



A Review of Technology Innovation in Increasing Rice Production

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Abstract

Rice is the main commodity in Indonesia so it needs to be supported by technological innovation in the context of increasing production. Currently, the Agricultural Research and Development Agency has created technological innovations to increase rice production because it is necessary to disseminate information on technological innovations so that all users can know and take advantage of these innovations. The purpose of writing this paper is to provide information and an overview of some of the current agricultural technological innovations in Indonesia that contribute to increasing rice production in Indonesia. Several agricultural technology innovations are currently being implemented such as new superior varieties technology, planting jajar legowo, Salibu rice cultivation system, hazton rice cultivation, SRI rice cultivation technology, integrated planting calendar, and integrated crop management. These technological innovations have had an impact on increasing rice production in Indonesia

Keywords: agricultural technology, innovation, rice, yield

A. Introduction

Rice is an important and strategic commodity so that future rice production must be increased in line with an increase in population. In 2020, Indonesia's population is estimated at 263 million and

in 2005 it increased to 275 million. For this reason, the government has established a P2BN program that is committed to increasing rice production by 5% every year. All businesses ranging from the expansion of the planting area through expansion of the area as well as the increase in the crop index increased productivity and post-harvest efficiency have been carried out. The result was that in 2008 Indonesia achieved self-sufficiency in rice again (Indonesian Center for Rice Research, 2009)

From 2005 to 2014, the average rate of productivity growth of 1.05 percent per year was relatively higher when compared to the growth rate of rice harvested area of 0.58 percent per year. This condition indicates that the main source of growth in world rice production is growth in productivity. This has implications for resource

Land to support the growth of world rice production is increasingly limited, so the hope of improvement is increasing. Rice production in the future remains the growth of productivity. Considering that productivity is largely determined by technological progress, to achieve sustainable growth in world rice production requires adequate funding and investment in research and development. (Agricultural Research and Development Agency 2015)

The purpose of writing this paper is to provide information and an overview of some of the current agricultural technological innovations in Indonesia that contribute to increasing rice production in Indonesia.

B. Inovation in Increasing Rice Production

Increased agricultural production is a result of the use of techniques or methods in farming. It is impossible to expect high yields using only plants and animals or the same methods. There must be changes made, both to agricultural inputs and the methods used when agriculture is to be developed in the sense that its production is to be increased. For agricultural development to continue to meet the growing human needs, there must always be changes. When the change stopped, then agricultural development stopped. Production stops rising or can decrease due to declining soil fertility or increased damage by increasingly rampant pests.

It does not also mean that each working method, each type of production input is higher. Improving just one or a few small parts of existing farming aspects can cause increased production. There are limiting factors that cause the use of a new method to produce different results when the new method is applied elsewhere without any adjustments. A new technique that is often referred to as innovation must be able to increase yield or reduce costs very prominently to be accepted by the community or most farmers.

It cannot be denied that the role of technology is very strategic in supporting increased agricultural production. As it is known that an increase in rice production from 54.1 million tons of paddy in 2004 to 60.3 million tons of paddy in 2008 (an average of 2.8% per year) even reached 5.2% per year during the period 2006-2008. So that making Indonesia back to self-sufficiency in rice in 2008 after being achieved in 1984 was an impact of the application of technology. (Sembiring, 2008)

Affirmation of the role of technology in achieving food production was also stated by Sumarno (2006) who stated that the spectacular increase in rice production in the last 35 years was the contribution of the application of more advanced technology called Green revolution technology.

According to Mosher (1981) and Mubyarto (1989) who put technology as a condition for the development of agriculture, it is even emphasized that technology is constantly changing. If there is no change in technology, then agricultural development will stop. Production stops at an increase, it can even decrease due to declining soil fertility or due to increased damage by increasingly rampant disease pests. This view of technological change can be interpreted as adaptive technology to the local biophysical conditions and socio-cultural environment.

Innovation will become the needs of farmers if innovation can solve the problems being faced by farmers. So that the correct identification of problems becomes very important, there are at least

two reasons, namely: (a) what we consider to be a problem, is not necessarily a problem faced by farmers, (b) if the problem turns out to be true is a problem of farmers, the solution is not necessarily in accordance with the conditions of farmers.

