

Production Systems and Farming Systems in the Mekong Delta

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Abstract

The Mekong Delta is the most important agricultural area of Vietnam. It contributes to nearly half of food production and most of the exports of rice from Vietnam. Rice monoculture is a dominant tendency of agricultural development there. This situation is not compatible with environmental conservation and rural development. However, other than rice, there is a great potential to develop integrated farming systems there. The diversity of the physical conditions and the difference in the socio-economic conditions lead to the division of the Delta into many distinct agroecozones. There have been five main agroecosystems in the Delta: forest and barren land, floating rice-based system, rainfed rice-based system, irrigated rice system, and mixed garden system. The transition of the agroecosystems from an extensive, simple and low-yielding system into an intensive, complicated and productive system contributes to the development of agriculture and rural communities in the Delta. This transition is characterized by two dimensions: the systems naturally develop by themselves (vertically) and gradually transform into each other (horizontally). The horizontal development which has been supported by the government has rapidly changed the agroecosystems. In recent years, dramatic changes have led to a high efficiency of production systems but also have brought about a strain on the resources utilization. The vertical development which is controlled by the farmers, in contrast leads to a high performance and is in harmony with the environment but receives a very limited attention. It is important to understand the development rules of these dimensions in order to fully mobilize the resources in an integrated way.

This paper includes two parts. In the first part, the historical development of the predominant production systems in the Mekong Delta is outlined, their characteristics, performance and perspective are described. In the second part, the results of a case study in O Mon district are presented as an example of the potential of the integrated farming systems approach in the irrigated agroecosystem.

Introduction

Mekong Delta is the most important agricultural region in Vietnam. The Delta which covers about 20% of the Vietnamese territory, is home to 22% of the country's total population. The Delta provides 60% of total value of fishery production, nearly half of food production and most of the rice exported from Vietnam.

Even though the Mekong delta plays a major role in the country's economy and contributes to a significant development of agricultural production, its residents still experience very

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low living standards. The National Survey on Living Standards in 1993 showed that during the period 1990-1993, the income of farm-households in the Mekong Delta increased at a much lower level than the country-wide income. Rural development in this region is still not sustainable, mainly because of the predominance of rice-monoculture.

Since a long time, the Delta has been considered to be one of the agricultural regions with the highest comparative advantage for rice production in the world. In the 1920s and 1930s rice from the Delta helped Vietnam to account for about 23% of the world rice exports and to become the world-second largest rice exporter after Burma. The natural comparative advantage still exists today and has brought Vietnam back to be one of the largest rice exporters in the world since 1989. However, a monoculture system centered on rice exports is not an optimum model for rural development in the Delta. Low rice price, uncertain markets, and poor marketing facilities have hurt farmers' income and not allowed them to accumulate capital for reproduction. In addition, the intensive farming technologies have brought about many adverse effects on environmental conditions. While the quantity of agricultural chemicals gradually increases and gene resources are rapidly depleted, the resistance of pests and diseases against pesticides and insecticides becomes stronger and the accumulation of chemicals on soils, water and products becomes unacceptable. Obviously, it will be too late if people only count on the natural comparative advantages and develop agriculture and rural commodity based on a mono-export-oriented system.

Fortunately, during the long struggle with nature, the creative and hard-working farmers in the Delta have developed a remarkable approach which not only allows them to fulfill the decision makers' targets (in many cases different from farmers' targets) and also help them increase their income within limited resources and in an uncertain environment, namely through the adoption of diversified development of the production systems in the Delta.

