Fisheries community behaviour towards water quality of the Deket river, Lamongan district

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Abstract. The river as a water source is one of the natural resources which has a multipurpose function for life, livelihood and also aquaculture. The Deket River is one of the rivers in Lamongan Regency that has experienced a decline in water quality, due to contamination by domestic and industrial waste. This study aims to determine the behaviour, perceptions and attitudes of the fisheries community towards the quality of the waters in the Deket River, Lamongan Regency. This research uses descriptive quantitative and qualitative methods. This research was conducted at 3 stations and 3 sample points for observation of water quality. The lab test results show that the average value of 3 stations still has several parameters that exceed the maximum threshold and are classified as light pollution. Based on the multiple linear regression test, people's perceptions and attitudes about the decline in water quality affect fisheries community behaviour by 49%. Several water quality parameters caused by domestic and industrial waste have values above the maximum threshold, so they can be an indicator of degradation in water quality. The decline in water quality in the Deket River can affect the behaviour of the fisheries community around the riverbanks.

1. Introduction
The river is an indicator of water quality with the use of rivers often used as waste disposal [1]. The function of rivers is as a source of drinking water, transportation, and also a source of irrigation for fisheries activity [2]. Human activities make rivers vulnerable to water pollution. Likewise, industrial growth can cause a decrease in environmental quality [3]. There is a relationship between total population (humans) and a decrease in the quality of the environment [4]. There are 3 factors for decreasing the quality of the environment by humans, namely the number of people, the number of natural resources used by each human being, and the environmental impact of the natural resources used [5].

Low water quality conditions will make some species unable to tolerate environmental conditions so that a small number of species will be found with a large number of individuals and dominance by certain organisms [6]. Lamongan Regency is an area that has many rivers with their mouths going to the Bengawan Solo River. According to data from the Central Statistics Agency of Lamongan Regency in 2017, 43 large-scale industries have been established and 4 of them are in Deket District.

There is a large-scale industry in Deket Sub-district resulting in wastewater polluting the river. Wastewater can come from various sources, including households, cities, industries, agriculture and so
The river in the Deket sub-district is widely used for fisheries activities such as filling aquaculture ponds. The existence of pollution due to domestic and industrial waste will cause the death of organisms and huge losses for fish farmers. This wastewater can result in the death of organisms or water biota in which the measurement of the impact of aquatic waste can be carried out in various ways [7].

Water quality of aquatic environment related to fisheries development Cultivation has become the world's concern today, especially from the impact of the decline in the quality of public waters used as cultivation media [8]. The general but important thing is that of quality water will affect optimal growth from fish that are cultivated and harvested in ponds. Study of water quality will combine Physico-chemical parameters and biological indicators [9].

Aquaculture activities are very dependent on environmental factors such as water quality from aquaculture media, pollution waters and epidemic disease. Efforts to increase technical efficiency become less effective when environmental factors neglected in the pond production process. Polluted environmental factors cause a decrease in the health of farmed fish so that it will cause losses for farmers [10].

Therefore, it is the water quality parameter can be used to assess the effects of industrial and domestic waste disposal as benchmarks the success of aquaculture. It is also important to conduct an in-depth analysis of how the perceptions, attitudes and behaviour of the people living around the river Deket, Lamongan Regency, to find out the activities and active roles of local communities in environmental damage. This study aims to determine the behaviour, perceptions and attitudes of the fisheries community towards the quality of the waters in the Deket River, Lamongan Regency.

2. Material and methods
2.1. Location and time
Water sampling and interviews were conducted at three stations, namely in Rejosari Village, Pandanpancur Village, Dinoyo Village, Deket District, Lamongan Regency, East Java in January-March 2020. Water quality measurements were carried out at the Surabaya Health Laboratory Center and the Lamongan Fisheries Service. The complete plan of the study can be seen in Figure 1.

