The Potential of Waste Recycling Program to Supporta Green Campus

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ABSTRACT

High volume of organic waste may decrease the quality of the environment. This research is done in order to manage organic waste recycling to support Green Campus at Universitas Pendidikan Indonesia (UPI). This exploratory and action research is carried out at the Botanical Garden UPI, within four months. Participants including lecturers (3), students (30) and non-academic staffs (4) contributed in waste recycling programs. These programs of recycled organic waste produced dried maggot, liquid fertilizer, organic compost and eco-enzyme. Organic waste were collected from FPMIPA UPI as a pilot project. The results showed that 1 kg of fresh organic waste produced 4 liter of eco-enzyme (within
3 months), 1 kg of organic waste produced 2 liter of liquid fertilizer (within 1 month), 1 kg of organic waste produced 0.5 kg of organic compost (within 1 month) and 4 kg of organic waste produced 1 kg of dried maggot (within 2 month). Therefore, 2 kg of organicwaste produced daily from one Faculty (1500 stakeholders civitas academy) may be not be an environmental problem. However the understanding and awareness of environmental education in practices is still low among the students. It is suggested, that promotion and socialization of environmental practices and regulation policy in high level of awareness are implemented, in order to support Green Campus.

Keywords: *green campus, organic waste, environmental practice*

1. INTRODUCTION

Global environmental issues have become a main topic throughout the world. As a result, governments, communities, and other sectors of civil society are increasingly concerned with anticipating the future effects of global warming. Therefore, campus which is a place to improve the quality of education for the younger generation, should participate in doing an action to reduceenvironmental problems. Also, Universities should be a role model in implementing environmentally friendly elements in every aspect, namely increasing awareness of issues of sustainability, change and social action.

This program was initiated by UI Green Metric. UI Green Metric refers to three main criteria that are used as measurement aspects, namely Environment, Economy, and Social. Environmental aspects include the use of natural resources, environmental management, and pollution prevention. Economic aspects include profits and cost savings. And social aspects include education, community, and social involvement. Green Metric parameters include transportation, water use, waste management, governance & infrastructure, energy & climate change, and education. Green campus is a holistic approach to ensure sustainability through its internal as well as external activities within the

higher education community [1] and may contribute Green Metric UI. This concept incorporate teachers, students and non- academic staffs in improving energy efficiency, conserving resources, enhancing environmental quality including habitat preservation, healthy living environment, use of renewable energy and management of wastes water recycling. One of the sustainable development goals that initiated by the United Nations from 2005 to 2030 focuses on the agenda of preventing and organizing climate action change and grow affordable

and clean energy (https://www.undp.org/sustainable-development-goals). All countries without exception

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including Indonesia are responsible for the realization of these goals. The green campus program of UPI is a program that encourages students and lecturers to play a role and support the achievement of sustainable development goals. The UPI is located in Bandung, West Java at 6.8 ºLS107.59E, with an altitude of + 920 asl. Geographically, the location of UPI is favorable for the formation of a macroclimate, which has an annual average temperature in the range of 18-28°C. It has a total land area of around 67 ha, with an area in general of 30% providing open space opportunities covering 70% of the area. Furthermore, to maintain a conducive microclimate of the area there are botanical gardens, Isola gardens, other Faculty parks, green open spaces in the form of clusters, green-belts for pedestrian paths to support the creation of healthy low emission areas. The Botanical Garden as the center of the campus eco-system at FPMIPA, Department of Biology Education, is one of the Natural Resources Conservation. This paper broadly discusses the implementation of green campus in UPI. In this study, organic waste recycled was the main activities to support green campus. It is hoped that the awareness of the academic community regarding knowledge, understanding and support in implementing a green campus can be achieved even though it requires a long period of time. In the future, university responds or deals with sustainability issues, will then become recommendations for implementation through policies, actions, and communications.

2. METHODS

First, This study is a combination of exploratory and action research is carried out at the Botanical Garden UPI, within four months. Participants including lecturers (3), students (30) and non-academic staffs (4) contributed in this research. The action research were four organic waste recycled (Fig.1): dried maggot, liquid fertilizer, organic compost and eco-enzyme. The organic wastes were collected from FPMIPA UPI. Field observations during recycled process were done, in order to identify the constraint this program. The following is the process of each organic waste recycled.

A. Dried maggot (1a)

There are some alternatives to use dried maggot as food alternative. Fistly, it can be used directly and give to fish as a meal. Dried maggot can be an alternative animal feed because of its economical, environmentally friendly, easy to mass produce and it is easy to transport and pack them. This way could increase the selling price. The procedure is clean it twice in a flowing water and afterward soak maggot in hot water. Wait until it dry, so maggot can be inserted to an oven or roasted at 40^{O}C for 45 minutes. When it is done, then packed it. It can be modified as maggot flour and maggot pellets for animal feed.

