Mapping the Problems, Stakeholders, and Potential Solutions of Solid Waste Management in a New-Emergence Tourist Area: A Case Study in Nglanggeran, Gunungsewu UNESCO Global Geopark

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Abstract. After being selected as a UNESCO Global Geopark in 2015 and promoted as an ecotourism area, Nglanggeran Village in the Gunungsewu area can attract as many as 300,000 visitors/year. Although tourism activities on one side bring economic benefits, on the other side they raise environmental problems. One of the problems is the increase of solid waste volume generated by the visitors. This study aimed to map the problems and investigate the stakeholders in current solid waste management in Nglanggeran. An ethnographic approach was applied in this research. Primary data was collected during the field works through participant observation, interviews with key actors, and Focus Group Discussions with stakeholders. The result reveals that the relevant stakeholders in solid waste management in this area are: the community-based tourism organization, women in the households/homestays, informal waste collectors (scavengers), and informal waste traders. The absence of formal waste management in the area and the missing link to the existing solid waste infrastructure become the main problems in this area. Integrating informal stakeholders (waste collectors and traders) as well as educating the visitors to reduce their waste become survival strategies in the short-term.

Keywords: solid waste management, ecotourism, stakeholders

1. Introduction
Nglanggeran is a village which is located in the range of Gunungsewu hillocks in southern Yogyakarta Special Region, Indonesia. Having exotic views, Nglanggeran was launched as a community-based tourist destination in 2007. The main attraction of the area is an ancient volcano, formed by an old volcanic material fragment that used to be an active volcano million years ago [1]. After being selected as a UNESCO Global Geopark in 2015, Nglanggeran can attract as many as 325,303 visitors/year [2].

Nglanggeran is considered successful in community-based tourism management. It often becomes a national pilot for community-based tourism in Indonesia. The eminence of tourism management in Nglanggeran is its management that empowers the local community as managers as well as parties who benefit. Members of the Tourism Awareness Group (Kelompok Sadar Wisata, or Pokdarwis) of Nglanggeran consist of local youth who do not have permanent job. The involvement of these youths is the strength of Pokdarwis because tourism activities arise from the community and are intended for the community itself. Nglanggeran also has an integrated information system using internet-based information technology that enable potential visitors to select activities and homestays in the area.
The volume of solid waste in Nglanggeran increases rapidly along with the number of tourists. Similar to Asian and other developing countries [3], the present solid waste management is having difficulties coping with the massive increase of solid waste streams in the mountain area—where most attractions are there, and in the homestay areas—where the visitors stay overnight. Due to inadequate solid waste management system, inappropriate dumping site and practice of waste burning can be found all over the village. Solid waste problems can have detrimental effects on local people and the environment. Moreover, according to Ogawa [4], the poor visual appearance of an area has negative impacts on tourist visits and investments. As a new emerging tourist area, with all of its limitation, Nglanggeran has to cope with geopark standard which places conservation line with tourism development.

As a good solid waste management must involve all stakeholders from the household level, local level, provincial level and even the national level in order to enhance collaboration [5], this study aimed to investigate and to map the crucial problems and the main stakeholders involved in managing solid waste in Nglanggeran. This study intended to explore community information, the previous and existing solid waste management in the community, and their willingness to be involved in solid waste management. Using the results of this study, an appropriate strategy for solid waste management in Nglanggeran is expected to be formulated. The concept of appropriateness is frequently mentioned, and this concept is used in its original sense, referring to a good match between local conditions and the system that is provided, without any prior assumptions about the type of solution that will serve most effectively. Appropriate strategy does not always mean simple, low-technology or labor-intensive, but it means that all relevant factors are considered when decisions are made [6].

2. Research Methodology
Ethnographic approach was applied in this research. Ethnographic research is often use in the field of waste management and is known as a powerful qualitative method to helps researchers understand individual and community behaviour [7, 8]. It is a qualitative method where researchers observe and/or interact with a study’s participants in their real-life environment [9]. Ethnography is found to be useful in the early stages of a user-centered design project.

This is because ethnography focuses on developing an understanding of the design problem. In this research, participant as observer method was used. The researchers stayed as guests in research area, joined several village meetings, visiting waste processing facility, as well as conducting this research. There were two types of primary data collected during the field works of the study:

a. Qualitative data. Qualitative data was gained with participant-observation approach, interviews with key actors, and Focus Group Discussion. Identified key actors were head and members of Pokdarwis, waste collectors, waste buyers, head of village, and government officers in Department of Environmental Control, Department of Public Works, and Department of Social Affairs. Focus Group Discussions with waste management stakeholders involved Pokdarwis, women in the households, homestay owners, and head of the village.

b. Quantitative data. Quantitative data was gained from household questionnaires and deep interviews. Twenty-five respondents were selected using snowball sampling technique. The main criteria of the respondents are household members who also run a homestay his/her house. Open and closed questions were designed for all respondents to investigate their current waste conditions, their wish for improvements, and their willingness to support proposed solutions. Deep interviews were conducted with six engaged respondents among them.

