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Impact of Economic Liberalization on Rice Intensification, Agricultural Diversification, and Rural Livelihoods in the Mekong Delta, Vietnam

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Abstract

In the late 80s, the Socialist Republic of Vietnam embarked on bold economic liberalization policies. The ensuing market, price, credit, and land tenure reforms allowed very reactive small farmers to use new technologies and to improve their livelihoods thanks to a dramatic agricultural growth, especially in irrigated rice production. This was particularly the case in the Mekong Delta and this article analyzes the impact of the economic liberalization reforms on this crucial agricultural system. The process of rice intensification is explained in detail, and an analysis of the closely related dynamics of diversification into non-rice activities is also provided.

The intensification of rice-based production systems with more fixed capital, working capital, and labor led to an increase in family incomes. But the evolutionary pathways of farming households reveal that, depending on their initial endowment in productive resources, the pace of capital accumulation has been unequal among farmers. Consequently, economic reforms are leading to an increased differentiation among farming households in terms of types of production system and income level.

At a time of increasing use of chemical inputs and renewable natural resources, and as social inequalities lead to labor migration, several key technological, environmental, and socioeconomic issues regarding the sustainability of rice intensification and agricultural diversification processes are discussed.

Keywords: economic liberalization, rice intensification, agricultural diversification, farmer differentiation, Mekong Delta, Vietnam

I Introduction

During the past 15 years, the process of economic liberalization profoundly transformed most of the countries under State planned economies. If most of them have experienced a decline in their economic growth during the years following the implementation of their liberalization policy, Vietnam has enjoyed a rapid, vigorous acceleration in its economic growth and an

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increase in the well-being of its population. This growth was particularly strong in the agricultural sector. A rapid increase in rice production allowed the country to reach food self-sufficiency and to become the second largest exporter in the world rice market, with annual rice exports reaching more than 3 million tons. Besides rice, the backbone of Vietnam's agricultural sector, non-rice farm products also experienced rapid growth rates in the 90s. Such a dramatic increase in agricultural production, the overall increase in household income, and the reduction in the rate of poverty positioned Vietnam as a successful case of liberalization policy. The Mekong Delta is a key region for agricultural growth in Vietnam because it is an essential "rice bowl" of the country, accounting for more than half of national rice production, with the highest growth rate of rice production recorded since 1985. Intensification of rice production and the diversification of farming activities led to a rapid agricultural growth in the Mekong Delta during the past 15 years and these key processes are examined in this article.

As paddy areas tend to stagnate since 1985, the growth in rice production resulted from a vigorous process of rice intensification leading to increased rice yields and a higher cropping index, which captures the average number of crops planted on the same piece of land per calendar year (ratio of the total sown area to the total area of paddies). From 1985 to 2000, the average rice yield in the Mekong Delta jumped by 39% to reach 4.2 tons of paddy per hectare, while the cropping index increased by 66% over this period to 1.9. At the same time, farming of non-rice products increased sharply and the share of paddy area out of total farm land decreased from 81% to 70% from 1985 to 2000.

Several authors described the rapid evolution of agriculture in the Mekong Delta. Tanaka [1994] and Nguyen Huu Chiem [1994] analyzed changes in cropping patterns following the launch of the economic liberalization. They showed the adoption of semi-dwarf high-yielding rice varieties (HYV) of the Green Revolution that have been introduced since the early 70s [Vo Tong Xuan 1995a]. The impact of the liberalization reforms of the early 80s on the growth of rice productivity was described by Pingali and Vo Tong Xuan [1992], and the analysis of the impact of the liberalization policy conducted by Nguyen Tri Khiêm [1994] showed that the increase in rice production was due to the expansion of irrigated rice areas. More recent research carried out by Kono [2001] underlined the key role played by the development of a network of canals and hydrological infrastructure in the intensification of rice cultivation in the Mekong Delta.

This article analyzes the major changes affecting farmers in the Delta following the implementation of liberalization policies in the late 80s and explains the responses of farming households to these profound transformations of their economic environment. It describes the linkages among major changes in the farm socioeconomic environment, farmers' behavior, and the adoption of new technology. Finally, the authors explain how and why economic liberalization led to both the intensification of rice production and agricultural diversification, and quantify the impact of these key processes on economic differentiation among farming households.

To assess the impact of economic reforms on rural livelihood systems, the authors rely on

a case study carried out in Omon District in the central plain of the Mekong Delta. A historical and systemic approach was used to determine the factors and conditions contributing to the agricultural development processes under study. Original data were collected during farm surveys and the transformations of the socioeconomic environment at the regional and country levels were analyzed through the available literature. Open interviews with key informants were used to assess the socioeconomic transformations and the related changes in local production systems before and after the liberalization process. In-depth interviews with 70 diverse households from two villages of Omon District were carried out to understand farmers' choices of production systems and their management strategies. A complementary sample description survey of 256 randomly selected farming households in Thoi Long village in the irrigated rice ecosystem and Dong Thuan village in the deepwater rice area was used to assess the distribution of each main type of farm according to its amount of productive resources, the characteristics of its production systems, and its economic results in 1995. Among these 256 households, a sub-sample of 80 farms was selected and surveyed in 2003 to analyze more recent changes in production systems and their economic performances.

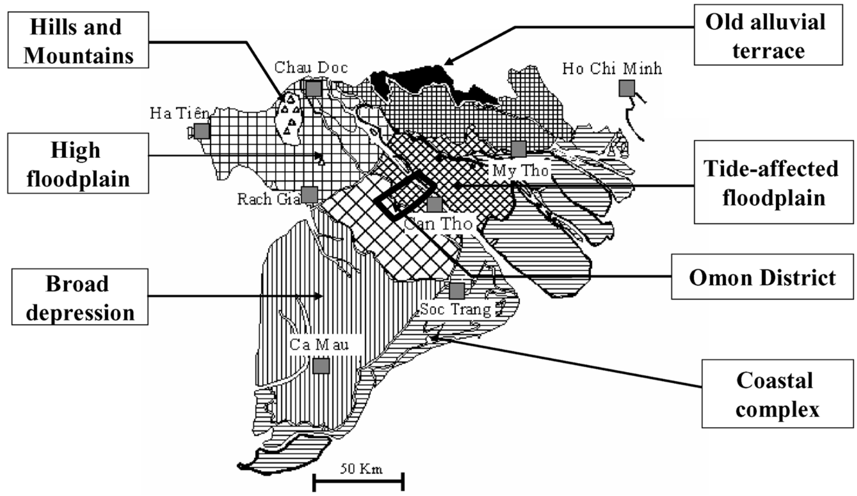
Following an overview of the key characteristics of Omon District, this article examines its agricultural situation before the economic reforms. The analysis of the rice intensification process by farmers in close relationship with the implementation of the economic reforms follows. Its linkages with current agricultural diversification are elucidated. The impact of these agricultural dynamics on the extent of farmer differentiation in terms of type of production system and level of income is quantified. Finally, recent changes are presented and several key issues regarding the sustainability of this agricultural development are discussed.

II Omon District: An Overview

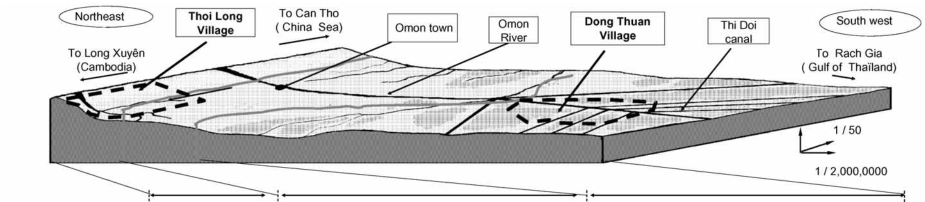
II–1 *Location and Physical Characteristics*

Omon District is located in the tide-affected central floodplain of the Mekong Delta (Map 1). It is characterized by a medium depth and duration of the flood, the absence of salinity throughout the year, and a relatively low level of soil acidity [Nguyen Huu Chiem 1993].

Omon District extends from the riverbank of the Bassac River (Hau River) to the lowlands of the Trans-Bassac floodplain. It is composed of three main subunits of the tide-affected floodplain: the natural levee (NL), the back swamp (BS), and the broad depression floodplain (BDFP). It is representative of the diversity of biophysical conditions of rice ecosystems in the central plain, including rainfed and deepwater ecosystems (Fig. 1). The irrigated ecosystem covers the northeastern part of the District and now accounts for two-thirds of the District area. The deepwater rice ecosystem still occurs in the southeastern part of the District. The NL is characterized by a shallow and short flood, no access to water by gravity during the dry season, and no soil acidity. The BS is characterized by an intermediate to high depth of flood, its medium duration, potential water intrusions at high tide during the dry season, and no soil acidity. The BS area is naturally connected to the Bassac River hydraulic network through



Map 1　Location of Omon District in the Mekong Delta, Vietnam
Source: [adapted from Nguyen Huu Chiem 1994]



	Land-form units	Natural levee	Backswamp		Broad Depression Floodplain	
	Rice ecosystems	Rainfed, shallow submergence-prone	Rainfed, medium-deep waterlogged	Deep water	Deep water	Very deep water
Physical characteristics	altitude (m)	1.2 to 2	1.2 to 1	1 to 0.8	0.8 to 0.6	less than 0.6
	Flood depth (m)	0 to 0.3	0.3 to 0.5	0.5 to 1	0.6 to 1	1 to 1.5
	Flood duration (month)	0 to 1.5	1.5 to 2.5	2.5 to 3	2.5 to 3.5	3.5 to 4.5
	potential natural gravity irrigation in Dry Season	No	yes	Yes	No	No
	Soil acidity	No	No	No to potential	Potential to medium	Medium to high
Land use	Non-rice production	**Orchards, vegetables**	**Orchard,** vegetables on river levees and raisebed		Vegetables, tubers, and orchards on embankment of primary canals and **sugarcane on raisebed**	
	Type of rice production system	Irrigated rice <- 3 HYV -> 1 HYV/2 NRAC <- 2 HYV/NRAC -> <--------- 2 HYV --------->			3 HYV Deepwater rice transplanting or direct-seeding NRAC / DWR	
	Animal husbandry	Swine, poultry, ducks, **aquaculture**	Ducks, aquaculture	Ducks	Swine, poultry, ducks, **aquaculture**	Ducks
	Other agricultural activities	Fisheries year-round				

Note　HYV: high-yielding rice variety; NRAC: non-rice annual crop; DWR: deepwater rice

Fig. 1　Geo-morphological Units, Physical Conditions, and Land Use in Omon District in 1995

rivers such as the Omon and Bang Tang. The BDFP is characterized by a deep and long flood, as well as strong soil acidity. It was not connected naturally to the Bassac River, but, thanks to a network of man-made canals, dug at the beginning of the twentieth century but only completed in the late 70s and 80s, it is now linked to it.

