Volume 6 (3) November 2026, Pages: 262-272

Environmental Pollution Journal

https://doi.org/10.58954/epj.v6i3.368



Spatial Analysis of Waste Volume, Composition Dominance, and Distance in Riparian Zone of Surabaya River

Nuril Haq Bilqishima Masdian✉, Meylisa Rheinia Lumintang, & Salwa Nurul Habiba
Universitas Brawijaya

Keywords

Surabaya River; Pile; Waste; Dominance; Border

Abstract

The Surabaya River is one of the main raw water sources currently under pollution pressure due to waste accumulation along its riparian zones. This study aims to identify the spatial distribution, composition dominance, and distance of waste piles from the riverbed in the Wringinanom–Karangpilang segment, as well as to analyze their relationship with the surrounding population density. Surveys were conducted through river navigation and land-based transects to record coordinates, measure volumes, identify dominant waste types, and calculate distances using integrated GPS data and satellite imagery. A quantitative-descriptive analysis was applied to characterize the waste piles observed. The findings are expected to serve as a basis for integrated waste management, law enforcement against illegal dumping, and public awareness efforts to prevent further degradation of water quality in urban riverbank areas.

INTRODUCTION

Waste is not merely something left behind; it reflects habits and ways of life. Solid waste is classified into two categories: organic and inorganic waste. Organic waste can decompose naturally, whereas inorganic waste is generally difficult to break down in nature. Inorganic waste can accumulate in excessive quantities and become a type of waste that poses a danger to the environment (Taufiq & Maulana, 2015). Population growth, urbanization, and consumerist lifestyles continue to drive these figures upward, with an increase of 70% projected by 2025. Indonesia generates a worrying amount of waste, averaging 151,921 tonnes per day, equivalent to 0.85 kg per person per day (Windasari et al., 2020). The habit of littering is influenced by everyday behavioral patterns and by how effectively existing regulations are implemented to address the problem (Anugrah et al., 2025).

Solid waste can be categorized based on its sources of generation, including households, public facilities, markets, roadways, industries, and offices. Household activities account for the largest proportion of solid waste generation, contributing approximately 40% of the total. A substantial portion of this waste is ultimately disposed of at final disposal sites (TPAs), where inadequate waste management practices often lead to uncontrolled accumulation, further exacerbating environmental pollution. Data from 2018 showed that 55.56% of TPAs used open dumping, meaning that waste was neither sorted nor otherwise managed, potentially causing negative impacts on the surrounding environment. According to Statistics Indonesia (BPS) data from 2018, East Java had an Environmental Carelessness Behavior Index (IPKLH) of 0.75. This lack of concern includes insufficient attention to waste management and environmental preservation (Andina, 2019).

The Surabaya River is part of the Brantas River Basin (DAS) and passes through several areas, including Gresik Regency, Sidoarjo Regency, and Surabaya City. The Surabaya River is classified as a Class 2 river under the applicable river water quality standards and can therefore be used by local communities to support

✉ nurilhaqbm@student.ub.ac.id , Malang, South Sulawesi
2776-5296 / ©2026 The Author(s). Published by Ecoton. This is an open access article under the CC BY license

their livelihoods, including irrigation, fish farming, industrial needs, and other purposes. The riparian area of the Surabaya River is a strategic area (Aliffia & Karnaningroem, 2019). The area surrounding the river is dominated by densely populated settlements, kiosks or stalls, and factory activities, alongside numerous domestic drainage channels that discharge into the river. These conditions cause human-generated waste to enter the water body, potentially reducing river water quality (Aanisa et al., 2023).

Population density adds pressure to Surabaya's waste management system because large volumes of daily waste must be handled by collection and disposal facilities that remain limited. Uneven urban management has encouraged lower-middle-income communities to establish settlements on unofficial land (Verawati, 2018). The spatial planning policy (RTRW) in Surabaya City has not been effectively implemented, particularly in areas along riverbanks (Sholehuddin, 2025). This situation is exacerbated by land-use changes, declining environmental carrying capacity, and suboptimal urban spatial management. For example, densely populated settlements along riverbanks increase community activities that significantly influence the practice of disposing of waste directly into rivers. This behavior increases environmental pollution, particularly the decline in river water quality due to waste contamination (Ariefahnoor et al., 2020). The Surabaya River plays a vital role as a raw water source for drinking water, but its quality has declined due to waste disposal into the river (Wijaya & Trihadiningrum, 2019).

