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Potential Availability of Indigenous Resources to Reduce Agriculture Environmental Problems in Klaten, Indonesia

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***Abstract*—Inorganic fertilizer usage in high doses for rice cultivation in Indonesia has become a sustainable agriculture threat. Klaten has approximately more than 50% of the total areas were used for agricultural land. It needs a huge amount of agricultural input, especially fertilizer requirements. It is better to select a fertilizer that concerns soil conservation and is more environmentally friendly, i.e. organic fertilizer implementation, utilizing the materials to ensure its adequate availability. This research aims to identify the potential availability of organic fertilizer materials, which the farmers usually use in Klaten, and analyze how farmers' existing conditions can utilize the indigenous sources as organic fertilizer materials. This research used a descriptive method by using the data from field observation. The results showed that the potential availability of organic fertilizers in Klaten, such as Local Microorganism (MOL) of the banana hump, papaya fruit, and pineapple fruit, are 24,493.55 liters per year. They can cover about 979,742 ha paddy field area; Plant Growth Promoting Rhizobacteria (PGPR) of the bamboo root is 210,290 liters per year, and it can cover about 8,412 ha paddy field area; and animal manure composted of cows, goats, sheep, buffaloes, horses, and chickens' dung is 101,841.91 tons per year, and it can cover about 20,368 ha paddy field area. The majority of the farmers used indigenous organic fertilizer because of their benefit for low-cost production and the ease of getting it.**

***Keywords*— Organic fertilizer; PGPR; environmental; manure; MOL.**

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I. INTRODUCTION

Modern agriculture meets several challenges, such as loss of soil fertility, climate factors fluctuating, and the increase of pests and disease attacks. Environmental Sustainability and safety of some agricultural products depend on environmentally friendly farming approaches. The application of organic fertilizer by using MOL (Local Microorganisms), PGPR (Plant Growth Promoting Rhizobacteria), and manure is necessary potential to be developed in an area to fulfill the needs of fertilizer in cropping cultivation. Even the farmers can produce it by themselves as an advantage. MOL is a liquid produced from natural ingredients as a medium to develop microorganisms that are useful for accelerating the decomposition of organic materials and for an additional nutrient to plant [1], [2].

To select a kind of fertilizer usage should pay attention to how the farmers can get the raw materials and based on homemade technology applicable to produce it. It is important to know the potential availability of a lot of materials that the farmers usually use as fertilizer raw materials. This information is very useful to them for fertilizer usage choice. The raw materials to produce MOL can be made from fruit and plant, roots, stems, and leaves. It is an easy and simple method that can be adopted by utilizing the materials near their house or obtainable in their village, which was sufficient available. By using organic fertilizer from the materials around is a better choice than inorganic fertilizer.

Banana hump is part of a banana tree that is rarely used and even a disposal matter, while inside a banana hump contains high nutrition such as 45.4% starch and 4.35% protein, it shows complete nutritional composition, such as carbohydrates, protein, water, and important minerals [3], [4]. Besides banana hump, papaya and pineapple often be used as raw materials to produce MOL. The nutrient contents in a papaya MOL are C 2.15%; N 0.18%; P 0.27%; K 0.29%; C / N ratio of 11.94 and has a pH of 5.55, even inside a papaya

fruit has carbohydrate, K, P, Mg, and Ca [5], [6]. Whereas in a pineapple (from roots, stems, leaves, and fruits), some nitrogen-fixing bacterias are related to the groups of *Azospirilium amazonense*, *Azospirilium lipoferum*, *Burkholderia sp*. and a group similar to the genus *Herbaspirilium* [7]. Inside a pineapple, fruit contains carbohydrates, fiber, and minerals, such as K, P, Na, Ca, and Fe [8].

PGPR is the utilization of rhizosphere bacteria that can increase plant growth. The bamboo root can be used as the raw material of PGPR because inside bamboo roots, microorganisms are useful for supporting soil fertility and plant health. Inside PGPR contains *Pseudomonas*, *Bacillus*, *Pantoea*, *Stenotrophomas*, *Acinetobacter*, *Serratia,* and *Exiguobacterium*. Bacterias inside PGPR produce phytohormone and increase the nutrition that supports plant growth. PGPR has many advantages, such as biostimulant, biofertilizer, and pathogenic organisms' restraint [9] - [11].

Utilization of manure from cow, goat, sheep, buffalo, and chicken as the raw material of manure is quite potential with the principle of optimizing the nutrients content. The availability of nutrients in the soil affects nutrient content in a plant and supports plant productivity so that the addition of manure can improve soil quality. There are some advantages when manure is composted, such as increasing nutrients content, lessening C/N, and decreasing water content in the same unit. The application of animal manure compost can increase the chemical, physical and biological fertility of the soil. Composted manure has more advantages than fresh manure while improving physical qualities, such as minimizes the quantity of matter, vehicle, and distribution costs, stink, and weed seed survives [12]-[14]. This research aimed to identify the potential availability of MOL of the banana hump, papaya fruit, pineapple fruit, bamboo root PGPR, and livestock manure in Klaten and analyze how the existing conditions of farmer willing aspects of utilizing the indigenous sources as organic fertilizer materials.

II. Materials and Methods

A. Study Area

Figure 1 shows that Klaten Regency is the location of this research. It has 65,556 ha areas and mostly lowlands based on natural conditions. There are many water sources in Klaten. Guarantee of water source availability is one of the essential needs in the agriculture sector, then Klaten areas are very promising to provide farming land requirement. The statistical data describes the location of Klaten at 110°26'14"-110°47'51" S and 7°32'19"-7°48'33" E. On the north side, they are bordering Boyolali Regency, on the east side of Sukoharjo Regency, on the south side of Gunung Kidul Regency, Yogyakarta Special Region Province, and with Sleman Regency, Yogyakarta Special Region Province in the west. Klaten Regency consists of 26 subdistricts. There are three level lands in Klaten such as 1) Kemalang, Karangnongko, Jatinom, and Tulung are part of the Merapi Mountain Plain, 2) little part of Bayat and Cawas are part of Slake Lime Mountain Plain; and 3) the whole areas in Klaten are part of lowland, except a little part of Merapi Mountain Slope and Limestone Mountain [15].

B. Data Collection

This research was conducted in Klaten Regency from December 2018 - March 2019. The data were found from field observations to determine the potential of existing resources in Klaten. The secondary data collections were obtained from the agriculture and food security department office, office of environment and forest department, subdistrict offices, and the statistical office. The collected data are the production of fruit, livestock population, bamboo plant population, and regional subdistricts monograph. The author conducted interviews with 102 farmers who used organic and non-organic fertilizer to know about their current condition (knowledge, how to get indigenous sources, livestock ownership, and indigenous source utilization advantages) and fertilizer usage by using the door to door and FGD. References to many journals and literature have studied or by browsing the internet to gain more information and strengthen the analysis.

