

THE ROLE OF POST HARVEST HANDLING ON RICE QUALITY IN INDONESIA

Peranan Pengelolaan Pasca Panen terhadap Kualitas Beras di Indonesia

Dewa Ketut Sadra Swastika

*Indonesian Centre for Agricultural Socio Economic and Policy Studies
Jl. A. Yani No. 70 Bogor 16161
E-mail : sadradewa@yahoo.com*

Naskah masuk : 28 Februari 2012

Naskah diterima : 20 April 2012

ABSTRAK

Beras berfungsi sebagai makanan pokok dan bahan baku berbagai produk pangan lainnya yang memerlukan kualitas tertentu. Perbaikan kualitas beras tidak memberikan insentif bagi petani dan pedagang di Indonesia, khususnya melalui perontokan, pengeringan, dan penggilingan. Di pihak lain, sebagian besar negara-negara penghasil padi member perhatian lebih pada peningkatan kualitas beras. Kualitas beras meliputi sifat-sifat fisik yang mempengaruhi penampilan maupun sifat-sifat kimia yang menentukan kualitas jika dimasak. Proses produksi, pasca panen, penggilingan dan pemasaran mempengaruhi kualitas beras. Peningkatan kualitas beras akan menguntungkan produsen maupun konsumen beras. Agar pedagang beras bersedia melakukan pasca panen secara baik diperlukan insentif harga yang memadai untuk gabah kering giling dan beras, misalnya harga pembelian oleh pemerintah. Teknologi pasca panen juga harus diperbaiki agar kualitas beras yang dihasilkan menjadi lebih baik.

Kata kunci : *beras, kualitas, pasca panen, insentif, Indonesia*

ABSTRACT

Aside from being a staple food, rice also has many uses, especially for food industry. Various rice uses require quality evaluation according to the requirement for a specific end use. Whether rice is acceptable for an intended use is determined by quality testing based on a fixed set of criteria. In Indonesia, the main problem of rice quality improvement is the absence of incentive for farmers and traders to improve rice quality, especially through proper threshing, drying, and milling. On the other hands, most rice producing countries are currently paying more attention to the development of post harvest handling and processing to ensure higher rice grain quality. Rice quality is multidimensional. It includes both physical characteristics that influence appearance, and chemical characteristics that determine cooking quality. Thus, rice grain quality is determined by: production process, post harvest handling, milling and marketing techniques. Among rice post harvest handling, proper threshing, drying, milling, and storage are the key points to produce good quality rice. Rice quality improvement is expected to increase national welfare by raising the value of rice to either consumers or producers. In order to encourage rice businessmen to do the proper post harvest handling, there should be attractive price incentives policy for selling dried paddy (*GKG*) and milled rice (*beras*). Price incentive could be in the form of government purchasing price (*HPP*). In other words, there should be an attractive incentive to do a proper threshing, drying and rice milling by using improved technology in order to produce high quality rice.

Key words : *milled rice, quality, post harvest, incentive, Indonesia*

INTRODUCTION

Providing sufficient rice at an affordable price is the main objective of Indonesian development policy, to achieve

food security and maintain political stability. Therefore, the government of Indonesia (GOI) has intervened heavily on rice production, marketing and pricing policy (Sudaryanto *et al.*, 2006; Sudaryanto and Swastika, 2008). Aside from being staple food and political commodity,

rice also has many uses in line with the rapid growth of food industry. Various rice uses require quality evaluation according to the requirement for a specific end use. Whether rice is acceptable for an intended use or not, is determined by quality testing based on a fixed set of criteria.

In Indonesia, the main problem of rice quality improvement is the absence of incentive for farmers and traders. The drying activity from a wet paddy (*GKP*) into a dried paddy (*GKG*) does not provide an attractive incentive for them. Meanwhile, farmers have to meet their urgent basic needs. That is why farmers can not delay to sell their product. They have to sell their paddy soon after harvesting, regardless the price, which is mostly low during the harvesting season. The same case also true for the paddy traders. The improper post harvest handling will results into a low quality of rice, and finally causes a lost in its economic value (Adnyana *et al.*, 2003). This article is aimed to describe the role of post harvest handling to improve rice quality and hence its market value.