II–2 *Evolution of Agricultural Production under the Implementation of the Liberalization Policy*

The evolution of agricultural production in Omon District is a relevant illustration of the rapid changes in the Mekong Delta production systems in recent years. This region registered an impressive growth in rice production following the implementation of the economic reforms, with an annual growth rate of around 17% from 1985 to 1995. In 1985, the average rice yield was 3.51 tons of paddy per hectare and the annual land physical productivity was 5.3 tons of paddy equivalent per hectare. In 1995, average rice yield reached 4.29 tons per hectare and annual land productivity jumped to 9.56 tons per hectare. During the same period, rapid agricultural diversification occurred in the central plain of the Mekong Delta. It was characterized by the expansion of orchards and fruit production areas on the natural levee and to a lesser extent in the BS, and by the growth of sugarcane production in the BDFP during the early 90s. In Omon District, the area planted to orchards expanded to an annual growth rate of 11.9%, and from 2,781 to 4,890 ha from 1990 to 1995.

II–3 *Current Characteristics of Agricultural Production and Land Use in Omon District*

The central plain of the Mekong Delta presents two original characteristics in terms of agricultural production: a high level of rice intensification associated with a relatively high level of agricultural diversification. With 9.6 tons of paddy produced per hectare and per year (compared with an average of 6.5 tons in the Mekong Delta), the central plain achieves a high level of physical productivity on its rice land. In Omon District, rice productivity increased to 10.6 tons of paddy per hectare and per year in 1995 as a consequence of a higher average yield per crop cycle (4.8 tons per hectare) associated with a higher cropping index (2.2 in 1995), and reached 13.2 tons of paddy per hectare and per year in 2002 with a average yield per crop cycle of 5 tons per hectare and a cropping index of 2.6. But cropping intensity varies according to land form units and rice ecosystems. Rice production systems with 2 or 3 crops of irrigated HYV per year on the same plot of land occupy the entire rice lands on the NL and in the BS. In the deepwater rice (DWR) areas, while the DWR cropping system was still present in 1995, production systems with 2 crops of HYV per year were already predominant and, in 2003, DWR was totally replaced by HYV-based cropping systems (Fig. 1).

This part of the Delta displays a relatively high level of diversity of its agricultural production. The total non-rice production area represents 17% of the total farm land (compared with an average of 16% for the whole Mekong Delta). The main non-rice type of production is orchards, covering 45% of the non-rice farm land. In Omon District, orchards are particularly frequent on the NL and, to a lesser extent, on the natural levees of rivers in the BS. Other significant non-rice crops are annual industrial crops of the following three kinds: grain legumes

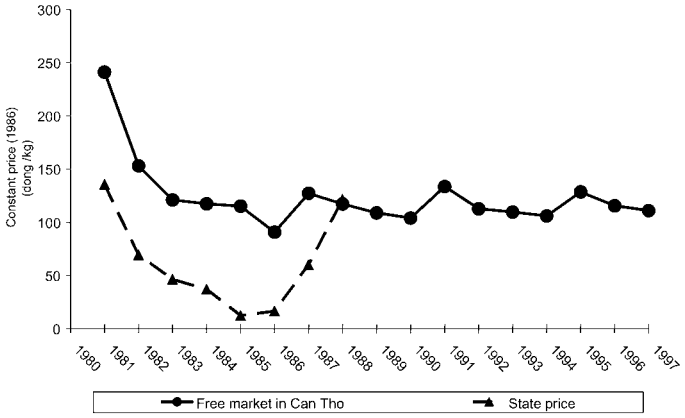
such as soybean and mungbean cultivated in rotation with HYV of rice in the irrigated ecosystem of the NL; tubers, especially sweet potatoes, produced in rotation with DWR in the BDFP; and sugarcane, which is mainly cultivated on raised beds in the BDFP (Fig. 1).

III　The Agricultural Situation before Economic Liberalization

III–1　*State Control over Agricultural Products and Trade in Inputs*

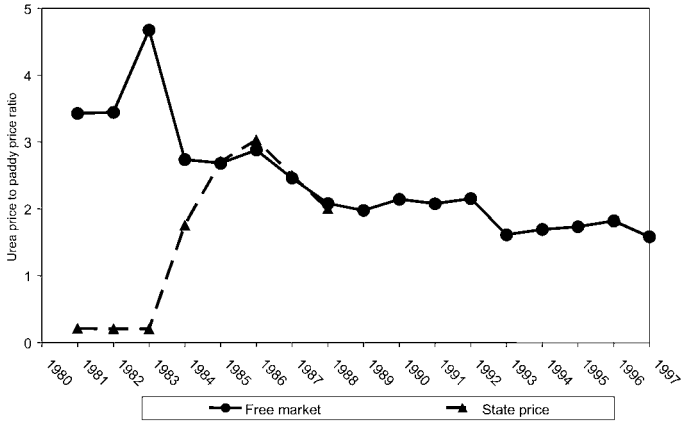
After the reunification of the country in 1976, trade in rice and agricultural inputs became a state monopoly. According to the contract 100 system that was put in place countrywide in

a.　Evolution of the constant price of paddy



Source: Price committee of Can Tho Province
Note: Inflation rate was used as deflator to calculate constant price.

b.　Evolution of the ratio between the price of 1 kg of urea and the price of 1 kg of paddy



Source: Price committee of Can Tho Province

Fig. 2　Evolution of Price Systems from 1981 to 1997

1981, farmers had to sell their rice to the state commercial system to reimburse inputs previously provided by the state distribution network [Pingali and Vo Tong Xuan 1992]. Under this system, farmers had to sell a contractual amount of their production to the state. Although their surplus could be sold on the free market, the level of the contractual amount to be delivered to the state was high and farmers had limited surpluses to sell on the free market. In 1985, the state price was a mere 20% of the free-market price (Fig. 2a).

The markets for key agricultural inputs such as chemical fertilizers (Urea, Di-Amono-Phosphate, etc.) and pesticides were also controlled by the state. The state supplied subsidized fertilizers to farmers organized in "production groups" called "*tap doan*" or cooperatives called "*hop tac xa*." Because of its disorganization, this state supply system encountered shortages, could not procure inputs on time, and saw products move away from the official commercial system to the free market, where at that time prices were 10 times higher. Even if some fertilizer could be found on the private market, farmers could not afford to buy it at a very high price and were not motivated to do so because of their low expectation to be able to sell their product at a price allowing the recovery of such a high cost of inputs. Event if they could buy fertilizer and sell their rice surpluses on the free market, the ratio between the price of urea and the price of paddy was high and provided no incentive to intensify (Fig. 2b). Under those conditions, farmers were applying low rates of chemical fertilizers that limited the level of rice yields. As a result of this low price of rice and low level of rice productivity, farmers' investment capacity was very limited [Le Coq 2001].

III–2 *Collectivization of Production Factors*

After 1976 and the integration of South Vietnam in the Socialist Republic of Vietnam, land became the property of the state and farmers had no guaranty of land tenure since their farm land could be taken away from them at any moment and re-allocated among farmers in "production groups" as observed during the late 70s and early 80s. With the creation of "production groups," means of production such as draft animals and moto-mechanized tools (e.g., pumps, hand-tractors, etc.) were taken away from their owners to become the property of the group. They were scarce and their collective use led to mismanagement and poor maintenance. In those days, farmers had no incentive to buy such farm equipment.

III–3 *Low Level of Farm Incomes and Limited Differentiation among Farming Households*

Farming household incomes were low because of the poor productivity of their production systems, the official pricing system in place, and the scarcity of off-farm and non-farm employment opportunities due to state control over commercial activities and the ban on private ownership of heavy equipment. Under those conditions, differentiation among farming households remained limited since production factors, especially land, were quite evenly distributed. Within "production groups" and cooperatives, rice fields were re-allocated among households according to their number of family labor units. Almost all the farmers had some land to cultivate, but all were smallholders. In the villages located in the NL and the BS, where

population density was high, one main family labor (*lao dong chinh*) received 0.13 to 0.15 hectare of land. In the villages located in the BDFP, where the population density was lower, farmers received 0.2 to 0.25 hectare per family labor [Vo Tong Xuan 1995b; Le Coq 2001]. After the payment of taxes and in-kind advances of the contract system, the potential for income generation in rice production was about the same among the local farms and close to the subsistence level. Some differentiation among households was due to differential access to non-rice fields, such as orchards in the NL and sugarcane plantations in the BDFP, because those kinds of land were usually not re-allocated among farmers under the production groups system. Nevertheless, differences in income levels among households due to this were still limited because non-rice production areas per farm were still at a low level while poor access to markets limited the potential incomes from those productions.

