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ARTICLE

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# Improvement of the Public Participation Waste Management System in Banda Aceh City


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***ABSTRACT***

*This study looks at how public participation can help change environmental governance in Banda Aceh City. Finding a way to involve the general public, companies, and the government is the key to improving environmental governance. Using data from Banda Aceh City from 2017 to 2021, an empirical study examines the interaction and influencing factors of enterprise pollution control, government oversight, and public engagement using evolutionary game theory. The study's findings demonstrate that government oversight can encourage businesses to aggressively reduce pollution and has a positive effect on environmental governance. The impact of government regulation is limited by businesses' income and costs; consequently, it is necessary to raise the fines for passive pollution control. Increasing the damage to the government's reputation can also effectively encourage government environmental oversight. The public's enthusiasm is strongly correlated with the cost and psychological benefits of participating in three industrial wastes, which are significantly better controlled with public participation. Public participation has the potential to partially replace governmental control. Public-government interactions are beneficial to environmental governance. The results of the study will contribute to the creation of an effective system while also improving environmental governance performance and public satisfaction.*



**Kata Kunci:**
Partisipasi Publik; Lingkungan; Pemerintah; *Evolutionary Game*



**ABSTRAK**

Studi ini melihat bagaimana partisipasi masyarakat dapat membantu perubahan tata kelola lingkungan di Kota Banda Aceh. Menemukan cara untuk melibatkan masyarakat umum, perusahaan, dan pemerintah adalah kunci untuk meningkatkan tata kelola lingkungan. Menggunakan data dari Kota Banda Aceh dari tahun 2017 hingga 2021, sebuah studi empiris mengkaji interaksi dan faktor-faktor yang mempengaruhi pengendalian polusi perusahaan, pengawasan pemerintah, dan keterlibatan publik menggunakan teori *Evolutionary Game*. Temuan penelitian menunjukkan bahwa pengawasan pemerintah dapat mendorong bisnis untuk secara agresif mengurangi polusi dan berdampak positif pada tata kelola lingkungan. Dampak regulasi pemerintah dibatasi oleh pendapatan dan biaya bisnis; akibatnya, perlu menaikkan denda untuk pengendalian polusi pasif. Meningkatkan kerusakan reputasi pemerintah juga dapat secara efektif mendorong pengawasan lingkungan pemerintah. Antusiasme publik sangat berkorelasi dengan biaya dan manfaat psikologis dari berpartisipasi dalam tiga limbah industri, yang secara signifikan



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lebih terkontrol dengan partisipasi publik. Partisipasi publik berpotensi menggantikan sebagian kontrol pemerintah. Interaksi publik-pemerintah bermanfaat bagi tata kelola lingkungan. Hasil kajian akan berkontribusi pada terciptanya sistem yang efektif sekaligus meningkatkan kinerja tata kelola lingkungan dan kepuasan publik

## A. INTRODUCTION

Greater public engagement, particularly when it comes to risk-related decision-making or risk governance during the past 20 years, has emerged in policy circles and academia, (Li & Gao, 2022). (Zhou et al., 2020) offers a normative-analytical architecture for regional environmental governance in ecoregions and creates new structures and procedures for public discourse and participation in transboundary regional environmental governance. The environmental governance practices of the government and the business are examined by (Hao et al., 2019).

The increase in population is followed by the rapid development of the city's economy, and this causes congestion in a city and creates a problem caused by humans. One of the problems is the management of environmental cleanliness in a city. Management is a series of activities that suggest implementation, planning, and monitoring achieve set goals. The amount of waste in Indonesia continues to increase every year. Indonesia produced 67.8 million tons of waste in 2020. Based on data from the Ministry of Environment and Forestry (KLHK), 37.3% of waste in Indonesia comes from household activities(Sidik, 2022). An increase in the amount of waste comes from domestic waste and non-domestic waste. Garbage non-domestic waste is waste that comes from commercial waste, industrial waste, institutional waste, building waste, municipal service waste, sludge processing plants, other residues, and agricultural waste. Trash production requires further management. If left unchecked, it will cause various problems, such as aesthetic problems, disease vectors, and groundwater contamination. The problem should become a shared responsibility, of the government to the community. To avoid this, it is necessary to design a waste management system by the rules outlined in UU no. 18 of 2008. Volume reduction(Pemerintah Kota Banda Aceh, 2021). Waste is one of the efforts to reduce the amount of waste generated.

