The Chao Phraya delta in perspective: a comparison with the Red River and Mekong deltas, Vietnam

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Abstract: *The deltas are the major rice bowls of Asia. They combine high population densities with intensive agriculture. Agricultural activities are strongly shaped by the hydrologic regime, its floods, low flows in the dry-season and the tidal effect. Their historical development seen in terms of settlements, cultural origin and socio-political formation are nevertheless contrasting. This paper attempts to highlight a few commonalities of the Red River, Mekong and Chao Phraya deltas, together with their main discrepancies. It thus provides a comparative perspective on the Chao Phraya delta and helps sketching out its particularities.*

The comparison between three Southeast Asian deltas will help us understand the peculiarities of the development of the Chao Phraya delta. The Red river delta belongs to the category of high population density deltas (over 300 inhabitants per km^2), covers 250,000 km^2 with 12 million inhabitants. While the Mekong and the Chao Phraya deltas belong to the category of less highly populated deltas.

The Red river and the Mekong rivers originate from the region where other great rivers of Asia as the Yang Tse Kiang, the Si kiang, the Salaween, the Irrawadi and the Brahmaputra also have their origins. It is also the region where cultivated rice probably originated (Chang T.T.,1976, Watabe, 1977). This region, according to Dao The Tuan (1997), is a centre of highest diversity of rice cultivars.

This region is inhabited by ethnic groups which belong to the Thai, Tibeto-Burman and Mon-khmer groups. The mountainous regions had the administration form of intermontane basin called Muong, governed by chiefs called Chao muong. The North Vietnamese Tai ethnic groups contributed to the formation of the Vietnamese nation. The first Thai kingdom on the territory of Northern Thailand was the kingdom of Lanna founded by the Yuan (a group of Thai) in the XIII century (Ishii, 1978). In the lower Mekong, inhabited by Mon-khmer ethnic groups, the kingdom of Funan spread from the I to the VI century and developed agriculture and trade (Malleret, 1962). We don't know if there were relations between these ethnic groups and states in the past, but there were migration waves of Thai ethnic groups from Yunnan to Laos, to Thailand and to the mountainous regions of North Vietnam, especially

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after the Mongol invasion of the XIII century, and further to the apogee of the Khmer empire which extended from Thailand to the delta of Mekong in the XIII century. From the XVII century the lower Mekong basin was colonised by the Vietnamese together with the Khmers.

People living in Southeast Asia have developed varied agrarian systems according to the ecological conditions of their environments (Kaida 1991). Most of the time they have used adaptive strategies to natural parameters (soil, relief, rainfall, flood, etc...) but gradually endeavoured to modify these conditions by different engineering and technological innovations (dikes, canals, lifting devices, genetic crop improvement, etc). According to O'Connor (1995) in the early era (700 A.D.) Mon, Khmer, Cham and Pyu ruled the southern part of mainland Southeast Asia. These ethnic groups were garden-farmers in uplands or flood-managing farmers in lowlands. People living in the Northern part of Southeast Asia, such as *Thai, Vietnamese* and *Burmese* specialised in wet rice agriculture and are known to be skilled irrigators. These people expended to the South and conquered three of the largest rice bowls of Asia: the Mekong, Chao Phraya and Irrawady river deltas.

1 The evolution of the agrarian systems of the Red River delta

The Red river delta is in reality the delta of two rivers: the Red river and the Thai Binh river, with an area of 15 000 km2. The apex is located at Viet Tri and the base follows the cost from Yen Hung (Quang Ninh province) to Kim Son (Ninh Binh province).

According to historians (History of Vietnam, 1983) the settlement of the delta began 4000 years ago with the birth of the Van Lang state, at the epoch of Hung kings, with Lac Viet (Mon-khmers) and Au Viet (Thai) tribes.

The Vietnamese agriculture began in the middle region of the Red river delta, probably at the Phung nguyen period, the early bronze period in the first half of the II millennium B.C., as shown by paddy husks found at the low layers of archaeological sites. Archaeologists think that the Red river delta settlement began 4000 years ago because sites of the Phung nguyen period were found in the delta, but we think that the lower delta was exploited later, during the Dong son period (I millienum B.C.).

In the following period, the exploitation of the delta was made possible by the construction of dikes as a protection against floods. At the beginning of our era, at Phong Khe district, dikes against the floods already existed. But only from 1077 onward was the construction of dikes undertaken on a large scale. In the XIX century, the dike system of the Red river delta was still being developed but it was completed only during the French period. Due to the presence of dikes, the natural sedimentation of silts in the delta was altered and the relief remained very heterogeneous. The breaking of dikes which happened frequently changed the relief of delta. The dike system also created difficulties for the drainage, and the delta is divided into polders ("*casiers*") which retain water. All the improvements to the drainage system implemented since the French period until now have not been able to solve the problem totally.

When the delta began to be exploited, irrigation was practised thanks to the tidal effect. This method was used by Nguyen Cong Tru to colonise the coastal area in the XIX century and is still in use in the present time. The digging of canals began in the Ly dynasty, such as the canal To lich (Ha noi) in 1192. During the Tran dynasty the To Lich canal (1256 and1281) and the Thien duc canal (Duong river) (1390) were completed. Irrigation in the delta was practised through the lifting of water from ponds, tanks, canals, lakes. Irrigation systems by gravity were built only later, during the French period, in the middle region (examples are the Kep system (Bac giang), Cau river system, the Vinh Yen system). The pumping station at Phu Xa (Son Tay) was the first pumping system and demonstrated that this method is cheaper than the former. From 1931 onwards, the construction of dikes near the sea cost, in order to reclaim land from the sea, and the drainage system of some *casiers* were implemented. In 1945, the area served by irrigation in the delta amounted to 377 000 ha, or 34 % of the area of rice fields of the delta. After the liberation of the delta in 1954, irrigation expanded mainly by the pumping method.

The exploitation of the delta was done by devising various modes of cultivation attuned to the different ecological settings. Coyaud (1950) distinguished the following types of cultivation according to different elevations:

- Summer crop non stable,
- Summer crop stable,
- Winter crop non stable, summer crop stable,
- Winter crop non stable,
- Winter and summer crops stable,
- Winter crop stable, summer crop non stable,
- Winter crop stable,
- Winter crop non stable,
- Flooded area, no rice cultivation.