![Figure 1. Deket River, Deket District, Lamongan Regency, East Java](image)

2.2. Data collection
This type of research is descriptive exploratory and qualitative research. Exploratory descriptive is used to determine the quality of the waters consisting of chemical parameters (chlorine, lead, nitrate and nitrite), physical parameters (DO, salinity, temperature and pH) and biological parameters (plankton
abundance) found in the river, Deket District, Lamongan Regency. Qualitative descriptive is used to describe the tendency of perceptions, attitudes and behaviour of fishery communities around the river in Deket District, represented by Rejosari Village, Pandanpancur Village and Dinoyo Village on river water conditions in Deket District, Lamongan Regency.

The water quality sampling technique is carried out by incidental sampling technique, water samples are taken using a water sampler bottle with a depth of 30 cm above the bottom of the water as much as 1,500 ml then put into a bottle that has been marked for each station and then entered inside the cool box, ice is applied to prevent biological and chemical changes, then the cool box is tightly closed and transportation to the laboratory is carried out. As for the tendency of perceptions, attitudes and behaviour of the fisheries community using purposive sampling method using observation techniques (observation), interviews, documentation and field notes. The indicators used in the interview can be seen in Table 1.

| No | Variable | Indicator |
|----|----------|-----------|
| 1  | Perception (X₁) | 1. Knowledge of the effect of washing kitchen utensils with river water  
2. Knowledge of the effect of washing clothes with river water  
3. Knowledge of the effect of bathing in river water  
4. Knowledge of industrial activities in the area  
5. Knowledge about the safety of clean water consumption in health  
6. Knowledge of safety in health  
7. Knowledge of pond rice activities within the area |
| 2  | Attitude (X₂) | 1. Knowledge of community activities regarding river water  
2. Knowledge of river water use  
3. Knowledge of industrial activities on river water  
4. Knowledge of river water use  
5. Knowledge of industrial waste to river water  
6. Knowledge of the influence of river water on pond rice field activities |
| 3  | Behaviour (Y) | 1. Waste disposal activities related to rivers  
2. Activities for disposing of household waste related to rivers  
3. Activities to use river water for household purposes  
4. Activities of using river water as clean water  
5. Activities to use river water for the benefit of pond rice fields  
6. Activities of using river water for cultivators  
7. Activities of using river water for fish growth  
8. The activity of using river water towards the survival rate of fish |

The scoring technique used in this research questionnaire was the Likert scale technique. according to Budiaji [11], Social phenomena in a society such as attitudes, opinions and perceptions can be measured using a Likert scale.

2.3. Data analysis
Water quality measurements were carried out at the Surabaya Health Laboratory Center and the Lamongan Fisheries Service.

2.3.1 Pollution index
Determination of pollution status is determined using the pollution index equation 1 based on the Decree of the State Minister for the Environment Number 115 of 2003 concerning Guidelines for Determining Water Quality Status as follows:

\[ PI_j = \sqrt{(Ci/Lij)^2 M + (Ci/Lij)^2 R} \]
Note:
Lij : the concentration of water quality parameters in the water design quality standard (j),
Ci : The concentration of water quality parameters in the water quality standard for the water quality parameter concentration of the survey results,
Plj : pollution index for designation (j),
(Ci/Lij)M : Maximum Ci / Lij value
(Ci/Lij)R : Average Ci / Lij value

The relationship between the level of pollution and the criteria for the pollution index is determined according to sea water quality standards based on the Decree of the State Minister for the Environment Number 115 of 2003 as follows:
1. 1.0 ≤Plj ≤1.0 : Meet the quality standard (good condition)
2. 1.0 <Plj ≤5.0 : Lightly polluted
3. 5.0 <Plj ≤10 : Moderately polluted
4. Plj > 10 : heavily polluted

2.3.2 Fisheries community behaviour analysis
To see the relationship between the variables X1 (perceptions of the fishery community), X2 (attitude of the fishery community), and Y (behaviour of the fishery community), the methods used are as follows:

a. Correlation coefficient test
Obilor and Amadi [12] suggest that Multiple correlation analysis can be used to determine how much the relationship and contribution of two or more independent variables (X) and the dependent variable (Y) simultaneously.