According to the Central Statistics Agency (Badan Pusat Statistik, 2022), one city that has experienced total population and economic growth has been the city of Banda Aceh. The level of the Gross Regional Domestic Product (GRDP) of Banda Aceh City reached Rp. 13,528,294.78 and an increase in the population to 254,904 people in 2021. This increased because of the large number of people entering and aiming to live and do all economic activities in Banda Aceh. Population increase causes people's consumption patterns to increase, and this can trigger the demand for an increase in goods and services. So total volume, type, and characteristics of waste produced by the community in Banda Aceh continue to grow.

Banda Aceh City has Mayor Regulation Number 46 of 2018 on Banda Aceh City Policy and Strategy in Household Waste Management and Types of Household Garbage Ladders. In 2021, Banda Aceh City's reduced waste amounted to 13,846.33 tons or 15.26% of the waste generated. divided into restrictions on the waste generation of 42.32 tons. The waste that is utilized from the source is 3.12 tons and the waste that is recycled from the source is 13,800.89 tons (Dinas Lingkungan Hidup Kebersihan Keindahan Kota Banda Aceh, 2022). The percentage is obtained from the division between the amount of waste reduction and the amount of waste generated by the City of Banda Aceh, with the standard that

each person emits 0.9 kg of waste per day. The city of Banda Aceh has also carried out waste management in 2021, with a total of 74,906.59 tons, or 82.53%. Reductions and treatments that have been carried out show the percentage of waste management is 88,752.92 tons, with a percentage of 97.78% (Dinas Lingkungan Hidup Kebersihan Keindahan Kota Banda Aceh, 2022). The percentage of waste management is the result of the sum of the amount of waste reduction by the number of waste management divided by total waste generation in the year 2021.

The chart below shows the comparison achievement of waste management based on the indicators from 2017–2021:

**Table 1.** Comparison of Waste Management Achievements

| Indicators | Years | | | | |
|---|---|---|---|---|---|
| | 2017 | 2018 | 2019 | 2020 | 2021 |
| Garbage Generation | 85.381 | 87.089 | 87.088 | 88.800 | 90.765 |
| Waste Reduction | 8,77% | 12,44% | 15,49% | 13,84% | 15,26 % |
| Garbage Handling | 77,41% | 83,50% | 79,67% | 83,03% | 82,53 % |
| Waste management | 86,18% | 95,94% | 95,16% | 96,87% | 97,78 % |

Source: Dinas Lingkungan Hidup, Kebersihan dan Keindahan Kota Banda Aceh

There is an increase in waste management indicators every year. This indicates an increase in the participating community in waste management and more and more provision of trash bins with various types of waste. Besides that, this is also due to a lot of socialization and training being carried out on waste management so that people know the importance of waste management because it has an environmental and economic value at the same time. Environmental pollution is one of the problems faced by some urban areas in Indonesia. There is no exception in the city of Banda Aceh. Every citizen has the right to a clean and healthy environment for the convenience of the survival of all city residents. For To support comfort, the City of Banda Aceh provides facilities for residents to participate in monitoring the cleanliness and beauty of the city(Pemerintah Kota Banda Aceh, 2021). Citizens can file complaints against environmental factors that are considered disturbing the comfort of their surroundings through various platforms provided, such as social media, such as Twitter, Facebook, Instagram, and YouTube, as well as websites and call centers, so that it can be followed up by running the program handling of environmental complaints. Based on the handling carried out in 2021, there are 502 reports reported, with the most reporting conducted through the call center, as many as 472 reports(Dinas Lingkungan Hidup Kebersihan Keindahan Kota Banda Aceh, 2022). Reporting is at least done through the website and YouTube, i.e. as many as 0 reports. Complaints that have been successfully followed up. This shows that handling is carried out 100%, with details as follows:

**Table 2.** Details of Citizen Reports Through Social Media and Call Center

| Type of Social Media | Year | |
|---|---|---|
| | 2021 | |
| | complaints | Solutions |
| Instagram | 19 | 19 |
| Twitter | 10 | 10 |
| Facebook | 1 | 1 |
| Website | 0 | 0 |
| Call Center | 472 | 472 |
| Youtube | 0 | 0 |

