



Promoting Social Innovation Based on Environmental Volunteer to Develop Plastic Waste Management Strategies in the Green Campus Model

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<https://doi.org/10.18280/iji.080118>

ABSTRACT

Received: 18 July 2024

Revised: 15 September 2024

Accepted: 23 September 2024

Available online: 28 February 2025

Keywords:

social innovation, plastic waste management strategy, Green Campus Model

UM is a higher education institution (PTN) that is consistent with the values of sustainable and prosperous life, as well as the concept of Sustainable Development Goals (SDGs) and 6 UI Green Metric indicators. One of the wishes which it wants to become are managing and administrating plastic waste in UM. The objectives to identify plastic waste management strategies at UM, and create social innovations that incorporate environmental volunteers on strategies for plastic waste management using the Green Campus Model. The method used in this research is development with the data collection by questionnaires, interview, observation, documentation and forum group discussion (FGD). Results were evaluated by quantitative expression statistically as tabulation, percentile and SWOT analysis. It is also a sign that the plastic waste interventions conducted on UM are rather effective, with 90% of strategy successfully implemented and managed to reduce 30% plastic waste in one year. In collaboration with the head of family, the head of garden head of public lecture building general Faculty sub-section, cleaning floor team, cleaning room team (outsource), environmental volunteer team intra-campus student organizations and Malang City Waste Bank as well as related small businesses. Although the study has achieved a lot of success, the extensive proportions increase in participant knowledge and experience with additional mentoring to increased implementation effectiveness.

1. INTRODUCTION

One of the most serious environmental problems that the world is currently confronted with is plastic waste pollution [1]. Although plastic is cheap, lightweight, and flexible, it takes hundreds of years to fully degrade [2]. The growing number of students on campus has led to a yearly increase in the use of plastic products. The rise in population and higher living standards, along with a lack of information about waste management, contribute to the substantial environmental damage caused by plastic trash [3]. Furthermore, the engagement level in proper plastic waste management is rather low [4]. Littering is a negative habit that leads to environmental pollution [5], air pollution [6] and blocking water channels, which can result in flooding [7]. Poor management of growing plastic waste can have negative impacts on both human health and the environment [8].

The plastic waste issue is evolving into a progressively complex problem for society [9]. This is due to the disparity between the usage of plastic and the accumulation of plastic waste resulting from its use in daily life. The issue of plastic waste has a significant influence on both the marine and land ecosystems [10-13]. Furthermore, plastic waste poses significant challenges to both human and animal health. Hence,

effective plastic waste management plays a crucial role in both mitigating and resolving the issue of plastic waste pollution.

The current challenges in waste management include: (1) absence of waste processing strategies, (2) inadequate waste sorting methods, (3) insufficient public hygiene services, (4) limited environmental education, (5) lack of social supervision on waste policies, and (6) absence of social innovation programs for waste managers [14].

The growing student population on campus has led to an equal rise in the volume of waste that needs to be properly managed and disposed away. The waste generated on campus is significant in terms of its capacity to contribute to environmental waste. Efficient management of waste is essentials [15-21]. The government has implemented several initiatives to address garbage processing and management, but it has not yet achieved optimal levels of waste management, including the management of waste generated on campuses.

The curriculum implemented by Universitas Negeri Malang (UM) in 2021 is a Life-Based Curriculum. The Life-Based Curriculum is enhanced by the university's objective to transform into a campus that promotes both physical health and intellectual growth. UM requires that each department implements a curriculum that fosters qualities such as faithfulness, patriotism, environmental awareness, innovation,

creativity, sportsmanship, honesty, and justice. These qualities are representative of the students and alumni. In addition to the curriculum, there are activities related to Environmental Volunteers that are organized by the university student council from environmental department, and the Environmental Activity Unit in each faculty's student council. These activities aim to enhance the implementation of the curriculum.

In order to assess social aspect regarding student attitudes towards plastic waste on campus, a comprehensive methodology involving observation, conversation, and action can be employed. This technique encompasses two key aspects: (1) the level of concern among the students regarding sustainable packaging; (2) their knowledge and practice of waste sorting methods; (3) students actively engage as environmental volunteers in the plastic waste care movement; (4) students actively participate in training programs focused on plastic waste recycling; (5) student knowledge of the

process of selling plastic waste to waste management organizations.

