Influence of Community Behaviour on Water Quality in Sekanak River, Palembang

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Abstract. This study was carried out to analyze the effect of community behavior on water quality degradation in the Sekanak River. Both qualitative and quantitative research methods were used in this study. The quantitative research data was gathered by conducting a questioner survey of 100 selected households living along the riverbank to identify community behaviour. It was also used to measure the water quality status using Pollution Index (PI) Method. The descriptive qualitative component included analyzing and elaborating the actual data of community behavior toward water quality assessment using triangulation data sources. The questionnaire results of the research revealed that the household’s knowledge and attitude on disposal management, sanitation and hygiene at the river bank were in high level. They are generally knowledgeable, having positive attitude and also practiced good personal hygiene, but twenty percent was still throw the garbage to the river. Furthermore, a total of seven sampling station has been identified along the river. The result showed that water quality status from the upstream to the downstream had slightly polluted. It is also evident that COD, BOD, NH3-N and Phosphate have exceeded the allowable threshold levels. This may attributed to the anthropogenic activities such as washing and throwing garbage which can be indicated from changing in the levels of COD and phosphate. However, water pollution inevitably occurs due to the unavailability of communal wastewater treatment plant, poor waste management and lack of public stimulus such as incentive and punishment that encourage participation of communities to conserve water resource. Besides the technical aspect, Dealing with complex socio-ecological issues are considerable importance components of a long-term environmental strategy. It is recommended that education, legislation and incentivization are necessary to spur and improve people awareness and potential role as “river guards”.

Keywords: community behaviour, pollution index, water quality, water resource
to improve the river function as the site of water tourism [4]. Sekanak river is one of Musi River tributaries that is flowing along the city center of Palembang from Sekanak traditional market until Soekarno Hatta street which has total area of 11,40 km² long. It is part of nineteen drainage systems existing in Palembang area [5].

People behavior is a key determinant factor of river water quality. Settlements lying along Sekanak River bank are densely populated area with rusun (flats) dominating in the middle of the area. These flats consist of many blocks which are the source of pollution by changing the function of Sekanak River become the household waste disposal. Sekanak River is used by people who live especially in the river bank as a place to dispose variety of domestic sewage. Accordingly, Sekanak River has been contaminated which can be identified physically by discoloration and also stink coming from the river. If it continues, not only more complex health issues are being faced, but also the purpose of being a tourism object and transportation is hard to be achieved.

According to the facts, a study in regard to the influence of people behavior on water quality in Sekanak River is significantly required because the key success of natural resource preservation is the presence of active participation of local communities. An initial study was conducted to analyze sanitation behaviors of communities living along Sekanak River bank as well as their clean and healthy living behavior (PHBS) practices. The aim of this study is also to assess the river water quality using physical, chemical and biological parameters, and then the influence of people behavior on the result of assessment is analyzed using descriptive qualitative approach.

Previous studies related to water quality is commonly more concerned on pollutant content in water bodies, while this research evolves the parameters of pollutant sources in regard to the aspect of sanitation behavior and hygiene intervention. This study eventually is expected to support strategy formulation on river normalization by encouraging community awareness and their potential participation as “guardian of river”.

2. Study Sites and Methods

2.1 Study Sites
This research was conducted since February until August 2018. Administratively, the study area includes several kelurahan (sub-districts) in which the stream of Sekanak River passes through i.e. Bukit Baru, Bukit Lama, Demang Lebar Daun, Lorok Pakjo, 19 Ilir, 22 Ilir, 23 Ilir, Talang Semut, 24 Ilir, 26 Ilir, and 27 Ilir. Table 1 and figure 1 show the water quality sampling points along Sekanak River. This used both primary and secondary data. Primary data was collected through questioner, interview and observation, whereas secondary data was obtained from study literature, prior studies report and statistical data issued by related agencies.

