Agricultural Zoning Based on an Economic Viewpoint in the Mekong Delta of Vietnam

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Abstract

In addition to the classification of agricultural zones in the Mekong Delta of Vietnam developed by Vietnamese scientists, we propose here another classification from an economic viewpoint for the mid-1990s. Our criteria for zoning were as follows: soil fertility, agricultural land size per household, and degree of development of the non-agricultural sector. 1) High- fertility soil zone is characterized by a high paddy yield, double ～ triple cropping of paddy per year, and small-scale agricultural land area and includes some inland provinces. 2) Medium-fertility soil zone is characterized by a medium paddy yield, double cropping of paddy per year, and medium-scale agricultural land area and includes only Can Tho province. 3) Low-fertility soil zone of paddy type is characterized by a low paddy yield, mono～double cropping of paddy per year, and large-scale agricultural land area and includes some coastal provinces, which are affected by saline water intrusion. 4) Low-fertility soil zone of non-paddy type is characterized by a low paddy yield, separation from paddy-predominant land utilization, and small-scale agricultural land area and includes only Ben Tre province. 5) Long An and An Giang provinces are remarkable by the strong influence of the non-agricultural sector on agriculture due to the urbanization around Ho Chi Minh City or foreign trade across the Cambodian border.

Key words: soil fertility, agricultural land size, urbanization.

The Southern part of Vietnam is comprised of two main regions, differentiated according to their geographic, topographic and hydrological characteristics: the Mekong Delta (Cuu Long Delta) and the northern part of the south-eastern region. The former currently consists of 12 provinces; Long An, Dong Thap, An Giang, Tien Giang, Ben Tre, Vinh Long, Can Tho, Tra Vinh, Kien Giang, Soc Trang, Bac Lieu, and Ca Mau(1). It covers 4 million ha, of which 2.7 million ha are devoted to agriculture and 1.95 million ha to paddy cultivation. Some natural advantages make the Mekong Delta the most important agricultural region in Vietnam. Being one of the seven agro-economic regions of Vietnam, in 1995, the Mekong Delta supplied 51% of the national output of paddy, the staple food in Vietnam. However, the Mekong Delta itself shows a natural and economic diversity that divides it into some agricultural zones. Attempts have been made by Vietnamese agronomists to delineate them. This paper intends to classify agricultural zones in the Mekong Delta of Vietnam from an economic viewpoint.

Concept of agricultural zones

"Analysis of Japan capitalism"[19], a Marxist classic in this country written by Yamada and published in 1934, discussed two aspects in order to define Japanese agricultural zones, excluding Hokkaido and Korea from the "proper" Japanese agriculture(2) as follows: 1) regional characteristics of the landlords' land-holdings and of small landholdings, 2) relationship between agricultural production and non-agricultural and capitalistic production. Yamada unified these viewpoints in placing emphasis on the former and defined Japanese agricultural zones, by showing the conflicting relationship between the Kinki and Tohoku types.

When Hoshi[7] analyzed Japanese agricultural zones in 1970, he followed essentially Yamada's two viewpoints and his concept of unification. However he modified them partly because of the implementation of the Agricultural Land Reform in 1945, replacing the term "regional characteristics of the landlords' landholdings" by "those of the small peasantry's landholding".

Isobe[10] emphasized the "regional characteristics of the relationship between agricultural production and non-agricultural production" and defined Japanese agricultural zones in 1980. He argued that the partiality and the centralization of enterprises' location conditioned by the modern industrial structure in relation to the labor-market and the land-market determine the regional differences in agricultural productivity structure. He insisted on "the regional differences in the low-wage structure in the countryside" and analyzed the agricultural zones, by indicating the basic discrepancy between the Kinki and Tohoku types. According to his theory, the former was characterized by "higher wages, lower agricultural productivity, lower rent, and regression of agriculture", while the latter showed opposite characteristics.

The present author followed the concept of Isobe who emphasized the relationship between agricultural production and non-agricultural capitalism, but with some modifications. "Low-wage structure in the countryside" was replaced by "wage structure in rural labor market" [20].

Discussions for more than sixty years showed that the influence of the landlords' establishment and of the non-agricultural capitalism, especially the former, on agricultural production was strong before World War II in Japan. On the other hand, after the War, small peasantry's landholding and non-agricultural capitalism, especially the latter, markedly affected the definition of agricultural zones in Japan.

In the Mekong Delta of Vietnam, landlords' landholding relation was removed in 1967 under the implementation of the land reform. Actually, it completely disappeared(3). Moreover the influence of non-agricultural industries on agricultural production through the labor-market and land-market is still limited geographically to the area around large agglomerations, like Ho Chi Minh City, in the Mekong Delta.

