

**ECONOMIC IMPACT OF HYBRID RICE IN VIETNAM:
AN INITIAL ASSESSMENT**

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ABSTRACT

The study examined current situation of hybrid rice production in Vietnam and gave preliminary assessment of economic impact of hybrid rice production at national and farm levels. Secondary data on F1 hybrid seed and hybrid rice production were collected from Ministry of Agriculture and Rural Development (MARD). Primary data on rice production at farm level was collected through a survey of randomly selected 100 farm households in Ha Tay and Nam Dinh provinces in the Red River Delta. The approach “with” and “without” comparison was utilized for impact assessment. Descriptive statistic analysis was used with Paache index and geometric growth rate. Food balance sheet for the country was computed, partial budget analysis was used to assess changes in income from rice if inbred rice is replaced by hybrids. The result showed that at national level, hybrid rice had brought about 600,000 tons of additional paddy output annually compared the scenario of no hybrids, which is equivalent to 2.1% total paddy output of the country and good for 1.88 million of population. F1 seed production had created an additional employment of about 15,000 workdays for rural labor force annually. Hybrid rice, however, had drawn about 1.55% of rice export earnings (14.5 million US\$) for seed importation yearly and more than 5.5 millions US\$ for R&D during the period 1992-2006. Yet it was shown that hybrid rice had contributed very minimally on the improvement of overall paddy yield in the country and rate of adoption stood at 8% and F1 seed production had been down recently. At farm level, hybrid rice consumed about 30kg of chemical fertilizer/ha (equivalent to 16-17% increase) more than inbreds, but contributed to less than a 3% additional gain in total farm household's paddy output and brought an additional income of 15.27-27.82 US\$/ha for rice growers in the Red River Delta. Minimal contribution of hybrids to farm's output and income resulted from the fact that farmers in RRD had attained higher level in rice farming and benefited from favorable conditions. A complete assessment of hybrid rice development program (covering all ecological regions) should be implemented to consult MARD whether hybrid rice should be further developed at what level. The study concluded that for the future development of hybrids, major areas need to be improved includes rice breeding (good hybrid quality with more advantageous yield), seed industry development, capacity of R&D and seed production, and awareness of the general public and key leaders to the potential of hybrid rice technology.

Keywords: Hybrid rice, economic impact, national level, household income, Vietnam

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1. Introduction

Rice, the main staple food for most Vietnamese (except for some minority groups, such as H'mong), dominates Vietnam's agriculture with about 45% agricultural land devoted to rice production in 2007 (General Statistics Office (GSO), 2008). This sub-sector is a major source of income, employment, foreign exchange earnings, and an important contributor to the economic growth of the country.

Vietnam became a rice exporter in 1989, and is now recognized as the second biggest rice exporter in the world. However, not all of the regions in the country have achieved self-sufficiency in rice production, especially provinces in Northern Vietnam where the highest incidence of poverty is observed. While the Mekong river delta is the main basin of rice production in Vietnam, high marketing costs and demands for export have been obstacles for rice trade flow from South to North, hence this adversely affects the government's attempts to ensure food security in the country overall.

Hybrid rice, proven to have 20% yield advantage over inbred rice in China (Yuan, 2004), was first introduced in Vietnam in 1991 with demonstrations in selected provinces in the North. Hybrid rice was then planted on a wide scale in the following year with an area of 1200 ha, and has now expanded to almost 600.000 ha in 2006 (Table 2), and is concentrated in the North. Given the fact that most of the sub-regions of the North are in rice-deficit situations (Nga, 2006), hybrid rice likely serves as one of the factors contributing to food security in the North of Vietnam.

To promote hybrid rice production, Vietnam's government has spent a large amount of money importing hybrid seed, on R&D for hybrid rice production, and on subsidizing hybrid rice seed production. However, an evaluation of the likely impact of hybrid rice on the national, as well farm level, has not yet been conducted. In view of this, the study attempts to provide preliminary results on the likely impact of hybrid rice, focusing on the economic aspects. Specifically, the study aims to:

- Provide an overview on hybrid rice production in Vietnam;
- Assess key impacts of hybrid rice production at national and farm level; and
- Recommend areas that need to be improved for future development of hybrid rice in Vietnam.

2. Hybrid rice production and adoption in selected Asian countries

China

Hybrid rice was first successfully developed in China in the 1970s. In 2003, an area of 15,210 ha was devoted to hybrid rice in the country, accounting for about 52% of the total rice area of the country (Table 1) and more than 90% of the total hybrid rice area planted in Asia. Average hybrid rice yield in China was recorded at 7 tons/ha in 2004 (Yuan, 2004b), 1.4 tons higher than inbred rice yield. China has developed super hybrid rice since 1996, which attained yields of 12 tons/ha in the period 2001-2005 (Yuan, 2004b). Hybrid rice is

expected to attain yields of 13 tons/ha in the country in the future. However, the rate of hybrid rice adoption has decreased steadily (at low pace) because of changing demand. According to David (2005), Chinese's income levels have increased, consumers demand for good quality rice has increased, while hybrid rice varieties have not been able to meet this demand.

Bangladesh

Hybrid rice research was initiated at the Bangladesh Rice Research Institute (BRRI) in 1983 but only for academic purposes. The government encouraged private sector companies to import hybrid rice seeds and try them with farmers. Some private seed companies imported rice hybrids and evaluated them through on-farm trials during 1997-98 *boro* season (winter rice). In 2001, about 20,000 ha was devoted to hybrid rice production in the country, this figure was report at 49,655 ha in 2003, making up less than 1% of the total rice area of Bangladesh (Table 1). Husain (2001) shows that grain yields of hybrids were 14% higher than that of high yield varieties. Constraints to hybrid rice adoption in Bangladesh included external dependence and higher cost of seed, higher need for management skills, input intensity, higher incidence of pest and diseases, inadequate yield gains and lower head -rice recovery. Stickiness of cooked rice and its relatively inferior quality in terms of taste were also considered as other constraints for hybrid rice adoption.

