



# The Influence of Community Behavior on Water Quality of the Anyar River in Surakarta City Based on Physical-Chemical Parameters

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**Abstract** - The Anyar River is a tributary of the Bengawan Solo River, which is located in the city of Surakarta. The Anyar River has a watershed area of approximately 305.2 km<sup>2</sup> and the length of the main river from the Anyar River is approximately 61.96 km. This river is important for people's lives, but the awareness of the surrounding community is still lacking, as evidenced by several community houses that there is still feces disposal from the septic tank, which is channeled directly to the Anyar River through pipes. The surrounding community did not hold any cleaning activities for the Anyar River, only a rule from the local RT not to throw garbage in the Anyar River. When the dry season arrives, the water in the Anyar River will recede and will occasionally be polluted when it is dry. These things will certainly affect the quality of the water in the Anyar River. This study aims to determine the effect of community behavior on the water quality of the Anyar River, Surakarta City, based on water physico-chemical parameters. The research method used is a descriptive qualitative method, obtained through observation and interviews as well as several journal articles related to physical and chemical parameters in water. The results of this study indicate that at the three main location points in the Anyar River, no water pollution was found based on the results of measurements of physical-chemical parameters such as pH, temperature, DO, TDS, and turbidity. However, at location point II, the branch was found to be more polluted because it was used by local residents for direct disposal. From the results of the study, it can be concluded that the awareness of citizens to maintain water quality in the Anyar River is still a bit lacking, so some recommendations are given by inviting residents to work together to clean the river; make IPAL and household water disposal (septic tank) independently; emphasize not to throw garbage in the river; and residents can take advantage of PAHs during the rainy season.

**Keywords** – Anyar River, Parameters, Water Pollution, Society

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## 1. Introduction

Water is essential to the survival of all living things on Earth. One of the sources of water can come from surface water. Surface water in Indonesia has abundant availability. However, the quality of surface water, such as rivers in Indonesia, does not yet have a good enough quality. This is demonstrated in 2019, when Indonesia has 98 rivers, 54 of which are lightly polluted, 6 of which are mild to moderately polluted, and 38 of which are heavily polluted (Firmansyah et al., 2021). This condition is even worse when compared to conditions in 2018. These water quality problems can be caused by various anthropogenic activities from upstream to downstream. Some of the anthropogenic activities carried out, such as disposing of garbage, liquid

waste, and industrial activities in water bodies, sometimes do not use the right environmental management principles. In certain areas, such as Surakarta, there have also been some water problems. Water problems that have occurred in Surakarta are floods, land subsidence, and groundwater crisis problems. In addition, quoted from Kompas.com (11/13/2019), Head of Pollution Control Section of the Solo Environmental Service (DLH), Indah Warniati explained that water pollution in Surakarta had also occurred in the Tirtanadi River, precisely in the Anyar River in the form of foam because there was contamination. Detergent in which the waterfall creates foam on the surface of the river water. The pollutants come from detergents, softeners, and clothing fragrances from household activities. Based on

some of the existing problems, it shows that the lack of public awareness to care about the environment is still lacking. This condition is certainly quite worrying for sustainability in the future.

Starting from remote areas to all citizens, especially in Indonesia, they definitely use water to meet their daily needs. Activities such as cooking, washing, bathing, and so on, of course, require water. However, keep in mind that the amount of fresh water on earth is constant. According to Ramdhan, et al. (2021), the supply of fresh water is inversely proportional to the total population. Currently, the exploitation of easy water sources continues to develop. If the need for water continues to increase, it will have consequences for finding new water sources. Human activities that continue to increase will produce a lot of waste that is dumped into the environment. This will certainly make groundwater and surface water contaminated. So many contradictions between the improvement of water quality for human health and the increase of water contamination. One type of surface water is river water. River water will continue to flow through the existing channels around residential areas until later it will end up in the sea. River water is usually used by residents as a means for washing clothes and other household activities. Sometimes, some residents also use river water to catch fish, which will be consumed later. Then, at the motorbike washing places, this time the water can also be used to wash the motorbike, where the water used to wash the motorbike will be channeled back to the river so that it can save the quantity of clean water. This condition shows that river water has an important role in people's lives. However, the use of river water should be accompanied by the awareness of residents not to directly dispose of the waste from the activities carried out so as not to pollute the river water, which will later be reused by other residents, so that it is proper as good citizens to take care of each other well.

