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VETIVER GRASS WASTE FEASIBILITY AS ADDED VALUES IN SUSTAINABLE AGRICULTURE MANAGEMENT

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Abstract

This study aims to identify the feasibility of vetiver waste and its added value in supporting sustainable agriculture management. This study also identifies pH, humidity, light intensity, and temperature levels of organic fertilizers from vetiver waste. In addition, this study also aims to determine the effect of fertilizers on soil quality around vetiver and other plants. This study used observation and interview methods for primary data collection and is supported by literature reviews as a secondary data collection method. This study focuses on the quality of fertilizer from vetiver waste, by comparing soil quality before and after the application of fertilizer. The air condition was also measured to analyse the impact of the relationship between air and soil productivity. The results of this study indicated that before and after applying the fertilizer on the soil, the average pH value of the soil is 5.0 that categorized as Moderately Acid remain the same which is categorized as a reasonable level according to the Soil Quality Index and the Standar Nasional Indonesia. In addition, the fertilizer from vetiver waste that has pH of 5.5 and 6 meets the Standar Nasional Indonesia and suitable for use on plants. Another benefits of vetiver waste are this material do not pollute the environment which is indicated by relatively good air quality (PM 10 with 37 and 32; PM 2.5 with 27 and 25; PM 1.0 with 15 and 13). In conclusion, vetiver fertilizer is a feasible to be utilize in plant cultivation and reduces the volume of agricultural waste and has an economic value (IDR 5,580,000/month).

Keywords: Agricultural, Fertilizer, Vetiver grass waste.

1. Introduction

Agricultural waste is one of the causes of environmental pollution which refers to waste that is generated from various agricultural processing products [1]. The agricultural waste consists of unprocessable and processable material. There are several components and characteristics of chemical properties produced by agricultural waste, such as nutrient content of about 3% ($N + P_2O_5 + K_2O$, dry mass) and average organic matter content of 24.9 % in vegetables [2]. Approximately, 998 tons of agricultural waste are produced annually worldwide [3]. The waste consists of animals, food processing, plant, and other waste. In Indonesia, the total organic waste reached 60 to 70% in general [4]. However, most of the waste is still underutilized and left to rot or burn openly in the field, especially in developing countries [5]. Meanwhile, a solution to overcome this problem is to reprocess the waste into fertilizer. This treatment can assist in improving soil quality by increasing the pH value of the soil, organic matter, and the total soil nitrogen content [2]. The processing of agricultural waste as organic fertilizer is one of the best solutions to maintain sustainability of agriculture. It is supported by the research conducted in Kampar District, Riau, which shows that of 40,930 tons of agricultural waste, 50% or 20,465 tons is used as organic fertilizer [6].

One of the uses of agricultural waste is the processing of organic fertilizers from vetiver plant waste (Vetiveria zizanioides). Vetiver plants have characteristics as long-lasting plants, grow in rows rapidly, and extend to a height of 1 to 2 m. This plant originates from the South and Southeast Asia region which is commonly used for aromatherapy oil, animal feed, and thatched roofs. In the 1950s, it was used for the first time in Fiji because the vetiver plant is considered as a relatively low-cost effective technology in stabilizing and conserving soil [7, 8]. The roots of the vetiver plant can grow rapidly to a depth of 3 meters in a year with rigid and stiff stems. Vetiver roots can absorb more water than other plants. This plant has a trunk-shaped similar to a sugar cane tree with a smaller size. The leaf tips of some vetiver plants have a sharp shape due to the presence of small thorns. However, the plants used for oil processing have softer tips [9]. For soil and water conservation, this plant has an ideal shape. Vetiver plants are resistant to soil moisture, soil acidity, alkalinity at pH 3.3 to 10.5, as well as extreme temperatures from 10° to 48°C in Australia [8]. This plant can also adapt to poor soil conditions such as soil containing Aluminum (Al) and Manganese (Mn) [10]. It was supported by Truong that explained if the soil in a place had a high acid content, vetiver could still grow well [11]. In addition, Cuong also believes that in dry soil or land, vetiver still contains sufficient salt. It is because the root system works well so that the salt gained is not excessive and get deeper nutrients. It is what makes vetiver can grow in various environments with different conditions and has many benefits, one of which is to absorb nitrogen and phosphorus. In other words, vetiver is a suitable plant for treating polluted water [12]. Many previous studies acknowledge the benefits of Vetiver grass, Vetiver root oil is known as one of the finest fixatives used in perfumery [13], and it also acts as a landslide disaster mitigation when planted in landslide-prone area. When planted in a row, vetiver plants form a very effective hedge for slowing and spreading water runoff, reducing soil erosion, retaining soil humidity, trapping sediment, and agricultural chemicals [14]. Vetiver root can be a heavy metal accumulator plant (phytopromediation) [15]. Unfortunately, there is no research that discusses the benefits of vetiver grass waste related to sustainable agriculture from these studies.