India

Research on hybrid rice was initiated in India in the 1980s with imported materials from China, which was then shown to be not adaptable to local conditions. With support from FAO and UNDP, India has developed its research network in hybrid rice since the early 1990s. The private sector actively participates in hybrid rice production, especially seed production. However farmer's adoption of hybrids in the country is still at a low level. In 2003, the area devoted to hybrid rice was about 200,000 ha, less than 1% of total country's rice area. Therefore, emphasis is now given to creating awareness among farmers, especially in the states of Uttar Pradesh, Maharashtra, and Karnataka. In India, hybrid rice area has been reduced and is now mostly confined to "small areas where there are government and seed industry on-farm demonstration programs" (Grain, 2005).

Myanmar

Myanmar started research on hybrid rice in 1997 and released its hybrid seeds. Hybrid rice activities in Myanmar are being pursued by both the public and private sectors. The private sector is primarily dominated by Chinese seed companies, which are involved mainly in the dissemination of Chinese-bred hybrids. In 2001, the area cultivated in hybrid rice was about 10,000 ha (Table 1). Yield advantage of hybrid was shown to be about 12% -48% over inbred varieties through experimental trials done by IRRI and the Mandalay Division in 2003. IR58025A and IR68897A are among the 15 IRRI-developed lines being maintained at CARI. These two lines have been selected for large-scale use in the development of rice hybrids.

Philippines

The Philippines became the fourth country to engage in hybrid rice and released its first hybrid seedling in 1993. The development and use of hybrid rice technology as a major approach for further increasing rice productivity has drawn attention from the government. A Hybrid Rice Commercialization Program (HRCP) initiated in 2001, is the centerpiece strategy of the governments' Ginintuang Masaganang Ani (GMA) program

to attain rice self-sufficiency in the country. The HRCP targets 135 hectares in 2002, 200,000 ha in 2003 and 300,000 ha in 2004 (PhilRice, 2005).

According to the Philippine government statistics, hybrid rice varieties in the previous 12 seasons from 2001-2007 have recorded a yield advantage of 33% over those of inbred certified seeds. The adoption of hybrid seeds by farmers has been slow, moving from about 5% in 2004 to 11% of total rice area in 2005 (David, 2006). The Philippine government has subsidized hybrid seed heavily (SEARCA, 2005). This creates problems for the dissemination of hybrid rice as it depends on the government's budget, especially in times of financial crisis and budget deficits, as has been the case over the past several years.

3. Hybrid rice in Vietnam

3.1. Research in hybrid rice

Research in hybrid rice was initiated in the late 1970s at Vietnam's Institute of Agricultural Science. Since 1983, CLRRRI and IRRI have been in collaboration to develop hybrid rice technology for farmers in the Mekong River Delta provinces. Experimental results show that hybrid rice outyielded inbred rice by 18-45% (Luat et al, 1994). At present, institutions involved in hybrid rice research are the Hybrid Rice Research Center, Hanoi University of Agriculture, Cuu Long Rice Research Institute, and the Agricultural Genetic Institute. Vietnamese scientists have selected and produced parental lines with novel characteristics for rice production in the country, such as 103S, T1S-96, T4S, T23S, T70S, T100, AMS27S (Tram, 2007). These lines are used to produce Vietnamese F1 seed such as VL20, VL24, TH3-3, TH3-4, HYT83, and HYT92.

3.2. F1 seed production

Vietnam first released F1 seed in 1992, which was produced in a limited area of less than 200 ha (Fig. 1). With very low yield (on average of 302kg/ha), total F1 seed amount released in 1992 was recorded at about 52 tons. F1 seed area declined slightly during 1992 - 1995, but then recovered and expanded quickly after that, reaching 1920 ha in 2006. There has also been significant improvement in productivity, which was recorded at 2.2 tons/ha in 2006, 7 times higher than in 1992. The main production areas of hybrid seed are provinces in the north, such as Thanh Hoa, Hai Phong, Ha Nam, and Nam Dinh. In 2005, an area of 820 ha was devoted to Vietnamese seeds, accounting for about 60% of the total hybrid seed area in the country. The rest was planted in Chinese hybrid varieties. This suggests that Vietnamese hybrid rice seeds are accepted and preferred by growers.

Domestic supply of F1 seed, however, has not been able to meet the demand, which grew quickly due to the rapid expansion of hybrid rice production in the country (Fig. 2). Vietnam has had to import F1 seed (mainly from China). In 1998, the imported quantity of seed was 4,106 tons, this figure tripled to 13,316 tons in 2006 (Fig. 2). On average, total domestically produced seeds meet 18.54% demand. In 2008, it was reported that the F1 seed area dropped to 1200 ha (NNVN, 2008).

3.3. Hybrid rice adoption in Vietnam

In 1992, the total area devoted to hybrid rice was recorded at 11,094 ha (Table 2), accounting for 0.17% of the total rice production area. Up until now, hybrid rice is planted in about 40 of the 64 provinces in the country. The Red River Delta (RRD) takes the lead in hybrid rice production with a 51.25% share in 2000 (Table 3). This rate declined to 36%

in 2006. The North Central Coast has become the region with the highest adoption rate in the country recently, recorded at 38.23% in 2006.

In the Red River Delta, Ninh Binh province had largest hybrid rice area, at 94,800 ha in 2000, but this area declined to 84,000 ha in 2006. Other provinces that experienced declines in hybrid rice adoption are Ha Nam, Hai Duong, Thai Binh, Ha Noi, Vinh Phuc. Other provinces have expanded the area of hybrid rice. For example Hung Yen has an annual growth rate of hybrid area posted at 14%, and the increase in area is 7.35% in Bac Ninh. However, hybrid adoption in the RRD has declined at rate of 1.07% during the period 2000-2006 (Table 4). Possible reasons are (i) Removal of price subsidy; (ii) Unstable source of seed; (iii) There is some inbred rice with comparable yield, such as Q5, Khang Dan; and (iv) Farmers moved to varieties with medium yield but high quality and value, such as Bac Thom 7.