RICE QUALITY AND ITS MARKET VALUE

Rice Quality

Rice, unlike most other cereals, is consumed mainly as a whole grain. Therefore physical properties such as grain size and shape, uniformity, impurity, percentage of broken grain, degree of milling, aroma, color, and general appearance are the important properties. Furthermore, since most of rice is milled, the important physical properties are determined primarily by the milled endosperm. Selection for improved milling, cooking, eating qualities as well as nutrient content are essential components of breeding programs designed to meet industry standards or taste and cooking characteristics preferred by consumers in key markets (Rachmat *et al.*, 2005; Rachmat *et al.*, 2006; Plant Sciences, 2003).

Three groups of factors determine the characteristics of rice quality are: (1) genetic control (variety), (2) environmental conditions (cultural practices), and (3) post harvest and processing techniques. The first factor is beyond the capacity of farmers and trader's

handling. It is basically the breeding aspect in generating a new variety. The genetic character of a particular variety dictates to a large degree of the grain quality characteristics. Plant breeders continually refine and improve genetic traits of new varieties required to produce the most desirable products (Plant Sciences, 2003).

The second factor can be controlled by farmers. Marked differences in rice quality occur as a result of the environmental conditions and cultural practices during growth. Farmers can improve the grain quality by improving the cultural practices. An example of good cultural practice is an Integrated Crop and Resources Management (ICM or PTT) such as: practicing a good land preparation, using good seeds, young seedling, proper balance fertilizing using organic and non-organic fertilizers, pest and disease control, and proper water management (Puslitbangtan, 2000; Wardana *et al.*, 2005).

The third factor influencing quality, namely independence of genetics or the environment is associated with threshing, drying, milling, packaging, storage, and distribution. Physically moving the rice with machines can damage the kernels and decrease head yields. Therefore, choosing a proper milling machine is another important effort to obtain a good quality of rice. As frequently occurs, prolonged periods of storage under unfavorable conditions can result in unexpected flavors or odors, so that decrease the quality (Plant Sciences, 2003).

Market Value

There is a very limited comprehensive study regarding the: added value of quality improvement and the choice and preference of rice consumers in Indonesia. Most of the studies were done in a partial manner. Unneverhr *et al.* (1992) did the study on Consumer Demand for Rice Grain Quality. The other scientists did the different aspect of rice quality. The results of the study on consumer preference showed that the Javanese generally prefer the soft cooking rice (called *pulen*) with moderate amylose content, while consumers in Sumatra and Kalimantan mostly prefer the relatively hard cooking (*pera*) with high amylose content. On the other hands, the

farm labors and construction labors prefer rice with high energy, regardless the softness and the taste (Adnyana *et al.*, 2003).

The rice quality in this case is mainly determined by the demand and preference of consumers in a particular region. The price of rice at local market is a true indicator of consumer preference. The consumers tend to buy the best quality that they can afford, and discriminate using a range of different factors depending on locality and economy. The most common factors or characteristics considered are variety, impurity, aroma, color, percentage of broken, degree of milling, grain shape, and size (Rachmat *et al.*, 2005). The more characteristics are met the better is the quality, and hence have a higher market price.

The local varieties of rice, such as: Cianjur in West Java, Rojo Lele in Central and East Java, Hijau Gading in Bali, Ampek Angkek Canduang and Bareh Solok in West Sumatra, have a higher market value compared to high yielding varieties. These superiorities are mainly due to the consumers' preference in the respective region. In addition, those local varieties have the better eating quality, such as aroma and taste for the consumers in each location (Adnyana *et al.*, 2003).

The study of Rachmat *et al.* (2006) in West Java showed that rice quality is varied. Most of them are long and slender kernels, chalkiness ranged between 10-20 percent, and head rice around 69-84 percent. The amylose content was intermediate (20-21%), the gelatinization temperature was high-intermediate (70-74°C), and the gel consistency was soft (65-70).

According to Rachmat *et al.* (2006), quality incentive defined as the additional return assuming the quality level can be raised from grade 3 to grade 1 was up to 25 percent. Grade 1 represents a good quality; grade 2 indicates a medium quality, while grade 3 refers to a poor quality. On the other hands, the price difference among markets could reach 22 percent. This difference indicating the different consumers' preference across location. They also reported that rice color was the important parameter determining consumers' preference, and consequently determining price difference. There was a significant correlation between the rice price

and its grade, with the correlation coefficient of 0.95.