This study aims to identify the feasibility of vetiver waste and its added value in supporting sustainable agriculture management. This study also identifies the pH, humidity, light intensity, and temperature levels of organic fertilizers from vetiver waste processing as well as to discover the effect of fertilizers on soil quality around vetiver plants and other plants. This study used observation and interview methods for primary data collection and is supported by literature reviews as a secondary data collection method.

2. Method

This study used primary and secondary data as data collection method. Primary data was carried out by a direct survey to the Indosains Essential Oils Plant in Tj. Karya, Samarang District, Garut Regency, West Java, Indonesia. We also conducted interviews with the owner, factory workers, and the surrounding community. Meanwhile, the secondary data was collected by conducting literature studies from various journals and other scientific papers related to the topic. We used descriptive-quantitative methods by providing descriptions and observations in the field, which are supported by the acquisition of values for each variable studied (pH, humidity, light intensity, and temperature of soil and fertilizer) at Tj. Karya (Fig. 1).

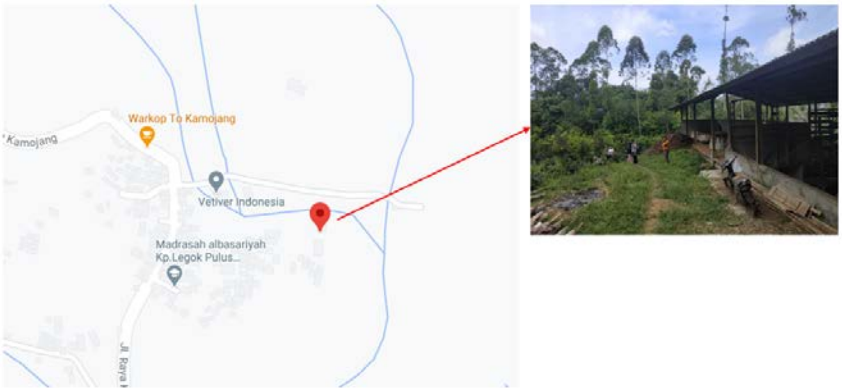

Fig. 1. Research location.

We performed analysis in the lab by measuring soil pH to determine soil conditions in the research site. The classification of soil pH classification was carried out based on the following groupings that is shown in Table 1.

Table 1. Soil pH range classification [16].

Category	Range of pH
Ultra acid	<3.5
Extreme acid	3.5- 4.4
Very strong acid	4.5- 5.0
Strong acid	5.1- 5.5
Moderate acid	5.6- 6.0
Sight acid	6.1- 6.5
Neutral	6.6- 7.3
Slightly alkaline	7.4- 7.8
Moderately alkaline	7.9- 8.4
Strongly alkaline	8.5- 9.0
Very strong alkaline	>9.0

As for the classification of light intensity in the soil, it was determined using a 4 in 1 Digital Soil Survey Instrument with the determinations as can be seen in Table 2 below:

Table 2. Interpret environment sunlight intensity [16].

⇒						**Increase in amount and quality of light**		
Low-	Low	Low+	Nor-	Nor	Nor+	High-	High	High+
Very	Low	Much	Slighty	Normal	Slighty	Much	High	very
0-200 LUX			>200-1000 LUX			>1000-2000 LUX		

As for the classification of soil humidity, it was determined using a 4 in 1 Digital Soil Survey Instrument with the indicators as can be seen in Table 3 below:

Table 3. Interpret environment sunlight intensity [16].