| No. | Sampling Sites          | Coordinate Points |
|-----|-------------------------|-------------------|
|     |                         | S                 | E                 |
| 1   | Jl. Tanjung Barangan    | 02°58’54.68””     | 104°42’48.56””    |
| 2   | Jl. Demang Lebar Daun  | 02°59’02.33””     | 104°43’22.53””    |
| 3   | Belakang Polsri         | 02°58’52.52””     | 104°43’52.39””    |
| 4   | Jl. Letnan Mukmin       | 02°58’51.08””     | 104°44’15.83””    |
| 5   | Jl. Radial              | 02°58’51.48””     | 104°44’55.32””    |
| 6   | Kelurahan Talang Semut | 02°59’18.89””     | 104°45’15.45””    |
| 7   | Outfall                 | 02°59’39.72””     | 104°45’26.32””    |
2.2 Data Collection and Analysis

2.2.1 Identification of PHBS and Sanitation
To identify sanitation and clean & healthy living behavior (PHBS) practices, primary data through questionnaire was used followed by validity and reliability tests. In addition, quantitative descriptive data analysis was measured by weighting the questionnaire result which Likert Scale was performed and then, data was classified using class interval [6]. Following is the assessment category based on percentage of respondent answers.

| No. | Answer Scales | Category       |
|-----|---------------|----------------|
| 1   | 1.00 – 1.80   | Very low       |
| 2   | 1.81 – 2.60   | low            |
| 3   | 2.61 – 3.40   | sufficient     |
| 4   | 3.41 – 4.20   | High           |
| 5   | 4.21 – 5.00   | Very high      |

Source: [7]

2.2.2 Analysis on Water Quality Status
To identify sanitation and clean & healthy living behavior (PHBS) practices, primary data through questionnaire was used the measurement of water quality in Sekanak River was conducted in seven sampling points using purposive sampling method. Several factors such as accessibility, cost and study period were considered. In addition, grab sampling was the method used to measure the water quality level. It is collected a sample at a specific time and point which gives an indication of the water quality at that point in time based on Indonesian National Standard (SNI) 6989.59:2008. This study analyzed water quality based on its physical, chemical and microbiological characteristics.

The water quality of Sekanak River was compared with water quality criteria class I based on Sumatra Governor Regulation No. 16 2005 about ambient river water and waste water standard. As for
the status of water quality using Pollution Index (IP) or Pollution Index based on KepmenLH No. 115 of the year 2003. Pollution index values can be used to find out the value of the quality of the river water to a certain designation and as a basis for improving the quality of the water in case of pollution. Pollution index calculations are done using the equation (1):

\[ PI_j = \sqrt{\left(\frac{C_i}{L_{ij}}\right)^M + \left(\frac{C_i}{L_{ij}}\right)^R} \] ................................................(1)

Where:
- \( PI_j \) : pollution index for designation \((j)\)
- \( L_{ij} \) : concentration of water quality parameters stated in the Water Quality Standard \((j)\)
- \( C_i \) : concentration of water quality parameters \((i)\)
- with \(\left(\frac{C_i}{L_{ij}}\right) R\) : value, \(\frac{C_i}{L_{ij}}\) mean and \(\left(\frac{C_i}{L_{ij}}\right) M\) : value, maximum \(\frac{C_i}{L_{ij}}\).

2.2.3 Effect of Community Behaviour on River Water Quality

Analysis of the data used to answer the third objective, namely the influence of community behavior on water quality is descriptive qualitative data analysis that is describing and analyzing the data obtained, then elaborated in the form of an actual explanation. This analysis was conducted based on the results of water quality analysis, community sanitation and PHBS behavior questionnaires, literature studies, and in-depth interviews with related parties.

Furthermore, to analyze the influence of people behavior on water quality, triangulation of data sources was used. It facilitates validation of data through cross verification from two or more sources. In this case, the convergence of information was not only from questioner, interview, and observation, but also studies from literature and former researchers.

3. Results and Discussion

3.1. Community Behavior Description

3.1.1. Knowledge. The results of test frequencies analysis can be seen in figure. Based on the feature, it is known that more than half of the respondents have good knowledge about how to manage the correct waste and good sanitation. The community has known the importance of maintaining the cleanliness of the river and the environment. In addition, the use of clean water for consumption and private MCK activities using PDAM water has been carried out by almost all respondents.