Gresik Regency is an industrial area with relatively dense settlements and is traversed by the Surabaya River. According to waste management data from the Ministry of Environment and Forestry (KLHK), in 2023 Gresik Regency was one of the largest contributors to waste accumulation, reaching 200 tonnes per day (Sholihah et al., 2025). This is certainly one of the main factors contributing to pollution in the Surabaya River. Waste discarded into the river can accumulate along its banks and increase the risk of flooding. Discarded waste can be carried by the river flow when discharge increases or during floods. The Surabaya River lies near the downstream part of the Brantas River Basin and is therefore at risk of accumulating waste transported from upstream areas (Briantama et al., 2024). Inadequate waste sorting causes different types of waste to mix and produce unpleasant odors (Radjak et al., 2023).

Research on pollution in the Surabaya River has largely focused on water quality and pollutant parameters, such as heavy metals, bacteria, and the physical and chemical characteristics of the water.Studies on waste accumulation have predominantly focused on waste composition and pollution sources, with limited attention to the spatial distribution and volume of waste accumulation along riverbanks. Quantitative relationships between population density and the amount of accumulated waste have rarely been examined in depth. Measuring the distance between waste piles and the river channel has also not been a primary focus, leaving limited information about the potential for waste to be carried by river flow during floods or high tides. Mapping of waste accumulation points is generally conducted at final disposal sites or directly in water bodies, rather than in riparian areas near settlements. This study seeks to address this knowledge gap by conducting field observations along the Surabaya River segment from Wringinanom to Karangpilang.

This provides the basis for the present study, which focuses on waste accumulation along the Surabaya River. The study aims to determine whether waste accumulation along riverbanks is proportional to population density in the surrounding areas. The research design combines identification of waste-pile volume, dominant composition, and distance from the river channel across the

three administrative areas traversed by the Surabaya River. The survey used two routes to validate recorded locations. Spatial analysis integrated GPS data with Google Earth to improve the accuracy of distance measurements. The findings are expected to provide a stronger scientific basis for waste management in urban areas, particularly those adjacent to rivers. It is also hoped that this study will increase public awareness and provide the government with information about the urgency of pollution in the Surabaya River.

RESEARCH METHODS

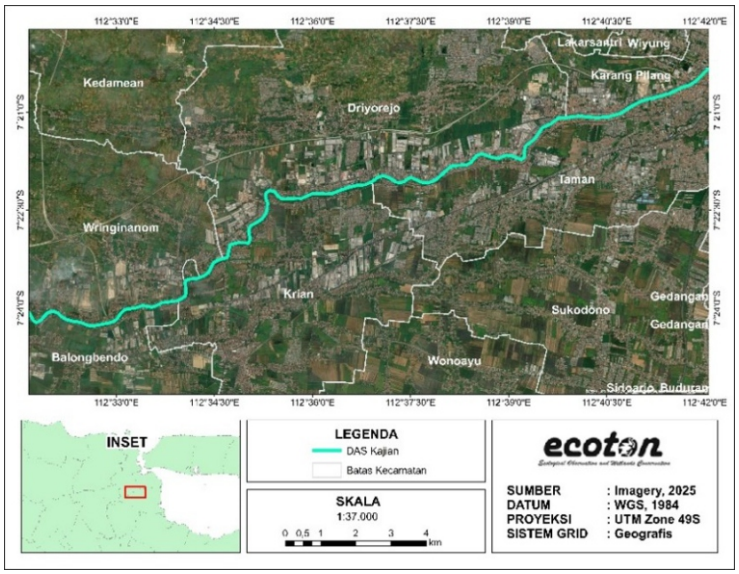
This study used a descriptive quantitative approach to describe waste-pile data collected along the riparian zone of the Surabaya River. The research covered part of the Surabaya River, from Wringinanom District to Karangpilang District. The study area included three administrative areas: Gresik Regency, Sidoarjo Regency, and Surabaya City. These areas were considered sufficiently representative for observing waste pollution along the Surabaya River. The observation route crossed densely populated areas to examine their relationship with the amount of accumulated waste. The study area covered both the left and right sides of the river's riparian zone, along the routes shown in Figure 1.