Karl Marx classified agricultural land based on the soil fertility in his discussion on the first form of differential rent[13]. He argued showing Table 1: "Let us assume the existence of four kinds of soils: A, B, C, D. Let us furthermore assume the price of one

Table 1. First form of differential rent

Type	Product		Capital	Profit		Rent	
of soil	Quarters	Shillings	advanced	Quarters	Shillings	Quarters	Shillings
A	1	60	50	1/6	10	-	-
B	2	120	50	1+1/6	70	1	60
C	3	180	50	2+1/6	130	2	120
D	4	240	50	3+1/6	190	3	180
Total	10 qrs	600 sh.				6qrs	360sh

Source: Marx, K. [13)]

quarter of wheat = £3, or 60 shillings. Since the rent is solely differential rent, this price of 60 shillings per quarter for the worst soil is equal to the price of production, that is, equal to the capital plus average profit. / Let A be this worst soil, which yields 1 quarter = 60 shillings for each 50 shillings spent; hence the profit amounts to 10 shillings, or 20%. / Let B yield 2 quarters = 120 shillings for the same expenditure. This would mean 70 shillings of profit, or a surplus-profit of 60 shillings. / Let C yield 3 quarters../ We would then have the following sequence: / The respective rents are: D = 190 sh. – 10sh., or the difference between D and A; C = 130 sh. –10 sh., or the difference between B and A..."

Marx discussing the first form of differential rent put two preconditions: First, of the two different causes of differential rent – quite independent of capital — , he did not consider the location and confined himself to natural fertility. Secondly, he assumed the existence of a particular stage of development in agriculture considering the fact that since fertility always implies an economic relation, a relation with the existing chemical and mechanical level of development in agriculture, it changes with the level of development. Marx added another precondition to his whole discussion on rent before. He confined himself to the investment of capital in agriculture per se, that is, in the production of the principal agricultural crop that feeds a given population. Then he dealt with wheat for this purpose, because it was the principal means of subsistence in "modern capitalistically developed nations".

The argument on the first form of differential rent developed by Marx did not assign a zone to a given area, but classified soils according to their fertility. However, if agricultural zones in a given area are defined from the viewpoint of soil fertility, and an agricultural zone corresponds to a soil type, we may replace the soil type in the table by an agricultural zone. In that case, soil classification applies to agricultural zoning. We will use such criteria for defining agricultural zones in the Mekong Delta[(4)].

At present, we examine the suitability of Marx preconditions in the Mekong Delta. Firstly, we can consider mainly the principal agricultural crop that feeds a given population. However, we deal with paddy instead of wheat, because the former is mainly cultivated in the Mekong Delta as Vietnamese staple food. Paddy fields accounted for 72 % of the total agricultural land area in the Mekong Delta in 1995. Secondly, of the two different causes of differential rent, throughout most areas in the Mekong Delta, we may neglect the location and confine ourselves to natural fertility. It seems that the influence of city on agricultural production through labor-market, land-market, or agricultural goods' market is still limited to the outskirts of large agglomerations in the Mekong Delta. Thirdly, we can assume that the technological conditions throughout the delta are similar. In fact, there are high-yielding varieties of rice in the delta which were developed by IRRI. The varieties require good irrigation systems, the application of a certain amount of chemicals, and good care, thus a certain level of development in agricultural technology. However, as we will see later, crop rotation varies depending on the localities and the natural conditions (saline water intrusion, depth of water during the flooding period, etc.).

Agricultural zones in the Mekong Delta can be classified as follows.

1) Soil fertility: Reflected by yield of paddy.

2) Small peasantry's landholding: Regional characteristics are reflected by the agricultural land size per household.

3) Development of non-agricultural activities: Still

Table 2. Principal agro-ecological zones in the Mekong Delta (NIAPP)

Geomorphology	Agro-ecological zones	Area (1,000ha)	%
Inundation Plain	Fluvial plain	1,200	31.5
	Closed depression	496	13.0
	Open depression	218	5.7
Coastal plain	High coastal plain	670	17.6
	Low coastal plain	648	17.0
	Closed depression	195	5.1
	Tidal coastal plain	216	5.7
Alluvial terraces	High and middle terraces	124	3.3
Hills and mountains	Mountainous zone of An Giang	42	1.1

Source; IAS [8]

limited in the Mekong Delta, with the level of urbanization as an indicator.

Classification of agricultural zones in the Mekong Delta by Vietnamese agronomists

According to the agro-ecological map of the Mekong Delta developed by the NIAPP[5], the Mekong Delta comprises four geomorphological types: (1) inundation plain; (2) littoral plain; (3) alluvial terraces; (4) hills and mountains.

These types are subdivided into nine agro-ecological zones. The criteria for classification are based on geomorphological differences, the types of soil, the depth and duration of inundation, and the availability of water for irrigation during the dry season. Table 2 shows the nine agro-ecological zones of the Mekong Delta and gives their relative importance in terms of area.

Here short descriptions of each zone are as follows (Lai *et al.* [12], CLRRI[4]):

Fluvial plain is an alluvial soil zone with fresh water between the Hau Giang River and the Tien Giang River.

Closed depression, depression plain, is a flooded zone of the Plain of Reeds (*Dong Thap Muoi*). Deep flooding occurs from August to November there. The zone includes large swamp areas with acid sulfate soils.

Opened depression is a lowland area around Ha Tien (coastal area near the Cambodian frontier), submerged and covered with acid sulfate soils. The zone is also partly affected by saline water intrusion during the dry season and by flooding during the rainy season. Meanwhile, soils are characterized by a high content of organic matter and good drainage.

High coastal plain is an estuary zone that includes alluvial and acid sulfate soils. The zone is affected by saline water intrusion during the dry season.

Low coastal plain is the low-lying zone of Ca Mau Peninsula, which includes potential acid sulfate soils with poor drainage. The zone is affected by tidal flood and saline water intrusion.

Closed depression, coastal plain, is a zone of *Melaleuca* forest or swamp, with peat soils or acid sulfate soils.

