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Domestic Waste Management Strategy in Batang Bayang River, West Pasaman Regency

Afkar[1*], Nurhasan Syah[1], Eri Barlian[1], Nasfryzal Carlo[1]

[1] Environmental Science Study Program, Postgraduate School, Universitas Negeri Padang, Padang, Indonesia.

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Corresponding Author:
Afkar
afkarsfs@gmail.com

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Abstract: Batang Bayang River is one of the rivers that crosses densely populated settlements in Nagari Ujunggading, Lembah Melintang District. Domestic waste from the community, both liquid and solid, is often dumped directly into the river. This causes the condition of the river water quality to worsen due to minimal efforts to manage domestic waste and the habit of people who throw organic and inorganic waste into the river carelessly. The purpose of this study was to analyze river quality against community behavior and then recommend strategies for handling it. The research method used was to analyze test data from the laboratory and determine the level of river pollution using the Pollution Index (IP). To determine community knowledge, attitudes and actions using a questionnaire. The results of the correlation test showed that there was a relationship between knowledge and action with a significance value of 0.001 <0.05, between attitudes towards actions with a significance value of 0.002 <0.05, and between knowledge and attitudes with a significance value of 0.011 <0.05. The handling strategy that can be done by the community is to process waste at home and create a waste bank. The strategy for the government is to provide outreach to the community, create village regulations, create TPS, build domestic IPAL, implement prokasih, cross-sector cooperation and budget priorities in the West Pasaman Regency APBD.

Keywords: Community behavior; Domestic waste; River water quality

Introduction

The environmental condition may change due to the entry of pollutants derived from natural processes and human activities (anthropogenic sources) (Fitriani et al., 2021). Residential development and trading activities along the banks of the River have affected water quality (Supardiono et al., 2023). The increase in population has resulted in increased consumption of water and food, which has led to an increase in the amount of domestic waste, both liquid and solid. The threat to the environment is also increasing with the increasing amount of domestic waste. The first threat is pollution of rivers as recipients of this waste. Pollution occurs because people do not care about their waste, coupled with inadequate facilities and infrastructure. Water conditions are getting worse due to the lack of domestic waste management measures and the habit of humans carelessly throwing organic and inorganic waste into water sources. This has significantly increased the level of water pollution (Susanti et al., 2017).

Data from the Ministry of Environment and Forestry and the Environment for 2021 shows that Indonesia produces 67.8 million tons of waste (Widiyanti et al., 2024). Based on the 2020 environmental statistics report, 57.42% of households dispose of their liquid waste into drainage channels, rivers, or gutters. 18.71% of households use septic tanks for wastewater disposal. 10.26% of the population uses septic tanks to dispose of liquid waste. 1.67% of liquid waste disposers use infiltration wells. 1.28% of liquid waste disposers use wastewater treatment plants or gutters (Afifah et al.,

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2022). The factors that can cause the huge amount of food waste are population, urbanization, cooking processes, community culture of wasting food, purchasing planning, inventory planning, and serving portion (Gerda et al., 2023). One of the products of household waste is waste water. If it is not managed properly, it will be very detrimental and will be the biggest contributor to environmental pollution (Abrauw et al., 2023). The processes within watersheds are affected by both natural inputs, such as rainfall, and human-induced outputs, such as water discharge (Mosi et al., 2024). Rivers have various important roles in supporting human life. In addition to providing water for daily activities such as washing dishes and bathing, rivers also function as tourist attractions, transportation routes, power plants, and agricultural irrigation systems.

The disposal of liquid waste in the form of used bath water, washing, kitchen activities and solid waste in the form of garbage carried out by the community continuously will worsen the decline in river water quality. According to research in Jakarta, 75% of pollution in city water sources comes from human waste. On the other hand, 15% comes from the commercial and office sectors, and 10% comes from industry (Wirawan, 2019). Although sanitation, or household waste management, is an important human need that seeks to separate human-caused waste from other forms of urban waste in an effort to curb the spread of disease (Mahendra et al., 2023). Residential homes, restaurants, workplaces, companies, flats, and dormitories are sources of household wastewater. There are two main categories of household wastewater: backwater and greywater. "Blackwater" refers to wastewater from septic tanks that has been treated to eliminate the need for further treatment before being discharged. Greywater, on the other hand, is runoff from household uses such as washing dishes and bathing, as well as water that has been used for other purposes around the house (Maliga et al., 2022; Vergneau-Grosset et al., 2022). Most people dispose of greywater waste into the ground, gutters, and rivers without any prior treatment.