The multiple correlation coefficient is formulated:

$$R_{x_1, x_2, \ldots, x_i, y} = \sqrt{b_1 \sum x_1 + b_2 \sum x_2 y + y \over \sum y}$$

Note:
$$\sum x_1$$ : Amount of x1 data
$$\sum y$$ : Amount of Y data
$$\sum y^2$$ : Amount of Y2 data
$$\sum x_1 y$$ : Amount of x1y data
b1,...,b5 : The regression coefficient od each variable
Rx1,x2,...,xi,y : the correlation coefficient between the variable x and variable y.

In multiple correlation test, can use SPSS (Statistical Product and Service Solutions). Data analysis in this study used SPSS assistance.

b. Linear regression test
Multiple linear regression analysis is used to determine the effect of two or more independent variables on one dependent variable simultaneously [13]. The formula used is as follows:
\[ Y = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + e \]

Note:
\( \alpha_0 \) : Constant
\( \beta_1 - \beta_2 \) : Independent variable regression coefficient
\( Y \) : Fishery community behaviour
\( X_1 \) : The perception of the fishery community
\( X_2 \) : The attitude of the fishery community
e : Stnadart error

In multiple regression analysis, SPSS (Statistical Product and Service Solutions) can be used. Data analysis in this study used SPSS assistance.

c. ANOVA (Analysis of Variant) test
ANOVA shows all the independent variables included in the regression model have a joint influence on the dependent variable, according to [14]. The test steps are as follows:

Determine the formulation of the hypothesis
\[ H_0 : \beta_1 = \beta_2 = \ldots = \beta_n = 0 \]

Note: there is no significant influence from the independent variable, namely the perception of the fishery community (\( X_1 \)), the attitude of the fishery community (\( X_2 \)) to the dependent variable, the behaviour of the fishery community (\( Y \)).

\[ H_1 : \beta_k \neq 0 \]

Note: There is a significant influence of the perception variable of the fishery community, namely \( X_1 \), the attitude of the fishery community \( X_2 \), on the dependent variable, namely the behaviour of the fishery community \( Y \) or at least one \( X \) influences \( Y \).

Determine the significance level (alpha) of 5\% (\( \alpha = 0.05 \)) and the degrees of freedom (df) = (n-k-1)
Criteria for testing decisions. Comparing between F count and F table. If F count > F table, then \( H_0 \) is rejected and \( H_1 \) is accepted, it means that each independent variable can jointly explain and have a significant effect on the dependent variable. If F count < F table, then \( H_0 \) is accepted and \( H_1 \) is rejected, meaning that each independent variable together does not have a significant effect on the dependent variable.

3. Result and discussion
3.1 Water quality analysis
Data chemical parameters (chlorine, lead, nitrate and nitrite), physical parameters (DO, salinity, temperature and pH) and biological parameters (plankton abundance) measured in the river, Deket District, Lamongan Regency were carried out by in-situ measurements. The results of measuring water quality parameters during the study can be seen in Table 2.

3.1.1 Chemical parameter
a. Chlorine (Cl\(_2\))
Based on the results of research conducted in Deket District. The measurement of residual chlorine was found to have the highest chlorine content at the Rejosari village station with a value of 2-3 mg/l, based on the Decree of the State Minister for the Environment Number Kep-51 / MenLH /
10/1995 concerning Quality Standards for Liquid Waste for Industrial Activities, it stipulates that the chlorine parameter that is allowed to be discharged is 1 mg/L in the form of free chlorine (Cl₂).

