CANALS IN THE MEKONG DELTA: A HISTORICAL OVERVIEW FROM 200 C.E. TO THE PRESENT

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• Q3 The Mekong• Delta is one of the most productive agricultural regions in the world. It supports more than 20 million people living in a dense network of canals and creeks that today irrigate more than 2 million hectares of rice paddy. This landscape of dense settlement and intensive irrigated agriculture is relatively recent, although the earliest canal projects date to "Fu Nan" or Oc Eo culture circa 200 C.E. Today's water regime is not so much a single water system as it is a landscape built of multiple layers of canals in various stages of development and degradation. Some waterways continue to serve as primary transportation and irrigation works: others lie abandoned, their traces sometimes only visible through analysis of aerial photography or historical reports. This overview describes these historical layers of canalization and the context for some of the major projects in each period.

GEOLOGIC OVERVIEW

The Mekong Delta of today comprises roughly 6 million hectares (5 million in Vietnam and 1 million in Cambodia) of alluvial plains. It is bordered by the Gulf of Thailand in the west and the South China Sea in the east. The main channel of the Mekong River is believed to have formed sometime between 2 and 50 million years ago in the late Tertiary period. The older, higher terraces of its delta may have formed as early as 1 million years ago. Corings of sediment in the lower delta alluvium show alternating bands affected by freshwater and saltwater, suggesting that as recently as 6000 years ago, mean sea level may have reached a post-Ice Age high water point before declining to recent historical levels.

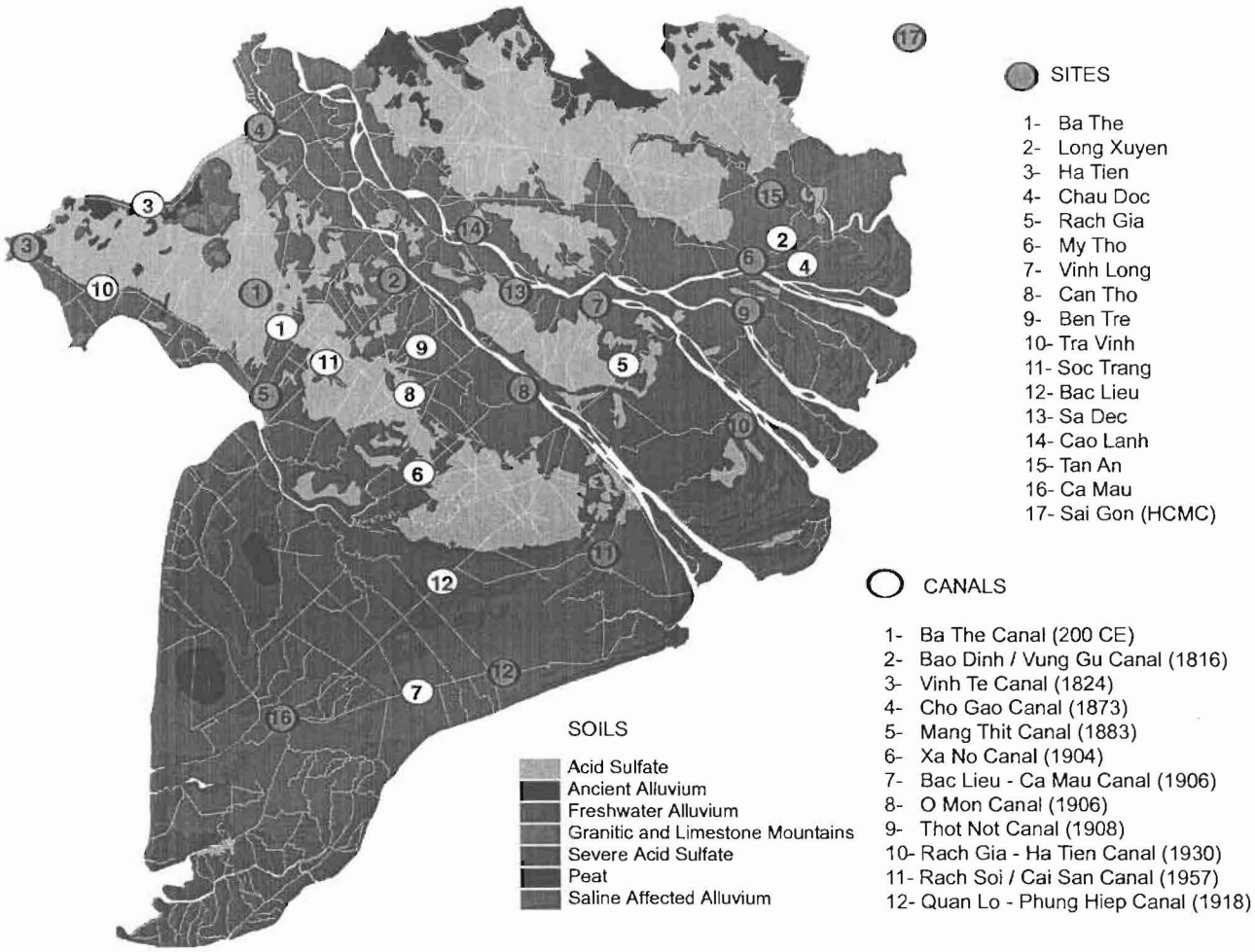
The slope of the delta is so flat that tidal surges affect water flow in canals and creeks up to 100 kilometers upstream. Two separate tidal regimes along the western and eastern coasts cause complicated periodic variations in water currents, depending on the proximity to both coasts. When opposing water currents meet, either at an intersection of waterways or along the path of a canal, they deposit sediment into bars that often block boat traffic. Vietnamese settlers, and probably earlier inhabitants, formed markets at these halfway points, convenient places for exchange. Choices for early modern settlements here were largely responses to water conditions and associated soil deposits.

