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RIVER MANAGEMENT BASED ON PHYSICAL CHEMICAL PARAMETERS OF WATER QUALITY IN WAI BATU GAJAH, AMBON CITY

Pengelolaan Sungai Berbasis Paramater Fisik Kimia Kualitas Air di Wai Batu Gajah, Kota Ambon

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ABSTRACT

The increased population in Ambon City has significantly affected the water quality of several rivers, including Wai Batu Gajah. This study investigates the water's physicochemical parameters, documents community activities, and evaluates existing management efforts to propose effective strategies and programs. A field survey was conducted during May–June 2023 at seven observation stations, assessing parameters such as odor, color, width, depth, substrate type, temperature, total suspended solids (TSS), current velocity, pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), and ammonia. Laboratory analyses were performed at the Health and Instrument Calibration Center of Maluku Province, while data on community activities were obtained through questionnaires administered to 35 respondents. The results were compared with river water quality standards. Findings reveal that at stations 6–7 the water is turbid, dark-colored, and emits a pungent odor. The river's average width and depth are 7.82 m and 48.49 cm, respectively; stations 1–6 feature a rocky sandy substrate, whereas station 7 exhibits a muddy sandy substrate. Although TSS (0.0399 mg/l) and pH (8.65) values meet the standards, DO (stations 5–7), BOD (stations 6–7), and ammonia (stations 4–7) do not. Community activities include bathing, washing, and waste disposal, and current management measures involve rainwater harvesting, biopore construction, waste bank initiatives, and riverbank excavation. SWOT and TOWS analyses yielded six management strategies and 16 water quality improvement programs for Wai Batu Gajah.

Key words: Physical Chemical, Management, River, Wai Batu Gajah, Water Quality

ABSTRAK

Peningkatan jumlah penduduk berdampak pada kualitas air beberapa sungai di Kota Ambon, salah satunya Wai Batu Gajah. Penelitian ini bertujuan menganalisa parameter fisik kimia perairan, mendeskripsikan aktivitas masyarakat dan upaya pengelolaan yang telah dilakukan, serta merekomendasikan strategi pengelolaan serta program di Wai Batu Gajah. Penelitian

dilakukan di Wai Batu Gajah, Kota Ambon pada Mei-Juni 2023 di 7 stasiun pengamatan. Parameter fisik kimia yang diukur meliputi bau, warna, lebar, ketinggian, tipe substrat, suhu, TSS, kecepatan arus, pH, DO, BOD, dan amonia. Metode pengambilan data parameter fisik kimia dilakukan secara langsung di lapangan, selanjutnya dianalisa pada laboratorium Balai Kesehatan dan Kalibrasi Alat Provinsi Maluku. Data aktivitas masyarakat diperoleh melalui wawancara menggunakan kuesioner kepada 35 responden. Nilai parameter fisik kimia perairan dirujuk dengan baku mutu sungai. Strategi dan program pengelolaan dianalisis dengan metode SWOT dan TOWS. Hasil penelitian menunjukan pada stasiun 6-7, warna perairan keruh dan kehitaman serta menimbulkan bau menyengat. Rata-rata lebar dan ketinggian sungai masing-masing sebesar 7,82 m dan 48,49 cm. Tipe substrat stasiun 1-6 didominasi pasir berbatu sedangkan pasir berlumpur pada stasiun 7. Rata-rata nilai TSS sebesar 0,0399 mg/l dan nilai pH sebesar 8,65 menunjukan nilai tersebut sesuai baku mutu. Nilai DO untuk stasiun 5-7, BOD pada stasiun 6-7, serta nilai amonia untuk stasiun 4-7 tidak sesuai baku mutu. Aktivitas masyarakat yang dilakukan yaitu mandi, mencuci dan membuang sampah. Upaya pengelolaan yang telah dilakukan yaitu panen air hujan, pembuatan lubang biopori, bank sampah, serta susur sungai. Terdapat 6 strategi pengelolaan dengan 16 program untuk pengelolaan kualitas air Wai Batu Gajah.

Kata Kunci: Fisik Kimia, Kualitas Air, Pengelolaan, Sungai, Wai Batu Gajah

INTRODUCTION

One of the aquatic ecosystems that is under environmental pressure is the river ecosystem (von Schiller *et al.*, 2017; Yanti *et al.*, 2024). The high activity of people living around rivers results in environmental changes, as indicated by the resulting water pollution (Kospa & Rahmadi, 2019). Various activities originating from households as causes of river pollution include washing, bathing, defecating, direct waste disposal and others (Silaban *et al.*, 2024). One of the factors that contributes to river pollution is the location of residential areas right on the edge (border) of the river, making it easier for people to dispose of household waste, both liquid and solid, organic and inorganic, directly into the river (Artawan *et al.*, 2023; Nofrima, 2022). The increase in population has resulted in an increasing need for housing land so that people use the riverbank area as a place to live. This is also what happened in Ambon City as the capital of Maluku with a population that has increased by 347,288 people in 2020 to 362,639 people in 2024 (BPS, 2024).

