Production and Waste Management for Initiation of Green Campus Program at Universitas Negeri Malang

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Abstract. In 2017, Universitas Negeri Malang (UM) was declared as a green campus, which is a concept developed for environmental management. It is necessary to provide data and information on environmental management at UM to support the green campus. One of them is the problem of waste and its management. The purpose of this study was to determine the amount and type of waste, analyze the factors that affect the production and management of waste, and develop waste management strategies at UM. The research approach included surveys, observations, questionnaires, random interviews on all campus elements in nine faculties. The data were processed and analyzed descriptively. The amount of waste generated at UM was 1.5-2.0 tons per day and increased two times higher at a special event. The garbage produced in the form of organic (50%) and inorganic waste (50%). Organic waste consisted of leaves and food scraps, while inorganic waste included plastic (food wrap and bottles of mineral water), cardboard, and paper. The sorting of the type of garbage only occurred inside the campus; it would be re-mixed in landfills. Therefore, waste management at UM has been dominated by a conventional method (collecting, transporting, and disposing of) with landfilling as the final dumping. Some strategies were needed in the form of building the integrated waste management centers, socialization of sustainable campus waste management, integration of environmental knowledge in specific courses in each study program, and green programs carried out jointly by the campus community to realize UM as a green campus.

Keywords: Production, management, waste, green campus, strategy

1. Introduction
Unlimited real change in this world nowadays is inevitable. So, every country, nation, and community needs to adapt to this change. The success of the adaptation is indicated by the achievement of a community set out in the Millennium Development Goals (MDG) [1]. The campus which has declared itself as an agent of change needs to actively participate in anticipating and adapting global changes that occur such as climate change, economic change, social, and cultural changes.

Universitas Negeri Malang (UM) which states itself as a university with a vision to achieve the status of an excellent and authoritative university in upholding the Three Principles of Higher Education (Education, Research and Development, Community Services) proves that it is capable of and able to deal with this change. One of them is creating conducive and manageable campus conditions through the green campus program. This case is in line with the Universitas Negeri Malang...
2011-2030 Development Master Plan which mandates the development direction of UM as The Learning University. Some of them are the construction of buildings and the provision of facilities and the arrangement of the campus environment directed at building construction, the provision of facilities, and the arrangement of the campus environment that teaches.

In 2017, Universitas Negeri Malang was declared as a green campus, which is a concept developed for environmental management at UM. UM defines the green campus as a conscious effort carried out in a planned manner by campus residents to synergize the goals, objectives, and activities of the entire activities to ensure the safety, comfort, and productivity of work achieving the advantages that have been set together. The green campus is a reflection of the involvement of the entire academic communities in the campus environment so that they always pay attention to the health and environment aspects around them [2]. In the context of environmental preservation, it is not only a campus environment filled with trees but also the extent to which campus can utilize existing resources in the campus environment effectively and efficiently, such as the use of paper, electricity, water, land, waste management, and waste, etc. [3].

In improving the campus-friendly image, now, there are tools to assess Green Campus's performance known as Green Metric. There are six categories in green metrics, i.e., settings and infrastructure, energy and climate change, waste, water, transportation, and education [4]. In 2010, Universitas Indonesia (UI) established the UI Green Metric World University Ranking as a platform for universities around the world to share their information and practices to achieve sustainability in their campuses [5]. According to UI Green Metric's assessment data in 2017, among 619 universities in the world, UM was positioned at 566 [6].

The improvement of data, information, practice, and good campus management is necessary to realize UM as a green campus and improve its position in green metrics. Some of them are about waste and its management. The campus is one of the places where many people are doing activities, which in turn will produce waste. With regular users and activities even on holidays, there can be certain types of waste produced every day. The problem of waste is a challenge not only for urban management but also for educational institutions. Higher education is a more significant contributor to society for achieving sustainability [7]. University researchers have provided first alarms regarding environmental challenges through their research investigations. The research aimed to determine the amount of waste produced by UM, to know the type of waste, and to develop a waste management strategy.

2. Methods
Surveys, observations, interviews, and questionnaires were utilized to find out existing data related to waste and its management and determined. The composition of waste generation, sorting patterns, and management methods that have been carried out was conducted in nine faculties at UM, i.e., faculty of education, faculty of letters, faculty of mathematics and natural sciences, faculty of economics, faculty of engineering, faculty of sport sciences, faculty of social sciences, and faculty of psychology education.