**Table 2. Water quality of Deket River**

| Parameter       | Unit     | Station 1 | Station 2 | Station 3 |
|-----------------|----------|-----------|-----------|-----------|
| Chlorine (Cl₂)  | mg/L     | 3 2 2     | 0 1 0     | 0 0 0     |
| Lead (Pb)       | mg/L     | <0.009 <0.009 <0.009 | <0.009 <0.009 <0.009 | <0.009 <0.009 <0.009 |
| Abundance of Plankton | sel/L   | 1250 837 1346 | 1583 1417 1530 | 5083 4667 5167 |
| pH              | %C       | 7.45 7.86 8.04 | 7.56 7.79 7.7 | 7.41 7.45 7.47 |
| Temperature     | ºC       | 29.5 29 28.6 | 30.4 30.3 30.8 | 31.4 31.8 30.7 |
| DO              | mg/L     | 3.23 3.45 2.67 | 4.91 4.50 4.49 | 5.10 5.50 5.59 |
| Salinity        | %/o      | 0 0 0     | 0 0 0     | 0 0 0     |
| Nitrate         | mg/L     | 0.7 0.8 0.5 | 1.0 1.1 0.9 | 1.3 1.4 1.7 |
| Nitrite         | mg/L     | 0.11 0.13 0.09 | 0.16 0.18 0.19 | 0.18 0.20 0.25 |

b. **Lead (Pb)**
The heavy metal content of Lead (Pb) at the three stations had values below 0.0098 mg/L. Lead testing quality standards based on PP. 82 of 2001 concerning water quality management and water pollution control, determined that the lead parameter in the permissible water was 0.03 mg/L. Lead (Pb) is categorized as a metal that is poisonous and dangerous for aquatic life. Lead metal (Pb) naturally enters the waters through the process of Pb crystallization in the air and falls with the help of rainwater [15].

c. **Nitrate**
The lowest nitrate value in Sungai Deket is at Station 1 with a value between 0.5 - 0.8 mg/L and the highest is at Station 3 with a value of 1.3 - 1.7 mg/L. Nitrate is an indicator of the presence of nutrients in the waters in a form that can be directly utilized by organisms such as phytoplankton in the photosynthetic process. Nitrate content in waters is important in supporting the integrity of the ecosystem. Nitrate is very important because it is an element used in the photosynthesis process and is an element used for phytoplankton growth. A lot of nitrate levels in water can be said to be good or fertile because, with nitrate, there will be a lot of phytoplankton in one water so that photosynthesis will occur which produces O2 which is very much needed for organisms and can be used for the cultivation process [16].

d. **Nitrite**
Nitrite compounds are another form of inorganic nitrogen, the composition of inorganic nitrogen is strongly influenced by the free oxygen content in water, if oxygen is low then nitrate will also be low. Meanwhile, nitrite acts as an electron acceptor in the process into nitrogen gas. Nitrite compounds can influence nitrification and denitrification processes [17]. The nitrate value in the Deket River ranges from 0.09 - 0.25 mg/L and the lowest is at Station 1.

3.1.2 **Physics parameters**
a. **DO (Dissolved Oxygen)**
DO values ranged from 2.67-5.59 mg/L. The highest DO is at station 3 and the lowest is at Station 1. Dissolved Oxygen is needed by all living things for respiratory processes, metabolic processes or substance exchange which then produces energy for growth and reproduction [18]. Based on the regulations of the Ministry of Environment, dissolved oxygen in waters is at least 2 mg/L and in marine waters/ecnotourism a minimum of 5 mg/L.

b. Salinity
The results of observations of salinity at all stations are 0 ppt, this indicates that the water in the river in Deket sub-district is freshwater. Salinity is the concentration of all salt solutions obtained in seawater, where water salinity affects the osmotic pressure of water, the higher the salinity, the greater the osmotic pressure. [19]

c. pH
The value of the degree of acidity (pH) at all Deket sub-district stations is 7.41-8.04. the highest value of pH is at station 1. A waters that have a very alkaline or very acidic pH value will endanger the survival of the organism because it will interfere with the metabolic and respiration processes [19].

d. Temperature
The average temperature of the measurement results in the river in Deket District, the highest is 31.8 at station 3 and the lowest is 28.6 at station 1. A temperature rise can cause stratification or water coating, this water stratification can affect water stirring and is needed to spread oxygen the presence of water coating in the base layer does not become anaerobic. Changes in surface temperature can affect physical, chemical and biological processes in these waters [20].