There are five main rivers that flow in the Ambon City area, namely Wai Ruhu, Wai Batu Merah, Wai Tomu, Wai Batu Gajah and Wai Batu Gantung (Wai means river). Each river has similarities, namely the dense population on the banks of the river, especially in the downstream areas. This is shown by the high level of waste that is seen as a result of household waste (Pesulima *et al.*, 2018). In addition, the result of the decomposition process of organic waste that is dumped directly into the river causes a pungent odor which can later cause disease in the community (Aini *et al.*, 2023). Many actions have been taken by both the city government, the community and environmentalists to reduce environmental pressure on river waters, but have not had a positive impact. Some of these actions include appeals in the form of prohibition signs, river cleaning actions, written and unwritten regulations at the sub-district/district level, and the establishment of a Waste Bank (Tuhumury, 2020).

The decline in river water quality not only impacts the resources in the river but also impacts resources in coastal and marine areas (Tuahatu & Tuhumury, 2022). A real example is the large amount of floating waste in the waters of Ambon Bay which comes from the river flow when it rains. Especially plastic waste which dominates the type of waste found in the waters of Ambon Bay. In addition, the color of the water changes to brownish due to eroded

soil particles carried by the river flow which will go directly to the waters of Ambon Bay. As is known, one of the functions of the river is to carry soil particles that are eroded due to the erosion process. River water quality affects aquaculture activities in the waters of Ambon Bay. The large number of floating net cages in the waters of Ambon Bay shows that the location supports aquaculture activities, but the large amount of fresh water entering and high pollution can damage aquaculture commodities. The decline in water quality in Wai Batu Gajah also occurs due to changes in land cover and dense settlements around the river (Muin & Somae, 2023). Dense settlements have resulted in this river being used as a place to dump household waste and various other activities. Various problems that have emerged indicate that the river area in Ambon City has an urgency to be managed properly. This study aims to analyze the physical and chemical parameters of Wai Batu Gajah waters, describe community activities and management efforts that have been carried out, and recommend appropriate management strategies and programs in Wai Batu Gajah.

RESEARCH METHODS

Time and Place of Research

This research was conducted in Wai Batu Gajah, Sirimau District, in May-June 2023. Wai Batu Gajah is a river that flows in Ambon City with a river length of 6.7 km.

Tools and Materials

The tools and materials used in this study include thermometers, meter rolls, graduated rods, ping pong balls, stopwatches, sample bottles, questionnaires, and tools and materials used in the Maluku Province Health and Equipment Calibration Center Laboratory to measure pH, DO, BOD and ammonia.

Research Procedures

Data collection was conducted at 7 observation stations (Table 1) representing the upstream, middle and downstream areas of Wai Batu Gajah. The physical parameters measured included odor, color, width, height, substrate type, temperature, TSS (Total Suspended Solid) and current speed, while chemical parameters included pH, DO, BOD, and ammonia. The odor, color, and type of river substrate were identified directly in the field. The width of the river was measured using a meter roll, while the height of the river was measured with a graduated stick. The temperature was measured using a thermometer, while the current speed used the floating media method (ping pong ball). Water sampling for river water chemical parameters at each station used sample bottles to be measured at the accredited Maluku Province Health and Equipment Calibration Center Laboratory. Community activities were obtained through interviews and direct observations in the field. To produce an appropriate management strategy, an interview method using a questionnaire was used. Interviews were conducted with 35 respondents consisting of the Batu Gajah sub-district government, as well as randomly selected communities who live around the river and use it directly.

Table 1. Description of observation stations

Station	Coordinate Points	Location Image	Location Description
1	3°42'42.23"S 128°11'40.32"E		Located at the upstream of Wai Batu Gajah, precisely in Batu Gajah Village. The river is shallow, located between trees, and quite far from residents' houses.
2	3°42'32.32"S 128°11'37.53"E		Located at RT 004/RW 005, Batu Gajah Village. The river is shallow and still natural, surrounded by trees and rocks.
3	3°42'21.02"S 128°11'25.15"E		Located at RT 001/RW 004, Batu Gajah Village. The river is shallow with residential areas along the river. The river water is quite clear.
4	3°42'17.94"S 128°11'13.08"E		Located at RT 004/RW 002, Batu Gajah Village. The river is shallow, located in the middle of a dense settlement, the color of the river is not very clear and there are piles of garbage.
5	3°42'6.96"S 128°10'56.61"E		Located at RT 002/RW 005, Ahusen Village. The river is shallow with residential areas along the river. The river water is not very clear and smells a little.

