Community Satisfaction Level To The Drainage Channel In Citarum Riverbanks

Destari Anwariani, Rositayanti Hadisoebroto, Diana Irvindiaty Hendrawan

Abstract: The condition of the drainage channel is strongly influenced by the community activities and participation in maintaining it since public awareness influence the quality of the drainage channel performance. Lack knowledge on the function of the drainage channel is indicated by the community attitude that directly disposese domestic wastewater and solid waste into it which could decrease the river water quality. Drainage service can be assessed based on the level of performance and importance of the community on the Citarum Riverbank segment 18. The study was conducted to analyze the importance and performance of the drainage channel with the Importance Performance Analysis (IPA) as well as the pollutant load caused by domestic wastewater on the Citarum Riverbank Segment 18. The research was conducted in 6 urban villages consisting of the villages of Adiarsa Timur, Telukjambe, Puseurjaya, Sukiharja, Adiarsa Barat, and Nagasari which sampling was carried out with the period February, April, and June 2019 in the morning and evening based on the peak hour time of wastewater generated. It is found that BOD pollutant load in the drainage channel is 33.07 - 37861.21 kg/day that indicate the high level of pollution due to domestic wastewater in the drainage channel. The results of the analysis with IPA indicate that the quality of the performance of the drainage channel has met the needs and desires of the community. It could be concluded that pollution in drainage channel is not consider to be important issue by community.

Index Terms: BOD Loading, Citarum Riverbank, Domestic Wastewater, Drainage, Importance Performance Analysis (IPA), Greywater, Pollutant Load

1. INTRODUCTION
RRegional infrastructure has an important part in one area, one of them is drainage system. The negative impact caused by the poor drainage channel system in one area would public health influenced and disruption of community activities due to damage of drainage channel. The role of government and community in maintaining drainage channel is very important, public awareness greatly affects the quality of drainage channel performance. Behavior to keep the environment clean and free from waste was still not fully carried out by to continued practice and culture of the community as well as lack of knowledge regarding handling the drainage channels. Lack of knowledge to the function of the drainage channel is indicated by the attitude of the community who directly dispose greywater into the drainage canal [1]. Wastewater that flow into drainage channel could pollute the environment if supported by the poor drainage conditions [2]. In area with poor drainage systems, runoff water that mixed with faeces could spread pathogens bacteria to the community and increase health risks [3]. The problem of self-purification in water bodies could be occurred from untreated wastewater that entering directly to the stream [4]. Citarum river that flows from upstream in Bandung area has bad reputation due to low water quality and pollution. Consistently Citarum river list as one of the most polluted rivers in the world. Citarum river has flows from the north to the south of the volcanic mountain which are 270 km long and has importance function as the main water sources to Jakarta area [5]. Citarum river is a vital object for water supply to Bandung and Jakarta area, there are nearly 10 million people and 25 million people both in Bandung area and Jakarta area. Over the past 20 years, water quality of Citarum river has been dropped showed from COD parameter that 9 times higher and Fecal coliform 5000 times higher than water quality standard [6]. The decrease of water quality are characterized by changes in the color and odor of the water, even thought there are still people in the riverbanks use Citarum river water for their daily needs [7] The condition of Citarum river has been polluted by domestic waste generated from household activities in the riverbank such as solid waste and human waste. The rapid domestic growth in the Citarum riverbanks makes the river a place for domestic waste disposal without threatened first by sewage treatment [8]. Citarum riverbank has a typical housing in the form of unregulated settlements and yet not supported with communal Waste Water Treatment Plant (WWTP). Potential contribution of domestic wastewater from drainage channel could impact water quality of Citarum river. The behavior of flowing household wastewater directly into the river was still continuing in the Citarum riverbanks. This could affect the environmental conditions or residential areas on the riverbanks. Bad behavior from people who lives in the riverbank that is throwing solid waste and liquid waste into the river could causes a decrease of water quality [9]. Domestic wastewater can be divided into blackwater and greywater. Definition of greywater is wastewater that comes from the kitchen, water used to wash clothes, and bath water, while blackwater contained human waste. [10] Greywater is defined as wastewater that generated from household activities except from toilet, the activity that produced greywater which include activities from bathrooms, showers, laundry, and kitchens. The percentage of greywater from household activities represent 50-80% of total water use, while among these wastes, greywater laundry represents up to 33% [11]. This study was conducted on the performance analysis of the drainage channels in Citarum riverbank and calculates the pollutant load on the greywater quality on the drainage channels.

2 METHODS

2.1 Location and Time of Study
This research was conducted in the Citarum riverbank segment 18, Karawang, West Java, Indonesia. Determination of sampling points in drainage channel was based on the largest channel in the area. This study was conducted in 6
urban villages consisting of East Adiarsa, Telukjambe, Puseuqaya, Sukaharja, Adiarsa Barat, and Nagasari. For the water quality, sampling was carried out in two different times which is in the morning and afternoon at 06.00-09.00 AM and 15.00-19.00 PM, both were the peak hour of water consumption in household activities. This research conducted in three period times which is in February, April, and June 2019.