Research on sustainable environments has been conducted extensively over the past 20 years, from competitions to design green campuses, which have been started by national and international educational and non-educational institutions with an interest in sustainable environments. The presence of UI Green Metric has prompted and continues to stimulate universities at both national and international levels to persistently develop and enhance eco-friendly technological advancements and infrastructure in accordance with the criteria outlined in UI Green Metric, namely Setting and Infrastructure (SI), Energy and Climate Change (EC), Waste (WS), Water (WR), Transportation (TR), and Education and Research (ER). The value of waste management at UM has consistently grown over the years, as has the ranking position of UI Green Metric, both in national and international levels. This growing pattern is seen in the corresponding Table 1.

Table 1. Results of the assessment and ranking in the ui green metric world university ranking 2017-2023 for UM

Year	Setting and Infrastructure	Energy and Climate Change	Waste	Water	Transportation	Education and Research	Total Skor	Indonesia Ranking	Global Ranking
2017	559	683	447	330	411	288	2718	43	565
2018	275	825	600	200	325	900	3125	48	617
2019	275	825	600	300	325	300	2525	57	717
2020	500	1600	825	450	1250	1275	5900	26	345
2021	775	1675	825	700	1150	1250	6375	37	346
2022	900	1725	825	700	1400	1475	7025	32	288
2023	1150	1600	1125	800	1400	1675	7750	28	210

UM is an educational institution committed to fostering students from various academic levels, from diploma to doctorate, with a focus on physical health, intellectual health, and sustainability. UM's vision is in line with the SDGs and the UI Green Metric indicators, which encourage the integration of sustainability in campus management.

In order to achieve this vision, UM aligns its efforts with the SDGs goals and the six UI Green Metric indicators, and is committed to environmental sustainability through the establishment of the Green Campus Team since 2017. This team leads the implementation of environmentally friendly technologies and involves students and lecturers in environmental volunteer activities, emphasizing UM's dedication to protecting and preserving the campus environment.

Ensuring that UM becomes an environmentally sustainable campus is a shared responsibility borne by the entire university community, resulting in a large number of students and lecturers actively participating as environmental volunteer members. Therefore, the objectives of this study are to: (1) identify the approach taken by UM in managing plastic waste, and (2) create social innovation by utilizing environmental volunteers to develop plastic waste management solutions in order to support the Green Campus at UM.

2. LITERATURE REVIEW

Plastic is a material composed of polymers and is either synthetic or semi-synthetic [22]. The utilization of elastic plastic makes it highly suitable for everyday use [13]. Plastic offers numerous advantages in both residential and industrial settings, but it also causes damage on the environment [23].

Every individual who utilizes plastic in daily activities is expected to produce 1.3 kg of waste plastic on average per day [22]. The plastic waste problem is worrying and getting worse, since it is predicted to increase twice by 2050 [24]. Furthermore, the process of plastic degradation requires several centuries [25].

The global community is currently engaged in discussions regarding plastic waste [9]. Plastic pollution in ecosystems on land [26] and seas [10] is currently the environmental issue that is raising worry. Plastic waste has a direct negative impact on the environment [27], as well as on humans and animals [28]. This aligns with the results of prior research indicating that plastic pieces create a threat to river ecosystems, leading to increased flood hazards due to its blockage of the drainage system [12]. Furthermore, plastics with non-biodegradable characteristics will transform into microplastics when exposed to sunlight [29].

Afterwards, the clean plastic waste process technique was further developed into a hierarchical concept, establishing a prioritized order for general waste treatment. The order is as follows: (a) Step 1 Reduce: minimize waste production by trying to produce as little waste as possible; (b) Step 2 Reuse: utilize the waste directly; (c) Step 3 Recycle: the process of cleaning or turning something so that it can be used again, either as a raw material or as a source of energy; (d) Step 4 Treatment: the material is used and then processed in order to make it easier to handle afterward, or to ensure that it may be discharged into the environment without causing damage; (e) Step 5 Dispose: remove any excess or waste that cannot be handled by properly dumping it into the environment and should be done using effective and secure technical methods, such as placing it in an efficient and planned landfill; (f) Step 6 Remediation: environmental media, including water and soil,

that have been contaminated as a result of improper waste management, must be restored or repaired using suitable technical methods, such as bioremediation.