Water plays an important role in life on this earth, so water quality needs to be maintained and considered. Water quality is defined as the characteristics of water and contains several components that influence it, both biotic and abiotic components in water (Noor et al., 2019). Through testing using water parameters, one can determine the quality of water in a certain area. The purpose of this test is to determine whether the water quality has been polluted or not by contaminants which affect the physical, biological, and chemical parameters of the water. Water can be said to be of good quality if it meets several water parameters such as physics, chemistry, and biology. Physical parameters according to the Regulation of the Minister of Health of the Republic of Indonesia No. 49/Menkes/Per/2010 are generally identified according to the physical condition of the water. Physical parameter tests consist of odor, turbidity, taste, temperature, color, and the number of dissolved solids (TDS) (Sahidi et al., 2019). Chemical parameter tests consist of the level of

acidity (pH), dissolved oxygen (DO), salinity, and alkalinity. Biological parameter tests consist of plankton and fish.

Everyone on this earth definitely needs water as a source of their life because, considering that water covers two-thirds of the land, including the human body, most of it consists of water. Various sources of water on earth can be found in glaciers, rivers, lakes, rainwater, groundwater, and the like (Sivaranjani et al., 2015). Water itself has properties that are very susceptible to pollution, so that water is very easily polluted. Water pollution is pollution in water bodies that can be caused by human activities. Anthropogenic waste pollution can degrade water quality and pose important problems that must be resolved (Blettler et al., 2018). The cause of the decline in water quality can be influenced by sources of pollutants that enter water bodies (Kospa and Rahmadi, 2019). Almost all living organisms can be harmed if there is a change in the physical, chemical, or biological conditions of water. The domino effect can be caused by water pollution, which will lead to a fresh water crisis, threatened drinking water availability, and some important needs of living things. Water pollution is not only bad for humans but also for the environment. There are several impacts of water pollution, such as various diseases, ecosystem damage, eutrophication, and disruption of the food chain. Water that has been polluted is unfit for human consumption because it can cause health problems. Some of the diseases caused by consuming contaminated water include hepatitis, cholera, typhus, and other diseases. Not only that, the food chain will also be affected by the consequences of water pollution, so it has the potential to cause human health problems. This is known because the load of water pollutants and toxic substances enters through aquatic animals such as fish, which are then consumed by humans. The quality of clean water is very important for the life of living things, especially humans when carrying out daily activities. Due to this, it is mandatory for people who use clean water for activities such as washing, cooking, and others to maintain good quality so that it does not have a bad impact on the environment.

The Anyar River is a tributary of the Bengawan Solo River, which is located in the city of Surakarta. The Anyar River has a watershed area of approximately 305.2 km<sup>2</sup> and the length of the main river from Anyar River is approximately 61.96 km (Islan et al., 2017). The Anyar River plays an important role in the drainage channel that empties into the Bengawan Solo River. However, the awareness of the surrounding community is still lacking, as evidenced by several community houses that there is still feces disposal from the septic tank, which is channeled directly to the Anyar River through pipes. The surrounding community did not hold any cleaning activities for the Anyar River, only a rule from the local RT not to throw garbage in the Anyar River. When the dry season arrives, the water in Anyar River will recede and will occasionally be polluted when it is dry. These things will certainly affect the quality of the water in the Anyar River. Therefore, to

determine the effect of community behavior on the water quality of the Anyar River, Surakarta City, based on water physic-chemical parameters, this research was conducted.