![Figure 2. Community Knowledge](image-url)
The results of this study are consistent with the study of Eilam and Trop [8] that one's knowledge is influenced by several factors, one of which is education. About 50 percent of the education of the people on the banks of the Sekanak River are at the upper secondary level, namely graduating from high school and higher education, while the rest is still relatively low. Education is the process of changing the attitude and behavior of a person or group of people. Knowledge has an important role in influencing a person's behavior in their daily activities, especially in terms of receiving everything through the media or being delivered directly. If new behaviors are formed or the behavior adopted is based on knowledge, awareness and good attitude, then the behavior will be long lasting and vice versa [9]. Therefore, respondents who have a low level of education are expected to increase their knowledge in river conservation through socialization or extension activities.

3.1.2. Attitude.

The attitude of the average community is very good in receiving and responding to PHBS and sanitation activities as shown in figure 3. According to Notoatmodjo [10] the attitude of the community is influenced by the level of knowledge. The attitude affects a person's behavior, but is not automatically realized in action because there are other supporting factors that are needed, among others: facilities, experience, motivation and environment [11]. attitude is a tendency to respond negatively or positively to an object using a persuasive approach, both individual and community models. In other words, to change people's attitudes, a persuasive approach is needed by individuals or institutions as examples of success for the community [12].

![Figure 3. Community Attitude](image)

The attitude of public acceptance of PHBS and sanitation activities is formed based on subjective norms that are individual motivation to follow or obey others. Based on these subjective norms, community compliance to preserve rivers and the environment can be carried out spontaneously due to normative beliefs. For people living on the banks of the Sekanak River, this normative belief can be obtained from community leaders and related agencies who are role models and have persuasive ability to encourage communities to be actively involved in river conservation activities (Burton, 2007).

3.1.3. Actions. The results of the questionnaire on the actions of the Sekanak River banks show that 80 percent of the community has routinely carried out PHBS and sanitation activities, including not throwing garbage into the river and routinely maintaining the cleanliness of the environment around the house, using private MCK and consuming clean water. However, around 20 percent of respondents have not routinely applied PHBS by still throwing trash into the river and not managing waste properly (figure 4) especially by residents in Lorok Pakjo Village. This means that there are people who still have not implemented their knowledge in PHBS and sanitation activities in their daily activities.
The actions of the people living on the banks of the Sekanak River are formed based on behavioral beliefs, namely beliefs obtained from knowledge or experience about the positive values of PHBS and sanitation activities [12]. Behavioral belief factors can have a stronger influence through attitudes towards behavioral factors, meaning that there is an attitude to implement PHBS and sanitation activities with the perception that its application to the Sekanak River will have a good impact on environmental hygiene and preservation. The motivation and intention of the community in preserving the environment in the Sekanak River is formed from control beliefs, namely the belief that individuals are able to take action because they are supported by internal and external resources, including the provision of appropriate TPS and communal WWTPs.

3.2. Analysis on Water Quality Status

Water sampling to test the quality of the Sekanak River water was carried out at seven different monitoring points along the Sekanak River starting from the upstream to near the river mouth. The water sample was taken once based on the grab sampling method in accordance with SNI 6989.59: 2008 in February 2018 when the river water was high.

Furthermore, water samples were immediately submitted to the Laboratory of the Environment and Hygiene Office of Palembang City to be tested for quality with physical parameters (Temperature, TSS), organic chemistry (pH, BOD, COD, Nitrate, Nitrite, Ammonia, Phosphates) and microbiology (total Coliform). Then the lab test results for the Sekanak River water quality at each monitoring point compared to the applicable water quality standard. Sekanak River Allotment based on South Sumatra Governor Regulation No. 16 of 2005 concerning River Water Quality Standards and Liquid Waste is determined as class I water quality standards. The class I water quality classification can be used for drinking water, and/or other requirements that require water quality is the same as that use. Following are the results of measurements of water quality in 7 (seven) different monitoring points which are presented in Table 3.

