The Citarum River as our front yard: A case of community engagement in Bintang Alam, Indonesia

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Abstract. Indonesia is facing not only a severe problem of solid waste management and river sustainability but also a lack of community awareness in managing the environment. This paper explores community engagement activities conducted in Bintang Alam, Karawang, Indonesia, to improve the community concern regarding the Citarum River, which is located close to the community under study. This community of Bintang Alam has been involved in constructing a trail along the river to provide a shortcut from a housing complex to the nearest mosque and planting fruit trees along the riverbank. The waste composition was analyzed by Indonesia Standard of SNI 19.3964.1994. To reduce the amount of waste disposed of in the river and landfills, the residents favor the development of a waste bank. Eight months of observation documented excellent progress in residents’ awareness of the importance of managing the trail, eliminating waste disposed of along the river banks, but no improvement in developing a waste bank. It has been suggested that community engagement involving multi-year grants might make more continuous advocacy in the community possible. The characteristics of funding, which is in the form of a grant with a prescribed deadline, often hinder sustainable advocacy.

1. Introduction

Solid waste, commonly known as garbage, trash, rubbish, describes disposed-of materials/ remnants that are unwanted or useless and solid in form and originate from human or animal activity [1]. According to the Indonesia Ministry of Environment and Forestry and the Ministry of Industry, in 2016, Indonesia’s waste generation was recorded as reaching 65.2 tons annually [2]. Under the Law of the Republic of Indonesia No. 18/2008 on Waste Management, the procedure of managing waste includes sorting, collecting, transporting, and final processing. Most of the waste produced in Indonesia is directly sent to landfills, like Jakarta, where out of the 6,000 tons of waste generated daily, 4000 tons are disposed in landfills [3]. The amount of waste directly transported to landfills has resulted in these sites’ near-full status, as has occurred in the Bantargebang [4] and Jalupang [5] landfills.

Another problem for Indonesian solid-waste management is the high amount of waste disposed of in the rivers and the lack of concern for river sustainability [6, 7]. Many rivers in Indonesia sustain a high influx of pollutants, such as heavy metals, organic contaminants, and contaminants of emerging concern [8].

The Citarum River plays a vital role in many sectors, such as by providing surface water for about 35 million people in West Java and Jakarta, where it irrigates an area of around 420,000 ha of rice fields and acts as a water source for approximately 2,000 factories [9, 10]. As the longest river in West
Java (269 km), the Citarum River consists of upper and lower river basins. The Upper Citarum River Basin (UCRB) runs from the Citarum Spring at Wayang Mountain to the inlet of the Saguling Reservoir and has a total basin area of about 1822 km² [9, 10]. The UCRB covers two cities and six regencies, including Bandung City, the most densely populated city in West Java, with a total of 2.5 million people. As West Java is one of the essential rice-producing regions in Indonesia, agricultural activities in the UCRB are massive, especially concerning paddy fields.

Better waste management, such as by waste-stream reduction, reuse, and recycling, can contribute to overcoming the problems of landfills reaching nearly full capacity [11, 12, 13]. The advantages of recycling include reducing the amount of waste deposited in landfills, protecting natural resources, and reducing energy and water use, thereby minimizing waste generated and, more importantly, saving on the use of land cover at landfills [1, 14, 15]. Previous studies mention different waste categories that can be subject to recycling, such as aluminum, paper, plastic, glass, metal, green, and construction waste [1].

Environmental management is necessary to support a better life for human beings [16]. As environmental quality improves, a better standard of living may also follow. Unmanaged waste streams may degrade environmental quality [17]. In general, Indonesia's waste recycling starts with individual waste pickers who collect recyclable waste, which they then transport to a small or large collector. These collectors, known as waste suppliers or middlemen, deliver collected waste to a recycling factory [18].

Many important factors potentially affect the success of waste management. Public participation is a critical factor in waste management because managing waste should start from its sources [19]. An earlier study in Indonesia suggested that increased public involvement in waste management could reduce waste transported to landfills by approximately 33% [20].

This study aims to increase the Citarum Riverbanks' management by engaging community participation who live near the river in different types of activities, such as waste management and landscaping the riverbanks. During this study, community engagement was channeled into constructing a trail along the riverbank from the Bintang Alam housing complex to the nearest mosque. Along with this activity, community awareness was raised for developing a waste bank. The potential for waste recycling was assessed to obtain a picture of such a waste bank's economic benefit. The role played by the community was also analyzed before and after the intervention.