The challenge is to what extent the farmers and other marketing agents can do the proper technology, starting from farm management and post harvest handling, in order to have a better quality and then higher value added. The better the cultural practices at farmers' level the better is the grain quality of paddy. Similarly, the proper post harvest handling done by farmers and traders, will results into a better quality of rice.

POST HARVEST HANDLING

The Existing Condition

The existing conditions of post harvest handling in Indonesia are generally as follows: (1) high yield losses during harvest and post harvest handling; (2) low quality and uniformity of rice; (3) lack of post harvest machinery and technology at farmers level; (4) farmers groups are not able to determine price of their products; (5) lack of detail information on harvesting schedule and production map at the village level. The high yield loss is mainly due to improper technology of harvesting, threshing, transporting the paddy from the field to farmers' houses up to rice millers, drying, and milling. (DG-PMAP, 2009; Setyono, 2009).

The CBS data shows a significant reduction in yield losses from 20.51 percent in 1995/1996 to 10.82 percent in 2005/2007. However, these two data are not comparable, because the losses measurement in 2005-2007 was only done during dry harvesting season, while the largest losses usually occur during the wet harvesting season.

In more detail, the existing conditions of post harvest handling activities are as follows.

Harvesting Technology

Swastika and Mardjan (2010) reported that farmers in West Java and East Java determined the right time to do harvesting by using the physical indicators for maturity, namely the yellowness of grains about 90-95 percent. This way is confirmed with the method

recommended by Nugraha (2008a) regarding the good criteria to determine readiness of rice to harvest. The other additional criterion is the leaf below the panicle is starting to dry. Farmers do harvesting by using sickle. No modern technology, such as using reaper, stripper, or combine harvester is adopted.

Threshing Technology

Currently, there are at least three technologies of threshing adopted by farmers and labors in the field, namely: (1) *Gebot*, hitting paddy on the wooden or bamboo base; (2) Pedal Thresher technology; and (3) Power Thresher technology. Power thresher is currently considered as the best threshing technology in Indonesia. Threshing uses power thresher resulting in a better quality of paddy. Meanwhile, most of farmers in Java do threshing by using *gebot* technology. Regarding the time of threshing, Nugraha (2005) reported that farmers generally delayed threshing paddy for about 1-3 days after cutting. Even in *ceblokan* system (monopoly to harvest), the delayed threshing could reach 5-7 days. The delay threshing will causes the quality deterioration and quantity losses of paddy. The quality deterioration could be in terms of grain germination, damage and grain yellowing, while the quantity loses is in terms of grain losses. In more detail, the quality and quantity losses due to delay threshing (Nugraha, 2008b) are presented in Table 1.

Drying Technology

Drying technology is related to the form of rice trade. Rice can be sold in the form of wet paddy (GKP), dried paddy (GKG) and milled rice. When farmers or traders want to sell their paddy in the form of GKG, then they

need to do drying activity. Even when they want to sell their product in the form of milled rice, then they need to do drying and milling. Swastika and Mardjan (2010) reported that most of farmers and traders in West Java and East Java sold their product in the form of wet paddy (GKP). It is because there is no incentive for them to do drying. So that, drying is mostly done by the rice millers. Only a small portion of paddy is dried by farmers for home consumption.

Farmers in West Java and East Java are drying their paddy under the sun using mats or simple drying floor. Similarly, most of rice millers drying their paddy using sun drying floor. Some rice millers in West Java use both sun drying floor and mechanical dryer. There are at least two kind of mechanical dryer, namely gas dryer (using liquid petroleum gas/LPG fuel) and husk dryer (using rice husk fuel). The mechanical dryers are mainly used during the rainy season, while the sun drying floor is used mainly during dry season. Some problems of using sun drying floor are: (1) needs more space, (2) very dependent upon weather situation, (3) easily contaminated by dust or other foreign matters, and (4) more losses due to animals, vehicles, and strong wind. On the other hands, mechanical dryer need less space compared to sun drying technology. The important advantages of using mechanical dryer are: (1) not depend upon weather, (2) need less space, (3) lower losses, and (4) better quality of paddy, compared to sun drying (Setyono and Sutrisno, 2003).