C. The Role of Various Technology Innovation in Increasing Rice Production

1. New Superior Varieties

New superior varieties (VUB) of lowland rice is a solution to increase rice production because VUB has a higher yield potential than local varieties. According to suprihatno, Darajat, Satoo, Bahaeki, Widiarta, Indrasari, Lesaman & Sambiring (2007), superior varieties are one of the components of innovative technology to increase rice productivity, both through increasing the potential or yield, as well as increasing its resistance to biotic and abiotic stresses. Furthermore, according to Suryana & Prajogo (1997) superior varieties have more uniform plant growth advantages so that the harvest becomes synchronous, higher yields, higher yield quality and in accordance with consumer tastes, and plants will have high resistance to pest and disease disorders and adaptability high on the environment so that it can reduce the use of inputs such as fertilizers and pesticides.

According to Suprihatno *et al.*, (2007), superior varieties are one of the components of innovative technology to increase rice productivity, both through increasing the potential or yield, as well as increasing its resistance to biotic and abiotic stresses. Furthermore According to Abdullah, Tjokrowidjoyo & Sularjo (2008), VUB lowland rice needs to be developed in Indonesia, because 1) lowland rice is the main supplier of national production so that planting VUB will increase productivity, production and income of farmers, 2)

The Ministry of Agriculture, in this case, the Agency for Agricultural Research and Development in supporting the increase in rice production, the Ministry of Agriculture has released more than 100 superior varieties of rice (Indonesian Center for Rice Research, 2009). It is expected that the release of these superior varieties can be actualized by their genetic potential through the development of cultivation technology with the Integrated Plant and Resource Management (PTT) Approach. The contribution of superior varieties in increasing rice productivity reaches 75% if integrated with irrigation and fertilizing technology (IAARD, 2007)

2. Legowo Jajar Planting System

Legowa is a planting technique by adjusting the spacing between clumps and between rows, resulting in compaction of rice clumps in rows and widening the distance between rows. In the two-row rows legowo system, all rice groves are in the margins of the crop. As a result, all these clumps of rice have benefited from border effects.

The step to increase production and productivity is to modify plant spacing by using legowo spacing. According to Suriapermana *et al*, (2000). The legowo planting system is a form of technological engineering to optimize rice productivity with population regulation so that the plants get growing space and optimal sunlight. Some advantages of how to plant jajar legowo include (1) increasing plant population, (2) reducing rat and snail pest attacks and (3) reducing iron poisoning (Departemen Pertanian, 2008).

At this time the super jowo legowo technology has been developed, jajar legowo super can increase production to 13.9 tons / ha. Jajar Legowo Super Technology is an integrated cultivation technology for irrigation based on planting jajar legowo 2: 1. This super technology is produced by Balitbangtan after going through research and studies at various locations in Indonesia. In addition to using the 2: 1 jowo legowo planting system as the basis of application in the field, an important part of Jajar Legowo Super technology is 1). New Superior Variety (VUB) of high yield potential, 2) Biodecomposer, given before tillage, 3). Biofertilizer as seed treatment and balanced fertilization based on Soil Test Equipment (PUTS), 4) Control of Plant Pests (OPT) using vegetable pesticides and inorganic pesticides based on threshold control, and 5). Agricultural tools and machinery,

especially for planting (jarwo transplanters) and harvesting (combine harvester). (Agricultural Research and Development Agency, 2015)

3. System Of Rice Intensification (SRI)

SRI is one of the innovations in rice cultivation methods developed since the 1980s by the French priest and agriculturalist, Fr. Henri de Laulanie, who has been stationed in Madagascar since 1961. Initially, SRI was short for "Systeme de riziculture intensive" and first appeared in the *Tropicultura Journal* in 1993. At that time, SRI was only known locally and its distribution was limited. Since the late 1990s, SRI began to go global as a result of efforts not to give up Prof. Norman Uphoff, former director of the Cornell International Institute for Food, Agriculture and Development (CIIFAD). In 1999, SRI was tested for the first time outside Madagascar, in China and Indonesia (Stoop, Uphoff, & Kassam, 2002).

