Economic Value from the Household Environment Using EM4 Addition of Compost Solid Fertilizer in Banda Aceh

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Abstract. As population is growing in Banda Aceh city, the waste generation rate also increasing. Therefore, there is an effort to overcome this alarming increasing rate of waste generation. This study intends to find out whether the leaves around the households in the Banda Aceh region can be made into solid compost with the addition of EM4 to meet the C/N ratio. Preparation of solid compost fertilizer that comes from household environment uses raw materials of vegetable residues in the form of cassava leaves and stems, water spinach leaves and stems, spinach leaves, papaya skin, mulberry leaves, rimbang nuts, dried leaves fermented using microorganism 4 (EM4). The nutrient content of solid compost fertilizer has met the minimum technical requirements of organic solid fertilizer so that it can serve as business opportunity in Aceh. Thus, the element C/N ratio of 10 indicates that it meets the minimum standards.

Keywords: EM4, compost fertilizer, organic solid waste

1. Introduction

The growing population of Banda Aceh City over the last 5 years has apparently been in line with the increasing waste generation in Banda Aceh City [1,2]. Therefore, there is an effort to overcome the increasing waste generation. Composting is one way to reduce the waste produced by household. Law No.18 Year 2008 states that household waste is garbage derived from daily household activities, excluding stools and specific waste (waste containing toxic materials) [3]. The type of waste that can decompose is organic waste, also called wet waste, such as food and leaf blowing [4]. Composting is necessary because it is a process of degrading organic matter by microorganisms and organisms under controlled conditions into materials such as stable humus [5]. Utilization of organic waste into compost can reduce the burden of the environment. In addition, the sorting results can reduce waste generation and generate compost fertilizer which can also be sold or managed so as to increase household income [6].

The people of Banda Aceh generally reduce solid waste such as food scraps, plastics, paper, leaves, and others by burning or disposing them directly to landfills. Burning waste is considered not good because the smoke from the burning process will cause air pollution and eventually damage the human respiratory system. Meanwhile, when made compost, then the manufacturing process takes about 6 months [7].

Efforts to shorten the time of composting can be done by adding Microorganism 4 (EM4). EM4 was first discovered by prof. Terou Higa from Japan's Ryukyus University. The solution contains numerous fermented microorganisms that can work effectively in the fermentation of organic matter. However in urban areas EM4 use for waste management has not been widely used [8]. The benefits of this study are
as follows: 1) It can provide knowledge about compost fertilizer generating from household environment in Banda Aceh City by adding microorganism 4 (EM4), 2) It is an effort to support the concept of sustainable development that is environmentally sound, 3) Composted solid fertilizer produced by households can open business opportunities.

1.1. Problem Formulation
Does the leaves around the households in the Banda Aceh region meet the C/N ratio elements if liquid compost is made with the addition of EM4?

1.2. The Research Purpose
The purpose of this study is to find out if the leaves around the households in the Banda Aceh region are made of solid compost with the addition of EM4 to meet the C/N ratio or not.

2. Experimental Method
2.1. The Location to produce Compost Fertilizer
Implementation of composting that comes from the household environment in the form of organic waste was done in the yard of the resident's house on Jl. Nyak Moebin No.92, Kota Banda Aceh. Meanwhile, the execution time lasted for a month and laboratory tests in Baristand lasted for a month as well. Thus, the length of labor to get the results of laboratory tests was two months along February-March in 2018.

2.2. Components of Solid Compost Fertilizers
Preparation of solid compost fertilizer that comes from household environment uses raw materials of vegetable residues in the form of cassava leaves and stems, water spinach leaves and stems, spinach leaves, papaya skin, mulberry leaves, rimbang nuts, dried leaves fermented using microorganism 4 (EM4). EM4 is a microorganism culture that can be applied as an inoculant to increase the diversity of soil microorganisms. EM4 can also be used as a starter to accelerate the decomposition process, so that the composting process can take place more quickly [9].

The comparison between dry and wet waste comparisons is 2: 1. EM4 amounts as much as 50 ml, sugar ¼ kg, and enough water. While the required equipment is a perforated trash bin, 1 meter high, a machete to smooth the raw material, black tarps 1.5 meters, the tub in which to stir organic trash, cutting wooden board as a place to chop, and 2 meter plastic strap.

When illustrated in the flow chart diagram, then the manufacture of compost fertilizer is as follows:
The success of composting fertilizer can be seen from its soft texture, blackish brown color, and sting smell like the humus forest aroma.