⇒			**Increase in Wetness**	
Dry+	Dry	Nor	Wet	Wet+
Very dry	Dry	Normal	Wet	Very Wet
1-3		>3-8	>8-10	

3. Results and Discussion

3.1. Quality standard of vetiver fertilizer

Based on the Standar Nasional Indonesia (SNI 7763-2018) stated in the Regulation of Ministry of Agriculture, types of fertilizers based on the form are divided into two, namely solid and liquid fertilizers. Standard solid organic fertilizers with good quality have pH values ranging from 4 to 9 and humidity content of 8 to 25% [17]. Therefore, it is known that pH value of vetiver roots decomposition before and after changing into fertilizer is different. However, it is still appropriate according to the Standar Nasional Indonesia, namely 5.5 (Moderate Acid) for vetiver roots decomposition at an early stage and 6.0 (Neutral) for vetiver roots decomposition, with dry and normal humidity.

The humidity conditions for fertilizers are classified as normal at 22°C with low light intensity. Based on these conditions, it could be classified as fertilizers in accordance with the Standar Nasional Indonesia. Therefore, organic fertilizers from the vetiver waste can help the formation of soil physical and biological properties.

Soil physical properties are influenced by the use of organic fertilizers, such as the formation of soil structure, soil pore size, water absorption capacity, and soil temperature fluctuations. In addition, the use of organic fertilizers can help to reduce the use of chemical fertilizers by 50%. Thereby, it reduces production costs and maintaining land quality [18]. However, the use of vetiver fertilizer for long-term used is not recommended. It will cause a nutrient imbalance, due to the heavy metal or other sediments that contained in organic. Therefore, it has an impact on the growth and production of plants that used the fertilizer [19] (See Table 4).

Table 4. Data collection of vetiver.

No.	Time	pH	Humidity	Temperature	Light Intensity
Semi Vetiver Fertilizer					
	10.22 AM- 10.25 AM	5.5	Normal	22°C	Low -
Vetiver Fertilizer					
	10.22 AM- 10.25 AM	6.0	Dry	27°C	Low

3.1.1. Soil quality

Good quality of soil can be measured if it has a certain pH level and temperature. Each soil has a different pH value, depending on the environment. The pH value in the soil is divided into several levels, namely Severely Acid (<3.0), Strongly Acid (3.01 - 4.0), Moderately Acid (4.01 - 5.5), Slightly Acid (5.51 - 6.8), Near Neutral (6.81 - 7.2), Slightly Alkaline (7.21 - 7.5), Moderately Alkaline (7.51 - 8.5), and Strongly Alkaline (> 8.5) [20]. In addition, soil temperature can measure soil quality in an environment. The soil temperature depends on the ratio of energy absorbed and is also influenced by air temperature variation which changes every day [21].

In Severely Acid soil conditions, nearly no plants can grow. Whereas in Strongly Acid soil, only the most acid-tolerant plants can grow. Some plants that are not tolerant of acid can grow in Moderately Acid soil depends on the level of Aluminium (Al), Manganese (Mn), and other metals that can be extracted in the soil. Meanwhile, Slightly Acid soil is optimal for the growth of many types of plants, especially those that are acid resistant. Soil with Near Neutral conditions is the most commonly used for the growth of various plants. Slightly Alkaline soil is the optimal soil for a variety of plants, except for plants that are more suitable for planting in acidic conditions. Moderately Alkaline soil is usually preferred by plants that can adapt to such conditions. Meanwhile, Strongly Alkaline soils are usually preferred by plants which are only suitable at pH levels above 8.5 [20] (See Table 5). Besides pH, another indicator of good soil is temperature. The ideal soil temperature for plants ranges from 65 to 75°F or about 18 to 24°C. It is important to check the temperature in the soil both during the day and night [22]. This temperature is ideal because the range is neither too cold nor too hot.

We conducted this research by testing the soil without fertilizer quality at 10.22 AM- 10.37 AM with three minutes difference time interval to get accurate results. The test was using 4 in 1 Soil Survey Instruments tools to measure the pH value, soil humidity, temperature, and light intensity of the soil. The results of the test are shown in Table 6.