The rice millers in these two provinces reported that the use of mechanical dryer resulting in a better quality of dried paddy and then milled rice. Although the drying cost is higher than using sun drying floor, however, the milling rate and the price of milled rice is

Table 1. Quality and Quantity Losses Due to Delayed Threshing

Length of delay	Quality losses		Quantity losses (%)
	Germinated (%)	Damage (%)	
1 night	1.77	2.14	0.87
2 nights	2.11	2.67	1.35
3 nights	2.22	2.84	3.12

Source: Nugraha, 2008b.

higher. Therefore, they got higher profit. In terms of investment, when the dryers are used at their mean capacity, using husk dryer is more profitable compared with sun drying floor, in both short and long run (Swastika, 2012).

Rice Milling Technology

Rice milling is a process of transforming rice from paddy into milled rice. The Indonesian Association of Rice Millers (PERPADI) reported that currently in Indonesia there are about 110,000 rice millers. These number of rice millers are processing about 58 million tons of dried paddy (GKG) per year. About 80 percent of them are the small scale, with mostly less than 1 ton milled rice production per day. The small scale rice millers are mostly practice a simple technology, called single pass, consist of one husker and one polisher, without separator (PERPADI, 2009). PERPADI recommended the double pass technology consisting of two huskers, one separator, and two polishers. So that the sequence of the machines are Husker-Husker-Separator-Polisher-Polisher. Setyono (2009) reported the results of his study in 5 provinces showed that 90 percent of small scale rice millers produced low quality of milled rice, with broken rice more than 25 percent.

Apart from low quality, Gaybita, in PERPADI (2009) reported that the low performance of milling machines in Indonesia has caused a high loss, equivalent to 1.2 million tons of milled rice, or equivalent to Rp 5 trillion per year. He also reported that about 90,000 of rice millers did not have mechanical dryers, so that, about 35 million tons of paddy could not be dried properly. Consequently, the price of dried paddy was Rp 200 lower than

the expected price, causes a loss of Rp 7 trillion per year. It is really fantastic, at the rice millers there was a total loss of Rp 12 trillion, due to improper drying and milling. However, none of rice miller realized that there was a big value of losses in the rice milling industry.

By using single pass technology, the milling rate of small millers was 63 percent on average, while the medium scale millers have milling rate of 66 percent on average. The broken rice was 27.5 percent for the small scale millers and 20 percent for the medium scale millers. This result is confirmed with that of Setyono (2009).

Sutrisno (2010) reported that the drying and milling technologies will determine the quality of milled rice, as presented in table 2. As shown in Table 2, that the use of mechanical dryer resulting in a better quality of milled rice, compared to using sun drying floor. Similarly, the use of double pass machine resulting in a better quality of milled rice, compared to using single pass milling machine.

The study of Swastika and Mardjan (2010) showed that the main constraint of farmers, labors, and traders to adopt modern post harvest technologies is the ignorance of them regarding such the technologies. It was mainly due to lack of introduction, promotion and demonstration of the new post harvest machinery. In addition, their study also reported that there was no incentive for the traders to do drying, so that they prefer to sell wet paddy (GKP) rather than dried paddy (GKG).

The low level application of post harvest technology to some extent is also due to lack of post harvest machinery and

Table 2. The Quality of Milled Rice Based on the Drying and Milling Technologies

Components of Quality	Single pass machine		Double pass machine	
	Sun Drying Floor	Mech'l Dryer	Sun Drying Floor	Mech'l Dryer
Head Rice	35.80	59.86	38.88	65.48
Broken Rice	52.34	33.50	49.93	28.48
Turn Green	6.45	4.31	6.87	4.45
Change in Color	0.28	0.10	0.17	0.00
Foreign Matters	0.00	0.00	0.04	0.00

Source: Sutrisno, 2010

technology at farmers level. The business on renting post harvest machinery is likely less attractive. This is mainly due to lack of attractive incentive dealing with rice quality. Farmers groups are also ineffective in dealing with rice quality improvement and respective market price. So that, they have a low bargaining power since they sell their products individually in a low volume and less access to market information.