Rivers have always been an important water supplier for various social purposes. As time goes by, the impact of its activities on the function of rivers also develops. Unfortunately, one of the common uses of rivers is as a place to dispose of garbage (Azhar et al., 2024). In addition to liquid domestic waste, solid domestic waste in the form of garbage is the largest source of pollution in rivers. The results of the study showed that 19 to 23 million metric tons or 11 percent of plastic waste entered the aquatic environment in 2016 and an estimated 53 million metric tons of plastic waste entered the aquatic environment in 2030 (Stephani et al., 2020). In Presidential Regulation 97 of 2017, the government expressed its attention and commitment to plastic waste management with a target of 30% reduction and 70% handling by 2025. West Pasaman Regency produces 64,783.41 tons of waste per year, with details of 11,563.20 tons (17.85%) in the form of managed waste and 52,298.64 tons (80.73%) in the form of unmanaged waste, based on statistical data from the Ministry of Environment's SIPSN. River ecosystems are very important for biodiversity as bioindicators of water quality because of their sensitivity to environmental changes (Soares et al., 2025). The high amount of unmanaged waste will worsen river pollution because most people, especially those living around rivers, tend to throw their waste into the river.

The waste problem is a strategic issue that must be resolved immediately because the impacts are very complex (Rahmadani et al., 2025). Solid waste has become a problem as well as a threat to the sustainability of life. The increase in the world's population every year directly increases the consumption of daily needs related to solid waste generation (Septianingrum et al., 2023). Focus on river areas significant novelty is the special attention to waste management in river areas. This is important because rivers are ecosystems that are vulnerable to pollution, then domestic waste is often the main source of pollution of the aquatic environment and finally waste management strategies in river areas require a multidimensional approach. This research is also important because it considers the Regional Development Context, this research has the potential to provide real contributions to environmental management policies at the local level and efforts to preserve river ecosystems and community empowerment in waste management.

Method

This study combines physical and social research. Physical research is to test the quality of river water while social research is to analyze community behavior in managing their waste. The data used in physical research are the results of river water sample tests and wastewater samples tested in the laboratory. While in social research in the form of questionnaires, interviews and direct observations in the field. The research location is in the Batang Bayang River and the community around the Batang Bayang River, Lembah Melintang District, West Pasaman Regency.

The population in the physical study was the Batang Bayang River from upstream to downstream. Domestic wastewater samples were taken at 3 sample points. The determination of 3 sample points was in accordance with the number of large drainages flowing into the Batang Bayang River, namely drainage that crosses Jorong Lombok, Jorong Irian and Jorong Taluak Ambun. For river water samples, 5 points were taken. Sample point 1 was taken in the upstream section as an indicator of water quality above the Jorong Tampus area, point 2 was taken after the outfall of the Jorong Lombok drainage channel, point 3 after the outfall of the Jorong Irian drainage channel, point 4 after the outfall of the Jorong Taluak Ambun drainage channel and point 5 downstream. Community samples are 74 respondents spread across 5 Jorong, namely Jorong Tampus, Lombok, Irian, Taluak Ambun and Koto Pinang.

The river water quality parameters tested are pH, TSS, DO, BOD, COD, Total Phosphate, Nitrate, Fecal Coli, Total Coliform compared to the quality standards for class II river water in accordance with PP no. 22 of 2021 concerning the Implementation of Protection and Environmental Management. While the parameters of domestic waste are pH, TSS, COD, BOD, Ammonia, Oil and Fat and Total Coliform compared to domestic waste quality standards according to Permen LHK no. 68 of 2016 concerning Domestic Wastewater Quality Standards. In measuring community behavior, there are three domains, namely knowledge, attitudes and actions. The instrument used to measure community behavior is a questionnaire that has been tested for validity and reliability previously, the questionnaire value uses a Likert scale from strongly agree (5), agree (4), undecided (3), disagree (2), strongly disagree (1). In measuring community behavior there are three domains, namely knowledge, attitudes and actions. To measure knowledge, it is said to be good if it is correct in filling out the questionnaire 76% -100%, Moderate 57% - 75%, Bad ≤ 56% (Putri, 2015). For Attitude, it is said to be Good> 75%, Moderate 50% -75%, Bad <50% (Arikunto, 2019). To measure Action, it is said to be Good 76% - 100%, Moderate 57% -75% and Bad ≤ 56% (Arikunto, 2019).