2.3 Preparation Procedure

The preparation procedure of making solid compost are as follows: 1) Cutting organic waste for 1cm on the cutting board until it becomes smooth, 2) Prepare 2 liters of water and mix with EM4, insert sugar, and then dissolve, 3) Enter the wet and dried garbage that has been chopped into the tub; then mix them with the water solution until they are well mixed, so that all the waste are exposed to the solution, 4) After being well mixed, put into the trash that has been perforated using a drill, 5) Cover tightly with tarp and wrap with plastic. The purpose of being put into a tightly closed tub is to have a good fermentation of the compost, 6) Within a month, the organic waste will be destroyed evenly indicating that the temperature or heating on the organic waste has been appropriate, 7) Sift the garbage and put it in plastic to take to the laboratory, 8) Plants need macro nutrients in the form of nutrients Nitrogen (N), Phosphor (P), and Calium (K) in large quantities. Nitrogen, an important component of chlorophyll, nucleotides, nucleic acids, amino acids, acts to stimulate overall plant growth, especially in the leaves and stems, branches, and stems. The element P plays a role in stimulating sapling formation, root development, and accelerating flowering, and cooking. Meanwhile, the element K serves to process the formation of carbohydrates and proteins that can strengthen roots, stems, leaves, flowers and fruit apart from overcoming drought [10], so the eight step to conduct an analysis of C, N, P, K and C/N ratios in the Baristand laboratory, Banda Aceh.
3.0 Result And Discussion

3.1 The components of Compost Solid Fertilizer

The results of the test on solid compost fertilizer are shown on the table of compost test of organic solid compost of household waste in table 1.

| Table 1. Compost Solid Fertilizer |
|-----------------------------------|
| No | Components | Test Result Compost Solid (%) |
|---|------------|-------------------------------|
| 1 | N | 3.00 |
| 2 | P | 0.60 |
| 3 | K | 1.49 |
| 4 | C | 25.02 |
| 5 | C/N | 10.00 |

*Resource: Lab. Baristand Aceh, 2018*

Minister of Agriculture Regulation No. 70/Permentan /sr.140/10/2011 on organic fertilizers, biological fertilizers and enhancers states that the minimum technical requirements of minimal organic fertilizer for macro nutrients (N + P + K) are at least 4 (Table 2, Minimum Technical Requirements of Organic Solid Fertilizers) [11]. Meanwhile, in Table 1, the test result shows that macro nutrient is 5.09%, so that the solid compost fertilizer that comes from household waste in this research can be said to have fulfilled the minimum requirement of organic solid fertilizer, while the organic C element is at least 15% where in Table 1 the results show a value of 25.02.

| Table 2. Minimum Technical Requirements of Organic Solid Fertilizers |
|----------------------------------------------------------|
| No | Parameter | Unit | Competency Standard |
|----|-----------|------|---------------------|
|    |           |      | Granule / Pellet    | Crumb / Crude |
|    |           |      | Pure | Enriched microbes | Pure | Enriched microbes |
| 1. | C – organic | % | min 15 | min 15 | min 15 | min 15 |
| 2. | C/N ratio | % | 15-25 | 15-25 | 15-25 | 15-25 |
| 3. | Accompanied Ingredients | % | max 2 | max 2 | max 2 | max 2 |
|    | (Plastic, glass, gravel) | | | | | |
| 4. | Water Level | % | 8-20 | 10-25 | 15-25 | 15-25 |
| 5. | Heavy metal: | ppm | max 10 | max 10 | max 10 | max 10 |
|    | As | | max 1 | max 1 | max 1 | max 1 |
|    | Hg | Ppm | Max 50 | max 50 | max 50 | max 50 |
|    | Pb | Ppm | max 2 | max 2 | max 2 | max 2 |
| 6. | pH | | 4-9 | 4-9 | 4-9 | 4-9 |
| 7. | Macro Elements | % | min 4 | | | |
|    | (N+P2O5+K2O) | | | | | |

*Source: Minister of Agriculture Regulation No.70/Permentan/sr.140 /10/2011*
For the C/N ratio, according to the results of the discussion of the experts within Puslitbangtanak, Directorate of Fertilizers and Pesticides, IPB of the Department of Soil, Disperindag, and the Fertilizer and User Entrepreneurs Association in table 3, it is agreed that the minimum standard for C/N ratio is 10-25. C/N ratio is one of the parameters used to determine the quality of compost for the mammers that regulated by the Peraturan Menteri Pertanian (Permentan) and Standard Nasional Indonesia (SNI). It means that the value of test result of 10 meets the minimum standards.