2. Method

2.1. Location of the study

Telukjambe Timur is a subdistrict of Karawang regency with a population of 138,982 people [21]. The Telukjambe Timur subdistrict shares borders with Karawang Barat and Karawang Timur in the north, Telukjambe Barat in the west, Klari subdistrict in the east, and Ciampel subdistrict in the south. The Jakarta-Cikampek toll road links the Telukjambe Timur subdistrict to many surrounding large cities, including Jakarta, Bogor, and Bandung, and the southern section has been developed into an industrial estate of Karawang regency. The Telukjambe Timur subdistrict represents the subdistrict with the highest and densest population in Karawang regency, totaling 113,065 people. [22]

The Telukjambe Timur subdistrict consists of nine villages and nineteen housing complexes. One of them, the object of this study, is Telukjambe Village, specifically, the Bintang Alam housing complex. The housing complex is located directly beside the Citarum River and shares a border with a textile plant, PT Indo Liberty Textiles Indonesia. Most residents in Karawang work in industrial sectors and are involved in either processing or trading at nearby industrial estates; only a few people work in other sectors. In 2010, Karawang was heavily flooded following the destruction of the flood gate at Jatiluhur Dam due to a massive and lengthy rainfall. The Bintang Alam housing complex was submerged and rendered temporarily unlivable [23]. This incident raised awareness among the people to the importance of protecting the sustainability of the river as part of the village; one suggested action was to manage waste and prevent waste disposal into the waters of the Citarum.
All residents at the Bintang Allam housing complex rely on government waste collection systems to manage their waste. There are two residents' associations (of the Rukun Warga/RW, an Indonesian regional administrative division) at this particular housing complex. Both have similar waste transport systems that rely on a waste truck with a capacity of 20 m³ or 12 tons from the local government cleanliness office (Figure 1). According to RW 12, Mr. Jono, waste is collected twice a week simultaneously from the two residents' associations on Mondays and Thursdays. It takes about four hours to collect all of the household waste at the Bintang Allam housing complex.

![Figure 1. Waste management at Bintang Alam Housing Complex [24, 25].](image)

The method of waste disposal at this housing complex starts by placing a designated waste bin in front of each house. The purpose is to enable homeowners to put their household waste in the correct location to be easily collected and then transported to the landfill. The truck usually arrives around 07:00 in the morning. Each family is obliged to pay a fee of Rp30,000 monthly (1US$ = 15,500 Indonesian rupiah at the time of writing in 2020) to the association (RW). The monthly fee is for the management of the cleanliness and security of the housing complex.

2.2. Waste composition
Before planning the development of a waste bank, the waste composition at the Bintang Allam housing complex was analyzed using the method of Indonesia Standard of SNI 19.3964.1994. Waste sampling and analyses were conducted over eight consecutive days; then, the data were sorted into three categories. Data obtained in this study included waste composition and the amount of waste generated. Data on the potential benefit of waste recycling from the economic perspective were gathered using questionnaires distributed to local individual waste pickers and analyzed statistically. Community meetings were conducted to evaluate the potential of waste bank development.

2.3. Community engagement
The community is engaged in constructing a trail from the residential area to the nearest mosque (Fig. 2), greening nearby vacant land and the riverbank, and planning a waste bank. The trail is located along one bank of the Citarum River close to the Bintang Alam Housing Complex. The trail is paved with bricks and is approximately one kilometer in length. The local leaders, such as the heads of the resident's associations, RW, Rukun Tetangga/RT (an administrative division of Indonesian villages under RW), and the head of Telukjambe Village and the local mosque were involved in all activities. The role played by community engagement was observed before and after the intervention.
Figure 2. Trail design along a bank of the Citarum River.

3. Results and discussion

3.1. Waste recycling potential

The volume of waste sampled at the Bintang Alam Housing Complex was 49.67–95.06 kg per day or 0.61 kg/person/day. With 5,500 people, the Bintang Allam housing complex produced 3334.39 kg/day during the study period. Most of the waste was organic, totaling 72.44% (Fig. 3), and approximately 85% of the total organic waste was food waste, such as leftover rice, bones, and uncooked parts vegetables. The second-largest waste category as paper/card (non-multi-layered paper) comprised 7.71%, with the composition dominated by packaging such as duplex board and cardboard. The third-largest group was a plastic waste (non-multi-layered), with an average percentage of 5.927%. Most plastic waste found in this sampling was plastic shopping bags. Other waste products, such as plastic bottles and transparent plastic glasses, were challenging to find since individual waste pickers had already collected them.