Farmers in the South have started growing larger areas of hybrids recently. Arize B-TE1 (India originated) have been introduced in the South recently and shown its advantages over inbred rice in terms of yield and resistance to unfavorable soil conditions. Farmers in the South, (i.e. Binh Dinh, Quang Nam, Kien Giang) are becoming more convinced in the use of hybrid rice.

4. Methodology

4.1. Study area and data collection

Secondary data on hybrid seed and hybrid rice production in Vietnam and some Asian countries were collected from the Department of Plant Cultivation, Ministry of Agriculture and Rural Development (MARD), IRRI web page, FAO, India hybrid rice webpage, GRAIN publications. A case study on hybrids at farm level was done in Nam Dinh and Ha Tay in spring 2007 and summer 2006 crop seasons. Primary data on rice production (inputs, cost, output, etc.) of both hybrids and inbred was collected in a survey of 100 farm households in the two provinces.

4.2. Analytical tools

Vietnam's hybrid rice development is briefly described in terms of seed and hybrid rice areas, productivity, volume of production, and its share of total output. Trend analysis with the aid of tables, graphs, and geometric growth rate were used to show the pattern of development.

To examine the impact of hybrid rice technology at national and farm levels in Vietnam, the approach "with" and "without" comparison was made. The simple descriptive statistic method was used with Paache indices. This study also made use of food balance sheet computation method described in Que and Thao (2004). Partial budget analysis was used to evaluate likely impact of hybrid rice on farm households' income. Hybrid rice is expected to have positive impact on total rice output of household, but lower price might contribute to insignificant change in gross output value. Also, fertilizer cost for hybrid rice is expected to be higher than that of inbreds.

There is a number of hybrid and inbred varieties grown at the survey site, hence the most popular varieties are chosen for the analysis. Hybrid rice here refers to Nhi uu 838 and TH3-3, inbred rice refers to Bac Thom 7 and Khang Dan.

5. Impact of hybrid rice in Vietnam

5.1. At national level

Production of F1 seed creates more employment in rural areas

According to the latest survey on F1 seed production in Truc Ninh district, Nam Dinh province in April 2008,, total labor required for 1 ha of F1 seed production is approximately 400 workdays. Compared with total labor required for 1 ha of inbred rice production in the North, which was estimated at about 300 workdays/ha, production of F1 seed creates about 100 workdays/ha¹. Hence, total number of workdays created by F1 seed production has increased with area expansion. Table 5 shows that F1 hybrid production has created more than 15,000 workdays yearly since 2001. In 2007, a workday in seed production was paid with around VND 49,000, (Tung, 2008), almost the same with average wage rate in the survey sites. This is an opportunity for unemployed labor in rural areas, especially women and old farmers. F1 seed production created about 1.2 million workdays in the period 1992 - 2006.

Production of hybrid rice contributes to higher overall paddy yield of the country

During the period 1992-2006, overall paddy yield of the country increased from 3.33 tons/ha to 4.89 tons/ha (Table 6) , as a result of yield improvement and changes in area structure devoted of both hybrids and inbreds. Table 7 shows that the major source of overall paddy yield improvement in the period is attributed to increase in paddy yield of hybrid and inbred rice. For instance, total yield change is 1.56 tons/ha (during the period 1992-2006, of which 1.33 tons/ha is resulted from improvement i n hybrid and inbred yield and the rest is attributed to area structural changes).

Table 6 shows that there was a minimal improvement in hybrid paddy yield in the period 1992-2006 (0.1% annually), while inbred paddy yield grew at rate of 2.4% annually. Even though Vietnam experienced a high adoption rate of hybrid as compared to other Asian countries (8% recently), this change in area structure contributes much less than yield improvement. Hence, hybrid rice has contributed very little to overall paddy yield improvement of Vietnam since 1992.

Production of hybrid rice contributes to higher total paddy output of the country

Despite of much lower rate in productivity improvement as compared with inbreds during the period 1992-2006, hybrids are still advantageous over inbreds in terms of yields (6.32 tons/ha vs. 4.66 tons/ha in 2006, table 6). With higher yield and expanding area of hybrids, total paddy output of the country has been at higher level as compared with case of no hybrids. Table 8 shows that if no hybrids were planted, total paddy output of the country would be 21.56 million tons instead of 21.59 million tons in 1992. With hybrid rice, additional output was estimated at 906,000 tons in 2007. On average, hybrid rice brought an additional quantity of 589,800 tons of paddy annually during the period 1992 -2006, or 2.1% paddy output compared with case of no hybrids.

Production of hybrid rice contributes to higher level of food security

According to the socioeconomic survey of MARD in 2001, annual per capita rice consumption was 178 kg². Gains in total output contributes to higher level of food security,

¹ This figure is a little bit lower than stated in FAO (2004), which was 400 -500 workdays/ha required for F1 seed production in the North Vietnam.

² which included both home and outside consumption, and different rice -made products such as noodle, cakes, etc.

as it makes higher quantity of rice supply, hence quantity of rice available for human consumption. Table 8 presents estimates for the number of people that could be fed with additional rice gained from hybrid rice production. In 1992, about 18.04 tons rice gained from hybrids which could feed 101,359 people in a year. This figure increased to approximately 2.9 million people in 2006. On average, gains in hybrids production could ensure food security for 1.88 million people annually. This is approximately the population of 1-3 provinces in North East, North West, North Central Coast, or the Central Highlands. Given the fact that these regions are rice-deficit, hybrid rice production is a big opportunity for improving food security in these regions.

Hybrid rice has drawn resources from the country

To develop hybrid rice, the government has spent money on seed importation and seed production subsidy: seed price subsidy, technical trainings, research and development. During the period 1998-2006, the average import quantity of seed was recorded at 11,172 tons yearly, valued at 14.5 million USD. Annual spending on hybrid seed imports were 1.55% of total earnings from rice exports (Table 9). Vietnam spent a total of 130.3 million USD importing seed during the period 1998-2006. According to the Department of Agriculture (2005), total budget spent for the extension program and R&D in hybrid rice production from 1993-2005 is recorded at 82.4 billion VND (approximately 5.5 million USD). Some provinces spent more for their hybrid rice program (Thanh Hoa, Nam Dinh).