6	3°41'59.51"S 128°10'44.44"E		Located at RT 003/RW 002, Urimessing. The river is shallow with dense residential areas along the river. There is a lot of garbage and several drain pipes from residents' houses. The waters smell and look dirty.
7	3°41'46.92"S 128°10'31.52"E		Located in RT 002/RW 004, Silale Village. Located at the mouth of the river with densely populated settlements. There is a lot of garbage in the water body, blackish blue in color and smells pungent.

Data Analysis

The results of the physical and chemical parameters of Wai Batu Gajah waters are then referred to the river water quality standards in accordance with Government Regulation Number 22 of 2021 concerning the Implementation of Environmental Protection and Management, especially Appendix VI concerning River Water Quality Standards and the Like. The management strategy is analyzed using the SWOT (Strengths, Weaknesses, Opportunities, and Threats) method by comparing internal factors (strengths and weaknesses) and external factors (opportunities and threats) so that strategic decisions can be made. The analysis is continued with TOWS which focuses on developing strategic options based on the identified SWOT factors. TOWS analysis is used to develop management strategies through efforts to overcome internal weaknesses and external threats, while continuing to increase strengths and take advantage of opportunities.

DISCUSSION

Physical Parameters of Wai Batu Gajah Waters

Based on field observations, at stations 1-2 there is no odor because there is no community activity around these two stations. At stations 3-5, the river water smells bad but not pungent. While the pungent odor appears at station 6, and is even more pungent at station 7. Based on the results of water color identification, at each station 1-3 it looks clear compared to the other stations. This is because the distance between the station and the residential area is quite far. The color of the water at stations 4-6 looks cloudy, while at station 7 it is blackish blue.

The width of Wai Batu Gajah ranges from 5.11 m -11.62 m with an average of 7.82 m. There are differences in river conditions that result in differences in river width at Wai Batu Gajah. The condition of the river at stations 1-2 is still natural, while at stations 3-7 river normalization has been carried out resulting in changes in the cross-sectional area of the river.

The results of water level measurements at Wai Batu Gajah show that the observation station with the highest measurement results is station 7, which is 66.97 cm. The lowest

measurement result at station 2 was 34.3 cm, so the average water height from the seven stations was 48.49 cm.

Visually, the substrate type in Wai Batu Gajah is dominated by rocky sand, especially at stations 1-6, while at station 7 it is more dominated by muddy sand. This is due to the hydrological factor of Wai Batu Gajah which has a high current velocity. The results of current measurements obtained an average at the 7 observation stations of 0.64 m/second (Figure 1), with the highest current at station 1 of 0.84 m/second and the lowest at station 7 of 0.28 m/second.

Based on the results of TSS (Total Suspended Solid) measurements in the laboratory, the TSS range in Wai Batu Gajah is 0.0268 - 0.0412 mg/l, with an average of 0.0399 mg/l. The highest TSS at station 3 is 0.0412 mg/l, while the lowest TSS at station 7 is 0.0412 mg/l (Figure 2). Based on river water quality standards, the TSS at Wai Batu Gajah is still within the range of quality standards set for classes I – IV.