IV　An Impressive Intensification of Rice Production

The economic reforms launched in the late 80s deeply modified the socioeconomic environment of farms in terms of changes in the conditions for the exchange of inputs and products through market liberalization and in production conditions thanks to the privatization of production factors. These profound changes initiated a tremendous process of rice intensification during the last decade and across the different ecosystems: the intensification of HYV systems in the irrigated ecosystem on the NL and BS, and the expansion of the HYV system in the former DWR ecosystem in the BDFP. To provide a better understanding of the specific effects of market liberalization and the recognition of private ownership, we separate the intensification process into two steps: intensification of input use and yield increase on the one hand, and intensification of fixed assets and an increase in cropping intensity on the other.

IV–1　*Trade Liberalization and Intensification of Input Use*

In 1988–89, the state suppressed its partial monopoly on rice and domestic trade in agricultural products [Pingali and Vo Tong Xuan 1992; Vo Tong Xuan 1995b; Dao The Tuan 1997]. Private trading was authorized and farmers were free to sell their rice on a unified market. By selling all their production on the free market, farmers got higher benefits from their rice production. Without any change in their cropping practices and production systems, but just thanks to this increase in gross product, farmers could obtain a higher level of added value per hectare from their rice crops at constant prices (Stage 1 on Fig. 3). This benefited mainly farmers exploiting the irrigated rice ecosystem (Stage 1 on Fig. 3a) more than those cultivating in the DWR ecosystem (Stage 1 on Fig. 3b).

The liberalization of the domestic market, coupled with the opening of international trade, allowed farmers to export the rice surpluses from the Mekong Delta that were formerly transferred to the northern and central parts of the country through the state commercial system. Barter trade helped Vietnam to rapidly increase its imports of key chemical inputs such as urea. Vietnam, which was a net importing country until 1988, suddenly started to export

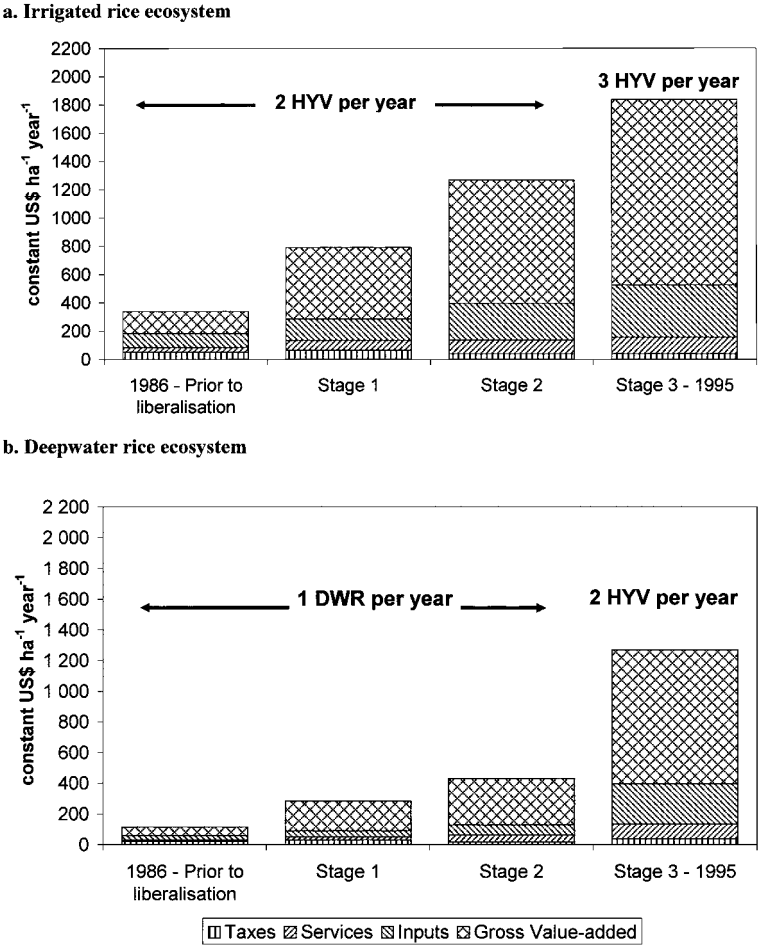


Fig. 3 Steps in Rice Intensification and Corresponding Changes in Rice Productivity for Irrigated and Deepwater Rice Ecosystems in Omon District, Mekong Delta, during 1986–95

Sources:

1986: Amount of fertilizer used estimated according to the contract system recommendation. Yield level, pesticide use, and services estimated through farmers historical interviews (CTU-CIRAD, 1995). Paddy price based on State price according to the price committee of Can Tho Province.

Stage 1: same level of yield, fertilizer, pesticide and services as in 1986 but under the free market price system in 1990 according to the price committee of Can Tho Province

Stages 2 and 3: based on survey of 256 households (CTU-CIRAD, 1995)

Notes: The rate of inflation was used as deflator to calculate constant prices.

HYV: high-yielding rice varieties

more than 1.5 million tons of rice after 1990. From 1990 to 1995, the volume of mineral fertilizer imports climbed almost threefold from 460,000 to 1,260,000 tons per year. At the country level, the amount of chemical fertilizer available per hectare of farm land jumped from 89 kg in 1990 to 214 kg in 1995 (data compiled from GSO and FAOstat). Thanks to the improved availability of chemical fertilizers, the constant price of fertilizer on the unified market decreased significantly. If the constant price of paddy remained rather stable on the free market after 1985 (Fig. 2a), the ratio between a kilogram of urea and a kilogram of paddy decreased from 2.8 in 1985 to around 1.5 in 1995 (Fig. 2b). This provided a strong incentive to farmers to increase their use of mineral fertilizers. At the District level, the average rate of application of mineral fertilizers jumped from 192 kg per hectare in 1985 to an average level of 350 kg per hectare in 1995 on the 256 farms surveyed in Omon District in 1995. In the same fashion, the liberalization of the pesticide domestic market led to an increase in their availability and use at the farm level. Farmers increased their use of pesticides to control pests and to limit crop losses. This overall increase in key input use, especially mineral fertilizer, led to a rapid growth in rice yields and land productivity (Stage 2 on Fig. 3). This increase was particularly important in the irrigated ecosystem, where the planting of fertilizer-responsive HYV was already well established.

Market liberalization generated a first step of rice intensification based on an increase in the use of chemical inputs allowing strong growth in the physical productivity of the land through yield improvement. But market liberalization alone cannot explain either the tremendous increase in rice production observed since 1988 or the present high level of land productivity in Omon District.

IV–2 *Privatization of Production Factors and Intensification of Rice Cropping Patterns*

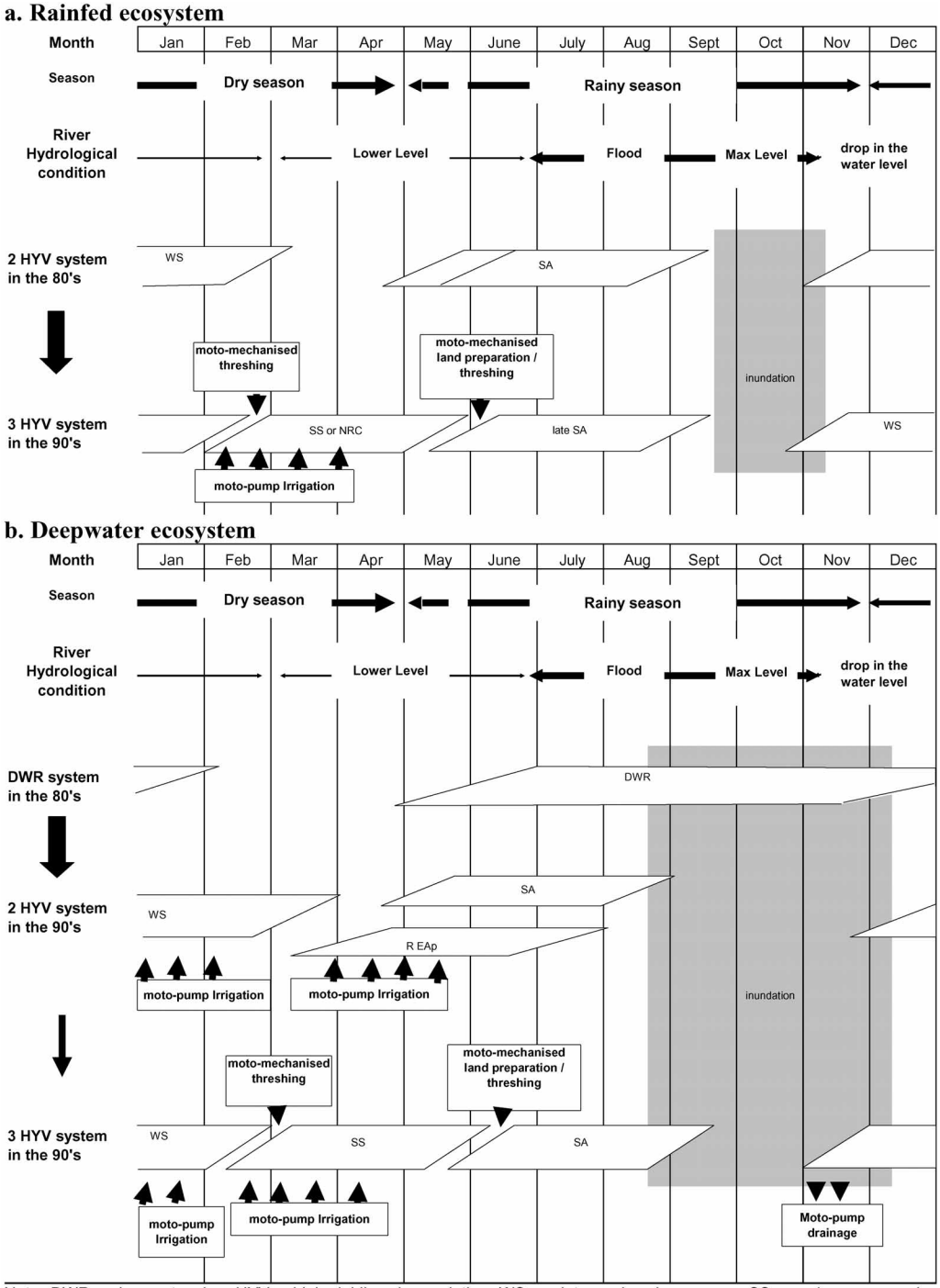
In parallel with market liberalization and in agreement with the resolution No. 10 of the Vietnamese Politburo, the Vietnamese authorities recognized the status and role of household-based production units in agriculture and private ownership of land and farm equipment. After an initial set of reforms towards liberalization in the early 80s, this policy change provided a strong signal for more radical de-collectivization. This led to the dismantlement of the “production groups” that were previously managing the production equipment and the farmers’ access to production factors (delivery of chemical fertilizers and marketing of agricultural products) according to the Contract 100 system. In 1988, the means of production were either auctioned back to individual farming households or given back to their former owners. This recognition of private ownership of the means of production created another incentive for farmers to invest in the acquisition of farm equipment for rice intensification. Imports of second-hand engines from neighboring Asian countries rapidly increased the availability of pumps and hand-tractors and small-scale production units of axial-flow threshers mushroomed across the Delta. Farmers with enough capital to buy such equipment used it for their own cropping activities and made these investments even more profitable by renting out the machines to more-deprived farmers. This process led to a rapid improvement in the availability of farm equipment for all farmers.