Source: Dinas Lingkungan Hidup, Kebersihan dan Keindahan Kota Banda Aceh

From the results of public reports, the government needs to create several programs to improve environmentally sound waste management with integrated waste management based on 3R. Integrated waste management is carried out to reduce the volume of waste by anticipating the use of landfill land. The use of infrastructure facilities is optimized because it can reduce the cost of transporting public waste from TPS (Temporary Disposal) to the TPA and encourage community participation to maintain the environment with the waste management system implemented by the government. Creating an integrated waste management system requires a large amount of money. The need for cooperation between the government and the community The willingness of the community to help the government by providing several facilities and infrastructure for waste management by how to donate the rest of the community's income every month, helping the government to sort waste from people's homes before it is transported by garbage trucks to the landfill to overcome the landfill's increasing limitations (AMAL, 2021).

## B. LITERATURE REVIEW

Public engagement is important bottom-up and community-based approaches highlight this, therefore academics have studied international cooperation(Chu et al., 2022). Greater public engagement, particularly when it comes to risk-related decision-making or risk governance during the past 20 years, has emerged in policy circles and academia, (Li & Gao, 2022). (Zhou et al., 2020) offers a normative-analytical architecture for regional environmental governance in ecoregions and creates new structures and procedures for public discourse and participation in transboundary regional environmental governance. The environmental governance practices of the government and the business are examined by (Hao et al., 2019). Three alternative scenarios are used to discuss the Nash equilibrium. The findings indicate that if the government has a sizable budget, it will satisfy its preferences while the firm does not contribute, and if it has a small budget, it will make every effort to support environmental governance while the enterprise does not contribute. An analysis of a consultation program that was run at the last step of Malopolska's Natura 2000 site selection is presented by (Jin & Zheng, 2021). They examine participant goals and expectations, normative underpinnings of the consultation program, and participation styles and levels. The findings demonstrate the participative process's limited success in accurately reflecting all key stakeholders and enabling their actual influence on decision-making.

Simultaneously, academics have developed numerous environmental governance models and engaged in qualitative research. (Adami et al., 2016) use the game technique to investigate the relationship between the enterprise's and the public's interests in environmental governance. Two full-information dynamic game models are created to describe the options for business strategy. The game's equilibrium demonstrates that public power has a significant impact on the choice of business strategy(Xu et al., 2019). Plummer et al.'s findings support a hypothesis that links increased activity levels with higher ratings of

the process and, consequently, better assessments of the results. We provide novel insights into how stakeholders' engagement in activities and their experiences with management and governance processes influence their judgments of outcomes.

The mentioned publications all offer guidance for theoretical and applied environmental governance studies(Chen et al., 2019). However, the majority of studies use static qualitative analysis and social investigation techniques and concentrate on topics like the beneficial effects of public participation, its influencing factors and modes, and the dearth of research on the interactions between the general public, businesses, and the government. The process of institutional framework is essentially one big game with linked players. It is important to study participant interaction from a dynamic standpoint. The majority of literature examines the game between the public, businesses, and governments; it does not combine the public, businesses, and governments in one research framework. We create a tripartite evolutionary game model of business, the public, and government and examine how they interact(Chu et al., 2022).

These topics are covered in this article. The rest of this study is divided into the following sections. The research gap that we concentrate on is identified in Section 2 after an assessment of pertinent literature. The tripartite evolutionary game model is developed in Section 3. Analysis of the evolution process and stability analysis are done, and we examined the effects of government and public participation. monitoring of business pollution prevention practices. Final observations and a look forward Section outline the direction of the research.

First of all, the majority of current research studies focus on how the public or the government interacts with businesses. Nevertheless, avoid placing the public, business, and government in the same study framework. We think about how to consider the general public, business, and government as three constrained rational game actors and develop an algorithm. evolutionary game model of enterprise pollution, public involvement, and governmental regulation. We will discuss the stability strategy and evolutionary process. Additionally, the majority of the literature uses a typical multiple regression model to analyze the variables that affect how businesses behave in terms of the environment, but they ignore the transboundary nature of industrial pollution and its spatial spillover impact. We construct the spatial error model and spatial lag model based on the theory of the spatial model, conduct additional empirical research in Banda Aceh City from 2017 to 2021, and provide recommendations for environmental governance from three perspectives of enterprise, government, and the public, which aid in offering practical guidance and a benchmark.