Data were collected over seven days, on 8–9 July and 21–25 July 2025, in two stages. In the first stage, the river was surveyed by boat, following the river flow to record the number and coordinates of waste piles. Coordinates were collected using the GPS Essential application. In the second stage, the river was surveyed again from land to validate the waste-pile locations identified from the coordinates collected in the first stage. Waste was also identified to determine the dominant waste type at each pile. A 1 kg sample was taken from each location and the dominant waste type was identified. The volume of each waste pile was also measured using a measuring tape to determine the percentage of waste accumulation in each district.

$$V = L \, x \, W x \, H \quad (1)$$

$$P_i = \frac{(V_1 \, x \, V_2 \, x \, V_3 ... V_i)}{V_n} \times 100\% \quad (2)$$

where (V) represents the waste volume (m^3), (L) is the length (m), (W) is the width (m), and (H) is the height of the accumulated waste (m). The total volume was estimated by multiplying these three dimensions at each sampling location. Pi is percentage of waste accumulation per district, V_i is the volume of each waste pile categorized by district, and V_n is the total volume of waste piles across the entire study area. The percentage of waste



Source: Processed Primary Data, (2025)

Figure 1
Research Location Map

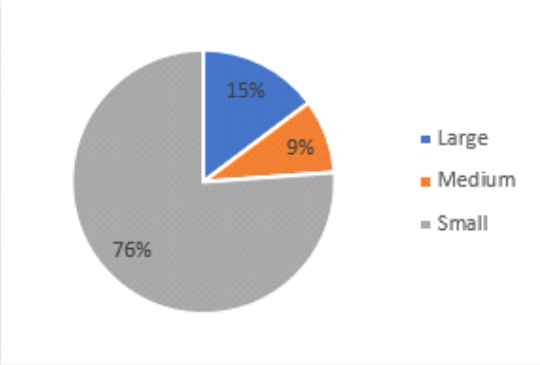
accumulation per district was calculated to determine the severity of pollution in each district based on the largest waste volume across the whole segment.

Each waste pile was also classified into three size categories: small (<60 m³), medium (60–100 m³), and large (>100 m³). Data were processed using Microsoft Excel and presented as pie charts. The distance between each waste pile and the river channel was also measured to determine the potential for household waste to be carried into the river when water levels rise during high tide or flooding. Purposive sampling was used to select waste accumulation sites for distance measurements. The samples consisted of the smallest and largest waste piles in each district. Google Earth was used to measure the distance between each pile's coordinates and the river channel. The resulting data were processed in Microsoft Excel and presented as a bar chart.

RESULT AND DISCUSSION

A total of 88 waste-pile locations were identified during the study. The recorded locations were on both the left and right sides of the Surabaya River riparian zone, from the Wringinanom to Karangpilang segment. The piles varied in size and were therefore further classified according to volume. The distribution of waste-pile locations by size is shown in Figure 2.

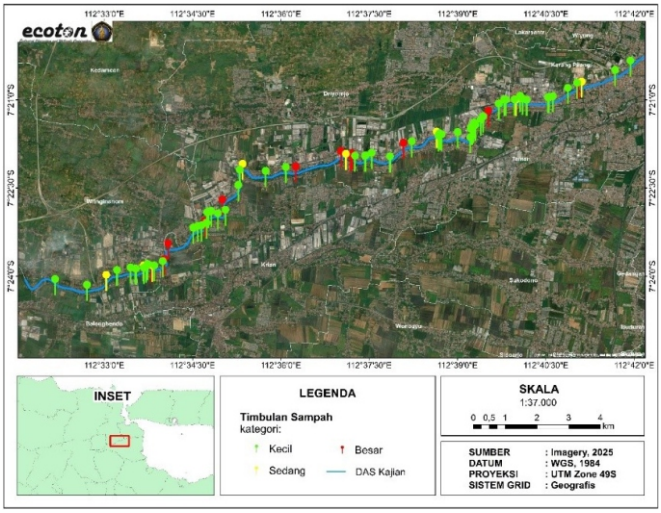
The findings were dominated by small piles with volumes below 60 m³, comprising 67 locations marked in green. Eight medium-sized piles, with volumes ranging from 60–100 m³, were marked in yellow. The remaining 13 locations were large piles exceeding 100 m³ and were marked in red. Different colors were used to distinguish pile sizes, identify locations with the highest pollution levels, and help determine the urgency of pollution management. The percentages of each size category are shown inFigure 3.