Table 1. River Sampling Point Location

Point	Coordinate
T1	N : 000 17′ 12.2″ E : 0990 34′ 05.3″
T2	N : 000 16′ 24.3″ E : 0990 33′ 41.0″
T3	N: 000 16′ 13.8″ E : 0990 33′ 39.5″
T4	N : 000 16′ 02.7″ E : 0990 33′ 29.7″
T5	N : 000 15′ 47.1″ E : 0990 34′ 04.8″

Table 2. Domestic Waste Sampling Point Location

Point	Coordinate
T1	N : 000 16′ 27.6″ E : 0090 33′ 41.3″
T2	N: 000 16′ 17.4″ E : 0990 33′ 37.7″
T3	N″ 000 16′ 06.8″ E : 0990 33′ 31.2″

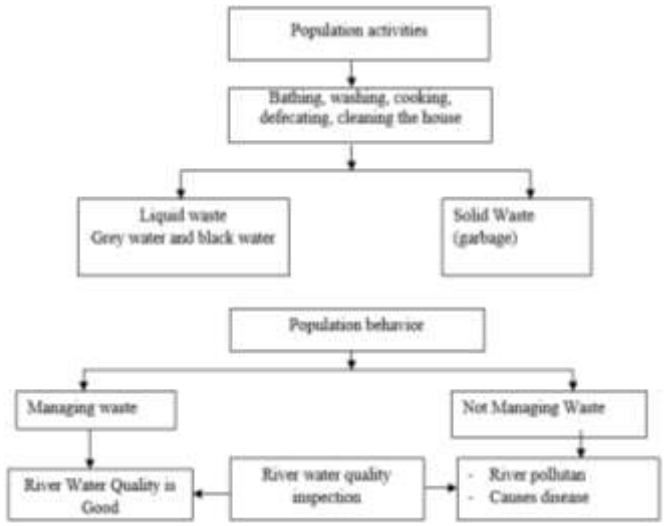

Figure 1. Research chat flow

Result and Discussion

Solid waste management is a significant global challenge, especially in small island developing states, where fragmented institutions, financial constraints and inadequate technology exacerbate pollution problems (Matagi et al., 2024). Solid waste is a major problem for countries worldwide, especially developing countries (Harfadli et al., 2025). Many previous studies have revealed poor waste management, especially in underdeveloped countries where management should be planned (Hussain et al., 2022). Ujunggading is the most densely populated Nagari in West Pasaman Regency, denser than the capital of Simpang Empat Regency. Ujunggading Nagari has been expanded by the West Pasaman Regency Government in 2022 which has been registered by the Ministry of Home Affairs. Based on Regional Regulation Number 6 of 2022, Ujunggading Nagari was expanded into 8 Nagari and preparatory Nagari have been formed. However, this study still uses the old parent Nagari data because the status of the new Nagari is not yet definitive.

The river condition is quite clear during the dry season or when there is no rain in the upper reaches of the river. During the rainy season, the river looks very cloudy due to the large amount of erosion that occurs in the upper reaches. All locations are within the class II river water quality standard, with the lowest TSS value at Point 2 of 2.13 mg/L and the highest at Point 3, all of which are below the maximum value of 50 mg/L. The average pH value at all locations is 7, which is within the acceptable range for class II river water quality. The pH value decreases slightly from Point 1 to Point 5, although it is still not statistically significant. This decrease is in accordance with the entry of waste from Point 2 to Point 5. Although the dissolved oxygen (DO) level drops to 6.8

Mg/L at Points 2 and 3, it is still below the class II river water quality standard of 7.10 Mg/L at Point 1. The DO quality standard for class II river water is at least 4 Mg/L. Both DO values of Point 4 and Point 5, which are 3.6 and 2.91 Mg/L respectively, are higher than the quality standard. More organic materials enter the river from Points 4 and 5, both from drainage or city runoff, as well as from scattered garbage, thus increasing the need for oxygen by bacteria to decompose organic materials.