The characteristics of social innovation, as defined by Dhewanto et al. [30] and Damario and Comini [31] encompass the following: (1) Cross-sectoral: Social innovation has the potential to occur in multiple sectors and can be interconnected and sustainable; (2) Open and Collaborative: Social innovation requires the collaboration of all stakeholders; (3) Grassroots and Bottom-Up: Social innovation typically originates from the lower levels of society (bottom-up); (4) Pro-sumtion and Co-Production: enhancing the empowerment of target communities, enabling them to transition from being just consumers to being active producers; (5) Mutualism: social innovation demonstrates an interconnection or interdependence among all parties involved; (6) Establishes New Roles and Relationships: Social innovation typically emerges and evolves through collaboration with and participation of beneficiaries or users; (7) Better Use of Assets and Resources: Social innovation is commonly seen as the effective utilization of limited or insufficient resources, which are transformed into valuable commodities that can be marketed, such as recycled plastic waste; (8) Develops Assets and Capabilities: Social innovation requires a significant amount of time for its effects to become visible to people engaged in it.

Corresponding with this explanation, Murray et al. [32] proposed a perspective on the development of social innovation's developmental stages. This perspective uses a sequential evaluation method for the advancement of social innovation. The process includes: (1) Using prompts as the initial phase of problem analysis; (2) Generating proposals or ideas for problem-solving; (3) Conducting prototyping or initial trials to test these ideas; (4) Ensuring the consistent implementation of ideas through sustaining efforts; (5) Expanding innovations through scaling, which involves legalizing and expanding the organization; (6) Systematically designing strategies to address the problems.

3. METHODS

This study is development research that focused on the development of social innovation in plastic waste management at the UM through the participation of Environmental Volunteers. The data utilized in this study includes primary data and secondary data. Primary data were collected through direct interviews and questionnaires with informants, while secondary data were gained from additional sources. Data collecting methods include observation, interviews, questionnaires, documentation, and Forum Group Discussion (FGD).

This study focused on the faculty of social sciences, UM with respondents including: 1 head of family, 1 head of garden area, 1 head of lecture building, 10 heads of general sub-sections from each faculty, 8 cleaners, 8 room cleaning area officers (outsourcing), and 6 environmental volunteer officers and environmental department volunteers at the university and faculty levels. Each role provides important insights into the implementation of the curriculum and campus operations in the faculty, so their contributions remain significant for in-depth and relevant analysis (Figure 1).

The data was analyzed using quantitative descriptive analysis, which involved tabulation, percentage calculation,

and SWOT analysis. In addition, an internal analysis was performed using the Strategic Factors Analysis Summary (IFAS) and an external analysis using the Strategic Factors Analysis Summary (EFAS) to identify potential strategies for implementing the Green Campus Model at UM for social innovation in plastic waste management.

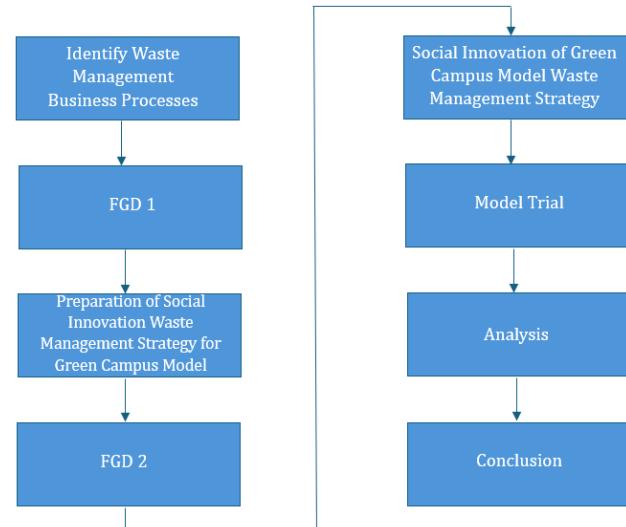


Figure 1. Research flow diagram

4. RESULTS AND DISCUSSION

4.1 Plastic waste management at UM

Students show concern for plastic waste by supporting the use of environmentally friendly packaging. Based on the questionnaire data, no students were classified as having very low concern, while 11.11% of students were included in the low concern category. 55.56% of students showed a high level of concern, and 33.33% of students showed a very high level of concern (Figure 2).