By using those moto-mechanized tools for irrigation and soil preparation, farmers significantly improved their water management, especially in the irrigated ecosystem. Rice yields of the HYV-based cropping systems increased as well as labor productivity thanks to the adoption of the direct-seeding technique for crop establishment. The moto-mechanization of farm operations became even more important when associated with the recognition of farmer land-use rights. In 1988, a first land reform provided individual farmers with land-use rights. This new land tenure system was reinforced in 1993 with the proclamation of a new land law granting long-term land-use rights to farmers. These rights could be considered as land property rights since they could be exchanged, mortgaged, and transferred through inheritance or sale. This better security of land tenure was another incentive for farmers to invest in labor and capital for land improvement.

Kono [2001] described the inherited large-scale hydraulic network developed for drainage purposes under the French colonial regime and its improvement and completion for irrigation during the collective regime of the Socialist Republic of Vietnam in the late 70s and 80s. Farmers performed complementary land improvement operations at the field and individual household scales. In the favorable parts of the rainfed and deepwater ecosystems of the NL and BS, they leveled the land and raised the dikes to improve water control. And, in the very deepwater ecosystem of the BDFP, farmers undertook important investments. They leveled the fields and built ditches, furrows, and dikes surrounding the plots to control water at the field scale. Such land improvement operations could take place more rapidly thanks to the availability of heavy earth-moving equipment such as modified four-wheel tractors used like small bulldozers. The combined effects of land improvement and an increased availability of moto-mechanized tools for irrigation, land preparation, and rice threshing contributed to another increase in paddy yields and labor productivity. But they also facilitated the adoption of new production systems and an increase in the local cropping index as shown in Fig. 4.

In the irrigated rice ecosystem, the availability of pumps allowed farmers to irrigate in the dry season and to insert a new rice crop cycle during that period of the year. The moto-mechanization of land preparation and threshing operations reduced the work load between two successive crop cycles and facilitated the implementation of cropping systems based on three HYV crop cycles per year. A higher cropping index enabled farmers to obtain a further increase in the added value per ha of rice land and per year (Stage 3 in Fig. 3a).

In the DWR ecosystem, pumps were also available to irrigate during the dry season as irrigation by gravity is not possible in these areas after the flood. This allowed an expansion of cropping systems based on two HYV crops per year. Equipped with a pump and a system of dikes around their fields, farmers could drain water out of their rice field to begin the first rice crop earlier than before and begin to introduce an intensive cropping system based on three HYV rice crop cycles per year. As a consequence, the added value per land unit increased dramatically (Stage 3 in Fig. 3b). Simulation shows that the return on investment in land leveling, in building dikes around the fields, and in small irrigation at the field level to switch from the traditional DWR cropping system to the irrigated two or even three HYV-based



Note: DWR = deepwater rice; HYV = high-yielding rice varieties; WS = winter-spring rice season; SS = spring-summer rice season; SA = summer-autumn rice season; NRC = non-rice crop; ESA = early summer-autumn rice season

Fig. 4　Changes in Cropping Patterns in Omon District

cropping systems was less than one year. The cost of such land improvement amounting to US$174 per hectare was less than the far higher gross product obtained from the first HYV rice crop. Following a slight reduction of the gross value-added during the first year of land improvement (Year 1) compared to the DWR system (Year 0), the gross value-added increased dramatically as soon as the following year (Year 2) as seen on Fig. 5. The new cropping systems required more agricultural inputs and labor. If labor productivity per day decreased

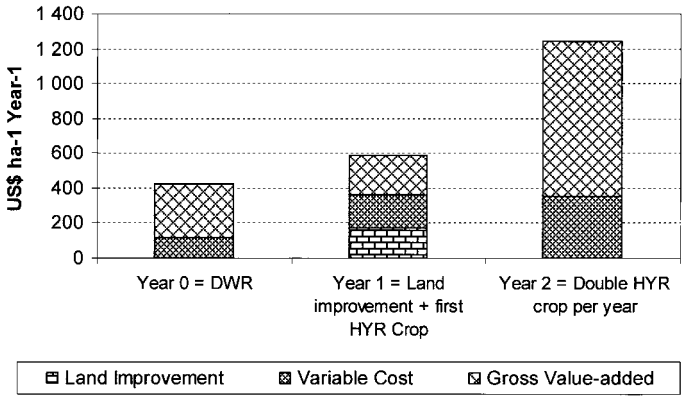


Fig. 5 Changes in the Economic Results of Rice Production from Deepwater Rice (DWR) to the Irrigated Rice System
Source : Household survey CTU-CIRAD 1995

Table 1 Economic Results of the Main Cropping Systems in Omon District, 1995 Crop Year

	Rice-based Cropping Systems					Non-rice Systems		
	Rice Monoculture			Rice and Non-rice System				
	Deepwater Rice (DWR)	Irrigated Rice Systems 2 HYR Crops per Year	Irrigated Rice Systems 3 HYR Crops per Year	Sweet Potato/ DWR	2 HYR / Mungbean	Sugar Cane	Orchard* in Production	Orchard* Average in 10 years
Gross product (US$ ha^{-1} year^{-1})	423	1,247	1,837	1,951	2,139	1,268	2,021	1,213
Variable cost (US$ ha^{-1} year^{-1})	114	350	486	318	577	444	269	229
Added value (US$ ha^{-1} year^{-1})	310	897	1,350	1,633	1,561	823	1,753	984
Labor (day ha^{-1} year^{-1})	49	169	260	448	469	285	354	301
Value-added per day labor (US$ day^{-1})	6.3	5.3	5.2	3.6	3.3	2.9	5.0	3.3

Source: Survey of 256 farmers by CTU-CIRAD in Omon District, 1995
Notes: Gross product, value-added, variable cost for 256 farms
Labor estimates based on interviews of selected farmerss
* Citrus production

from US$6.3 to US$5.3 vis-à-vis the traditional DWR cropping system, farmer total income from rice production increased markedly from US$310 to US$897 per hectare and per year thanks to an impressive increase in land productivity (Table 1).

IV–3　*State Support for Rice Intensification*

Even if the impetus toward rapid acceleration of rice intensification was the state withdrawal from market and production functions and the recognition of the farming household economy, state institutions still played a facilitating role in the process. Their involvement was threefold: (1) the continuation of rice research, especially breeding of potentially high-yielding semi-dwarf cultivars, and their dissemination through extension services; (2) the reform of the credit system to improve small farmers' access to loans; and (3) further development in hydraulic infrastructure.

The process of rice intensification was supported by active research programs in cooperation with international centers, particularly the Philippines-based International Rice Research Institute (IRRI), and the dissemination of new short-duration (85–90 days) varieties, adapted to different environments (such as soil acidity) and resistant to a broader spectrum of insect pests and diseases [Vo Tong Xuan 1995a]. Since new technology was disseminated through the "production groups" during the "collective period," a new agricultural extension service dedicated to supporting individual farming households was created in 1993. Although the resources of this new extension system remained scarce, it contributed significantly to the intensification process by disseminating HYV seeds and by providing technical advice for rice production, e.g. fertilizer and pest management, through demonstration plots, training courses, technical leaflets, etc.

During the collective period, the procurement of credit was supporting only the production groups. In 1990, the Vietnam Agricultural Bank (VAB) was created to provide credit to farming households. Initially, VAB provided mainly short-term loans for rice production. Although access to formal credit was conditioned by the availability of land titles, called "*bang khoan dat*," this reform helped most farmers in acquiring increased amounts of key agricultural inputs.