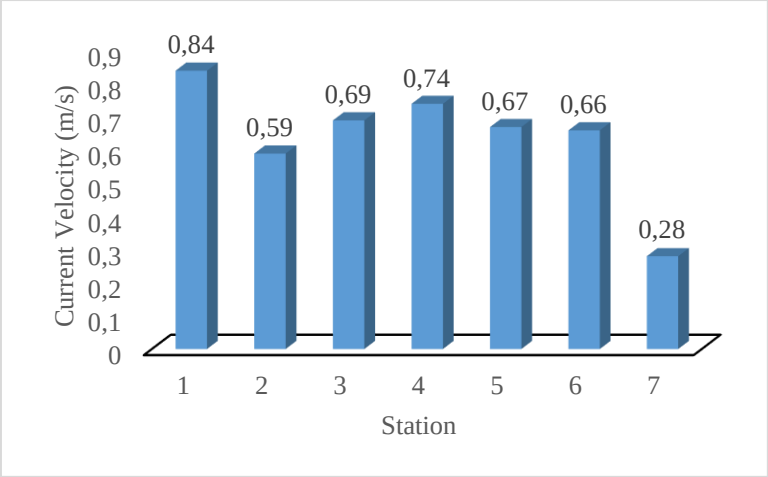

Figure 1. Current speed in Wai Batu Gajah

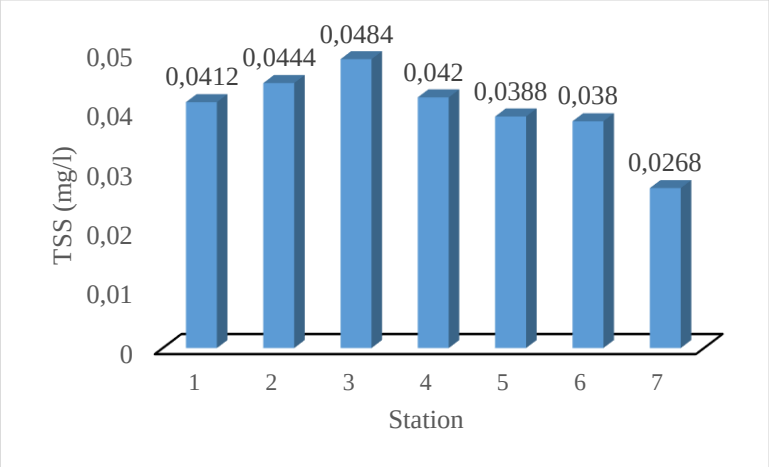

Figure 2. Total Suspended Solid (TSS) in Wai Batu Gajah

Chemical Parameters of Wai Batu Gajah Waters

The pH value in Wai Batu Gajah ranges from 8.41-8.87 with an average of 8.65 (Figure 3). Based on the river water quality standards, the average pH in Wai Batu Gajah is still within the range of the standard quality set for classes I-IV, namely 6-9.

Based on the measurement results, the DO range in Wai Batu Gajah is 2.3-7.15 mg/l, with an average of 5.50 mg/l. The highest DO value at station 1 is 7.15 mg/l, while the lowest DO is at station 6, namely 2.30 mg/l (Figure 4). Based on the river water quality standards, the average DO in Wai Batu Gajah is less than the standard quality set, namely 6 mg/l, especially at stations 5-7. Stations 5-7 have DO below 6 mg/l so that they do not comply with the class I category for drinking water and can only be used for recreational water purposes, freshwater fish farming, livestock, irrigating crops or other appropriate uses.