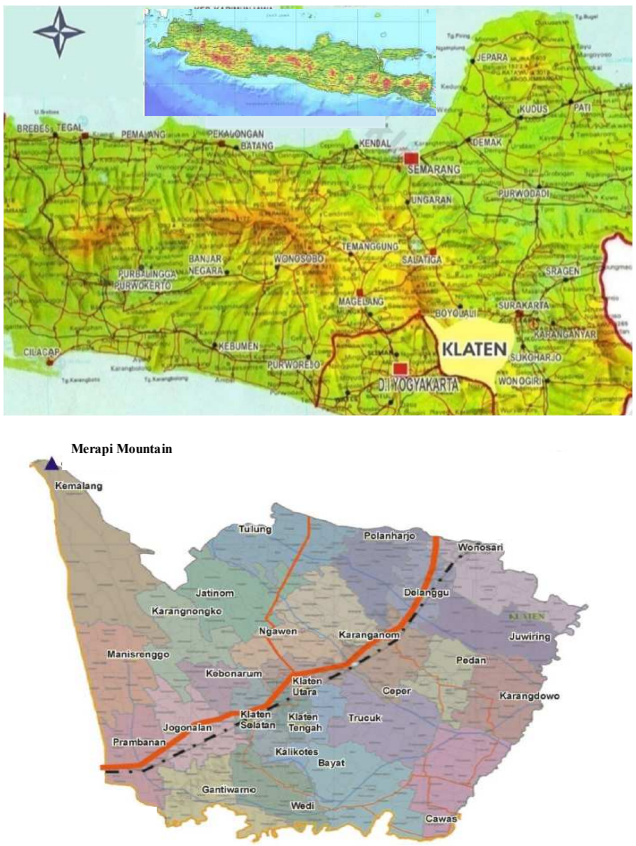

Fig. 1 Location of the research in Klaten Regency, Central Java, Indonesia. Source: [16]; [15]

C. Data Analysis

The analysis used in this study is descriptive statistics. The population of banana trees and papaya fruit and pineapple fruit productivity were calculated based on the average number per year (2014-2018) to determine the amount of potential availability of MOL. The population of bamboo trees was calculated to determine the amount of potential availability of PGPR. The population of livestock was calculated to determine the potential availability of animal manure compost.

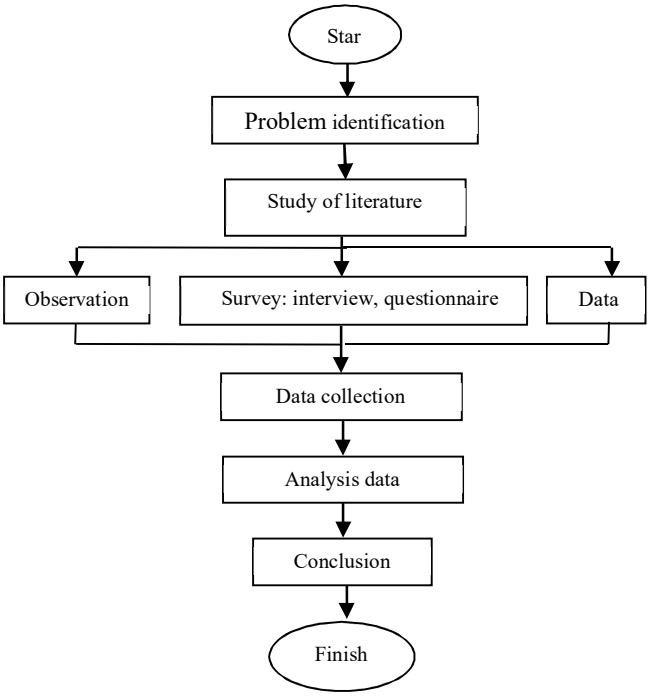

Fig. 2 Flowchart of Research Methods

Each calculation has consideration scientifically assumption to analyze the results. Figure 2 shows the steps of research methods.

III. Results and Discussion

A. Estimation of MOL and PGPR Potential Availability

The Farmers in Klaten have applied MOL by using raw materials that can be found around. The advantages of its usage are easy to get and sometimes free of charge. One of the materials is a banana hump, other kinds which often used are papaya and pineapple, but if they used fruit part as a raw material must be considered that the fruit is part of a plant that can be consumed, so it is be recommended using rotten or discarded fruit, not fresh fruit. Based on statistical data calculation, the average number of banana trees in Klaten per year is around 881,855 trees. A banana tree had a banana hump part of approximately 10 kg. So, in Klaten, it can result in around 8,818.9 tons of banana hump per year [17]. While the average annual production of papaya fruit is 3,409.8 tons, and pineapple fruit is 18.5 tons. It is better to use banana hump than papaya fruit and pineapple fruit as MOL raw materials in Klaten. Using 5 kg of a banana hump can produce nearly 10 liters of MOL [18]. Simultaneously, 1 kg of very ripe papaya obtained about 2 liters MOL [19]. Assuming that the amount of pineapple fruit need as a raw material of MOL is the same amount of papaya fruit need, in 1 kg, pineapple fruit can be obtained 2 liters of MOL. The potential availability of MOL in Klaten Regency is 24,493,550 liters per year consists of 17,637,120 liters MOL of the banana hump, 6,819,600 liters MOL of papaya fruit, and 36,833 liters MOL of pineapple fruit, as shown in Table 1.

TABLE I
THE POTENTIAL AVAILABILITY OF MOL AND PGPR IN KLATEN REGENCY PER YEAR

Subdistrict	MOL of Banana Hump (10^3 liters)	MOL of Papaya Fruit (10^3 liters)	MOL of Pineapple Fruit (103 liters)	PGPR of Bamboo Root (10^3 liters)
Prambanan	1,150.92	86.40	0	*)
Gantiwarno	558.06	39.37	0	11,100
Wedi	301.95	4,282.10	0	12,300
Bayat	1,962.20	90.23	1.30	15,500
Cawas	983.29	20.60	0	15,500
Trucuk	120.61	7.77	0	36,000
Kalikotes	408.96	32.37	0	*)
Kebonarum	19.67	9.27	0	*)
Jogonalan	615.13	158.30	0	*)
Manisrenggo	1,00917	295.23	35.53	*)
Karangnongko	2,197.91	278.63	0	20,000
Ngawen	461.66	54.97	0	*)
Ceper	92.55	47.13	0	51,790
Pedan	20.63	39.03	0	*)
Karangdowo	240.87	75.37	0	6,000
Juwiring	1,459.38	1.10	0	*)
Wonosari	551.81	101.93	0	*)
Delanggu	720.28	288.63	0	*)
Polanharjo	660.59	132.77	0	*)
Karanganom	251.34	0	0	3,000
Tulung	583.96	258.73	0	*)
Jatinom	1,284.19	123.50	0	33,600
Kemalang	1,614.74	187.00	0	*)
Klaten Selatan	160.35	4.37	0	*)
Klaten Tengah	72.47	20.43	0	*)
Klaten Utara	134.43	184.37	0	6,000
Total	17,637.12	6,819.60	36.83	210,290

*Sourced: calculated from [15]; [20]; [21]. *) Data not available*

The highest subdistrict with MOL of banana hump potential availability per year is Karangnongko. The highest subdistrict with MOL of papaya fruit potential availability per year is Wedi, and the highest subdistrict with MOL of pineapple fruit potential availability is Manisrenggo (Table I). Nevertheless, Wedi is the highest subdistrict of MOL potential availability per year (Figure 3).

