

Geomorphology, Hydrology and Rice Cultivation in the Chao Phraya Delta of Thailand

By YOSHIKAZU TAKAYA

The Center for Southeast Asian Studies, Kyoto University
(Yoshida, Sakyo, Kyoto, 606 Japan)

Abstract

The Chao Phraya Delta has four rice cultural regions each with distinct hydrographic conditions. They are; 1) the old delta, where transplant fields of short to medium-age varieties and broadcast fields of floating rice form a mosaic that reflects the topographic relief; 2) the fluvial part of the young delta, which is characterized by an expanse of floating rice; 3) the delta flat, which was formerly a monotonous area of broadcast deep-water rice but now accommodates rainy season transplanted rice, dry season transplanted rice, and traditional broadcast rice, depending on the type of irrigation facilities that have been introduced; and 4) the coastal zone, which is dominated by long-established transplanting of possibly non-photosensitive varieties of rice.

Geomorphology

More than 95% of the rice-growing area of the Chao Phraya Delta is located on the flat central part of the deltaic lowland. This central part can be divided into 4 geomorphologic regions, as shown in Fig. 1.

1) Old delta

The old delta is a slightly undulating, upper Pleistocene surface that slopes gently from 15 m above sea level at the apex to 3 m at the skirt. The surface of this terrace has local relief of up to 1.5 m. The swells have Low Humic Gley soil underlaid with somewhat indurated clay, while the swales have soft alluvial clay. Three major rivers, the Chao Phraya, the Noi and the Suphanburi,

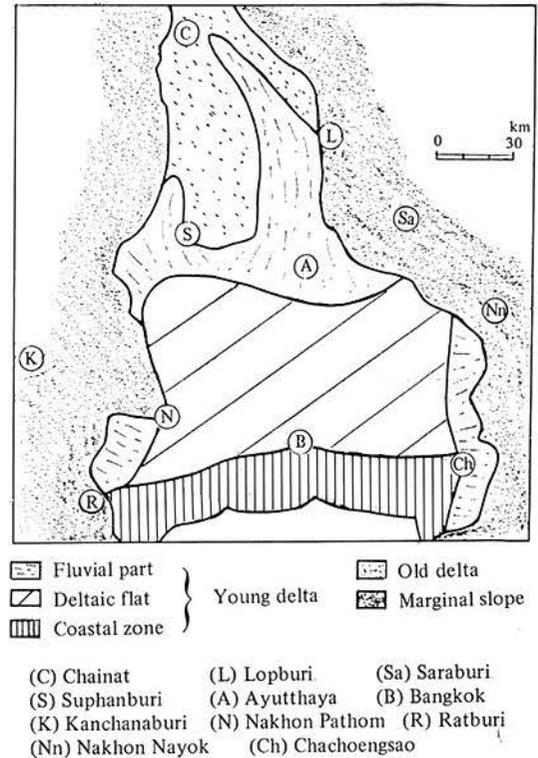


Fig. 1. A map showing 4 geomorphologic regions

cut through the terrace surface and form river banks 3 to 6 m high.

2) Fluvial part of the young delta

This portion of the young delta is made up of fluvial deposits. As a part of the young delta, the deposits are still soft and not yet dehydrated. Their major component is brownish gray clay with some interlayers of levee sand. Elevation averages as low as 1 to 3 m above sea level, but local relief attains 2 m or more, due to the network of levees and

backswamps of the numerous channels in the region.

3) *Deltaic flat of the young delta*

This is a broad expanse of flat lowland with local relief of less than 0.5 m and an extremely low creek density. It was formed as a lagoonal tidal flat over the past several thousand years. Dark gray to black, heavy, brackish clay is the main constituent. In places, particularly in the eastern half of the delta, acid sulphate soil lies near to the ground surface.⁵⁾

4) *Coastal zone of the young delta*

The coastal zone is about 20 km wide and also flat and low-lying. It is distinguished from the delta flat by the dominance of marine deposits. Gray to bluish gray clay is the main constituent, but beach sand is not uncommon. Occasionally soil shows high salinity.

Hydrology

The sum of the *in situ* rainfall and the inflow flood, and its interaction with the topographic conditions, determines the hydrology of a given spot. The 4 geomorphologic regions each have corresponding hydrologic characteristics. The monthly water depth in the field at 15 representative places in the delta is shown in Fig. 2.

1) *Rain-fed area*

Since the ground level of the old delta lies above the flood level of the Chao Praya River, the old delta is exclusively rain-fed. On the swells, the rainy-season inundation seldom exceeds 10 cm in depth and does not last long. The swales, however, receive deep and prolonged inundation, caused by the accumulation of local runoff. In local depressions inundation may start as early as July and last as late as December or even January, and may attain a maximum depth of more than 2 m.