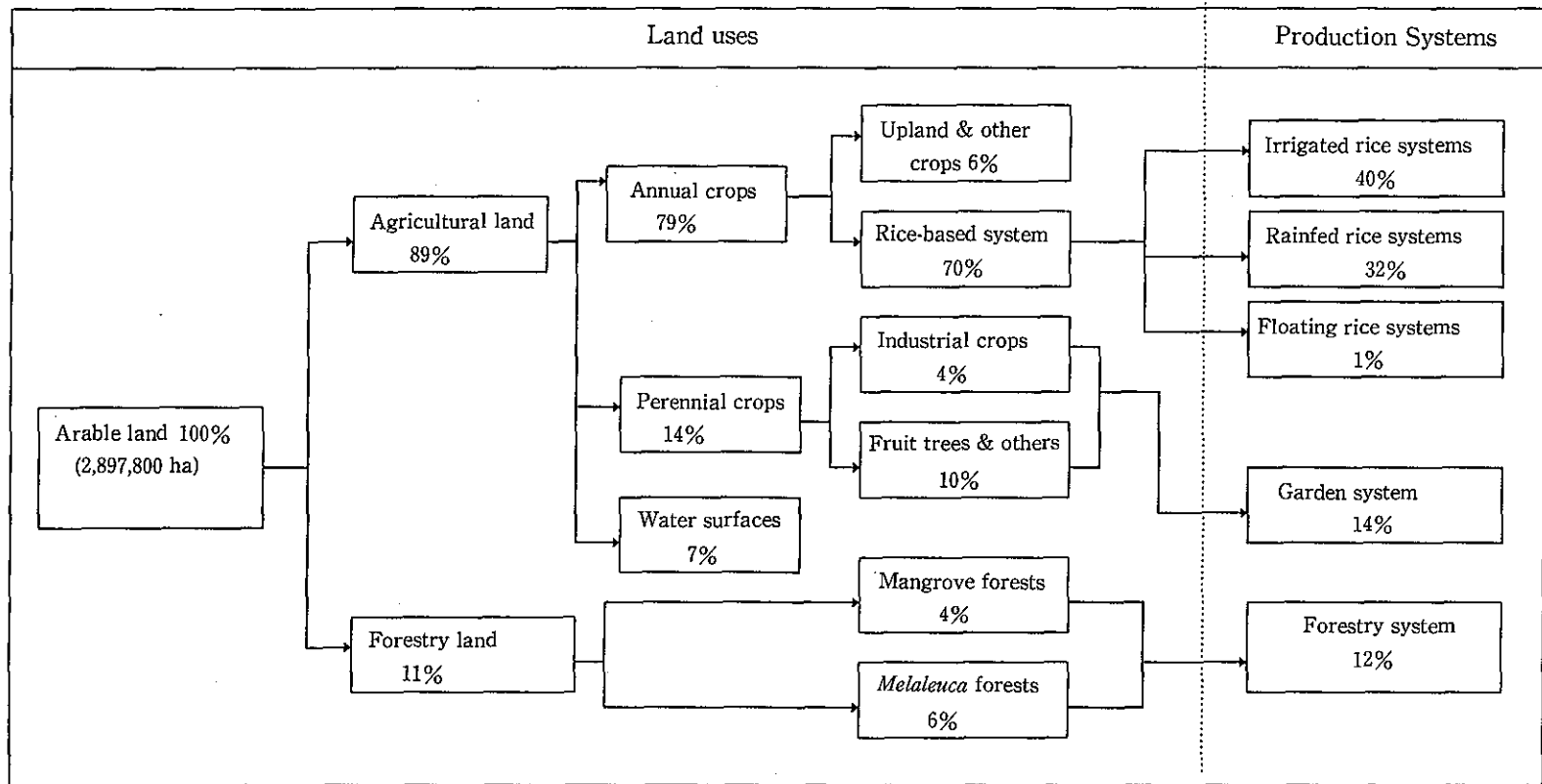
Five dominant production systems in the Mekong Delta

Due to the variety of environmental conditions, and the development of farming practices, the types of land use became diversified in the Mekong Delta. Knowing how to use the land resources of M.D is not dependent only on the environmental conditions but also on decisions made by humans from their management and activities. A description and classification of the terminology related to production systems and farming systems is very useful to systematically formulate the relationship between production activities and surrounding conditions.

A production system is defined as a formal and functional combination of production operations in a primary production sector (agricultural, forestry and fisheries) in a specific physical zone. The system is characterized by the skills, structure of production activities in conjunction with physical and socio-economic conditions of the region. In terms of ecology, the agro-production system corresponds to an agro-ecosystem (Dao The Tuan. 1984 ; Conway, 1986 ; IRRI, 1989) but the production aspect is emphasized.