**2. Materials and Methods**

**2.1 Time and Location**

The research scheme used is an empirical one which is carried out offline. The empirical scheme is carried out through observation and interview methods while maintaining health protocols. The research was conducted in April 2022 in Surakarta City. In detail, the observation activities were carried out for one day in the first week and interviews were carried out for one day in the second week. The location that will be the object of research is Anyar River, which is carried out at three location points. With a river length of 61.96 km, the distribution of location points is carried out at both ends of the river and at the middle point of the river, precisely at the point where the flow of the river is branching. The radius from location points I to point location II reaches 120 m, while the radius from location points II to location point III reaches 151 m.



Figure 1. Anyar River research location

**2.2 Data Collection**

Observation and interviews are data collection methods used in this study. Observation is a method carried out by observing and recording conditions, visual characteristics, and events at the research location (Alamri, 2019). Meanwhile, interviews are data collection activities based on the opinions of sources obtained through dialogue questions regarding the conditions of the research location (Katz-Buonincontro and Anderson, 2018). Observations and interviews were conducted offline while still observing

health protocols. Observations were carried out for one day in the first week. Observations in this study were carried out experimentally directly at the location with the Horiba U-52-30 Multi-Parameter Water Quality Meter so that water quality based on physical and chemical parameters could be known. Observational data will be used as material for analysis of water quality testing. Then, interviews were conducted for one day in the second week. Interviews were conducted using personal interviews consisting of one researcher and three respondents to find out the relationship between the water quality of the Anyar River and the daily activities carried out by the community around the Anyar River. The data obtained from the interviews will be compared with the data from the observations and analysed in order to determine the correlation between the two.

**2.3 Data Analysis**

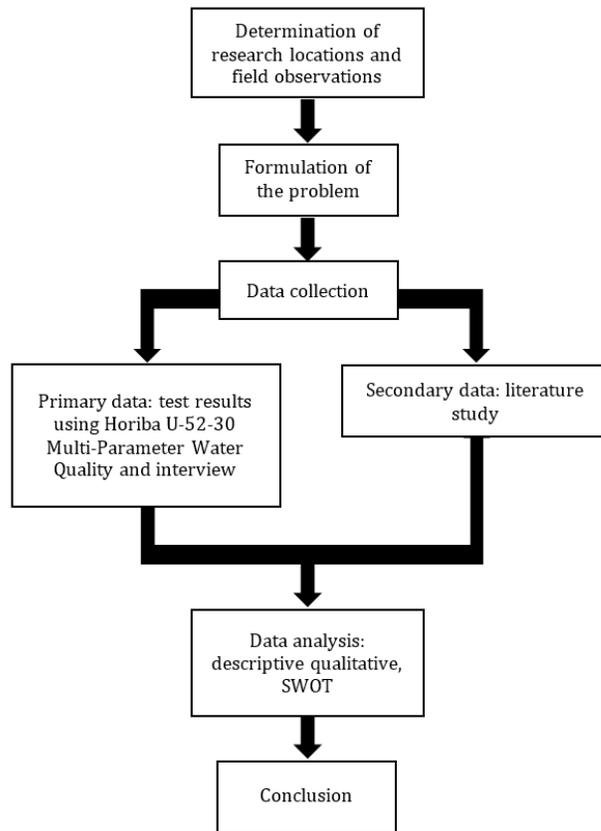


Figure 2. Research Diagram

There are two types of data used in this study, including primary data and secondary data. Primary data was obtained through direct measurement of water quality parameters using the Horiba U-52-30 Multi-Parameter Water Quality Meter to determine the pH, temperature, DO, TDS, and turbidity values. The data is then presented in tabular form and analysed descriptively; a comparison is made using the Water Quality Standard Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management; and recommendations are

given based on the results of the SWOT analysis. Meanwhile, secondary data was obtained from journals and literature relevant to the research conducted so as to strengthen the results of the research conducted. The stages carried out in this research can see in Figure 2.