Questionnaires and interviews with all elements of campus were assigned to 30 people chosen randomly in each faculty. All elements of campus were household managers of each building and unit, campus waste management (cleaning service, sweeper, garbage transport driver, and gardener), academicians (lecturers and students), and non-teaching staff.

The questions consisted of 12 points related to the waste and its management which can be grouped into: attitude and compliance (such as the habit of disposing of garbage in its place, the amount and types of garbage produced per day on campus, obedience to read and follow the instructions given), and insight (comprised knowledge of waste separation, assessment of the condition of garbage in campus and waste management), and regulation (included standard operation procedure, rules). The data were processed and analyzed descriptively. Some flowcharts were made to compare conventional processes to integrated waste management.
3. Results and Discussion

3.1. Description of the process, amount, and type of waste produced at Universitas Negeri Malang

According to the Republic of Indonesia Law Number 18 of 2008 [8], waste is the daily residue of human’s activity and/or a solid natural process. The garbage from each building was collected in a temporary landfill located in each faculty before being taken by a garbage truck to the final disposal site in Malang. The garbage that still had selling-value would be taken by the janitor and scavenger. The waste included plastic bottles of mineral water, glass bottles, cardboard, and paper, while the garbage from other types would be brought to the landfill (Figure 1).

![Garbage management diagram]

Figure 1. Waste management at Universitas Negeri Malang

The total amount of waste produced on campus was 1.5-2 tons/day. This amount will increase in certain moments such as graduation and campus celebrations, which can reach two times higher. The waste consisted of organic (50%) and non-organic (50%). The organic waste included leaves and food scraps as much as 0.75 – 1 ton/day. The non-organic waste contained plastic food wrap, mineral water bottles, cardboard, and paper as much as 0.75 - 1 ton/day. Both types of waste were separated and collected in different places. Furthermore, organic and non-organic wastes were transported by two garbage trucks belonging to UM to the final disposal site. According to existing management, it is necessary to follow up on the sorting type of waste so as can minimize the amount disposed of into the final disposal site.

3.2. Factors that influence the waste production and management

According to interviews and questionnaires, the factors that influence waste production in the UM campus environment were: First, the intensity of producing and disposing of garbage while on campus was quite high. This was indicated by the amount of waste produced 1.5-2 ton/day. Second, as many as 95% of campus residents threw trash in the space provided; however, 5% of the campus residents had not done so. Third, students who disposed of garbage by reading the instructions provided (organic and inorganic waste) were 63.3%, while 36.7% of them did not read the instructions even though they knew the purpose of waste separation. Fourth, the amount of inorganic waste was still high (50%) and dominated by plastic.

The factors that influenced waste management in the UM campus were: 1) Standard Operational Procedure (SOP) in waste management was available. However, not all janitors and campus residents
knew about it. In each building or area, there was at least one janitor who was in charge of cleanliness. 2) The facilities and infrastructure that supported campus cleanliness, such as the number of adequate bins and garbage trucks were available. 3) Every year, ± 1000 bins were budgeted for each axis of the building in the UM campus. Nevertheless, there were some complaints from the campus community related to the left and unused trash bins, some trash bins without instructions (organic and inorganic) and insufficient trash capacity in specific locations such as canteens. 4) The selection and sorting of waste were done before the waste was taken to the final disposal site. There were temporary disposal sites in each faculty. 5) The trash was transported every morning using garbage trucks and taken to the final disposal site. 6) The funds for managing organic waste into compost and recycling inorganic waste were not yet available.

There were still students who had not disposed their trash in place, did not dispose the trash in accordance with the instructions that had been provided, and ignored the reasons of waste separation. Those cases indicated that socialization is crucial. Moreover, integrated programs were needed in certain academic courses or activities to provide knowledge and change the perspective that results in environmental awareness behavior changes.

To support the campus waste management, an SOP was needed for janitors and campus waste management as a whole. In addition, it was necessary to follow up the waste sorting that had been done at UM, such as composting. For this reason, funds and procurement of locations were needed for the process, as well as the provision of incinerators for burning inorganic waste that cannot be sold or utilized.