Source: Processed Primary Data, (2025)

Figure 3
Classification of Waste Piles by Volume

Driyorejo District recorded the highest number of waste accumulation sites, with 27 piles and a total volume of 2,218.28 m³, accounting for 40.7% of the overall waste volume. In contrast, Balongbendo District had the lowest number of waste accumulation sites,



Source: Processed Primary Data, (2025)

Figure 1
Research Location Map

with only six piles, totaling approximately 545.04 m^3 or 10% of the total waste volume. Krian District, however, recorded the lowest contribution to the overall waste volume, with 267.32 m^3, equivalent to 4.9% of the total. Krian had slightly more waste accumulation sites than Balongbendo, with eight piles; however, the individual piles were smaller in size. These data are presented in Table 1.

Driyorejo District had a high population density of 34,669.95 people /km^2. This was consistent with the large volume of waste found in Driyorejo. Another factor that may influence this is urban sprawl in Driyorejo, where population and settlement areas have expanded without being matched by adequate planning. Urban sprawl can result in uneven and dispersed growth (Pahlevi et al., 2023).

Table 1
Waste Piles in the Wringinanom-Karangpilang Segment

Disctrict	Number of Piles	Volume (m^3)	Volume (%)
Wringinanom	10	918.43	16.85
Krian	8	267.32	4.9
Driyorejo	27	2,218.28	40.7
Balongbendo	6	545.04	10
Taman	23	1,185	21.74
Karangpilang	14	316.6	5.81

Source: Processed Primary Data, 2025

In Wringinanom District, 10 waste piles were found, with a total volume of 918.43 m^3, contributing 16.85%. Taman had the second-highest number of piles after Driyorejo, with 23 locations and a total volume of 1,185 m^3, or 21.74% of the total volume. The final segment was in Karangpilang, with 14 piles representing 5.81% of the total volume, or 316.6 m^3. Waste accumulation in each district may be influenced by various factors, such as economic conditions and population density. Each individual generates waste daily; therefore, if waste is not managed properly, high population density can increase the amount of accumulated waste. Population density in each district is presented in Table 2.

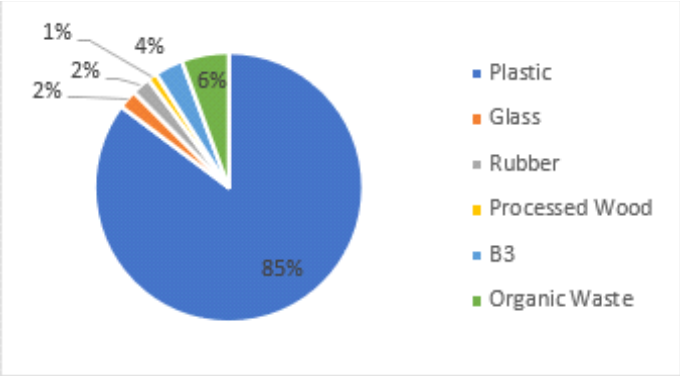
In 2016, Driyorejo reportedly had 29 waste banks operating under the coordination of the Petiken Lestari Central Waste Bank (BSI). However, the effective operation of these facilities depends on improved management practices and consistent supervision by the local government. Active community participation is also crucial, particularly in promoting public awareness of proper waste disposal practices and encouraging residents to bring recyclable waste to the nearest waste bank (Sholihah et al., 2025). However, the findings indicate a lack of public participation and awareness, particularly among people living in river riparian areas.

Table 2
Population Density

District	Population Density (People/km^2)	Waste-pile Volume (m^3)
Wringinanom	20,625.74	918.43
Krian	3,951.37	267.32
Driyorejo	34,669.95	2,218.28
Balongbendo	47,438	545.04
Taman	6,375.49	1,185
Karangpilang	8,040	316.6

Source: (BPS Kabupaten Gresik, 2024b, 2024a; BPS Kabupaten Sidoarjo, 2022, 2023; BPS Kecamatan Sidoarjo, 2023; BPS Kota Surabaya, 2024)

The waste piles were further categorized according to their dominant composition in the Surabaya River riparian zone. Categories included plastic, glass, rubber, processed wood, hazardous and toxic waste (B3), metal, paper, fabric, and organic waste. Organic waste includes waste or residues from living organisms, such as animal excrement, food scraps, dry leaves, and tree branches (Taufiq & Maulana, 2015). The findings showed that 75 piles were dominated by plastic; two were dominated by glass; another two by rubber waste in the form of used tires; three by hazardous and toxic waste in the form of baby diapers; five by organic waste; and one remaining pile by processed wood. No piles dominated by metal, paper, or fabric were found. The percentages of dominant waste types are presented in Figure 4.



