CROP AND LIVESTOCK INTEGRATED FARMING IN SUPPORTING OF SUSTAINABLE AGRICULTURE

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ABSTRACT

Discuss about farming activity could not separated from soil and water resources utilities. The hardest challenge in the farming strategic is how to keep the resources so the farming continuity is always in stable condition. Sustainable farming system should implement by: compare organic-inorganic, soil, water, plant disease control, and also increase the agricultural diversity that combined with the increase of flow and relation between them. By-product from one technology in agricultural system becomes input to the other technology or agricultural component. Livestock that integrated to the crop gives more advantages, because organic fertilizer would increase the soil fertility and decrease inorganic fertilizer utility. So they would pressure production cost and increase the plant production. Manure produce for plant fertilizer was a recycle flow in integrated farming system which implemented the Low External Input Sustainable Agriculture (LEISA) method to minimize the production cost. Basic on the reality that happen in the steps of assessment, the change of inorganic fertilizer to organic fertilizer should done steps by steps, so they would not cause the decrease of crop production.

Key Words: Sustainable Farming, Crop-Livestock Integrated Farming.

INTRODUCTION

Technology development in the modern farming depends on the science and technology ability to change the environment become optimally to support life and growth of plant and animal, compare to natural environment. The policy of farming and village development stress on the internal input utility to raise the farming result. All these technology input replace the natural process control and local resources (Jan Beek *et al.,* 1997). The farming concept known as green revolution. Those farming implementation support by point of view that farming result can stabilize and rise up by using the high external input only. In this view only chemical farming or agrochemical things which able to rise up the result and completely forget the pressure to the environment. An organic fertilizer replaces the livestock waste fertilizer, compose, fixation nitrogen plant, and soil fertilizer potency. Pestiside replace the mechanical and biological desease and herb control method. The main pressing of green revolution is to raise the food production by create a high response of external input plant variety to support their growth and genetic potential.

Food crop expert give opinion that the use of agricultural by-product for feed was the exploitation of organic component from the soil. So according to their opinion that organic things better to burn and left it to the ground, at least their mineral would left in soil as fertilizer. Across with that opinion we should remember that a million ton of organic compound including nitrogen would disappear when it was burn out.

Because of that reason, the best thing that should we do is optimalyzing the function of crop by-product as feed, and the manure which are produce by the cattle, then back it to the soil as a fertilizer.

The problem that almost seen in the realisation was the low courage from the farmer to use the manure as their fertilizer. They have so many reason which are: (1) using livestock waste more complicated cause they need labours to take them away, (2) sometimes happen that after using the livestock create another problem, like herb growth, (3) or even happens they got skin desease after using the fertilizer especially in their feet, (4) and there are condition that the farmer feel discussing using those fertilizer and it smell unpleasant (Musofie, 2000).

To solve that kind problem, we need a fertilizer treatment before give to the plant. By some treatment the organic compound in the fertilizer would decomposing become qualified organic fertilizer and ready to use. The doses become smaller (25-30%) before treatment. Disinfections happen when they were treated so the herb seed and pathogenic bacteria destroyed and they become odourless (Musofie and Wardhani, 2002).

MATERIALS AND METHODS

This research was done to developt the models of manure processing as organic fertilizer for crops and to developt the efisiency farming in crop-livestock farming system. This study was done in two research activities: (1) processing of organic fertilizer with basic material from manure by fermentation treatment, dan (2) utilization of this treated manure as organic fertilizer for paddy and red pepper (chili).

Processing of manure by added *pRimadec C-15®* decomposer and urea. The doses in each ton of manure were 4 kg of *pRimadec C-15®* and 4 kg of urea. Completely decomposing did at least 3-4 weeks with recovering and aeration each week. They were done to release the air circulation and change the organic material by microbial activity; meanwhile the watering process has function to stabilize the humidity so the decomposing could be done. The end product was an organic fertilizer with physical condition dark brown, broke able structure, and odourless.

Utilization of that organic fertilizer on paddy plantation was done in three steps, they were:

Step 1. The assessment was done in February-May 2004. The doses of this organic fertilizer 1000-1500 kg/ha, meanwhile urea still give with doses about 350-360 kg/ha as used by the farmer in the assessment location. The paddy variety that planted were IR-64 according to the generally what choose by the local farmer.

Step II. The assessment was done in Oktober-Desember 2004. The doses of organic fertilizer rise up to 2500 kg/ha and the urea fertilizer doses were decrease until about ± 30% from the first step, and they were 120 kg/ha, the paddy variety were IR-64, menthik wangi and shinta nur.