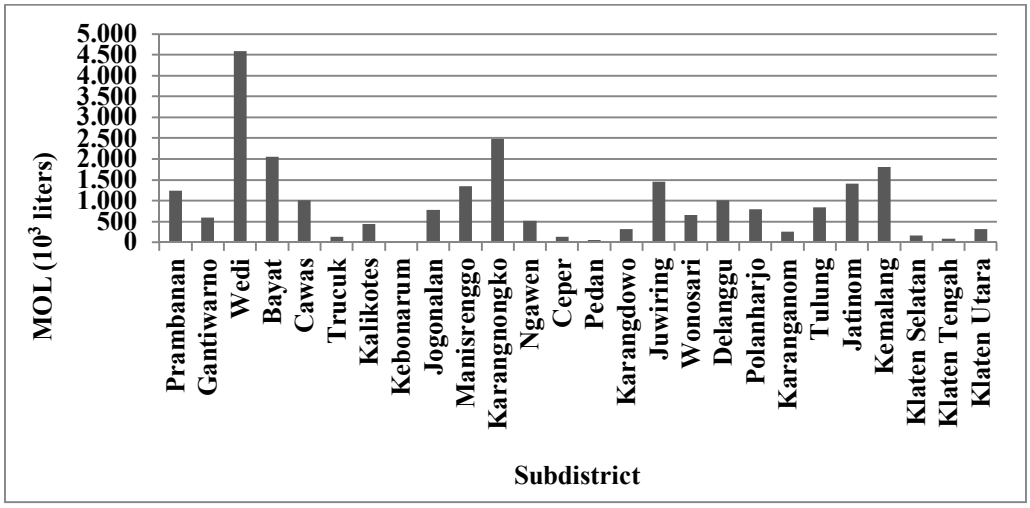

Fig. 3 Subdistrict potential availability of MOL (banana hump, papaya, and pineapple) in Klaten Regency
Source: Calculated from [15]; [21]

The bamboo root can be used as the raw material of PGPR; the farmers in Klaten usually used this bamboo root with the soil attached. Bamboo plants in Klaten are found along both sides of the river and in the yard but rarely seen in the field. Most people do not utilize bamboo roots, even waste material, and not useful. From the field, observation was found that the potential availability of bamboo trees in 10 Subdistricts consists of Jatinom, Wedi, Karangnongko, Bayat, Gantiwarno, Cawas, Karanganom, North Klaten, Trucuk, and Ceper is approximately 51.15 ha with a total population of trees is 10,230 trees. The farmers usually obtain about 0.5 kg root of one bamboo tree, and of 0.5 kg bamboo root can produce 40 liters PGPR. The potential availability of PGPR from bamboo roots in Klaten from 11 subdistricts is around 210,290 liters per year. Figure 4 shows that Ceper is the highest subdistrict of PGPR potential availability among 11 subdistricts in Klaten.

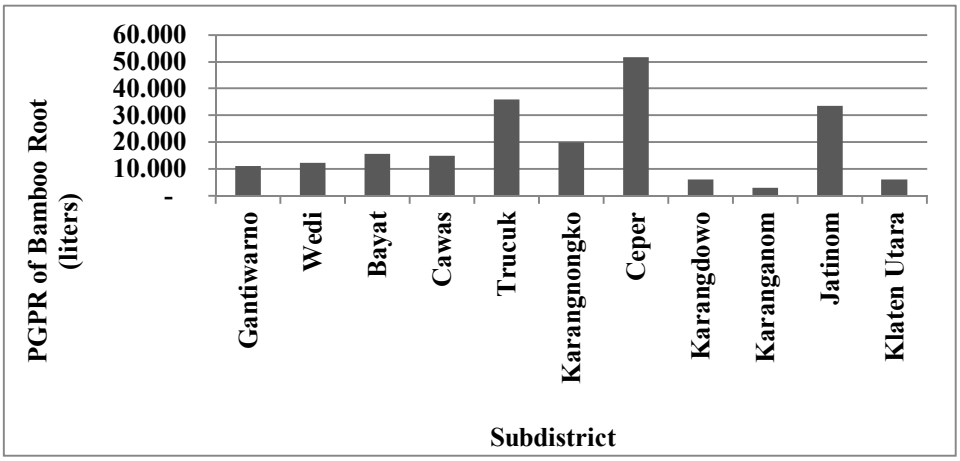

Fig. 4 Subdistrict potential availability of bamboo root PGPR in Klaten Regency
Source: Calculated from [20]

B. Estimation of Animal Manure Compost Potential Availability

The composition of nutrients found in some livestock manure such as cow, goat, sheep, buffalo, horse, and chicken. In solid form, the highest nutrient content of N is found in chicken manure, and the lowest is in cow manure, the highest P nutrient content is in chicken manure, and the weakest in cow manure, the highest K nutrient content is in sheep manure and the lowest in cow manure. Whereas in liquid form, the highest content of N nutrients is in goat manure and the lowest is in chicken and buffalo manure, the highest P nutrient content is in chicken manure, and the lowest in horse manure, the highest K nutrient content in sheep manure and the lowest is in chicken manure. Manure also produces micronutrients, such as Fe, Zn, Bo, Mn, Cu, and Mo, so manure plays an important role in maintaining crop production [22], [23]. For adult cows, buffaloes or horses can produce manure average of 3 kg per day, and goats or sheep around 1 kg per day and chickens have about 200 grams of manure per day if the manure is composted, then the assumption of the shrinkage is about 30-40% [12], so the estimation production of wet livestock manure is shown on Table II.

TABLE II
CALCULATION OF WET LIVESTOCK MANURE PRODUCTION

Kind of Livestock	Number of Livestock	Wet Livestock Manure (10^6 tons per year)	Wet Livestock Manure (kg per day of an animal)
Cow	11,107,800	12,16	2.99925
Goat	13,441,700	4,91	1.00077
Sheep	8,245,800	3,01	1.00009
Buffalo	2,572,400	2,82	3.00034
Horse	432,100	0,47	2.98003
Chicken	1,247,636,000	91,08	0.20001

Source: Calculated from [24]

There are various raw materials of manure in Klaten, from the dung of cows, goats, sheep, buffaloes, horses, and chickens. The average population of adult animals in Klaten are 47,144 cows; 46,281 goats; 23,377 sheep; 632 buffaloes; 273 horses and 2,418,615 chickens. However, cow manure is the famous option by the farmers selected as organic fertilizer material because its dung is easy to get and quickly collected. In manure contains a high concentration of organic matter, especially in the cow's stomach (rumen), some microorganisms can accelerate the composting process because the rumen is a suitable place for its breeding to produce manure from cow dung without additional probiotics [25]. Table III shows that the potential availability of composted manure in Klaten is approximately 101,841.91 tons per year.

TABLE III
POTENTIAL AVAILABILITY OF ANIMAL MANURE COMPOST IN KLATEN REGENCY

Kind of Livestock	Wet Livestock Manure (kg per day)	Animal Manure Compost	
		Wet Livestock Manure (kg per day)	Wet Livestock Manure (kg per day)
Cow	141,396.64	56,558.66	20,643.91
Goat	46,316.64	18,526.65	6,762.23
Sheep	23,379.10	9,351.64	3,413.35
Buffalo	1,896.21	758.49	276.85
Horse	813.55	325.42	118.78
Chicken	483,745.19	193,498.07	70,626.80
	Total		101,841.91

Source: Calculated from [15]

The highest subdistrict potential availability of animal manure compost per year is in Bayat, and the lowest is in Klaten Tengah (Figure 5). This is consisting of the 6 (six) kinds of animal manure compost, the highest subdistrict potential availability of cows, goats, sheep, and horses manure compost is Jatinom, the highest subdistrict potential availability of buffalo's manure compost is Polanharjo, and the highest subdistrict potential availability of chickens manure compost is Bayat.