## C. METHOD

A literature search is a type of research. Syaodih (2009) states that library research employs a series of studies to examine library data collection methods or various library information, such as books, encyclopedias, journals, newspapers, and documents. Literature studies or literary studies (literary studies, literary studies) cover or critically examine the knowledge, ideas, or insights contained in science-oriented literature and make theoretical contributions to specific topics, as stated by Farisi (2010).

The motivation behind writing or writing a study is to track down different hypotheses, consistencies, examinations, standards, or thoughts that are utilized to investigate and settle formalized research questions. Descriptive analysis—namely, understanding and an explanation for the reader's comprehension—follows the data's descriptive analysis to form the core of this study. The literature review's findings are used to identify waste management, particularly in Aceh Province.

Policy and practice are outnumbered by so-called descriptive, analytical, and reflective contributions in policy research. Some studies merely attempt to document what is occurring,

frequently employing commonly used terms. As a starting point, for instance, teachers, students, classes, and schools. In other instances, research takes a more analytical approach, looking for patterns, trends, and relationships between variables, aspects, or dimensions. This kind of research focuses, for instance, on the student experience, teaching and learning practice, assessment, management, policy, and broader developments and trends. There are not many descriptive and analytical researchers who can defend themselves from criticism. generally through the use of policies or current concepts derived from research and theory. This is frequently done to contribute to or influence the implementation of policies. improvement practice, but without critical inquiries regarding content, focus, concept, or direction. Others use knowable theories in substantive, gestural, and metaphorical ways, such as Lave and Wenger's work on legit-peripheral participation and communities of practice, complex theory, problem-based learning theory, and Kolb and Dewey's work on experiential and experimental learning, among others.

## D. RESULT AND DISCUSSION

The waste problem includes 3 parts, namely downstream, process, and upstream. On the downstream side, garbage disposal continues to increase. In the process section, there are limited resources from both the community and the government. in the upstream part, in the form of a less-than-optimal system that applies to final processing(Terhadap et al., 2021). Communities are playing an important role in overcoming the waste problem. Downstream, the participation of public awareness is needed to reduce the amount of waste generated. This downstream part is commonly referred to as "community-based waste management. Waste management activities by society are based on the need for environmental cleanliness and ideological values. In addition, it is also encouraged by the community's cooperation in the community realization of Pancasila values. This provides educational value for people who do not understand the importance of waste.

Community institutions are organizations that aim to promote the interests of society. Realizing a waste-free Banda Aceh by 2025 and supporting Banda Aceh as a Green City needs support from various community organizations. partnerships with various parties, especially the community care for the environment in Banda Aceh City. Partnering communities are tasked with inviting and educating citizens to participate in love activities. Providing education and training to all communities, which is incorporated by giving hearings about activities that support a waste-free Banda Aceh by 2025. Giving education and training is accompanied by the signing of the MoU (Memorandum of Understanding) as a sign of partnership. 23 communities have been given protection training and environmental management (PPLH) from the target determined, namely 20 communities or social institutions. This shows social institutions that have been given education and training have exceeded the target (80%), which is 92%. Some of the activities that environmental care communities have carried out in 2021 are like sorting trash, turning off the lights for 60 minutes at a point, cleaning the beach, cleaning the terminal, and recycling. The activities carried out have raised awareness in society of the importance of protecting the environment and have an impact on reducing garbage in Banda Aceh City.

Period of 2017-2022 Banda Aceh City government, through the Environment Service Life, Cleanliness, and Beauty of Banda Aceh City, develops waste reduction strategies through activities using the Waste Collection Point (WCP) method/system. This WCP system is community-based waste management by forming community groups to sort various types of waste and collect it at one point. They will sell the recyclable waste or process it in the village, while the residual waste (which cannot be recycled) will be disposed of in the TPA Blangstar by Pemko Banda Aceh. With the WCP system getting maximum service, clean environment, and economic value from waste recycling, the government

also succeeded in increasing community participation in waste management, the target national waste reduction is met, increasing waste retribution, increasing the capacity of TPS per population unit, and can reduce the cost of the load. 54% of waste is delivered to the Blang Bintang landfill.