Some Simple Measures of Good Rice Quality

The most common physical characteristic of rice quality is the moisture content. To some extent, the lower the moisture content the better is the quality. The moisture content will strongly determines the length of preservation, wherever is it being stored. Table 3 shows the preservation time of paddy based on its moisture content and temperature of the storage. The higher the moisture content and the higher the storage temperature the shorter is the preservation time. In contrast, the lower moisture content in combination with lower temperature will improve the time limit of preservation. Rice is very difficult to preserve at the moisture content of 18 percent and temperature higher

than 15°C. When the moisture is about 20 percent the preservation is becoming more difficult, even at the temperature of 10°C. These phenomena show that rice should be dried until at least 15 percent moisture content (Kuo, 2009).

The Importance of Rice Quality Improvement

The rice producing countries are currently paying more attention to the development of premium products and post harvest handling and processing to ensure higher rice grain quality. It was well known since a long time ago that Indonesian consumers showed a significant preference for better milling quality and, in particular, a very strong preference for white (well polished) rice. In addition, consumers in the Philippines, Indonesia and Thailand prefer fewer broken rice, or more head rice. These characteristics of rice quality could only be achieved by a proper milling process. Unfortunately, there is under investment in research to improve the quality of agricultural commodities, rather than in research to increase yields (Unnevehr, 1992).

It is unfortunate, that the majority of rice consumers in Indonesia are currently the

Table 3. Preservation Limit of Rice in Accordance with Its Moisture Content and Storage Temperature

Moisture Content (%)	Storage Temperature (°C)	Time Limit of Preservation
15	0~10	3 years
	15	2 years
	20	1.5 years
	25	1 year
16	0~10	3 years
	10	2.5 years
	15	1.5 years
	20	1 year
	25	0.5 year
18	0~5	1 year
	10	0.5 year
	15~25	Difficult to preserve
20	0~5	0.5 year
	10~25	Difficult to preserve

Source: Kuo, 2009.

middle and low income classes. Therefore, the highest proportion of demand for rice is the medium quality. Some rice millers in West Java and East Java have tried to produce premium rice. The study of Swastika *et al.* (2009) reported that the average price of low quality rice at small rice millers in West Kalimantan, West Java, and South Sulawesi was about Rp 4,200/kg. After being re-polished into medium quality, it can be sold to Bulog with the price of Rp 4,600/kg. Meanwhile, the price of medium quality rice produced directly by medium rice millers was about Rp 5,200/kg. The high quality rice can be sold at the price of Rp 6,000/kg at the rice millers. This situation indicated that under normal condition, there is a bit incentive to produce medium and high quality rice through price difference.

But, sometimes they have to mix the premium rice with the low quality, in order to get the medium quality of rice. Because, the rice wholesalers sometimes request the medium quality rice, due to high demand for medium quality rice (Swastika and Mardjan, 2010). Currently, it is fine, since the per capita income of Indonesian people remains relatively low. In the future, the rice millers have to anticipate the rising demand for premium rice, in line with the improvement of per capita income.

Unnevehr *et al.* (1992) and Damardjati and Oka (1992) reported that as per capita income grows, Asian rice consumers will shift to better quality rice. Under this situation, the quality improvement becomes more important. In the Philippines, Indonesia, Thailand and

Malaysia, consumers prefer greater rice head content. So that, quality improvement of paddy is the key to get a higher rice head content. Threshing and drying are the two key points to get a good quality of paddy before milling. Furthermore, the Indonesian consumers prefer: whiter, more polished, more whole grain, fewer yellow or damage grain. These characteristics can be obtained by proper rice milling. Thus there is a need to encourage rice miller to adopt a proper drying and milling technologies to meet the quality required by consumers.

By using a partial differentiation model, Isvilanonda *et al.* (2008) reported their finding in Thailand, that the estimated expenditure elasticity of quality rice demand is positive (0.132) and greater than that of quantity rice demand elasticity (0.082). This finding reflects the importance of high quality rice in the diet of high income households. As per capita income increases, the demand for high quality rice will increase.

The increasing demand for high quality rice is also indicated by the positive growth of price indices. FAO (2009) reported that the trends of world price indices of various rice qualities are as presented in Table 4.

As shown in Table 4, the growth of price indices of high quality rice (such as Japonica rice, Aromatic rice and Indica high quality rice) is much higher than that of low quality Indica rice. The high growth of price indices of high quality rice indicates the increasing demand for high quality rice.