The results of the water quality analysis in table 3 indicate the following parameters:

a. pH

The measurement results of the Sekanak River water pH showed that the average pH at monitoring points II to VII was at a normal pH in accordance with the class I water quality standard which is between 6 - 9. While at the monitoring point I the pH was below 6 which was acidic.

b. Temperature

The results of the measurement of the temperature of the Sekanak River water at the location of the monitoring points I to VII shows that the water temperature is at a temperature of 27°C. These conditions are in accordance with the class I water quality criteria which is at a deviation of 3°C from its natural temperature, then the condition of river water quality in terms of temperature parameters is still in the water quality criteria according to its designation.
### Table 3. Water Quality Status of Sekanak River

| Parameter | Unit | Sampling Sites | Water Quality Standard | Class 1 |
|-----------|------|----------------|------------------------|---------|
| Ph        | -    | 5.07 7.18 6.92 7.20 7.50 7.30 7.23 | Deviation 6-9 |
| Suhu      | °C   | 27.3 27.1 27.1 27.1 27.1 27.0 27.0 | 3 |
| TSS       | mg/l | 49 51 31 98 19 29 22 | 50 |
| TDS       | mg/l | 19.25 116.7 122.8 140.3 179.5 159.5 76.2 | 1000 |
| COD       | mg/l | 12.69 48.54 49.31 44.39 38.0 52.83 13.95 | 10 |
| BOD5      | mg/l | 2.79 10.68 10.85 9.76 8.36 11.62 3.06 | 2 |
| Nitrite   | mg/l | 0.034 0.018 0.016 0.018 0.009 0.009 0.048 | 0.06 |
| Nitrate   | mg/l | 0.05 0.74 2.49 0.73 2.07 2.34 1.235 | 0.5 |
| Phosfat   | mg/l | 2.36 2.47 2.49 1.56 2.41 2.40 0.33 | 0.2 |
| Total     | MPN/100 ml | 23 64 43 74 43 64 35 | 1000 |
| Coliform  |      |                |                        |         |

Source: Lab Analysis, 2018

c. TSS & TDS
Suspended Solids Value (TSS) at the location of monitoring points II and IV have exceeded the water quality standard which is more than 50 mg / liter with the highest value at the monitoring point IV. TSS value is influenced by the level of sediment suspended in the waters. High sedimentation around the river, and the high activity of residents around the river has a strong influence on the decline in the physical quality of river waters. Total Dissolved Solids (TDS) from all monitoring points ranged from 19.25 - 179.5 mg / liter. The range of TDS values found is still in accordance with the water quality standards (<1000 mg Sumatra Governor Regulation No. 16 of 2005). This indicates that the amount of residue dissolved in the waters still meets water quality standards.

d. COD (Chemical Oxygen Demand)
A high COD concentration indicates the greater the level of pollution that occurs at water. COD measurement results at the location of the I-VII monitoring point have exceeded the established water quality standard threshold (10 mg / liter) which ranges from 12.69 to 52.83 where at the pantauVI location point has the highest COD value.

e. BOD5 (Biological Oxygen Demand)
The results of BOD measurement analysis at all locations monitored shows that the BOD value is not in accordance with the water quality quality standard which is more than 2 mg / liter based on the criteria of Class I River Water. The highest value is also at the location of the monitoring point VI, reaching 11.62 mg / liter. The greater the BOD concentration indicates that the process has been contaminated.

f. Nitrite (NO3-N) and Nitrate (NO2-N)
The results of the analysis of Nitrite and Nitrate parameters in all monitoring points showed that they were still at the threshold of Criteria for Class I River Water according to the Governor of South Sumatra Regulation No. 16, 2005. The measurement results of nitrate content in the Sekanak River ranged from 0.009 to 0.048 mg // liter. Nitrate-nitrogen levels in natural waters were about 0.1 mg / liter meaning that it is still in its natural state. Meanwhile, the source of nitrite comes from industrial waste and domestic waste. Nitrite concentrations in the Sekanak River, it ranged from 0.7 to 1.4 mg / liter [13]. This value indicates that Sekanak River water is not in its natural condition, even though it is still below the water threshold.

