Pollution source of Cileungsi-Cikeas-Bekasi River

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Abstract. Sources of pollutants in the Cileungsi-Cikeas-Bekasi River Basin were inventoried, through data obtained from the district's Environmental Agency where the three rivers cross. Pollutant sources were also determined based on searches in the form of type, number, and location, using google maps and google earth. The search results are mapped by applying ArcGIS. The aim of the research was to determine land-based source of pollution entering the river. The types and sources of pollutants vary greatly in terms of type, location, and number. In the three river basins, it is known that there were 413 industrial sectors, 538 restaurants, 457 housing complexes, 80 hospitals, 92 hotels, 53 shopping centers, 37 livestock, 147 small and medium sized entities (SMEs), and 59 domestic. The source of pollutants entering the Cikeas River was dominated by housing complexes. The source of pollutants entering the Cileungsi River was dominated by industry. Meanwhile, the sources of pollutants entering Bekasi River were mostly shopping centers, hotels, hospitals, and restaurants.

Keywords: catchment area; domestic; land-based; pollution source

1. Introduction

In September 2018 there was pollution incident in Bekasi River, where the water looked foamy, black and smelly due to an increase in pollution (republika.co.id 05/09/18). It is suspected that this came from industrial waste, which was not treated properly, and was deliberately disposed into the river. Indeed, there are many industries along this river basin. Waste that is disposed into the river stream results in high levels of suspended solids and turbidity. In addition, industrial wastewater that does not undergo proper treatment also causes the river to smell, especially during the dry season when the river discharge experiences a reduction [1].

Therefore, it is necessary to have an inventory of pollutant sources research in the watershed of Cileungsi-Cikeas-Bekasi River as an objective of this research. In accordance with PerMenLH (Ministry of Environment Regulation) No. 1/2010 concerning Pollution Control Procedures, the government has the authority to carry out an inventory and identification of sources of pollution and environmental damage.

2. Methodology

The source of pollutants in the Cileungsi-Cikeas-Bekasi River Basin was identified through data obtained from the Environment Agency (DLH) and internet searches (google map and google earth),
either type, number or location. The search results were mapped by applying ArcGIS. Sources of pollutants were grouped into 1) industry, 2) restaurants, 3) housing complexes, 4) hospitals, 5) hotels, 6) shopping center, 7) livestock, 8) small and medium sized entities (SMEs), 9) domestic/residential areas.

Map of the distribution of sources of industry, residence, restaurant, shopping center, hospital, hotel, livestock, and SMEs in the Cileungsi-Cikeas-Bekasi River Basin which was clustered based on the number in an area of 4 km².

3. Results and discussion
The types of pollutants in the Cileungsi-Cikeas-Bekasi watershed vary greatly in terms of type, number and location. Invented along the Cileungsi-Cikeas-Kali Bekasi watershed, the number of industrial pollutants is 413, 538 restaurants, 457 housing complexes, 80 hospitals, 92 hotels, 53 shopping centers, 37 livestock, 147 SMEs, and domestic/residential as many as 59. Industry, housing and restaurants have the largest quantity compared to other activities. The existence of this pollutant source will greatly affect the characteristics of water quality [2].

Map of the distribution of sources of industry, residence, and restaurant surrounding Cileungsi-Cikeas-Bekasi River Basin which is clustered based on the number in an area of 4 km² appears to have a large symbol. In addition, a map of the distribution of pollution sources for shopping centers, hospitals, hotels, livestock, and SMEs in the Cileungsi-Cikeas-Bekasi River Basin, clustered based on the number in an area of 4 km² was also mapped and showed a relatively smaller symbol size (figure 1).

![Map of Industry, Housing, Restaurant in Watershed of Cileungsi-Cikeas-Bekasi River](image)

**Figure 1.** Industry, housing/residential area, and restaurant mostly found in Cileungsi-Cikeas-Bekasi River Watershed.

The source of pollutants entering the Cileungsi River was dominated by industry (figure 2). Therefore, pollutants entering the Cileungsi River are more likely to be related to inorganic materials, synthetic organic materials, and a number of metals that are pollutants of the industry. The source of pollutants entering the Cikeas River was dominated by housing complexes (figure 3). Contamination materials originating from household activities are mainly related to organic matter, which is food waste,
surfactants derived from the use of detergents. Therefore, the associated water quality parameters include dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammonia (NH₃), nitrite (NO₂), nitrate (NO₃), orthophosphate (PO₄), etc.

Figure 2. Industry mostly found in Cileungsi River Watershed.

Figure 3. Housing/residential area mostly in Cikeas River Watershed.
The sources of pollutants entering Bekasi River were mostly shopping centers, hotels, hospitals and restaurants (figure 4, figure 5, and figure 6). Hotel, hospital, and restaurant activities also relate to organic materials, such as food scraps, detergent use, bathroom use, laundry, etc. Human activity such as industry and housing in the watershed greatly affect the quality of river [3–5].

Figure 4. Hotels in Bekasi River Watershed.

Figure 5. Hospitals in Bekasi River Watershed.
Based on PerMenPUPR (Ministry of Public Work and Housing) No.28/2015 concerning the establishment of river border and lake borders, the area along the river boundary may not be disturbed by various activities, except for certain activities for the public interest as regulated in regulations.

The boundary line on the river without embankment within the urban area is determined below:

a. At least 10 m from the left and right banks of the river trough, for a river depth of ≤ 3 m.
b. At least 15 m from the left and right banks of the river trough, for a river depth of > 3-20 m.
c. At least 30 m from the left and right banks of the river trough, for a river depth of > 20 m.

The boundary line of the river that is not embanked outside the urban area consists of the following:

a. Large river with river flow area of >500 km²: the boundary line of the large non-embanked river outside the urban area is determined to be at least 100 m from the left and right banks of the river trough along the riverbed.

b. Small river with watershed area of ≤500 km²: the boundary line of a small non-embanked river outside the urban area is determined at least 50 m from the left and right banks of the river trench along the channel.

Through this regulatory approach, on the map of the distribution of pollutant sources in the Cileungsii-Cikeas-Bekasi River Basin, it can be seen the types of activities that are near or are included in the river boundary line. The results can be taken into account in decision making and prosecution for activities likely deemed to be violating [6–8].

In connection with the existence of a more dominant industry, efforts to control and monitor industrial waste need to be intensified. For example, in the form of checking compliance with liquid waste disposal permits. If the dominant source of pollution is domestic waste, the government needs to consider the construction of a communal domestic waste treatment plant. This applies especially to high-end residential developers.

4. Conclusion
The main source of pollutants that enter the Cikeas sub-watershed was a housing complex, in the Cileungsi sub-watershed was dominated by the industrial sector, and in the Bekasi River sub-watershed it was dominated by shopping centers, hotels, hospitals and restaurants.
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