The concept of community-based waste management itself must be accompanied by community empowerment. Community empowerment is to make people the power to manage waste so that it becomes something useful and worth selling. It is known that empowerment refers to the ability of people to have the ability to meet basic needs, increase revenue, and be able to participate in the process. In the context of community empowerment, contributions from each actor, namely the government, the community, and the private sector, from an expected partnership model. The government's role is more or less in determining signs and game rules in general. Party The private sector plays a role in the implementation of policy actions in the community. The community plays a role in the form of participation, both at the level of formulation, implementation, monitoring, and evaluation. forming a partnership aiming to achieve better results by providing mutual benefits between partners. Help the partnership takes an understanding of the world of organisms divided into Pseudo Partnership (Pseudo Partnership), Mutualism Partnership (PartnershipMutualistic), and Conjugation Partnership.

## Public Behavior in Waste Management

Previous studies have confirmed that individual waste management behavior is influenced by both rational-based and altruistic-oriented beliefs and attitudes. Scholars incorporated personal norms in Ajzen's theory of planned behavior and confirmed its usefulness in predicting waste management behavior. However, limited attention has been paid to the interactions between the variables in the model. Scholars also commented that the cognitive dimension was largely neglected in the current socio-psychological framework of waste management behavior. In the field of environmental psychology, theory of planned behavior (TPB) and value-belief-norm model of environmentalism (VBN) represents two influential yet distinct approaches to understand pro-environmental behavior. The TPB explains pro-environmental behavior as a rational choice based on deliberate calculation of the expected costs and benefits of as well as the ability to perform the given behavior under certain social pressure.

In the context of waste management, community participation can be in the form of sorting between organic and inorganic waste in the storage process, or through composting on a family scale and reducing the use of goods that are not easily recyclable. Public participation in waste management can be in the form of direct or indirect participation. What is meant by this indirect participation is community involvement in financial matters, namely participation in waste management using the payment of retribution for waste services through the relevant offices that directly provide services in cleaning.

Banda Aceh City Environmental Beauty and Cleanliness Service (DLHK3) Programs that refer to the Mayor of Banda Aceh Regulation No. 7 2017 concerning Guidelines for the Implementation of Community-Based Waste Management Communities With Waste Collecting Point System.

Based on the applicable regulations, the Waste Collecting Point (Point Garbage collection), hereinafter referred to as WCP, is a system of waste management at the source which is carried out independently by gampong residents with a membership of 20–30 households for one WCP facility. Waste means waste, collecting means collection, and point means point. Waste means waste, literally translated from English, WCP program. From the translation, it can be interpreted that WCP is garbage collection at the designated assembly point.-based waste management community with the WCP system began to be implemented

in Banda Aceh City in 2016. This management system is implemented by the Environment Agency Cleanliness and Beauty of the City (DLHK3) Banda Aceh to reduce the volume of waste, especially the amount of waste from the source or waste household. WCP is a waste management system from sources that is community-based and is carried out independently by the participating villages (gampong). WCP is applied in every village (gampong) and contains 20–30 houses for one WCP facility.

The sorting carried out by the WCP consists of sorting organic waste, bottle waste, packaging waste, and residual waste. Aside from sorting, the facility also processes organic waste into compost and packaging waste into the craft. The processing was initially socialized by the DLHK3 Banda Aceh, which is then carried out periodically by the community participating in the WCP. The DLHK3 BandaAceh monitors the WCP program in addition to collecting residual waste every week. Since 2016 until now, there have been 15 villages (Gampong) that have taken part in the WCP program, and there are already 34 WCP points/depots out of 15 villages. From 34 WCP points/depots, 721 households participated in this program. Each WCP is provided with one waste collection point in the form of a 2x1.5 meter room as a collection, sorting, and waste management point.

Based on the applicable regulations, each WCP also has Trustees, Supervisors, Cleaning Leaders, Chairpersons, WCP Members, and Production Center Facilitators. The supervisor is entrusted to Keuchik, the village secretary and head of the village service. The supervisor is entrusted to the chairman of Tuha Peut and the Chairperson Village youth. While the cleaning leader and chairman are appointed by Keuchik and chosen by the local rules Jurong mother. The Head Gampong Cleanliness Leader (Head Gampong Cleanliness) is the person appointed by the Geuchik to coordinate village cleaning activities. Next up, the Production Center WCP is a place for community group activities in processing organic waste in the form of village parks and recycling craft areas. The Production Center Facilitator is the person appointed by Keuchik to assist groups of production centers that process waste into economically valuable goods.