2.2 Working Methods
The data needed in this study include primary and secondary data consisting of (1) drainage water quality (2) questionnaires (3) population demographics (4) land use maps (5) sanitation activities, and (6) socio-economic conditions of the population. The data has been collected and tabulated and will be analyzed descriptively. Sampling was carried out at 6 drainage points located on the Citarum riverbanks. Sampling points can be seen in the Table 1.

### TABLE 1
**SAMPLING POINTS LOCATION**

<table>
<thead>
<tr>
<th>Location</th>
<th>Villages</th>
<th>Longitude (East)</th>
<th>Longitude (South)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adiarsa Timur</td>
<td>107°18'38.8&quot;</td>
<td>06°19'29.6&quot;</td>
</tr>
<tr>
<td>2</td>
<td>Teluk Jambe</td>
<td>107°18'27.9&quot;</td>
<td>06°19'26.9&quot;</td>
</tr>
<tr>
<td>3</td>
<td>Puseuqaya</td>
<td>107°18'00.9&quot;</td>
<td>06°19'20.1&quot;</td>
</tr>
<tr>
<td>4</td>
<td>Adiarsa Barat</td>
<td>107°18'04.8&quot;</td>
<td>06°18'49.4&quot;</td>
</tr>
<tr>
<td>5</td>
<td>Sukaharja</td>
<td>107°18'02.0&quot;</td>
<td>06°18'48.6&quot;</td>
</tr>
<tr>
<td>6</td>
<td>Nagasari</td>
<td>107°17'48.2&quot;</td>
<td>06°18'38.9&quot;</td>
</tr>
</tbody>
</table>

Data of the community behavior in the Citarum riverbank segment 18 in disposing domestic wastewater and utilizing materials that have the potential to reduce the quality of river water were collected by the survey methods using questionnaires, observations and direct interviews. The method used in determining the respondent samples using Slovin formula and the distribution of sample proportions that makes stratified populations in each region was carried out using a proportional random sampling technique

\[ n = \frac{N}{1+Ne^2} \]  
\[ n = \frac{X}{N} \times N_1 \]

Where:  
- \( N \): number of populations  
- \( n \): number of samples  
- \( e \): limit of tolerancy errors (0.05)  
- \( N_n \): number of samples specified  
- \( X \): total population  
- \( N_1 \): class of population

To calculate the pollutant from each drainage channels, it could be calculated using the discharges data and the concentration of BOD parameter using this following formula

\[ BP = CxQxf \]

Where:
- \( BP \): Pollutan load (Kg/day)  
- \( Cs \): measured levels are actually pollutants (mg/liter)  
- \( Qs \): water quantity (m³/day)  
- \( F \): conversion factor

The results of the questionnaires will then be analyzed using Importance Performance Analysis (IPA) to see satisfaction with performance of the drainage channel using this following formula

\[ Xi = \frac{\sum X_i}{n} \]  
\[ Yi = \frac{\sum Y_i}{n} \]

Where:
- \( Xi \): Average level of performance score  
- \( Yi \): Average level of satisfaction score  
- \( X_i \): Total performance score  
- \( Y_i \): Total satisfaction score  
- \( n \): Number of respondents  
- \( K \): Number of variables

3 RESULTS AND DISCUSSION
The condition of the drainage channel in Karawang Regency is greatly influenced by the presence of a large river that crosses Karawang, namely Citarum river. The Citarum river holds input from the drainage channel located on the riverbank. The condition of the drainage channel affects the performance of the drainage channel in accordance with its designation. Community activities on Citarum riverbanks influence the condition of the drainage channel, one of them is the cleanliness of the canals from solid waste that can inhibit the flow of water on the canal. The drainage channel performance can be assessed based on the Importance Performance Analysis (IPA) to see the ability of the community satisfaction level regarding the drainage channel to the government performance that has been carried out. Analysis was done using a diagram that divided into 4 regions by two straight line intersecting and consisting of the X axis and Y axis.

### TABLE 2
**PERFORMANCE AND SATISFACTION SCORES**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Name of attribute</th>
<th>Average ( Xi )</th>
<th>Average ( Yi )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ENVIRONMENTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Availability of drainage channels</td>
<td>3.48</td>
<td>3.61</td>
</tr>
<tr>
<td>3</td>
<td>Maintenance of drainage channels</td>
<td>2.91</td>
<td>3.39</td>
</tr>
<tr>
<td>4</td>
<td>Enforcement of regulations</td>
<td>2.90</td>
<td>3.16</td>
</tr>
<tr>
<td>5</td>
<td>Stability of drainage channels</td>
<td>2.83</td>
<td>3.40</td>
</tr>
<tr>
<td>6</td>
<td>Garbage handling in the drainage channel</td>
<td>2.93</td>
<td>3.35</td>
</tr>
<tr>
<td>7</td>
<td>Maintenance of drainage channel buildings</td>
<td>3.29</td>
<td>3.45</td>
</tr>
</tbody>
</table>
The level of satisfaction with performance can be compared with the importance of the drainage channel can be seen from the average value in each quadrant displayed in the graph where the X axis is the level of performance and on the Y axis is the level of importance.