In general in high and medium fields practised summer rice during the rainy season. The fields were embanked to retain water. This is the method of rainfed lowland. On low fields, when there was not yet protection, during the rainy season the fields were flooded. The flood in the Red river came abruptly, without regular timing like in the Mekong, so it was impossible to plant floating rice as in the south. It is possible only to plant rice during the dry season after the receding of water by retaining water. This crop is called *Chiem* or winter rice. In this delta the winter is relatively fresh so it needs to have cold tolerant varieties. These varieties are also tolerant to drought, to acid and saline soils. They are short duration varieties but the vegetative period lasts 6 to 7 months due to the low temperature.

In the XIX century we have some records about the population of the Red river delta. From 1847 to 1923 the population increased 3,83 times or 1,6 % per year. The population in 1931 was 6,500,000 in the rural area and only 350,000 in the urban area. After 1931 the increase was only 1% per year due to out-migration. Comparing the population of 1995 with that of 1930 we see that the population density after more than 60 years increased more than 2 times.

Vietnam is one of the countries in Southeast Asia which had a centralised state relatively early. It was explained by the fact that there were needs of struggle against natural calamities and foreign invasion. It was a hydraulic state with an Asian mode of production, or Oriental despotism. The ideology of this administration system was Confucianism, influenced by the Chinese system.

The social system in the Red river delta corresponds to what E. Wolf has labelled "closed corporate communities" (Rambo, 1973). The villages of Northern Vietnam have many characteristics which coincide with this system:

1. The village in the north Vietnam is a cluster of houses, bordered by a hedge of lived bamboo. The village was a microsociety formed in a process of peasants' struggle against natural calamities and foreign invasions.

2. But villages had a certain autonomy, the State did not control directly village affairs. Village affairs were managed by a council of notables. Peasants had little or no contact with upper administrations. Villages established their own laws that were even stronger than the king's laws. The duties (taxes, corvée and military service) were distributed to communes, which deal with villagers.

3. The peasant of the Red river delta have a high peasant mentality; he is strongly attached to his land, dreams of increasing it, thanks to whatever saving he can achieve. The differentiation of land ownership was regulated by the spirit of communitarism which is very developed in the villages of the North. The system of communal land was conserved and even protected by the State. The land was regularly distributed to eligible villagers. The cottage industry was controlled by trade guilds. Religious activity in general served to impede the accumulation of capital. There were limitations for outsiders to become members of the community.

4. Production was primarily for subsistence purposes. The land tenure system was typical of a subsistence economy. Small scale trading of surpluses is carried on in the peasant market system. Due to the lack of land, animal husbandry and cottage industries are also developed to compensate for the limitation of income drawn from agriculture.

Regarding land property, we know the situation of the beginning of the XIX century through the Cadastre of Gia Long. If we compare the situation of these cadastres with that of given by Henri (1930) we can assess historical changes. While at the beginning of the XIX century landowners in Ha Dong and Thai Binh had on the average 1,9 and 7,3 ha, in 1931, when the population had increased about 4 times, the average property was only 0,7 and 1,3 ha.

While there was formerly no data of landless peasants, after Gourou (1936), landless peasants amounted to 51% of registered males (of 18 to 60 years).

We calculated the Gini coefficient which show the level of equity within landowners and found that this coefficient after a century increased from 0,4 - 0,5 to near 0,6, which means that the differentiation increased.

The area of communal land in the Red river delta in 1930 was 26 %.

According to Gourou (1936), the area of rice fields of the Red river delta in 1930 totalled 1,100,000 ha, to which 100,000 ha of upland crops should be added. The cropping area was broken down in the followings types:

Ricefields with one winter crop: 250,000 ha
Ricefields with one summer crop: 350,000 ha
Ricefields with two crops: 500,000 ha

Thus, the area under winter rice was 750,000 ha and that under summer rice was 850,000 ha. From 1930 to 1950 fields double cropped with rice increased by 30 %.

Comparing the situation of 1930 with that of 1985, rice land decreased by 18 %. Rice double-cropping did not increase compared with 1930, probably due to different definitions. But in 1930 the land double cropped with rice made up 45% of the total rice land and reached 59% in 1985.

TAB.1 : THE EVOLUTION OF THE AGRARIAN SYSTEM OF THE RED RIVER DELTA

	Rural population	Arable and permanent crops land		Food production		Food crops yield
	Million	Million ha	M2/n	1000 t	Kg/h	T/ha
1930	6,5	1,2	1846	1,8	277	1,5
1998	14.2	0,783	551	6.2	439	4.4
Growth rate	1,1	-0,6	-1,8	1,8	0,7	1.6

During the past 65 years the population of the Red river delta increased only twofold, because of the war and of out-migration to mountainous areas or to the south. The agricultural land was reduced by one third, and the land per capita decreased 3 times. But due to intensification, food production increased more than 3 times and the food per capita increased close to 1.65 times. Concurrently, the peasant's income increased 1,5 time. Equity increased, especially after the land reform in 1954, but later started to slightly decline.

After a period of collective agriculture from the beginning of 60's to the end of 80's, the system returned to the peasant household and to market economy. Surveys made in the beginning of 90's showed that farmers in the Red river delta had enough food to eat, but a high percentage were still under the threshold of reproduction. The number of commercial farmers was very low, while most were in the intermediate group between self-sufficiency and production for the market. The most important constraint for the development of the household economy nowadays in this region is the lack of market.

During the process of intensification the area under winter rice increased due to the development of irrigation. The yield of winter-spring rice increased due to the use of high yielding varieties. The area under summer rice slightly decreased due to the change of some flooding area into fish ponds. The area of upland food crops such as maize and tuber crops varies: it increased before 1990 due to the development of winter cropping season but later decreased due to the lack of market for vegetables and pork.

When the population density rose, the man land ratio increased, the part of rice in the gross income decreased, and the part of cash crops increased accordingly. The gross income per capita increased until reaching a density of 1000 h/km2, and subsequently decreased. The land area cannot provide enough employment for peasants and this triggered two processes: migration and the development of non-agricultural activities.