## Businesses in Waste Management

Supporting the Aceh Government in responding to this problem, PT Semen Indonesia (Persero) Tbk, through its subsidiary PT Solusi Bangun Indonesia Tbk (SBI), signed a joint agreement with the Aceh Government for waste management at the TPA at the Regional Technical Implementation Unit (UPTD) Regional Waste Handling Center ( BPSR) DLHK Aceh, in Gampong Data Makmur, Blangstar District, Aceh Besar.

Waste management at the TPA at the UPTD BPSR DLHK Aceh, in Gampong Data Makmur, Blangstar District, Aceh Besar, will be a solution to the waste problems faced by Banda Aceh City and Aceh Besar District so far. As a partner of the Government of Aceh in overcoming the waste problem, SBI has experience and expertise in managing waste in a safe and environmentally friendly way. This is our commitment to delivering value-added and sustainability-oriented solutions.

The waste management technology offered by SBI is to process domestic waste with biological physics methods to be used as refuse-derived fuel (RDF) as a fuel substitute at the Lhoknga Factory, Aceh Besar, which is managed by SBI's subsidiary, PT Solusi Bangun Andalas. This waste management will be carried out in a facility that will be built in collaboration with SBI, together with the Aceh Besar District Government and Banda Aceh City, the Danish Government through the Environment Protection program, the Ministry of PUPR, and the Aceh Provincial Government. Waste management in RDF is not new for SBI. Before the construction of the RDF facility in Aceh, which will begin with the implementation of a feasibility study, SBI has already successfully managed waste at the first RDF facility in Indonesia, located in Cilacap Regency, Central Java.

In addition, SBI also cooperates with the DKI Jakarta Provincial Government for waste management at the Bantargebang TPST. The RDF facility in Aceh is planned to be able to manage up to 300 tons of waste per day, which is expected to help reduce the volume of waste that is stockpiled in the UPTD BPSR DLHK Aceh TPA.

## Government in Waste Management

The role of the government or community leaders is related to the socialization and dissemination of information regarding waste management. This socialization will provide an understanding of waste management should be carried out by each individual so that problems regarding waste can be addressed starting from the root, namely the source of waste. In addition, the role of government/community leaders is also related to the supervision of waste management actions at the level of households.

The Banda Aceh City Government has enacted Banda Aceh City Qanun Number 1 of 2017 concerning waste management. In the Qanun (city regulations), it is regulated regarding sanctions for anyone who throws garbage in any place, including throwing trash from inside the car onto the road, can be subject to a maximum imprisonment of 1 month and a maximum fine of 10 million rupiahs. (dlhk3.bandaacehkota, 2020) If we refer to these regulations, there are no more parties who litter, but the fact remains, people, don't pay attention to the rules and still throw garbage carelessly so that it becomes a bad sight and air pollution gives off an unpleasant odor. Currently, the Banda Aceh City Government has implemented a Hand Catch Operation (OTT) policy on waste disposal carelessly. This policy is law enforcement of the Banda City Qanun Aceh Number 1 of 2017 Regarding waste management, this OTT team includes city government officials, prosecutors, police, and courts. OTT policy this littering has been carried out at various points in Banda City Aceh. As many as seven residents were netted by OTT for littering.

In implementing the OTT policy for littering, the City of Banda Aceh has made various efforts, namely:

a. Counseling and Socialization DLHK3 Banda Aceh City has made efforts to implement the OTT Policy of Indiscriminate Waste Disposal by communicating with the community through socialization in implementing the OTT policy for littering, namely by conducting direct counseling. Besides that, DLHK3 also conducts counseling indirectly through existing media such as well social media and print media. Unfortunately, the efforts carried out by DLHK3 are not completely accepted by the community, so there are still people who do not know about the policy OTT the littering and there are still people who litter. DLHK3 has not maximized building public awareness; efforts are still not penetrating the public's attention about the importance of maintaining environmental cleanliness. This is an important responsibility of DLHK3 in socializing more optimally and its implementation can go directly to the community. The role of the media in communicating with the community is undoubtedly very low to be met for DLHK3 to have a more effective way of delivering the message.
b. Installation of Appeal Flyers