Tidal coastal plain includes swampy tidal areas from Long An to Minh Hai provinces. The zone is submerged and there are mangrove forests.

High and middle terraces form an old alluvial-soil zone in the Long An and Dong Thap provinces, along the border of Vietnam-Cambodia.

Mountainous zone of An Giang is covered with gray soils.

In the meantime, progress in agricultural technology is reflected in the geographic distribution of crop rotations, based on the geographic differences in natural conditions among the regions. Chiem[2] analyzed these aspects in detail, comparing crop rotations in the 1970s with those in the 1990s in the Mekong Delta. Sanh et al. (Sanh *et al.* chapter of Xuan *et al.*[17]) proposed another agro-ecological zoning in the delta, incorporating the Chiem's results. The authors observed some characteristics such as rainfall, temperature, soil, topography, crop rotations, and water resources and divided the delta into seven agro-ecological zones as follows:

Fresh water alluvium zone covers an area of 900 k ha. The zone is well known for rice production and cultivation of fruit trees.

Upland and mountainous zone is located in An Giang and Kien Giang provinces with less than 200 k ha. Rain-fed farming is practiced in several small areas.

Cassava, groundnut, mung bean, cotton, and fruit trees are planted there.

Plain of Reeds is located in Dong Thap province, covering an area of 500 k ha. This is the lowest zone of the delta, with a topography of 0.5 m below mean sea level. The zone is characterized by acid sulfate soils. Recently, in several parts of this plain where fresh water supplied by irrigation is available, rice has been cultivated. The remaining area has not yet been exploited or is just planted with *Melaleuca* forests. High flooding level during the rainy season is recorded.

Long Xuyen Quadrangles covers an area of 400 k ha and is also dominated by acid sulfate soils. Moreover, high flooding level during the rainy season is recorded. In several parts of this quadrangle where fresh water supplied by irrigation is available, farmers grow commonly two rice crops per year. Also *Melaleuca, Eucalyptus*, pineapple, cashew, etc. can be grown there.

Trans – Bassac Depression covers an area of 600 k ha. Most of the food crops and fruit trees of the delta are found there.

Coastal zone occupies an area of 600 k ha. Agriculture in the zone depends mainly on rainwater.

Ca Mau Peninsula extends over an area of 800 k ha covered permanently or seasonally with salinity-affected soils.

Obviously, lack of or, at least, weakness of socio-economic viewpoint characterizes the zoning.

Data sources

As data source for the indicator of urbanization mentioned later, we used the Status of Labor-Employment in Vietnam, 1997[1)]. On the other hand, as data source for the indicators of soil fertility and of agricultural land size, we used the Statistical Data of Agriculture, Forestry and Fishery, 1985-1995[5)]. Generally speaking, some characteristics of the data sources limit the scope of analyses. Characteristics of the analysis based on data sources are as follows:

1) Since regional data used are given at the provincial level, our observation on indicators should also be made at the provincial level.

2) The most recent data used are those of 1995 (soil fertility and land size) and 1997 (urbanization). Minh Hai province was divided into two provinces (Bac Lieu and Ca Mau) in 1997. Then, when we use the former data, we should deal with this area as one province, namely Minh Hai province.

3) Concerning the data on paddy cropping, the Statistical Data of Agriculture, Forestry and Fishery differentiate merely two seasons of paddy cropping; namely winter paddy and spring paddy. However, in some areas of the Mekong Delta, paddy cropping occurs in three seasons. Since this aspect is not indicated in the statistical book, manipulation for data analyses should be performed.

There is another recent agricultural data source; namely Statistical Yearbook, 1997 [6)], which is more useful than the Statistical Data of Agriculture, Forestry and Fishery for the following reasons:

1) The former supplies more recent data than the latter (1996).

2) Since the former was published in 1998, namely after the division of Minh Hai province into Bac Lieu and Ca Mau provinces, data on these two provinces are supplied.

3) The former refers to three seasons of paddy cropping (winter paddy, spring paddy and autumn paddy), which reflects the actual conditions of paddy cropping in the delta.

However, the former does not give any information on agricultural land size. Moreover, the book provides actual data of paddy yield only for 1995 and 1996 and estimated data in 1997. For annual fluctuations in paddy yield, average of several years' yields should be adopted as an indicator of paddy yield. The Statistical Data of Agriculture, Forestry and Fishery provide data on agricultural land size and paddy yields from 1985 to 1995. Thus we used this statistical book as the main source for the agricultural data (soil fertility and land size).

Regional differences in paddy yield

Regional differences in soil fertility are reflected by regional differences in paddy yield in the Mekong Delta under the conditions mentioned previously. Accordingly we examined the yield using the

Table 3. Yield of paddy by province (average of 1993-1995)
(unit: t/ha, cropping frequency/year)

Province	Per sown area	Per paddy field area	Winter	Spring	Cropping frequency
An Giang	4.9	8.4	3.6	6.1	1.7
Dong Thap	4.4	8.1	2.3	5.3	1.8
Tien Giang	4.4	11.5	3.6	5.3	2.6
Vinh long	4.4	9.1	3.7	5.2	2.1
Can Tho	4.0	7.3	2.9	4.6	1.8
Soc Trang	3.5	5.0	3.1	3.6	1.4
Kien Giang	3.5	5.0	2.6	4.3	1.4
Minh Hai	3.5	3.7	3.5	-	1.0
Ben Tre	3.4	4.5	3.0	4.0	1.3
Tra Vinh	3.4	4.8	2.8	3.9	1.4
Long An	3.1	4.6	1.9	3.6	1.5
Mekong Delta	3.9	6.2	3.0	4.8	1.6
Whole Country	3.6	5.6	2.9	4.2	1.6

