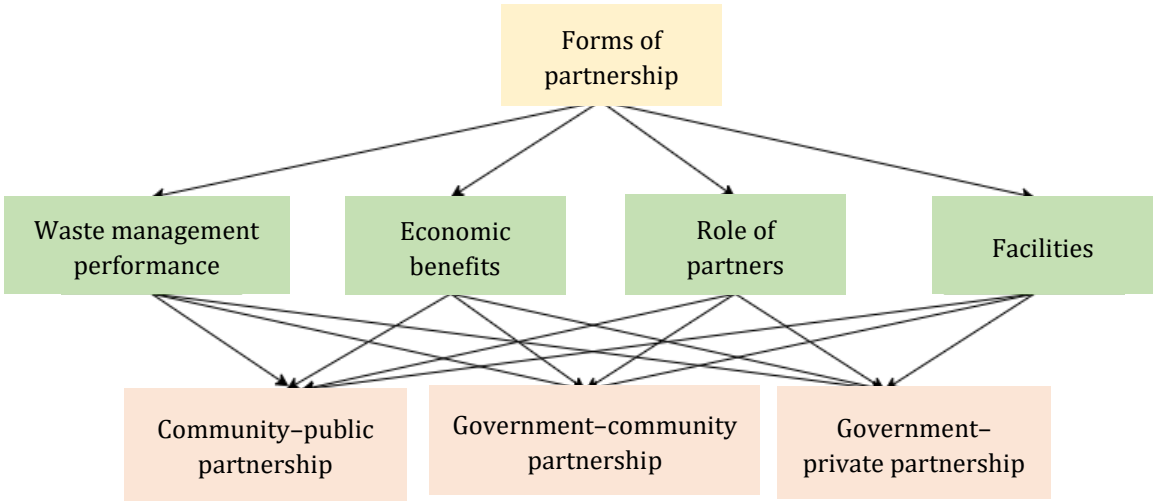

Fig. 2. The relationship of AHP analysis

The selection of assessment objects at this alternative level has considered the current partnership patterns in plastic waste management in Central Jakarta. In the community and public partnership, the context involves waste management from the community side, which consists of waste collectors as a form of independence in managing plastic waste

based on personal or group profitability. In the government and community partnership, the context involves waste management as a relationship between the government and waste bank programs aimed at achieving waste management independence by community groups. In the government and private partnership, the context involves the collaboration between the government and the private sector in the waste management process, involving regulatory activities, mechanism arrangements, and transactional aspects. To illustrate the connection between objectives, criteria, and alternative criteria, it can be seen in the hierarchy as follows.

The priorities at the criteria level are reflected in the average eigenvalue, starting with Economic Benefit, followed by Partnership, Waste Management Performance, and Infrastructure. From these results, it is evident that in the plastic waste management partnership pattern, Economic Benefit is rated as the most important target criterion by stakeholders. Partnership is prioritized second as it is a key effort to trigger economic benefits. Waste Management Performance ranks third, indicating that partnerships could improve if waste management performance improves. Lastly, Infrastructure is considered a supporting criterion to drive economic benefits as the main priority and support waste management performance. Based on the calculations of the pairwise comparison matrix and eigenvalues, the priority values for the criteria are determined as follows.

Table 2. Priority criteria determination

Criteria	Average value
Economic benefit	0.567
Partnership	0.2688
Waste management performance	0.1008
Infrastructure	0.0624
Total	1

The final formulation in determining the partnership management for plastic waste in Jakarta involves selecting the best alternative criteria or partnership model. The step in making the best alternative decision is to rank the predetermined alternatives. The formula used for decision-making involves multiplying the eigen values of the criteria by the eigen values of each alternative criterion, as shown in the formula:

$$\textit{Eigen alternative } n = \begin{array}{l}\textit{(Criterion 1 eigen value} \times \textit{Alternative criterion 1 eigen value)} + \\ \textit{(Criterion 2 eigen value} \times \textit{Alternative criterion 2 eigen value)} + \\ \textit{(Criterion 3 eigen value} \times \textit{Alternative criterion 3 eigen value)} + \\ \textit{(Criterion 4 eigen value} \times \textit{Alternative criterion 4 eigen value)}\end{array} \quad \text{(Eq.1)}$$

From the calculations above, it can be seen that the partnership between the government and the private sector is rated as the strongest partnership model for plastic waste management in Central Jakarta.