   Another effort of DLHK3 in implementing the OTT policy of waste littering in the city of Banda Aceh, namely, DLHK3 has made several appeals related to the OTT policy for waste disposal carelessly to the people in Banda Aceh City, namely in Ule Lheu, Taman Sari, and Big mosque. Appeal pamphlets that have been made by DLHK3 regarding the OTT policy on littering are very minimal considering that Banda Aceh City is the downtown area of Aceh Province, so many immigrants from outside the city of Banda Aceh want to come to Banda Aceh. The lack of facilities appeal pamphlet provided by DLHK3 to implement the policy demonstrates that

DLHK3 has not maximized its efforts to publicize the OTT policy on littering in Banda Aceh City. DLHK3 has the rightful authority to allocate its cleaning budget. However, it seems very clear at this time there are only 3 appeals that decorate the area, so it can be realized that DLHK3 is not fully using the allocation of funds that should be used and appropriate in overcoming littering.

The management of the Banda Aceh City IPLT is carried out by the City Cleanliness and Beauty Service Banda Aceh. By the Qanun of the City of Banda Aceh No. 2 of 2008 concerning the Composition of Organization and Work Procedure of the Banda Aceh City Government, the management of IPLT is under the management of the Management Section of the Sludge Management Installation (IPLT), Management Sector waste and B3 waste, the Department of Environment, Cleanliness and City Beauty (DK3) Banda Aceh.

Refers to the legal basis, legal meaning, hierarchy, and basic principles. In waste management, the main actors in waste reduction activities can be identified into 2 actors, namely the community and business actors, each classified as a producer. Society consists of individuals, groups of people, and legal entities. Manufacturers include business actors (1) in the manufacturing sector, (2) in the retail sector, and (3) in the food and beverage service sector.

The community is the main actor in reducing waste because the community is a responsible waste producer of the waste generated and its position as the source of waste generation includes households, apartments, offices, schools and campuses, Islamic boarding schools, areas, and public facilities. Whereas Producers are business actors who produce goods that use packaging, distribute goods that use packaging, and originate from imports or sell goods using containers that cannot or are difficult to decompose naturally, which includes the food and beverage industry, consumer goods industry, daily life, cosmetics, and personal care industry, restaurants, cafes, catering services, hotels, shopping centers, modern shops, and marketplaces.

So, the target group for waste reduction activities must be focused on the people who are active in the sources of waste generation and producers, with the main target of behavior change through massive and measurable public and producer awareness programs through communication, information, and education (IEC) and rule enforcement.

*Bank Sampah* is a strategy to build awareness in the community so that they can be "friends" with garbage to get direct economic benefits from waste. So, the garbage bank can't stand alone but must be integrated with the 3R movement in the community so that the direct benefits are felt. A healthy society is not only a strong populist economy but also the development of a clean and green environment to create a healthy society. By uniting the waste bank with the 3R movement, they will create a unified whole between citizens, waste banks, and a clean and green environment at the local level. The integration of waste bank with 3R is an embodiment of concrete aspects of sustainable development that harmonize environmental, social, and economic aspects through the principle of thinking globally, and acting locally.

Waste sorting activities are carried out by (a) anyone at the source, (b) the area manager, and (c) the district/city government. Considering the main actor handling waste is the district/city government, then the position of the government in the process of sorting waste becomes very important. Two main roles must be carried out by the government, namely organizing the sorting process itself and providing waste sorting facilities such as segregated waste containers, segregated temporary shelters, and waste collection tools. In addition, in the context of handling services waste to the community, district/city governments have the responsibility to provide waste sorting facilities in the form of segregated waste containers and segregated waste transport equipment. Referring to the provisions of Article 18 PP 81/2012 Paragraph (1), collection activities are carried out by (1) managers area and (2)

district/city governments. That is to say, activities Garbage collection is the duty and authority of the area manager, and the district/city government is not the duty and authority of the community. To fulfill these provisions, the area manager and district or city governments are given the additional task of providing garbage collection facilities.