Migration is not a new process in the delta. In the 1930s, emigration accounted for the removal of about 15,000 persons per year. The organised migration from the delta helped reduce population pressure. Temporary migration to the cities in search of jobs is increasing. It was estimated that 13 % of the rural labour force emigrated for this purpose.

Another process occurring in the densely populated area is the development of non-agricultural activities in order to compensate for the lack of income. This process already existed long time ago. In the thirties the number of peasants involved in these activities was 250,000, or 6,8% of the active population. The most important activities are handicraft, food processing and commerce, especially the latter two. Many handicrafts production are constrained by the lack of market.

So we can conclude that in the Red river delta when the population pressure increased, the expansion of arable land was limited, irrigation was developed in order to increase the cropping intensity, firstly to grow two rice crops, later to develop winter crops. When the potential of the development of agricultural activities was limited, people emigrated or developed non-agricultural activities.

2 The evolution of the agrarian systems of the Mekong delta.

The Mekong plain is a vast low-lying area, which comprises the Mekong delta in Vietnam, most of the lowlands of Cambodia, a small part of southern Laos and a small part of eastern Thailand. The plain is 800 km from the north to the south and 600 km from the east to the west. The area of the whole delta is about 7.2 million ha, including 4 million ha in the Vietnamese part.

The Mekong delta part of Vietnam covers 12 provinces of South Vietnam (Cochinchina). This part of Vietnam is a delta formed by two rivers: the Mekong and the Dong Nai. The largest branch of the river is called Hau Giang (fleuve posterieur) and the second river branch, called Tien Giang (fleuve anterieur), divides the region into two subregions : the Transbassac and the Cisbassac.

Archaeological discoveries and ancient Chinese texts show that 2000 years ago there was a kingdom named Funan, extending in the Mekong delta. A site near the village of Oc eo was excavated during World war II. Aerial photographs revealed traces of an ancient hydraulic network. But the occurrence of Funan is still debated without definitive conclusion. In the 6th century this area was invaded by the Khmers which found the Tchen La kingdom. But the Khmers only developed the terraces of the old Mekong delta, named «Dry Tchen la», leaving the young delta, named "Water Tchen la" in an unexploited situation.

Before the settlement of the Vietnamese, this region was inhabited by a few communities of Khmers, living in Soc, villages located on the levees of the rivers. In 1296 a Chinese ambassador Chau Da Quan reported that this region was covered by dense forests and large savannahs without any big trees. In 1818 when the mandarin Nguyen Van Thoai received an order to construct a canal from Long Xuyen to Rach Gia, he declared that this area had not yet been trodden by any human foot (Brocheux, 1995).

In the middle of the XVI century, Nguyen Hoang left the kingdom of the North (Dang Ngoai-Outer kingdom) to Central Vietnam and his son found the South kingdom (Dang Trong-Inner kingdom). They began the «March to the South» (*Nam tien*) by the settlement of Central and South Vietnam. The South kingdom was a kingdom founded on a military system with the aim of fighting with the North. In order to strengthen the military force, foreign trade was developed. This kingdom was more open and more market-oriented. The ideology of the political system was Buddhism instead of Confucianism.

At the end of the XVII century, settlements reached Dong Nai and Gia Dinh in the northern border of the delta and the colonisation of the young delta began. In 1757 they reached Chau Doc the furthest point on the West of the delta. At that time a group of Chinese came and established in My Tho, Vinh Long and Sa Dec; in 1715, another group founded the settlement of Ha Tien.

The conquest of the delta was done by digging canals such as Vinh Te and Long An Ha, and founding *don dien* (military settlements). The canal network was improved and completed by the French colonial regime since 1875. From 1900 onwards, a new program was implemented where both functions of canals were prioritised: canals were a means to access the area of settlements, and (through the construction of drainage channels) a means of rendering the land arable (Brocheux, 1995).

In the XIX century we don't have data on population for the delta. We can take data of the whole Cochinchina. The population of the West of Cochinchina in 1908 totalled 863,987.

The Mekong delta social system resembles Erich Wolf "open peasant system" (Rambo, 1973), with the following characteristics:

1. Villages in the south were organised from former military colonies, and were loose communities. Boundaries of the community were poorly demarcated. Villages were of the ribbon type, with individual houses strung along a canal or a road, often for distances of several kilometres. The physical dispersion and the relatively high rate of immigration all militated against the development of a sense of village solidarity.

2. Land was privately owned and freely alienable. Communal land was very limited. The bulk of the cultivated land was owned by large absentee landlords and worked by tenant farmers. The peasantry was strongly differentiated. Although these village were organised by northerners the village communitarism was weakly developed.

3. Villages are not isolated from the national society. Peasants are exposed to the presence of outsiders in the form of merchants, government officials and police...

4. Production is for the market with dependence on the outside capital inputs. Tenants were dependent on the large landlords for the provision of working capital.

The settlement of Cochinchina began in the eastern part in the 16th century, after peasant rebellions in the North (1511-1522). Only after 1698 did the kingdom of Dang Trong of the Nguyen lords extend its administrative control on this area. At that time there were already 40,000 households. The organised colonisation started in this period. Before this period reclaimed land belonged to individuals. In South Vietnam the formation of villages and communes was based on the private ownership of land, different from that of the North where the village community was formed on the basis of the communal land property. In the XVII and the XVIII centuries, the colonisation was achieved by soldiers, many military farms were founded, and this land belonged to the State. Villages also established village land acquired by the village with its own resources, for common services.

In 1836 the Emperor Minh Mang decided to make a cadastre of the 6 provinces of Cochinchina in order to collect a land tax. From the cadastres of 124 villages of Cochinchina we calculated the Gini coefficient in order to determinate the level of differentiation of peasant households. The Gini coefficient of cantons in the Mekong delta were ranging from 0.6 to 0.8, while that of the Red river delta was in the 0.4 - 0.6 bracket.

Data of land ownership during the French domination given by Henri (1932) show that the differentiation of peasants was at the same level than earlier in the XIX century. The number of landowners in South Vietnam was 255,047. The number of registered males was 1,100,000, so the number of landless was 845,000 (2/3 of registered). In 1929-30, large-scale holdings predominated in West Cochinchina (Mien Tay). Family-held private property and communal land had always coexisted in the Vietnamese village, but the percentage of communal fields was only 3 %.