Table 3. Minimum Technical Requirement of Organic Solid Fertilizer

| No | Parameter                                      | Solid  | Liquid |
|----|-----------------------------------------------|--------|--------|
| 1  | C-organic (%)                                 | ≥ 12   | ≥ 4.5  |
| 2  | C/N ratio                                     | 10-25  | -      |
| 3  | Accompanied Ingredients %                     | ≤ 2    | -      |
|    | (Plastic, glass, gravel)                      |        |        |
| 4  | Water Level (%)                               | 4-12   | -      |
|    | - Granule                                     |        |        |
|    | - Crude                                       | 13-20  | -      |
| 5  | Level of heavy metal                          |        |        |
|    | As (ppm)                                      | ≤ 10   | ≤ 10   |
|    | Hg (ppm)                                      | ≤ 1    | ≤ 1    |
|    | Pb (ppm)                                      | ≤ 50   | ≤ 50   |
|    | Cd (ppm)                                      | ≤ 10   | ≤ 10   |
| 6  | pH                                           | 4-8    | 4-8    |
| 7  | Total Level                                   |        |        |
|    | - P2O5 (%)                                    | < 5    | < 5    |
|    | - K2O (%)                                     | < 5    | < 5    |
| 8  | Pathogen Microbe                              | Stated | Stated |
|    | (Ecoli, Salmonella)                           |        |        |
| 9  | Macro Elements (%)                            |        |        |
|    | Zn, Cu, Mn                                    | Max 0.500 | Max 0.2500 |
|    | Co                                            | Max 0.002 | Max 0.0005 |
|    | B                                             | Max 0.250 | Max 0.1250 |
|    | Mo                                            | Max 0.001 | Max 0.0010 |
|    | Fe                                            | Max 0.400 | Max 0.0400 |

Source: The results of the discussion of Puslitbangtanak experts, Directorate of Fertilizers and Pesticides, IPB Department of Land, Disperindag, and the Association of Fertilizers and Users Entrepreneurs.

3.2 Development Potential of Compost Solid Fertilizer

Based on the results of solid compost test conducted, the organic compost fertilizer can be said to have economic value. The selling price of organic solid compost in Banda Aceh City can be seen in table 4.

Table 4. Selling price of organic solid compost in Banda Aceh City

| No | Stores/garden         | Price 4 kg (Rp) | Price/kg (Rp) |
|----|-----------------------|-----------------|---------------|
| 1  | Taman Sari Garden     | 10.000/4kg      | 2.500,-       |
| 2  | Lilywandy Nursery Garden | 13.000/4kg   | 3.250,-       |
| 3  | Flowers Garden        | 15.000/4kg      | 3.750,-       |
| 4  | Usaha Tani Store      | 14.000/4kg      | 3.500,-       |

Source: primary data, 2018.
The cheapest price of organic compost fertilizer is Rp. 10,000,-, while the highest is Rp. 15,000,- per 4 kg (per pack). The average price of organic solid compost in Banda Aceh City is Rp. 13,000 per 4 kg (per pack). If the average per kilo is Rp. 3,250,-. Dengan asumsi bahan pembuatan per 4 kg sebesar Rp. 1,000, maka keuntungan rata-rata dari seluruh sample adalah sebesar Rp. 2,250 (1,500 + 2,250 + 2,750 + 2,500 = 9,000/4 = 2,250).

All packaging of organic solid compost product sold in the market does not have the composition of N, P, K, C, C/N ratio. This is because the content of the fertilizer is not always the same in every production. In terms of color, the solid composts sold in Banda Aceh City are all blackish brown, indicating an indication of fertilizer that meets minimum standards. However, fertilizers that meet the minimum standards are not only seen from their color, but also from their components. Since all the fertilizers sold in the market are not listed as to how big the minimum content of N, P, K, C, C/N is, then the possibility of the fertilizer for not having met the minimum standards could have happened.

It is possible to get the cheapest price of the organic compost fertilizer in the plant sellers (garden) who also supply organic compost fertilizer to the Department of cleanliness of Banda Aceh. Meanwhile, at the place of the plant sellers (garden), the organic compost fertilizers are sold Rp. 15,000,- to the maximum because they make on their own. There are also the same fertilizers supplied from Medan and thus sold at the price of Rp. 13,000,-. The price is also affected by the location of the sale. In places located in the middle of the city and on the roadside or in a strategic place, then the selling price tends to be higher. In contrast to the location of sales outside the city area, the selling price is relatively cheaper. The raw material of the fertilizer also affects, but the composition of the raw material is not listed on the product packaging.

The comparison between raw materials and the price of organic compost fertilizer on the market can illustrate that this product has a promising economic potential. In addition, sustainable economic development with environmental insight is a good concept, because maintaining the environment and cleanliness and also doing waste management properly, one of which is to utilize compost from household waste actually has benefits received by the local community. The execution time of this liquid compost takes one month. However, since it took a laboratory test in Baristand laboratory for one month, the total labourship to get the results was two months.

4.0 Conclusion
The nutrient content of solid compost fertilizer has met the minimum technical requirements of organic solid fertilizer so that it can serve as business opportunity in Aceh. Thus the element C/N ratio of 10 indicates that it meets the minimum standards. It means that solid compost fertilizer can be used as business opportunity for household in Aceh because has economic value as much as Rp. 2,250.

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