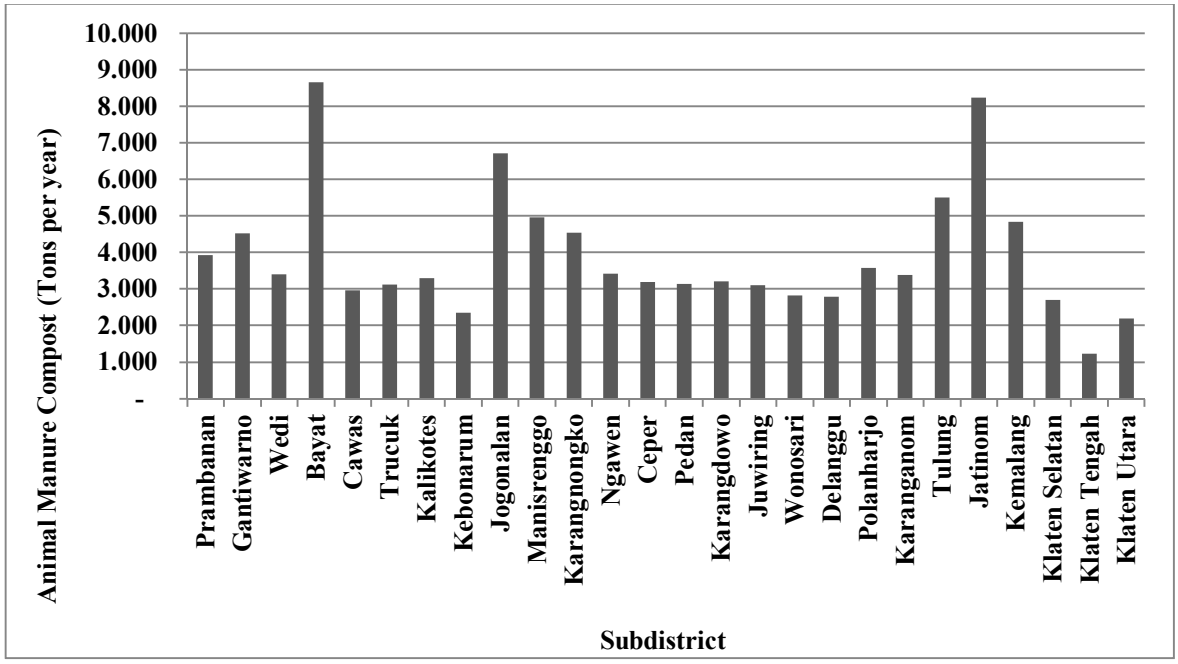

Fig. 5 Subdistrict potential availability of animal manure compost in Klaten Regency
Source: Calculated from [15]

In paddy field area, farmers in Klaten usually implement MOL and PGPR mix together with each dosage are 25 liters per ha, whereas manure compost alone dosage 5 tons per ha. Based on the potential availability estimation of each organic fertilizer in Klaten above, MOL production can cover approximately 979,742 ha paddy field area, PGPR can cover approximately 8,412 ha paddy field area and animal manure compost can cover approximately 20,368 ha paddy field area.

C. Existing Condition of the Farmer Willing Aspects to Utilize Indigenous Sources as Organic Fertilizer

As mentioned previously, the interviews were conducted to reveal how the farmers in Klaten can adopt the use of indigenous sources as organic fertilizer materials presumptive a lot of aspects that can influence them to utilize it. The first aspect is exactly on "does the farmer know about MOL and PGPR?", it is a basic factor related to how much the farmers' curiosity in the use of organic fertilizers by using indigenous

materials. Figure 6 shows the percentage of farmers known about MOL and PGPR was more than 95% for each MOL and PGPR. It shows that the farmers have basic inner capital to become more capable as needed, raising their legitimacy of knowledge flow. When they have enough experience and will be supported by their knowledge capacity, they can be grown fast and can do it by themselves.

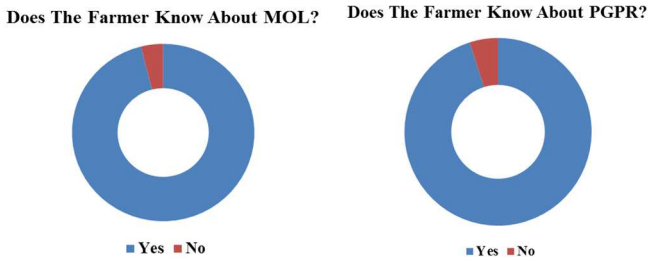

Fig. 6 The farmers' knowledge about MOL and PGPR

The second aspect is the "easy of getting indigenous sources around" if available near their house or in their villages. It can reduce their difficulty in getting the materials. It is very important to know the availability of the indigenous sources is ready and too easy to be obtained by the farmers to eliminate the negative impact of homemade organic fertilizer because of the difficulty getting the raw materials. Among the farmers who had the statement that easily available to get indigenous sources around were the majority consist of more than 50% of the farmer obtained the indigenous materials from their ownership and only 1% by buying it (Figure 7). It indicates that the availability of the indigenous sources in a sufficient amount near their house area—the raw materials availability of fertilizer influences farmers to choose organic farming systems [26].

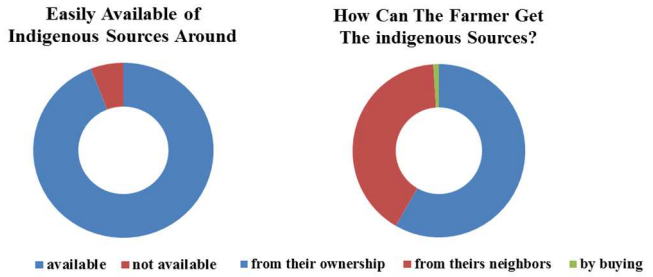

Fig. 7 The Availability of indigenous sources

The third aspect is exactly on "does the farmer have livestock farming?", it is very useful to collaborate agricultural activities with livestock waste utilization. At Klaten, the people also have livestock as their livelihood, besides as a farmer. It is a good blend activity that can support each other, in the agriculture sector can acquire the benefit from manure production of the livestock. On the other hand, the livestock farming sector can benefit from sufficient feed from the rest yield, such as paddy straw, juvenile plants, weed waste, etc. More than 50% of the farmers have livestock farming (Figure 8). It is a good prospect when the farmers can implement a livestock waste management system by utilizing it to become manure. It is related to how they can fulfill the need for manure and ensuring its sufficient availability.

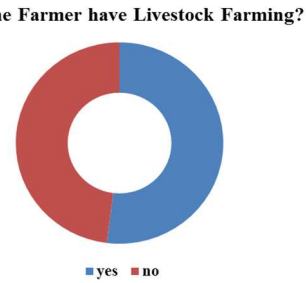

Fig. 8 Livestock farming ownership

The fourth aspect is "why they use indigenous sources as organic fertilizer materials?". For this question, a respondent can answer more than one reason depending on their assumption about the benefit of its usage. It can refer to the enthusiasm of the farmers and their hopes for the implementation of homemade indigenous organic fertilizers. The majority of the farmers used indigenous organic fertilizer because the benefit of low-cost production was the first main reason, and number two was easy to get the materials (Figure 9). It indicates that the farmers had a big problem with their farming management in the fertilizer cost production. Therefore, by using indigenous sources should be a better choice to break their problem. Based on the previous second aspect, only 1% of the farmers got the materials by buying. It implies that 99% of the materials are free of charge to reduce the production cost. The author underlines more environmental-friendly choices. It is the main factor and urgently needed for indigenous organic fertilizer applications besides other reasons. All of the farming activities should consider the quality of the environment around the land farm. It is very important to be maintained and can sustain to the future.