The mode of farming, as described by Henri was predominantly indirect, or tenant farming, with the exception of Rach Gia and Chau Doc where direct farming or mixed farming (some land in direct cultivation, some rented out) was more popular. Managers of the delta could not employ gangs of agricultural workers, leaving them with no alternative but to rent land to *ta dien*. The *ta dien* was not a real sharecropper paying his rent with a portion of the harvest, as in other countries. This system was found only in Chau Doc where landowners received 2/3 of the harvest. In general, the landowner provided the land and added livestock, advances of rice and paddy as food and seed, and a sum of money as credit. The *ta dien* supplied tools and labour and he paid a part of his harvest as a rent. The most common situation was the landowner renting his land to a land broker who recruited the *ta dien*. The profits of the land broker were a part of the land rent and the interest of the advances that he granted to the *ta dien*. The land rent was from 8 to 30 gia of paddy according to the quality of land (a gia equals to 40 litres). The advance should be repaid two gia of paddy for one and 3 gia of paddy for one piaster (Brocheux, 1995).

After the August revolution in 1945 many institutional changes occurred. In 1946-47, land which previously belonged to the French and French collaborators was redistributed and land rents were reduced to 25 %. In the south, in 1955-56, a land reform occurred under Ngo Dinh Diem regime which restricted rents and maximum land ownership to 100 ha. Again in 1970,

land reforms occurred both in territories controlled by the Provisory Revolutionary Government and by the Nguyen Van Thieu Government. Following the liberation of South Vietnam, collectivisation was introduced in 1978 but had little time to take root as de-collectivisation was initiated in 1981 with the Decree No. 100 and the process took place throughout the whole country between 1980-1988. All these reforms contributed to making the land distribution more equitable.

Peasant households in the Mekong delta are more commercial than that of the Red river.

In the XVI century when the first Vietnamese's settled in the east and the west of Cochinchina, there were two types of fields:

- the upland fields (*son dien*, literally mountainous fields),

- the lowland field (*thao dien*, literally herbaceous fields). The cultivation of upland fields was done with the slash and burn system, as in the present mountainous areas. The cultivation of lowland fields depended on the swamping of the field. In less swampy fields, the soil needed to be ploughed before planting, and in the more swampy fields the cultivation could be done without ploughing (no-tillage system).

After the conquest of Cochinchina by the French in 1868, rice production was developed to a higher level. At that time the rice area was already 350,000 ha. A permanent commission was named in 1875 to improve and complete the canal network between Saigon and the Bassac river. After 1884 dredgers were used, and the digging and maintenance of canals were improved. From 1886 to 1930 the drainage work allowed the reclamation of 1,425,000 ha of land. Roads were constructed on the excavated material (embankments), and followed the canals. With the development of the canal system, the rice area increased and in many regions the no-tillage system evolved to the ploughing system.

The rice area of the Mekong delta increased very rapidly during this period:

1880: 522,000 ha

1910: 1,528,000 ha

1930: 2,443,000 ha

In 1901, floating rice varieties were introduced from Cambodia and allowed to make use of the flooding area of the Long Xuyen quadrilateral of An giang province and the plain of reeds. In 1930, the different types of rice culture in the Mekong delta were estimated by Y. Henri (1932) as follows:

	Cochinchina	Mekong delta
- Rainfed single transplanting rice:	1 649 740	1 369 720 ha
- Double transplanting rice:	392 470	392 470 ha
- Floating rice:	217 550	217 550 ha
- Total:	2 259 760	1 979 740 ha

The export of rice grew from 360,000 ton in average during the period 1875-1884 to 1,454 000 ton in the period 1925-1929. In 1925 Vietnam overtook Burma and became the first rice exporter of the world, reaching a maximum of 1,797,682 ton in 1928. After this year, rice production was depressed by the world crisis and export lowered to 1,064,000 ton in 1938.

In 1941 the General governor of French Indochina organised a conference to discuss how to improve the rice production: rice landlords asked for the construction of big irrigation systems and the water management technical services asked for the digging of drainage canals.

In 1944 the areas of the different types of rice cultivation in Cochinchina were as follows:

- Single transplanting rice: 1 541 000 ha
- Double transplanting rice: 436 000 ha
- Direct seeding rice 411 000 ha
- Total: 2 388 000 ha (Coyaud, 1950).

TAB. 2. THE DEVELOPMENT OF THE MEKONG DELTA IN RECENT TIMES

	Rural population	Arable land and permanent crops		Rice production		Rice yield
	Million	Million ha	m2/h	1000 t	Kg/h	T/ha
1930	3,2	2,0	6250	2,6	812	1,4
1998	12.0	2.55	2125	15.3	914	4.1
Growth rate	2,0	0,3	-1.6	2.6	0,02	1.6

During the last 70 years the population of the Mekong delta increased almost fourfold, the area per capita decreased 3 times, but is 5.3 times higher than that of the Red river delta, while the food production per capita is 2.6 times higher. The income per capita increased 1.5 times more than that of the Red river delta and is 1,2 time more than the later.

After the retreat of the French army, the production had to be restored after a long period of war. In 1957 the rice area was restored to 1,964,594 ha and the rice production reached 2,545 000 ton. Ten years later in 1967 the area was only 1,647,938 but the production was 3,190,000 ton. In 1974 the production almost reached 5 million ton. With the American aid, from 1965 to 1975 a great number of 4-wheel and 2-wheel tractors, a great amount of chemical fertilisers and pesticides were imported and high yielding rice varieties provoked the green revolution. After 6 years, 30% of the rice area was cropped with these varieties. Two new types of rice cropping systems were introduced:

- Two high yielding rice: winter- spring and summer-autumn on well irrigated areas.

- high yielding (summer-autumn) and traditional rice on medium flooded area where double transplanting rice was practised. Double transplanting rice was reduced from 250 000ha to 90 000 ha.

Traditional rice remained in the flooded area with floating rice and in the semi-flooded area with the double transplanting rice. The single transplanting area covered 1,5 million ha on

rainfed area, especially in regions affected by saline water. During this period the construction of irrigation systems was not yet undertaken and water was lifted by hundreds thousand of small pumps.