The first test was carried out at 10.22 AM- 10.25 AM. In the first test, it is shown that the pH value is 5.5 with normal soil humidity and very low light intensity by the temperature of 22°C. The second test was carried out at 10.25 AM- 10.28 AM. In this second test, the pH value and soil humidity had the same results as the first test. However, there was an increase of 1°C in the temperature to 23°C even though the light intensity remained the same as the first test. The third test was conducted at 10.28 AM- 10.31 AM. The third test results still had the same results in pH value and soil humidity with the first and second tests. Moreover, the light intensity still had the same results with the first and second tests, but the temperature had decreased by 1°C which is 22°C. The fourth test was conducted at 10.31 AM- 10.34 AM. In the fourth test, there was a decrease of 0.5 in the pH value of the soil which made it became 5.0 with normal soil humidity. The temperature and light intensity of the fourth test had the same results as the previous test. The last test was carried out at 10.34 AM- 10.37 AM. Different from previous test results, the pH value had decreased significantly by 1.5 which made it became 3.5. The soil humidity was also changed from normal to very wet. However, the temperature and light intensity still had the same results as the third and fourth tests.

Table 5. Soil pH levels [20].

pH Level	Description
< 3.0	Severely Acid- almost no plants can grow in this environment
3.01 - 4.0	Strongly Acid- only the most acid-tolerant plants can grow in this pH range and then only if organic matter levels are high enough to mitigate high levels of extractable Al (Aluminium) and other metals
4.01- 5.5	Moderately Acid- the growth of acid intolerant plants is affected depending on levels of extractable Al (Aluminium), Mn (Manganese), and other metals
5.51- 6.8	Slightly Acid- optimum for many plant species, particularly more acid-tolerant species
6.81- 7.2	Near Neutral- optimum for many plant species except those that prefer acid soils
7.21- 7.5	Slightly Alkaline- optimum for many plant species except the plants that prefer acid soils, possible deficiencies of available P and some metals (for example, Zn (Zinc))
7.51- 8.5	Moderately Alkaline- preferred by plants adapted to this pH range, possible P (Phosphorus) and metal deficiencies
> 8.5	Strongly Alkaline- preferred by plants adapted to this pH range, possible B (Boron) and other oxyanion toxicities

Table 6. The results of soil test without fertilizer.

No.	Time	pH Value	Soil Humidity	Temperature	Light Intensity
1	10.22 AM - 10.25 AM	5,5	Normal	22°C	Low -
2	10.25 AM - 10.28 AM	5,5	Normal	23°C	Low -
3	10.28 AM - 10.31 AM	5,5	Normal	22°C	Low -
4	10.31 AM - 10.34 AM	5,0	Normal	22°C	Low -
5	10.34 AM - 10.37 AM	3,5	Wet +	22°C	Low -

From the results of the soil test without fertilizer, the average pH value of the soil is 5.0 with normal soil humidity and very low light intensity by the average temperature of 22.2°C. Therefore, the soil quality that we studied is in the category of Moderately Acid because the average pH value is 5.0. The temperature on the soil is classified as ideal because the average temperature is 22.2°C. Even though it is a type of soil that tends to be acidic, vetiver can withstand extreme conditions.

3.1.2. Fertilized soil quality

Most of the agricultural land in Indonesia has degraded and decreased land productivity. It has resulted in a decrease of fertilizers use, especially organic fertilizers in Indonesia. Each type of fertilizer has its advantages and disadvantages. The role of organic fertilizers is considered quite important. This is because organic fertilizers have an important role in restoring chemical, physical, and biological soil [23]. One of the differences between liquid and solid organic fertilizers is shown from the shape. However, liquid fertilizers are considered more dangerous because of the large number of heavy metals and phenolic acids that can pollute the environment [24]. Therefore, this study used solid organic fertilizers.