Table 3. River Water Quality Test Results

Parameter	Test results					Unit	Quality Standards
	T1	T2	T3	T4	T5		
TSS	2.98	2.13	3.31	2.56	2.99	Mg/l	Max 50
PH	7.71	7.46	7.44	7.26	7.22	-	6-9
DO	7.10	6.80	6.80	3.6	2.91	Mg/l	Min 4
BOD5	2.53	2.53	2.90	3.47	3.57	Mg/l	Max 3
COD	9.91	9.91	10.19	10.15	10.22	Mg/l	Max 25
Nitrat	0.06	0.10	0.24	0.312	0.727	Mg/l	Max 10
Total fospat	0.14	0.07	0.10	0.079	0.10	Mg/l	Max 0.2
Fecalcoliform	24000	24000	24000	24000	24000	Mg/l	Max100000
Total Coliform	24000	24000	24000	24000	24000	Mg/l	Max 5000

Table 4. Domestic Waste Test Results

Parameter	Test results			Unit	Quality standards
	T1	T2	T3		
TSS	5.26	13.3	13.7	Mg/l	Max 30
pH	7.04	6.25	6.20	-	6-9
BOD5	33	31	35	Mg/l	Max 30
COD	37	34	41.5	Mg/l	Max 100
Ammonia	5.52	4.53	6.85	Mg/l	Max 10
Oils and fats	1.00	1.00	1.00	Mg/l	Max 5
Total coliform	24000	24000	24000	Jml 100 ml	Max 3000

Dissolved organic carbon (DO) levels decreased due to the increase in organic materials in the river because DO is one measure of the fertility of the aquatic ecosystem (Simanjuntak et al., 2021). Point 4 is a waste disposal site for the Ujunggading market, so it carries a lot of pollutants into the river. The BOD value of both points, which is 2.53 Mg/L, is still within the range of class II river water quality standards, which is 3 Mg/L as the upper limit. Although there was an increase of 2.90 Mg/L at Point 3, the river water quality criteria are still met. Both Point 4 and Point 5 have BOD values higher than the class II river water quality standard, namely at Point 4 of 3.47 Mg/L and at Point 5 of 3.57 Mg/L. The increase in BOD concentration is in line with the presence of waste discharge entering the river through Drainage and also water runoff from settlements and community businesses and the large amount of garbage scattered in the river. At Point 4, waste from the Ujunggading market also enters the river, especially waste disposed of through drainage channels plus liquid waste and garbage from the community that passes through this channel and finally enters the river.

The disposal of organic waste into waters will increase the need for biochemical oxygen (BOD) because these materials can rot or be decomposed by microbes. Water flowing from Point I to Point 5 will most likely carry a lot of garbage and other debris along its flow, so that BOD levels become higher. Darajatin (2011) reported in Ashar (2020) that research on river water quality showed a decrease in quality between the time before and after tofu waste was mixed, with physical and chemical parameters exceeding the quality standards. With a maximum permitted COD level of 25 mg/L, the COD measurement results at Point 2 and Point 1 showed the same results, namely 9.91 mg/L. Meanwhile, at Point 3 there was an increase, Point 4 was 10.19 Mg/L, and Point 5 was 10.22 Mg/L, but the quality standards for class II river water still met the quality standards at Points 3–5. COD is a measure of the oxygen needed to chemically oxidize organic matter, both biodegradable and non-biodegradable organic matter. The concentration of organic pollutants in river water can be seen from its COD value Residential. From Points 1-4, total phosphate is still within the parameters of class II river water quality standards. Phosphate is present in various forms in water, including inorganic solutions, dust, and living organisms. Detergents, industrial and household cleaning equipment, and fertilizers for plants are sources of inorganic phosphate. Legasari et al. (2023) who stated that organic phosphate comes from food and household waste.

The results of phosphate measurements showed concentrations ranging from 0.076 to 0.141 mg/L; however, the highest quality criterion is 0.2 mg/L, so the water is still classified as class II river water quality. Nitrate levels ranged from 0.064 Mg/L to 0.727 Mg/L, which is included in the class II river water quality category; however, the highest quality limit is 10 Mg/L. Fecal coli measurements at all sample points showed the same value, namely 24,000 MPN/100mL while the maximum fecal coli quality standard is 1,000 MPN/100 ML. Animal and human waste both contain coliform bacteria, and excessive levels of these bacteria can disrupt aquatic ecosystems in a number of ways. For example, when these bacteria decompose aerobically, they lower dissolved oxygen levels, which can kill fish and other aquatic life. In a 2012 study, Zainun et al. since many people still use rivers as toilets or to dispose of animal waste, fecal coliform in waterways is an indication that the river has been polluted by human and animal waste.

