Water Saving and Organic Fertilizers Based Technology to Remediate the Health of Paddy Soils and to Increase Rice Productivity in Indonesia

Simarmata, T.[1)], B. Joy[1)] and T. Turmuktini[2)]

1) Dep. of Soil Science, Faculty of Agriculture, Padjadjaran University, Bandung - Indonesia
2) Agriculture Faculty of Winaya Mukti University, Bandung – Indonesia

Contact Address: Tualar Simarmata, University Padjadjaran of Bandung, Soil Science Department, Agriculture Faculty, Jl. Raya Bandung-Sumedang km 21, 40600 Bandung, Indonesia,

e-mail: tualarsimarmata@yahoo.com

ABSTRACT

Permanent flooding of paddy soils not only reduces the soil biological power significantly, but also restricts the roots growth. Rice in continuously irrigated fields needs approximately 3,000 - 5000 L of water to produce 1 kg grain. Various field studies indicated mostly of paddy soils in Indonesia has a low organic content (<< 2 %). Under these conditions, the increasing of inorganic fertilizers dosage application may give a non significant effect on rice production and paddy soils can be categorized as a sick paddy soils. Remediation the paddy soil health can be achieved by managing the soil organic matter and organic based fertilizers application. The field results using several rice varieties in Indonesia revealed that the water saving technology combined with organic fertilizers (2 - 4 ton of straw compost) can produce grain yield about 8 - 12 t/ha (average of an increasing about 50 - 150% compared to anaerobic rice cultivation) and the water irrigation was reduced by at least 30 - 50% and as well as inorganic fertilizers was reduced by 25% This high rice yield is highly correlated with the increasing of roots zone about 4 - 10 times, number of productive tillers about 60 - 80 tillers, number of panicles, length of panicles and number of grain/panicle, and as well as due to the increaseof soil biodiversity.

Keywords: Paddy soils, organic fertilizers, soil health, straw compost, water saving

INTRODUCTION

Rice is one of the most important grains in Indonesia since this crop is the staple food for majority of the people.Paddy rice cultivation largely depends on irrigation and its consuming about 3000 – 5000 L of water to produce 1 kg of grain or it requires 15.000 – 30.000 m3/ha of water to produce 5 ton of grain yiled/ha (Nielsen, 2004, Simarmata, 2009).The result of various field studies indicated mostly of paddy soils in Indonesia has a low organic content (< 2%) and based on soil health indicator can be categorized as sick soils (Simarmata, 2009). Since 2006 we have developed system of organic based aerobic rice intensification system (SOBARI) to promote the soil biological activity (soil organisms) and to provide a favorable condition for rice roots growth (Uphoff,2004; Simarmata, 2009). This technology is a holistic rice production system by using and integrating the soil.biological power, soil organic matter, integrated organic based fertilizers and water management to remediate the soils health of paddy soils and to increase the rice producvtivity

MATERIAL AND METHODS

1. In Situ Composting of Rice Straw and Application During Land Cultivation

2. Land Preparation and Planting Technique

- Young single seedlings (12 – 15 days) is planted in twin methods (two single seedling is planted in line about 5 cm distance from each others at point of planting cross section.
- The seedling is planted by slipping in sideways rather than plunging it into the soil vertically makes the shape of the transplanted seedling more like an L than like a J. With an L shape, it is easier for the tip of the root to resume its growth downward into the soil.

3. Integrated Organic Based Fertilizer Management

The fertilizers application of SOBARI are divide in 3 steps, as follows:

- First fertilization as basic fertilizers is applied shortly before transplanting, consisted of 2 – 4 ton/ha straw compost combined with 50 kg urea, 50 kg SP-36 and 25 kg KCl or 50 kg urea and 100 kg NPK,
- Second Fertilization is about 100kg urea applied at 18 – 21 days after transplanting or after weeding. Leaf Color Chart (LCC) can be used to monitor the nutrient conditions and to determine the N rate
- Third fertilization is 50 – 100 kg urea and 25 – 50 kg KCl per hectare or 50 kg urea and 50 - 100 kg NPK are applied at 35 – 38 days after transplanting.

4. Water Management and Rice Performance

RESULTS AND DISCUSSION

Field Results

The field results of SOBARI from several Provinces or districts in Indonesia are summarized in Table 1.