In addition, the pH value in fertilizers also indirectly affects plant growth. This is because excessive use of fertilizers can affect the acidity of the soil in line with the acidity of the fertilizer [25]. Referring to SNI 19-7030-2004, the acidity level of a good fertilizer is at a neutral pH, namely in the pH value range from 4 to 8 [26]. The pH imbalance causes a number of problems for plants ranging from poisoning to nutrient deficiencies. Soil that has a low pH level can interfere with plant growth because it causes these plants to experience iron poisoning such as a huge amount of Al or Mn [27]. Meanwhile, a high pH level in soil generally contains lower P and micronutrients, which causes malnutrition in plants [28]. The pH imbalance can also disturb the microorganisms in the soil such as nitrifying bacteria and earthworms.

In this study, observations were made by identifying soil characteristics in three different locations within three minutes in order to get accurate results. The tools we used to measure pH value, soil humidity, temperature, and light intensity is 4 in 1 Soil Survey Instruments. The results of these observations are shown in Table 7.

Table 7. Results of soil observations.

No.	Time	pH	Soil Humidity	Temperature	Light Intensity
1	10.22 AM- 10.25 AM	6.5	Dry +	26°C	Low -
2	10.25 AM- 10.28 AM	6.5	Dry wet +	25°C	Low -
3	10.28 AM- 10.31 AM	6.0	Dry	25°C	Low -
4	10.31 AM- 10.34 AM	5.0	Wet	27°C	Low +
5	10.34 AM- 10.37 AM	5.5	Normal	26°C	Low +

The first tests were conducted at 10.22 AM - 10.25 AM at the Tj. Karya, Kec. Samarang, Garut Regency, West Java, Indonesia. It showed that the pH level in the soil fertilized with vetiver root was 6.5 with very dry soil humidity. The results from the first test also showed a relatively low light intensity level with a temperature of 26℃. The second test was carried out at 10.25 AM - 10.28 AM. In the second test, the pH of the vetiver fertilizer had the same results as the first test, namely 6.5 with dry wet soil humidity. The temperature at the second test has decreased to 25℃ with the same light intensity level as the first test. In the third time interval, 10.28 AM - 10.31 AM, the pH contained in the vetiver fertilizer decreased to 6.0 and the soil humidity was dry. There was no difference in the results of the temperature and light intensity level at the second and third tests. At the fourth test (10.31 AM -10.34 AM), there were changes in temperature and light intensity levels. The temperature was the highest with 27 ℃ and high light intensity level. The difference can also be seen in the pH and soil humidity, namely 5.0 and relatively wet soil humidity. The fifth test was conducted at 10.34 AM - 10.37 AM. At this time, there was an increase in pH to 5.5 with soil humidity at a normal level. The temperature at the last test had decreased by 1℃ to 26℃. Meanwhile, the light intensity level is still high.

From these observations, the use of fertilizers did not significantly change soil conditions in the short-term. In addition, the average pH level of the fertilizers used is at an acidity level of 5 indicating that it is still at a reasonable level according to the Standar Nasional Indonesia [26].

3.2. Air measurement

Air measurements in this study were carried out in two different locations, namely vetiver waste and vetiver plantation at 10.22 AM - 10.25 AM. The results of air measurements at two different locations are shown in Table 8. Air quality is classified into seven categories, namely very hazardous, hazardous, very unhealthy, unhealthy, unhealthy for the sensitive group, moderate, and good, which are grouped based on parameters PM 2.5, PM 1.0, Temperature Volatile Organic Compound (TVOC), and Formaldehyde (HCHO) [29].

Table 8. Air measurement.

No.	Time	Temperature	PM 10 (ug/m^3)	PM 2.5 (ug/m^3)	PM 1.0 (ug/m^3)	HCHO (ug/m^3)	(TVOC) (ug/m^3)	Humidity (%)
Location 1 (vetiver waste)								
	10.22 AM- 10.25 AM	26.7 °C	37	27	15	0.011	0.969	58
Location 2 (vetiver plantation)								
	10.22 AM- 10.25 AM	29.1 °C	32	25	13	0.011	0.758	46

The research conducted in two different locations that process vetiver waste into fertilizer. The vetiver fertilizer does not pollute the environment is shown by good air quality in both areas. In other cases, humidity is an indicator that show level of air pollution. The result of humidity measurement in both areas show that humidity levels are in ideal category which are 58% in first location and 46% in the second location. It is indicated that there is no air pollution in both location of vetiver processing. It is supported by Kurniawati stated that the higher the humidity, the higher carbon monoxide concentration [30]. Humidity is one of the important elements for humans, animals, and plants. In agriculture, humidity relatively plays a very important role in plant production. It directly affects the water relationship between plants and indirectly affects leaf growth, photosynthesis, pollination, disease occurrence, and economic outcomes. In general, the effects of humidity on agriculture are namely reducing evapotranspiration, increasing plant heat rate, affecting stomatal closure, reducing CO_2 absorption, as well as reducing the translocation effect of food and nutrient transpiration [31]. The ideal humidity levels for the environment are shown in Table 9.