Therefore, Mekong Delta can be divided into five main production systems (Fig.1, Table 1) :

1. The forestry system
2. The rainfed rice-based systems
3. The floating rice-based systems



Source: Data are derived from NIAPP, MAFI, Sub-FIPI

Fig. 1 Percentage of land use area and production systems in Mekong Delta (1995)

Table 1 Land use pattern in the Mekong Delta in 1990 (1,000 ha)*

	1977	1980	1985	1990	1995
TOTAL NATURAL AREA	4,013.6	3,987.6	3,965.8	3,957.2	3,955.5
Agricultural land	2,239.4	2,541.0	2,435.3	2,462.3	2,612.2
1 Annual crops	2,050.2	2,342.7	2,130.1	1,971.1	2,106.0
+ Triple cropping	20.4	35.8	4.2	10.24	239.0
- Paddy	12.7	23.0	1.1	6.6	193.9
- Paddy & upland crops	7.7	12.8	3.1	3.63	45.1
+ Double cropping	576.1	642.5	614.5	926.1	1,056.5
- Paddy	501.8	571.1	572.1	900.0	981.7
- Paddy & upland crops	74.3	71.4	42.4	26.1	74.5
+ Single cropping	1,390.2	157.2.8	1,355.1	890.5	640.5
+ Upland and other crops	63.5	91.6	156.3	144.3	170.0
2 Perennial crops	166.5	192.0	272.9	347.8	326.0
3 Fishery lands	22.7	6.3	32.3	145.4	180.2
Forest land	380.1	253.8	339.5	348.7	285.6
Barren land	627.1	547.9	621.6	562.0	434.4
Other land uses	767.0	644.9	569.4	582.2	623.4

* Islands are excluded: 62,000 ha

Sources: National Institute of Agricultural Planning and projection (NIAPP) and Directorate General of land Affairs (DGLA), 1996.

4. The irrigated rice-based systems

5. The garden system (Dang Kim Son, 1986)

In spite of the predominance of a production activity, a system consists of a combination of many production activities. The systems are not only characterized by their production operations but also by their socio-economic features. They can be recognized through field construction, the structure of farm economy, the type of residential settlement, etc. These structures not only reflect the way peasants optimize their resources into production processes, but also the approach farmers adopt to harmoniously develop their living conditions. Therefore, the development process of the production systems also reflects the rural and agricultural development in the Delta.

Each production system covered tens or some hundred thousands ha and displays its own "life". The systems have been created, developed, have competed and have been metamorphosed into each other. Generally, this evolution proceeds from simple to complicated, from extensive to intensive, from completely natural to more artificial.

Production system of forestry and waste land

Formerly, forests occupied more than half of the total area of the Delta and covered most of the problem soil areas (marshes, acid and saline soils). The mangrove forests with a timber reserve of about 100-150 m³/ha are found only in the coastal areas and they represent

a very rich ecosystem with a total mass of living organisms amounting to about 208-299 tons/ha. *Melaleuca* forests occur in inland swamps with a timber reserve of about 150-200 m³/ha. For living, peasants gradually changed from extensive exploitation of natural resources such as wood, animals, bees, fishes, etc. to agricultural, forestry, fisheries and farming activities inside the forest ecosystems. Therefore, this system has changed from a natural system into a production system. Today, as forests have been markedly destroyed, the system still remains in the areas which were deforested or are presently waste lands. The main agricultural activities include shifting cultivation, fishing and tree plantations. In production terms, a "field" of *Melaleuca* contributes a value equal to 10 tons of paddy for every 7-8 year cycle, and if farmers cultivate root crops on a rotation basis, they can harvest 2-8 tons of cassava or 20 tons of yam per ha annually. In this system, farmers live in temporary huts and may lead a nomadic life. Their animals also are set free. With many other resources, their farm income is not lower than the average level of the Delta's farmers. However, their living conditions are very low.

The rainfed rice system

This system is the oldest rice-based system in the Delta. It covers all the areas where rice can grow during the rainy season. The system consists of two types: deep water rice system which is practiced where the water depth ranges from 50 to 100 cm, and the rainy season rice system which is practiced in problem soils (acid sulfate, salinity, etc.). In many cases, both soil and water constraints may occur in the same place leading to mixed form. With the improvement of in-field canal systems, presently, in many areas, farmers grow an extra crop (summer-autumn) with some additional irrigation at the beginning of the wet season before cultivation of traditional rainfed crops. Traditionally, farmers in this system apply an extensive farming system for rice cultivation. Local varieties require a low level of material input and supply a low level of output. With 60-70 labor days per crop, and some USD for other inputs, farmers can obtain 2-2.5 tons paddy/ha. Since monoculture predominates in this system, farmers' income in the rainfed rice base system is the lowest according to Delta standards.