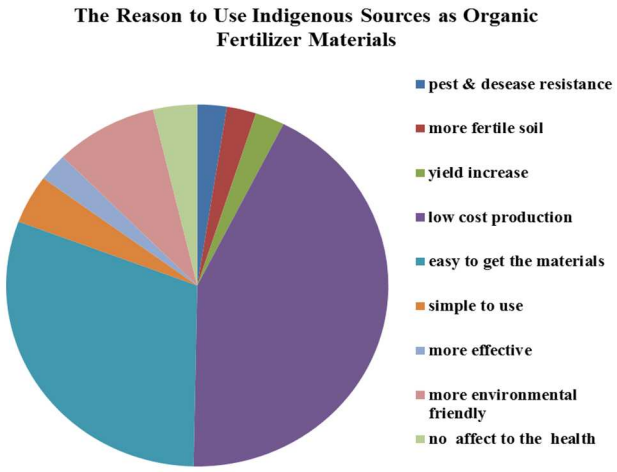

Fig. 9 The reason for the farmers to use indigenous organic fertilizer

In line with the fourth aspect above, some categories have described why the farmers are interested in implementing organic farming systems, such as indigenous ecosystem features, health protection, quality of organic products, promising cost of organic food, etc. [27]. The percentage of total income and profitability of crop farming become two of the substantial drivers' aspects of farmer choices on organic management practices adoption [28]. It indicates that indigenous organic fertilizer can support the success of

organic farming system adoption. Not only for the fertilizer usage choice but also for integrated organic farming management system application.

Each aspect is designed to deliver commonly descriptive conditions among the farmers, specifically fertilizer usage choice generated from the farming management system. The use of chemical fertilizer is very popular, but it may be decreased because of the negative impacts. It is a promising opportunity for indigenous organic fertilizer to replace chemical fertilizer needs. This transition needs time, beginning from education and promotion, integrated rural development supporting system, human capital, and homemade technology until government policy (Figure 10). The main challenge to all of the stakeholders in this effort is to ensure the availability of indigenous materials used for organic fertilizer production to gain better income for all of the farmers. It because fertilizer usage had a very significant influence on maximum plants [29]. The basic organic farming scheme is a self-sufficient function based on the natural practice of fertilizer usage [30]. Even at the household level, must increase the use of natural fertilizer amount [31]. It can be done by utilizing indigenous materials that are obtained from renewable natural resources.

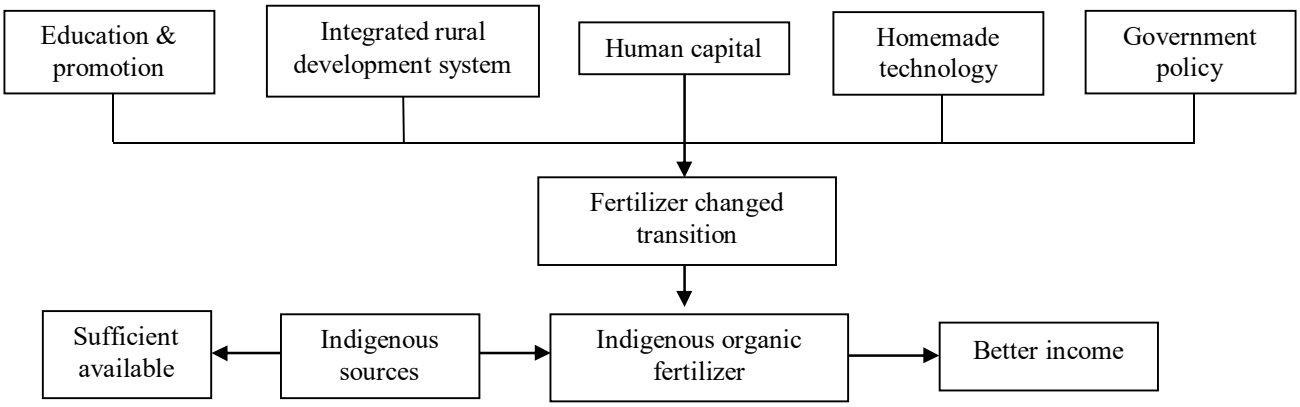

Fig. 10 The transition to indigenous organic fertilizer scheme

D. The Challenges and Opportunities of Indigenous Sources Development as Organic Fertilizer Materials

Modern agriculture is facing the sustainability of soil quality and fertility maintenance [32]. Environmental experts worried about using chemical fertilizers because it causes soil pollution and maybe also affects human health. The use of agricultural production input from non-renewable resources, such as inorganic chemical fertilizer and the continuous use of pesticides in high doses, can affect the decrease of quality and fertility of agricultural soil; even chemical fertilizer residue can decrease the quality of the soil. Today, it is time for modern agriculture to consider utilizing potential raw materials as organic fertilizer to reduce the use of inorganic fertilizer. It can maintain soil fertility and agricultural productivity and be environmentally friendly so that organic fertilizer more useful than chemical fertilizer [33] - [36].

The utilization of indigenous resources as raw materials for organic fertilizer can build a farmer's self-reliance spirit because they can produce organic fertilizer by themselves. The use of indigenous organic fertilizer is part of organic agriculture that can lessen chemical fertilizer usage [37]. Organic farming manages nutrient enhancement in system proceeds with no extra land cost [38].

Organic farming utilizes raw materials from renewable natural resources and conserves non-renewable resources. Its application minimizes the external intake of soil fertility and prioritizes the intake of organic materials using indigenous resources. The farmers are more self-reliant, and when fertilizer rarely happened, it does not affect the farmers [39], [40]. The development of organic agriculture has several significant benefits, such as increasing farmer's income, reducing external inputs cost, social capacity improvement, employment opportunities, food security growing up, and being more environmentally friendly [41].

The utilization of indigenous resources as raw materials of organic fertilizer is one way to resolve the need for inorganic fertilizer. Farmers in Klaten Regency have made their organic fertilizers by using raw materials around, such as banana hump, papaya fruit, and pineapple fruit to produce MOL, bamboo plant roots as raw material to make PGPR, and also to produce manure. The availability of the raw materials must be ensured and supported by all of the villagers and local governments to increase the plantation of those plants and livestock manure production. Then promote the technology of indigenous organic fertilizers that can affect plant growth and crop productivity enhancement.

The opportunity of indigenous organic fertilizer development in Klaten Regency is very potential by considering sufficient availability of the raw materials. The difficulties in developing a new fertilizer technology based on the experiences of biofertilizer introduction in Pakistan i.e., 1) lack of regulation, 2) lack of awareness among the farmers, 3) lack of public trust, 4) lack of promotion, 5) lack of organic matter availability the soil, and 6) lack of raw materials availability [42].

Nowadays, the number of bamboo trees is going down because land conversion used for agricultural land, plantations, and open land into logging affected the bamboo plants decreases, especially in Merapi Mount area [43]. There was a possibility of bamboo plants decrease in 4 (four) Subdistricts in part of Merapi Mountain slopes, such as

Kemalang, Karangnongko, Jatinom, and Tulung. The big potential utilization of bamboo root as PGPR raw material needs to pay attention to the bamboo plant number in Klaten.