3. Results and Discussions
This research was focused on two different sources of solid waste: from the tourism area (mountain Nglanggeran and its surroundings) and the homestays- where tourists stay overnight.

a. Solid waste from the mountain and its surrounding areas

The attractions in this area include educational tourism (tourists learn how to make traditional crafts, batik and local culinary), cultural events (traditional dance and music), adventure activities (hiking, flying fox, rock climbing), and agro-tourism (chocolate plantation and factory). Along with the increase number of tourists visiting Nglanggeran since 2014, the amount of solid waste also increased
rapidly. The condition of solid waste in the mountain and surrounding areas in 2014-2017 is presented in Table 1.

| Characteristic                  | Baseline conditions                              |
|--------------------------------|--------------------------------------------------|
| Physical components of solid waste | - Dominated by plastic waste (plastic bottles, single use plastic pouches, plastic wraps), aluminum-content waste (candy and snack wraps), and tissue paper  |
|                                 | - Few biodegradable waste                        |
| Volume of solid waste          | - circa 400 kg/month                             |
| Outspread of the waste         | - Although garbage bins were available in many spots, the waste was still scattered in the mountain and surroundings |
| Waste condition                | - All type of solid waste was mixed, not yet segregated |

There were two types of garbage bins: one for biodegradable waste and the other was for non-biodegradable waste. Despite the fact that garbage bins were provided in many spots, waste could still be found scattered in several areas. The main stakeholder in solid waste management in the mountain was youth organization (Pokdarwis). Pokdarwis’ main tasks included organizing the visitors (ticketing, accommodation, guiding), managing the tourist spots, and taking care of the waste generated by the visitors. All of the waste from the tourism area was collected twice per week and brought to a nearby waste collecting station. A waste processing station has been constructed by the government in an outskirt area, but without sufficient access. Mixed waste was then segregated in the processing station by Pokdarwis and sold to informal waste traders. These traders then sold the segregated waste further to waste buyers who treated and processed the waste into plastic ores for further uses. Fig. 1 summarizes the waste collecting process in Nglanggeran.

Figure 1. Waste collecting process in Nglanggeran tourism area

With rapid development of tourism in Nglanggeran this practice led to several problems as follows:
- The amount of the waste continued to increase, but the formal waste management system had not been developed. Based on the interviews with government institutions, there was not any plan within short term (five year ahead) to construct an integrated waste collecting system
- Waste processing station as one of the infrastructures had been constructed by the government. Unfortunately this facility did not have any operators. Therefore, Pokdarwis meanwhile had to tackle the works such as collecting, transporting and segregating the waste
Mixed waste had low economic value, but separate it in waste processing station consumed a lot of time. *Pokdarwis* members did not have much time to separate the waste, especially during tourism high season.

In 2017, a pilot project for solid waste management was initiated in Nglanggeran. Several strategies were introduced to overcome the solid waste problem. The first strategy was adopting the hierarchy of waste management (see Fig.1). The implementation of waste management hierarchy was carried out according to the following sequence of activities: (1) prevention of the production of waste by avoiding activities that possibly generate waste; (2) reduce the amount of waste by minimizing solid waste generation; (3) reuse the material recovered from the waste stream in their current forms; (4) recycle the waste materials by reprocessing them into products, materials or substances whether for the original or other purposes (including composting); (5) recover the energy from waste stream by incineration, anaerobic digestion or similar process (if possible); and (6) safely dispose the residual solid waste in environmentally sound manner (generally landfills).

**Figure 2. Solid waste management hierarchy [10, 11]**

Since the source of the waste was from the visitors, the tourism management body of Nglanggeran tried to limit the number of visitors and created a particular segment of tourists. Segmented tourism strategy aims to develop a competitive advantage by identifying suitable segments of tourists and offer them the service that will most satisfy their needs [12]. Segmented ecotourism helps to maintain the coexistence of local environment, community, and wildlife. This strategy was in accordance with the principal of sustainable tourism and nature conservation [13].

Before applying segmented tourism strategy, any visitors could come individually, anytime without any reservation. After the strategy applied visitors could only come by group reservation (e.g. school trips, family gathering, office gathering). Therefore, it was easier to organize and save time. With segmented tourist strategy, *Pokdarwis* could manage their time to serve the tourists as well as taking care of the environment- including managing solid waste.

Segmented tourist strategy proved to bring income improvement. Before the strategy was applied Nglanggeran received 300,000 visitors/annum or almost 1000 visitors/day during peak seasons. The total income from visitors reached IDR 1.4 billion/annum (ca. USD 98,500/annum). Segmented tourist and reservation required extra cost and led to the surge of ticket price. Although the number of visitors dropped to 250,000 visitors/annum, the annual income reached IDR 1.5 billion (ca. USD 106,217).