From a soils perspective, the delta can be divided into subregions connected to geologic and ecological processes: a freshwater alluvial zone, the Dông Tháp floodplain, the Long Xuyên Quadrangle, the eastern coastal zone, and the Cà Mau Peninsula (Fig. 1). The Mekong River deposits fresh sediment along the banks of the channel, creating alluvial banks that rise 2–3 meters above mean sea level. This freshwater alluvium area fosters the development of the richest natural paddy in the delta, allowing two and three rice crops per year. The combination of high banks and good drainage allows farmers to irrigate easily and also to raise fruit trees without fear of flooding. Ancient alluvium is characterized by higher soils associated with a postulated high seas episode that occurred roughly 6000 years before the present. In the present era, this higher land forms a natural barrier to the Dông Tháp floodplain, a depressed area characterized by high soil acidity and annual floods. The other large flood zone is the Long Xuyên Quadrangle south of the main river channel. The Quadrangle is remarkable for granite and limestone mountains that rise up dramatically from the plains some 200–700 meters to form islands on the land. At the base of Ba Thê mountain in this Quadrangle lie some of the most substantial sites for what George Coedès described as the "Fu Nan Kingdom": the first example of an Indianized kingdom in Indochina.

Both of these two depressed floodplains, whose average altitudes are less than 1 meter above mean sea level, form two flood sinks that form virtual, inland seas each September as the Mekong River reaches its annual flood stage in the wet season monsoon. The annual flooding of the Mekong from August to October is important for far-reaching effects on almost all activity in the region. The Tonle Sap (Great Lake) in Cambodia grows to three times its dry season size in June, July, and August. As the lake reaches its limit, water flow reverses in the Tonle Sap River, flows downstream, and recombines with the mainstream rivers at Phnom Penh. The river then floods the Long Xuyên Quadrangle and the Dông Tháp Plain.

ANCIENT SETTLEMENT

The earliest traces of organized human settlement in the Mekong Delta date to the "Fu Nan" period (100 B.C.E.–550 C.E.). The types of evidence found in these settlements can be grouped roughly into wooden piers and structures, jewelry and statuary, and vestiges of infrastructure—brick foundations, brick towers, and canal traces. The largest brick foundations lie at the Ba Thê site in the Long Xuyên Quadrangle. Using aerial photography in 1931, an amateur archaeologist, Pierre Paris, discovered traces of canals crossing the western delta, from Rạch Gía on the coast to Angkor Borei about 100 km to the northwest. What had previously been noted through ground surveys as straight creeks were actually the remaining traces of human-constructed waterways. Louis Malleret, a former director of the French L'Ecole Francaise d'Extrême-Orient, led digs in the 1940s and 1950s at canal sites discovered through aerial and ground surveys. Malleret's work and that of successive Vietnamese and international researchers has proven through comparison of pottery shards and other means that these canals dated to roughly 200–400 C.E. Styles in the pottery indicate containers for oils and other goods that resemble similar containers from eastern India in that time. The ancient canals also extended deep into the Cambodian portion of



• Q1 **Figure 1.** •.

the Mekong Delta, connecting the gulf coast ports with inland river ports at Tak Ev and Angkor Borei.