Source: Processed Primary Data, 2025

Figure 4
Percentage of Dominant Waste Types

The plastic waste found generally consisted of sachets, packaging, and plastic shopping bags. This indicates that plastic is closely associated with everyday life. Plastic is used for various activities because it is practical, lightweight, and economical. The consumption of single-use plastics, coupled with inadequate waste management practices, poses significant environmental challenges. Previous research has found plastic to be the most dominant type of waste, accounting for as much as 69% of all waste found at final disposal sites (TPAs) (Fitri & Ferza, 2019). Plastic pollution and poorly managed waste disposal in rivers cause significant environmental problems. Continued plastic use, combined with weak waste management systems, results in plastic waste entering river waters (Hamdi & Fajri, 2024).

The survey also identified plastic waste caught on tree branches, referred to as "plastic trees." A total of 1,328 plastic trees were found along the Surabaya River, from Gresik Regency to Surabaya City. Plastic trees were most frequently found in Gresik Regency, accounting for 51.9%, while 48.1% were found in Sidoarjo Regency and Surabaya City. These plastic trees may result from plastic waste from the riparian zone entering the river during high tide. When water discharge decreases, plastic waste such as shopping bags and other single-use plastics remains caught on branches along the riverbank.

Three locations were found to be dominated by hazardous and toxic waste, specifically baby diapers. These locations were in Wringinanom, Taman, and Driyorejo districts. The dominance of this waste type, particularly baby diapers, indicates inadequate waste management. Article 2(1) of Law No. 18 of 2008 on Waste Management distinguishes between household waste and household-like waste. Household waste refers to residues from household activities, while waste similar to household waste comes from industrial activities, public facilities, and commercial areas and may be hazardous. Although baby diapers are categorized as household waste,

disposable diapers have a high potential for bacterial contamination. Disposable baby diapers contain various potentially hazardous compounds, including dioxins, phthalates, sodium polyacrylate (SPA), and tributyltin (TBT). Additionally, bacterial contamination may arise from fecal matter retained in used diapers (Rahmadiana & Berutu, 2022).

Organic waste was the second most dominant waste category after plastic. Its sources may include household waste, fallen leaves, and tree branches accumulated along the riverbanks. Organic waste is generally biodegradable; however, inadequate waste management practices pose significant challenges to the proper handling and disposal of accumulated organic waste. This practice can contribute to air pollution through methane (CH_4) and carbon dioxide (CO_2) emissions generated during organic waste decomposition. It can also cause water pollution, characterized by changes in water color and turbidity, unpleasant odors, bacterial proliferation, degradation of fish habitats, and potential risks to public health (Linggi' & Pawarangan, 2018).

Based on the dominant waste types identified, almost all waste fell into the household-waste category and originated from informal settlements along the riverbank. Observations showed that most waste piles were located directly behind residents' homes, as shown in Figure 5. Uncontrolled use of urban space encourages people to dispose of waste in riparian areas. Indirectly, this activity reduces river water quality (Cahyani et al., 2019).