B. Liquid compost (1b)

It is a compost that contain high rich of Nitrogen and Carbon. Chopping vegetable waste/fruits is destroyed using a blender with the addition of water with a ratio of 1: 1. After smooth then put into the fermentor with a molase patch of 10% V/V and bioactivator 2-3% V/V. Then the solution is stirred until the homogeneous and closed. Furthermore, it is fermented for 21-30 days until a thick liquid is obtained, pH range of 4-6 and a distinctive aroma of fruit/vegetable liquid fertilizer .

The final process after obtaining the standard liquid fertilizer is filtered using a cloth to separate the fruit pulp. Indicators of the success of making liquid organic fertilizer with the fermentation process is characterized by the presence of a white layer on the surface, a distinctive odor (fruit/vegetables), and the color changes from green to brown and the resulting of liquid compost is brownish yellow. The white layer on the surface of the fertilizer is an *actinomycetes*, which is a type of microbial that grows after the formation of liquid fertilizer.

C. Organic compost (1c)

It is a pile of organic waste that over time breaks down or decomposes into a nutrient rich soil. This materials contain a nitrogen and carbon. The compost pile is made of a mixture of organic materials like garden trimmings, dry leaves, left food, rotten fruit and vegetable. The composition of soil: organic materials : molase: bioactivator is 10:10:1: 0.001. This decomposition process took 1-3 months. This process is carried out using 5 bag composters (volume 200 Liter).

D. Eco-enzyme (1d)

It is a complex solution produced from the mixture and fermentation of sugar molase, fresh organic waste (fruit and vegetable peels), and water with the ratio 1:3:10. Eco-enzyme was first developed by Dr. Rosukon Poompanvong, a founder of the Thai Organic Farming Association who has been researching since the 1980s. Eco- enzymes were introduced more widely by Dr. Joean Oon, a Naturopathy researcher from Penang, Malaysia. This fermentation is taken for 3 months. A white mold formation was observed on the top surface of the solution. After the fermentation process, it is separated and filtered. The solution of *Eco-enzyme* is dark brown and has a strong sweet and sour fermented fresh aroma. Chemical parameter of pH was measured to make sure

that acidicsolution is produced. This process is carried out using three drum containers (each with volume of 200 Liter).

Fig 1. Green campus program of organic waste recycled:

Dried maggot, Liquid compost, Fertilized compost and Eco-enzyme To support this green campus project, three posters are put up around strategies area at FPMIPA UPI. The posters are written like this: (a) Support the sustainability of Green Campusand Zero Waste Activities at the Botanical Gardens of the Department of Biology Education, The recycling cycle of organic waste generated from activities at FPMIPA to achieve Zero Waste through Compost, Eco-enzyme, Dried maggot, Biogas, and Liquid Compost; (b) No leftover, order enough food please; (c) Say no plastic bottle; and (d) Recognise your trash, disposed based its type.

3. RESULT AND DISCUSSION

In order to support the implementation of a more focused conservation programs at UPI. After 2-4 months, recycled organic waste produced dried maggot, liquid fertilizer, organic compost and eco-enzyme (Diagram 1). The results showed that 4 kg of organic waste produced 1 kg of dried maggot (within 2 month), 1 kg of organic waste produced 2 liter of liquid compost (within 2 month), 1 kg of organic waste produced 0.5 kg of fertilized compost (within 2 month) and 1 kg of fresh organic waste produced 4 liter of eco-enzym (within 3 months). Therefore 2 kg of organic waste produced daily from one Faculty (FPMIPA) (1500 civitas academy).

A. Recycled Organic Wastes

Four recycled organic wastes had different management and need observation. Dried maggot requires daily feed observation. And need organic ingredients from the kitchen every day/2 days. The bioconversion method is believed to be an appropriate solution, environmentally friendly and lively in recycling organic waste. And the dried maggot is one that can be used to do this. Bioconversion is a method of converting organic waste into a source of methane tons of organic waste in just two to three weeks using around 750 kg of maggot. Miraculously, BSF maggot is not only useful as a decomposer for organic waste, but can also be given directly as a supplement, or used as a raw material mixed with other components to produce complete feed with balanced nutrition. Suitable for ornamental fish, poultry, birds, reptiles, sugar gliders, and pets such as dogs and cats. It is used as fish and other livestock feed, besides that it can also be cultivated with bright economic potential. The emergence of maggot as a prime candidate for alternative raw materials for the