Although the state withdrew itself from the agricultural production sector, it continued to invest in improving the hydraulic infrastructure. It invested directly in the construction of primary canals. It was also involved in the organization of the cleaning and re-digging of secondary canals through the collection of the 10-day duty services, the preparation of work plans, and their negotiations with landowners [Kono 2001]. From 1985 to 1995, in Omon District, 120 kilometers of canals were dug in the BDFP, 20 kilometers in the BS, and 5 kilometers in the NL [Vo Tong Xuan *et al.* 1995].

The recent rice intensification provided impressive agricultural growth over a short time and a tremendous increase in the added value per year and per area unit due to rapid increases in both yield and cropping index (Stage 3 in Fig. 3). The moto-mechanization of the main farm operations and the increasing use of pesticides (including herbicides) boosted labor productivity and reduced the demand for labor per crop cycle. But, the expansion of new multiple-cropping

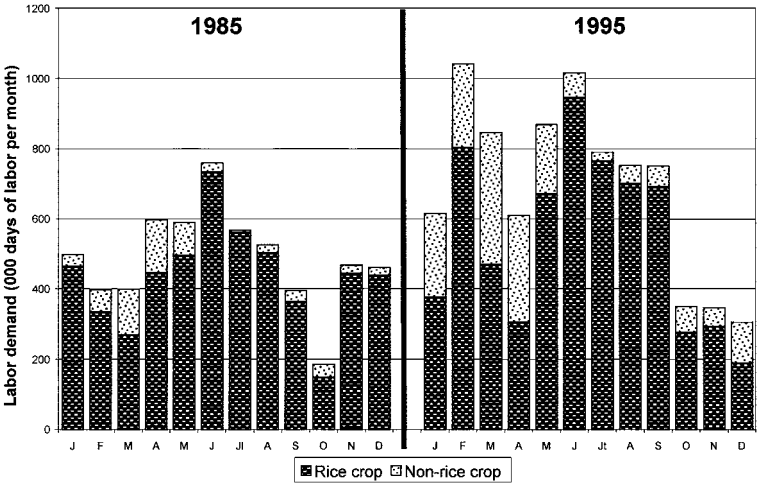


Fig. 6 Changes in Agricultural Labor Requirements for Rice and Non-rice Production in Omon District before and after the Economic Reforms

Notes: Estimation for labor demand per crop cycle and per hectare in 1985 and 1995 based on authors' survey in 1995
Cropped areas at the District level in 1985 and 1995 based on data from the Omon District statistical office
Rice, citrus, sugarcane, and sweet potato are taken into account, as well as the timing of planting and harvesting periods for each rice cycle according to household survey (CTU-CIRAD, 1995).

systems increased labor demand at the regional level and provided employment opportunities for family labor in productive activities year-round as shown in Fig. 6.

V The Diversification of Agricultural Production

On top of rice intensification in the Mekong Delta, the diversification of agricultural production in the central plain also played an important role in explaining the rapid agricultural growth observed in this region of Vietnam during the decade following the adoption of the liberalization policy. The implementation of the economic reforms increased cash income across the whole spectrum of the Vietnamese population. The development of industrial and service sectors in urban areas led to changes in food consumption patterns. The demand for food products of urban consumers and, to a lower extent, of rural consumers became more diversified [Figuié and Bricas 2003] as the share of non-rice products increased. New market opportunities for fruits and vegetables, sugar, animal products, etc., appeared and farmers started to seize them at a time when the price of rice remained stable.

V–1 *The Multiple Faces of Crop Diversification*

The pattern of agricultural diversification differed according to local agroecological characteristics. In such a deltaic region, the characteristics of the flood (its depth, duration,

etc.) strongly influence the possibility of growing non-rice crops. Two main types of crop diversification patterns are possible: non-rice annual crops in rotation with rice or the production of perennial crops.

Farmers selected two main categories of annual crops to be produced in rotation with rice. In the BDFP zone, sweet potato in the dry season followed the DWR crop. In the NL, farmers planted more upland crops such as soybean, mungbean, or various fruits and vegetables such as watermelon. The moto-mechanization of land preparation facilitated the production of tubers on the heavy clayey soils in the BDFP, while small-scale furrow irrigation expanded thanks to the availability of pumps. The adoption and expansion of these cropping systems were easy as they were already familiar to the local farmers. But, under the new economic conditions of their farm environment, they enabled farmers to increase the added value by land unit. The "upland crop–deepwater rice" (UC-DWR) cropping system allowed this added value per land unit to increase by 427% compared with DWR only. In the NL zone, the "two HYV rice crops–upland crop" (2HYV-UC) system increased the value-added per land unit 74% vis-à-vis the production of two HYV only as shown in Table 1. Compared with rice monoculture systems, the new ones required higher variable costs (for planting materials, seeds, pesticides, etc.) and much more labor for manual land preparation (to make furrows, raised beds, etc.), especially for tubers, daily irrigations, and manual harvests. These new cropping systems were so labor-intensive that their labor productivity (added value per day) was lower than with rice monoculture. If the use of extra family labor was necessary during the peak of labor demand at harvest, farmers often adjusted the area planted to non-rice crops to their capacity to implement daily irrigations. For mungbean and soybean on the NL, one labor unit can irrigate some 0.10 to 0.25 ha with manual tools, and up to 0.3 ha with motorized pumps. For sweet potato on the BDFP, one labor unit irrigates up to 0.13 ha in 4 hours with a watering bucket. For crops with higher water needs such as watermelon, one labor unit irrigates a maximum of 0.05 ha in 4 hours with manual tools and 0.3 ha with motorized pumps.

Because perennial species cannot tolerate any submergence, crop diversification based on them required significant land improvement techniques. The construction of raised beds required 150 to 350 working days per hectare depending on the topography and the height of the beds. The lower the field and deeper the flood, the higher the raised beds to avoid submergence. High beds in low-lying areas also have a smaller useful area for crop production compared to the total field size. This proportion varies from 75% in the NL and the rainfed ecosystem down to only 55% in deepwater areas. Avoiding submergence in the BDFP zone is costly and difficult to secure. The higher depth of submergence implies the construction of bigger ridges while the potential soil acidity requires the implementation of labor-intensive soil management techniques i.e. the construction of raised bed in two phases to put the top soil at the surface of the raised bed. As a consequence, orchards are widespread on the NL, where submergence is easier to avoid, while sugarcane plantations are more common in the lower and more acidic BDFP, where some flooding cannot be avoided. Farmers plant sugarcane because it is more tolerant to acidity and is harvested once a year before the flood, whereas flooding

leads to the death of fruit trees, especially citrus species.

Sugarcane production was used to avoid redistribution of the land in the BDFP zone during the early 80s, but planted area expanded in the early 90s and allowed an increase of 116% in the added value per land unit compared with DWR. Sugarcane production is much more labor-intensive than DWR because it requires several manual operations (such as furrowing at plantation time, repeated irrigations, and cane harvest) and the variable costs are also higher than in rice production. As a result, under current prices, sugarcane production had a lower added value per hectare than the two HYV-based rice cropping system (Table 1).

Fruit production in the NL of the Mekong River is an old activity, and an expansion of horticulture occurred during the 70s to meet the increased urban demand during the Vietnam War. Later on, because of the lack of market opportunities, most of the mixed orchards were abandoned if only used for family consumption. During the last decade, new market opportunities were created and prices for horticultural products climbed. The replanting and specialization of existing orchards as well as the creation of new ones on rice land occurred. In this second case, costly investments had to be made for land improvement to secure good water control: the construction of raised beds for drainage, and of dikes around the orchards for flood protection. Numerous irrigations and maintenance operations made the management of orchards more labor-intensive than rice monoculture. After reaching their productive periods and under the price levels observed in the mid-90s, orchards were providing the highest added value per land unit and per year than any other cropping system, and a level of labor productivity almost as high as the ones obtained by the 2 and 3 HYV-based rice cropping systems (Table 1).

Whatever the type of non-rice production selected by the farmers based on local ecological conditions and their investment capacity, they all participated in the search for an increased added value per land unit and per year. This expansion was facilitated by easier access to the moto-mechanization of tedious operations and the increased availability of cheaper and more diverse key agricultural inputs. The adoption of non-rice production resulted in labor intensification compared with rice monoculture. The specific long-term investments in fixed capital required by the adoption of non-rice cropping systems were usually low since most of the equipment was also used in rice production (pumps, hand tractors, sprayers, etc.), except when prior earth-moving land improvement was necessary in the case of fruit and sugarcane production in low-lying areas.

V–2 *Complementarities between Rice and Non-rice Production*

Rice intensification and the diversification of agricultural production in Omon District were two very interdependent processes. As stated above, rice intensification allowed farmers to improve their capacity for accumulation and use it to expand non-rice production. This is particularly obvious in the case of orchards in the NL, where the farmers who established large plantations benefited from larger rice lands. But, in the BDFP, greater income brought about by the adoption of the UC-DWR system and/or sugarcane production was gradually invested in land

improvement of paddy fields to expand high-productivity HYV-based rice cropping systems.

At the household level, rice intensification allowed farmers to maintain food self-sufficiency. When farmers decided to convert part of their rice land into orchards, they also expanded the three HYV-based rice cropping pattern to harvest enough paddy to meet family needs. Financially, since non-rice cash cropping is relatively risky because of price fluctuations, crop diseases, or floods, rice intensification was providing a kind of "safety net" for small farmers when they decided to diversify their combination of production. At the same farm level, rice intensification and diversification into non-rice cash crops were also complementary regarding the management of working capital and the use of family labor. By increasing farmers' cash income, the expansion of non-rice crops allowed farmers to improve their technical and economic performances in rice production. Consequently households managing a mixed production system, including rice and orchards, tend to achieve higher rice yield thanks to their better capacity for investment compared with other smallholders involved in rice monoculture only (Table 2).