Table 3. Ranking of plastic waste management partnership schemes

Alternative	Calculation result	Ranking
Government-community	0.26	3
Private sector-community	0.36	2
Government-private sector	0.38	1
Total	1	

3.1.2 Proposal for strengthening partnerships in plastic waste management in Central Jakarta

The AHP analysis indicates that the best partnership pattern for plastic waste management in Jakarta is the government-private sector partnership, which is expected to better promote economic advantage priorities compared to other partnership models. The proposed scheme for strengthening partnerships in plastic waste management is as follows:

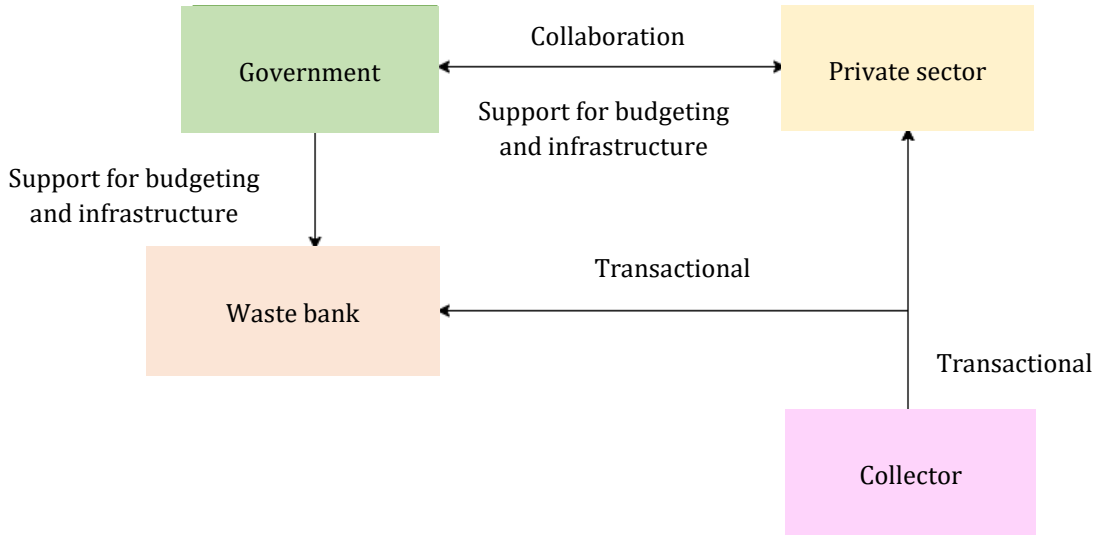

Fig. 3. Proposed form of partnership strengthening in management government – private sector

A review of the comparison patterns in plastic waste management among stakeholders indicates that the government-private sector partnership has the potential to generate benefits for other partnership models. The government-private sector partnership is the most effective cooperation model for managing plastic trash in Jakarta, according to the AHP report. It is anticipated that this strategy will increase economic benefits more successfully than alternative collaboration structures. It has been determined that the government-private sector partnership model has the ability to improve other partnership models after comparing the flow patterns of plastic waste management among stakeholders.

The partnership between the government and the private sector can stimulate the government-public partnership model through waste banks by encouraging the continuity of waste management contributions. Infrastructure support is also very likely to be obtained within the context of the government-private sector partnership. However, the collaboration between the government and the private sector needs to be managed through proper regulations so that the capacity of institutions, as extensions of both the government and private sector, can effectively fulfill their roles in improving plastic waste management. The initiative of cooperation between the government and the private sector (PPP) has been widely implemented in developed countries such as the United Kingdom, the United States, and Australia. In the UK, PPP was initiated through private sector financial contributions to the public sector, with most PPPs receiving financial support from private entities (Dolla & Laishram, 2019).

4. Conclusions

The best partnership model based on AHP analysis is the Government-Private sector partnership. This form of partnership can drive increased economic benefits and improve the performance of plastic waste management. Strengthening this Government-Private partnership can take the form of budgetary and infrastructure support. Such support will enhance the role of other partners involved in plastic waste management at the grassroots level.

Collaboration with partners, especially with the private sector and organizations, can be enhanced by starting communication with start-ups, artists, small and medium enterprises (SMEs), humanitarian organizations, academics, homemakers, and communities to work together. Currently, the Province of Jakarta is promoting the "Jakarta City of Collaboration" initiative. However, waste management, especially plastic waste, has not yet become a priority agenda within this initiative. In this regard, the Environmental Agency plays a key role in incorporating plastic waste management into the political agenda.

By doing so, the slogan "Jakarta City of Collaboration" or "+Jakarta" (read: PlusJakarta) can become more holistic and sustainable. By including plastic waste management in the agenda, the goal is to accelerate Jakarta's transformation into a city that facilitates various ideas, information, and roles, fostering collaboration to realize a city that integrates a culture and ecosystem of mutual support between the government and the residents of Jakarta.

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Author Contribution
Both authors contributed equally to the conception, design, data collection, analysis, and interpretation of results, as well as drafting, revising, and final approval of the manuscript for publication.

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