Fig. 2. Program of green campus recycled organic waste produced dried maggot, liquid compost, fertilized compost and eco-enzyme manufacture of fish feed, because Maggot meets the criteria needed for the manufacture of fish feed. This means that the components needed to make fish feed that contain good nutrition can be obtained from Maggot. Apart from that, Maggot is also considered to have potential because it is easy to obtain, process, and can be reached by the wider community at a low price. Meanwhile, the component in question is protein which is the main need for fish and can be obtained from fish feed. One of the feed nutrients that plays an important role in fish growth is protein. The quality of protein is highly dependent on its ease of digestion and the biological value determined by the amino acids that make it up.

The more complete the amino acid content, the better the quality of the protein. Before maggot emerged as a prime candidate, fish feed manufacturers had to work hard to provide good and quality products with high protein content. However, these efforts resulted in the price consequences of these fish feed products being expensive, because raw materials with high protein had to be imported.

Liquid compost requires initial treatment. Various organic waste leftover food, vegetables and fruits were collected from the UPI canteen (especially FPMIPA), then added EM4 (Effective Microorganism) activator and liquid molasses. For further fermentation is carried out for 21-30 days in a simple digester. Liquid fertilizer that has been fermented for 30 days is characterized by a distinctive aroma of fruits and

vegetables, a pH between 4-5 and a brown color. The final process liquid fertilizer packaged in 250 ml bottles.

Fertilizer compost can use leftover kitchen waste and piles of leaves that have been chopped before. This was done for 1 week for garbage collection and chopp its. Leaf waste from the garden or around the FPMIPA yard in large quantities can be fulfilled for 1 week for processing in drum containers (200 liters).

Eco-enzym requires vegetable leaves and fruit peels that are fresh and clean without any decay. The need for 45 kg of fresh organic waste is very difficult to obtain in 1 day within FPMIPA.There are several ways, namely collecting fresh fruit peels from fruit traders, and leftover vegetables from the market which are carried out simultaneously in 1 day. However, if the number of volunteer workers is limited, the collection of this organic matter can be collected and put into a drum filled with molases and water, gradually over 1 week and tightly closed.

B. Field Study

During 4 months field observation in FPMIPA UPI, there are four findings have to be discussed. Firstly, mostly students were not interested in participating this green campus project. Even, there were some posters about environmental care around FPMIPA, they don't use the rubbish bin according to its intended purpose.

They throw away the rubbish in appropriate bin. The support and care from all members of the academy is still lacking in this activity, even though environmental science has been studied since high school. It showed that students behaviour in treating organic and anorganic waste is not wisely. Whatever, environmental education is not new for all students. They have learnt from school and social media. The learning method of environmental education should be improved. knowledge from the natural and social sciences and humanities is needed to understand the principles of Sustainable Development (SD), how it can be implemented, the attitudes and values that are involved and the consequences of their applications.

Education is a critical component for promoting SD and improving the capability of people to address environmental and developmental issues [2].

They can understand the principles of Education for Sustainable Development (ESD) [3]. When appropriate knowledge and skills have been acquired, learners canthen make appropriate environmental choices in their behavior [4]. Undergraduate students should have opportunities to recognize and identify more issues about SD/ESD [5]. This is an important aspect to prepare the new generation to cope with the future and its needs. Importance of the problems related to climate change and using and managing available natural resources. It specified that the main goal of SD is to improve the value of life on earth. Improving the value of life on earth suggests a change in the attitudes and behaviors of each individual toward the environment and a change in lifestyles to consider environmental issues and problems [3].

In regard to ESD at higher education levels, Agenda 21 calls for cross-disciplinary courses“which promote research and common teaching approaches on ESD” and colleges partnerships with other educational and community areas [6]. In general, the goal of ESD is to improve the knowledge of students and to develop the skills necessary for participation in development issues [7]. Therefore, education at higher education levels is critical forpromoting SD and improving the capacity to address environmental and developmental issues. According to United Nations Economic Commission for Europe [8],

education is a precondition for SD because it advances and supports the aptitude of assessing and making preferences for SD of individuals, groups, associations, institutions and countries. Changing the aspects of individuals makes our world healthier, more comfortable and less harmful. As a result,the quality of life will improve. However, each canteen at FPMIPA has separated organic and organic waste making its easy to use in recycling waste.

CONCLUSION

UPI with its commitment to become a conservation-minded university should develops programs to support for the performance of entire academic community while preserving the environment. The improvement in environmental awareness of human resources is also a concern and becomes a sustainable new culture.

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