Table 2 Economic Results of HYV-based Rice Cropping System by Type of Production System

	2HYV Rice Crop System				3HYV Rice Crop System			
	on NL		on BDFP		on NL		on BDFP	
	Rice Monoculture Only	Mixed Production System	Rice Monoculture Only	Mixed Production System	Rice Monoculture Only	Mixed Production System	Rice Monoculture Only	Mixed Production System
Yield (tons ha^{-1} $year^{-1}$)	9.1	9.9	9.5	10.2	13.3	14.1	13.8	14.5
Standard deviation	1.6	1.5	1.6	2.0	1.9	2.1	2.4	2.0
Variable cost (US$ ha^{-1} $year^{-1}$)	361	352	331	394	502	528	559	566
Standard deviation	13	28	37	33	48	41	64	58
Value-added (US$ ha^{-1} $year^{-1}$)	798	925	904	946	1,219	1,307	1,239	1,315
Standard deviation	69	65	116	83	85	129	159	121

Source: Survey of 256 farmers by CTU-CIRAD in Omon District, 1995

V–3 *Toward Intensification at the Whole Production System Level*

In the local context of small-scale household-based agriculture on tiny holdings, diversification corresponds to farmers' main strategy of seeking greater land productivity. Closely combined with rice intensification at the field and farm levels, crop diversification generates more intensification of land and labor uses, as well as increases in working capital and fixed assets. At the District level, the combination of diversification with rice intensification produced a large increase in agricultural production, agricultural added value for the community, and local demand for labor throughout the year, as displayed in Fig. 6.

V–4 *Is the Diversification Process Sustainable?*

While diversification contributed to the intensification of whole production system in the 90s,

recent observations show that this process is difficult to sustain because of technical and market problems.

Following the rapid expansion of citrus plantation on the NL in the late 90s, the epidemy of greening disease, combined with floods, led to a major damage to citrus trees. Although safe roots stock was released by the extension system, most of the farmers decided to grow other species such as longan, mango or sapodilla. Consequently, the expansion of orchards slowed down from 11.9% per year during the 1990–95 period to a mere 0.3% from the 1995 to 2000. In some situations, farmers decided to abandon fruits trees and return to rice production.

On the BDFP, the pace of crop diversification was also strongly reduced in the late 90s with the collapse of the sugarcane production. While sugarcane provided better income than DWR, its economic performance was lower than HYV-based cropping systems that expanded in this zone thanks to the availability of pumps, and land improvement and irrigation canals. Facing strong price fluctuation and economic losses in sugarcane production, farmers switch to irrigated rice and sugarcane areas dived from 127,000 to 43 hectares from 1995 to 2002. At the same time, for the same reasons, sweet potato has been gradually replaced by less risky HYV-based monoculture. Sweet potatoes areas in Omon District decreased from 458 in 1990 to 20 hectares in 2002.

While in general the pace of crop diversification slowed down in the recent years at the District level, in the BDFP it was even reduced.

VI Dynamics and Extent of Differentiation among Farming Households

VI–1 *Abolition of Collective Production Groups and Initial Differentiation among Farmers*

The recognition of family-based agriculture by the state and the abolition of the collective production groups (“*tap doan*”), “linkage production groups” (“*lien tap doan*”), and cooperatives between the late 80s and the beginning of the 90s created inequalities in the endowment of production factors among the local farming households through the reallocation of land and fixed agricultural assets. The land was redistributed to farmers according to the land ownership situation before the collectivization. Many farmers recovered the fields they owned in the early 80s. These corresponded roughly to the land received under the “Land to the Tiller Reform” initiated in 1971 [Callison 1983]. But another land distribution was necessary in the early 90s because of the re-emergence of a class of landless farmers and the existence of holdings of more than 3 hectares of land. In those days, the ratio of land per family labor varied from 0 to more than 1.5 hectares. This land redistribution in the early 90s led to a rapid and extensive differentiation among farm holdings in terms of income levels from rice production and capacities to accumulate capital. While some farming households were able to produce rice surpluses and improve their capacity for capital accumulation without changing their existing rice production system, other smallholders could not generate enough cash income from rice to meet their basic family needs. Based on our estimates of the added value produced by each main cropping system, and with an average ratio of 1.7 family members per labor, households

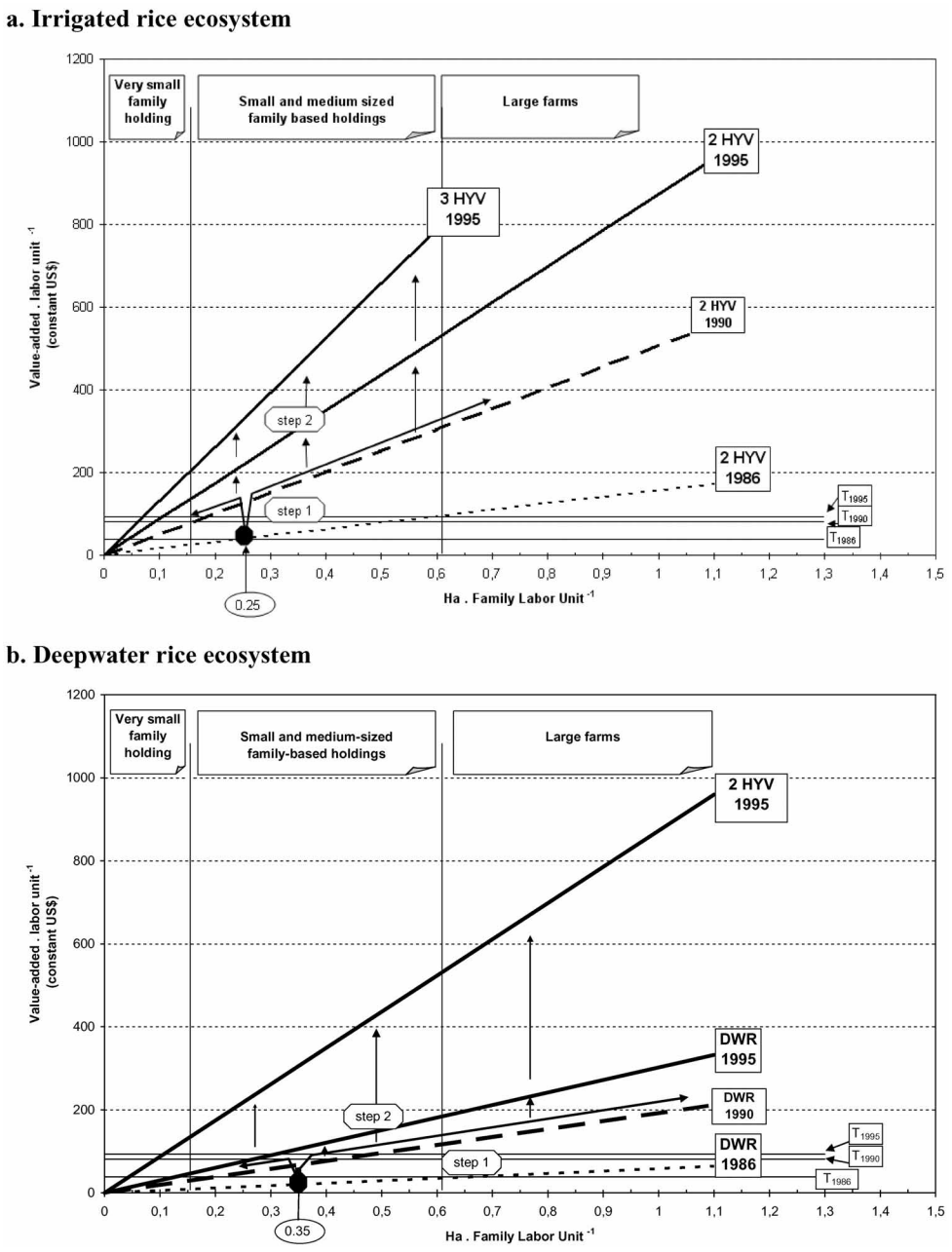


Fig. 7　Dynamics of Labor Productivity in Rice in Omon District from 1986 to 1995

Source: Household survey by CTU-CIRAD in Omon District, 1995

Notes: T1986, T1990, and T1995 correspond to an income threshold, respectively, in 1986, 1990, and 1995. This represents the necessary equivalent income for 1 family labor unit to provide rice and non-rice food for its family. It is based on an equivalent of needs estimated at 424 kg of paddy equivalent per family member per year and 1.7 total family members per family labor unit.

DWR: deepwater rice system; 2 HYV: 2 HYV rice cropping system; 3 HYV: 3 HYV rice cropping system

practicing the two HYV-based rice crop system on less than 0.15 hectare of rice land per family labor (equivalent to a total farm size of some 0.40 ha) on the NL or in the BS zone could not satisfy their basic needs. This was also the case of small farmers relying on DWR cultivation with less than 0.45 hectare per family worker (equivalent to a total farm size of 1.2 ha) in the BDFP zone. These farming situations are displayed as step 1 in Fig. 7.