Step III. The assessment was done in December 2004-March 2005. The doses of organic and urea fertilizer are the same amount of with the second steps. The paddy variety was ciherang.

Utilization of organic fertilizer on red pepper plantation was done to compare in the utilization of conventional and organic fertilizer, and done in land wide of 1700 m^2 and 2100 m^2 each treatment.

RESULTS AND DISCUSSION

Processing of Manure

Organic fertilizer made from basic material livestock waste by added *pRimadec C-15®* decomposer and urea. The doses in each ton of manure were 4 kg of *pRimadec C-15®* and 4 kg of urea. Completely decomposing did at least 3-4 weeks with recovering and aeration each week.

In the beginning of the process compose has pH value and temperature equal to the environment. They were 6 in pH value and 18-20 ^{0}C in temperature. And then the temperature rise up because of microbial activity from *pRimadec C-15®* decomposer. This phase dominated by thermopile bacteria. Along the process they also produce ammonia gas and nitrogen, pH become basic. Up to 60 ^{0}C made thermopiles bacteria dead and replace by actinomycetes bacteria. After maximal temperature reach (and made almost all living things inside them destroy), the temperature go down and then we got the finish compose. So this organic fertilizer could function without worried about the side effect that become barrier factor for almost farmer but become solution for their problem that happens in the area.

Utilization of manure directly for plant fertilizer would cause unpleasant smell and increase the flies' population (Musofie, 2004). Composting technology seems become the right solution to solve this problem. Sutedjo *et al.* (1995) said that composting basically are concentrate organic compound and let them separated become a material with low good balance in C/N ratio before implicated as fertilizer. The advantages that we got from that method are first reducing the environment destruction. Yuliprianto (1991) said that by composting we can minimalist or even lusted unpleasant smell that caused by organic waste, reduce the using of chemical fertilizer, stabilize and continuing the natural fertile of the soil. Bahar (1986) also add that along the composting process in the concentrate material of organic fertilizer the temperature reach until 70 ^{0}C. In this condition they would able to killed the pathogen microbe, plant desease, growth of seed, insect and the eggs, fermes and the eggs and also reduce the unpleased smell from those compos. Second, the advantages that we got from the organic fertilizer are: 1) they were a material which rich of organic material need by plant, they were nitrogen, phosphor, potassium, and also contain another minerals; 2) good if it is use in tropical area, because the soil generally were broke by high sunrise, and compos function is to reduce and hold the strong sunrise, those mechanism made the soil always in good humidity, erosion resistance, and covering the crop root.

Manure of duck and cattle that treated by fermentation caused the death of ectoparacite do not contain pathogen bacteria and odourless. The death ectoparacite, which found in the composting process are: *Acarus*, *Dermanyssus*, *Cheyletiella*, and *Megninia*. Observation result shows that in the composting process from the first until the last weeks, the ectoparacyte that are found were decrease in the amount or in the genus. And in the first week the ectoparacyte found in death condition. In the end of the composting process the *Dermanyssus* and the unpleasant smell were unexist in compose. The death of ectoparacyte and pathogen bacteria has correlation with the high temperature of the concentrate material, which reaches until 67-71 ^{0}C.

Table 1. Nutrient content of organic fertilizer from a treated duck manure

Nutrient content	%
Nitrogen total (%)	3,42- 4,46
P_2O_5 (%)	15,53-18,08
K_2O (%)	8,51-12,18
Cl (%)	0,15- 0,19

Table 2. Quality insurances of guano fertilizer (SNI 02-2872-1992)

Description	Insurances
Smell	Specific
Water content	Max 10
Total of Nitrogen	Min 3,5
Phosphor count as P_2O_5 (%)	Minn 10
Potassium count as K_2O (%)	Min 6
Chloride count as Cl (%)	Max 0,5

Table 3. Nutrient content of organic fertilizer from a treated cattle manure

Nutrient	%
C organic	11.44-18.28
N organic	1.97- 2.79
NH4	0.20- 0.31
NO3	0.02- 0.06
Total nitrogen	2.19- 3.16
P_2O_5	1.48- 2.20
K_2O	1.31- 1.69
Na	0.35- 0.47
Ca	0.78- 1.00
Mg	0.17- 0.23

Table 4. Paddy yield in each steps (dried rice seed, ton/ha)

Variety of paddy	Step I	Step II	Step III
IR-64	6.02 ± 0.12	6.75 ± 0.72	
Menthik wangi		6.9 ± 0.29	
Shinta nur		7.0 ± 0.31	10.08 ± 0.24
Ciherang			8.28 ± 0.22