Table 4. The Trends of World Price Indices, 2005-2009

Year	Indica		Japonica	Aromatic
	High Quality	Low Quality		
2005	124	128	127	108
2006	135	129	153	117
2007	156	159	168	157
2008	296	289	315	251
2009	229	197	341	232
Growth (%/y)	16.57	11.38	28.01	21.06

Source: FAO, 2010. http://www.fao.org/es/ESC/en/15/70/highlight_71.html; (2002-2004 = 100)

Some Lesson Learned from China and Thailand

The improvement in the output of China's premium rice and the constant progress in rice processing technology have been conducive to enhance the international competitiveness of rice from China, and make it possible for China's rice to advance to the international premium-price rice consumer market in the future. There is still a gap between the current production and the potential demand of domestic consumers for premium rice. This situation provides a considerable space for international rice trade (Xubo, 2004).

In Thailand, rice is a staple food. It is suggested that a strategic policy should pay much more attention to the development of premium products and post harvest handling and processing to ensure higher grain quality (Isvilanonda *et al.*, 2008). The president of Rice Association in Thailand recommended the government advise farmers to grow quality grain, rather than focusing on volume. Thai rice needs to set out its own position as high-value rice, rather than competing with other rice-exporting countries. Currently, consumers are inclined to eat higher quality rice grain. Thailand must rapidly develop the quality of its rice to serve the market demand. There is high demand for premium rice in many markets, especially among upper class consumers in European countries, who have high purchasing power (Pratruangkrai, 2010).

For the case of Indonesia, Pratruangkrai (2010) found that Indonesian market had wide variations. As an emerging nation, 10 percent of its population of, approximately 240 million has high purchasing power, and there is an increasing demand for high quality and organic rice. Thailand is attempting to persuade Indonesia to allow the import of 50,000-10,000 tons of "hom mali" and other premium-grade rice annually to Jakarta market and serve the rising demand from high-ended consumers. But Jakarta has not allowed imports of high-quality rice from Thailand. This situation is an opportunity for rice millers in Indonesia to produce high quality rice.

The above discussion indicates that the demand for high quality rice is currently emerging, and will be increasing in the future.

To anticipate this emerging demand and at the same time to improve the competitiveness of Indonesian rice, there is a need to improve post harvest handling, especially threshing, drying and milling activities. Two strategic policies are needed to encourage the businessmen to do proper threshing and drying. Firstly, the government purchasing price (*HPP*) of dried paddy should be adjusted, to provide an incentive for traders to do drying. Secondly, the government of Indonesia should intensively promote the drying technology, especially the mechanical dryer using rice husk as a fuel. This effort can be done by doing a pilot project on husk dryer in some sub districts by involving extension workers in collaboration with farmers group, traders, and rice millers. This technology has a good future prospect, because rice husk is abundant and remains considered as a waste. The technology is available and has been introduced by the Indonesian Rice Research Centre and Indonesian Centre for Post Harvest Research. By using husk dryer, the high cost of drying by using kerosene could be minimized. The study of Swastika and Setiyanto (2011) reported that among three types of rice dryers (sun drying floor, gas dryer and husk dryer) husk dryers is the most profitable dryer. Another strategic policy is to promote better and more complete milling machine. It can be done through improvement of some components of rice milling machines.

The Food and Agriculture Organization (FAO) in 2009-2011 implemented a project on "Strategy for Improving The Rice Post Harvest System in Indonesia" in two provinces (West Java and East Java), from July 2009 until June 2011. The FAO's project has trained more than 600 people, consist of Extension Workers, Bureau of Statistic at district level, BULOG Staffs, Farmers Group, Thresher Operators, Rice Millers, and other relevant people, regarding the Improved Post Harvest Technologies, Loss Assessment Methodology, Maintenance and Repair of Threshing Machine, Good Storage, Demonstration of Mechanical Dryers, and Rice Milling Improvement. The main objective of this project was to improve the capacity of extension workers, statistic personnel, farmers groups, and harvester labors to do post harvest handling. This project can be

replicated in other provinces as a follow up of such a project.

CLOSING REMARK

From the above discussion, one can conclude that there is currently less incentive for farmers and traders in Indonesia to do rice quality improvement, due to less appreciation on higher rice quality. However, in the future the demand for high quality rice will be emerging. Indonesia should start to anticipate the future emerging demand for high rice quality through adoption of improved post harvest technology.