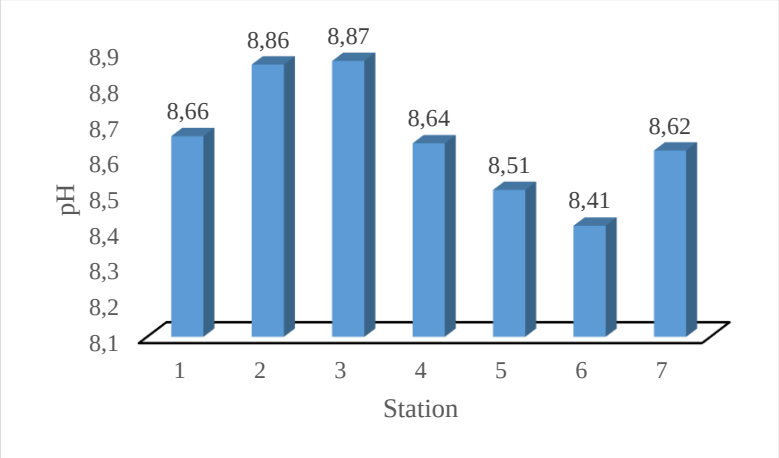

Figure 3. pH value in Wai Batu Gajah

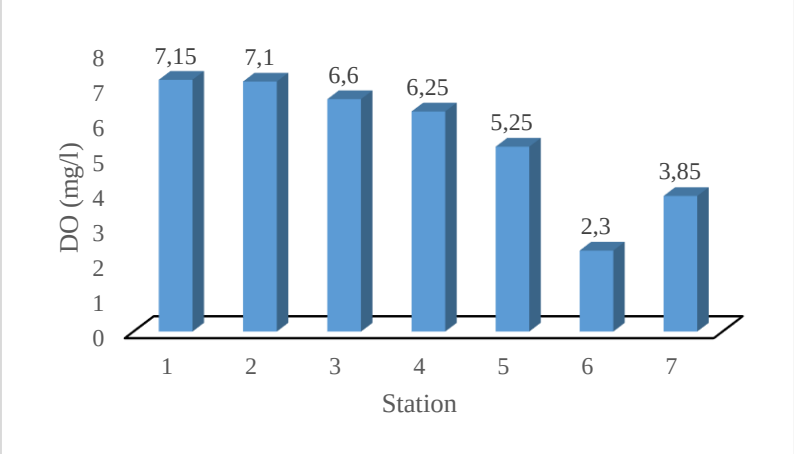

Figure 4. DO values in Wai Batu Gajah

The results of the BOD measurement of Wai Batu Gajah ranged from 1.60-27 mg/l, with an average reaching 7.64 mg/l. The highest BOD was at station 6, which was 27 mg/l, while the lowest BOD was at station 1, which was 1.60 mg/l (Figure 5). Based on the river water quality standards, the average BOD in Wai Batu Gajah meets the quality standards set at stations 1-5, but does not meet the quality standards at stations 6 and 7, especially for class III (6 mg/l) and class IV (12 mg/l).

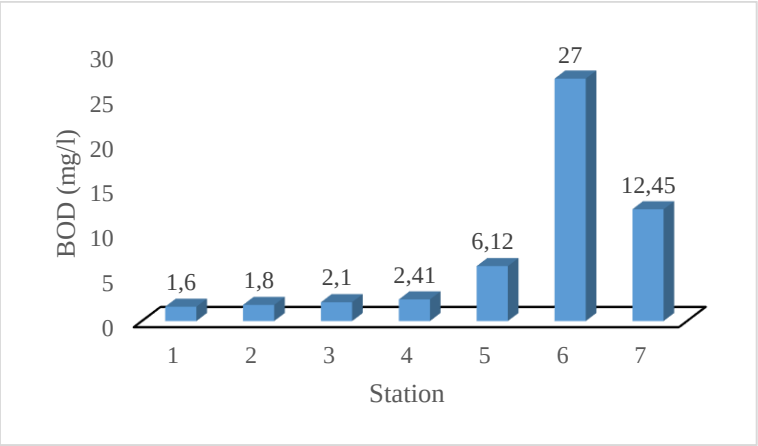

Figure 5. BOD value in Wai Batu Gajah

The measurement results show that the range of ammonia values in Wai Batu Gajah ranges from 0-0.44 mg/l, with an average reaching 0.11 mg/l (Figure 6). The highest ammonia value was at station 7, which was 0.44 mg/l, while the lowest ammonia was at stations 1-3, which was 0 mg/l. The average ammonia value in Wai Batu Gajah did not meet the class I quality standard of 0.1 mg/l, especially at stations 4-7.

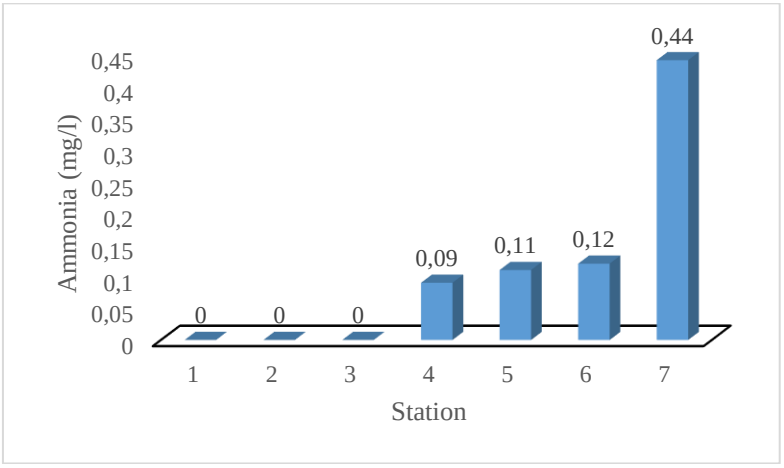

Figure 6. Ammonia Value in Wai Batu Gajah

Community Activities and Management Efforts at Wai Batu Gajah

The daily activities of the community in Wai Batu Gajah were identified as bathing, washing, and throwing away garbage (Figure 7). Although various activities that have negative impacts occur in Wai Batu Gajah, many efforts have been made by the government, the community, and environmental care institutions. The action plan for the Maluku Government's flagship program, namely "Climate Village" and "Tabaos Maluku Free of Waste", has formed several River Care Communities (KPS) spread across five large rivers in Ambon City. The purpose of establishing KPS is to increase public awareness and participation through environmental programs in collaboration with local government agencies, as well as to monitor changes that occur in river waters. There are 12 KPS in Wai Batu Gajah that operate from the upstream to the downstream of the river. Several activity programs that have been carried out include rainwater harvesting, waste banks, biopores, river schools, and river cleaning actions..