The hybrid rice development program in Vietnam has received support from MARD and local governments in various forms. However, hybrid rice area has not shown increased development and even the hybrid seed area has declined to 1200 ha in 2008 (NNVN, 2008). As a result, a larger quantity of seed is imported and larger amounts of foreign exchange are required.

5.2. At farm level: case in the Red River Delta

Hybrid rice is expected to improve total rice output of farm households. Its impact on a household's income is uncertain as lower price may leverage yield advantages.

Profile of surveyed farm households and varieties adopted

The average size of a farm household is about 5 people and 3 of them are in the labor force (Table 10). The respondents have an average of 8.34 years of education. On average, each household has 0.38 ha devoted to rice production.

The majority of farm households planted both hybrids and non-hybrids (91% and 73% of total sample in spring and summer seasons, respectively). Hybrid varieties are Nhi uu 838 , Nhi uu 63, D uu 527, TH3-3. Inbred varieties are Khang Dan, Bac Thom 7, and Nep 97.

Fertilizer application

Table 11 shows that hybrid rice consumed Nitrogen much more than inbred in both seasons. In spring 2007, total Nitrogen for 1 ha of hybrid rice was estimated at 116.7 kg/ha, 29 kg higher than inbred. The difference is bigger in summer 2006. Farmers applied P₂O₅ for hybrids at a higher rate than for inbreds in spring, but less than for inbreds in the summer. For K₂O, it was found that farmers applied less for hybrids. In spring 2007, a hectare of hybrid rice was treated with 45.05 kg K₂O, while this figure is 54.48kg for inbred rice. However, it is correct that farmers spent more on chemical fertilizers for hybrids than for inbreds with the difference being about 30 kg /ha (Table 11)

Impact of hybrid to total paddy output of farm household

In spring 2007, the average yield of paddy was estimated at 6.39 tons/ha and 6.19 tons/ha for hybrid and inbred respectively, which is quite high for inbred. Paddy yield in the summer was about one ton lower than in the spring (Table 12). With about 65% and 34% of the total rice area planted to hybrids in the spring and summer crop seasons respectively, total paddy output was estimated at an average of 2.43 tons in spring season and 2.12 tons in summer season. Assuming that no hybrid rice was planted, total paddy output would be 2.38 tons and 1.98 tons in the spring and summer seasons, respectively. Changes in total paddy output due to hybrid adoption was minimal, which brought about 49 kg for household in spring crop season (Table 12), accounting for only a 2.1% increase. The reason for the low contribution of hybrids is because farmers in the survey site have attained high yield from inbreds.

Impact of hybrid to household's income from rice production

Assuming inbred rice is now replaced with hybrids, will farmers become better-off? Table 13 shows that if one ha of inbred is replaced, total estimated increase in income is 27.82 USD and 15.27 USD in spring and summer seasons respectively. It is likely that the positive impact of hybrids on farm household's income is insignificant. A simple calculation shows that by replacing inbreds with hybrids, a typical farm household with total rice area of 0.38 ha would gain about 10.7 USD and 5.9 USD VND in spring and summer, respectively.

Reasons for hybrid rice adoption

Figure 3 shows that yield advantage is the reason for the majority of farmers to plant hybrid rice (79% of respondents). This is somewhat inconsistent because hybrid rice did not show a significant higher yield in the above analysis. However, it should be noted that there is a difference in the yield in lodging areas, where farmers planted almost no inbred rice because of the low resistance to lodging conditions. The study also has missed the analysis of how different types of soil influence the yield.

About one-third reported that hybrids are less susceptible to insects and more resistant to lodging. Shorter life time (which opens opportunity to have cash crop in winter), better rice cooking quality, and better selling price were rewarded to Vietnamese hybrid rice. It was reported that the price of TH3-3 was higher than some inbreds, such as Khang Dan, Q5.

Production distribution

About one half of a farm household's total paddy output is sold after drying. For hybrid rice, farmers kept 50% of the total output for home consumption (36.33%), and to store it to sell later (12%). It was observed that farmers kept a smaller percentage of inbred paddy output for home consumption (29.08%). However, there is no difference in the pattern of using rice for food between inbred and hybrid. Farmers used 23.55% and 24.76% of total hybrid and total inbred outputs for food consumption, respectively (Table 14). This may help to change some people's thinking that hybrid rice is just used for animal feed. While 12.78% of hybrid output was used for feeding animals, about 4.27% of total inbred produces was used for the same purpose.

6. Constraints to hybrid rice adoption in Vietnam

The availability of quality seed at a reasonable price is a crucial factor behind the large-scale adoption of hybrid technology for any crop. China's success in the large-scale adoption of hybrid rice can also be attributed to the efficient hybrid seed production and distribution

system. In Vietnam, hybrid rice production has scaled up at a slow rate recently due to problems of hybrid seed and grain quality.

Unstable supply of hybrid seed

With almost 80% of seed imported from China, Vietnamese farmers are dependent on seed supply from outside in terms of quantity, quality, variety and price. A tightening of the supply from China would result in excess demand in domestic market and price would go up, the case that happened in the winter-spring crop 2005 and summer crop season 2008. It was reported that the price of Chinese hybrid seed in 2008 was more than doubled the previous year, and many farmers in RRD were not able to buy TH3-3 or VL-20 seed.

The dependence on the seed source may be partly attributed to the low capacity of domestic seed production and distribution system, possible causes are:

- Many seed companies prefer to import seed instead of produce and market the domestically produced seed because it is more profitable and less risky.
- Limited capacity to enlarge hybrid seed areas. Aside from that, seed companies take advantage of the government's subsidy by reporting incorrectly their capacity of production or higher seed area planted.
- Limited knowledge on hybrid seed production is also a problem. Aside from risks caused by unfavorable climate, poor synchronization of the parental lines has resulted in low (even zero) yield, and this is mostly due to limited knowledge of technical assistants and seed growers.
- Dependence of parental seeds imported from China, as Vietnam is not able to supply the required parental seeds for production.