The floating rice system

In the beginning of the 20th century, this system was applied in the flooded areas, annually covered with water at a depth of more than one meter. It is a very extensive production system. After ploughing land with tractors, farmer sows rice seeds and does not apply fertilizer or pesticide. Rice yield is very low: 1-2 tons/ha but input is also minimal. Along with the development of irrigation system, nowadays, water resources are available during the dry season in these areas. Therefore, floating rice has been rapidly replaced by irrigated rice. Due to the reduction of the farm size, the multicropping models involving cash crops and rice account for less than 10% to more than 80% of cultivated areas of the system. This fact completely changes the characteristics of the floating rice production system. In most cases, the upland crops are irrigated by hand or by small pumps; the system became a very intensive farming system with cash crops being the main crops. Farm income has been improved considerably. Like the rainfed rice system, in floating rice areas, farmers' houses are scattered along the canal networks. Their houses are built on stilts and lean on the dike. Even

if floating life seems uncomfortable, animal husbandry is a considerable source of farm income.

Irrigated rice-based system

The irrigated system includes production systems in which one or more than one crop of rice or upland crops can be grown with irrigation water during the dry season. These systems cover almost the whole area near the Mekong River and are equipped with irrigation systems. It is a highly diversified system. In the areas which are not affected by annual flood and soil problems, farmers grow three crops per year or even seven crops per two years. In the other areas, where some physical constraints exist, two rice crops are being cultivated. Chemical inputs are applied at a rather high rate while labor input is minimal and mechanization is not intensively used. Only land preparation, irrigation and threshing are performed by machines. Rice yield varies from system to system and the gap among them is still high. Even though crop diversification has a potential, it is not adequately supported. As an intermediary form, some coastal areas receive only supplementary pumping irrigation in the wet season. The farmers in the irrigated system live in the area connected to the roads or waterways. In this system, farming is highly diversified including animal husbandry, and non-farm activities which contribute considerably to farmers' income. However, the diversification of farming systems is still not as advanced as it should be.

Mixed garden production system

In the central part of the Delta, without physical constraints, farmers grow fruit trees in their residential areas and extend these activities into commercial gardens. This system is based on the "raised bed" technique: a form of field construction in which, perennial trees are grown in many long and wide beds alternating with a network of small canals. Inside each farm, farmers use their resources for both orchards and irrigated rice fields. Since the population density is always high in these regions, farming systems are highly intensive accounting for the most diversified production systems in the Delta. Usually three crops of rice are cultivated per year. In some city suburb areas, vegetables can be grown in rotation with rice. In the gardens, mixed varieties of fruit trees are combined with aquaculture in the canals. Fish also can be raised with rice in the fields. Animal raising and other production activities are important sources of income for the farmer as well. Since the structure of the villages is more compact than in the other systems, the communal relations in this system are closer than in the others. Gardens and rice fields are harmoniously combined. From bird's eye view, systems combining perennial trees and annual crops fields appear like the skin of a leopard with different pied parts. Integrated farming leads to a high economic performance in relation to farm income. Consequently, in spite of the high population density, farmers can continuously improve their income in this system.

History, dynamics and trend of development of production systems in the Mekong Delta

In the rural and agricultural development process, five production systems gradually