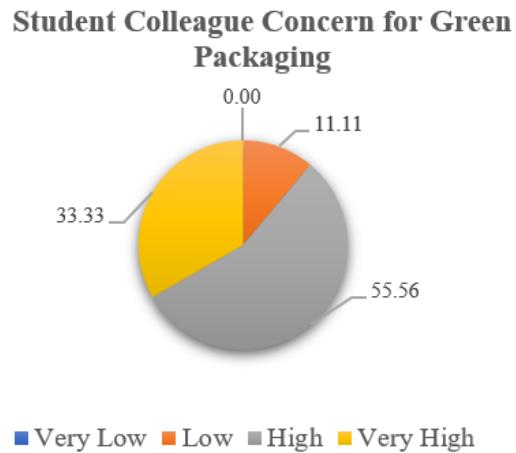


Figure 2. Diagram of student concern for green packaging

This data is also shown from the attitude of students who use tumblers to refill their drinks, along with the UM which has provided refill drinking water taps in several strategic locations. In addition, a number of students prefer to use cloth bags rather than plastic bags to carry their belongings (Figure 3).



(a) Students using refillable water bottles



(b) Student refilling water bottle at a water fountain

Figure 3. Examples of student concern for green packaging

The students and cleaning staff's concern for the sorting of plastic waste is impressive. UM has a household Unit dedicated to managing waste management issues. Furthermore, the university and faculty student councils also own an environmental department. Within the Research and Community Service Institute, there exists a Green Campus Unit as part of the Environmental and Disaster Migration Center at the university level. Within each academic department, there is also a dedicated Green Campus Unit. For students who are not part of the abovementioned teams, a significant number of them are affiliated with the Environmental Volunteer Group and the Student Activity Unit known as *Bhumi*. All the units and groups mentioned above synergistically contribute to addressing environmental issues, especially the challenge of plastic waste. Plastic waste sorting is carried out in every building, or once it is already on the Mobile Truck for waste collection, as shown in the following Figure 4.



(a) A temporary collection site for plastic waste on campus



(b) A collection point for plastic bottles to be recycled

Figure 4. Plastic waste management

Among the students surveyed, 77.78% were frequently engaged in environmental volunteer activities, 11.11% were engaged in such activities occasionally, none were engaged in them sometimes, and 11.11% never participated in them. The graph is shown in the following Figure 5.

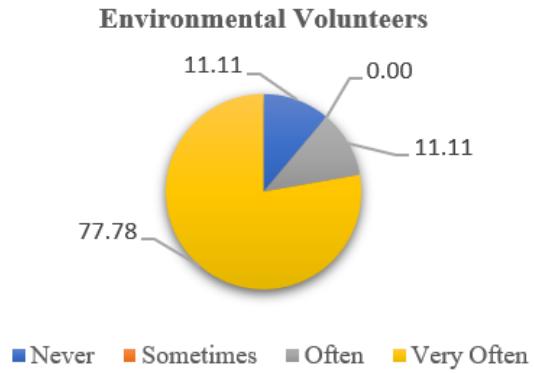


Figure 5. Diagram of respondents who are actively involved in environmental volunteers

The participation of students in training on recycling plastic waste has been consistently high. The study found that 66.67% of the respondents always participate in plastic waste recycling training, while 0% often participate, 11.11% sometimes participate, and 22.22% never participate. The graph is shown in the following Figure 6.

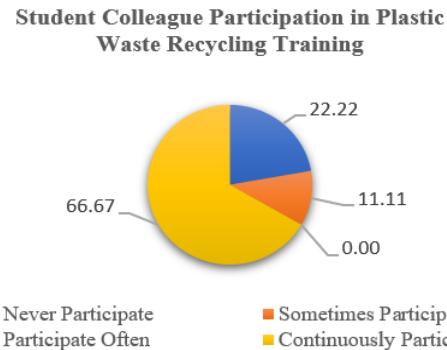


Figure 6. Diagram of student participation in plastic waste recycling training

Students' understanding of companies that handle the sales of plastic waste is to be evaluated. The percentage composition

of individuals based on their level of understanding is as follows: 11.11% belong into the category of very high understanding, 55.56% belong into the category of high understanding, 22.22% belong into the category of low understanding, and 11.11% belong into the category of very low understanding. The graph is shown in the following Figure 7.