A proper post harvest handling plays a very important role in determining rice quality. In order to encourage farmers and traders to do quality improvement through adoption of improved post harvest handling technologies (especially to do good threshing, drying, and rice milling), there should be an attractive incentive for them. The incentive could be created through an attractive price difference between wet paddy (*GKP*) and dried paddy (*GKG*), as well as between dried paddy and milled rice. So that, the formation of government purchasing price (*HPP*) of wet paddy, dried paddy and milled rice should be in a proper way by considering (i) farm production cost, (ii) reasonable farmers profit margin, (iii) post harvest handling cost, (iv) conversions from *GKP* to *GKG* and from *GKG* to milled rice (*beras*), (v) milling cost, and (vi) considerable profit margin for paddy traders and rice miller.

In terms of improved post harvest technologies development, there should be an intensive introduction and promotion of power thresher, mechanical rice dryer with rice husk fuel, and an improved rice milling technology. These efforts could be done through intensive training, as has been initiated by FAO in collaboration with the Ministry of Agriculture. The Government of Indonesia (GOI) should also encourage the small and medium entrepreneur to run a business on post harvest machinery rental by providing a soft bank credit (loan).

REFERENCES

- Adnyana, M.O., J.S. Munarso, dan D.S. Damardjati. 2003. Ekonomi Kualitas Beras dan Selera Konsumen. *dalam* Kasryno *et al.* 2003 (Eds). Ekonomi Padi dan Beras. Badan Litbang Pertanian. Jakarta.
- Damardjati, D.S. and M. Oka. 1992. Evaluation of Urban Consumer Preference for Rice Quality Characteristics in Indonesia. *In* Unnevehr *et al.* (Eds). Consumer Demand for Rice Grain Quality. IRRI and IDRC. Los Baños.
- Direktorat Jenderal Pengolahan dan Pemasaran Hasil Pertanian. 2009. Kebijakan Penanganan Pasca Panen, Perberasan Nasional, Penerapan Jaminan Mutu dan Keamanan Pangan serta Pemasaran Gabah/Beras. Paper dipresentasikan pada Workshop Revitalisasi Penggilingan Padi, tanggal 7-9 Mei 2009. Kerjasama Ditjen PPHP dengan Bulog. Jakarta.
- Isvilanonda, Somporn, Kongrith, and Weerasak. 2008. Thai Household's Rice Consumption and Its Demand Elasticity. ASEAN Economic Bulletin. Monday, December 2008. <http://www.allbusiness.com/economy-economic-indicators/economic-conditions-growth/12313521-1.html>
- Kuo, P. 2009. Grain Drying Principle. Suncue Company Ltd. Paper presented at the Workshop on Rice Milling Revitalization in Jakarta 7-9 May 2009. DG-PMAP, Ministry of Agriculture & Bulog. Jakarta.
- Mardjan, S. 2010. Assessment of Rice-Post Harvest Losses. Survey Report. Collaborative Study between Food And Agriculture Organization (FAO) and The Directorate General of Processing and Marketing of Agricultural Products, Ministry of Agriculture Republic of Indonesia. Jakarta.
- Nugraha, S. 2005. Paddy Harvesting and Threshing Lost Assessment. Proceeding of International Rice Conference 2005. September, 12-14, 2005. Tabanan, Bali. Indonesian Agency for Agricultural Research and Development in Cooperation with International rice Research Institute (IRRI).
- Nugraha, S. 2008a. Penentuan Umur Panen dan Sistem Panen. Informasi Ringkas Bank Pengetahuan Padi Indonesia 2008. Badan Penelitian dan Pengembangan Pertanian. Jakarta.