Figure 7. Community activities carried out in Wai Batu Gajah
Source: field documentation

Wai Batu Gajah Management Strategy

Based on the SWOT analysis, internal factors identified are 4 strengths and 4 weaknesses, while external factors include 4 opportunities and 3 threats (Table 2). Furthermore, based on the TOWS matrix, 6 strategies were obtained to manage Wai Batu Gajah.

Table 2. SWOT and TOWS matrix for Wai Batu Gajah management

Internal / Eksternal	**Strengths:**	**Weaknesses:**
	1. Natural conditions of the river upstream 2. Physical and chemical parameters of the river at several observation points are still in accordance with quality standards 3. The existence of river care groups (KPS) 4. The existence of educational and collaborative programs of the government, community and private sector to maintain the sustainability of the river	1. There is still organic and inorganic waste, especially in the downstream of the river, which causes a pungent odor 2. There are still people who do not care and are not involved in river care programs 3. Dense settlements on the banks of the river are increasing so that waste production in the river is also increasing 4. There has been no firm action from the local government for violations found

Opportunities: 1. The existence of a cleanliness program from the city government 2. There is cooperation with the private sector for a river care program 3. There are government regulations regarding water quality and river pollution control 4. River normalization has been carried out	**S-O Strategy** 1. Improvement and development of educational and collaborative programs for river sustainability	**W-O Strategy** 1. Enforcement of regulations regarding the development of residential areas around/on riverbanks and the use of rivers as waste disposal sites.
Threats: 1. High rainfall intensity every year 2. Weak law enforcement 3. Global warming phenomenon	**S-T Strategy** 1. Maintaining the sustainability of river upstreams 2. Cooperation with related parties to monitor river water discharge during the rainy and dry seasons	**W-T Strategy** 1. Periodic monitoring and evaluation of programs that have been implemented 2. Monitoring of river water quality (physical, chemical, biological) in the face of climate change

DISCUSSION

The pungent odor in Wai Batu Gajah comes from the entry of organic or easily decomposed household waste that is dumped into the river and will flow into the downstream area. Organic waste in the form of food scraps that are thrown away every day will decompose, causing an odor from the process (Saputri & Arsi, 2019). The very pungent odor is caused by gases such as Hydrogen Sulfide (H_2S), Ammonia (NH_3) (Priyambada & Wardana, 2018) which are produced from the decomposition process that occurs due to the accumulation of waste that has been deposited for a long time.

The clear color of the water at stations 1-3 indicates that the water is in good condition because the distance between the station and the residential area is quite far. Meanwhile, rivers that are located in fairly dense residential areas tend to receive input from water flow from household waste, both organic and inorganic, such as soap, oil, and food scraps. There are several factors that can also affect water color, namely suspended solutions, types of plankton, minerals, and decomposition of organic materials (Rosarina & Laksanawati, 2019).

The width of Wai Batu Gajah depends on the condition of the river which is still natural and has undergone changes or normalization. The increasing population in Ambon City has become one of the factors that has resulted in the conversion of green land into residential areas and other uses that do not pay attention to the principles of good water management, resulting in the flood phenomenon that occurs every year (Helwend & Lasaiba, 2022; Tentua *et al.*, 2018). River normalization is carried out on river cross-sections with a capacity that can no longer accommodate the overflow and water discharge that passes through, so that it can reduce the risk of flooding.

The water level at station 7 is higher than other stations due to the formation of a delta at the river mouth, so that river water and the material carried are blocked. The water level in the river is influenced by several factors such as the intensity of rainwater entering the water body (Wiadnyana *et al.*, 2019), as well as the different river topography from upstream to downstream (Jamalludin *et al.*, 2023).

The type of substrate obtained is influenced by the hydrological factors of Wai Batu Gajah which has a high current velocity. Rivers are waters characterized by unidirectional and relatively strong currents with speeds ranging from 0.1-1.0 m/second. The current originating from the river carries sediment material towards the sea, but when the current velocity is low, which occurs at station 7, sediment deposition is higher (Barus et al., 2020). The high and low current velocity in a river can affect the type of substrate (Riniatsih & Kushartono, 2009). The high current velocity in Wai Batu Gajah tends to have a substrate dominated by large particles such as rocks, gravel or sand, while for smaller and finer particles, they will continue to be carried by the strong river current and settle in the sloping downstream area.