1) Per sown area: Yield of paddy per sown area (year)
Per paddy field area: Yield of paddy per paddy field (year)
Winter: Yield of paddy per sown area (winter paddy)
Spring: Yield of paddy per sown area (spring paddy)
Cropping frequency: Cropping frequency of paddy per year
Source: General Statistical Office [5)]

statistical data. However, there are various indicators of paddy yield.

(1) Yield of paddy per paddy field (unhulled rice basis):

This indicator is based on the relationship between the production and land area. However, in the Mekong Delta, paddy is cultivated from 1 to 3 times per year. Therefore, the difference in the value of this indicator reflects not only the soil fertility but also crop rotations, mainly the latter. In general, the higher the cropping frequency, the larger the investment in land. Then, adopting this indicator, we consider the concept of differential rent II apart from that of differential rent I [(6)].

(2) Yield of paddy per sown area:

It appears that regional differences in the value of this indicator reflect the soil fertility if one of the next two conditions is met; 1) Similarity of crop rotation among regions, 2) Similarity of paddy yield among cropping seasons. However, actually, both conditions are not met in the Mekong Delta. As we will observe later, crop rotation varies with the regions. Moreover, paddy yield varies with the cropping season. Generally, paddy yield of the rainy season crop is lower than that of the dry season crop[(7)].

(3) Seasonal yield of paddy per seasonal sown area:

This indicator can be computed three times in some regions, in which paddy is cultivated three times per year. To identify the regional differences in soil fertility, this indicator could be computed for each cropping season in every province. After that, we should compare the computed results among regions. Average annual cropping frequency per household is markedly different depending on the provinces, ranging from 1.0 (Minh Hai) to 2.6 (Tien Giang) in the Mekong Delta in 1995, suggesting that triple cropping of paddy is very popular in some regions. However, as mentioned previously, in the statistical book used, yield data cover only double cropping; namely spring paddy and winter paddy. The former seems to correspond to the dry season cropping and the latter to the winter season cropping. However, correspondence between these two cropping seasons and actual three cropping seasons (winter-spring cropping, spring-summer cropping, and summer-autumn cropping for modern rice varieties or *mua* cropping for traditional rice varieties) is not given.

Table 3 shows the values of the second indicator computed in every province in the Mekong Delta. For yearly fluctuations of paddy yield, we computed the average yield in the recent three years (1993-5). In the table, the provinces are arranged in the order of paddy yield per sown area (second indicator). If the distribution of paddy yield per sown area at the provincial level followed a normal distribution, paddy yield in about 40% of provinces would range between

3.6 t/ha and 4.2 t/ha (medium ± 0.3 t/ha). The provinces in this range are classified into medium-fertility soil area. However, in fact, the yield distribution in the table does not follow a normal distribution and only Can Tho province belongs to the medium-fertility soil area. The other provinces are grouped with Can Tho into the high-fertility soil area and the low-fertility soil area in the table.

High-fertility soil area: An Giang, Tien Giang, Vinh Long, Dong Thap
Medium-fertility soil area: Can Tho
Low-fertility soil area: Minh Hai, Soc Trang, Kien Giang, Ben Tre, Tra Vinh, Long An

The relationship between the high-fertility soil area and the low-fertility soil area reappears in the annual cropping frequency in the Table. The cropping frequency in the high-fertility soil area ranges from 1.7 to 2.6 while, in the low-fertility soil area, it ranges from 1.0 to 1.5. The annual cropping frequency in the medium-fertility soil area (Can Tho) is within the range of the high-fertility soil area (1.8).

As a result of the disparity in the cropping frequency between the low-fertility soil area and the high-fertility soil area, there is a disparity in paddy yield per sown area between the two areas, emphasized in the paddy yield per paddy field area. Table 4 shows that, when the average paddy yield per sown area of the high-fertility soil area is 1.32 times higher than that of the low-fertility soil area, the average paddy yield per paddy field area of the former becomes 2.02 times higher than that of the latter. This increase in disparity is also observed between the medium-fertility soil area and the low-fertility soil area as well as even between the high-fertility soil area and the medium-fertility soil area. The average paddy yield per sown area of the medium-fertility soil area is 1.18 times higher than that of the low-fertility soil area, while that per paddy field area of the former is 1.58 times higher than that of the latter. The average paddy yield per sown area of the high-fertility soil area is 1.13 times higher than that of the medium-fertility soil area, while that per paddy field area of the former is 1.27 times higher than that of the latter (not marked in the Table). Then the yield disparity among soil fertility areas increases when the average paddy yield per sown area is replaced by that per paddy field area.

Then the following question can be raised: How can the regional differences in soil fertility be defined? What is the main factor that conditions the soil fertility areas at the provincial level?