The objectives of the SRI development are: (a) to make efficient use of production input and water utilization; (b) improving the quality / fertility of paddy fields through the provision of organic material intake; (c) developing environmentally friendly rice farming. (d) increase farmers' knowledge and skills about SRI rice farming and (e) increase farmers' income and welfare.

According to Berkelaar (2001), Kuswara (2003), Wardana, Juliardi, Sumedi & Iwan (2005), Uphoff (2002), Rochaedi (2005), Prayatna and Sony (2007), there are several important components in the application of SRI, including:

- 1) Seedlings are moved to the field (transplanted) earlier (young seedlings). In general, SRI recommends planting young seedlings when they are 8-15 days old. Transplanting when young seedlings can reduce shocks and increase the ability of plants to produce stems and roots during vegetative growth, so that stems appear more in number in a single family or grain of rice produced by panicles. Besides that, in order to get the maximum number of tillers and root growth.
- 2) Seeds are planted individually rather than in clusters. This is so that plants have enough space to spread and deepen rooting. Plants do not compete too tightly to get growth space, light or nutrients in the soil so that the root system becomes very good.
- 3) Wide planting distance. SRI recommends a wide spacing of at least 25 cm x 25 cm so that plant roots do not compete and have enough space to develop so that maximum tillers can be reached.
- 4) Soil conditions remain moist but not flooded (intermittent irrigation). SRI recommends intermittent irrigation techniques to create oxidized root conditions, to increase soil fertility and obtain long and dense plant roots. With SRI, the inundated condition is only maintained during vegetative growth. Furthermore, after disposal, paddy fields are flooded with 1-3 cm of water (as is conventional practice). Rice fields are completely irrigated starting 25 days before harvest.
- 5) Weeding. SRI recommends 2-3 times weeding using gasrok or lalandak, in addition to cleaning weeds, improving soil structure and increasing soil aeration.
- 6) Organic Materials (compost): SRI recommends the use of organic material (compost) to improve soil structure so that rice can grow well and nutrients are supplied to plants properly.

Based on the results of the study of Stoop *et al.* (2002) in Wardana *et al.* (2005), the application of SRI by farmers in Madagascar, in the 1980-1990 period was able to achieve rice yields of 10-15 tons per hectare. Very high rice yields are obtained from infertile paddy fields, without the use of inorganic fertilizers and less irrigation water. Whereas normal production in the same area only reaches 2 tons per hectare. In other areas of Madagascar for five years, hundreds of farmers harvested 8-9 tons per hectare (Berkelaar, 2001). Rice cultivation using the SRI method developed in several Eastern Indonesian regions has proven to be able to increase land productivity from 5.0 tons/ha to 7.4 tons / ha (Sato, 2007)

4. *Salibu Rice Cultivation*

Ralibu rice cultivation is a variant of return cultivation technology, which is the stump after harvesting the main crop which is about 25 cm high, maintained for 7-10 days or left until a new shoot comes out. If the shoots that come out are less than 70% then it is not recommended to do the cultivation of cranium. If the shoots grow > 70% then cut back uniformly to a height of 3-5 cm, then maintained well until harvest. Some of the benefits that can be obtained from the application of the cultivation of crossing rice are saving, labor, time, and cost, because there is no cultivation of land and replanting, besides it suppresses the habits of farmers burning straw after harvest (Erdiman, Nieldanina & Misran, 2013).

Cultivation of cross-bred rice can increase rice productivity per unit area and per unit time, and increase the harvest index from once to two to three times a year. If compared with conventional rat technology, salibum capable of producing several more and more uniform tillers, and productivity.