Seed quality

Quality control is vital to the widespread adoption of hybrid rice. Quality control is done throughout the entire process of seed production (including nucleus, breeder, foundation and certified seed production of both parental lines and F₁ hybrids). Seed quality standards are met by the intensive elimination of off-types (from seeding to harvesting) and careful handling during harvesting, threshing, drying, cleaning, processing, bagging and labeling (Virmani et al, 2002).

Lower quality of domestically produced seed also results from the weak capacity of seed producers. It was reported that in a quality test for hybrid seed in 2008, 46 out of 219 samples of hybrid rice seed did not meet the quality standards (Nguyen, 2008).

The weak performance of seed quality control system in Vietnam has been mentioned. Seed quality is not ensured especially in times of tight supply and excess demand when traders could make profits by importing and selling poor quality seed. Poor quality seeds result in low yield and economic loss for rice farmers; hence it discourages farmers from adopting the hybrids. It has happened that several seed companies sold seed to farmers with quality differing from that reported on the label. Other more recent cases happened in Binh Dinh province, two cooperatives in An Nhon districts provided farmers with seed stored from previous season. Poor storage caused low seed quality and very low germination rate. In Hung (2007), it was reported that only 84.9% of imported seed in 2006 was quality seed, and 74.4% of imported seed was certified to meet the requirement of purity.

Farmers prefer imported seed to domestically produced seed

The psychology that imported goods are better than domestic ones probably applies in this case. In 2006, seed produced by cooperatives in Vu Ban district was sold at 12,000 VND/kg

but farmers still bought imported seed (China) at about 20,000 VND/kg. Farmers believed that imported seeds were better than domestically produced seeds in terms of discoloration, grain size uniformity, presence of off-types, and germination rate (Tung, 2008). However in many cases, they were not aware that they had bought the domestically produced seeds in imported labels. The fact is that imported seed companies buy seed produced in Vietnam and pack it in it in sacks with their labels on it. Weaker demand for domestically produced seed has contributed to the slow rate of seed production in Vietnam.

Lack of parental lines and lack of good varieties for summer crop season

Vietnam has only been able to produce parental lines for F1 seed production recently, but it has not yet been able to produce the quantity required. Lack of parental lines contributes to more dependence on imported seed. This, coupled with seed companies' preferences for importing over producing seed themselves, has hindered the expansion of F1 seed production in Vietnam.

Hybrid rice is susceptible to blast disease during the summer season, and this is especially true of Chinese varieties. That is one of the reasons hybrid rice is not preferred during the summer season. Some of 2-lines hybrids of Vietnam have advantages of shorter maturation time and less susceptibility to blast disease, but are not adaptable to a wide range of conditions.

Grain quality and awareness of public and key leaders

Grain quality is one of major factors limiting the adoption of hybrid rice in most of the Asian countries (Dat, 2002). Most of the widely adopted Chinese varieties in Vietnam, such as Nhi uu, Bac uu, D uu, were reported to be of lower quality than inbreds, but they are still being used for food. Recently, Vietnamese hybrid rice (TH3 -3, VL20, HYT 83, and HYT 92) has been appreciated for its better cooking quality and higher yield than some inbreds, but these varieties are not adaptable to a wide range of conditions.

Whether hybrid rice should be developed in Vietnam or not, and at what scale is a controversial topic among government leaders and scientists. Some view that the government's investment in hybrid rice development program is not effective and efficient, the quality of hybrids is low, or hybrids have high susceptibility to diseases. These views are a result of the fact that great efforts (budget, human resources) have been put into hybrid rice development in the past 16 years, but hybrid rice adoption is still at a low rate and Vietnam depends much on Chinese seed production.

7. Conclusions and future outlook

Conclusion

Hybrid rice has contributed to higher paddy output, hence better food security in Vietnam, especially in the North by providing an additional amount of almost 600,000 tons annually. This amount is good for about 1.88 million people (2.5% of total population) every year. This extra amount creates better accessibility to food for the poor consumers. Without hybrid rice technology, it would require about 138,000 ha more to produce the same quantity, which is not feasible because some previously agricultural land has been built up and is used for other purposes³. Hybrid seed production opens opportunities for rural

³ In period 2001-2005, more than 366,000 ha of agricultural land were transferred to non-agricultural purposes (KTNT, 2008).

employment. However, the analysis shows that hybrids have contributed very minimally to the improvement of paddy yield over the past 16 years.

At farm level, hybrid rice in the Red River Delta was not found to have a yield advantage (15-20%) over inbred rice as expected. As a result, hybrid rice contributed to less than a 3% additional gain in total farm household's paddy output. The lower price of hybrids contributes to a minimal positive impact of hybrid rice on farm household's income from rice. The fact is that rice farmers in the RRD had attained a higher level in rice farming practices and benefited from favorable conditions for both hybrids and inbreds. Future studies on the impact of hybrid rice should be concerned with specific ecological conditions for rice.

Future outlook

With a decrease in rice area, hybrid seed area, and also the slow trend in hybrid rice adoption recently, MARD has paid special attention to the promotion of hybrid rice and to maintaining the area devoted to rice. The Prime Minister required the Ministry of Resources and Environment to review and report on the current status of agricultural land in the country, especially rice area (Decree 391/Q -TTg dated April, 2008). Besides this, MARD encourages enterprises/companies (with more than 100 ha of rice seed) to produce hybrid seed to avoid the need to import a large quantity of seed. The Department of Plant Cultivation (MARD) proposed to increase spending from 1.5-3 times higher for extension projects in hybrid rice production, focusing on seed (NNVN, 2008). The focus on hybrid rice should be extended to the southern and central part of Vietnam, especially to the south central coast where hybrids have an advantage over inbreds in their better resistance to unfavorable conditions. For the target of MARD – to be self-sufficient in hybrid seed for 70% hybrid rice area in 2010- more efforts should be initiated to enlarge seed production areas.