After segmented tourism strategy was adopted, several measures were introduced in Nglanggeran:
- To reduce the number of wastes, before groups of tourists visited the mountain, *Pokdarwis* served them with meals and snacks using traditional plates from leaves and washable cutleries.
The groups received short education to encourage the use of self-water container and to prohibit littering. New garbage bins with three compartments (biodegradable, non-biodegradable, paper) were installed in some spots. Visitors were encouraged to separate the wastes since the beginning. Compared to the baseline conditions in 2014-2017 which are presented in Table 1, the solid waste management conditions have improved after these measures were applied (see Table 2).

Table 2. Existing conditions of solid waste in Nglanggeran (as of 2020)

| Characteristic                  | Existing Solid Waste Conditions                                      |
|--------------------------------|---------------------------------------------------------------------|
| Physical components of solid waste | - The number of plastic waste (bottles, bags, wraps) decreased significantly. Aluminum-content waste (candy and snack wraps) and tissue paper were still many. |
|                                  | - Few biodegradable waste                                           |
| Volume of solid waste           | - Circa 200 kg/month                                                 |
| Outspread of the waste          | - Number of scattered wastes decreased after education               |
| Waste condition                 | - Waste was mostly segregated after education and provision of new bins |

b. Domestic Solid Waste from Homestays

Most households in Nglanggeran earned their main living from agriculture and farming, and gained second income from tourism. Many of them offered accommodation for visitors and invited the guests to experience daily life in the village. With the surge number of visitors, the amount of domestic waste also increased. Table 3 describes the existing solid waste handling for each type of domestic solid waste.

Table 3. Existing domestic solid waste treatment in Nglanggeran

| Type of waste                        | Treatment                      | Level of treatment                                                                 |
|--------------------------------------|--------------------------------|-----------------------------------------------------------------------------------|
| Organic waste from kitchen and food left over | Fed to the cattle/chicken     | - Very good and the problem was solved                                              |
| Dry leaves/garden waste              | Mostly buried or burned        | - Poor, there was still possibility that the treatment causes environmental pollution. There was an effort to introduce composting technique to the community |
| Cattle dung                          | Treated for fertilizer         | - Very good and the problem was solved                                              |
| Single use plastic bags              | Burned                         | - Poor, there was still possibility that the treatment causes environmental pollution |
| Plastic bottles/containers (shampoo, mineral water, body lotion, etc.) | Segregated and sold to waste collectors/traders | - Good, although the price was very low, all households prefer this as the best solution to make their house clean |

Based on Table 3, types of solid waste that still caused problems were dry leaves from garden waste, plastic bags, and containers. Although the village had a waste processing station, this facility was not optimum to cope with those kind of waste. As mentioned before, this facility was located in the outskirt with poor access and did not have any formal operators. Pokdarwis could only manage the waste from the mountain, but not from the homestays and households.
Unlike the problem in the ancient mountain area, the solid waste problem in homestays and households considered to be more complicated and needed more attention. Based on the questionnaire with twenty-five respondents, 100% of the respondents agreed that solid waste became a problem in the households. All of them wished to have clean houses and environment, but they could not manage collecting and transporting their waste. Therefore, all households and homestays relied on the informal waste traders, who also played the role as waste collectors from door to door. According to all respondents, the problem lied on the reliability of the waste traders. The traders did not pick up the waste regularly, and this caused accumulation of waste in the households. In such condition 72% households decided to burn their plastic waste, while 28% of them buried it. Whilst 84% of the respondents agreed to pay for a solid waste service (if there will be any service), 16% of the respondents were not willing to pay and rather burn their waste. Willingness to pay to support improvement of solid waste management was circa IDR 10,000/month (USD 0.67/month), or 0.56% of their minimum monthly wages.

4. Conclusions and Recommendations

With segmented tourist and education strategies, Nglanggeran nearly could solve solid waste problem in the tourism area. In line with sustainable tourism principle [14], the strategies were able to make optimal use of all their resources. The education given to visitors by Pokdarwis ensured a meaningful experience to the tourists and raised their awareness about sustainability issues, particularly solid waste.

The biggest problem in this waste management was the absence of organization to manage solid waste in households’ level, including homestays. In the future, a formal waste management organization is recommended. This organization could be part of the community or involving a new stakeholder and paid to do the chores. Although physical infrastructure has been prepared, it was not optimum. The location of the waste processing station was too far away from the settlements and the access was poor. Moreover, the processing station did not have any formal operators.

The other strategy to manage domestic waste was to reduce plastic from its sources, in this case the visitors and the household’s members. They should also be accustomed to segregate their waste in order to increase the interest of the traders and increase the selling value of their waste. Since formal waste management has not existed yet, informal waste traders still played important roles to solve the problems.

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