The banana hump can be utilized as an organic fertilizer because the nutritional content in it is very useful in the vegetative growth of plants and supports disease prevention. There are microbial decomposers of organic material in banana hump at the inside and outside, such as *Bacillus sp.*, *Aeromonas sp.*, and *Aspergillus nigger*. Banana trees that have been cut off will be rotten. The banana hump will only be used as feed or seeds [44] - [46]. Banana hump with mixed materials as the raw material of MOL and analyzed N and P content in that various MOL [47]. The result indicated that the use of banana hump mix with Siam weed was the highest of N and P content, and banana hump alone was the least N and P content. The mixed material had a higher content of N and P content than the banana hump alone (Table IV).

TABLE IV
N AND P CONTENT IN MOL

MOL	Nitrogen (%)	Phosphor (ppm)
Banana hump	0.0045	176.30
Banana humpt + fruits	0.0108	159.99
Banana hump + siam weed	0.0993	514.14
Banana hump + fruits + tobacco	0.0911	436.65

Source: [47]

Table IV above indicates that there is an open opportunity to improve MOL with various materials depending on the benefit of its usage. Based on Table V, MOL of papaya waste fermented utilization for 15 days has increased the content of macronutrients (N, P, K, Ca, and Mg) and micronutrients (Fe, Zn, and Mn) higher than before fermentation [48], so it is highly recommended when making MOL prefer to be fermented first.

TABLE V
CHEMICAL AMOUNT OF PAPAYA MOL BEFORE AND AFTER FERMENTATION

Chemical Content	Papaya Waste MOL	
	Day 0	Day 15th
N(%)	0.10	0.45
P (ppm)	117.56	274.67
K (ppm)	162.45	199.16
Ca (ppm)	57.61	159.63
Mg (ppm)	54612	1,457.16
Fe (ppm)	2.21	6.50
Zn (ppm)	0.69	0.64
Mn (ppm)	1.94	2.80
pH	5.32	3.68
C-organic	16.35	13.61
C/N	16.35	30.24
BO(%)	28.18	23.46

Source: [48]

The decomposition process of the physical solid form happened through fermentation and several important elements in complex and simple compounds form are released into the fermentation solvent [3]. A manure waste is the main worry in livestock, especially for a big cattle feedlot. One solution for managing this problem is by composting the manure [14]. Based on Table VI shows the estimation of N lost between composted manure and fresh manure application to maize, composted manure had lower losses (9%) than fresh manure (23%).

TABLE VI
FATE NITROGEN

Treatment	Gross N Unaccounted for, kg ha^{-1} (1)	Nitrate in the soil profile, kg ha^{-1}	Net N un-accounted for, (lost), kg ha^{-1} (2)	N lost, % of total supplied (3)
Composted manure	15.7	2.2	13.5	9.1
Fresh manure	33.2	11.2	22.0	22.6

Source: [49]
[1]available N minus N in crop (grain and stover); [2]column 1 minus column 2; [3]column 3 divided by total nitrogen applied

Table VI above indicates that composted manure has a stronger binding of N than fresh manure [49]. Composting has progressively appraised a suitable approach for recycling the excess of manure as a steadied and sanitized end product for agriculture [50]. Therefore, it better to compost the manure than without composting, and no doubt about the solution of livestock waste by utilizing it to become organic fertilizer.

Soil fertility condition that affects plant growth is influenced by environmental factors so that it is needed to prevent agricultural land from soil pollution. Healthy and fertile agricultural land conditions will support agrarian sustainability. A sustainable agriculture system is an agriculture system that optimizes the interaction among human resources, natural resources, environment, technology, and institutions to meet the principles of sustainability, renewable and ecological diversity with the aim of human being welfare [51], [52]. The sustainable farming system will keep the balance of material and energy related to ecosystems (carbon, nitrogen, water, biota, energy, etc.) so that natural resources concern about the local wisdom approach. It can be realized by integrating several efforts, such as intensive use of resources (energy and nutrients), locally oriented, intensification of farmers' expertise, not use supporting materials excessively, diversity maintenance, and environmentally friendly [53] [54].

Beside fertilizer selection, a crop farming system needs an early detection system to prevent harvesting failure [45]. Thus, the promising approach of sustainable agriculture has to do some innovations, not only for natural resource usage but also for micro and macrofaunal supporting plant growth or as a natural predator of pests and diseases. They are earthworms, bug, spider, ant, and owls. They are not endangered for a human being, mostly consist of various insects. Alterations to the diversity of insects show a good detection of the changing ecosystem. Therefore, a healthy environment is the purpose of organic agriculture application to maintain soil fertility and the appropriate place for some useful creatures breeding. Natural surroundings have provided adequate biodiversity resources. However, the continuous use of natural resources, especially for non-renewable resources, affects the scarcity of natural resources, such as water, fossil fuels, minerals, CO_2, food, and productive land [55] - [57].

People in this world are attempting to discover technology with the environment protection approach of renewable energy resources [58]. Agriculture is closely related to the

natural environment because of its activity of natural resource exploitation in agricultural management. The intensification of agricultural activities caused our natural resources polluted. In comparison, more than 40% of the land surface in the world is for agricultural cultivation. The availability of natural resources such as water, soil and vegetation must be maintained well in every land usage [59]-[62]. The utilization of indigenous sources can be expanded not only about fertilizer usage but also about other use of farming activities based on an environmentally friendly approach.

IV. Conclusion

the importance of an environmentally friendly approach in the agricultural sector needs an effort by using an appropriate fertilizer based on local wisdom spirit and potential indigenous materials around. Organic fertilizers are one of many efforts to maintain natural resources, especially soil fertility as farming land. Using MOL of the banana hump, papaya fruit, and pineapple fruit, PGPR of bamboo root and animal manure as indigenous organic fertilizer raw materials have become an alternative solution to replace inorganic fertilizer. At Klaten Regency has potential availability of organic fertilizers, such as Local Microorganism (MOL) of the banana hump, papaya fruit, and pineapple fruit are 24,493.55 liters per year can cover approximately 979,742 ha paddy field; Plant Growth Promoting Rhizobacteria (PGPR) of the bamboo root is 210,290 liters per year can cover around 8,412 ha paddy field; and animal manure compost of cows, goats, sheep, buffaloes, horses, and chickens is 101,841.91 tons per year can cover approximately 20,368 ha paddy field. The majority of the farmers used indigenous organic fertilizer because of their benefit for low-cost production and the ease to get it. The results of this study can support further research on this topic, especially to strengthen the analysis of other indigenous sources that can be used as organic fertilizer materials and considering organic fertilizer application with the same materials that were used in this research.

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References

[1] Gopalakrishnan, S., Sathya, A., Vijayabharathi, R., Varshney, R. K., Gowda, C. L. L., and Krishnamurthy, L., "Plant growth promoting rhizobia: challenges and opportunities", 3 Biotech, vol. 5(4). pp. 355–377, 2015.

[2] Lindung, "Teknologi Mikroorganisme EM_4 dan MOL [EM_4 and MOL Microorganism Technology]," Balai Pelatihan Pertanian Jambi, Ministry of Agriculture, 2015.

[3] Suhastyo A. A., "Studi Mikrobiologi dan Sifat Kimia Mikroorganisme Lokal (MOL) yang Digunakan Pada Budidaya Padi Metode SRI (System of Rice Intensification) [Study of Microbiology and Chemical Properties of Local Microorganism that Used in Rice Cultivation of SRI Method]", Tesis. School of Graduates. Institut Pertanian Bogor, Bogor, 2011.