According to statistics from the West Pasaman District Health Office in the first half of 2024, 1,574 households in Lembah Melintang District did not have access to adequate sanitation. Many individuals continue to defecate in the river because of this. Although 5,000 MPN/100 ML is the maximum Total Coliform quality standard, all sample locations showed the same result, namely 24,000 MPN/100 mL. The TSS value in domestic waste samples increased between sample point 1 and point 2 and point 3, but was still within the domestic waste quality standard. From point 1 to points 2 and 3, the pH value decreased, but was still within the required quality standard. The biological oxygen demand (BOD) value of domestic waste at Points 1-3 is higher than the quality standard which states that the maximum BOD value allowed for this type of waste is 30 mg/L. All COD test points for domestic waste are still within the quality standard range although there is an increase in the value from Point 1 to Point 3. In the Total coliform test from Points 1 to 3, it exceeds the quality standard with a value of 24,000 MPN/100 ml where the quality standard is 3,000 MPN/100ml.

Water Quality Status

Solid waste management can be seen as a complex system, which often involves systemic interactions and multiple feedbacks associated with population, economic development patterns, waste treatment technology, costs, etc (Vega et al., 2024). The Batang Bayang River Pollution Index is calculated using nine parameters: pH, total dissolved solids, dissolved oxygen, biological oxygen demand, nitrate, total phosphate, fecal coliform, and total coliform bacteria. For this calculation, the quality criteria for class II river water are used. The table below shows the results of river water quality calculations carried out at each sampling location.

Table 5. Water Quality Status

Location	Pollution index (IP)	Status
T1	5,698	Medium pollution
T2	5,691	Medium pollution
T3	5,699	Medium pollution
T4	5,709	Medium pollution
T5	5,714	Medium pollution

Based on the evaluation of river water quality using the river pollution index, it shows that the average pollution index value is 5, with an increase from Point 1 to Point 5. All sampling locations are within this range. The river water quality is classified as moderate at all sampling locations. A lot of human waste and liquid waste and garbage are dumped into the river which causes the river water quality to decline to moderate pollution status.

Community Behavior

Knowledge

The challenge of effective waste management is a pressing concern in the context of global sustainability (Alsabt et al., 2024). From the results of the population knowledge measurement, most of their knowledge is lacking as many as 35 people or 47% while good knowledge is as many as 29 people or 39% and sufficient 10 people or 13%. Lack of knowledge is due to the level of education of the community, most of which 51% are high school and 24% are junior high school and 7% are elementary school. However, 39% of respondents can still be considered knowledgeable at the same level of education. In accordance with the results of the study (Sangga, 2019), it was found that 21 respondents or 70% had insufficient knowledge about waste management, while 9 respondents or 30% had sufficient knowledge. The results of the correlation test between knowledge and action showed that there was a significance value of 0.001 <0.05. This value can prove that there is a relationship between the knowledge variable and action and also the results of the correlation test between knowledge and attitude showed that there was a significance value of 0.011 <0.05. This value can prove that there is a relationship between the knowledge variable and attitude.

Attiitude

With the development of society and economy, as well as the gradual modification of lifestyles and consumption patterns of villagers in rural, the generation of domestic waste in villages and towns is increasing (Cheng et al., 2024). Most of the community's attitudes are bad at 45%, then moderate at 31% and good at 24%. Many residents are of the view that it is okay to throw garbage in the river because the river will be clean again when the river water is large because it is carried by the river current. The river will still serve the daily needs of the community, such as washing and bathing. The behavior of each community is influenced by the attitudes of its members. It is believed that a positive attitude will lead to good behavior, although this is not guaranteed (Sari et al., 2019). Lack of education about proper waste disposal practices causes negative sentiment. The results of the correlation test between attitudes and actions show that there is a significance value of 0.002 <0.05. This value can prove that there is a relationship between the attitude variable and actions.

