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Hybrid Rice Development in Indonesia

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INTRODUCTION

With the total population predicted to reach 318.9 million in 2045, one of the pressing challenges for Indonesia is to meet demand for rice as staple food. On the other hand, the capacity to produce sufficient food is threatened due to limited natural resources (particularly land and water) coupled with the impact of climate change and other natural shocks such as droughts and floods. The Ministry of Agraria and Spatial Planning (2018) recently releases that the available land suitable for rice crop is 7.1 million hectare. This figure is one million hectare lower than was reported in 2012 (8.1 million hectare), which means that land corversion from rice to other uses is approximately 166.7 thousand hectare per year.

Considering limited land resources, then to increase rice production should be implemented primarily by increasing rice productivity. Along this line, planting newly developed High Yielding Varieties (HYVs) of rice coupled with improved production technologies is a priority policy framework. Conventional technologies to create new HYVs is becoming more difficult due to limited genetic diversity. Responding to these challenges, hybrid rice technology should be developed to complement current research efforts using conventional breeding technology. From technical point of view, the first generation (F_1) of cross breeding or hybrid creates heterosis phenomenon which imply that the F_1 is more superior than their parents (Indonesian Center for Rice Research, 2018). This effort is also benefited from the advancement of science on biotechnology, molecular marker, etc.

The purpose of this brief is to review the historical development and achievements in developing hybrid rice. The primary focus is on R&D program and government policy supports.

R&D programs and achievements

The history of R&D on hybrid rice in Indonesia started in 1983. In 2001, R&D was intensified in collaboration with the International Rice Research Institute (IRRI) and the United Nation Food and Agricultural Organization (FAO). In 2002, the first two hybrid rice

were released. Since then some combination of hybrid rice, CMS lines, maintainer, and restorer have been produced. Up until 2013, 19 hybrid rice varieties have been released by the Ministry of Agriculture, and 121 hybrid rice varieties have also been released by the private sector. The result of field trial conducted by the Indonesian Center for Rice Research has shown that productivity of hybrid rice has shown in the range of 6.24-8.40 ton/hectare, which is 15.2% higher than average productivity of the non-hybrid variety (Table 1). The yield performance of hybrid rice in Indonesia is comparable to those in other countries. For instance, average yield of hybrid rice in China is 7.40 ton/hectare, whereas in the Philippines the average yield is much lower, only 5.74 ton/hectare.

Table 1. Average yield of some hybrid rice in Indonesia

Hybrid rice	Year of release	Average yield (ton/ha)
Maro	2002	6.24
Rokan	2002	6.44
Hipa 3	2004	7.90
Hipa 5	2007	7.29
Hipa 8	2009	7.50
Hipa 9	2010	8.10
Hipa 12	2011	7.70
Hipa 14	2011	8.40
Hipa 18	2013	7.80
Hipa 19	2013	7.80

Source: Indonesian Center for Rice Research (2018)

The adoption of hybrid rice is still very small, around 0.34-3.39% during 2013-2017 (Table 2). Compared to other peer countries, this adoption rate is still very low. In China, the most advance country on hybrid rice, the area planted to hybrid rice has reached 54%, whereas the share of hybrid rice on production was accounted for 57.5% in 2017. In the Philippines, 16.07% of rice area is planted to hybrid rice, whereas the share on rice production is 20.66%.

Low adoption of hybrid rice is due to: (a) yield different between hybrid and non-hybrid is not so significant, whereas hybrid rice seed price is much higher; (b) grain quality lower than non-hybrid variety; (c) seed production rate is still low which imply higher seed price.

Table 2. Area planted to hybrid and non-hybrid rice in Indonesia, 2013-2017 (000 ha).