When a collective unit was dismantled, its farm equipment either was given back to the former owners or was sold to group members at a low price or through auctions. Most of the farm machinery, such as pumps, hand-tractors, and four-wheel tractors, was often in poor condition, but its ownership was still a significant factor in the economic differentiation among local farmers. Heavy equipment was used in the owners' fields to increase productivity and decrease the demand for labor, but it was also rented out to other farms for a fee, thus increasing the income of its owners thanks to such contractual farm services. Fig. 8 displays the five main types of farms created by the above-mentioned reallocation of farming assets: landless farmers, very small family-based holdings of rice producers with manual tools, small and medium-sized family-based holdings of rice producers with manual tools, medium-sized family-based producers of rice and non-rice products with manual tools, and medium-sized or

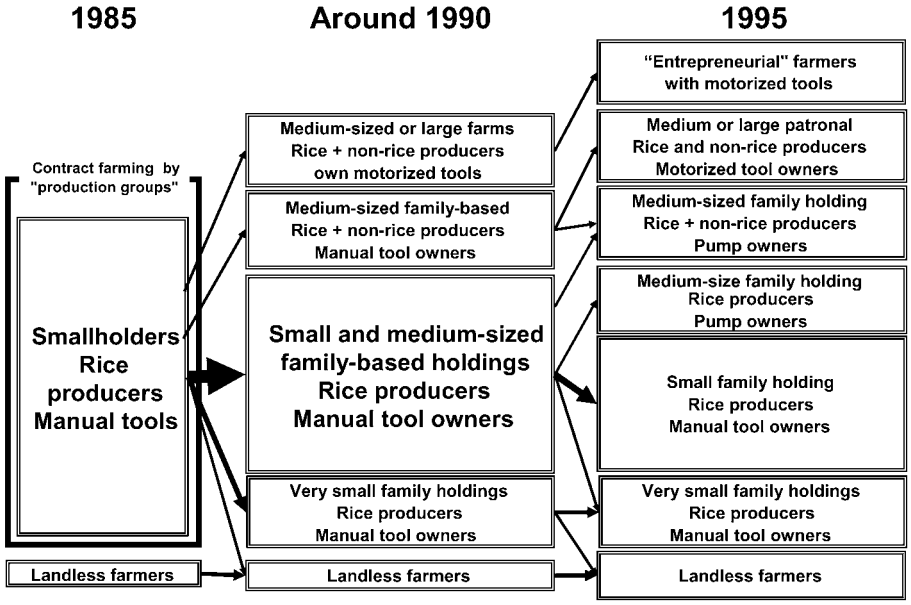


Fig. 8 Differentiation among the Main Types of Farms in Omon District from 1985 to 1995
Source: Survey by CTU and CIRAD in Omon District, 1995
Note: In 1985, although there has been a land distribution in the early 80s when the "production groups" were established, some landless farmers did not receive land, especially in highly populated areas where land was too scarce to allow the allocation of 0.10 to 0.13 hectare per family member. The administration requested them to settle on recently reclaimed land. However, due to the poor living conditions in those areas, some landless farmers decided to stay in their villages and made a living as seasonal wage earners and from traditional non-farm activities such as fishing.

large-sized producers of rice and non-rice products with motorized farm machinery.

VI–2 *An Increasing Differentiation among Farmers through the Diversification of Production Systems and Off-farm Economic Activities*

Different access to key production factors such as land quantity and quality and farm equipment created an unequal pace of capital accumulation among farmers. Depending on farmers' capacity to balance rice and non-rice production, they take rapidly advantage of new market opportunities for agricultural products and for off-farm employment.

The analysis of the evolutionary trajectories of each main type of farm helps to understand their different use of productive resources and different trends for their accumulation. In the context of relative land scarcity and limited access to financial markets of the early 90s, access to land and land rights was the driving force of differentiation among farmers. Access to institutional credit was expanding and was effective in facilitating rice intensification. The institutional credit system for farming households of Omon District was initiated in 1991 and 47% of farmers were using it in 1995 according to the farm survey carried out by CTU-CIRAD on that year. But it did not modify existing differences in the capacity for accumulation among farmers since credit was mainly limited to short-term loans to buy farm inputs, their amounts depending on the area of rice land (the land-use right was the sole collateral required by the bank). These loans could not help to develop new production requiring more costly and long-term investments for the acquisition of farm equipment and/or land improvement. In a context characterized by low endowments in working capital and limited access to institutional credit for investments, land became a major source of capital since it could be mortgaged against "private" loans. Farmers who benefited from the land reform and obtained larger holdings could sell a plot of land or mortgage it to mobilize enough capital for investments in leveling paddy fields in the BDFP to expand their rice area under the intensive HYV-based rice cropping system, or in creating orchards on the NL. Usually, the larger farms invested in non-rice cash crops and most of them managed mixed production systems.

As the gold price of paddy land increased at the annual rates of 15, 21, 20% for lower, medium and upper fields respectively between 1989 and 1994 [Le Coq *et al*. 2004], landless farmers and very small holders could not access more land. Even when these tiny farms managed to intensify their cropping patterns (with the three HYV-based rice cropping system in the NL or UC-DWR in the BDFP) by renting moto-mechanized tools and using credit (from whatever sources), they could achieve economic performances allowing them to sustain their families from agricultural production only. As they were very vulnerable to natural disasters, price fluctuations, and the poor health of family members, the vicious circle of indebtedness was common among them and could force them to sell their land.

Small and medium-sized family holdings that benefited from reforms were able to intensify their agricultural production system and to increase their income. Part of their cash income from agricultural production was invested in pumps to secure water control in their rice fields and some of them managed to develop non-rice production on raised beds. As they remained

vulnerable to variable prices for their non-rice products and to climatic shocks, most of the small holdings practiced rice monoculture because of their lack of capital to invest in other production or after failing to sustain such cash-cropping activities. Most of the medium-sized farms developed a mixed production system in a more sustainable way since the volume of their rice production provided a more stable source of cash income.

Medium- and large-sized producers of rice and non-rice crops who could rapidly develop a higher capacity of investment invested in motorized pumps for irrigation and drainage in their fields and for rent to poorer neighbors. They were also in a more favorable position to rapidly take advantage of new market opportunities and they replanted their orchards with more lucrative citrus species. As their cash income increased markedly, they were able to expand the non-rice component of their production systems and had to use more hired workers in labor-intensive fruit and sugarcane plantations. Some of these entrepreneurs also invested in land accumulation, in the development of large-scale trading activities, or in the acquisition of more moto-mechanized farm equipment for contractual services on smaller farms. Among this category of well-off households, two types emerged: large "patronal" farmers focusing on agricultural production and entrepreneurs gradually developing their non-farm economic activities.

VI–3 *Current Extent of Farmer Differentiation and Trends*

The above-described processes of capital accumulation, or lack of, increased the differentiation among farmers in terms of land and farm equipment availability, production, and livelihood systems. In 1995, five main types of farming households could be distinguished: landless farmers, very small family holdings, small and medium-sized family farms, "patronal" farmers, and entrepreneurs. Their respective key characteristics and economic performances are displayed in Table 3.

Landless farmers represented about 10% of the total number of households in Omon District. They were either farmers who lost their land during its redistribution following the dismantlement of the production groups or smallholders who sold their tiny plots of land after the economic liberalization. They had to rely on non-permanent agricultural wages for their living. Thanks to the dual processes of rice intensification and crop diversification, men found employment mainly in transporting rice or other agricultural products, in land improvement activities (construction of raised beds and dikes, digging of canals), or in land preparation for sugarcane and sweet potatoes, while women were hired for hand-weeding in paddy fields and rice or sugarcane harvesting. Although the intensification of land use increased the demand for hired labor, landless households could not find income-generating opportunities throughout the year in their own villages. To find such opportunities, they moved within the countryside to follow the periods of peak labor demand at rice harvesting throughout the Mekong Delta. Some relied on fishing or petty trade activities to complement their meager income. Their average income remained low at around US$157/labor/year in 1995. In the late 90s marked by the reduced pace of diversification and a decrease of labor demand in rice due to new crop

Table 3　Characteristics of the Main Types of Farms in Omon District, 1995

Farmer's Type	Landless	Very Small Family Holdings	Small and Medium Family Holdings	"Patronal" Farmers	"Entrepreneurial" Farmers
Frequency (%)	10	15	55	9	11
Main types of production systems	–	Rice	Rice (+ non-rice)	Rice + non-rice	Rice + non-rice
Percentage of farmers practicing exclusive rice monoculture (%)	0	75	52	33	30
Average cultivated area (ha/household)	0.05	0.44	1.22	2.71	1.70
Standard deviation	0.05	0.21	0.69	1.30	1.38
Main type of equipment owned	Manual	Manual	Manual (or motorized)	Motorized	Moto-mechanized
Percentage of farmers owning motorized tools (%)	0	19	43	66	100
Type of off-farm activities	Hired farm laborer	Hired farm laborer and/or small scale fishing	Hired farm laborer and/or small scale fishing, trade or handicrafts	Small scale trade or handicrafts	Agricultural services, large scale trade, product processing
Percentage of family income from off-farm activities (%)	95	48	25	5	50
Family income (US$ labor^{-1} year^{-1})	187	225	329	584	488
Standard deviation	179	134	195	405	366

Source: Survey of 256 farmers by CTU and CIRAD in Omon District, 1995

Note: The sample was randomly chosen among a list of farmers having a homestate plot of land according to 1992's cadastrial data.　This sample corresponds to 12% of the total number of farmers in this list and in 2 hamlets in each of Thoi Long and Dong Thuan villages.

management techniques (land preparation and herbicide use), labor requirements were not enough to fully employ wage-earners from landless and very small holdings. These workers started to rely on off-farm employment in urban areas, especially in Ho Chi Minh City, through seasonal or permanent migrations of a family worker or by moving the whole household to the city.