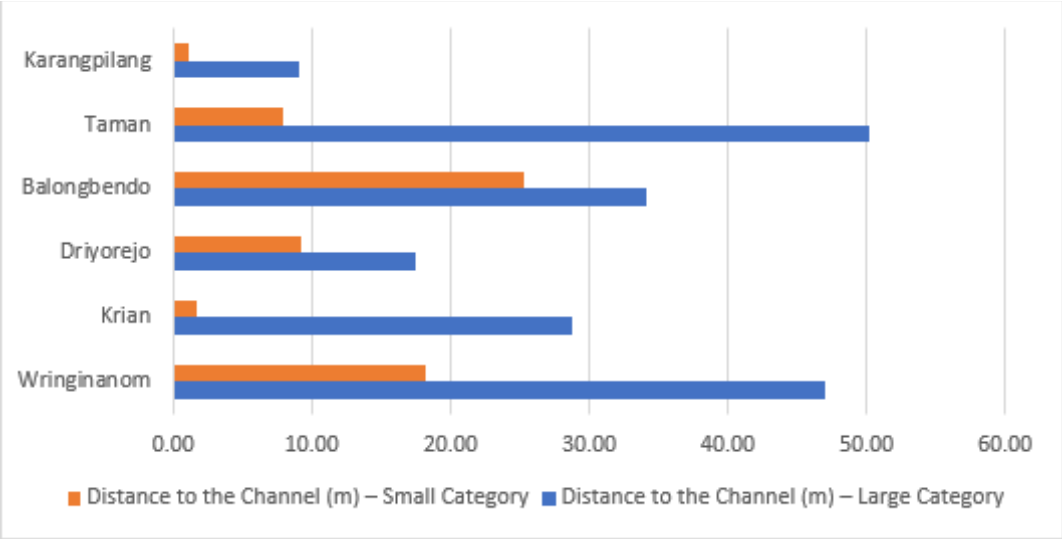
The distance between waste piles and the river flow can affect the risk of waste entering the water body. Therefore, the distance between waste piles and the river channel was measured. The largest and smallest waste piles in each district were selected for distance measurements to assess the potential risk of river contamination associated with waste accumulation. The measured distances are presented in Figure 6.

The measurements showed that the smallest piles in each district were closer to the water body than the large piles. Most small piles were less than 20 m away. The closest small pile was in Karangpilang District, at a distance of 1.16 m. The farthest small pile was in Balongbendo District, 25.34 m from the water body. Most large piles were relatively far from the water body, at distances greater than 20 m. The closest large pile was in Karangpilang District, 9.01 m away, while the farthest large pile was in Taman District, 50.18 m from the water body.



Source: Authors' Documentation, (2025)

Figure 5
Waste Piles Behind Residential Areas



Source: Processed Primary Data, (2025)

Figure 6

Distribution of Distances Between Waste Piles and the River Channel

Distances of less than 10 m fall into the extreme category, with a high risk of pollution, whereas distances greater than 20 m can be considered to have a low pollution risk. Karangpilang was the area with the highest risk of waste entering the river compared with the other study areas. However, waste piles more than 20 m away may still enter the water body during the rainy season or floods. Increased water discharge can carry waste from the riparian zone into the river, potentially transporting it downstream and ultimately into the sea.

Waste management in Indonesia, particularly in the Surabaya River area, requires a rapid response to protect environmental cleanliness and health. The findings indicate that a key issue is the direct disposal of household and industrial waste into rivers. This not only creates flood risks and degrades water quality, but also threatens ecosystems and public health. Addressing this problem requires integrated strategies. One key approach is to strengthen waste management infrastructure through the establishment of waste banks. These facilities provide community-based platforms for waste sorting, collection, and recycling, while also supporting organic waste management through composting activities (Mandasari et al., 2021). Increasing the number of waste bins in public spaces is also important, as convenient access encourages people to dispose of waste properly (Haerani et al., 2019). Improving the efficiency of waste collection and transportation systems, particularly in terms of scheduling and operational management, is also essential to preventing waste accumulation that may contribute to river pollution. The provision of adequate waste management infrastructure and services can further encourage proper waste disposal practices and reduce indiscriminate littering (Fauziah & Suparmi, 2022).

Another crucial aspect of an effective waste management strategy is public education. Various studies highlight that many residents, particularly homemakers, do not fully understand how to sort organic and inorganic waste. It is important to raise awareness so that people do not dispose of waste indiscriminately, especially into rivers. Educational programs can offer a solution by teaching the importance of keeping rivers clean, waste-sorting techniques, and ways to create added value from waste. Law enforcement also plays an important role. Law of the Republic of Indonesia No. 18 of 2008 on Waste

Management explicitly prohibits waste disposal in inappropriate places, including riverbanks. Therefore, strict and consistent sanctions are needed to change harmful community habits (Radjak et al., 2023). Through these strategic measures, waste problems in the Surabaya River are expected to be addressed sustainably.

CONCLUSION

This study found that waste accumulation along the riparian zone of the Surabaya River, particularly in the Wringinanom–Karangpilang segment, is closely associated with the high population density of surrounding areas. Districts with higher population densities, such as Driyorejo, exhibited the largest waste volumes, predominantly consisting of household waste, particularly plastic. The proximity of waste accumulation sites to the river channel further increases the potential for water pollution, especially during periods of rising river levels. Therefore, integrated waste management is needed through improved waste bank facilities, environmental education to promote behavioral change, and stricter enforcement to prevent further environmental degradation.