3.1.3 Biological Parameter

a. Plankton
In the river in Deket sub-district, an overall abundance of plankton was found of 34,083 cells/L which is classified as water with moderate plankton diversity (Figure 2.). At Station 1, 6 types of plankton were found, at Station 2 there were 6 types of plankton and at Station 3 there were 6 types of plankton. Can be seen in Table 3. Plankton has an important role for water because it is used as primary and secondary producer [21].

| No | Phytoplankton                     | Station 1 (Rejosari) | Station 2 (Pandanpancur) | Station 3 (Dinoyo) |
|----|-----------------------------------|----------------------|--------------------------|-------------------|
| 1  | *Alexandrium* sp.                 | √                    |                          |                   |
| 2  | *Guinardia* sp.                   |                      |                          |                   |
| 3  | *Stephanodiscus* sp.              | √                    |                          |                   |
| 4  | *Radiococcus planktonicus* sp.    | √                    |                          |                   |
| 5  | *Detonula* sp.                    |                      |                          |                   |
| 6  | *Cylindrotheca* sp.               |                      |                          |                   |
| 7  | *Skeletonema* sp.                 | √                    | √                        |                   |
| 8  | *Tetrasium* sp.                   |                      |                          |                   |
| 9  | *Chlamydomonas* sp.               | √                    | √                        |                   |
| 10 | *Cyclotella* sp.                  |                      |                          |                   |
| 11 | *Cochlodinium* sp.                |                      |                          |                   |
| 12 | *Phormodium* sp.                  |                      |                          |                   |

Table 3. Plankton organisms identification living in Deket River
3.1.4 Pollution index

The calculation results of the parameter values of each station are entered into the pollution index formula under the Decree of the Minister of Environment number 115 of 2003 concerning Determination of Water Quality Status. Based on the calculation results, the results of the evaluation of the water quality status at each station in the Deket River, Deket District, Lamongan Regency were categorized as lightly polluted. The value of the pollution index in the Deket River, Deket District, Lamongan Regency is 2.19. With the highest value found at Station 1 Location Point 1 of 4.02 (Table 4).

| Station   | Pollution Index | Water Quality Status   |
|-----------|-----------------|------------------------|
| Station 1 |                 |                        |
| Location 1| 4.02            | Lightly polluted       |
| Location 2| 2.90            | Lightly polluted       |
| Location 3| 3               | Lightly polluted       |
| Station 2 |                 |                        |
| Location 1| 1.58            | Lightly polluted       |
| Location 2| 1.80            | Lightly polluted       |
| Location 3| 1.70            | Lightly polluted       |
| Station 3 |                 |                        |
| Location 1| 1.58            | Lightly polluted       |
| Location 2| 1.57            | Lightly polluted       |
| Location 3| 1.56            | Lightly polluted       |

The results shown in Table 4 show that Station 1, 2 and 3 are lightly polluted, but at station 1 the results are relatively high compared to the two stations, this is because at station 1 there is an industrial area. Water pollution is strongly influenced by industrial and household activities so that an area will be vulnerable to an environmental change [22].

At Station 1 there are also many ponds used for fishery activities, the Deket River is used by fish farmers as a medium for cultivation. If the waters are polluted, it will have an impact on the health of the fish and their production. Aquaculture products are in great demand but in short supply. However,
the environmental issue has a concern over the impacts of Aquaculture. Aquaculture is greatly influenced by the quality of an environment, the big problem that most often causes harm to aquaculture activities is water pollution [23].