The continued support of the government will be needed for the development of hybrid rice in the country. The major issues that still need to be addressed include: the lack of hybrids with good quality, the advantage of yield and adaptability to various ecological conditions, the absence of a strong private rice seed industry (in terms of producing and willingness to market the domestic seed); inadequately trained labor for R&D; problems with genetic purity and flowering synchronization in hybrid seed production; the limited number and experience of seed growers; inadequate equipment for research and seed production; small and fragmented F1 seed production areas; and the limited awareness of the general public and key leaders to the potential of hybrid rice technology.

Hybrid rice development has brought about changes in paddy productivity and total output of the country, and other positive impacts. Meanwhile, it has been the target of much spending from the government. The question of whether the hybrid development program is effective and efficient, and hence should be continued, is still unresolved.

REFERENCES

- Dat Van Tran. 2002. Hybrid rice for food security: recent progress and large -scale production issues. <http://www.fao.org>
- David, C.C. 2005. "Philippine Hybrid Rice Program." Paper presented at the SEARCA-ADSS. Los Baños, Laguna (June 21, 2005).
- David, Cristina C. 2006. Philippine Hybrid Rice Program: A case for Redesign and scaling Down. Manila: Philippine Institute for Development studies (PIDs).
- FAO.2004. Hybrid rice for food security. <http://www.fao.org/rice2004/en/f-sheet/factsheet6.pdf>.
- GRAIN.2005. "Fiasco in the field - An update on hybrid rice in Asia." <http://www.grain.org/>
- Hung, Le Quang. 2007. K t qu h u ki m lúa lai 2006. K t qu kh o nghi m gi ng cây tr ng. Hanoi Agricultural Publishing House, pp 228 -232.
- Husain, A. M. Muazzam. 2001. Socio-economic assessment of hybrid rice adoption by farmers in Bangladesh.Agricultural Research and Extension Network. Newsletter No. 44.
- Luat, Nguyen Van, Nguyen Van Suan, and S.S. Virmani. 1994. Current status and future outlook on hybrid rice in Vietnam. Vietnam and IRRI: A Partnership in Rice Research Proceedings of a Conference held in Hanoi Vietn am.
- Nga, Nguyen Thi Duong. 2006. Spatial integration of rice markets in Vietnam. Unpublished PhD thesis. University of the Philippines at Los Banos.
- Nguyen Binh. 2008. C n nh p kh u h n 13.000 t n gi ng lúa lai. <http://www.laodong.com.vn>
- PhilRice. 2005. Midterm Impact Assessment of Hybrid rice Technology in the Philippines.
- Quang, Pham Dong, Le Quy Tuong, Nguyen Quoc Ly and CTV. K t qu i u tra gi ng cây tr ng trên c n c hai n m 2003-2004. 2005. Khoa h c công ngh nông nghi p và phát tri n nông thôn, 20 n m i m i. National Politic Publishing House.
- Que, N.N and Tran Dinh Thao. 2004. Báo Cáo T ng Quan Ngành Lúa G o Vi t Nam.
- SEARCA. 2005. Future Directions in Philippine Hybrid Rice . Policy Brief Series
- Tram, Nguyen Thi. 2007. K t qu ch n t o gi ng lúa lai hai dòng. Paper presented at Workshop " Hybrid rice and agricultural biology system", held at Hanoi University of Agriculture.
- Tung, Dang Huy. 2008. Phát tri n s n xu t h t gi ng lúa lai trên a bàn huy n Tr c Ninh - t nh Nam nh. Unpublished BSc thesis, Hanoi University of Agriculture.
- Virmani S.S , C.X. Mao, R.S. Toledo, M. Hossain and A. Janaiah. 2002. Hybrid Rice Seed Production Technology and Its Impact on Seed Industries and Rural Employment Opportunities in Asia. <http://www.agnet.org/library>
- Yuan Longping. 2004a. Hybrid rice for food security in the world, FAO rice conf erence, Rome, Italy. <http://www.fao.org/rice2004/en/pdf/longping.pdf>
- Yuan Longping. 2004b. Hybrid Rice Technology for Food Security in the World The World Food Prize International Symposium , October 15, 2004

TABLES

Table 1. Hybrid rice adoption in selected Asian countries

Country	Area cultivated (ha)			Hybrid rice as % of total area
	1997	2001	2003	
China	17,708,000	15,821,000	15,210,000	52
Vietnam	187,000	480,000	600,000	8
India	120,000	200,000	<200,000	<1
Philippines	500	90,000	107,000	3
Bangladesh	0	20,000	49,655	<1
Burma	0	10,000	unknown	-
Pakistan	0	0	Field trials	-

Source: GRAIN, 2005

Table 2. Hybrid rice area in Vietnam, 1992-2006 (ha)

Year	Total	Spring season	Summer season	Rate of adoption
1992	11094	1156	9938	0.17
1993	34648	17025	17623	0.53
1994	60100	45400	14700	0.91
1995	73500	39600	33900	1.09
1996	127700	60400	77300	1.82
1997	187800	110800	77000	2.65
1998	200000	120000	80000	2.72
1999	233000	127000	106000	3.04
2000	435508	227615	207893	5.68
2001	480000	300000	180000	6.41
2002	500000	300000	200000	6.68
2003	600000	350000	250000	8.06
2004	577000	350000	222104	8.09
2005	601944	350000	251944	8.21
2006	584000	346000	238000	7.97

Source: Department of Plant Cultivation statistics, MARD

Table 3. Hybrid rice area in different ecological areas of Vietnam, selected years.