2) *Flood-accumulation area*

This corresponds to the fluvial portion of

the young delta. Inundation begins with the start of the heavy and continuous rain of the rainy season, usually at the end of August. In late September a huge flood arrives from higher up the Chao Phraya and raises the water level rapidly by a meter or so. This is the most severely flood-stricken area in the delta. The maximum water depth in many places exceeds 2 m and may reach 4 m in the lowest plots. Water remains to the end of December in most places, and some plots remain perennially swampy.

3) *Flood-dispersion area*

The river flood, emerging from the fluvial part of the delta, spreads onto the delta flat forming a sheet flow. The flood water on the delta flat rises slowly, attains its maximum level from early September to late October, then falls, disappearing in early December. The maximum water depth averages 0.5 m in normal flood years. From January through April, the ground surface parches.

4) *Perennially swampy zone*

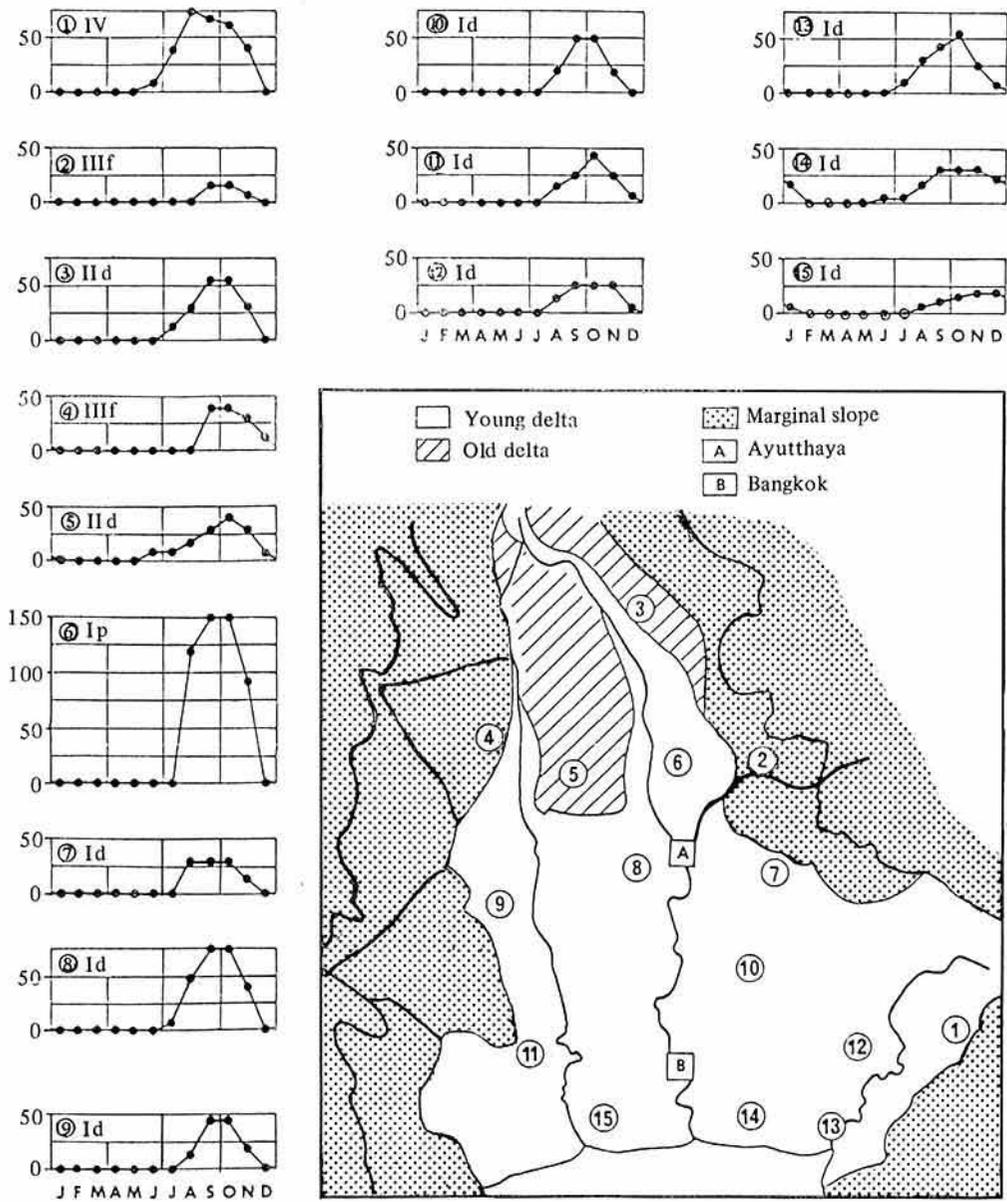
Seasonal flooding is weak in this zone, and, because of the proximity of the sea, conditions are more perennially wet. The monsoon flood arrives here late, in October, November, or even December, with a levelled-off peak of 20 to 30 cm. Soil, however, retains water for more than 10 months and never parches. In the ubiquitous tidal creeks, water becomes saline during the dry season.

Rice culture

Corresponding to these geo-hydrologic conditions, the characteristic practices of rice culture differ in the four regions. The former and present patterns of cultivation are as follows.