Referring to Article 19 of PP 81/2012, here are some provisions related to waste transportation: (1) waste transportation is carried out by the district/city government; (2) waste transportation equipment is provided by the district/city government, including segregated waste that does not pollute the environment; (3) waste transportation from TPS/TPS3R to the final processing site (TPA) or integrated waste processing site (TPST); (4) government agencies/cities can provide intermediate stations (SPA); and (5) provisions regarding the measurement of waste. Some important things that haven't been arranged in PP 81/2012 and need to be added in the transportation aspect, among others: (1) transporting residue from TPS3R to TPA; (2) transporting segregated waste from waste sources, TPS, and/or TPS3R, to the waste processing site and/or TPST; and (3) transporting residue from the processing site and/or TPST to the TPA. The technical and operational provisions are further regulated in Article 23, Article 24, Article 25, and Article 26 of the Regulation of the Minister of Public Works No. 3/2013, among others: (1) optimizing the capacity of the means of transportation, rhythm, and frequency; (2) transportation patterns; (3) means of transportation; and (4) route transportation. Regarding means of transportation, several types of equipment transportation can be used, namely: (a) dump trucks; (b) Carroll trucks; (c) compactor trucks; (d) street sweaters; and (e) trailers.

Although questions regarding the evolutionary implications of individual variation have received less attention recently, there has recently been interesting in evolutionary explanations for personality differences. This latter effect of consistent individual variation lends itself particularly well to formal analysis methods from evolutionary game theory. Below, we go into greater detail about the effects of consistency and individual variation on the course of evolution, including examples of evolutionary game theory models for each situation. There is a positive feedback loop as a result: the more consistent individuals there are, the more social responsiveness pays off, which can result in even greater consistency. This division is mirrored in the neglect of mechanistic constraints in evolutionary models. However, there is also a growing understanding that asking questions about evolution without taking into account proximate causes might be deceptive. For the development of a more developed theory of the relationship between ultimate explanations and proximate causes, we argue that the study of the evolution of individual differences would be an excellent test case.

## E. CONCLUSION

This study analyzes the relationship between government, enterprises, and the public in environmental governance and identifies the influences of government and the public on firms' environmental behavior using the three-part evolutionary game model. The following recommendations are made from the perspectives of the government, businesses, and the general public based on the research findings.We think about how to consider the general public, business, and government as three constrained rational game actors and develop an algorithm. evolutionary game model of enterprise pollution, public involvement, and governmental regulation. Additionally, the majority of the literature uses a typical multiple regression model to analyze the variables that affect how businesses behave in terms of the environment, but they ignore the transboundary nature of industrial pollution and its spatial spillover impact. We construct the spatial error model and spatial lag model based on the theory of the spatial model, conduct additional empirical research in Banda Aceh City from 2017 to 2021, and provide recommendations for environmental governance from three

perspectives of enterprise, government, and the public, which aid in offering practical guidance and a benchmark

(1) The power of the government to regulate the environment is improved

The government handles several challenging issues, including environmental regulation and environmental law enforcement, through the "propaganda-organization-supervision-punishment" method. Improve environmental protection institutions, mechanisms, and policies. Improve environmental protection laws and regulations. Refine environmental standards. Popularize environmental protection knowledge through network media and other channels.

(2) Businesses increase their capacity to regulate pollution

Businesses need to improve their capacity for scientific research and innovation, create and master key technologies, quicken the shift from one mode of development to another, realize the efficient transformation and upgrading of high energy consumption and high pollution industries, boost the effectiveness of energy recycling, and reduce the release of various pollutants. Businesses should establish a low-carbon economy and green finance model, deepen their collaboration with scientific research institutes, adapt and adopt frontier technologies, and upgrade green technology in non-environmental protection businesses.

(3) Public participation skills are improved

The people should fervently exercise their right to information, participation, reporting, compensation claims, and legal recourse. The public should improve its management and organizational level, strengthen its capacity for cooperation with the government and the media, strengthen its capacity for horizontal communication, cultivate an international perspective, provide forward-looking policy recommendations for decision-making, and more fully fulfill its role in environmental governance. At the same time, we must appropriately direct and utilize the public and business sectors, igniting their passion and enormous potential. We won't be able to create ecological civilization until the "top-down" and "bottom-up" techniques are combined. Government and public participation in enterprise environmental behavior is a complex system that is influenced by a variety of factors. We don't take the affecting aspects into account thoroughly enough. Future research will examine other affecting elements, such as pertinent rules and policies.

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