Only after the liberalisation in 1975 was implemented in the delta a program of water management. 15 systems of dikes against flood were constructed in the upper part, a network of 75 big canals with hundred medium and thousand small ones drain water for leaching the acid sulphate area and providing non saline water. Several gate systems on the coastal area protect agricultural land from the intrusion of saline water. More than 100 electric pumping station and more than 2200 big and medium pumps serve the irrigation work. The area of irrigated summer-autumn rice increased 2 times. The irrigated area grew up to 350,000 ha, or by 60%. The change of cropping system was characterised by the increase of winter-spring and summer-autumn rice and the decrease of the traditional summer rice.

The mechanisation of agriculture was also developed. In 1983 big tractors increased by 60 % and small tractors by 50 % compared with 1975. The provision of fertilisers especially of phosphorous and of pesticides also was improved. Especially the agricultural research and breeding work was conducted together with the introduction of high yielding varieties. All these improvements, together with the institutional reforms, induced a rapid development of the rice production which changed the country from a rice importer in the beginning of eighties to a rice exporter since the end of the eighties.

Recent surveys show that in the Mekong delta the rice surplus of farmers increased very rapidly in all types of households. The diversification process is going very slow, especially regarding the development of animal husbandry and non agricultural activities.

3 The evolution of the agrarian systems of the Chao Phraya delta

The Chao Phraya delta area is comprised of three main regions (Takaya, 1978): the old delta is the undulating part near the apex of the delta, Chai Nat; the flood plain, with an alternation of levees and deeply flooded backswamps; the young delta, the low-lying and flat area on the southern part. With an area of 1,810,000 ha, the Chao Phraya delta is slightly larger than the Red river one, but much smaller than the Mekong one.

Between 6000 and 3000 BC, most of the lower delta was covered by the sea. Ancient settlements were found on the margin of the lateral terraces. U-Thong, on the West, is believed to have flourished as early as 500 BC (Valliphodom, 1992), while many later sites of the Dvaravati period (first millennium AD), can be found both in the upper and the lower delta (most of the latter on moats and on the terraces margins, as most of the central area remained an inhospitable swamp) (Higham and Thosarat, 1998).

The major ethnic group in Thailand is the Thai, who were valley-dwelling wet-rice growers in the intermontane basins of North Thailand. The Lanna Thai kingdom founded in the XIII century exploited an intermontane basin, and the Sukothai kingdom founded in 1238 exploited a fan-terrace complex. Only the Ayutthaya kingdom, with the core area shifted to

the old delta in the XVI century, began the colonisation of the delta. Watabe (1978) showed that the wet rice was first grown in the delta north of Ayutthaya from the XI to the XV centuries, expanded in the same area from the XV to XVIII centuries and spread rapidly to the young delta in and after the XIX century. During the Ayutthaya (1350) and the early Bangkok periods (end of XVIII century), more than 20 large-scale canals (canal linking the Chao Phraya and the Bang Pakong rivers, shortcuts in the meanders of the Chao Phraya) were dug by an army of corvée peasants. At the beginning of the XVIII century, the first two canals between Chao Phraya and Tha Chin rivers (Mahachai and Yong canals) were dug, principally for military and transportation purposes. The liberation of the corvée peasants (phrai) and debt slaves (that) that accompanied the dismantling of the old social order in the late XIX century allowed the peasants to migrate and supplied the labour force for the reclamation of the young delta. From the reign of the king Rama III (1824) a large number of Chinese immigrants settled in Bangkok, and their hired labour provided a working force for canal digging which proved much more efficient than corvée labour, significantly contributing to the reclamation of the delta.

The ancient states of the Thai-inhabited Muang of the intermontane basin of the southeast Asia were numerous and not centralised. The Lanna Thai kingdom founded in the XIII century by the Yuan of Northern Thailand was an example of this type. The water management was practised by the village (ban) or group of village (muang) community . In such condition there was no need to found centralised state. The landownership rested with the headman of the Muang. The land was distributed to serfs (5-25 rai) and slaves (5 rai) against contribution of corvée, services and rent in nature.

In the middle of the XIV century, with the foundation of the Ayutthaya kingdom, the canal excavation for the reclamation of the delta needed a state of an other type. The kingdom also developed trade activities. In the end of the XVIII century, when the capital was transferred to Bangkok, started the reclamation of the young delta, agriculture gradually shifted to an export-oriented rice monoculture (Ishii, 1978).

The social division during the Ayutthaya period and the early Ratanakosin can be simplified as follows:

- the free peasants, who were allowed to occupy, clear and cultivate unused land, and could sell or mortgage if they wished to do so. They were obliged to participate to public works and obligations and to pay different taxes.

- the so-called slaves, who most of time were prisoners of war or people who had chosen to attach themselves to a patron because of indebtedness.

- the nobles and patrons who were granted titles and land within the Sakdi na system.

Three labour sources were possible for landlords: 1) Corvée labour. The load of corvée system gradually decreased between 1780 and 1910. By the turn of the century, the corvée was abolished and replaced by a capitation tax, later eliminated in 1938; 2) Bondsmen labour. Bondmanship was abolished in the 1890's; 3) Wage labourers: In the second half of the last century the hire of Chinese labour was common, as was hired labour of Lao people in the 1890s.

The commercial rice monoculture developed in response to demand for rice from China and other Asian countries in the last half of XIX century, especially after the benchmark Bowring treaty. From the middle of the XIX century onward, canal excavation was mostly aimed at the expansion of riceland. Between the late XIX and early XX centuries, canal excavations proceeded rapidly following the legal confirmation of private ownership of adjoining land. While peasant settlers were granted the usufruct right of the land they cleared, most of the land reclaimed during the last century was granted by the king to royalty or noble officials. The first half of the XX century would witness the explosion of peasants colonisation.

Concession for land development to private companies in 1889 rapidly increased the speed of land reclamation, with the use of mechanisation. In 1905 the Royal Irrigation Department was established. Between the two World Wars, three projects were initiated, where diversion dams or regulators delivered water in canals which, for the first time, were fully irrigation canals. Main land development works were eventually carried out after World War II. In 1952 the Greater Chao Phraya Project was constructed for the irrigation of the northern part of the delta. The Greater Mae Klong Project, initiated in 1972, was further implemented on the western side of the delta. In the young delta, no gravity irrigation is possible because of the flatness of the area. Canal excavation in order to turn water available by pumping, construction of dikes for flood and salt water intrusion protection, were developed (Kasetsart University and ORSTOM, 1996).