In the ancient world, the Mekong Delta was an important halfway point for sailing ships travelling with the monsoons between India and China. As a possible warehousing center developed along these ancient canals, the Oc Eo site allowed ships from both destinations a useful trade interchange and provided them with important naval stores and valuable supplies brought downriver from the forest interior: rhinoceros horn, elephants, feathers, aromatic woods, and wild spices. Chinese records from both trade missions and accounts of Fu Nan monks visiting China note major settlements along the main course of the Mekong River below Phnom Penh, including the sites at Oc Eo/Ba Thê, Angkor Borei, and a site in Dông Tháp Muòi. Inscriptions described Indian merchant colonies at Southeast Asian ports, including those in the Mekong Delta. The situation of Indian merchants here enriched local rulers, allowing them to raise funds and craftsmen to build ships of their own.

Environmental factors may have played a role in the decline of pottery and evidence of population in the lower delta. Soil cores at the Oc Eo site reveal high concentrations of Rhizophera pollen spores in deeper layers, suggesting that saltwater mangrove trees populated a floodplain that is entirely freshwater today. Every year, the sea coast may have receded further from the Oc Eo site, and the canals may have slowly filled with sediment from the rivers, turning them into shallow creeks and ponds. This would in turn change the wetlands ecology to one favorable for freshwater tree species. This freshwater plant community would have also attracted mosquitoes that carry endemic malaria and parasites, thus putting dense populations at greater risk of disease outbreaks.

VIETNAMESE SETTLEMENT

There is no further evidence of major canal projects or dense settlement in the Mekong Delta for more than 1000 years after the decline of "Fu Nan." From the ninth to fourteenth centuries, the upstream kingdom of Angkor controlled the entire region and conducted its major trade routes by highways that stretched westward into present-day Thailand and to the west coast of the Isthmus of Kra. Archaeological evidence near present-day coastal towns of Trà Vinh and Sóc Trang suggest that river ports here conducted small-scale local trade

with Southeast Asian and Chinese merchant ships. One possible explanation for the lag in development of the Mekong Delta after Fu Nan could be that the very same waterways and flat landscape that facilitated easy transportation also allowed easy attack by enemy fleets. Steles at Angkor Thom (Siem Reap) depict naval battles with ships from Champa that attacked the Khmer capital by way of the Mekong River. The numerous islands in the Gulf of Thailand also provided easy harbor for all manner of pirates—Malay, Siamese, Chinese, European. Until Vietnamese settlers began migrating southward to the delta in the seventeenth century, island-like Khmer trading ports and administrative outposts of the Khmer kingdom characterized the area. Populations of Khmer villagers lived in some of the richest, naturally irrigated alluvial regions in areas that are today still ethnically Khmer: Sóc Trang, Trà Vinh, Trà Nóc, and Sa Déc.

One of the most important factors in Vietnamese settlement and early modern canalization was the increasing importance of rice as a trade commodity. Until the seventeenth century, rice was rarely traded by ship and in cities as were gold, spices, ivory, and aromatic woods. It was a local subsistence commodity and generally in greater abundance than the human labor necessary to cultivate it. In the seventeenth century, increasing population pressures in the Red River Delta brought on widespread famines and social unrest; to the present day, this population density in the north and the "southward progression" have played important roles in spurring development of waterways and infrastructure in the Mekong Delta. The upset of the ruling Minh Dynasty in 1644 also led to a mass exodus of Minh loyalists to Vietnam and other kingdoms that granted them asylum. In 1679, 3000 Fukien troops arrived in the Vietnamese kingdom. The Vietnamese ruler, anxious not to have them so close to his capital, sent them to the south where they formed the commercial towns of Biên Hòa, Sài Gòn, and Mỹ Tho. In 1681, another Chinese emigré, Mặc Cúu, immigrated to Cambodia and succeeded in winning a concession from the Khmer king to develop a trading port at Hà Tiên. From 1690 to 1780, Hà Tiên became a virtual city-state, trading most of the forest products of Cambodia by a Chinese-controlled shipping network centered at this Gulf Coast port. The more powerful kingdom of Siam now controlled the Isthmus of Kra, so Hà Tiên became an important trading port much in the same way as Oc Eo before it.