In Fig. 1, the low-fertility zone of paddy type and that of non-paddy type (explained later) correspond to the low-fertility soil area. We may notice that the zones consist of provinces that have coastal regions and are affected by saline water intrusion during the dry season, which follows the tidal regime. The saline water intrusion seems to determine the low yields, especially during the dry season in these provinces. In some regions, severe saline water intrusion makes the dry season cropping even impossible. Then the saline water intrusion affects both the soil fertility and the cropping frequency. In

Table 4. Yield of paddy based on soil fertility area (average 1993-5)
(unit: t/ha, cropping frequency/year)

Soil fertility area	Per sown area		Per paddy field area		Winter		Spring		Cropping frequency
	t/ha	Index	t/ha	Index	t/ha	Index	t/ha	Index	
High-fertility soil area	4.5	132	9.3	202	3.3	118	5.5	141	2.1
Medium-fertility soil area	4.0	118	7.3	158	2.9	104	4.6	118	1.8
Low-fertility soil area	3.4	100	4.6	100	2.8	100	3.9	100	1.3

1) Per sown area: Yield of paddy per sown area (year)
Per paddy field area: Yield of paddy per paddy field area (year)
Winter: Yield of paddy per sown area (winter paddy)
Spring: Yield of paddy per sown area (spring paddy)
Cropping frequency: Cropping frequency of paddy per year
Index: Index of yield based on the low-fertility soil area
2) For soil fertility area, refer to the text.
Source: General Statistical Office [5)]

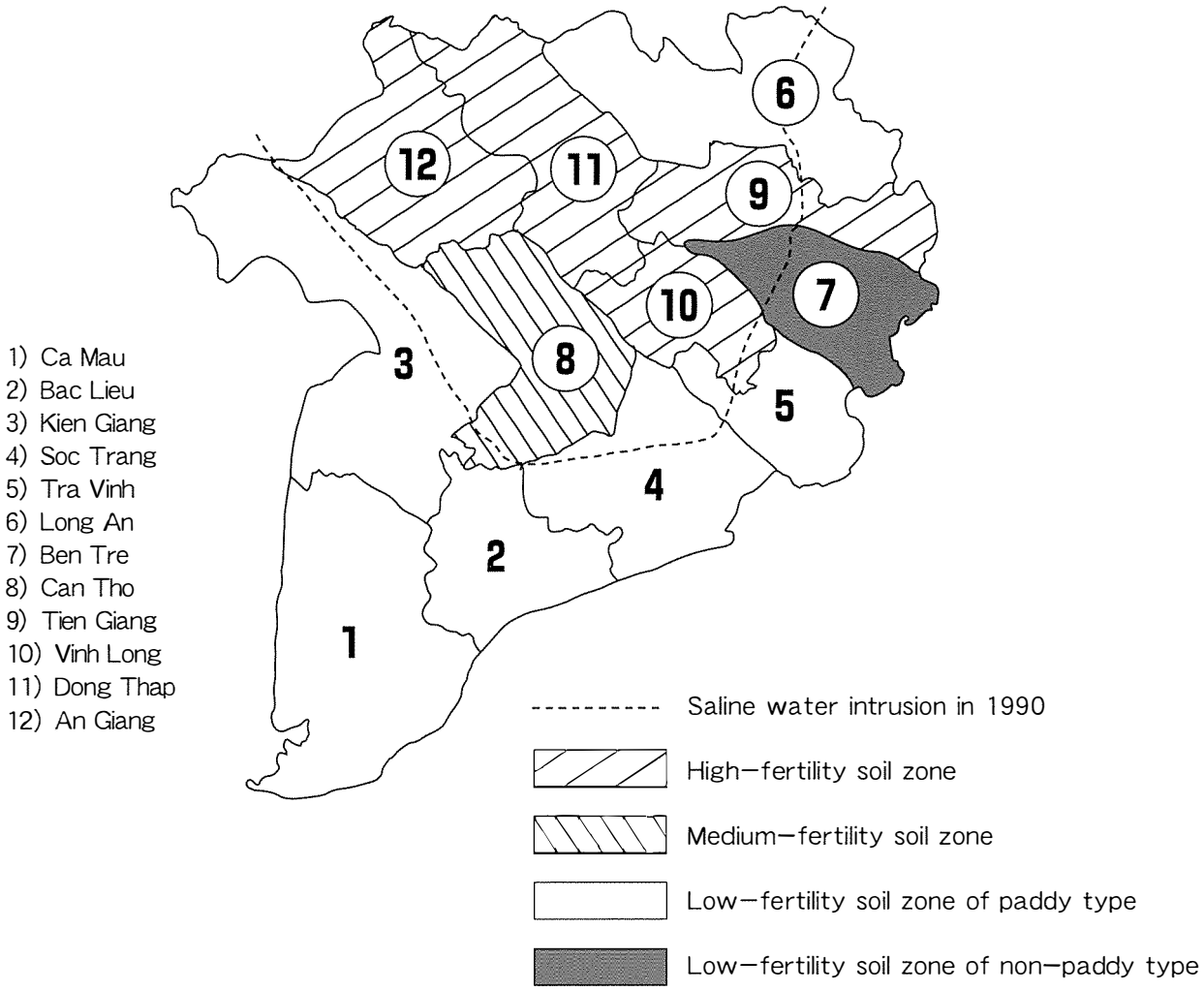

Fig.1. Agricultural zones and saline water intrusion in the Mekong Delta
Source: General Statistical Office[5], Xuan *et al.*[7]

Table 4, for the winter crop, the average paddy yield per sown area of the high-fertility soil area is 1.18 times higher than that of the low-fertility soil area while the former is 1.41 times higher than the latter for the spring crop. In Table 3, the absence of data for the spring paddy yield in Minh Hai province shows that the dry season paddy cropping is almost impossible throughout the whole province.