Year	Season	Hybrid	Non-hybrid	Total	% Hybrid
2013	Wet	117.8	6,332.2	6,450.0	1.83
	Dry	193.7	5,519.2	5,712.9	3.39
2014	Wet	96.2	8,096.5	8,192.7	1.17
	Dry	18.7	5,460.1	5,478.8	0.34
2015	Wet	44.4	5,719.5	5,763.9	0.77
	Dry	53.7	6,060.1	6,113.8	0.88
2016	Wet	17.1	2,426.7	2,443.8	0.70
	Dry	21.3	5,738.8	5,760.1	0.37
2017	Wet	16.8	4,126.0	4,142.8	0.41

Source: Indonesian Center for Rice Research (2018)

Some researches of the Indonesian Center for Rice Research have shown that cultivation of hybrid rice will show good performance if planted in favorable environment (irrigated paddy field) along with intensive input use and appropriate farming practices. In other words, successful hybrid rice cultivation will be achieved if it is planted in a relativelly well developed rice production areas. Based on this criteria, there are 33 districts/municipalities in Java and Bali islands which have potential as hybrid rice production areas. More specifically, the potential areas are 752,303 ha in West Java, 342,241 ha in Central Java, and 517,416 ha in East Java.

R&D priority to support hybrid rice development in the future should be focused on: (a) adaptability of hybrid rice in various production environments; (b) increasing the performance of seed production; (c) initiation of two lines system which shows higher yield compared to the three lines system; (d) improving grain quality. To achieve those objectives, R&D effort should be strengthened involving universities, international research centers, and the private sector.

Policy support

To promote the development of hybrid rice, the Ministry of Agriculture has formulated some policy initiatives, which will be discussed in the following. It also includes some more areas to be done.

(1) **Provide grant of hybrid rice seed to small holder farmers in pilot rice production area.** To accelerate the increase on rice production in major rice producing provinces, the Ministry of Agriculture provides grant of certified seed to small holder farmers. In 2017 there was 791,925 hectare of paddy area which received the grant, and 7.58% of which was planted to hybrid rice. To promote the adoption of hybrid rice, in the future the area which received the grant of hybrid rice seed should be increased to 10-15% of total paddy area.

(2) **Provide license to the private sector to import hybrid rice seeds with the condition that after two years the seeds must be produced in Indonesia.** To accelerate the adoption of hybrid rice, importing rice seed is a short cut policy strategy. However, before planted widely the imported hybrid seed has to pass series of field testing to assess its yield performance and enviromental risk. Some company mention that this requirement creates uncertainty on the timely utilization of hybrid rice in the field. Therefore, it is necessary to simplify and shorten the field testing process. To promote local economic activities, the imported seed should be produced domestically after two years since the import permit is granted. In practice, the two years time limit is not strictly followed by the private sector, and there is no strict enforcement as well.

(3) **Facilitate the process of having patent, copy right, and plant variety protection for the researchers**. Some reasearch outputs are diseminated publicly and free of charge, but some others have to go to private sector for further scalling up and mass production. For this purpose, the Center for Technology Transfer Management facilitate reseachers to easier access of patent, copy right, plant variety protection, and other arrangements as necessary.

(4) Promotion, business incubation, and pre-licensing to enable prospective licensor to conduct field trials. After the hybrid rice is patented, it takes some time to attract the interest of private sector to adopt and commercialize the seed. Therefore, it needs some bridgeing process to facilitate the private sector.

(5) Strengthening hybrid rice R&D capacity. Currently there are only 3-5 persons working on rice breeding, including on hybrid rice. Considering complex challenges

to face on this area in the future, the critical mass of scientist working on hybrid rice needs to be increased. Given limited number of researchers, another step to intensify R&D activities on this area is by strengthening R&D collaboration, in particular with the Internationl Rice Research Insitute (IRRI).

CONCLUSION

Responding to the challenge of increasing demand for rice, development of hybrid rice is one of the options. However, hybrid rice development in Indonesia is very slow, which indicate s unacceptable characteristics of the hybrid rice compared to the non-hybrid. Therefore, investments on R&D priority program supported by condusive policy environments is necessary. R&D on hybrid rice should focus on increasing productivity, improvement of grain quality, and increasing seed rate to reduce seed price. To accelerate adoption of hybrid rice, rice development policy program should include hybrid rice as one of the menu. Percentage of area receives hybrid rice seed grant from the Ministry of Agriculture to small holder farmers should be expanded. At initial stage, subsidy on seed price will also be acceptable, but gradually phased out as the adoption rate is increasing.

REFERENCES

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