### 3. Results and discussion

#### 3.1. Anyar River Water Quality Analysis

Table 1. Water quality parameter measurement data

Parameter	Location		
	I	II	III
Temperature (°C)	28.98	29.84	29.41
Turbidity (NTU)	30.1	28	33.4
TDS (mg/L)	1000	1000	1000
pH	7.8	7.8	7.9
DO	2.3	2.2	2.1

Table 2. Comparison of primary data and water quality standards

Parameter	Primary Data	Water Quality Standards
Temperature (°C)	28.98-29.84	Deviation 3
Turbidity (NTU)	28-33.4	-
TDS (mg/L)	1000	2000
pH	7.8-7.9	6-9
DO	2.1-2.3	> 1



Figure 3. Location I



Figure 4. Location II



Figure 5. Location II (Inlet)



Figure 6. Location III

##### 3.1.1. Temperature

In the data from measurements that have been carried out directly at the three location points in the Anyar River, the temperature ranges from 28.98-29.84 degrees Celsius. The lowest temperature is at location I, with a value of 28.98 degrees Celsius, while the highest temperature is at location II, with a value of 29.84 degrees Celsius. This

category can be said to be good because it still meets the grade 4 water quality standard values listed in PP No 22 of 2021 with a deviation value of 3, which means it is still normal following the natural conditions in the Anyar River. According to Mardhia and Abdullah (2018), if the temperature exceeds the quality standard, it can affect the survival of aquatic animals or aquatic plants where dissolved oxygen levels decrease, followed by an increase in temperature. Water temperature can be caused by the high or low intensity of sunlight entering water bodies and the density of vegetation around riverbanks (Marlina et al., 2017).

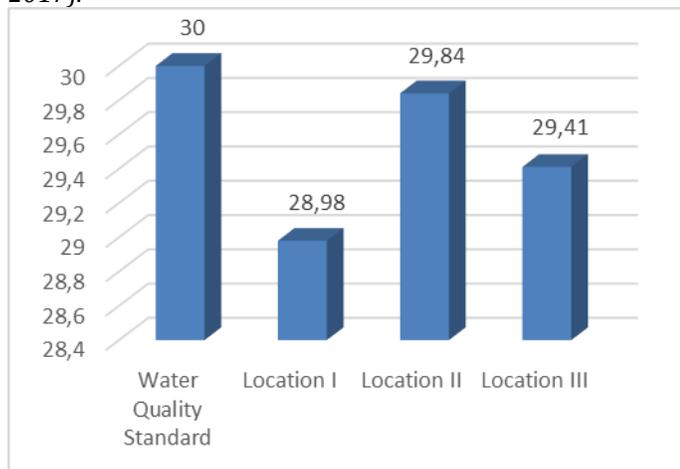


Figure 7. Graph of Temperature

### 3.1.2. Turbidity

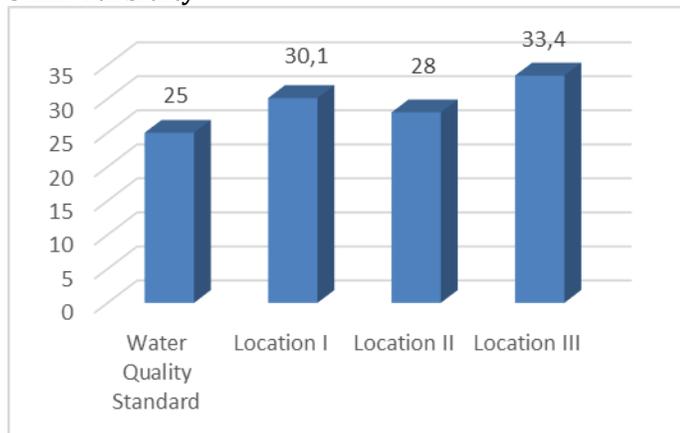


Figure 8. Graph of Turbidity

The results of direct measurements in measuring physical parameters, one of which is turbidity, show that the value of water turbidity in the Anyar River is in the range of 28–33.4 NTU. The lowest turbidity value was at the main location point II of 28 NTU, while the highest value was obtained at the location point III of 33.4. Boyd (1990) explained that turbidity can be caused by the presence of suspended particles ranging from small fine particles to coarse particles. Turbidity can occur due to physical and chemical events in the water in the form of decomposition and sedimentation events (Syarifudin and Santoso, 2019).