If the TSS value of river water is high (> 400 mg/l), it will increase the turbidity of the water due to the presence of fine particles or mud due to soil erosion carried by the water flow (Setyawati *et al.*, 2023). The TSS parameter is one of the important factors determining water quality. The higher the TSS value, the more it will affect the entry of sunlight as one of the important elements in the photosynthesis process. Suspended particles and plankton in the water column can absorb and scatter light (Calantropio & Chiabrando, 2024) thereby weakening the penetration of sunlight in the water.

Although the pH value in Wai Batu Gajah is still within the standard quality range, pH can affect the toxicity of the water, considering the high activity, especially at observation stations near the downstream of the river. If the pH is <7, the water will be acidic and corrosive, heavy metal toxicity will increase (Robi *et al.*, 2021), and result in inhibition of the nitrification process (Zhou *et al.*, 2023). Too high a pH value will increase alkalinity and reduce carbon dioxide in the water.

The low DO value at stations 5-7 is caused by the presence of organic household waste and waste that is discharged through drain pipes. This results in more dissolved oxygen being needed by decomposing bacteria in the water to decompose organic compounds that enter the water body. A decrease in DO can have a negative impact on aquatic organisms that really need the availability of dissolved oxygen to live, such as fish or other aquatic animals (Ali *et al.*, 2022). Low DO can also cause a foul odor arising from the decomposition process (Wang *et al.*, 2024) or degradation of organic or inorganic materials in the water body.

High BOD values indicate bacterial activity that uses dissolved oxygen to decompose organic matter. The source of organic matter in Wai Batu Gajah waters comes from household waste in the form of food scraps or liquid waste such as detergent. Bacterial activity in decomposing organic matter is in aerobic conditions whose enzyme activity requires dissolved oxygen. When the dissolved oxygen content is depleted, the decomposition process is taken over by anaerobic bacteria that do not require oxygen. This causes BOD in water to be inversely proportional to DO. The higher the BOD, the lower the DO (Wahyuni *et al.*, 2024).

The presence of ammonia in Wai Batu Gajah comes from feces and domestic wastewater. Ammonia through the nitrification process can be converted into nitrite and nitrate by microbes (Hendrawan *et al.*, 2021). This causes if ammonia is high, nitrite will also increase and river water is toxic because it interferes with the binding of oxygen in the blood. In the nitrification process, ammonia from household organic waste will be oxidized by Nitrosomonas or Nitrococcus bacteria into nitrite compounds. The nitrite compounds produced will then be oxidized again by Nitrobacter into nitrate compounds. Temperature, pH, and DO parameters also affect the nitrification process to reduce ammonia at stations 5-7. A temperature of 30°C, pH 5.8-8.5, and DO> 1 mg/l are needed for the nitrification process to run optimally. The pH and DO parameters at stations 5-7 have met optimal conditions, but temperatures that are too low inhibit the nitrification process so that ammonia will not be completely oxidized into nitrite and nitrate.

Some of the community activities carried out every day in Wai Batu Gajah include bathing, washing, throwing away garbage (Figure 7). Washing and bathing activities are generally carried out by people in the upstream part of the river because the water conditions are clear and cool. This activity is carried out by mothers to wash clothes and children to bathe, especially when it rains. The water level is higher during the rainy season than during the dry season, making the upstream of Wai Batu Gajah a swimming spot.

People living in the middle to downstream areas of the river generally do not use river water for washing and bathing because the water is murky and tends to smell. Real activities seen in both areas are dumping waste directly into the river. The dense settlement conditions in the downstream areas make it easy for people to dump household waste directly into the river. Not only that, the drainage (bathing, washing, toilets) for bathing, washing and defecating purposes are directly dumped into the river, causing a pungent stench. As is known, soap and detergent waste can reduce the quality of river water. Soap and detergent are used by everyone every day and are organic pollutants that, when decomposed, will cause an odor. In addition, excessive foam produced from cleaning fluids in the form of soap, detergent, shampoo has a negative impact on aquatic biota (Larasati *et al.*, 2021). Foam in the water will interfere with the fish's breathing process, increase the turbidity of the water so that the photosynthesis process can be hampered and interfere with fish metabolism due to irritation of the gills exposed to foam (Putri *et al.*, 2022).

Rainwater harvesting is a continuation program of Kampung Iklim. Ambon City with high rainfall intensity can be utilized if managed properly. The community participating in this program is taught to understand and care about rainwater and its benefits. Rainwater harvesting activities begin with the process of collecting rainwater that flows from the roofs of residents' houses and then channeling it through pipes to enter a water reservoir. The rainwater is left for 10-15 minutes to precipitate harmful particles in the water, then purified and separated into alkaline pH with relatively cheap simple tools. The rainwater collection process also aims to reduce rainwater entering the river so that it does not cause flooding.