To foster social innovation through environmental volunteers and implement a strategy for plastic waste management utilizing the Green Campus Model, it is essential to carry out a SWOT analysis (Figure 8). The SWOT analysis is performed using data collected through surveys, interviews, and the outcomes of two Forum Group Discussions. Conducting an internal analysis using the Strategic Factors Analysis Summary (IFAS) and an external analysis using the Strategic Factors Analysis Summary (EFAS) to identify strategies that can be applied for the Green Campus Model of plastic waste management social innovation at UM. The findings can be seen in the following Table 2.

Table 2. SWOT analysis results of plastic waste management at UM

		Internal Factors (IFAS)		Weight	Rating	Score
	Strength (S)					
1	At the university level, there are heads of assets, heads of households, and heads of the cleanliness sub-division.			0.4	4	1.6
2	Every faculty has a head of general sub-division.			0.4	3	1.2
3	There is head of sub-division in joint lecture building.			0.4	3	1.2
4	The university already has a rector's decree on waste management regulations.			0.3	3	0.9
5	UM already has a road map for green campus.			0.4	4	1.6
6	UM has an Innovation Plan in Environmentally Friendly Waste Management.			0.4	2	0.8
7	Has a green campus team unit.			0.3	3	0.9
8	The University Students Council has a ministry of environment.			0.3	3	0.9
9	The Faculty Students Council has a ministry of environment.			0.3	2	0.6
10	Has a student activity unit, namely Bhumi.			0.2	3	0.6
11	Has Environmental Volunteers.			0.3	3	0.9
12	There are already sorted trash bins.			0.2	4	0.8
13	There are already refillable drinking water taps.			0.4	3	1.2
14	There are already 5 mobile garbage trucks that serve as temporary shelter.			0.3	3	0.9
15	UM already has an integrated laboratory dedicated to researching plastic waste.			0.3	3	0.9
Total				4.9		1.5
Weakness (W)						
1	Not every faculty has a dedicated trash bin.			0.4	2	0.8
2	Food and beverages are still frequently sold in plastic containers at canteens.			0.3	2	0.9
3	Many building cleaners still dispose of their waste in mixed form.			0.4	3	1.2
4	Not every student knows that it's important to dispose of trash properly.			0.3	3	0.9
5	Not every student uses reusable drink containers (tumblers).			0.3	3	0.9
6	Two drainage drains that flow through UM and are regularly used to transport plastic garbage are those that originate in Sumberasari village.			0.2	2	0.4
Total						5.1
X = Strength - Weakness						9.9
External Factors (EFAS)						
Opportunity (O)						
1	Integrated Waste Management Facility has been built at UM.			0.4	4	1.6
2	The cleaning staff has received training on managing plastic waste.			0.3	4	1.2
3	Plastic waste pressing machines will be purchased by UM.			0.3	3	0.9
4	The level of cooperation with Malang Waste Bank is improving.			0.2	4	0.8
5	There is a strong level of cooperation between the environmental department of Malang City and Perum Jasa Tirta.			0.2	3	0.6
6	The rise of startups related to plastic waste innovation.			0.2	4	0.8
Total						5.9
Threat (T)						
1	There are an increasing number of students.			0.3	3	0.9
2	There are street sellers at UM on the side of Jalan Surabaya, which contributes to the growing volume of plastic waste.			0.2	2	0.4
3	Third parties frequently hire out the university's multifunctional buildings for big events.			0.3	2	0.6
4	The capacity of the final shelter in <i>Supit Urang</i> is decreasing.			0.3	3	0.9
Total						2.8
Y = Opportunity - Threat						3.1

Understanding About Selling Plastics to Companies That Manage Plastic Waste

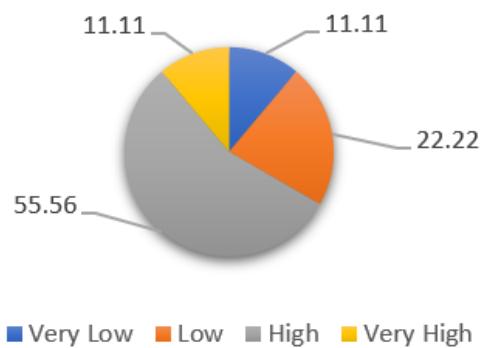


Figure 7. Diagram of student participation in plastic waste recycling training

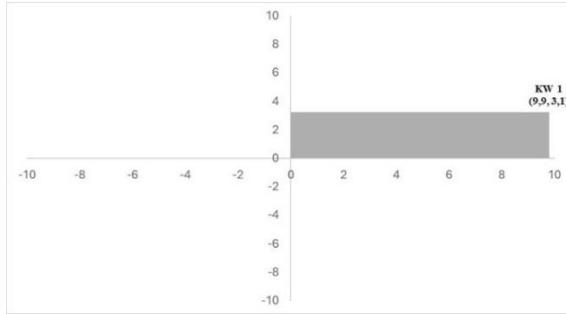


Figure 8. SWOT analysis quadrant

4.1 Social innovation based on environmental volunteers in developing plastic waste management

Students can be prepared to create a sustainable environment and become future green activists by implementing environmental education. Environmental