It has often been pointed out that saline and acid sulfate soils are the two main problem soils in the Mekong Delta that constrain agricultural development. According to our observation, certainly the former corresponds actually to the low-fertility soil area. However, the latter may not always be associated with low yields any more. We might rather state that results of many studies and surveys on acid sulfate soils show that through integrated farming systems approaches these agro-ecosystems can give rise to more profitable farming (Duong *et al.* chapter of Xuan *et al.*[7])[8]. The acid sulfate soils have potentially a high fertility. The content of organic matter in the soils is rather high. However, the toxicity in the soils was formerly an important constraint on the utilization of these soils for agriculture (Chiem[3]).

Regional differences in land size

Wataya[16] analyzed theoretically the structure of agricultural productivity and differentiated it into two factors; 1) proto-productivity of labor and 2) social-productivity of labor. The structure of agricultural productivity is a synthesis of these two opposite factors. In the former factor, soil fertility, location of

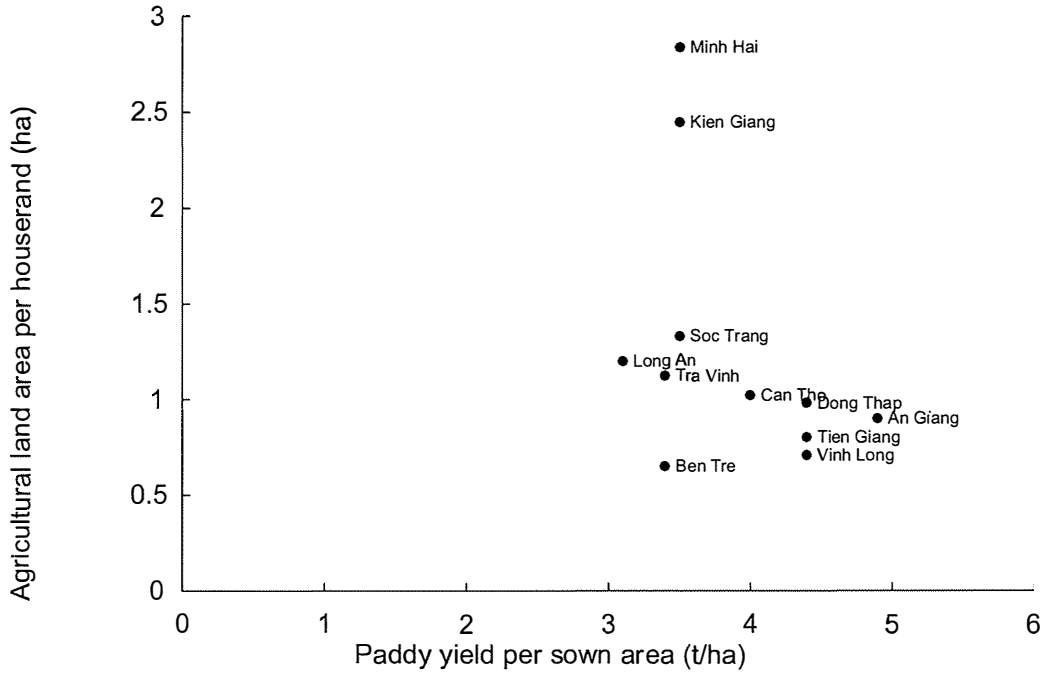

Fig.2. Paddy yield and agricultural land area per household.

land, and agricultural land size are considered. Hoshi[7] considered agricultural land size per household as an important factor, in his analysis of the Japanese agricultural zones, as mentioned earlier. The average farm size is also an important factor that conditions agricultural zones in the Mekong Delta. As an indicator of average farm size, we can select based on statistical data:

(1) Paddy field area per household:

Even if paddy is the main crop in the Mekong Delta, the range of farm size should not be restricted to the paddy field area.

(2) Agricultural land area per household:

This is a more suitable indicator for estimating the average farm size.

Table 5 shows the computed values of these indicators using the data from 1995. In the Table, the provinces are arranged according to the value of the second indicator. What is remarkable is that provinces belonging to the low-fertility soil area tend to have a larger average agricultural land area per household than those in the high-fertility soil area. In Fig. 2, each province is placed on a plane that indicates the relationship between paddy yield per

Table 5. Average agricultural land area per household by province, 1995 (unit: ha)

Province	Agri. land (ha) (A)	Paddy field (ha) (B)	Paddy field rate (B/A)
Minh Hai	2.84	1.53	0.54
Kien Giang	2.45	1.88	0.77
Soc Trang	1.33	1.07	0.80
Long An	1.20	1.07	0.89
Tra Vinh	1.12	0.79	0.71
Can Tho	1.02	0.84	0.82
Dong Thap	0.98	0.86	0.87
An Giang	0.90	0.80	0.89
Tien Giang	0.80	0.48	0.61
Vinh Long	0.71	0.53	0.75
Ben Tre	0.65	0.24	0.37
Mekong Delta	1.18	0.85	0.72
Whole country	0.70	0.40	0.57