Natural waters contain nitrite around 0.001 mg / liter and should not exceed 0.06 mg / liter. Based on the distribution of nitrite concentrations in the Sekanak River, it ranged from 0.7 to 1.4 mg / liter.
This value indicates that the Sekanak River water is not in its natural condition, even though it is still below the water threshold.

g. NH3-N (Ammonia)

Based on the results of measurements of ammonia levels on the Sekanak River at the location of the monitoring point I, it is still below the established water quality standard, while at the location of monitoring point II to VII has exceeded the river water quality which ranged from 0.73 to 2.49 mg / liter. Ammonia levels on natural waters are usually less than 0.1 mg / l. High levels of ammonia can be indicated by contamination of organic matter from domestic waste, industrial waste, and agricultural fertilizer runoff [13].

h. Phosphate

Based on the results of measurements of phosphate content in Sekanak River obtained content of 0.33 - 2.49 mg / liter, compared to the value of phosphate in accordance with the water quality criteria, then the condition of the quality of the Sekanak River water for the Phosphate parameter is not in accordance with its designation. Liter meaning that it is still in its natural state. Meanwhile, the source of nitrite comes from industrial waste and domestic waste. Natural waters contain nitrite around 0.001 mg / liter and should not exceed 0.06 mg / liter. Based on the distribution of nitrite concentrations in the Sekanak River, it ranged from 0.7 to 1.4 mg / liter. This value indicates that the Sekanak River water is not in its natural condition, even though it is still below the water threshold.

i. NH3-N (Ammonia)

Based on the results of measurements of ammonia levels on the Sekanak River at the location of the monitoring point I, it is still below the established water quality standard, while at the location of monitoring point II to VII has exceeded the river water quality standard which ranged from 0.73 to 2.49 mg / liter. Ammonia levels on natural waters are usually less than 0.1 mg / l. High levels of ammonia can be indicated by contamination of organic matter from domestic waste, industrial waste, and agricultural fertilizer runoff [13].

j. Phosphate

Based on the results of measurements of phosphate content in Sekanak River obtained content of 0.33 - 2.49 mg / liter, compared to the value of phosphate in accordance with the water quality criteria of 0.2 mg / l, then the condition of the quality of the Sekanak River water for the Phosphate parameter is not in accordance with its designation.

k. Total Coliform

Indicators of contamination of domestic waste in waters can be seen from the presence of coliform bacteria. Several types of diseases can be transmitted by coliform bacteria through water, especially stomach diseases such as typhus, cholera and dysentery [14].

The results of Coliform total bacterial analysis on Sekanak River water showed the total bacterial coliform per 100 ml of river water at the monitoring points I to VII ranges between 23 - 74 MPN / 100 ml. This amount is still within the water threshold criteria for class I river water quality of 1000 mg / Liter, so it is still suitable for its designation.

3.3. Analysis on Water Quality Status

Based on the Minister of Environment Decree No.115 of 2003 the status of water quality that is permitted can be measured using the Pollution Index method. Management of water quality on the basis of the Pollution Index (IP) provides information to decision makers to be able to assess the quality of the water body for an allotment and take measures to improve quality in the event of quality degradation due to the presence of pollutant compounds. Table 4 shows the results of the calculation of the status of water quality at seven sampling sites on the Sekanak River:

Based on the results of the Pollution Index (IP) calculation, it can be seen that the status of River Sekanak water quality from the estuary to the upstream end has mild polluted conditions. This result makes river water quality from upstream to downstream at all monitoring points cannot be utilized in accordance with class I water allotment, namely for drinking water raw water, and or other uses that require the same water quality as these uses, so water pollution control is needed Sungai Sekanak so that...
it can be utilized and maintain the quality of the Sekanak River water in accordance with the target water quality standards.