In 1995, the very small family holdings made up around 15% of the total number of farming households in Omon District. They had access to only small plots of rice land after the dismantlement of the production groups and farmed less than 0.15 hectare per family labor, that is to say, less than 0.8 hectare of farm land per household. They managed to intensify their rice-cropping systems by using hired motorized equipment. In the irrigated ecosystem, most of them adopted the three HYV-based rice cropping system which is less risky than the 2HYV-UC system, requires less investment, and provide a stronger food security at the household level. In the BDFP, most of the smallholders had not developed HYV-based rice cropping

patterns yet in 1995 because of their lack of cash for land leveling. In this agroecological zone, most of these very small holdings still managed the UC-DWR cropping system instead. Facing low market price in the late 90s, they introduced multiple HYV-based rice cropping systems. With very limited cash flow, they had to sell rice quickly at harvest and reaped low prices. They also had to pay for agricultural services and, sometimes, financial constraints forced them to reduce input use in their rice fields. If they could rely on seasonal credit from official sources for rice production, they usually had to find more informal sources in the BDFP, where the availability of credit was less developed. Because of their lack of capacity for investment, they could not establish orchards or sugarcane plantations, or rear more animals. Very often, their low agricultural income was not sufficient to cover the basic needs of their families and they needed to seek complementary sources of cash from employment as hired laborers or from fishing. On average, these off-farm activities contributed to more than 50% of the total annual cash income of this category of farmers.

The family-based small and medium holdings correspond to the most frequent situation as they made up some 55% of the total number of farms in 1995. They farm from 0.15 to 0.6 hectare per family labor and can satisfy their basic needs from their farming activities. They usually produce a small capacity for the accumulation of productive resources. They obtain complementary earnings from off-farm employment as temporary wage earners, fishing, petty trading, or the manufacturing of handicrafts. Those activities could amount to around 20% to 25% of their total annual income. Depending on the characteristics of their production systems, they display contrasting situations. Farmers practicing rice monoculture tend to intensify their production systems without owning motorized machinery. In 1995, most of them were still managing DWR-based systems in the BDFP zone, but some had begun to experiment with the high productivity of two or even three HYV-based rice systems by hiring heavy farm equipment. In 2003, those farmers had fully adopted the intensive HYV-based rice systems. On the NL and in the BS, this category of farmers usually chooses to develop two or three HYV-based rice cropping systems depending on the local ecological conditions.

In 1995, the remaining share of farmers (40% on NL and 70% on BDFP) had developed mixed production systems comprising high-productivity multiple rice-cropping systems and non-rice production. They usually had access to more land and working capital to develop land, establish industrial or fruit crop plantations, and acquire heavy farm machinery. In the irrigated rice ecosystem, most of them had adopted the three HYV-based rice cropping system, and also introduced HYV-based rice cropping systems in the BDFP zone. Their perspectives are diverse. The economic performance of farms with rice and orchards depends on the age of the fruit plantations. If farmers were already harvesting the products, they could invest more in improving their cropping systems. But, in the case of young tangerine orchards, the situation was more critical as the *huang long binh* greening disease could still destroy their plantations. In 2003, most of them had replanted their orchards with new species such as longan, mango and sapodilla. In the BDFP, because of the decreasing and very fluctuating price of sugar, the trend toward improving water control and adopting HYV-based rice cropping systems observed

in 1995, reinforced the specialization in high productivity rice production.

The “patronal” farmers were an important category representing around 20% of the total number of farming households. With more than US$450 per family labor, they registered the highest level of average annual net income and amount of fixed assets. Having access to an average of 2.45 hectares of land, they managed larger holdings with mixed combinations of crop production. Particularly, they planted relatively large areas to non-rice crops and used many hired laborers during periods of high labor demand for weeding and rice, sugarcane, and fruit harvesting. In 2003 on the NL farmers still manage mixed combination of crops (multiple HYV-based rice cropping system and new fruit trees on raised beds) while on the BDFP, large farmers abandoned sugarcane production and specialized in intensive rice production. They also increase their incomes through expansion of their off-farm business activities, the introduction of rice-fish systems, or the production of high quality aromatic rice.

VII　Concluding Remarks

The economic reforms launched in the late 80s have established a radically new socioeconomic environment enabling small farmers to embark on a rapid intensification of their production systems in fixed capital (motorization and moto-mechanization), working capital (agricultural inputs), and labor. This explains the impressive growth in agricultural production observed during the decade following the adoption of the liberalization policy. If the impetus for rice intensification was provided by these economic reforms allowing farmers to recover a capacity for investment, it also benefited from the inheritance of previous investments in hydraulic infrastructure that was completed and further improved during the period of liberalization. The impressive pace of agricultural and economic changes was due to a rapid mobilization of capital toward productive investments in farm equipment by the well-off farmers that indirectly benefited all farmers through an increased access to the mechanization of labor-demanding farm operations, leading to higher land and labor productivities. A spillover effect between relatively large farms and smaller-scale producers took place and enabled most farming households to benefit from economic reforms. If the moto-mechanization of farm operations increased labor productivity, it also created new job opportunities thanks to the intensification and diversification of rice and non-rice production systems. These processes allowed the distribution of the increasing added value created among the rural population thanks to a higher demand for agricultural labor and new employment opportunities for disadvantaged households. Particularly, the widespread increase in household cash income in the countryside led to a sharp increase in local small-scale trading activities.

Nevertheless, in 1995, farmers’ income remained low and the average daily net income per capita was still below the symbolic threshold of US$1. Although land productivity increased dramatically during the past decade, the tiny size of the farms, the stagnation of the rice price, combined with a relatively low increase in labor productivity limited the rise in income for a majority of the households in the countryside of Omon District. During the same period, the

gap between income of urban and rural dwellers has been widening [Cours 2001]. In the countryside, we showed that the policy of liberalization led to a significant level of differentiation among farming households depending on their endowments in production factors and types of production systems. The perspectives of a quarter of the total number of farming households struggling on landless or very small holdings looked bleak since they could easily be excluded from the agricultural sector.

In general, if the economic liberalization policy could be considered as a successful experience in terms of agricultural production, the increase in farmers' income, and the well-being of a majority of the rural households in Omon District, important new environmental and socioeconomic issues are emerging that could damage the sustainability of the recent transformations of the farming sector. Rice intensification relied heavily on a rapid growth in the use of chemical inputs. In the Mekong Delta, farmers sprayed insecticides more than three times per rice crop during the mid-90s [Heong and Esclada 1997], most of the time in an inefficient way, and this overuse of pesticides has affected the local resource base. Combined with more fishing activities, the use of pesticides led to reduced natural fish stocks in the rivers and canals that represent the main source of protein for local families in the Mekong Delta and a key source of complementary income for very small and landless farmers. Crop intensification also relied on an increase in the water demand for agricultural production of both rice and non-rice crops during the dry season. The increasing intensive use of water for irrigation in the central plain, especially during the dry season, could lead to a reduction in the availability of freshwater in the more downstream areas of the Delta, which could negatively affect their potential for agricultural production.

But the main socioeconomic issue deals with the future of landless rural people and very small farms. Based on the level of differentiation among farmers assessed in 1995, the continuation of the same trend leads to even more important social inequalities. During the early stage of the process of liberalization, all farmers had a common interest in the adoption of cropping systems maximizing land productivity. Later on, well-off "patronal" and "entrepreneurial" farmers emerged who are less interested in further intensification of their production systems if the economic return is lower than an investment in labor-intensive activities. While earlier moto-mechanization of tedious farm operations increased the cropping index and the local demand for farm labor, further mechanization of the already highly intensive cropping systems, particularly at harvest, could lead to a reduction in the employment of hired workers in rice. This will negatively affect the income and well-being of landless rural families and very small farms. This could accelerate their elimination from the agricultural sector and give way to a process of land concentration as described by Yamazaki and Nguyen Duong Ngoc Thanh [1997]. This process could increase the exclusion of landless and small farmers from agricultural production and feed the migration of poor rural people toward urban centers.

Agricultural diversification helped to boost the production of added value and job creation in the countryside as mentioned by Izumi [2001]. But due to technical and marketing problems, this process slowed down in the Omon District in recent years putting its sustainability into

question. Since the reactivity of local small farmers to new opportunities is very high, fluctuations in the market price of non-rice farm products are important. Late adopters of new production tend to get lower benefits and may even register financial losses from such new activities, especially if their technical skills are limited. Particularly, this has been the case among citrus growers facing the *huang long binh* greening disease [Cao Van *et al.* 1997]. In the BDFP, where ecological conditions are not favorable to perennial plantations, the specialization in intensive rice monoculture has only been counter balanced recently by the introduction of rice-fish system.

To cope with those key emerging issues, more attention should be paid by researchers and policymakers to promoting a more efficient use of pesticides, chemical fertilizers, and water in the local high-productivity and multiple-cropping systems. To limit the negative effects of the migration of resource-poor farmers toward cities, the development of rural non-farm activities and agro-industries could be promoted to generate more value-added from agricultural products, to reduce economic risks, especially for non rice products, and to create new job opportunities. In this sense, the adoption of more integrated mixed production systems (including rice, fish, orchard, small animal rearing) should be encouraged. The promotion of new kinds of farmer organizations is needed to better adapt agricultural products to supply chain demand (seasonality, quality, etc.). These professional organizations could also improve the dialogue and coordination between government agricultural agencies and producers. These seem to be a necessary condition to maintain a broad distribution of the benefits of rapid agricultural growth and to limit the disparities in cash income among the farming households of Omon District.

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