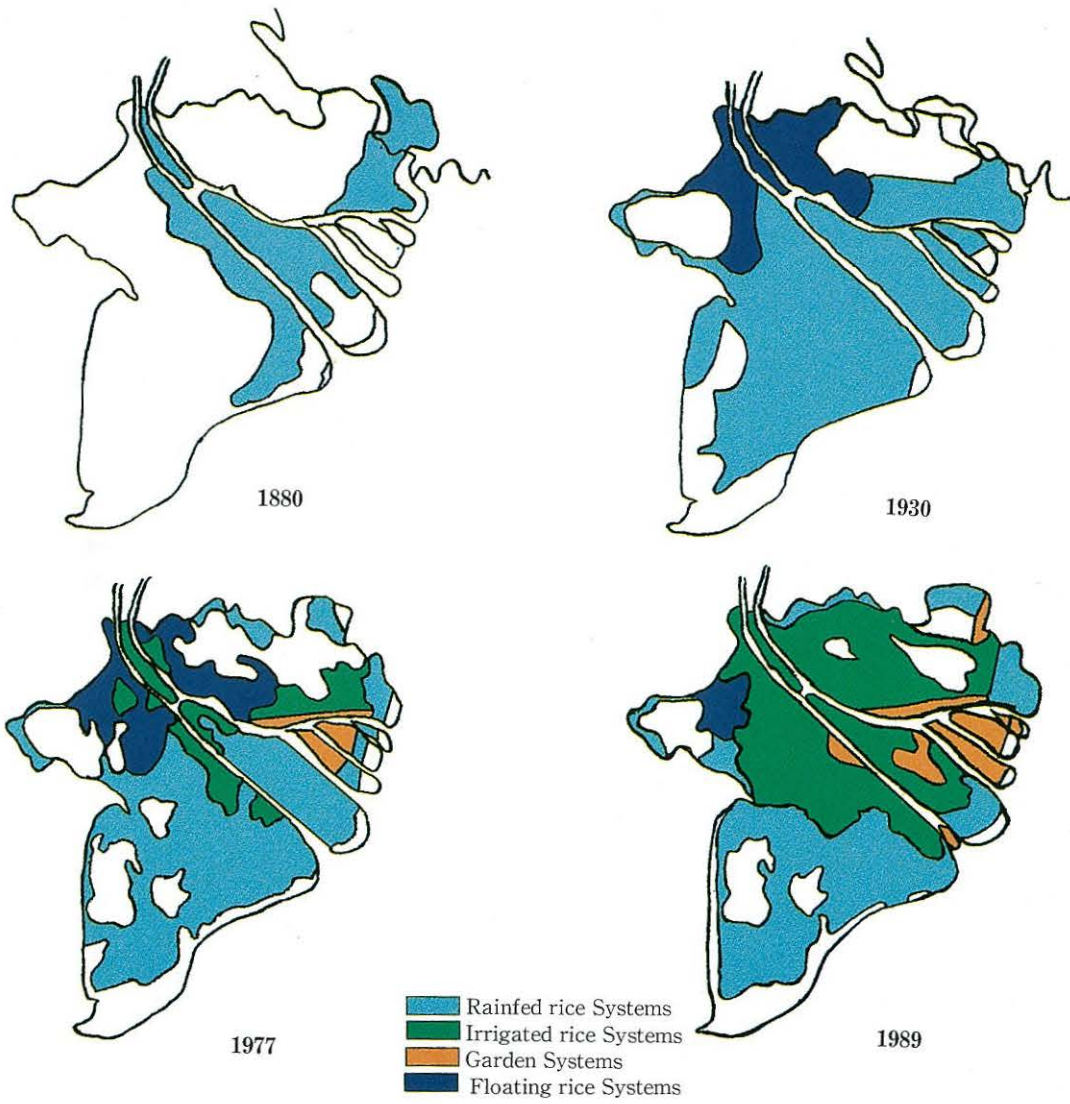


Fig. 2 Development of production systems in Mekong Delta (1880-1989).

took shape and replaced each other. The forest system changed to rainfed rice system and later to floating rice system. All these systems have recently experienced a decline and been replaced by the irrigated system. This system in turn, has been replaced by the garden system. These interchangeable processes occurred as farmers sought higher income and authorities attempted to develop targets. The tendency to change from one to another production system is referred to as "horizontal development" (Table 2). It results from the construction of facilities, especially water control facilities which may lead to development on a large scale, but requires a large amount of investment and is associated with unpredictable effects on the environment and social conditions (Fig. 2).

Table 2 Horizontal development of production systems in the Mekong Delta

	Forest system	Floating rice system	Rainfed rice system	Irrigated rice system	Garden system*
Change in areas, 1980-1995 (1980s areas = 100%)	75	9	55	263	188
Total output (\$ US/year/ha)	263**	218	349	1036	2727
Net benefit (\$ US/year/ha)	-	76	122	466	954
Investment cost to change*** (\$ US/ha)	-	150	214	426	1026

*Fruit tree gardens only (excluding coconuts).

**Net present value.

***Accumulated investment cost in order to change from forestry system to new systems (first year investment).

Three hundred years ago, the Mekong Delta of Vietnam started to be exploited on a large scale, with forests and reed plants being gradually replaced by various types of farming systems. During the agricultural development process, the forest systems deteriorated. The tropical-broad-leaved forests were wiped out. The *Melaleuca* forests (on acid sulfate soils) have largely disappeared, covering presents about 100 thousand ha (5% compared to the original area). The mangrove forests (on saline mud of coastal fringe) were also destroyed. Today, about less than 100 thousand ha (around 30% of the original area) are still covered by mangrove forests (NEDECO, 1993 ; Binh *et al.*, 1995). Presently, all the forest areas consist of newly regenerated trees with low biological yield and farming low production ecosystems.