Table 4 Water Quality Status of Sekanak River

| Sampling Sites | Ci/Li | Pollution Index | Status          |
|----------------|-------|-----------------|-----------------|
| I              | 6.36  | 1.30            | 4.59            | Slightly polluted |
| II             | 6.46  | 1.92            | 4.76            | Slightly polluted |
| III            | 6.48  | 2.16            | 4.83            | Slightly polluted |
| IV             | 5.46  | 1.92            | 4.09            | Slightly polluted |
| V              | 6.40  | 1.93            | 4.73            | Slightly polluted |
| VI             | 6.40  | 2.14            | 4.77            | Slightly polluted |
| VII            | 2.96  | 1.04            | 2.22            | Slightly polluted |

3.4. Status Effect of Community Behavior on Sekanak River Water Quality

Refer to the results of the analysis of the quality of the Sekanak River, it was found that the COD and BOD contents had exceeded the predetermined river water quality standards. The high value of BOD and COD contained in river water shows the amount of organic material that can be degraded biologically or which are difficult to be degraded biologically such as dead plants and animals, domestic and industrial waste. This is in accordance with the fact in the field that several points on the edge of the river there is a pile of garbage that is used as illegal TPS by local residents.

Figure 5. Existence Of Illegal Polling Stations Along The Sekanak River

In addition, the chemical parameters that exceed the standard values are Nitrate and Phosphate. Nitrate levels that exceed quality standards such as locations 1 and 2, which are 10.64 mg / l, are an illustration of their existence water pollution by human activities, waste fertilizer, and animal feces. Eating water with high Nitrate levels will cause a decrease in blood capacity which functions to bind oxygen, so that it will be enough to endanger humans, especially babies under 5 months because it will cause blue baby disease [15]. For drinking water needs, nitrate levels are expected to be no more than 10 mg / l [13]. The high value of Phosphate shows the presence of detergent
in water which is one indicator of the presence of river pollution from community MCK activities. Based on the results of field observations, the average community living on the banks of Sungai Sekanak already has a private toilet. However, there are still activities from residents' homes and food selling activities that wash and dispose of leftovers on the banks of the river. In addition, pollution occurs mainly because drainage channels from people's homes are directly channeled into the river body without any prior processing. The unavailability of Communal Wastewater Disposal (IPAL) Installation facilities causes a high number of chemical parameters.

![Figure 6. Flow of Drainage Channels from Residents' Settlements](image)

The government program to restore the Sekanak River has been planned since 2016 and working preparations have begun since the beginning of 2018. This restoration program is carried out by digging 2 meters deep into the Sekanak River to the Lambidaro River, so that tidal water from the Musi River can enter creeks that. In the water quality table at the VII monitoring point near the estuary it can be seen that the pollution value is lower than the other monitoring points. This is because the river dredging process has begun to be carried out from the estuary to the Sekanak bridge which can be seen in figure 7.

![Figure 7. Restoration Process of Sekanak River](image)

The revitalization step certainly cannot only be carried out technically, but must be supported by improving the socio-ecological aspects as an important component of the long-term environmental conservation strategy. Awareness raising, the ability and participation of the people living on the banks of the Sekanak River towards the preservation of rivers are a separate challenge related to education, training and community counseling. This aims to encourage people to develop critical thinking, ethical and creative skills in assessing environmental situations and making decisions about the situation. In addition, through environmental education the community is expected to develop capacity and commitment to act individually and collectively in order to maintain and improve the quality of the environment.
4. Conclusion
In summary, according to the findings of the study, it can be concluded that: 1) Based on the questioner results, it is revealed that the knowledge and attitude of society living in Sekanak River Bank on disposal management, sanitation and hygiene were in high level, but for about 20 percent of the community identified still throwing their domestic waste directly into the river body. 2) The result of Pollution Index (IP) measurement shows that the quality status of Sekanak River from seven sampling points is exceeded the criteria of water quality class I based on the regulations of the South Sumatera Governor No. 16 2005. 3) Lab tests shows that COD, BOD, NH3-N and phosphate has exceeded a predetermined quality, this pollution results indicating the presence of domestic waste and industrial effluents. In addition, the high value of the phosphate indicates the content of detergents which is one of the indicators of river pollution. 4) The behavior of the community who still throw garbage into the river, the existence of illegal polling stations located on the edge of the River, and yet the availability of facilities to cultivate communal IPAL domestic waste from the houses of citizens caused the Sekanak River still continues polluted.

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