Isnan (2016) explains that the level of turbidity of good clean water is worth 25 NTU. If viewed from the results of the measurement of the level of turbidity in the Anyar River, it can be said that the results do not meet or are not feasible. The measurements were carried out at the location point II of the *inlets*, where the location point looks cloudier because it is used by local residents for direct drainage, meaning that it is more polluted and also experiences sedimentation. Therefore, the location point of this *inlet* II is more polluted than the other location points.

### 3.1.3. Total Dissolved Solid (TDS)

According to Irwan and Afdal (2016), river water usually has higher dissolved solids than lake water due to many anthropogenic activities such as community activities, while dissolved solids in lake water can come from fish metabolism residues and fishery activities. The results obtained from the measurement of Total Dissolved Solids (TDS) in the Anyar River obtained a result of 1000 mg/L. The Total Dissolved Solids (TDS) values at all three locations had the same results. Based on the value of class 4 water quality standards listed in PP No 22 of 2021, it states that the results of Total Dissolved Solids (TDS) are at least 2000 mg/L, which means that the results of the measurement of Total Dissolved Solids (TDS) in Anyar River can still be said to be good. This is because the low value of Total Dissolved Solids (TDS) means that the water quality is considered good and vice versa. The higher the suspended solids, the higher the turbidity value. With a high turbidity value, the oxygen content will decrease. This is also influenced by the intensity of sunlight entering the waters, which is very limited, causing phytoplankton to be unable to carry out the photosynthesis process to produce oxygen.

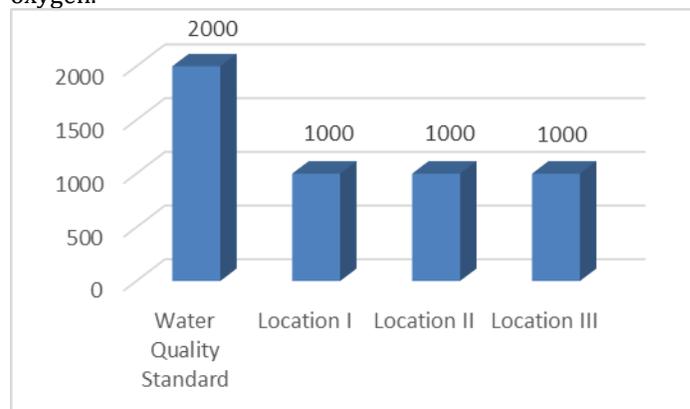


Figure 9. Graph of Total Dissolved Solid

### 3.1.4. Acidity (pH)

From the measurement data listed in the table above, the results show that the degree of acidity (pH) is in the range of 7.8–7.9. Where location point I and main location point II have a pH of 7.8, while location point 3 has a pH of 7.9. At location point II, there is an *inlet* location point where this *inlet* location point has a pH of 7.9. This *inlet* location point has a higher pH than the main location point

because at the *inlet* location points it is more polluted due to direct contamination from household waste disposal of local residents. The pH category in the Anyar River can be said to be good because it still meets the water quality standard value, which is in the range of 6–9 according to PP No. 22 of 2021. The location point of this *inlet* has a higher pH than the main location point, which means that the water at this location point is alkaline in nature. This is because at the point of *inlet* location it is more polluted due to direct contamination from household waste disposal of local residents, such as waste from detergent waste originating from the washing activities of local residents. The degree of acidity (pH) is an important factor in water because the pH value in water can determine the nature of the water between being acidic or alkaline, which will affect biological life in the water (Djoharam *et al.*, 2018). The category for pH in the Anyar River can be said to be good because it still meets the water quality standard value, which is in the range of 6–9 according to Government Regulation No. 22 of 2021.