1) Agri. Land: Agricultural land area per household
Paddy field: Paddy field area per household

Source: General statistical office[5]

Table 6. Output of paddy per household based on soil fertility area (average 1993-1995) (unit: t/household)

Soil fertility area	t/household	Index (1)	Index (2)
High-fertility soil area	6.1	111	124
Medium-fertility soil area	6.2	112	127
Low-fertility soil area (1)	5.5	100	-
Low-fertility soil area (2)	4.9	-	100

1) Low-fertility soil area (1) excludes the data of Ben Tre province while low-fertility soil area (2) includes the data of Ben Tre.
2) Index (1): Index of yield based on low-fertility soil area (1)
Index (2): Index of yield based on low-fertility soil area (2)
Source: General Statistical Office [5)]

sown area and average agricultural land area per household. Here, Can Tho province is again a borderline as before. All the provinces which are placed above Can Tho in Table 5, namely Minh Hai, Kien Giang, Soc Trang, Long An and Tra Vinh show a relatively low paddy yield and belong to the low-fertility soil area. On the other hand, four of the five provinces below Can Tho in the Table, namely Dong Thap, An Giang, Tien Giang and Vinh Long show a relatively high paddy yield and belong to the high-fertility soil area. The only exception is Ben Tre province. This is the only province that belongs to the low-fertility soil area and is placed below Can Tho in the Table. Ben Tre has the smallest average agricultural land area per household among the provinces. This province is also remarkable in that the paddy field rate is the lowest substantially below 50 %, in Table 5. This is the only province in which paddy cropping is not predominant in agricultural land. Chiem[2)] stated that "Ben Tre province has long been famous for its coconut gardens. According to old farmers there, these coconut gardens were developed a century ago and many old coconut trees have been replanted." Lai[11)] also mentions that fruit tree cultivation consisting not only of coconut gardens but also of mixed gardens with longan, rambutan, etc. is a predominant land utilization in some regions of Ben Tre province.

Therefore, the low paddy yield and low cropping frequency in the low-fertility soil area are compensated by a larger agricultural land size per household while the smaller one in the high-fertility soil area is compensated by a higher paddy yield and multiple cropping. These compensations seem to occur in relation to the tendency to balance the agricultural income per household among regions. Ben Tre presents a unique aspect characterized by a low soil fertility and the smallest agricultural land area per household. This is also the only province that deviates from the paddy-predominant farming systems at the provincial level.

Table 6 shows the output of paddy per household depending on the soil fertility area. Values of this indicator are the product of paddy yield per paddy field and paddy field area per household. The latter is not the indicator of agricultural land area per household itself which we adopted but is closely related to it in the paddy-predominant areas. The output of paddy per household approximately reflects the agricultural income per household there. Ben Tre province shows a very low output of paddy per household (1.5t/household) compared with the other provinces under the conditions described previously. Then, in the Table, we computed the output of paddy in the low-fertility soil area in two different ways. One figure includes the data of Ben Tre unlike the other. Comparison of indexes in Table 6 with those of paddy yield per sown area and per paddy field in Table 4 shows the degree of compensation for paddy yield by paddy field size. The disparity between the high-fertility soil area and the medium-fertility soil area, which was obvious in the two indexes in Table 4, disappears in Table 6. The disparity between the high-fertility soil area and the low-fertility soil area decreases from the two indexes in Table 4 to the indexes in Table 6, even if we refer to index (2) in Table 6. It is thus indicated that, the low-fertility soil area partly compensates the disadvantage of soil fertility by a larger paddy field area per household. There is still a disparity in the output between the

high-fertility soil area and the low-fertility soil area shown in Table 6.

Regional differences in non-agricultural activities

Non-agricultural activities conducted in rural areas and in addition to agricultural activities markedly affect the farmers and agriculture. The job opportunities provided by the non-agricultural sector in the rural areas give farmers other income sources, which modify the productive system of farm households, and determine the opportunity cost of family labor in family farming. The non-agricultural sector sometimes even competes with the agricultural sector in the rural labor market. The competition between the two sectors is also found in the land market, especially in areas where industrialization or urbanization progresses rapidly. By gathering labor, non-agricultural activities in rural areas provide a wider local market for agricultural products. The local market is the only one for fresh products, when processing facilities and transportation methods are not well developed in the rural areas. Thus the regional differences in the intensity of non-agricultural activities markedly affect the regional characteristics of agriculture.

Here the percentage of labor in the non-agricultural sector compared with the total labor was used as an indicator for estimating the intensity of non-agricultural activities. The higher the value of this indicator, the more we consider that the non-agricultural activities are intensive. Table 7 shows the values of this indicator by province. Two provinces, An Giang and Long An, are conspicuous for the high rate of this indicator. The eastern part of Long An is influenced by urbanization centered on Ho Chi Minh City. Also, some industrial zones attract foreign companies[9]. An Giang is characterized by active trade around the Cambodian border[10].