In addition to the three dominant waste categories in the sampling, there were the following different types of waste with their respective average quantities: absorbent hygiene products, 3.074 kg/day; multi-layered, 1.986 kg/day; textiles, 1.336 kg/day; specific hazardous wastes, 0.847 kg/day; glass, 0.564 kg/day; wood, 0.529 kg/day; electrical and electronics, 0.521 kg/day; metal, 0.521 kg/day; Styrofoam, 0.314 kg/day; and rubber, 0.006 kg/day.
Figure 3. Composition of household waste at the Bintang Allam Housing Complex, Karawang.

The price of recycling waste varies from one waste picker to the next. On average, plastic bottle waste sells for Rp2,013 per kg, used paper for Rp1,218 per kg, cardboard waste for Rp1,241 per kg, and tin/metal waste for Rp1,523 per kg (1US$ = Rp14,500 in 2020). Under the assumption that 50% of those items are recycled, Table 1 presents the potential economic benefit of recycled waste.

| No. | Waste Category       | Waste Pile (kg/day) | Waste Price (Rp/kg) | Potential Recycling (kg/day) | Potential Selling Price (Rp/day) |
|-----|----------------------|---------------------|---------------------|-------------------------------|---------------------------------|
| 1.  | Plastic bottles      | 13.04               | Rp2,013             | 6.52                          | Rp13,125                        |
| 2.  | Used paper           | 24.89               | Rp1,218             | 12.44                         | Rp15,152                        |
| 3.  | Card                 | 167.83              | Rp1,241             | 83.91                         | Rp104,157                       |
| 4.  | Tin/metal            | 20.30               | Rp1,523             | 10.15                         | Rp15,457                        |
|     | TOTAL                | 113.03              |                     | 113.03                        | Rp147,891                       |

Besides reducing the volume of waste disposed of in the landfill, recycling also yielded a profit of approximately Rp147,891 per day or, Rp4,000,000 in one month. During the community meetings, the residents raised their concerns over waste bank development (Fig. 4). The main concern was that not many households were willing to engage in waste separation, while previous studies have provided evidence that household waste sorting is the starting point of waste management [26, 27]. The results of the survey on residents' perceptions of waste management in the context of the Citarum River are presented in Fig. 5. The questionnaire suggests that the people are knowledgeable about the importance of taking care of the river and its banks by not disposing of waste carelessly: 38.67% of residents knew they could not dispose of waste directly into the Citarum River since it can harm the environment. However, 4% of the residents still disposed of their solid waste into the Citarum River, especially when no regular waste collection was available due to the waste truck breaking down. The observation of waste management along the trail yielded surprising results.
Figure 4. Environment management meeting with residents of Telukjambe.

Figure 5. Residents’ perceptions of waste management before intervention.
The knowledge derived from the intervention was easily put into practice. In the eighth month of trail construction, there were no piles of waste along the riverbanks. The constructed trails were also well-taken care of with lush greenery in the form of different types of plants, such as bread fruit (*Artocarpus communis*), stink bean (*Parkia speciosa*), avocado (*Persea americana*), and mango (*Mangifera Indica L.*). One shortcoming of this project is that only a portion of the residents subsequently became involved in attempting to develop a waste bank. Lack of awareness among some of the residents accounts for the problem. Time constraints on lobbying the residents regarding changes are also an issue. As a previous study mentioned, community engagement is an ongoing process, not a one-time act [28]. The characteristics of funding, which is in the form of a grant and has a prescribed deadline, often become a hindrance to sustainable advocacy.

### 4. Conclusion

The Citarum River plays a significant role in the surrounding population; however, many problems have arisen due to overpopulation along the river banks, causing solid waste mismanagement and water contamination. In this study, a community of Bintang Alam, Karawang, close to the Citarum

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**Figure 6.** Before (a) and after (b) riverbank management.
River engaged in constructed a trail along a bank of the Citarum River, and fruit plants were planted. A pleasant environment for the community was provided; the amount of waste disposed to the river has been reduced. However, due to time constraints and characteristics of funding, the development of a waste bank remains a challenge. It has been suggested that community engagement involving multi-year grants might make more continuous advocacy in the community possible.

Acknowledgements
The authors and Telukjambe residents would like to thank Universitas Indonesia for financial support under grants NKB-1393/UN2.R3.1/HKP.05.00/2019 and NKP-1953/UN2.R3.1/HKP.05.00/2019, and NKB-118/UN2.R3.1/HKP.05.00/2019.

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