[4] Munadjim, "Teknologi Pengolahan Pisang [Banana Processing Technology]", Gramedia, Jakarta, 1983.

[5] Herniwati and S. H. Nanny, "Efektivitas Beberapa Mikroorganisme Lokal (MOL) sebagai Biodekomposer dalam Pengolahan Bahan Organik yang Diperkaya Zeolite [The Effectiveness of Some Local Microorganisms (MOL) as Biodecomposer in the Processing of Organic Matter with Zeolite Enriched]", Balai Pengkajian Teknologi Pertanian Sulawesi Utara, Balai Penelitian dan Pengembangan Pertanian, Ministry of Agriculture, 2014.

[6] Verheij E.W and R. E. Coronel, "Edible Fruits and Nuts, Plant Resources of Southeast Asia No. 2", Prosea Foundation, Bogor, Indonesia, 1992.

[7] Weber O. B., Baldani V. L. D., Baldani, Teixeira K. R. S., Kirchhof G., Baldani J. I. and Dobereiner J., "Isolation and characterization of diazotrophic bacteria from banana and pineapple plants", Plant Soil, vol. 210. pp. 103-113, 1999.

[8] Tee E.S., Mohd Ismail N., Mohd Nasir A., and Khatijah I., "Nutrient Composition of Malaysian Foods", ASEAN-Australia Economic Cooperation Programme, Kuala Lumpur, 1998.

[9] Bhattacharyya, P. N., and Jha, D. K., "Plant growth-promoting rhizobacteria (PGPR): Emergence in agriculture", World Journal of Microbiology and Biotechnology, vol. 28(4). pp. 1327–1350, 2012.

[10] Santosa Slamet, Edi Purwanto, Suranto, and Sajidan, "Sustainability of Organic Agriculture System by Plant Growth Promoting Rhizobacteria (PGPR)", International Conference on Science, Education, and Humanities Research (ASSEHR), vol. 247. pp. 459-464, 2018.

[11] Ryan Peter R., Yves D., Linda S. Thomashow, and David M. Weller, "Rhizosphere engineering and management for sustainable agriculture", Plant Soil, vol. 321. pp. 363-383, 2009.

[12] Hartatik Wiwik and L. R. Widowati, "Pupuk Organik dan Pupuk Hayati [Organic Fertilizer and Biofertilizer]", Balai Besar Litbang Sumberdaya Lahan Pertanian, Ministry of Agriculture, 2006. http://balittanah.litbang.pertanian.go.id/ind/dokumentasi/buku/buku%20pupuk%20hayatipupuk%20organik/04pukan_wiwik.pdf. Downloaded at 6 Februari 2020.

[13] Bachtiar, Ghulahmadi M., Melati M., Guntoro G., and Sutandi A., "Perbedaan kebutuhan nitrogen untuk produksi kedelai di tanah mineral dan mineral bergambut dengan budidaya jenuh air [The nitrogen need for soybean plants in mineral soil and peat mineral with water-saturated cultivation]", Jurnal Penelitian Pertanian Tanaman Pangan, vol. 35 (3). pp. 217-227, 2016.

[14] Schlegel A. J., "Effect of composted manure on soil chemical properties and nitrogen use by grain sorghum", Journal of Production Agriculture, vol. 5 (1). pp. 153-157, 1992.

[15] Klaten Regency in Figures 2019, Center of Statistic Agency, Klaten Regency.

[16] https://www.romadecade.org/peta-jawa/. Donloaded 25 Maret 2020.

[17] Hermawan D, "Karakteristik Fisikokimia Tepung Bonggol Pisang Kapok dan Mas dengan Cara Fermentasi Spontan [Physicochemical Characteristics of Kepok and Mas Banana Hump Flour by Spontaneous Fermentation]", Skripsi. Fakultas Teknologi Hasil Pertanian, Universitas Jember, Jember, 2012.

[18] Aini Dian N., Sugiyanto B., and Herlinawati, "Aplikasi mikroorganisme lokal bonggol pisang dan pupuk kandang kambing terhadap produksi kedelai (*Glycine max L. Merrill*) varietas Baluran [Local microorganisms application of banana hump and Goat Manure to Production of Soybean (*Glycine max L. Merrill*) Baluran varieties]", Agriprima: Journal of Applied Agricultural Sciences, vol. 1 (1). pp. 35-43, 2017.

[19] YSDK, "Bagaimana Membuat MOL dan Biopestisida [How to Make MOL and Biopesticides]", Yayasan Swadaya Dian Khatulistiwa, Kalimantan Barat, 2017. http://ysdkkalbar.org/2017/04/08/4-springtime-color-schemes-to-try-at-home/. Donloaded at 8 Februari 2020.

[20] Forest Statistic, Environment and Forestry Department, Central Java Province, 2017.

[21] Fruits and Vegetables Annual Report in Klaten 2013-2018, Agriculture Food Security and Fisheries Department of Klaten, The Ministry of Agriculture.

[22] Lingga P. and Marsono, "Petunjuk Pembuatan Pupuk [The Guidance of Fertilizer Usage]", PT Penebar Swadaya, Jakarta, 2002.

[23] Saputro D. Dwi, Burhan R. Wijaya, and Yuni W., "Pengelolaan limbah peternakan sapi untuk meningkatkan kapasitas produksi pada kelompok ternak Patra Sutera [Cattle waste management to increase production capacity in Patra Sutera livestock group]", Rekayasa, vol. 12 (2). pp. 91-98, 2014.

[24] Center of Statistic Agency. Indonesian Statistic. Jakarta, 2004.

[25] Sinaga Sauland, "Pembuatan Pupuk Kompos untuk Pupuk Organik [The Making of Compost for Organic Fertilizer]", unpad.ac.id/SaulandSinaga, 2009.

[26] Thapa, G. B., and Rattanasuteerakul, K., "Adoption and extent of organic vegetable farming in Mahasarakham province, Thailand", Applied Geography, vol. 31(1). pp. 201–209, 2011.