3.3. The UM campus waste management strategy in the program leads to a green campus

Universitas Negeri Malang with its commitment to become a green campus was expected to have an integrated Waste Management Center so that it could carry out its waste processing independently, no longer using the conventional system known as waste management "collect - transport - dispose." To manage waste in an integrated manner, the readiness of all parties was needed to change the way of thinking and perspective in handling waste [9]. The failure of agency assessment and application of technology (BPPT) with its zero waste concepts was one of the valuable lessons about the importance of the role of all parties in minimizing, sorting, and separating waste as early as possible.

To invite all parties to participate in waste management, it was necessary to 1) Conduct socialization of sustainable campus waste management. The socialization program that had been carried out so far during the training of students did not have a real influence. This case was reflected by the respondents (randomly selected UM students) who provided suggestions for the dissemination of the importance of throwing garbage in its place and in accordance with its type, i.e., organic and inorganic. 2) Integrate the environmental knowledge in particular courses in each Study Program. This method has been applied by several campuses in Indonesia such as Institut Teknologi Bandung and Universitas Indonesia. 3) Carry out sustainable programs and activities on green movement independently by all campus communities, such as cleaning rivers, ditches on and around the UM campus, replacing old plants, cleaning ponds, etc. All those things should be done to change the way of thinking and perspective that results in improvements in campus citizens' behavior and awareness.

The technique for integrated waste management and processing, in general, could be described through the following processes: the waste from each building/faculty was sorted by its type, i.e., organic (food scraps, leaves), inorganic (cans, plastic, paper, cardboard, glass bottles, etc.), and hazardous and toxic materials (B3). The organic waste was composted using traditional or accelerated systems. The traditional composting (windrow system) was the most straightforward technology to accumulate the organic waste in a container equipped with air ducts so that oxygen can enter. The organic matter was allowed to decompose naturally by the activity of microorganisms. The compost would be made within ±3 weeks. The composting process was accelerated using a reactor with a supply of oxygen and water to ensure conditions remain aerobic. Furthermore, the compost was used for fertilizing plants that were on campus and sold. The benefits obtained could be used to meet the operational costs of an integrated waste management center (Figure 2).
The inorganic waste that still had sale value such as plastic bottles, glass bottles, cardboard, and paper could be sold or recycled. While the inorganic waste with no sale value was burned in an incinerator to reduce its mass and volume (Figure 2). The incineration process used high temperatures (above 800 °C) to produce moisture and residual ash that could be used for the composting process [8]. Related to laboratory activities (research and practicum) which produced hazardous and toxic materials, special place and processing were needed. Garbage containing hazardous and toxic materials was categorized as specific waste, i.e., the waste which was due to its nature, concentration, and/or volume required special management.

Three R (3R) stands for reuse, reduce and recycle. First R, reuse of waste that could still be used both for the same function and other functions, for example, beverage bottles converted into cooking oil, modified tires to become chairs and flower pots. The second R is reducing everything that caused waste, for example, carrying a bag/basket from home when shopping [10, 11]. The third R, recycle was processing waste into new products, for example, paper waste was processed into recycled paper, plastic waste was processed into plastic bags, and organic waste was processed into compost [12, 13]. The advantage of this 3R was to reduce the volume of organic waste that was discharged to landfill and could be resold so that it has economic value.

Figure 2. Self-governing waste management strategies at UM in the program towards the green campus

4. Conclusion
The amount of waste produced by Universitas Negeri Malang (UM) was quite high (1.5-2 tons/day). The waste was generated in the form of organic waste (50%) and inorganic (50%). The organic waste in the form of leaves and food scraps, while inorganic waste was in the form of plastic bottles of mineral water, cardboard, and paper. The waste sorting only occurred inside the campus but would be mixed again when it arrived in the final disposal site. The waste management that took place at UM campus still used conventional method (gathering, transporting and disposing) with landfilling as the final disposal site. The integrated waste management should be available at UM, i.e. waste management activities ranging from upstream to downstream. Also, a soft skill program was required in the form of socialization and training of waste management, integration of environmental knowledge in certain courses in each Study Program, and green movement activities carried out independently by all civitas in changing ways of thinking and perspectives resulting in improved behavior and awareness of campus residents.
Acknowledgments
We thank the Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang for financial support through Non-Tax State Revenues Grant.

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