REFERENCES

Aanisa, N. A. I., Rahmawati, R., Tasiman, B. H. A., & Astuti, Y. (2023). Analisis Kualitas dan Tingkat Pencemaran Limbah B3 Terlarut di Aliran Sungai Cideng. *Jurnal Ilmu Lingkungan*, *22*(1), 215–227. https://doi.org/10.14710/jil.22.1.215-227

Aliffia, A., & Karnaningroem, N. (2019). Simulation of Pollution Load Capacity Using Qual2kw Model in Kali Surabaya River (cangkir-Sepanjang Segment). *IOP Conference Series: Earth and Environmental Science*, *259*(1), 012019. https://doi.org/10.1088/1755-1315/259/1/012019

Andina, E. (2019). Analisis Perilaku Pemilahan Sampah di Kota Surabaya. *Aspirasi: Jurnal Masalah-masalah Sosial*, *10*(2), 119–138. https://doi.org/10.46807/aspirasi.v10i2.1424

Anugrah, I. R., Alfariz, M. Z., & Sapoe, T. C. (2025). *Model Pengelolaan Sampah Rumah Tangga di Desa Pejaten Kecamatan Kramatwatu*. *11*.

Ariefahnoor, D., Hasanah, N., & Surya, A. (2020). Pengelolaan Sampah Desa Gudang Tengah Melalui Manajemen Bank Sampah. *Jurnal Kacapuri: Jurnal Keilmuan Teknik Sipil*, *3*(1), 14. https://doi.org/10.31602/jk.v3i1.3594

BPS Kabupaten Gresik. (2024a). Kecamatan Driyorejo Dalam Angka 2024. *Badan Pusat Statistik Kabupaten Gresik*. https://gresikkab.bps.go.id/id/publication/2024/09/26/2b4deb35f21439986eb8a6da/kecamatan-driyorejo-dalam-angka-2024.html

BPS Kabupaten Gresik. (2024b). Kecamatan Wringinanom Dalam Angka 2024. *Badan Pusat Statistik Kabupaten Gresik*. https://gresikkab.bps.go.id/id/publication/2024/09/26/29e1b3a50d48f41d001235bd/kecamatan-wringinanom-dalam-angka-2024.html

BPS Kabupaten Sidoarjo. (2022). Kecamatan Balongbendo Dalam Angka 2022. *Badan Pusat Statistik Kabupaten Sidoarjo*. https://sidoarjokab.bps.go.id/id/publication/2022/09/26/2390ed7907446b68bb82a0a1/kecamatan-balong-bendo-dalam-angka-2022.html

BPS Kabupaten Sidoarjo. (2023). Kecamatan Krian Dalam Angka 2023. *Badan Pusat Statistik Kabupaten Sidoarjo*. https://sidoarjokab.bps.go.id/id/publication/2023/09/26/8e5b55a0f04424b6d09d31c4/kecamatan-krian-dalam-angka-2023.html

BPS Kecamatan Sidoarjo. (2023). Kecamatan Taman Dalam Angka 2023. *Badan Pusat Statistik Kabupaten*

Sidoarjo. https://sidoarjokab.bps.go.id/id/publication/2023/09/26/5ed8a09df08fd005c74fd73d/kecamatan-taman-dalam-angka-2023.html

BPS Kota Surabaya. (2024, September 26). Kecamatan Karang Pilang Dalam Angka 2024. *Badan Pusat Statistik Kota Surabaya*. https://surabayakota.bps.go.id/id/publication/2024/09/26/94de447c421edb673a3abd64/kecamatan-karang-pilang-dalam-angka-2024.html

Briantama, R. H., Suhartanto, E., & Sajali, M. A. (2024). Analisis Hidrologi dan Hidrolika Sungai Untuk Pemodelan Banjir Sebagai Upaya Mitigasi Bencana Pada Sungai Kali Surabaya. *Jurnal Teknologi dan Rekayasa Sumber Daya Air*, *4*(1), 969–981. https://doi.org/10.21776/ub.jtresda.2024.004.01.082

Cahyani, F. R., Widodo, H., & Masnun, M. A. (2019). Penegakan Hukum Terhadap Larangan Mendirikan Bangunan di Daerah Aliran Sungai Brantas di Kawasan Bendung Gunung Sari Surabaya. *Novum: Jurnal Hukum*, *6*(1), 1–9.