The Vietnamese kingdom established military and administrative posts in the Mekong Delta in the eighteenth century. In 1732, military campaigns led to the establishment of camps at Mesar (Mỹ Tho), Kampong Reussey (Bên Trè), Koh Gong (Gò Cong) and Peam Ba-rach (Long Xuyên). The court sent troops and new migrants to establish military plantations [dôn diên] in the new territories. These military plantations functioned as both garrisons and farming communities. At the same time, the Chinese developed mercantile posts and arranged the marketing of rice. The Tây Son civil war (1789–1802) and repeated Siamese invasions at Hà Tiên (1705, 1717, and 1771) led to the eventual abandonment of Hà Tiên and the establishment of Vietnamese control of the delta in 1802. For 60 years, the Court enticed settlers to establish garrisons and villages. In 1818, still worried about the threat of Siamese invasion, King Gia Long ordered his military governor in the delta, Thoại Ngọc Hâu, to assemble an army of conscript laborers to dig a canal 67 kilometers from a new river citadel at Châu Dôc to Hà Tiên. More than 50,000 laborers worked for 5 years and through several Khmer-led rebellions to complete the waterway. This strategic project was intended to allow greater Vietnamese control of the Gulf Coast and direct water routes to river garrisons. Two other major projects in this period connected the increasingly dense Sài Gòn watershed with the intermediate Vàm Co watershed and the Mekong river. The Bạo Dình Canal in 1816 allowed more direct access to the Khmer territory east of Mỹ Tho and solidified trading routes and administrative communication in the eastern delta. The Thoại Hà (Long Xuyên–Rach Giá) Canal was also completed in 1816. The rapidity of this project (3 months) and its location in the heart of the former "Fu Nan" kingdom suggests that this waterway may have dated to a much earlier period and only been "cleaned" in 1816. Historical records in the nineteenth century do not specify this difference, and they often alternately describe canals as rivers.

Midcentury violence led to the abandonment of coastal outposts for periods of years, and the neglect of these new waterways led to their being choked off with silt. The natural processes of sediment accretion and growth of aquatic plants played an important role in canal projects, especially in the costs of their upkeep. The interplay of tidal pulses and opposing river currents led to formation of transverse sediment bars across the channel of a canal. In a matter of months, if not continually cleaned by hand, these bars would reduce the navigable channel to a depth of half a meter, even at high tide in the dry season. Besides this hydraulic challenge, the water hyacinth or luc bình could quickly reproduce and choke off an entire waterway with a thick, floating mat of roots on the water's surface. Thus, without the continuous application of human labor in large numbers, most artificial waterways could not remain navigable for long. With each social uprising, canals quickly deteriorated so that after a few years, the costs of redredging would approach the original cost of construction. Another theme of canal degradation that also continued through the colonial and postcolonial eras was its role in aiding rebel groups.

With the French colonial conquest beginning in 1858 and lasting until 1867, rebel groups could only survive in the deep swamps far away from deeper rivers and streams. Battles at the Plain of Reeds in 1873 proved that control of waterways was vital for the French colonial regime. For two decades, the French colony's ruling admirals focused their efforts on linking strategic areas with the colonial metropole at Sài Gòn. In 1875, Admiral Duperré organized a permanent committee to improve naval communications between Sài Gòn and the Mekong Delta. This commission surveyed existing and proposed routes until 1879. During this time, the colonial government mobilized armies of corvée [conscript] laborers into government service. These first canals included Trà On (1876), Chò Gạo (1877), Set Say (1878), Phụ Tục (1878), Mirador (1879), and Saintard (1879). Of these, the Chò Gao Canal was one of the most

vital. Via several large waterways, it linked Sài Gòn with Mỹ Tho, the largest river port at the time. A gunboat or cannonière could now make the trip to the delta in just 8 hours.

The same problems of sediment accretion and controlling vegetation continued to dog French engineers as it had their Vietnamese predecessors. In just a few years, Chò Gạo was silted again, preventing passage of the larger boats and forcing them to make the much longer journey to the river port by entering the river from the sea. In 1883, the government paid the Eiffel company to construct steel railway bridges across the intermediate Vàm Co River to connect Sài Gòn with Mỹ Tho by train. As the colonial government grew stronger in the 1880s and the French succeeded in using mechanical dredges at Suez, the regime introduced mechanical dredges. The shallow and high-clay sediments here, however, forced the government to rely on labor crews until new dredges were built in the 1890s.

The period of colonial dredging contracts with a mechanical dredging firm lasted from 1894–1945. During the peak of colonial expansion from 1894–1930, the colonial regime dredged some of the major "transverse" waterways connecting the lower branch of the Mekong or Hậu Giang with the Gulf of Thailand. This lower part of the delta was the least inhabited, making it the easiest space for French colons to build plantations several thousand hectares in size. Major canals such as Xà No (1904), Lai Hiêu (1906), Thôt Nôt (1908), Ô Môn (1906), Vinh Tê (redredged,1914), Quạn Lô–Phụng Hiêp (1918), Ba Thê (redredged,1923), and Tri Tôn (1928) were developed. They also, dredged important waterways into Dông Tháp (1890–1904), from Bac Liêu to Cà Mau (1906), and from Rạch Giá to Hà Tiên (1930). This massive effort in mechanical dredging was accompanied by the immigration of laborers from the north; the population increased from 500,000 to almost 4 million in 1930.