1) *Old delta*

Traditionally, fast-growing varieties were transplanted on the swells, and deep-water rice and floating rice were broadcast in the swales. In years of late rain, the fast-growing varieties were also broadcast on the swells



(1) Ban Khok Mon, 12 km NNE of Phanom Sarakham, (2) 15 km E of Tha Rua, (3) Ban Pho Chai, 10 km E of Inburi, (4) 5 km SE of Dan Chang, (5) Ban Don Masang, (6) Ban Chao Pluk, (7) 2.4 km SW of Hin Khon, (8) 1.5 km S of Amphoe Sena, (9) 1 km W of Amphoe Song Phi Nong, (10) Amphoe Thanyaburi, (11) 6 km SE of Changwat Nakhon Pathom, (12) 8 km S of Amphoe Nam Prio, (13) 1 km N of Amphoe Bang Pakong, (14) 23 km W of Bangkok along Chonburi New Road, (15) 7 km E of Samut Sakhon

Fig. 2. A map showing the monthly water depth in the field at 15 representative places in the delta

in order to cope with the water deficit. People regarded the swells as marginal and the swales as stable and thus the most reliable areas for rice cultivation.

The extension of irrigation canals under the Greater Chao Phraya Project brought great changes to the region. On the swells, the transplanting of medium-age varieties has spread and become well established. But in the swales, the untimely accumulation of tail water from nearby swells has caused some people to abandon cultivation due to the deterioration of land drainability. Most, however, continue to grow floating rice.

2) *Fluvial part of the young delta*

This has remained the core area of floating rice since the Ayutthaya period.⁷⁾ Dry seed is sown on dry land in May, and at first it grows like an upland crop. With the advent of the deep flood from mid-August it grows rapidly, flowering and maturing with the recession of the flood. Harvesting is done in December and January.

Since it has never been possible to control the mighty flood, the rice varieties cultivated represent the sole adaptation to the natural flood regime. Sophisticated farming technology has not been adopted. The main interest of farmers has been to find hardy varieties that can withstand the harsh flood environment. The result is so-called *muang* rice, which is hardy but inferior for eating, and contains a considerable proportion of large red grains. So-called spring rice, or rice grown in the dry season in the receding flood, is also said to have been cultivated.³⁾

3) *Delta flat*

Rice fields on the delta flat are of recent opening, mostly being reclaimed between the 1860s and 1900.⁹⁾ The rice grown before 1900 was predominantly short-age varieties, since the inundation period was too short for long-age varieties to reach complete maturity.²⁾ It was only after man-made canals extended to this area that the long-age varieties spread.

The South Pasak Project (1915-1924), Thailand's first irrigation work involving

modern technology, greatly stabilized production, and the Greater Chao Phraya Project after World War II, by providing ample water from outside the area, gave farmers the chance to switch from the traditional broadcasting to transplanting. Now about half of the east bank of the Chao Phraya is covered by transplanted rice.

On the west side of the Chao Phraya, a unique project called the West Bank Project was carried out in the 1960s. One of its purposes was to convert the project area into huge reservoir that would protect Bangkok from submersion. The result was excessively deep inundation during the rainy season. Substantial parts of the area have shifted the rice growing season from the rainy season to the dry season. Dry season rice growing is made possible by pumping up water from the Chao Phraya and the Suphanburi River.⁴⁾

4) *Coastal zone*

The coastal zone has long been characterized by the prevalence of transplanting and the flexibility of the cropping calendar. Transplanting is possible because the soil is wet or moist almost throughout the year, and in fact transplanting is required because of the weed problem. This perennially moist region is the domain of perennial grass and sedge, which are very difficult to eradicate. Formerly, a herd of buffaloes, often as large as 20 to 30 head, was driven into a field to trample down the grass and sedge into the mud, and then rice was either transplanted or directly sown in the field. This well-grounded tradition has now been replaced by plowing, as a result of which the weed problem has been aggravated. Today the best way to deal with weeds is to transplant well-grown seedlings which have a better chance of suppressing the weeds.⁸⁾

The flexibility of the cropping calendar owes much to the perennial soil moisture and to the removal of the restriction imposed by dry-season salinity by the construction of a coastal embankment.

Rice cultivation in the coastal zone has a much longer history than that of the delta

flat. Travel reports by Europeans⁶⁾ indicate that it existed at least as long ago as the end of the 18th century. By the mid 19th century, the region, particularly where it merged with the delta flat, had established itself as an important *na swan* or high quality "garden rice" area. My hypothesis is that the transplanting of rice in the coastal zone started sometime in 3rd or 4th century A.D.. Grounds for this are the existence of very old archeological sites like Nakhon Pathom and U Thong at the western edge of the Chao Phraya delta. Oc-Éo, an archeological site on the Mekong Delta, which dates back to the 3rd century A.D. and produces half-fossilized rice grains, provides supporting evidence for this early commencement of rice cultivation in the coastal zone.

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