Fauziah, R., & Suparmi. (2022). Sistem Pengangkutan Sampah Kota Jambi. *Jambura Health and Sport Journal*, *4*(2), 127–138.

Fitri, S. E., & Ferza, R. (2019). Dinamika, Problematika, dan Implikasi Kebijakan Pengelolaan Sampah Plastik (studi Kasus Kota Bogor dan Kota Bekasi). *Jurnal Kebijakan Pembangunan*, *15*(1), 11–24.

Haerani, D., Syafrudin, & Sasongko, S. B. (2019). Pengelolaan Sampah Di Kota Tasikmalaya. *Proceeding Biology Education Conference*, *16*(1), 266–274.

Hamdi, S., & Fajri, M. F. (2024). Pengaruh Pembuangan Limbah Plastik terhadap Sungai Ciwulan Menyebabkan Gangguan pada Ekosistem Perairan Sungai. *Jurnal Penelitian Geografi*, *12*(1), 80–85.

Linggi', R. A., & Pawarangan, I. (2018). Pengaruh Sampah Rumah Tangga Organik dan Non Organik Terhadap Lingkungan. *Prosiding Semkaristek*, *1*(1).

Mandasari, D., Wirjodirdjo, B., & Anityasari, M. (2021). Peningkatan Fasilitas Bank Sampah sebagai Upaya Pengurangan Timbunan Sampah Perkotaan di TPS Surabaya. *Jurnal Teknik ITS*, *9*(2), F322–F327. https://doi.org/10.12962/j23373539.v9i2.56123

Pahlevi, M. R., Prayitno, G., & Dinanti, D. (2023). Tipologi Fenomena Urban Sprawl Di Kecamatan Driyorejo Kabupaten Gresik. *Planning for Urban Region and Environment*, *12*(1), 121–132.

Radjak, S. R. M., Rahmatiah, & Hatu, D. R. R. (2023). Perilaku Masyarakat Perkotaan dalam Membuang Sampah di Bantaran Sungai Bone di Kelurahan Talumolo, Kecamatan Dumbo Raya. *SOSIOLOGI: Jurnal Penelitian dan Pengabdian Kepada Masyarakat*, *1*(1), 23–35.

Rahmadiana, A., & Berutu, R. Y. (2022). Pembuangan Sampah Popok Pada DAS Brantas Sebagai Kejahatan Lingkungan dalam Perspektif Kriminologi. *Morality: Jurnal Ilmu Hukum*, *8*(2), 174–187.

Sholehuddin, M. (2025). Penegakan Hukum Terhadap Bangunan Pemukiman di Sempadan Sungai Oleh Pemerintah Kota Surabaya. *Media Hukum Indonesia (MHI)*, *2*(7), 53–60.

Sholihah, A. A., Ariestawati, A. S., & Nawangsari, E. R. (2025). Pemberdayaan Masyarakat Melalui Bank Sampah Induk Petiken Lestari di Kecamatan Driyorejo Kabupaten Gresik. *Indonesian Research Journal on Education*, *5*(4), 1042–1049.

Taufiq, A., & Maulana, M. F. (2015). Sosialisasi Sampah Organik dan Non Organik serta Pelatihan Kreasi Sampah. *Jurnal Inovasi dan Kewirausahaan*, *4*(1), 68–73.

UU Nomor 18, 18 tentang Pengelolaan Sampah (2008).

Verawati, M. (2018). Pemukimn Liar di Surabaya Tahun 1997-2000. *AVATARA, e-Journal Pendidikan Sejarah*, *6*(2), 88–93.

Wijaya, B. A., & Trihadiningrum, Y. (2019). Pencemaran Meso- dan Mikroplastik di Kali Surabaya pada Segmen Driyorejo hingga Karang Pilang. *JURNAL TEKNIK ITS*, *8*(2), 2011–2016.

Windasari, S., Hamid, A., & Juliatm, R. H. (2020). Hubungan Kebiasaan dan Ketersediaan Sarana dengan Perilaku Masyarakat dalam Membuang Sampah di Bantaran Sungai Kelurahan Brang Biji Kecamatan Sumbawa Tahun 2020. *Jurnal Kesehatan Dan Sains*, *4*(1), 106–115.