The area with rice crops increased rapidly and the structure of rice-based systems also became more complicated (Fig. 3). Rice fields expanded from the river basin into wherever rice could be irrigated by rain water except in problem soil areas such as soils with permanent salinity or acid sulfate soils. Since the early of 1900s, floating rice has been grown on a large scale and has been rapidly propagated to areas which are subjected to flood with a water level higher than one meter each year. After 30 years, more than 500,000 ha were cul-

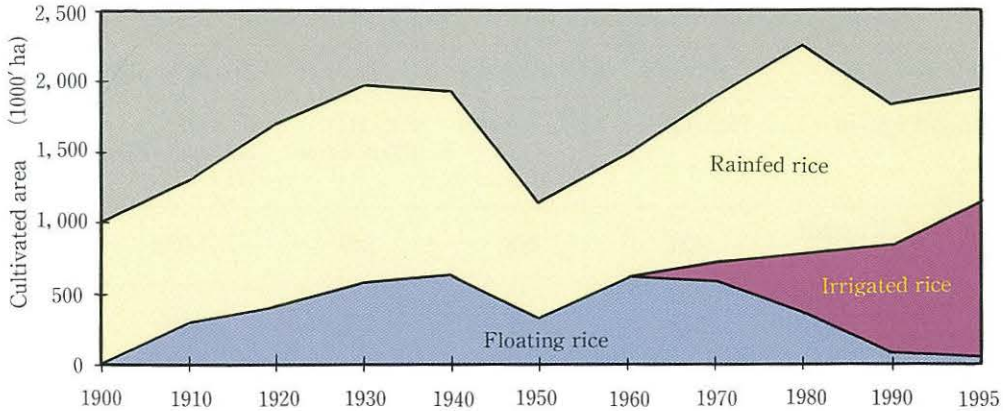


Fig. 3 Cultivated land with different rice based systems in Mekong Delta (1900-1995)

Sources: Data are derived from: Indo Chinese Annual Statistics Book (1936-1948), Annual Statistics Book of Republic Vietnam (1949-1970), National Institute of Agricultural Planning and Projection (1980-1995), Annual Statistics Book of Socialistic Republic of Vietnam (1975-1990), Institute for Water Resources Planning and Management (1900-1930).

tivated by this system. In 1968, modern rice varieties introduced from IRRI started to be used. Since 1975 and after the reorganization of agriculture in the 1990s, the irrigated rice-based systems have been spread replacing floating and rainfed rice-based systems. The area under irrigated rice-based systems increased from 300 thousand ha in 1975 to 1,100 thousand ha in 1995. Furthermore, when three crops of rice are cultivated the area increased from 12 thousand ha to 200 thousand ha up to now. The expansion of this system will continue until the time when water resources in the dry season reach a limit (according to the Interim Report of the Mekong Delta Master Plan, about 500 thousand ha more (MDMP, 1993)). Irrigated system is being encroached by the garden system.

From the end of the 19th century, coconuts had been grown in the gardens and fruit gardens became an important production system in the 1950s and 1960s. Only after 1975, due to favorable conditions did fruit gardens develop to a sizable production system. Total area of fruit gardens increased from 20 thousand ha in 1960 to around 154 thousand ha for fruit and 326 thousand ha for coconut and other perennial trees in 1995 (Sub NIAPP, 1996). However, the increase of the scale of the garden system was not matched with quality improvement. Uncertainty in the market and low development of market facilities distorted the natural development of the system. While the processing industry stagnated in the easy stages, the production of industrial crops such as coconut, pineapple, pepper, coca, etc, gradually decreased. The areas where citrus crops such as orange, grape-fruit, mandarin, etc. are cultivated are threatened by the damage caused by "greening disease". Even though the gardens are perennial production systems, their structure must be changed to cope with the uncertainties. Such a situation results in an ineffective system. The development of a sound development strategy and policy may enable the system to reach a high potential.