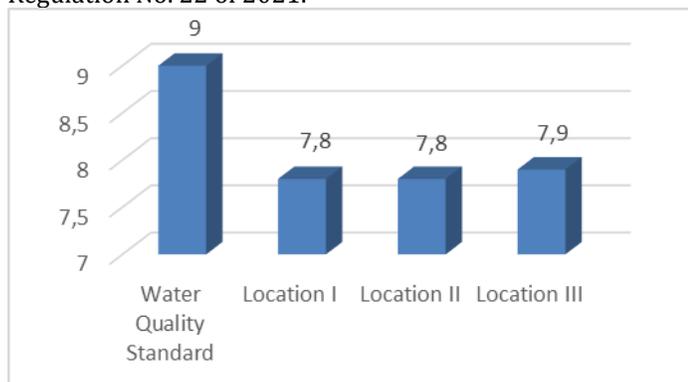


Figure 10. Graph of pH

### 3.1.5. Dissolved Oxygen (DO)

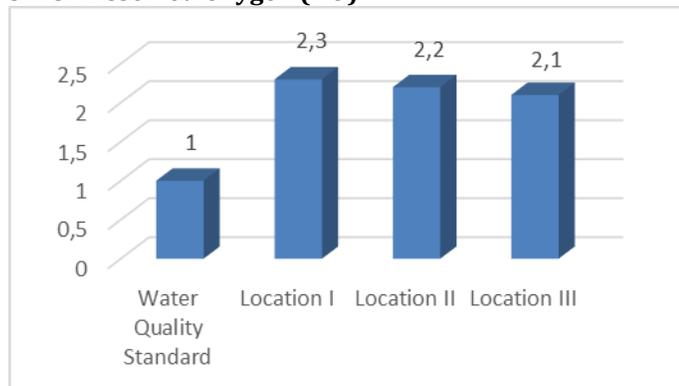


Figure 11. Graph of Dissolved Oxygen

From the data on the results of the Dissolved Oxygen (DO) measurements listed in the table above, the results show that the Dissolved Oxygen (DO) is in the range of 2.1-2.3. The location point with the lowest DO is at location point III, which is 2.1, while the location point with the highest DO is at location point I, which is 2.3. Based on the water quality standards listed in PP No 22 of 2021, it can be

said that the condition of the Anyar River based on its dissolved oxygen is still relatively good, with a quality standard value of more than 1. Oxygen itself plays an important role as an indicator of water quality because dissolved oxygen plays a role in the process of oxidation and reduction of organic and inorganic materials. With the oxidation and reduction processes, the role of dissolved oxygen is very important in helping to reduce the pollution load in the waters naturally. One of the causes of the decrease in dissolved oxygen concentration is the result of human activities such as the disposal of household waste, the agricultural sector, and the industrial sector around water bodies.

### 3.2. Analysis of the Relationship of Community Behavior with Water Quality

Based on the objectives studied in this study, the use of descriptive qualitative methods was carried out to analyze community behavior on the water quality of the Anyar River. This descriptive data on community behavior was generated from interviews with several residents living on the banks of the Anyar River and by conducting a theoretical study of some literature. The results of the interviews were conducted by representatives of residents who live near each data collection point. Each point was taken by a representative to be questioned regarding his actions in treating Anyar River. It was concluded from the interview that locations I and III already had WWTPs and household water pipes independently. WWTPs are provided along the footpaths in residential areas. Pipes are connected to each house to flow into the available septic tank. It is different with location II. It is very unfortunate that there are no WWTPs and independent water pipes provided at that location.