Action

Most of the community's actions are not good at 51%, sufficient at 18% and good at 31%. These community actions are in line with the low level of knowledge and attitudes that are mostly bad, resulting in bad actions as well. This is further exacerbated by the lack of waste management facilities and infrastructure in residential areas and weak law enforcement.

Handling Strategy

A significant proportion of this waste occurs at the household level (Pickering, 2023). The increase in population, changes in lifestyle, and industrialization all have a significant impact on waste generation (Vilakazi et al., 2023). Some strategies that are carried out to deal with river pollution due to domestic waste are as follows:

Processing Waste at Home

In the future, most of the waste generated by households will be processed at home by applying the 3R principles of Reduce, Reuse and Recycle. Processing waste at home needs to change the culture of people who are less concerned about waste. To raise public awareness, socialization and training are needed in processing waste so that people realize how important it is to process waste that has an impact on a clean environment, waste is no longer thrown into rivers, and can increase community income from the sale of waste. Waste that can be processed at home will drive the community's economy while reducing waste that will.

Establish a Waste Bank

Plastic pollution has gathered significant international attention, ranking as the world's third major contributor to waste (Fayshal, 2024). Garbage Bank is an important unit that can be relied on to manage waste in the community. With Garbage Bank, the community can save waste and can get money from the sale of their waste. From the field review, there is not a single Garbage Bank in Nagari Ujunggading. For the effectiveness of the Garbage Bank, it can be managed through the Village Business Entity so that it becomes income for the village.

Counseling to the Community

The lack of knowledge is that most people are still at the high school and junior high school level and is made worse by the fact that so far, counseling has never been carried out to the community. To improve the knowledge of the population to be better, counseling must be carried out to the community continuously. Although there is no guarantee that a well-informed community will behave well, there have been efforts to raise public awareness to care about the environment.

Building Domestic Wastewater Treatment Plant

In accordance with PermenPUPR No. 04/2017 concerning the implementation of a domestic wastewater management system, grey water wastewater must be managed before being discharged into drainage or into water bodies so that the wastewater meets quality standards before entering the river. Management is carried out using a wastewater treatment plant (IPAL). The obstacle to making this IPAL is that the cost of making it is quite expensive, so it must be built with a budget from the government. When the IPAL has been built, all community waste pipes are connected to the IPAL and processed so that the water quality is suitable for being discharged into the river.

Cross-Sector Cooperation

The attainment of a sustainable society requires achieving the circular development model based upon a nexus of economic, social, and environmental dimensions (Jassim et al., 2023). Collaboration in handling river pollution is very important. From the agency side, many have the same duties regarding rivers, so it is necessary to strengthen cooperation. In addition, handling river pollution cannot be done by the government alone, but there needs to be cross-sector cooperation between the government, researchers, the private sector, community organizations and the community. This cooperation must be encouraged by the government that embraces various parties. The government provides policy direction and guidelines so that cross-sector cooperation can be implemented. The private sector provides financial assistance in the development of waste processing facilities and infrastructure including education and training in managing waste. The results of processing community waste will be sold back to the company. Researchers or academics provide ideas and concepts that can be done in handling river pollution. Various discussion forums can be initiated by community institutions working in the environmental sector so that joint efforts can be made with community empowerment programs.

Make Waste Management a Priority for Regional Development

In regional development planning, there is a scale of priorities carried out by the regional government in implementing activities and development. So far, the budget for sanitation and waste has been very minimal in the West Pasaman Regency APBD.

Conclusion

Conclusions must be made in paragraph form or explained point by point: Based on the results of river water quality testing, there are a number of indicators that exceed the river water quality standards for class II Batang Bayang River. The river water quality index uses the IP method at all sample location points with moderately polluted status. Then most of the community's knowledge level is poor at 47%, good at 39% and sufficient at 13%. Community attitudes tend to be bad at 45%, moderate at 31% and good at 24%. Poor actions at 51%, sufficient at 18% and good at 31%. Last River pollution handling strategies can be carried out by managing waste at home, establishing waste banks, providing education to the community, building domestic wastewater treatment plants, cross-sector collaboration and making waste management a priority for regional development.

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Author Contributions

A: preparation of original draft, results, discussion, methodology, conclusions; N. S, E.B, N.C; analysis review, proofreading and editing.

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No conflict interest.

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