In parallel with the "horizontal development" approach, there is an alternative: "The

Table 3 Vertical development of production systems in the Mekong Delta

Original system	Forestry	Floating rice	Rainfed rice	Irrigated rice	Garden
Intensive system	Floating rice	FR - Sesame	Rice HT- Rainfed rice	Rice DX - Soybean - Rice HT	Garden + Animals
Total original output (\$ US/ha)	454	218	349	1,036	2,181
Total intensive output (\$ US/ha)	218	635	872	1,635	2,727
Original net benefit (\$ US/ha)	-	76	122	466	1,417
Intensive net benefit (\$ US/ha)	76	408	454	926	1,770
Investment cost to change (\$ US/ha)	-	227	210	181	151

vertical development” in which one farming system is converted to another based on the same production system or the dynamic development inside each production system (Table 3). This method of development requires the improvement of institutional mechanism, support services, policy and education in order to utilize farmers’ knowledge and resources but does not rely upon high external investment cost unlike in the “horizontal development” approach. The advantages of this approach are the ability to create favorable conditions under which farmers can mobilize their available resources to produce added income (higher than the self-sufficiency level). Hence, they can gradually accumulate capital for reinvestments. The production process based on internal dynamics can be applied everywhere in the Delta without any major problems or disruption. Obviously, it is a sustainable and effective method for rural development. However, this approach also has some weak points. In order to obtain the above advantages, a great deal of research is necessary and sound reforms to create favorable conditions for the development process should be implemented. Also implementation takes a long time. Unfortunately, these requirements in many cases involve too high a price for being accepted by decision-makers. As a means of satisfying both development directions, attention should be paid to the vertical development to mobilize farmers’ contribution while utilizing national resources through horizontal development (Fig. 4).

Case study in O Mon district, an example of integrated farming systems in an irrigated production system

O Mon district is located in the central part of the Delta. It is a typical irrigated production system without physical land constraints but with annual flood. High population density and small farm size force farmers to adopt a very intensive farming system. Due to