Region	2000		2006	
	Area (ha)	%	Area (ha)	%
Northern Mountainous region	109500	25.21	135000	22.93
Red River Delta	225400	51.25	214000	36.41
North Central Coast	99500	21.75	225000	38.23
Central Highland and South Central Coast	7800	1.79	14000	2.43
Total	442200	100.00	588000	100.00

Source: Division of Cultivation statistics, MARD

Table 4. Trend in hybrid adoption area in provinces in the Red River delta, selected years (ha)

Province	Year		Average growth rate 2000-2006 (%)
	2000	2006	
Ninh Binh	94800	84000	-2.00
Nam Dinh	34300	36000	0.81
Hai Phong	23800	24400	0.42
Thai Binh	25600	18200	-5.53
Vinh Phuc	15800	15000	-0.86
Ha Tay	6700	8000	3.00
Hung Yen	3550	7800	14.02
Bac Ninh	4900	7500	7.35
Ha Noi	6400	4500	-5.70
Hai Duong	3200	1500	-11.86
Ha Nam	2600	900	-16.21
RRD	221650	207800	-1.07

Table 5. Estimates of employment created by F1 hybrid seed production in Vietnam, 1992-2006

Year	F1 seed area (ha)	Total additional employment created(workdays)	Year	F1 seed area (ha)	Total additional employment created(workdays)
1992	173	17300	2000	620	62000
1993	154	15400	2001	1450	145000
1994	123	12300	2002	1600	160000
1995	101	10100	2003	1700	170000
1996	267	26700	2004	1500	150000
1997	410	41000	2005	1380	138000
1998	340	34000	2006	1920	192000
1999	455	45500			
Total					1219300

Sources: Computed on the basis of GSO, MARD data

Table 6. Trend in productivity of hybrid and inbred paddy, Vietnam, 1992 -2006 (tons/ha)

Year	Overall productivity	Hybrid yield	Inbred Yield
1992	3.33	6.22	3.33
1993	3.48	6.75	3.46
1994	3.57	5.84	3.54
1995	3.69	6.14	3.66
1996	3.77	5.85	3.73
1997	3.88	6.35	3.81
1998	3.96	6.50	3.89
1999	4.10	6.47	4.03
2000	4.24	6.45	4.11
2001	4.29	6.44	4.14
2002	4.55	6.30	4.42
2003	4.63	6.30	4.49
2004	5.03	6.08	4.92
2005	4.89	6.15	4.78
2006	4.89	6.32	4.77

Sources: Computed on the basic of GSO and MARD data

Table 7. Factors contributing to overall paddy yield improvement, Vietnam, 1992 -2006

	Change	
	Absolute (tons/ha)	Percentage (%)
Overall paddy increase	1.56	146.70
Contribution of yield increased	1.33	137.44
Contribution of area structure	0.22	106.74

Sources: Computed on the basic of GSO and MARD data

Table 8. Impact of hybrids to total paddy output and food security, Vietnam, 1992 - 2005

Year	Total paddy output (000 tons)	Total paddy output if no hybrids (000 tons)	Changes in paddy output (000 tons)	Changes in paddy output (%)	Change in rice quantity (000 tons)	No of people fed with additional rice gained from hybrids (person)
1992	21590.4	21558.9	31.5	0.15	18.04	101359
1993	22836.5	22723.2	113.3	0.50	64.92	364697
1994	23528.2	23390.7	137.5	0.59	78.75	442394
1995	24963.7	24782.0	181.7	0.73	104.10	584805
1996	26396.6	26126.9	269.7	1.03	154.51	868048
1997	27523.9	27048.6	475.3	1.76	272.27	1529621
1998	29145.5	28624.3	521.2	1.82	298.57	1677364
1999	31393.8	30826.5	567.3	1.84	324.97	1825694
2000	32529.5	31513.1	1016.4	3.23	582.28	3271209
2001	32108.4	31009.3	1099.1	3.54	629.63	3537221
2002	34063.5	33133.3	930.2	2.81	532.89	2993771
2003	34474.98	33392.8	1082.2	3.24	619.97	3482967
2004	35867.8	35217.0	650.8	1.85	372.85	2094664
2005	35832.9	35012.2	820.7	2.34	470.17	2641410
2006	35826.8	34929.4	897.4	2.57	514.11	2888261
Average (92-06)	29872.17	29285.89	586.28	2.00	335.87	1886899

Sources: Computed on the basis of GSO and MARD data

Table 9. Foreign exchange spent on seed importation, Vietnam, 1998 -2006

Year	Total spending on F1 hybrid seed		
	Value (mil.USD)	Compared with previous year (%)	As percentage of rice export earnings (%)
1998	5.42		0.54
1999	10.60	195.65	1.02
2000	14.15	133.45	2.12
2001	16.21	114.53	2.44
2002	14.33	88.42	1.98
2003	11.75	81.99	1.49
2004	18.85	160.46	2.19
2005	21.61	114.64	1.54
2006	17.37	80.36	1.38
Total	130.3		
Average	14.5	115.67	1.55

Sources: Sources: Computed on the basis of GSO and MARD data

Table 10. Socio-economic and demographic characteristics of farm households

Criteria	Unit	Quantity
Number of surveyed households (hh)	hh	100
Average size/hh	Person	4.57
Average number of labors	Person	2.76
Household head's age	Year	49.32
Years of household head's education	Year	8.34
Average rice area/household	Ha	0.38
HH with more than 50% income from agriculture.	hh	68

Sources: Calculated on the basis of surveyed data

Table 11. Chemical fertilizer application for hybrid and inbred rice by surveyed farm households (kg/ha)

Fertilizer	Spring 2007				Summer 2006			
	Hybrid	Inbred	Difference		Hybrid	Inbred	Difference	
	(1)	(2)	(3) = (1)-(2)	(4) = (1)/(2)	(5)	(6)	(7) = (5)-(6)	(8) = (5)/(6)
Nitrogen	116.89	87.88	29.01	33.02	163.21	97.12	66.08	68.04
P ₂ O ₅	55.23	45.38	9.85	21.70	56.93	74.80	-17.87	-23.89
K ₂ O	48.05	54.48	-6.43	-11.79	37.66	48.98	-11.32	-23.11
N+P+K	220.18	187.74	32.44	17.28	257.79	220.90	36.89	16.70

Source: Calculated on the basis of surveyed data

Table 12. Impact of hybrid rice on total output of farm household s

Indicators	Unit	Spring	Summer
Yield	kg/ha		
Hybrid	kg/ha	6,391.53	5389.35
Inbred	kg/ha	6194.17	5166.02
Share of hybrid in total hh's rice area	%	65	34
Total output /farm household	kg	2430.86	2015.43
Total output/farm household if no hybrids	kg	2381.53	1986.23
Additional output gained	kg	49.32	29.19
As percentage	%	2.07	1.47