In 1967 the rice acreage of dry season was only 3.7 % of the irrigable area in the Greater Chao Phraya Project. The introduction of high yield varieties, the construction of the Sirikit dam (1972) and the improvement of water control contributed to the rise of double rice cropping, with a total of 500,000 ha planted in 1979.

As a consequence of this gradual colonisation and "artificialisation" of the region, the delta society has much of the features attributed to frontier societies: a certain degree of independence from the grip of the central state, a propensity to evade social conflicts or responding to bankruptcy by moving further away, and the formation of villages with migrants from different origins and backgrounds, therefore with little "social glue". At the same time, the integration to the wider economy and national sphere was provided by the marketing of the rice production surplus. The description of the Thai society as "loosely structured", as coined by Embree in 1950, was reinforced by the Cornell-Thai Project research at Bang Chan, near Bangkok (Sharp et al.; 1953; Hanks; 1972; Phillips; 1970). This research team laid emphasis on the lack of strength and unity of the village as a social unit, on the absence of extended kinship groups, the lack of enduring rural social groups and of loyalty to the village, with co-operative labour exchange groups and other asocial arrangements based upon ad hoc dyadic ties with no duration.

The "loose structure" society was later challenged by sociologists carrying out village surveys in the North (Potter, 1976) and in the Northeast (Mizuno, 1978), who opposed it and attempted to show that rural villages were, on the contrary, as strongly structured as other Asian societies. Relevant to our present concern is the argument that the "loose structure paradigm has been linked to observations made in communities located in the Chao Phraya delta, near Bangkok, and that it could not readily apply to other different cultural regional

settings. The historical and ecological contexts are often brought up as the main factors explaining differences in social structure.

The population of the Central plain in 1990 was almost 13,781 million habitants, 20 % of the total population of Thailand. 5,9 million live in Bangkok, and 2 million in the vicinity of Bangkok (four neighbouring provinces). In Bangkok and the vicinity the population density was 1374 h/km^2, against 276 h/km^2 in rural areas. From 1960 to 1990, the population of the Central plain increased more than 2 fold.

TABLE 3: POPULATION CHANGE IN THE DELTA

	1960	1970	1980	1990
Bangkok	2,136,435 -	3,077,336 3.7	4,697,071 4.3	5,882,411 2.3
Bangkok vicinity	786,410 -	1,032,792 2.8	1,421,448 3.2	2,077,890 3.88
Rural central plain	3,561,595 -	3,986,228 1.13	4,774,887 1.82	5,518,057 1.46
Total central plain	6,484,440 -	8,096,356 2.2	10,893,406 3.0	13,478,358 2,15

Immigration played an important role to offset the low population of the delta during the 1850-1940 period. A post-war recession in rice production and a demographic saturation of the delta, together with the development of upland agriculture, boosted out-migration in the late 1950s and the 1960s. The population of the rural delta is still on the rise, but its agricultural population is decreasing slowly at present, while all the natural growth and net migration flow have been transferred to non-agricultural sectors. The share of agricultural population was 70 % of the total population in 1960 and 40 % in 1990.

From 1960 the economic development of Thailand was very rapid, the income per capita increased very fast, but the differentiation also increased. In 1979 the urban class (12.5 %) had an average income 9 times that of farmers (68.5 % of the population) (Trebuil, 1987). The Gini coefficient of income distribution and the number of people under the poverty line increased, even in the rural Central Plain (Krongkaew et al., 1992).

The study by Molle and Srijantr (1999) of the land system in 6 rural provinces of the Chao Phraya delta showed that:

1. After an increase between 1950 and 1963 (+36 %), the number of agricultural holdings has been found to level off.

2. The relative stability in the number of farms associated with a significant overall loss of agricultural land means that the average farm size has been declining (4.8 ha in 1950, 3,5 ha in 1993).

3. Rice mono-cropping also declined (96 % in 1937, 90 % in 1963 and 70 % in 1993).

4. During the last 40 years, a great number of farms over 4.8 ha have disappeared.

5. The Gini coefficient of farm land distribution increased: 1950- 0.41, 1963- 0.46, 1978- 0.47, 1993- 0.52. This means that the landownership differentiation has increased but this cannot readily be translated into socio-economic terms as the productivity of land varies and very intensive cash production (peri-urban vegetables, aquaculture, orchids, etc) are done on small areas.

6. The class of full tenants and mixed holders have not grown, but the class of full owners now dominates, most of these emerging new holdings being associated with small farms areas.

7. Tenancy, expressed both in the number of farms renting all or part of their land or in percentage of farmed land, has been rising to a peak in the early 70's and has, overall, been slightly declining hitherto. Despite some slight ups and downs (War, 1970 crisis, etc.), the most striking picture arrived at is that of a certain stability of the tenanted farmland, since as early as the 30's.

8. The rental arrangements and the types of rents have been shown to greatly vary according to the relations between owners and tenants, the price of rice, the projected land use and, more generally, the level of water control. Molle (forthcoming) has shown that, contrary to common wisdom, land owner-tenants had been rather balanced, despite some historical crises.

9. Surveys in the early 80s show that 9 % of agricultural households were landless wage labourers. The Central region had a higher percentage: 9-30% and this population has been growing hitherto. However, this is concomitant to the rise of pluri-activity (multiple occupation concerns 57% of rural households), job opportunities in intensive productions and the ageing of farmers increasingly resorting to hired labour.

The agrarian system of the delta, after the crisis in the late 60s early 70s, was able to re-balance itself significantly. The crux of the matter was that, on one hand, surplus labour was able to be absorbed by non-agricultural sectors, while on the other hand, agriculture could continue its transformation towards higher intensification (one million rai of triple cropping in 1998 and 1999) and diversification (aquaculture, cash crops). These two trends, however, are conditioned by the price of rice, by the existence of markets for other production and, overall, by the availability of water (see Molle et al. *this conference*).

4 Comparison of the three deltas

The description of the three deltas allows us to make a comparison of their main features.