Figure 12. Sighting of WWTP at Locations I and II

It is known based on the residents interviewed, that the domestic waste water disposal is directly channeled to the Anyar River through a pipe connected to it. Apart from WWTPs and water pipes, they were also asked how the community behaves in using river water. It is known that river water is rarely used for daily needs. Based on the results of water quality using the Horiba U-52-30 Multi-Parameter Water Quality Meter, the water quality of Anyar River is still in the category whose benefits can be used as plant irrigation. However, in reality, residents rarely use river water as plant irrigation. This is due to people's knowledge that the river water is not good for plants and is not suitable for watering. Another behavior carried out by the community towards Anyar River is in maintaining the cleanliness of the river. It is known that based on information from residents from the three locations, there has not been any activity by local residents who have done mutual cooperation to clean the river regularly. Residents only received an appeal from the head of the local RT not to litter into the river without an agenda to take care of the river.

**3.3. Anyar River SWOT Analysis**

SWOT stands for Strength, Weakness, Opportunity, and Threat. SWOT analysis is a method of determining the best control strategy by evaluating several factors such as strengths and weaknesses, opportunities and threats (Luntung and Tawas, 2019). According to Farihiyyah and Musthofa (2020), the SWOT analysis is divided into two factors, namely internal factors (Strength and Weakness) and external factors (Opportunity and Threat). The research in Anyar was also carried out using a SWOT analysis based on internal and external factors.

Table 3. SWOT Table

<p style="text-align: center;"><b>Strengths</b></p> <ol style="list-style-type: none"> <li>1. Have water pollution control regulations in place.</li> <li>2. The river does not contain a heavy pollutant load.</li> <li>3. There are regulations from local regional leaders.</li> </ol>	<p style="text-align: center;"><b>Weakness</b></p> <ol style="list-style-type: none"> <li>1. There is domestic waste in the river.</li> <li>2. There are no local regulations to carry out mutual cooperation activities to clean rivers regularly.</li> <li>3. There are still some people who throw garbage into the river.</li> </ol>
<p style="text-align: center;"><b>Opportunities</b></p> <ol style="list-style-type: none"> <li>1. Public awareness of the law.</li> <li>2. There is no source of heavy pollutants.</li> <li>3. Make an effort not to litter.</li> </ol>	<p style="text-align: center;"><b>Threats</b></p> <ol style="list-style-type: none"> <li>1. There is still domestic waste disposal.</li> <li>2. Increasing the frequency of people's littering.</li> </ol>

Strengths in the Anyar River are regulations that are used to control water pollution through evaluation of water quality standards as stipulated in Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management. This river does not contain a heavy pollutant load based on measurements made from the first location point to the third location point. Then there are regulations from local regional leaders such as RT and RW not to throw garbage into the river.

In addition to having strengths, there are also weaknesses in the Anyar River, such as there are still some households that dispose of domestic waste water into rivers; there are no local regulations to carry out mutual cooperation activities to clean rivers regularly; and there are still some people who throw garbage into the river.

As for the opportunities found in the Anyar River, including the regulations in PP No. 22 of 2021, local residents have become aware of the necessity of maintaining their behavior towards actions that can cause pollution in the Anyar River. The pollution in the Anyar River is also not too heavy because there is no location where the river is heavily polluted. Then, local residents can maintain their habit of not throwing garbage into the Anyar River.

However, there are also threats that can occur in the Anyar River, such as river water which can be polluted due to domestic waste disposal; river cleanliness is not maintained in a stable manner because there is no routine cleaning action in the Anyar River; and there is an increase in the frequency of people throwing garbage away, which can cause the volume of waste in the Anyar River to increase, which has the potential to cause water pollution and flooding.