Source: Calculated on the basis of surveyed data

Table 13. Partial budget analysis for the replacement of inbred with hybrid rice
(applied for 1 ha)

Changes	Spring crop	Summer crop
Positive effects		
Total additional income (USD)	1,482.83	1,228.78
Reduced cost(USD)	451.23	448.52
Total additional income and reduced cost(USD)	1,934.07	1,677.29
Negative effects		
Reduced income(USD)	1,548.54	1,224.51
Additional cost(USD)	357.70	437.52
Total reduced income and additional cost(USD)	1,906.24	1,662.03
Change in net income	27.82	15.27

Note: exchange rate is 15,000 VND: 1 USD

Source: Calculated on the basis of surveyed data

Table 14. Production distribution in spring 2007 crop season (%)

Purpose	Hybrid	Inbred
Total	100	100
1. Sold after drying	50.03	63.06
2. Home consumption	36.33	29.08
Food	23.55	24.76
Seed	0.00	0.06
Feed	12.78	4.27
Other	1.19	0.74
3. Store to sell later	12.12	5.27
4. Other	2.71	9.54

Source: Calculated on the basis of surveyed data

FIGURES

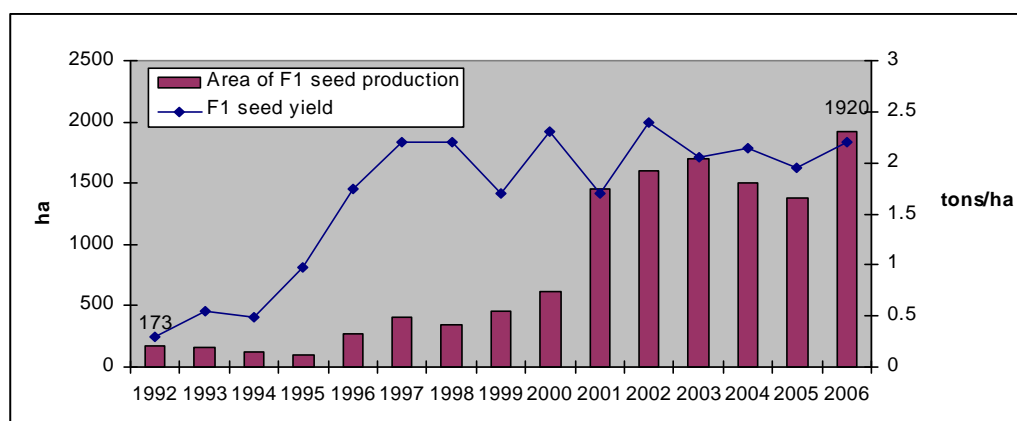


Figure 1. Trend in F1 hybrid seed area and yield, Vietnam, 1992 -2006

Source: MARD's statistics

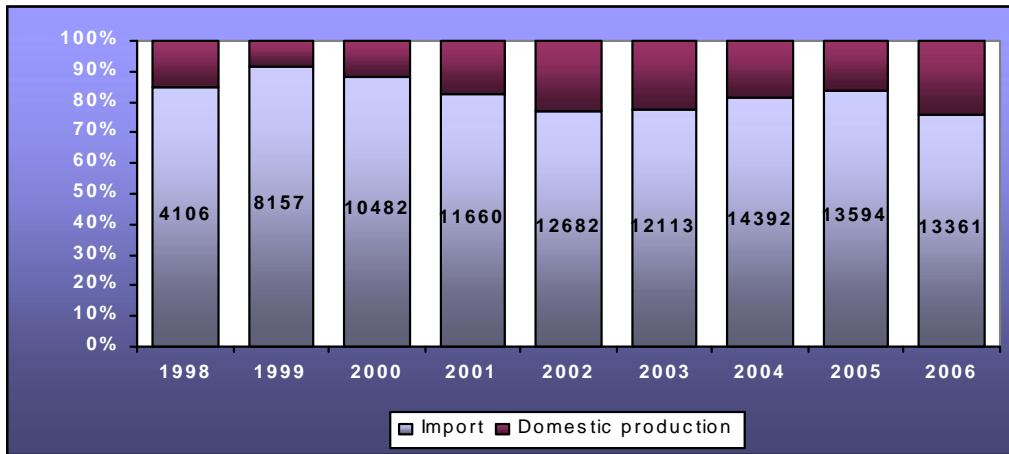


Figure 2. F1 hybrid rice production and import, Vietnam, 1998 -2006

Sources: MARD and Vietnam Custom

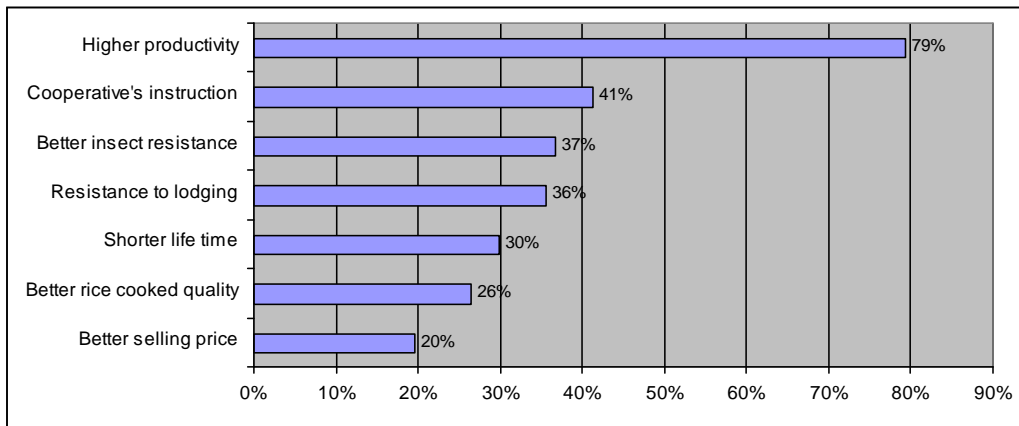


Figure 3. Reasons for hybrid rice adoption by farmers in Nam Dinh and Ha Tay

Sources: Computed from surveyed data

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