Table 5. Paddy yield quality that treated by organic fertilizer

Variety of paddy	Production capability (%)		Rice price in the farmer level (Rp/kg)		Rice price in the consumer level (Rp/kg)	
	Conventional fertilizer	Organic fertilizer	Conventional fertilizer	Organic fertilizer	Conventional fertilizer	Organic fertilizer
IR-64	62	64,5	2100	2400	2300	3550
	63	72,6	2500	3200	2900	4000
Shinta nur	63	71,5	2500	2900	2900	4000

Source: Musofie (2003)

Utilization of Fermented Manure as Organic Fertilizer for Paddy

Result of step 1 showed that basically the first plantation produces about 6.02 ± 0.12 ton/ha of dried rice seed did not different with what they have been done before. In step II of this study, paddy yield about 6.75 ± 0.72 ton/ha of IR-64; 6.9 ± 0.29 ton/ha of menthik wangi; and 7.0 ± 0.31 ton/ha of shinta nur. According to the result of step II and by considering the taste of the cooking rice, most of the farmer chooses to plant menthik wangi and shinta nur for the next plantation season. Result of this study in step

Tabel 6. Yield of red chilli in each treatments (kg)

Time of harvest	Treatment	
	Conventional fertilizer (land wide of 1700 m^2)	Organic fertilizer (land wide of 2100 m^2)
1	2	2
2	18	22
3	250	275
4	350	380
5	470	590
6	410	495
7	200	250
8	-	40
9	-	135
10	-	40
Total	1700	2229

The quality of organic fertilizer from the duck manure treated with *pRimadec C-15®* show in Table 1, meanwhile the organic fertilizer that is from beef cattle manure state in Table 3. If both of them compare to the standard of guano fertilizer, which are organic fertilizer, come from small bat faeces or poultry in SNI 02-2871-1992 (Table 2), those fertilizer including a good quality of fertilizer.

III showed that paddy yield higher than in steps I and II, they were 8.28 ± 0.22 ton/ha for ciherang and 10.08 ± 0.24 ton/ha shinta nur. The production potency shows the continuity rising from those steps, and shows the positive correlation of the utilization organic fertilizer from treated manure in the paddy farming (Table 4).

Basic on the reality that happen in the steps of assessment. The change of inorganic fertilizer to organic fertilizer should done steps by steps, so they would not cause the decrease of crop production. Generally the main thing that important from organic paddy farming than the conventional one are the plant not easy to fall down and attack by plant desease, the leaf physical appearance not to green with leaf score colour 3-4. Besides those advantages we also save a lot from the chemical fertilizer and another chemical cost. So from this condition we hope that there would be coordination between the crop and animal farmer. The crop farmer produce the crop by-product which are paddy and another kind of crop straw for cattle feed, meanwhile the animal farmer produce manure which in the future used as organic fertilizer and give advantages to the plant.

The use of organic fertilizer from manure, which treated by probiotic and have qualification as mention in the Table 1 and 3 show the better result in the quantity and the quality of paddy product. The manure treatment were recycle chain in integrated farming which are the implementation of low external input sustainable agriculture (LEISA) to minimize the production cost. The development of natural resources into lasting and health of plant growth, the additional of organic material should be general policy before the other kind of fertilizer give to increase the production stability. Field soil rehabilitation by organic fertilizer did not increase the rice seed production but even increase the quality and the sold price of product as mention in the Table 5 (Musofie, 2003).

Utilization of Fermented Manure as Organic Fertilizer for Red Pepper

Result of this observation showed that red pepper which fertilized with organic fertilizer have higher yield that with conventional fertilizer (Table 6).

Utilization of organic fertilizer can improved the plant productivity. Plant without organic fertilizer (conventional fertilizer) could harvest only of seven times; but plant with organic fertilizer could harvest of ten times.

CONCLUSION

Regenerative farming system by low external input sustainable agriculture does not means without any input or zero input, it could increase the land productivity, in condition that the farmer give their participate in all steps of technology development. Sustainable and friendly farming system should implemented by: compare the technology management of soil, water, plant desease control and also the variety of farming development that combine with the increasing of flow and relation between those technology. By product of one technology become an input for another technology. How to make those farming system is how to maximize the resources. Increasing the natural process could do this thing, press as minimal the use of external input and replaced it by internal input or by combine both of them. So the negative effect of environment could be press and give positive value to the most new of natural resource, and also increase the product of each sector. The utilization of organic fertilizer from manure that treated by probiotic show the better result in the quantity and the quality of plant product. The manure treatment were recycle chain in integrated farming to minimize the production cost. The change of inorganic fertilizer to organic fertilizer should done steps by steps, so they would not cause the decrease of crop production.

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