**TABLE 3**

<table>
<thead>
<tr>
<th>Period</th>
<th>Sampling points</th>
<th>Quantity (m³/day)</th>
<th>BOD (mg/L)</th>
<th>Pollutant Load (kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>1</td>
<td>3.23</td>
<td>120.35</td>
<td>3,735.93</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.52</td>
<td>274.30</td>
<td>3,695.45</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.52</td>
<td>277.08</td>
<td>784.56</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1.56</td>
<td>240.10</td>
<td>9,282.91</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.02</td>
<td>297.07</td>
<td>33.07</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0.28</td>
<td>172.16</td>
<td>438.97</td>
</tr>
</tbody>
</table>

4. **Quadrant IV**
In quadrant IV, the variable performance is satisfactory but is considered less important. Variables included in quadrant IV are the selection of the location of the drainage channel, coordination with the government and the community, and control of the operation of the drainage channel. Domestic wastewater is channeled into residential drainage channels which causes the condition of the settlement environment in Indonesia in general not well maintained, in terms of aesthetics and environmental health [12]. The high pollutant load capacity in drainage water indicates high levels of pollution caused by wastewater domestic. Pollutant load is the value of a pollutant contained in water or wastewater which is highly related to the use of land use [13]. Pollutant load in the drainage can be seen in the table below.

Based on Figure 1, it can be seen that the position of each variable was grouped in each quadrant as follows:

1. **Quadrant I**
In quadrant I shows that the variables is considered important and greatly affects the community. In this quadrant the channel performance is low but has a very important level of importance. Variables included in quadrant I is heaps of solid waste around the drainage channel. The quadrant I mean High importance & high performance. Factors located in this quadrant are considered as supporting factors for drainage performance so that stakeholders are obliged to ensure that these factors must be implemented and maintained properly.

2. **Quadrant II**
In quadrant II shows the performance has been successful so it must be maintained. Variables that enter into quadrant II are application of drainage channels to drain water reservoirs, handling waste in drainage channels, availability of drainage channels, maintenance of drainage channels, enforcement of regulations, drainage channel dimensions, stability of drainage channels, inspection and documentation of the condition of the drainage channel, control of the implementation of drainage channel, ease of channel maintenance, maintenance of drainage channel buildings, drainage channel repair, garbage handling in the drainage channel, flood in the drainage channel, operation of drainage system, controlling drainage operations, the willingness of personal initiatives in the management of drainage channel, the willingness of group cooperation in the management of drainage channels.

3. **Quadrant III**
In quadrant III the performance variable is low, but the expectations of the community are also low because they are considered less important. Variables that enter into quadrant III are the operation of supporting buildings in the drainage channel, and the operation of pumping equipments and recharge in the drainage channel.

4. **Quadrant IV**
In quadrant IV, the variable performance is satisfactory but is considered less important. Variables included in quadrant IV are the selection of the location of the drainage channel, coordination with the government and the community, and control of the operation of the drainage channel. Domestic wastewater is channeled into residential drainage channels which causes the condition of the settlement environment in Indonesia in general not well maintained, in terms of aesthetics and environmental health [12]. The high pollutant load capacity in drainage water indicates high levels of pollution caused by wastewater domestic. Pollutant load is the value of a pollutant contained in water or wastewater which is highly related to the use of land use [13]. Pollutant load in the drainage can be seen in the table below.
It can be seen in Table 3 that pollutant load is quite high at 33.07 – 37,861.21 kg/day. The highest pollutant load is found in drainage channel in the Telukjambe village. This is caused by the low quality of water which is characterized by the high value of BOD in the drainage channel caused by the entry of domestic wastewater into the canal. Water with high quality BOD parameters indicates that the amount of pollutants is high, especially pollutants caused by organic matter content [14]. The BOD value illustrates the presence of biodegradable organic matter into the waters, wastewater originating from household activities, restaurants, restaurants containing a lot of organic material which cause pollution which is characterized by increasing BOD, COD, and decreasing pH in water [15]. Waste disposal that come from activities of resident that entering water bodies from drainage could increase water pH value, TDS and decrease DO value [16]. Drainage flow containing domestic wastewater that goes directly to the river can cause a decrease in river water quality, hence the need for communal wastewater treatment to maintain environmental quality [17].

### 4 CONCLUSION

Pollution in the drainage channel is caused by the inclusion of direct household waste water towards the channel, due to high BOD values. The Importance Performance Analysis (IPA) shows the community on the riverbank considers the level of performance to be very important and the condition of the current drainage channel is satisfactory and thirst is maintained. However, there is some variable that need to be fixed such as treating the heaps of solid waste around the drainage channel that could affected drainage conditions, and also it was need to increasing the community awareness with good behavior regarding environmental health. Need to raise the community awareness on influence of greywater disposal into drainage channel. It is necessary to treat household wastewater that generated from the activities of resident to reduce pollution that occurs due to drainage channels on the Citarum River Segment 18. Communal wastewater treatment is needed especially to treat wastewater before entering the water bodies in purpose to decreasing water pollution.

### REFERENCES

2019.