- Nugraha, S. 2008b. Keterlambatan Perontokan Padi. Informasi Ringkas Bank Penge-tahuan Padi Indonesia 2008. Badan Penelitian dan Pengembangan Pertanian. Jakarta.
- Plan Sciences. 2003. Concept of Rice Quality. <http://www.plantsciences.ucdavis.edu/uccerice/QUALITY/rqw2003/C-1QualityConcepts2003.pdf>. Downloaded 12 June 2009.
- Pratruangkrai, P. 2010. Farmers Urged to Produce Quality, not Quantity. The Nation. August 27, 2010. <http://www.nationmulti-media.com/home/2010/08/27/business/Farmers-urged-to-produce-quality-not-quantity-30136735.html>
- Pusat Penelitian dan Pengembangan Tanaman Pangan. 2000. Inovasi Teknologi Tanaman Pangan dalam Memantapkan Ketahanan Pangan dan Mengembangkan Agribisnis. Puslitbangtan. Bogor.
- Rachmat, R., R.Thahir, Sudaryono, S. Lubis, Suismono, S. Nugraha, B.A.S. Susilo, M. Gummert, and J. Rickman. 2005. Empirical Relationship of Rice Price and Quality at Market Level. Proceeding of The International Rice Conference 2005, 12-14 September 2005. in Tabanan, Bali, Indonesia. IAARD in Cooperation with IRRI.
- Rachmat, R., R. Thahir, and M. Gummert. 2006. The Empirical Relationship between Price and Quality of Rice at Market Level in West Java. Indonesian Journl of Agricultural Scince 7(1), 2006. Indonesian Agency for Agricultural Research and Development. Jakarta.
- Setyono, A. 2009. Pebaikan Teknologi Pasca Panen Dalam Upaya Menekan Kehilangan Hasil Padi. Pengukuhan Profesor Riset tanggal 26 November 2009. Badan Penelitian dan Pengembangan Pertanian. Bogor.
- Setyono dan Sutrisno. 2003. Perawatan Gabah Pada Musim Hujan. Majalah Berita Puslitbang Tanaman Pangan No.26. Agust. 2003. Bogor.
- Sudaryanto, T., D.K.S. Swastika, B. Sayaka, and S. Bahri. 2006. Financial And Economic Profitability of Rice Farming Across Production Environments in Indonesia. Proceeding of International Rice Congress on Science, Technology, and Trade for Peace and Prosperity, at National Academy of Agricultural Sciences, New Delhi, India. Oct 2006. Published by International Rice Research Institute (IRRI), Los Baños, The Philippines.
- Sudaryanto, T. and D.K.S. Swastika. 2008. Development and Policy Issues in Indonesian Rice Industry. Paper presented at the "Rice Policy Forum", International Rice Research Institute, Los Baños, Philippines, 18-19 Feb. 2008.
- Sutrisno. 2010. Tinjauan Umum Susut dan Penanganan Pascapanen Padi di Indonesia. Fakultas Teknologi Pertanian, Institut Pertanian Bogor.
- Swastika, D.K.S. and S. Mardjan. 2010. The Constraints of Farmers, Labors, Traders and Millers to Adopt The Improved Post Harvest Technologies. Collaborative Study between Directorate General of Processing and Marketing of Agricultural Products and Indonesian Center for Agricultural Socio Economic and Policy Studies with Food and Agriculture Organization (FAO). Submitted to FAO-Rome and FAOR-Jakarta.
- Swastika, D.K.S and A. Setiyanto. 2011. The Financial Feasibility Study of Paddy Dryers in Indonesia: A Case Study in Subang District, West Java Province. Collaborative Study between Food and Agriculture Organization (FAO) and The Directorate General of Food Crops, Ministry of Agriculture Republic of Indonesia. Submitted to FAO-Rome.
- Swastika, D.K.S. 2012. The Financial Feasibility of Rice Dryers: A Case Study in Subang District. West Java. Indonesian Journal of Agricultural Science. Vol. 13 (1).
- Swastika, D.K.S., Sumaryanto, R.N. Suhaeti, R. Elizabeth, dan V. Darwis. 2009. Peningkatan Kinerja Usahatani dan Rantai Pasok Beras pada Berbagai Agro Ekosistem. Laporan Penelitian. Pusat Analisis Sosial Ekonomi dan Kebijakan Pertanian. Bogor.
- Unnevehr, L.J., B. Duff, and B.O. Juliano. 1992. Consumer Demand for Rice Grain Quality: Introduction and Major Finding. *In* Unnevehr *et al.* (Eds). Consumer Demand for Rice Grain Quality. IRRI and IDRC. Los Baños
- Wardana, I.P., P. Bindraban, and H. van Keulen. 2005. Facilitating Innovation for Integrated Crop and Resources Management for Rice

in West Java, Indonesia. Paper presented in The International Rice Conference 2005, 12-14 September 2005. in Tabanan, Bali, Indonesia. IAARD in Cooperation with IRRI.

Xubo, Y. 2004. The Present and Prospect for Trade of Chinese Rice. FAO Rice Conference, Rome, 12-13 Feb 2004.