Table 9. Air humidity.

Category	Humidity	Effect
Too dry	<45%	Allergy / Asthma Bacteria Virus Respiratory Infections
Ideal	45% - 65%	Safe for humans, animals, and plants
Too much humidity	>65%	Fungi Mite Bacteria

Table 9. Air humidity levels (Source: Badan Penelitian Tanaman dan Sayuran. Kementrian Pertanian. 1995)

If the humidity is less than 45%, it causes people to be susceptible to disease because the conditions are too dry for the throat and cause an itchy sensation. It also multiplies the virus quickly. Likewise, if the humidity level is more than 65%, it speeds up the growth of fungi, mites, and other bacteria on plants, animals, and humans. It results in disrupted growth and inhibits photosynthetic processes of the plant. For animals, it makes them disturbed by the presence of mites and fungi that might stick to their bodies. As for humans, it can affect the surrounding environment.

3.3. Added values from vetiver grass waste management

Vetiver has a high economic value because it can be processed into products such as essential oils. The demand and prices of essential oils have increased in the last three years. The price of essential oils in 2017 reached IDR 4,000,000 per kg. This has encouraged farmers to re-cultivate Vetiver. The largest area of vetiver production in Indonesia is in Garut. Garut accounts for 90 percent of Indonesia's vetiver production. Different from previous studies, this study focuses on waste from the production of vetiver essential oil. Vetiver grass waste consists of liquid and solid waste that has high economic value with good management. Solid waste can be used as a distillation fuel and fertilizer (Fig. 2).

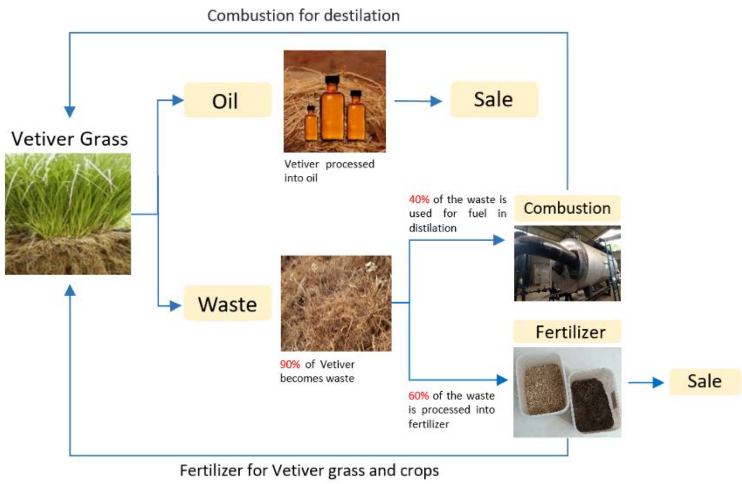

Fig. 2. Vetiver life cycle.

The distillation of Vetiver Grass yields two materials which are essential oil and waste. From the total amount of vetiver grass processed, 10% of the grass becomes essential oil which then can be sold. Meanwhile, 90% of the grass becomes the residue (waste). In addition, 60% of the waste produced from the distillation process is converted into fertilizer and the remaining 40% into fuel for the next distillation process. The fertilizer can also be used in the field or can be sold into the market.