4.1 The natural environments

The natural condition of the Red river delta with its "mosaic environment" strongly differs from that of the two southern deltas which have a flatter relief. The relief of the former delta was altered in its evolution by the construction of dikes. The development and maintenance of the dikes required a higher degree of centralised power than in the two frontier deltas, where floating rice could be grown in flood prone areas and where individual water lifting, or tidal irrigation, allowed farmers to start cultivating without collective constraints.

The Mekong and Chao Phraya deltas also constituted harsher environments, swampy, unhealthy and with little available land to construct homesteads. This partly explains their late wide-scale colonisation. In the case of the Mekong delta, severe constraints also include soil acidity and salinity.

Rainfall patterns are similar but the Mekong delta enjoys a longer rainy season. It allows in particular rainfed rice cultivation in the first part of the rainy season, which is not possible in the Chao Phraya Delta where total amounts are lower and more irregulars.

Differences in hydrology and topography also made it possible to construct a diversion dam at the apex of the Chao Phraya delta, thus allowing gravity irrigation in the northern part, something unthinkable in the Vietnamese deltas where flows are too powerful and upstream regulation by dams limited.

4.2 Natural hazards

The Red river delta and the other two deltas are exposed to drastically different risks of being flooded: the Red river is one of the most dangerous rivers in the world while the Mekong and Chao Phraya have more predictable and less destructive floods. The Red river is extremely flood prone because of its small cachtment basin which is subject to erratic but very heavy rainfall, its extremely steep gradient and low elevation and flat relief. The flood control was achieved by the mean of the construction of dikes. The lover reaches of the Mekong river and Chao Phraya with its larger watershed (the dampening capacity of the Tonle Sap for the mekong), the greater regularity of its rainfall pattern and its less extreme gradient profile, are not subject to extreme flooding. The regime of the river is a single annual gradual rise and fall of the waters rather than the frequent and unpredictable cresting characteristic of the Red river. This situation allowed the two southern deltas to cultivate floating rice.

The Red river delta is also faced with typhoons, while these are infrequent to rare in the two other deltas. This raises the risk of crop loss and make higher investment in drainage necessary.

4.3 The settlements

The Red river delta was settled much earlier than the other two deltas, hence its higher population density, the higher man land ratio, the higher population pressure on resources and the higher intensification in farming methods. All these factors put the Red river delta in a more difficult situation for development.

The southern deltas with larger size and later colonisation have less population pressure and were reclaimed by canals digging. Settlement was hampered by the lack of communication and of convenient location for homesteads, especially in the most southern parts. Even in present times, a chief objective of canal development in the Mekong delta is to expand the land suitable to accommodate the growing population.

This geographical feature also explains the high occurrence of ribbon villages in the southern deltas, while those of the Red river are more of the cluster type. In the Chao Phraya delta, there is a vivid contrast between the southern settlements, established along the canal embankments, and some older and cluster-type villages of the north of the delta.

4.4 The social systems

The Red river delta had an early centralised state. The Mekong delta was colonised by a military new founded state for the struggle against the Northern state. While the Chao Phraya delta was the development from a Muang state in a new context of large land reclamation and market development.

The villages of the Red river delta are "closed corporate communities" while that of southern deltas are open peasant communities" (Rambo, 1973). Northern Vietnamese villages have more communal land and have a higher level of equity. In the southern deltas land is more privately owned, agriculture was developed for commercial purpose. Thus, the stratification of peasants is more acute.

While the Chao Phraya delta frontier society can be considered loosely structured with regards to corporate communities, it is not deprived of strong "structural regularities" centred on flexible, voluntary patterns of relationships between individuals. Social control is apparent in issues such as money borrowing or land rental contracts (Molle, *forthcoming*). However, the implementation of large scale state initiated irrigation infrastructure did not help in creating a sense of community, as happened in the north where villages united to build run-of-the-river communal irrigation schemes.

The Red River delta's history is marked by a strong bias in favour of centralised and collective options of development. The Chinese background was reinforced by the necessity to tame the floods (hydraulic state) and, later, by the communist ideology. In the Mekong delta, the influence of the central power was less, although the colonial period and the reunification were times in which the state attempted to increase its control. In the Chao Phraya delta, the independence of the peasants at the frontier was even higher.

4.5 The objective of production

Due to the limitation of its resources, rural production in the Red river delta is more subsistence oriented than in the southern deltas, where production is more market oriented. In the Chao Phraya, the reclamation has been tightly governed by the boom of the rice economy which has offered an outlet to the labour force freed from bondsmanship. Although there are speculations on the impact of the opening of subsistence-oriented peasant economies to capitalism and market economies, it is inadequate to look at the Chao Phraya delta within such a framework, as its formation and social fabric are inseparable from the rice economy itself.

From what has been said earlier, we see that there are more similarities than differences between the Mekong and the Chao Phraya deltas. But there also important differences:

1. If we take the population pressure on resource and man land ratio and the level of intensification (as allowed by the present land development), the Mekong delta may rank higher; but if we take the level of industrialisation, the urbanisation, the migration, the decline of agriculture ... the Chao Phraya delta appears to be far "ahead".

2. If we take the Gini coefficient on income and land distribution we observe that the differentiation in the Chao Phraya delta is higher than in the Mekong delta, in its turn higher than in the Red River delta. However, it has been shown (Molle and Srijantr, 2000) that the Chao Phraya was remarkable by the resilience of its agrarian system rather than by a critical worsening of its socio-economic situation.

If we consider wider economic and societal transformations, it is the Red river which appears to be in the most worrying situation. The very low development rate of off-farm job activities and the closure of the upland frontier, and the already very high level of intensification achieved do not provide sufficient opportunities for increasing and diversifying incomes. The Mekong delta fares better as it still has significant scope for intensification and even expansion of agricultural production, and as the dynamism of Saigon is creating some job opportunities. The Chao Phraya delta has weathered the agrarian crisis it underwent 30 years ago but it might now face a process of agricultural demise, together with growing environmental problems.

All three deltas have to maintain delicate balances between their rural and urban components, an equilibrium which is governed by several interlinked factors, including demography, migration or non-farm job opportunities, the price of rice and the market for other productions, improved water management and adequate government policies.