5. *Hazton Rice Cultivation*

The Hazton technology was initiated and has been implemented in several districts in West Kalimantan Province and/or other provinces/districts in Indonesia. Hazton technology is a way to grow rice using old seeds 25-30 days after seedling with many dense seeds that are 20-30 stems per planting hole. The other components are more or less the same as Integrated Crop Management (PTT) recommended by the Agricultural Research and Development Agency. This technology was discovered in West Kalimantan in 2012, with various stages of the field testing it turned out that Hazton Technology was able to lift rice productivity in West Kalimantan. Before the farmers used Hazton Technology, rice productivity was only obtained as much as 3.1 tons of Dry Grain (GKG) per hectare, and even that was already very high and had used a complete technology package such as seeds, organic fertilizers, and inorganic fertilizers as recommended. After the farmers are familiar with Hazton Technology, the productivity potential can increase up to 8 - 16 tons of Dry Grain (GKP) or 6.88 - 13.76 tons of paddy per hectare. While

The results of the Hazton Technology trial at the Indonesian Center for Rice Research ranged from 4 - 9 tons/ha. Hazton Technology is a technology that is very simple, easy to apply in the field and does not change the technique of rice cultivation at the farm level so far that farmers initially only used rice seeds 2-3 stems per planting hole with Hazton Technology, farmers planted seeds with 20-30 stems per planting hole. Some of the advantages of Hazton Technology after being developed in the field are 1). Higher productivity, 2). Easy to plant, 3). Little or no replacing, 4). Little or no weeding, 5). Faster harvesting (2 weeks) than on a regular system, 6). Grain is more pithy and low empty/drunken, 7). Relatively resistant to pest attacks (golden snails, orong-orong), difficult drainage, and iron poisoning problems, 8). Percentage of high head rice (low broken rice), 9). Adaptability in the field is relatively high, and 10). More efficient in the use of inorganic fertilizers. While the weaknesses of Hazton Technology are: 1). Seed requirements are higher than the usual method and 2). Use a wider nursery (Dirjen Tanaman Pangan, 2015).

6. *Integrated Crop Management PTT*

Integrated crop management (PTT) is an approach in managing land, water, plants, plant pests (OPT), and climate in an integrated and sustainable manner to increase productivity, farmer income, and environmental sustainability. The principle of PTT includes four elements, namely integration, interaction, dynamic and participatory. The technological component in PTT is divided into two, namely the basic technology component consisting of (1) modern varieties, (2) quality and healthy seeds, (3) efficient fertilization, and (4) IPM in accordance with the target pest, and selected technology components consisting of (1) crop management, (2) young seedlings, (3) organic fertilizer, (4) intermittent irrigation, (5) liquid fertilizer, and (6) harvest and post-harvest handling (Ministry of Agriculture, 2008).

The results of PTT applications on irrigated paddy fields carried out by the Indonesian Center for Rice Research since 1999 in Sukamandi show that the increase in rice yields obtained varies according to the level and scale of the area of business. At the level of research and demonstration with the limited area (1 - 1.25 ha), it can increase yields on average 37%. This increase was then reduced to 27% and 16%, respectively at the assessment level with an area of 1-5 ha and the implementation level at 30 PTT locations with an area of 50-100 ha. Also, with PTT grain yield and rice quality also increased, the cost of rice farming was reduced, health and environmental sustainability were maintained (IAARD, 2007).

7. Planting calendar

Indonesia faces various challenges in maintaining rice self-sufficiency. Among the high population growth, the conversion of fertile paddy fields to other crops with higher sale value, the construction of residential areas, offices and industrial estates, increased inter-farm competition, limited water resources, floods and drought due to climate change (climate change) because of global warming, (Suyanto and Zaini, 2010)

A planting calendar is made to be used as a reference for farmers in planting annual crops. Plant calendars are made by combining maps of climate forecasts, water availability and planting classification. Plant calendars are then matched with cropping patterns carried out by farmers in the field so that they have high accuracy (Subagyo, 2007). Planting calendar map is a map that illustrates the potential pattern and planting time for food crops, especially rice, based on the potential and dynamics of climate and water resources.

The Ministry of Agriculture of the Republic of Indonesia through the Agro-climate Research Institute (Balitklimat) has since 2012.

D. Conclusions

Technological innovation is one step that can encourage increased rice production. Several agricultural technology innovations are currently being implemented such as new superior varieties technology, planting jajar legowo, Salibu rice cultivation system, hazton rice cultivation, SRI rice cultivation technology, integrated planting calendar, and integrated crop management. In its implementation in the field, technological innovation is partly acceptable in the community and some are still in the development stage. Hope in the future there will be new technological innovations whose application is easy so that they can be accepted in the community and have a real impact on increasing rice production.

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