education has been shown to positively impact the perception, behavior, and commitment of environmentally aware students, hence promoting the achievement of the Sustainability Development Goals (SDGs) on campus [7]. UM, as an environmentally friendly university, has developed the Green Campus Road Map for 2023-2027. This document serves as a guide for the university's environmental management. The road map is shown in the following Figure 9.

In order to accomplish the Green Campus Road Map, it is essential to develop a strategic policy for waste management on campus that involves the active participation of the entire university community. This involvement is crucial for promoting waste management through recycling, reusing, and composting initiatives. Therefore, engaging in these environmentally conscious activities can effectively decrease the production of waste, thereby promoting the adoption of sustainable environmental solutions [33]. The Innovation Plan in Environmentally Friendly Waste Management incorporates the strategic policy, as shown in the following Figure 10.

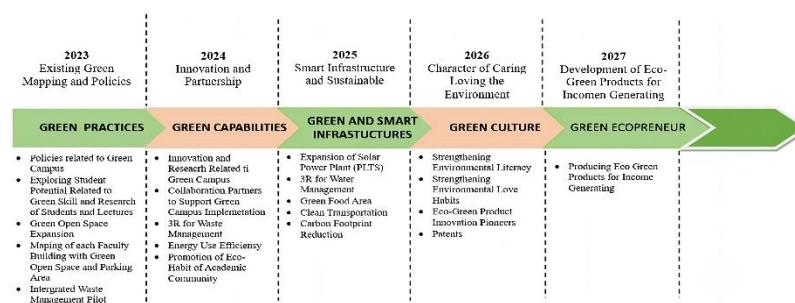


Figure 9. The green campus road map of UM for 2023-2027

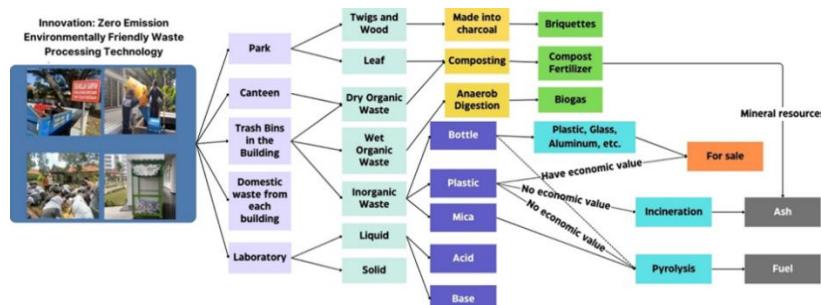


Figure 10. The Green Campus Model for waste management plan at UM

Table 3. Amount and sales results of inorganic waste for 10 days at UM

No.	Waste Type	Weight	Price/kg	Total Price
1	Plastic bottles	245 kg	Rp 3.000	Rp 735.000
2	Plastic bottles	185 kg	Rp 2.200	Rp 407.000
3	Cardboard	226 kg	Rp 2.100	Rp 474.600
4	Paper	26 kg	Rp 1.700	Rp 44.200
5	Iron	40 kg	Rp 4.500	Rp 180.000
6	Cans	15 kg	Rp 2.500	Rp 37.500
Total				Rp 1.878.300
No.	Waste Type	Weight	Price/kg	Total Price
1	Plastic bottles	245 kg	Rp 3.000	Rp 735.000
2	Plastic bottles	185 kg	Rp 2.200	Rp 407.000
3	Cardboard	226 kg	Rp 2.100	Rp 474.600
4	Paper	26 kg	Rp 1.700	Rp 44.200
5	Iron	40 kg	Rp 4.500	Rp 180.000
6	Cans	15 kg	Rp 2.500	Rp 37.500
Total				Rp 1.878.300

The waste management model for the Green Campus, particularly in regards to plastic waste, has been thoroughly tested and put into practice, as shown in the following Figure 11.