With the increase in fertilizer prices due to the removal of fertilizer subsidies, it is difficult for farmers to provide fertilizer. For this reason, it is necessary to find alternative [32]. The vetiver waste can be one of alternative to solve the problem. Unwise and non-scientific disposal of wastes not only bring the environmental damage but also results in loss of economic value of wastes. Since organic wastes are an abundant pool of organic matter and valuable plant nutrients, agricultural recycling of these wastes can be a promising alternative enabling value addition and their resourceful utilization. Land application of organic wastes stabilized through techniques such as composting, vermicomposting and anaerobic digestion resulting excellent organic fertilizer like compost augments soil fertility and crop yield. Additionally, the practice incorporates indirect environmental benefits such as reduced greenhouse gas emissions, land conservation due to reduced landfilling of wastes and substitute to chemical fertilizers. Economically, agricultural utilization of organic wastes can reduce the cost of landfilling, transportation of wastes, imports and production cost of chemical fertilizers and opens avenues for rural employment [33].

Many researchers studied the provision of compost with the common material such as rice straw, tea waste, or sawdust [34-36]. The similarity of this research showed that it could increase N content in the soil. The high N content in the fertilizer stimulate the growth of vegetative organs. Beside this material, the vetiver grass is one of the alternatives substitutes for fertilizer that are cheap, easy to obtain and do not reduce crop production, one of which is using organic fertilizers. The results showed that vegetative growth and production of peanut plants had significant differences from each dose of ash of waste distillation used [32].

Vetiver waste can be used as an organic fertilizer that has an advantage compared to non-organic fertilizer. Organic fertilizer is very beneficial for soil fertility due to a lower nutrient content than the non-organic fertilizers, so the soil nutrients balanced, reducing the risk of poisoning substances that are absorbed by plants, and increase public awareness to manage. Organic waste has a use value [37]. Managing organic waste into organic fertilizer is not only beneficial but also has economic value. The economic value derived from such organic waste management business of organic fertilizer. Waste production experience depreciation of 40% before becomes organic fertilizer [38]. Currently, organic fertilizer has a sale value of IDR 500 per kg, calculated from the waste of vetiver essential oil extraction by Plant Essential Oils Indosains in Tj. Karya, Samarang District, Garut, the benefits that can be shown in Table 10.

Table 10. Estimation of vetiver fertilizer production in a month.

Distillation Time	Waste Production (kg)	Organic Fertilizer (kg)	Organic Fertilizer Price (IDR)
First distillation	1960 kg	1176 kg	IDR 558,000
Second distillation	1960 kg	1176 kg	IDR 558,000
Third distillation	1960 kg	1176 kg	IDR 558,000
Fourth distillation	1960 kg	1176 kg	IDR 558,000
Fifth distillation	1960 kg	1176 kg	IDR 558,000
Sixth distillation	1960 kg	1176 kg	IDR 558,000
Seventh distillation	1960 kg	1176 kg	IDR 558,000
Eighth distillation	1960 kg	1176 kg	IDR 558,000
Ninth distillation	1960 kg	1176 kg	IDR 558,000
Tenth distillation	1960 kg	1176 kg	IDR 558,000
Total	19600 kg	11760 kg	IDR 5,580,000

In a month, the factory generally conducted ten distillations. The distillation of Vetiver grass processes in amount of 1960 kg of waste is turned into 1176kg organic fertilizer. Therefore, the company produced 11760kg of fertilizer with the estimated profit of IDR 5.580.000 every month. The difference of 784kg from the pre-processed and post-processed waste is the residue from distillation. Reducing the amount of waste from 19600kg a month to 7840kg proves that managing waste into fertilizer is not only profitable economically but also good for the environment.

4. Conclusion

The results of this study found that the quality of fertilizer from Vetiver waste met Standar Nasional Indonesia for fertilizer. The pH level ranges between 5.5 and 6.0 with humidity classified as dry and normal with a temperature of 22°C in low light intensity. Meanwhile, the soil conditions in the study area were quite acidic (average pH of 5.0). Nevertheless, after the soil was given fertilizer from vetiver waste, the soil pH and physical properties did not change. However, the biological properties of the soil changed. The air quality was in the range 0 - 50 so it can be categorized as good. The first location (PM 10 with a value of 37, PM 2.5 with a value of 27, PM 1.0 with a value of 15) and location third (PM 10 with a value of 32, PM 2.5 with a value of 25, PM 1.0 with a value of 13). The management of organic waste management into fertilizer is one of the steps to create a sustainable environmental and agriculture with promising economic value as an environmentally friendly business opportunity.

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