Table 1: Unmilled Rice Yield Summary of SOBARI in Different Province/District in Indonesia (Planting Season 2007 – 2009)

Location	Yield (t/ha)	Control (t/ha)	Increment (%)
SOBARI Experimental Fields and Demo Plot (Fac. of Agriculture of Padjadjaran Univ. Bandung), planted Rice (Ciherang, Dyahsuci, IR 64, Mekongga)	6 – 12	4 – 7	50 – 150%
Demo Plot in Research Institute for Rice of Indonesia, harvested July 2008 (Ciherang, Mekongga and Sintanur	7 – 10	-	-
West Java (Bandung, Garut, Sumedang, Bogor, Bekasih, Subang, etc.) with various rice variety	6 – 11	4 – 6	50 – 100 %
Banten (Serang, Lebak)	6 – 10	4 – 6	50 – 100 %
East Java (Tulung Agung, Jombang, Madiun, Blitar, Mojokerto, Nganjuk, etc.)	6 – 10	4 – 6	50 – 100 %
Central Java (Sragen, Sukoharjo, Wonogiri, Karang Anyar, Purworejo, Magelang, Semarang, etc.)	6 – 10	4 – 6	50 – 80%
Nort Sumatera (Sergei, Tebing Tinggi, Tapanuli, etc)	5 – 10	3 – 7	50 – 100 %
South Sulawesi (Gowa, Luwu, etc.) conducted by Famer Groups in 16 Subdistrict (Various Rice Variety)	6 – 10	3 – 6	50 – 200%
North Sulawesi (Minsel, Minut, etc.) conducted by Famer Groups with Various Rice Variety	6 – 10	3 – 7	50 – 200 %
Nusa Tenggara (Kupang, Ende, Bajawa, Nagekeo, Rote Ndao) conducted by Famer Groups with Various Rice Variety	6 – 10	2 – 6	50 – 300 %
West Kalimantan (2 ha)	8,9 ton	-	100%

Conclusions

The conclusions and suggestions can be summarized as follows:

1. SOBARI is a holistic of water saving and inorganic fertilizers reducing technology focusing on soil biological power, soil organic matter and organic based integrated fertilizers management for improving, maintaining the soil health and to increase rice productivities in sustainable ways.
2. SOBARI combined with application of 2 – 4 ton/ha straw compost can reduce the water irrigation at least 30 - 50%, and inorganic fertilizers by at least 25%, improve the soil health, and increase the rice yield about 50% - 100% compared with traditionally flooding rice cultivation.
3. The degraded health of paddy soils can be restored or remediated by application of 2 - 4 ton straw compost or 5 – 10 ton rice straw within 6 seasons (3 years), respectively.
4. The health of paddy soils and sustainability of rice production in Indonesia are highly depend on the rice straw or soil organic matter and integrated organic based fertilizer management.

REFERENCES

Anthofer, J. 2004. The Potential of the System of Rice Intensification (SRI) for Poverty Reduction in Cambodia.German Development Co-operation (GTZ), consultant, private address: Danzigerstr. 10, 78549 Spaichingen,Germany; e-mail: juergen.anthofer@t-online.de

Bouman, B.A.M., Hengsdijk, H., Hardy, H., Bindraban, P.S., Tuong, T.P., Ladha, J.K. (eds.), 2002.Water wise rice production. Proceedings of the international workshop on Water_wise rice production, 8_11 April 2002, Los Baños, Philippines. 356 p.

Dobermann.A and T.H. Fairhurst. 2002. Rice Straw Management. Better Crops International. Vol. 16, Special Supplement, May 2002.

Ho, M. W. 2004. Fantastic Rice Yields: Fact or Fallacy? Institute of Science in Society (ISIS) press release 02/07/04. <http://www.i-sis.org.uk>

Nielsen, T.K. 2004. Paddy cultivation. http://www.kellnielsen.dk/download/Paddy.pdf

Simarmata, T. 2009. Less water for better soil biological activity and growth of paddy rice in system of organic based aerobic rice intensification. Presented Paper on Internasional Seminar of Sustainable Resources Development: Management of Water and Land Resources from October 6th – 8th 2009 in Central Kalimantan

Suryana. A. 2008. Sustainable Food Security Development In Indonesia:Policies and Its Implementationpolicies Implementation. Presented at High-level Regional Policy DialogueOrganized by UN-ESCAP and Government of IndonesiaBali, 9-10 December 2008

Uphoff N. 2004. The system of rice intensification (SRI):capitalizing on existing yield potentials by changing management practices to increase rice productivity with fewer inputs and mor profitability. Cornell International Institute for Food, Agriculture and Development (CIIFAD)

Yang, C., Yang, L., Yang, Y., and Ouyang, Z. 2004. Rice root growth and nutrient uptake as influenced by organic manure in continuously and alternately flooded paddy soils.
http://www.sciencedirect.com/science/article/pii/S0378377404001489