Some areas, especially the fields near Cân Tho, flourished, but many of the waterways proved to be both economic and ecological disasters. The Lai Hiêu Canal brought on higher flooding, and its embankments cut off existing water circulation that led both to the spread of cholera in 1908 and the failure of many preexisting fields. A series of typhoons from 1904–1908 caused abnormally high flooding in the Plain of Reeds and the abandonment of plantations and fields after several years of lost crops. Canals also led to drying of soils in floodplains that were high in sulfate content. This drying of soils produced acid sulfate that then leached into the waterways and in turn quickly reduced crop productivity. With the onset of the world depression in 1931 and the collapse in rice markets, the masses of migrant laborers employed as tenant farmers on the plantations began to protest. Hydraulic engineers also began to debate the future of projects in the area. One camp argued that it was necessary first to improve existing yields and to let some of the failed projects lie fallow. Another camp argued for more sophisticated mechanical approaches to drainage and irrigation, suggesting the redevelopment of casier or grids of irrigation canals where farmers could be resettled. Except for small settlement projects near Ba Thê, the colonial government did not develop any other large projects before it was ousted from power in 1945 and subsequently entered into a 9-year war with the Viêt Minh.

During the Second Indochina War (1945–1954), the Government of South Vietnam attempted to develop several of these casier styled resettlement projects in a fashion similar to those proposed by the French before them. Of these, the single permanent project was the Cái San Project, a series of "transverse" canals in the lower delta and a smaller network of intersecting canals numbered from 1 to 17 and letters A to H. From 1955–1962, the Government resettled approximately 50,000 settlers, mostly Catholic, from their original villages in North Vietnam to 3-hectare tracts at Cái Săn. During the 1960s, American military and private contractors further built up the area with a highway paralleling the Rạch Sọi Canal (Highway 80) and an airport at the southern end of the area (today Rạch Giá Airport). For the most part, both wars prevented steady extension of waterways due to continued guerilla attacks. Like preceding antistate rebels, preventing easy circulation of government troops on the waterways and (increasingly) roads was vital to survival. Most of the familiar scenes of combat during the "American War" were encounters in the swampy interiors of swamps where previous canals had either deteriorated or been abandoned because of their low agricultural utility.

Since the conclusion of the war in 1975, and especially with the market orientation stimulated by Dôi Mói Reform in 1986, the Government today has begun a series of new projects. Like projects enacted in the 1950s, many of these contemporary development projects were continuations of earlier plans developed in the 1960s and early 1970s. For example, in 1996, the Government began work on the Mỹ Thuận Bridge, a project first surveyed by the Nippon Koei Corporation in 1963. This bridge, completed in 2001, became the longest span bridge in Southeast Asia and for the first time, allowed continuous highway transport across the upper branch of the Mekong River. A second span is due to be completed near C`ân Tho in 2005. Now at peace, government leaders have refocused their attention on Dông Tháp and former guerilla strongholds for future agricultural development. The Vietnamese delta population now is well over 17 million persons, however, so decisions to build canals and flood dikes are becoming increasingly difficult. Flood control in one area often results in diversion of the floodwaters to another zone or province downstream, thus giving rise to interprovincial disputes over access to clean water. A related issue is the construction of dams on the upper and middle Mekong Basin. The Mekong Committee is an international advisory body made up of representatives of the six riparian countries. With the reunification of the region and all member states into both the Mekong Committee and ASEAN, downstream countries have begun to lobby against diversionary projects upstream.

Another future concern in the Mekong Delta is the impact of global warming. As sea level rises just a few feet, thousands of hectares along the coast would be permanently inundated with salt water. The Mekong Delta is one of the flattest deltas in the world, so

fluctuations in both river levels and sea levels could require the construction of unprecedented sea dikes to protect areas of coastal rice paddy.

The apparent "system" of canals and water projects in the Mekong Delta reflects nearly 2000 years of experimentation. Some of those trials lasted into the present, and some others are barely visible now. The economic or environmental health of this system is largely dependent on regional social factors and the intensity of human activity here. Currently, the challenge for engineers and planners in this region is to reconcile these factors to distribute "clean" water equitably in a more predictable fashion.

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