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Natural environment

Red river delta	Mekong delta	Chao Phraya delta
Mosaic environment due to dikes	Almost flat due to natural sedimentation	Almost flat due to natural sedimentation
Most dangerous river of the world	Most benign river	Most benign river
Small catchment basin, steep gradient	Large watershed, low elevation, flat relief	Large watershed, low elevation, flat relief
Erratic and heavy rainfall	More regular rainfall pattern	Rainfall pattern with irregularities, especially during the early rainy season
Frequent typhoons	infrequent typhoons	Rare typhoons
Irregular and abrupt flooding with rapid rise of water	Regular flooding with regular annual gradual rise and fall of water	Relatively regular flooding with regular annual gradual rise and fall of water

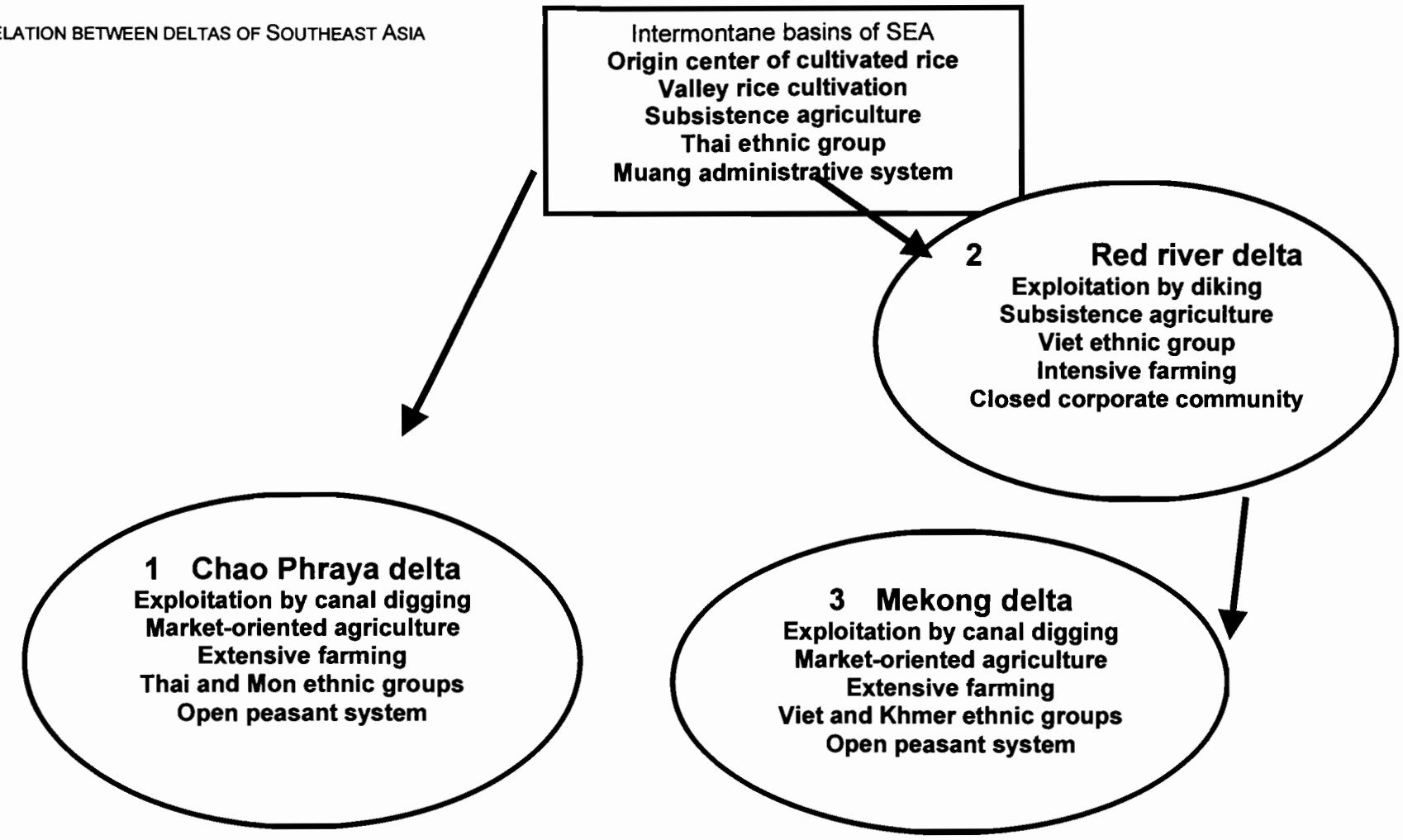
Settlement

Red river delta	Mekong delta	Chao Phraya delta
Early settlement (10th century)	Late settlement (18th century)	Late settlement (18th century)
High population density	Medium population density	Low population density
Lack of land for extension , intensive farming	Large area for extension, extensive farming	Large area for extension, extensive farming
Flood control by dikes and creation of heterogeneous landforms	Reclamation of land by canal digging and drainage	Reclamation of land by canal digging and drainage
Exploitation by intensive cultivation adaptation to different landforms	Exploitation by extensive method of cultivation	Exploitation by extensive method of cultivation

Socio-economic systems

Red river delta	Mekong delta	Chao Phraya delta
Needs of struggle against foreign invasion and flood control	Need of strengthening the Southern state and struggle against Northern state	Heritage of Muang slavery and Sakdina system
Early central state of oriental despotism type	Military and civil colonisation by soldiers and criminals	Civil colonisation by migrants and Chinese labour force
Strong influence of Confucianism	Strong influence of Mahayana Buddhism	Strong influence of Hinayana Buddhism
Strong village communitarism	Loose village communitarism	Loose village communitarism
Closed corporate community	Open peasant system	Open peasant system
Village autonomy	Less village autonomy	Relative village autonomy
Subsistence agriculture	Development of market economy	Development of market economy
High equity	Medium equity	Medium-low equity
Large out-migration	Large immigration from the North	Immigration, including from China, and outmigration from the 50s onward
Slow industrialisation and urbanisation, little job opportunities out of agriculture	Emerging industrialisation and urbanisation	Rapid industrialisation and urbanisation
Strong Chinese cultural influence	Strong Chinese economic influence	Strong Chinese economic influence

RELATION BETWEEN DELTAS OF SOUTHEAST ASIA



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