3.2 Fisheries community behaviour

Based on the questionnaire data, it was obtained that the people who live around the river area use this water for the needs of the pond rice fields, namely around 51.7% as users of the Deket river water as a source of water from the ponds. About 24% of the people who own ponds use the water from the nearest river for their pond rice fields, because many of the ponds are located directly on the banks of the Deket river, so the people who own the ponds use the Deket river water for their pond rice fields. There are around 39.6% of the people who live around the banks of the Deket river often use river water as clean water for washing clothes and also for bathing.

Correlation test is used to determine the relationship between perceptions and attitudes of the community towards the behaviour of the fishery community around the Deket River. Correlation data can be seen in Table 5. Based on Table 5, it can be seen that the behaviour of fishery communities around the Deket river is influenced by perceptions of river pollution, which r count for the relationship between perceptions and fisheries community behaviour is 0.652. So that the results of this study show that only people's perceptions have an influence and have not had an impact or have occurred on people's attitudes and behaviour towards water pollution in the Deket river.

ANOVA test using SPSS 16 software was carried out to determine the effect of perceptions and attitudes of the fishery community on the behaviour of the people around the Deket river. Based on Table 5, the results show that the perceptions and attitudes of the community around the Deket river about river environmental pollution significantly influence the behaviour of the fishery community.

Meanwhile, linear regression testing was carried out using the SPSS 16 program to determine how much influence the perceptions and attitudes of the community have on the behaviour of the people around the Deket river. The data can be seen in Table 5. Based on these data, it is found that the community's perceptions and attitudes about river pollution can influence the behaviour of the people around the Deket River by 49%.

| Test                | Station 1 (Rejosari) | Station 2 (Pandanpancur) | Station 3 (Dinoyo) |
|---------------------|----------------------|--------------------------|-------------------|
| Coef. Correlation   | 0.652**              | 0.049                    | 0.002             |
| Linier Regression   | 0.49                 | 0.004                    | 0.082             |
| ANOVA               | 0.000**              | 0.966                    | 0.195             |

Remarks: * The ANOVA significance level is significant at $\alpha = 0.01$;
** The ANOVA significance level is significant at $\alpha = 0.05$

The effects of environmental pollution on the physiology and population of organisms as well as on humans themselves, because it is unethical to expose the human subject to material or energy that can be harmful, a reduction in the population of organisms is not appropriate if it is always the result of a response to human activities, and variations in these effects are can be learned is very large and complex.

The study of the growth of organisms provides a suitable indication of the danger of pollutants because growth is the result of many physiological pathways and is the result of many processes that can be disrupted by environmental influences, including pollutants. [22]. Environmental damage will cause social change and human behaviour, one of them are the Fisheries Community Behaviour. Five general driving forces for global environmental change consist of: population, affluence, technology, institutions, and culture [24].

Behaviour is a reaction that can be simple or complex [25]. In humans, in particular, there are forms of instinctive behaviour that are based on nature to sustain life [26]. Behaviour can also be influenced...
by indirect information, for example by looking at the experiences of friends or other people who have done it, and can also be influenced by other factors such as personal experience, influence of other people who are considered important[27].

Freedom of choice is related to being compelled to perform a behaviour. If someone is forced by a situation or condition to do a behaviour that is not following his attitude, he will not feel any responsibility [28]. One thing that can be concluded is that human behaviour is not simple to understand and predict. There are so many internal and external factors from the past, present and future dimensions that influence human behaviour [29].

4. Conclusion

Several water quality parameters caused by domestic and industrial waste have values above the maximum threshold in Station 1 but still in the light-polluted category, so they can be an indicator of degradation in water quality. The decline in water quality in the Deket River can affect the behaviour of the fisheries community around the riverbanks. Based on these data, it is found that the community's perceptions and attitudes about river pollution can influence the behaviour of the people around the Deket River by 49%.

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