Another program is to make biopore holes. There are approximately 250 biopore holes for settlements around the waters of Wai Batu Gajah. These Biopore holes are connected to water pipes in the ground, so that rainwater flowing on the surface of the ground can easily enter the ground. In other words, biopore holes aim to increase the process of water absorption into the soil. Solid organic waste such as leaves and fruit peels are also put into the biopore holes. This aims to make the waste into fertilizer that can then be used by the local community.

The waste bank program is also carried out by KPS in collaboration with the Pawnshop Office. As is known, waste banks have benefits not only ecologically but also economically. Ecologically, waste banks are able to reduce the waste produced by each person to then be recycled into new products that are ready to use. Economically, waste can be converted into money just like saving money in a bank. The collaboration established with the Pawnshop Office aims to change the value of money in the waste bank savings into gold, or in other words, saving waste into gold. Recycling activities at this waste bank are carried out by the Dasa Wisma group. Organic waste is recycled into compost, while inorganic waste in the form of plastic bottles that are generally saved can be recycled into handicrafts (flowers and flower pots, tissue holders and others).

River cleaning activities (river tracing) are also carried out every Friday by KPS together with the community living around Wai Batu Gajah from the upstream to the downstream of the river. This program is carried out in conjunction with the Ambon City Government program, namely Clean Environment Friday Morning (Jumpa Berlian). This activity is also supported by the River Region Office (BWS) by providing equipment such as gloves and plastic boots. Although this activity is a cleaning activity that is considered effective, garbage

is still visible in the river from household waste. Field observations show that this activity is not carried out routinely because it depends on the amount of garbage in the river. Garbage that is seen in small amounts is not removed so that it will be carried by the current to the downstream of the river. To prevent garbage disposal by the community, KPS is working with the private sector to install CCT at several points in Wai Batu Gajah. The purpose of installing CCTV is to monitor community activities and the condition of the river waters during high rainfall that has the potential for flooding. The results of monitoring from CCTV will then be reported to the Maluku Provincial River Region Office for follow-up. Although violations are still found to be committed by the community around Wai Batu Gajah, there has been no firm action based on the rules that have been set so that violations continue to occur.

Based on the resulting management strategy, several programs can be carried out as follows:

1. Strategy to improve and develop educational and collaborative programs for river sustainability, with the following programs:
   - Increase rainwater harvesting with appropriate technology to reduce the potential for flooding;
   - Increase biopore holes in strategic places in the river environment;
   - Increase waste banks through creative programs such as using a health check bonus system or a basic food or other basic necessities bonus;
   - River tracing activities become a regular monthly agenda;
   - Installation of prohibition signs in the form of boards or banners to maintain river cleanliness;
   - Installation of nets in the upper reaches of the river to prevent waste from entering the waters of Ambon Bay;
   - "My Sea, My Home" education for early childhood that provides understanding and awareness of protecting the coast and sea from an early age.
2. Strategy for enforcing regulations related to the development of residential areas around/on riverbanks and the use of rivers as waste disposal sites, with the following programs:
   - Socialization of regulations related to settlement development on river banks;
   - Law enforcement against development permits around rivers that can disrupt the condition of river flow water systems.
3. Strategy for preserving upstream rivers, with the following programs:
   - Prohibition of settlement development in upstream areas;
   - Prohibition of tree felling in any form or for any purpose;
   - Increasing the active role of KPS in monitoring destructive activities in upstream areas.
4. Strategy for collaborating with related parties to monitor river water discharge during rainy and dry seasons, with the following programs:
   - Collaboration with BWS to monitor river water discharge during rainy and dry seasons;
   - Public education on river area disaster mitigation in the face of global warming.
5. Periodic monitoring and evaluation strategies for programs that have been implemented, with the following programs:
   - Community involvement in every river care program that has been and will be implemented, considering that the impacts, both positive and negative, will be felt by the community.

6. River water quality monitoring strategy (physical, chemical, biological) in the face of climate change, with the following programs:
   - Involvement of academics through the latest scientific research on the water quality of Wai Batu Gajah.

CONCLUSION

Based on the results of the study, it can be concluded that the parameters of river water quality include color, odor, DO, BOD and ammonia at the Wai Batu Gajah downstream observation station. The activity of dumping waste into the river is still carried out by the community, especially those living on the riverbank. Several activities carried out by the community involving the government and the private sector to maintain river sustainability include rainwater harvesting, making biopore holes, waste banks, and river tracing. Based on the results of the analysis, there are 6 management strategies with 16 programs for managing the water quality of Wai Batu Gajah.

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