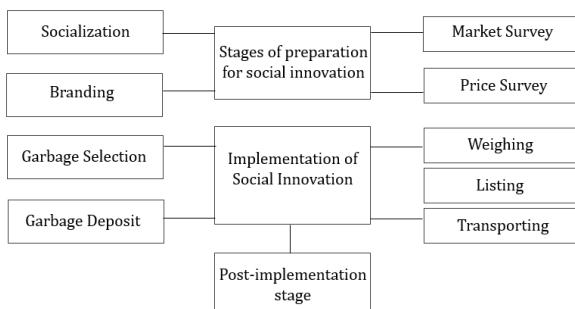


Figure 11. Implementation of social innovation for plastic waste management strategy

The results of the above SWOT analysis are categorized inside Quadrant I, specifically indicated as the Aggressive Strategy. In this quadrant, it is evident that waste management at UM presents a significant potential for improvement in terms of proper management. Efficient management of inorganic waste, particularly plastic waste, presents significant economic potential for enhancing health, particularly for the cleaning staff of the Building and Garden, and even for the UM as a whole. According to the study's findings, the Amount and Sales Results of Inorganic Waste for 10 Days at UM are shown in Table 3.

The implementation of inorganic waste management, specifically plastic waste, involves a collaborative effort among various stakeholders. These include the Head of Household, Head of Garden Area, Head of Joint Lecture Building, Head of General Sub-Division of each Faculty, Cleaning Team, Room Cleaning Area (outsourcing), Environmental Volunteer Team, student council member, as well as external parties who regularly purchase plastic waste from the university, namely the Malang City Waste Bank and small business related to waste management near to the university.

Therefore, engaging in extensive environmental volunteer for waste management initiatives can serve as an efficient way of enhancing student creativity and enhancing their economic income [34]. The lack of environmental understanding among students significantly adds to environmental issues, particularly in waste management [35-37]. Basically, students have a positive attitude and understanding of environmental issues in their surroundings [38]. However, the absence of practical training through educational programs limits their ability to effectively implement waste management practices, hence worsening environmental issues. There should be a policy to incorporate environmental education into both educational and non-educational activities [39].

The primary type of waste in UM is food and beverage packaging waste. The university is responsible for waste management and it requires participation and support from various stakeholders, including students [40-43]. The Green Campus concept is executed through a sequence of reduction, recycling, and reusing procedures for packaging trash, which then gets delivered to the trash bank [44]. Green Campus implements a policy that promotes environmental sustainability and fosters responsibility and dedication among

campus residents towards their surroundings [45]. The Green Campus approach fosters social innovation in plastic waste management strategies by collaborating with the Malang City Waste Bank and Micro, Small and Medium Enterprises (MSMEs) in the campus surroundings [45]. This relationship must be consistently enhanced to ensure the progressive improvement of environmental management sustainability on the UM campus.

Student participation in the trash management movement as environmental volunteers is a type of environmental education [46]. Universities must persist in promoting environmental education by urging students to develop practical plans and take concrete actions to protect their surrounding area [41-43]. This is crucial as the campus environment serves as a primary learning space where students spend a significant amount of their time [47, 48].

5. CONCLUSIONS

Based on the presentation and discussion of the research findings, it can be inferred that the plastic waste management at UM is well-planned and well implemented. The implementation of social innovation in plastic waste management has been effectively executed through the collaboration of all stakeholders. In order to enhance its implementation, it is necessary to enhance the knowledge of the individuals involved, which includes increasing the participation of Environmental Volunteers at UM. Additionally, external assistance from leaders or third parties is still crucial.

Implications for future research include the need for a more in-depth evaluation of the effectiveness of the implemented plastic waste management strategies. It is important to analyze the factors that influence the success of these social innovations. Future research could explore new methods to engage students and communities in sustainability programs, as well as assess the long-term impact of existing initiatives. Additionally, a broader study across educational institutions and communities in Indonesia could provide additional insights into the implementation of the Green Campus Model and plastic waste management in different contexts. This could help identify best practices as well as challenges that may be encountered in other locations.

ACKNOWLEDGMENT

Thank you for the research funding support provided by the Department of Research and Community Service (LPPM) of UM. Gratitude is expressed to the entire research team. The research has no intention or conflict of interest toward individuals or groups.

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