**3.4. Anyar River Handling Recommendations**

Based on the SWOT analysis that has been analyzed, there are several recommendations that can be made in Anyar River by local residents, namely:

First, the community's habit of working together to clean the river. One of the main causes of river pollution can be caused by the influence of irresponsible human activities. Therefore, it is necessary to have a role from the surrounding community to overcome this pollution. One of the roles of the community that can be played is by working together to clean the river. Mutual cooperation activities to clean rivers have several benefits, including minimizing the occurrence of floods, maintaining river ecosystems, minimizing health problems for local residents, providing clean water, and so on.

Second, operate WWTPs and household water disposal (septic tank) independently. Making WWTPs and making septic tanks can be one solution to prevent and overcome river pollution. A WWTP is a waste treatment plant that is built with the aim of cleaning and filtering liquids that have been polluted, both by organic and chemical pollutants from industry. The septic tank is a

watertight tank that functions as a container for storing and processing fecal waste on a domestic household scale. The purpose of making a septic tank is to maintain the cleanliness and health of the environment, including rivers.

Third, emphasize not throwing garbage around the river. Getting used to not throwing garbage in the river is one of the easiest and simplest efforts to make to prevent environmental pollution. Although this is the easiest and simplest effort, there are still many people who violate it and instead throw garbage into the river, which can lead to river contamination. This problem needs to get more attention. This application can be started by oneself by not throwing garbage into the river.

Fourth, residents can take advantage of PAH (Rainwater Harvesting) during the rainy season when there is a change from the rainy season to the dry season where the times start to recede or there is a drought. Utilization of PAHs is also one of the solutions to problems that can be done to overcome river pollution. Rainwater Harvesting (PAH) is a technique of collecting and storing rainwater in a reservoir or tank. Utilization of PAH is a form of preventive water management that can be done to overcome the threat of a clean water crisis, especially during the dry season, because it can save on the use of clean water (Rahim *et al.*, 2018). In addition, the use of PAH (Rainwater Harvesting) can also prevent flooding during the rainy season due to excess water supply because PAH (Rainwater Harvesting) can accommodate rainwater that falls (Lestari *et al.*, 2021).

Fifth, socialization of WWTPs to the local community. Many local people are still unfamiliar with how to make WWTPs and the benefits of WWTPs for their daily lives. Whereas the manufacture of WWTPs is very beneficial for the community, especially for people who live on the banks of rivers, because WWTPs play an important role in preventing and overcoming river pollution, Therefore, it is necessary to socialize WWTP with the community around Anyar River to increase knowledge of how to make simple WWTPs and their benefits for daily life. In this socialization, we can discuss the introduction of a good, effective, and efficient WWTP by explaining the tools, materials, and manufacturing methods that go into the benefits and uses of WWTP (Efendi *et al.*, 2020). The dissemination of this WWTPs is expected to help increase the need for clean water in settlements around the Anyar River, as well as prevent and overcome river pollution in the Anyar River.

#### 4. Conclusions

The Anyar River is a tributary of the Bengawan Solo River, which is located in the city of Surakarta, with an area of approximately 305.2 km<sup>2</sup> of watershed and the length of the main river is approximately 61.96 km. The Anyar River plays an important role in the drainage channel that empties into the Bengawan Solo River. It was concluded from the results of parameter measurements and interviews with local residents regarding the behaviour of the local community towards water quality in the Anyar River. The results obtained were that locations I and III

already had WWTPs and household water pipes independently. WWTPs are provided along the footpaths in residential areas. Then, the domestic waste water disposal is directly channeled to the Anyar River through a pipe connected to it. In addition, it is also known about the behaviour of the community in the use of river water that local people rarely use river water for their daily needs. Another behaviour is in maintaining the cleanliness of the river. There is no local resident who carries out mutual cooperation in cleaning the river regularly. There are several recommendations that can be made in Anyar River by local residents, namely the community's habit of working together to clean rivers; making WWTPs and household water disposal (septic tanks) independently; emphasizing not to throw garbage in rivers; and residents can use PAHs during the rainy season when there is a change from the rainy season to the dry season where the times start to recede or there is a drought.

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