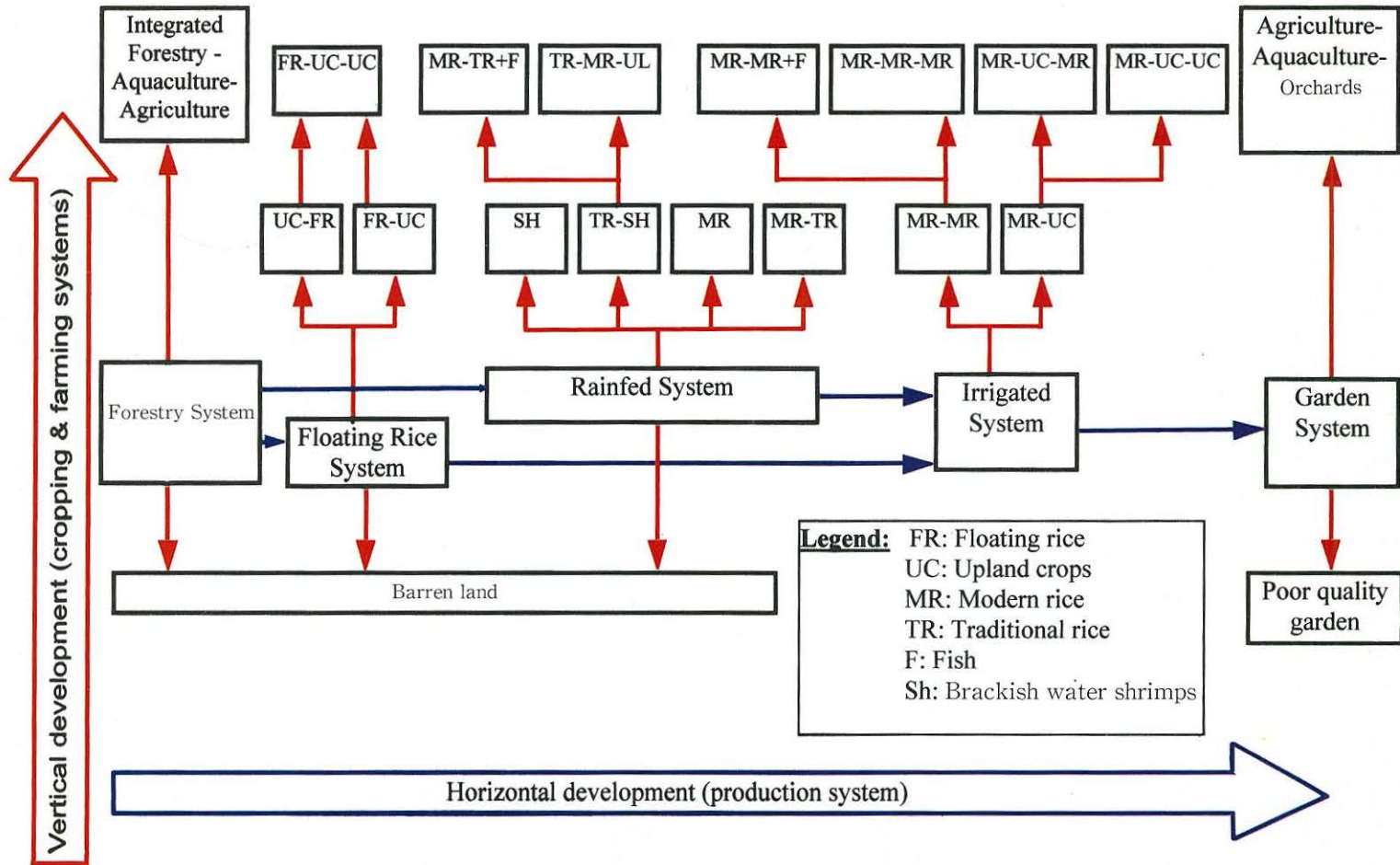


Fig. 4 Two-development dimensions of production systems in the Mekong Delta

the low price of rice, even if farmers grow two or three crops of rice their income is still rather low. Integrated farming systems such as animal husbandry, fisheries, garden cultivation have helped farmers increase their total income considerably (Table 4). However, since support services and infrastructure are poor, farmers face many risks when they try to diversify production activities. Results from a survey of 500 farmers conducted in 1995

Table 4 Per capita gross and net income of integrated models in Omon 1995

MODEL	Per capita total gross production (\$ US)	Per capita total net production (\$ US)	Per capita total agricultural value (\$ US)	Per capita net agricultural income (\$ US)	Per capita gross income extra agri. Income (\$ US)	Per capita net income extra agricultural (\$ US)
Rice double cropping	311	217	240	165	72	52
Rice double cropping + Fruit trees	556	293	317	214	239	79
Rice triple cropping	644	290	270	181	375	110
Rice triple cropping + Fruit trees	488	302	342	228	146	74
Rice triple cropping + Fruit trees + Fish	711	487	428	302	283	185

showed that the horizontal development is not sufficient to help farmers continuously improve their income when natural resources become a constraint. The research also showed that the potential of vertical development of irrigated production is promising but a great deal of research should be carried out to realize the potential.

References

- Beets, Willem C. (1990): Raising and sustaining productivity of small holder Farming system in the tropics. Ag Be Publishing-Holland.
- Binh, Nguyen Cong *et al.* (1995): MeKong Delta Development Research, Scientific Publishing House. Hanoi. 250 pp.
- CLRRI, (1996): Farm household survey in Omon District.
- Conway, Gordon R.(1986): Agro-ecosystem analysis for research and development. Winrock International Institute for Agricultural Development.
- IRRI, (1989): Agricultural Economics Department Glossary. FSR/E'89.
- International Rice Research Institute (1989): IRRI toward 2000 and beyond.

- Luat, Nguyen Van. (1991): Agricultural research and technology transfer in the M. D the present status and development strategy. VIE 87/031 project Mekong Delta Master Plan.
- MDMP VIE 87/031 (1991): Working Paper No.4 Agriculture, NEDECO.
- MDMP VIE 87/031 (1991): Review and assessment of agrotechnical practices (WP 28.2) NEDECO.
- MDMP VIE 87/031(1991): Working paper No. 12. Project appraisal ranking scenario formulation NEDECO, MDMP VIE 87/031 (1993): Master plan for the Mekong Delta in Vietnam. NEDECO.
- NEDECO (1993): Master plan for the Mekong Delta in Vietnam a perspective for sustainable development of land and water resources. October, 1993
- NIAPP (1997): Land use map of the Mekong Delta.
- Philipp, W. W. & P. F. Schmehl W. R. (1981): Farming systems research and development guidelines for developing countries, USAID.
- Son, Dang Kim (1986): Production system in the Mekong Delta, The Pub. House of Ho Chi Minh City. 383 pp.
- Tuan, Dao The (1984): Agro ecosystem. Scientific Publishing House, Hanoi. 174 pp..
- Xuan, Vo Tong (1991): Strategy development on agricultural and technology transfer in the Mekong Delta.