[27] Pinna, S., "Alternative farming and collective goals: Towards a powerful relationships for future food policies", Land Use Policy, vol. 61. pp. 339–352, 2017.
[28] Bravo-Monroy L., Potts S. G., and Tzanopoulos J., "Drivers influencing farmer decisions for adopting organic or conventional coffee management practices", Food Policy, vol. 58. pp. 49-61, 2016.
[29] Situmeang Y. P., Sudita I. D. N., and Suarta M., "Manure utilization from cows, goats, and chickens as compost biochar, and poschar in increasing the red chili yield", International Journal on Advanced Science Engineering Information Technology, vol. 9 (6). pp. 2088-2095, 2019.
[30] Markuszweska I and Kubacka M., "Does organic farming (OF) work in favour of protecting natural environment? A case study from Poland", Land Use Policy, vol. 67. pp. 498-507, 2017.
[31] Wasąg, Z., and Parafiniuk, S., "Ecological and social sustainability of agricultural production in the Roztocze region". Agriculture and Agricultural Science Procedia, vol. 7. pp. 287–291, 2015.
[32] Viaene, J., Van Lancker, J., Vandecasteele, B., Willekens, K., Bijttebier, J., Ruysschaert, G., De Neve, S., and Reubens, B., "Opportunities and barriers to on-farm composting and compost application: A case study from northwestern Europe", Waste Management, vol. 48. pp. 181–192, 2016.
[33] Rosmarkam A. and N. W. Yuwono, "Ilmu Kesuburan Tanah [Soil Fertility Science]", Kanisius Publisher, Yogyakarta, 2002.
[34] Soedjais Z., "Subsidi Pupuk Anorganik dan Pertanian Organik di Indonesia [Subsidies for Inorganic Fertilizers and Organic Agriculture in Indonesia]", School of Graduates, Universitas Gadjah Mada, Yogyakarta, 2010.
[35] Ariyanti Mira, Dewi I. R. Dewi, and N. Gita, "Utilization of organic fertilizer made out of oil palm midrib in oil palm nursery", International Journal on Advanced Science Engineering Information Technology, vol. 9 (4). pp. 1324-1329, 2019.
[36] Sutanto R., "Penerapan Pertanian Organik: Pemasyarakatan dan Pengembangannya [Organic Agriculture Application: Socialisation and Its Development", Kanisius Publisher, Yogyakarta, 2002.
[37] Jasim, A. H., Atab, H. A., and Abed, H. M., "Effect of chemical and organic soil fertilizers and their interactions with foliar fertilizers on growth and yield of broad bean *(Vicia faba L)*", Annals of the West University of Timisoara, vol 19 (2). pp. 149-156, 2016.
[38] Guldner D. and Krausmann F., "Nutrient recycling and soil fertility management in the course of the industrial transition of traditional, organic agriculture: The case of Bruck estate, 1787-1906", Agriculture, Ecosystems and Environment, vol. 249. pp. 80-90, 2017.
[39] Freyer B. and Bingen J., "Organic and non-organic farming is convergence possible?", Research in Rural Sociology and Development, vol. 21. pp. 281-310, 2017.
[40] Kardinan A., "Sistem Pertanian Organik [Organic Agriculture System]", Intimedia, Malang, 2016.
[41] Jouzi, Z., Azadi, H., Taheri, F., Zarafshani, K., Gebrehiwot, K., Van Passel, S., and Lebailly, P., "Organic farming and small-scale farmers: main opportunities and challenges", Ecological Economics, vol. 132. pp. 144–154, 2017.
[42] Naveed, M., Mehboob, I., Shaker, M. A., Baqir Hussain, M., and Farooq, M., "Biofertilizers in Pakistan: Initiatives and limitations", International Journal of Agriculture and Biology, vol. 17(3). pp. 411–420, 2015.
[43] Suharjo, Muhammad M., and Miftahul A., " Agihan Tanaman Bambu dan Implikasinya terhadap Potensi Air Tanah Daerah Kabupaten Klaten Jawa Tengah [Distribution of Bamboo Plant and Potential Implications on Groundwater in Klaten District, Central Java]", The 5th Urecol Proceeding, UAD, Yogyakarta, 2018.
[44] Setianingsih, R., "Kajian Pemanfaatan Pupuk Organik Cair Mikro Organisme Lokal (MOL) dalam Priming, Umur Bibit dan Peningkatan Daya Hasil Tanaman Padi (*Oryza sativa L.)*: Uji Coba Penerapan System of Rice Intensification (SRI) [Study of the Utilization of Liquid Organic Fertilizer of Local Micro Organisms (MOL) in Priming, Seedling Age and Increasing Yield of Rice (*Oryza sativa L.)*: The Application Trial of System of Rice Intensification (SRI)]", BPSB Propinsi DIY, Yogyakarta, 2009.
[45] Suranto, A. Arief, and Supyani, "The use of electrophoretic isozymes to detect tungro infected rice", Agrivita Journal of Agricultural Science, vol. 39 (2): 145-152, 2017.
[46] Amry R., "Effect of the Balance of Stone Banana (*Musa brachycarph*) and Wheat Flour on Some Characteristics of Dried Noodles", Skripsi. Industrial Agriculture Technology, Universitas Padjadjaran, Bandung, 2009.
[47] Novalina, Wilyus, and Hanibal, "The ffect of different liquid organic fertilizers on seedling growth of six upland rice varieties", Applied Science and Technology, vol. 1 (2). pp. 52-58, 2017.
[48] Handayani S. H., Y. Ahmad, and S. Ari, "Uji kualitas pupuk organik cair dari berbagai macam mikroorganisme lokal (MOL) [The quality test of liquid organic fertilizer from various types of local microorganisms (MOL)]", EL-VIVO, vol. 3 (1). pp. 54-60, 2015.
[49] Brinton Wm. F. Jr, "Nitrogen response of maize to fresh and composted manure", Biological Agriculture and Horticulture, vol. 3. pp. 55-64, 1985.
[50] Bernal M.P., J.A. Alburqueque, and R. Moral, "Composting of animal manures and chemical criteria for compost maturity assessment: a review", Bioresource Technology, vol. 100. pp. 5444-5453, 2009.
[51] Purwanto E., Samanhudi, and Sudarmi, "Studies of shading levels and nutrition sources on growth, yield and andrographolide content of sambiloto *(Adrographis paniculata Ness)*", Agrivita, vol. 33 (3). pp. 300-306, 2011.
[52] Hubeis Musa, W. Hardiana, and Wijaya N. H., "Prospect of high value added organic food based on farmers", IPB Press, Bogor, 2013.
[53] Schramski J. R., Z. J. Rutz, D. K. Gattie, and K. Li, "Trophically balanced sustainable agriculture", Ecological Economics, vol. 72. pp. 88-96, 2011.
[54] Srivastava P., S. Rishikesh, T. Sachchidanand, and R. Akhilesh S., "An urgent need for sustainable thinking in agriculture – an Indian scenario", Ecological Indicators, vol. 67. pp. 611-622, 2016.
[55] Budiadi, Musyafa, Hardiwinoto S., and Syahbudin A., "Changes in insect biodiversity on rehabilitation sites in the southern coastal areas of Java Island, Indonesia", Biodiversitas, vol. 21 (1). pp. 1-7, 2020.
[56] Regmi P. Punya and Weber K. E., "Problems to agricultural sustainability in developing countries and potential solution: diversity", International Journal Of Social Economics, vol. 27. pp. 788-801, 2000.
[57] Purnomo D., Y. Ahmad, and Budiastuti S., "Rice cultivation environmentally friendly by using the system of rice intensification (SRI) method and the use of liquid organic fertilizer", Jurnal Ekosains, vol. III (1). pp. 25-32, 2011.
[58] Gazali T. Ahmad and M. M. Azizul, "Evaluation of scale-up and environmental factors on microbial fuell cell", International Journal on Advanced Science Engineering Information Technology, vol. 9 (3). pp. 861-865, 2019.
[59] Wrzaszcz W and P. Konrad, "Environmentally sustainable agriculture in Poland-economic assessment", European Journal of Sustainable Development, vol. 4 (2). pp. 429-438, 2015.
[60] Datta S., S. Joginder, S. Sharanpeet, and S. Jaswinder, "Earthworms, pesticides and sustainable agriculture: a review", Environmental Science Pollution Research, vol. 23. pp. 8227-8243, 2016.
[61] Muhibuddin A., A. Lu'aili, A. A. Latief, and A. Atho'illah, "Biodiversity of soil fungi on integrated pest management farming system", Agrivita, vol. 33 (2). pp. 111-118, 2011.
[62] Budiastuti M. S., "The impact of global climate change on agricultural production", Agrosains, vol. 11 (1). pp. 22-27, 2009.