Table 7. Percentage of labor in non-agricultural sector compared with total labor by province, 1997 (unit: %)

Province	%
An Giang	48.0
Long An	44.1
Can Tho	42.1
Bac Lieu	39.2
Vinh Long	38.2
Tra Vinh	36.9
Tien Giang	35.8
Dong Thap	31.8
Ca Mau	31.2
Ben Tre	29.9
Kien Giang	25.0
Soc Trang	24.5
Mekong Delta	36.1
Whole country	34.2

Source: Center for Information; Statistics on Labor and Social Affairs [1)]

Conclusion

In addition to the classification of agricultural zones in the Mekong Delta of Vietnam developed by some Vietnamese agronomists, another classification from an economic viewpoint was proposed for the mid-1990s (Fig. 1). The criteria for zoning were based on soil fertility, agricultural land size per household, and degree of development of the non-agricultural sector.

Among the provinces with paddy-predominant land utilization, there was an inverse correlation between the first factor and the second. Average agricultural income among the provinces tended to be balanced, as reflected by the total paddy production per household despite the existence of regional differences in paddy yield.

The zoning we adopted is summarized as follows:

1) High-fertility soil zone is characterized by a high paddy yield, double-triple cropping of paddy per year, and small-scale agricultural land area per household. It includes An Giang, Tien Giang, Vinh Long, and Dong Thap provinces.

2) Medium-fertility soil zone is characterized by a medium paddy yield, double cropping of paddy per year, and middle-scale agricultural land area per household. It includes Can Tho province.

3) Low-fertility soil zone of paddy type is characterized by a low paddy yield, mono-double cropping of paddy per year, and large-scale agricultural land area per household. It includes Minh Hai, Soc Trang, Kien Giang, Tra Vinh, and Long An provinces.

4) Low-fertility soil zone of non-paddy type is characterized by a low paddy yield, separation from the paddy-predominant land utilization, and

small-scale agricultural land area per household. It includes Ben Tre province. This zone is remarkable for the separation from paddy-predominant land utilization while the other zones are considered to be paddy-predominant zones.

5) Long An and An Giang provinces are also remarkable by the strong influence of the non-agricultural sector on the agricultural sector due to the urbanization around Ho Chi Minh City or foreign trade across the Cambodian border.

6) The provinces belonging to the low-fertility soil zones are located in the coastal area, which is affected by saline water intrusion, especially during the dry season.

Notes

(1) Minh Hai province was divided into two provinces (Bac Lieu and Ca Mau) in 1997.

(2) Korea was a Japanese colony then.

(3) A recent article of Viet Nam News[15] warned that the landlord system could reappear in future as a result of farmers' differentiation process in the *Doi Moi* era.

(4) Yamada[18] classified Japanese agricultural zones in the 1930s based on yield and production cost for paddy.

(5) The map was published by the National Institute of Agricultural Planning and Projection (NIAPP) in 1987 in Ha Noi.

(6) In the recent development of paddy cropping in the Mekong delta, marginal productivity per unit of investment seems to increase when the investment increases due to the following technical innovations; a) introduction of the high-yielding modern varieties, b) introduction of dry season cropping. Incidentally, these two elements often are mutually related and occur simultaneously there.

(7) IAS (Viet, H. C.)[9] gives a good summary of the reasons for this phenomenon: At the beginning of the summer-autumn crop, seedlings are damaged and weakened due to high temperature and delayed rain. In the middle of the season, diseases and insects develop because of heavy rainfall and high humidity. The harvest stage coincides with the wet season; therefore the rate of paddy loss in the field is very high. As a result, the yield as well as quality of rice in this season is always lower than that in the other seasons.

(8) Prime Minister Vo Van Kiet praised, in a two-day conference, efforts of scientists and all concerned branches in implementing a ten-year socio-economic development program that has turned the Plain of Reed, a former wild and waterlogged area affected by serious acid sulfate soils into high yield rice farms. (Viet Nam News[14])

(9) In Long An province, thirty-one foreign direct investment projects were licensed during the period 1988-1997. This is the largest number in the Mekong Delta, (27%). (General Statistical Office [6])

(10) In An Giang province, the number of persons engaged in private trade, food sector, and services is the largest in the Mekong Delta, i.e. 87.6 k persons in 1997. (General Statistical Office [6])

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ベトナム・メコンデルタの農業地帯構成：既往研究の紹介と経済的視点からの提案

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摘要

ベトナム・メコンデルタの農業地帯構成に関しては、従来、ベトナム人科学者の手により、自然条件を重視しつついくつか提案されてきた。本稿では、省レベルのデータを用いて、経済的な視点から 90 年代中葉時点の農業地帯構成把握を試みた。ここで採用した地帯類型化の標識は、土地豊度、1 戸当り農地面積、非農業部門の発展度である。その結果、以下の地帯類型を得た。1) 優等地地帯は、高稲作収量、年間 2 ～ 3 回稲作、小規模農地により特徴づけられ、内陸部のいくつかの省を含んでいる。2) 中等地地帯は、中位の稲作収量、年 2 回稲作、中規模農地により特徴づけられ、カントー省のみが該当する。3) 稲作型の劣等地地帯は、低稲作収量、年 1 ～ 2 回稲作、大規模農地により特徴づけられ、沿岸部のいくつかの省を含んでいる。4) 非稲作型の劣等地地帯は、低稲作収量、稲作中心の土地利用からの脱却、小規模農地により特徴づけられ、ベンチェ省のみが該当する。5) ロンアン省及びアンギャン省は、農業に及ぼす非農業部門の影響の大きさから注目され、それぞれホーチミン市周辺の都市化、カンボジア国境近辺の商業活動がその原因である。

キーワード：土地豊度、農地規模、都市化