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The Delta Machine: Water Management in the Vietnamese Mekong Delta in Historical and Contemporary Perspectives

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Introduction

Since ancient times, a combination of natural and social forces has produced the Mekong Delta. The delta's unique waterscape – with its dense maze of canals, extensive horizons of rice fields, village orchards and aquaculture farms – is the result of natural forces such as rain, floods, sedimentation and tides, and of human constructions such as canals and dikes. This *made* landscape, defined by ongoing canal-building enterprises and other works associated with a rapidly urbanizing human landscape, remains at constant risk of being *unmade* by the destructive and sediment-spreading natural effects of seasonal floods, erosion from daily tidal fluxes, storms and also the manmade effects from poorly placed dikes and other works. Enormous investments are required to keep the waterways free of sediment for irrigation, flood control and transportation. Yet, the same sediment, associated nutrients contained in it, and water flow are crucially important to agricultural productivity, ecological biodiversity and efforts to avoid coastal erosion.

Many present-day challenges facing society in the delta are partly the result of past actions that have tended towards more mechanistic approaches to the

water environment premised on ideologies of centralized state control rather than support for local adaptation to change and variability. The clearly delineated physical geography of the delta bounded by coastlines and waterways has inspired grand plans of ambitious engineering. The predictability of this natural and social environment, assumed by such master planning, has been contradicted by periods of intense social conflict and continuing occurrences of catastrophic floods and variations in freshwater availability. The threats posed by these social upheavals and natural hazards have both interrupted and justified certain water resource development programmes. Contemporary conflicts over resources are an expression of agricultural intensification, urbanization, and corresponding demands for irrigation and flood protection that tend to foster dependency upon older technological approaches. In recent times, interest in more adaptive and decentralized approaches to water management has returned, although large-scale 'command-and-control' approaches continue to dominate; yet, modern era institutional, political and technological legacies prevent the easy adoption of new policy alternatives.

This chapter traces the historical and contemporary tensions between adaptive and control-oriented approaches to water in the Vietnamese delta region, considering the causes behind the historical shift from traditional approaches oriented to flexible adaptation, towards modernist policies of centralized governmental control. As with many regions of the world, this shift occurred in the late 19th and early 20th centuries. To what extent are future development choices constrained by the weight of a history of past choices supporting the state's technological domination over water environments? In an era where uncertainty and risk is of growing concern to policy-makers and inhabitants, a critical historical perspective on water resources management may reveal more clearly how past decisions have closed off present-day opportunities to pursue new approaches or to identify where opportunities for alternatives to contested policies might still exist.

Using historical examples that illustrate connections between contemporary problems and past decision-making in water control, this chapter focuses on three issues that are central to water resources development in the delta*: total management schemes, mechanical approaches to water management, and trends in adaptation and disaster response.* After giving a brief overview of past and contemporary issues in the delta waterscape, this chapter considers how an ideology of modern technocratic control came to dominate decision-making processes. This ideology has changed over the decades from its often violent implementation in the colonial era to the imported approaches favoured by state engineers under the advice of foreign consultants with experience in other river basins and deltas. Given the role that war and natural catastrophe played in limiting water resource development in these decades, the third section considers how such social and natural disasters not only disrupted attempts for centralized water management, but also presented some interesting alternatives in methods of individual adaptation and disaster response. By focusing on these three issues, the chapter examines the evolution of a unique

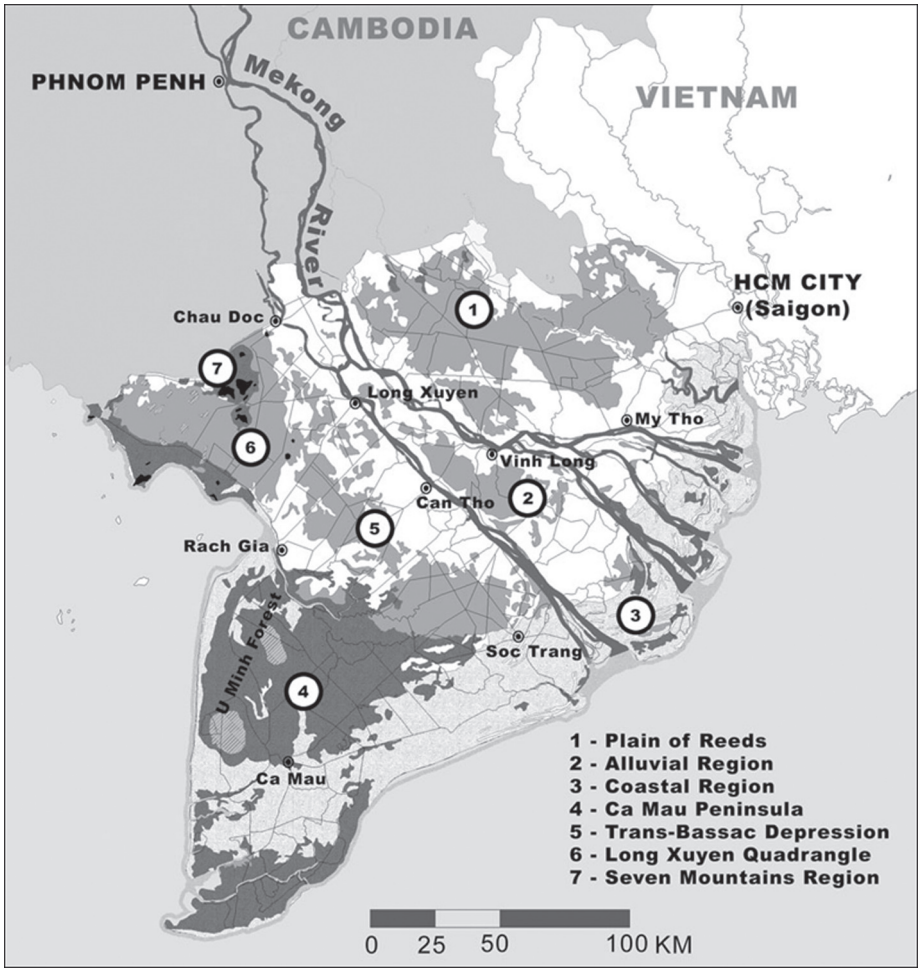

Figure 8.1 *The Vietnamese Mekong Delta*

Source: David Biggs

waterscape that has resulted in the creation of one of the most intensively populated and cultivated regions in the world, one that is now strongly embedded in national and global food economies. The chapter concludes by returning to its main premise that an historically informed analysis of present-day challenges may be employed not only to critique the assumptions of large-scale water management schemes, but to suggest more effective alternatives.

Historical and geographical overview

The Mekong Delta covers an area of roughly 5.9 million hectares and spans the southernmost border between present-day Vietnam and Cambodia, with roughly 4 million hectares in Vietnam. As indicated in Figure 8.1, the Vietnamese Mekong Delta can be divided into a number of regions defined by hydrology and soil chemistry. The most fertile and oldest cultivated regions are the naturally drained freshwater alluvial regions bordering the major channels of the Mekong River. Stretching across the river's two major branches, this area includes most of the delta's largest cities, including My Tho, Can Tho, Vinh Long and Long Xuyen. East of this region is an area subject to year-round or seasonal saltwater inundation referred to as the coastal zone. Especially since 1986, this area has been targeted both for construction of sea dikes and expansion of shrimp aquaculture. There are four major basins subjected to annual monsoon floods from August to December: the Plain of Reeds, the Long Xuyen Quadrangle, the Trans-Bassac Depression and the Ca Mau Peninsula. All of these areas are characterized by acid sulphate soils (represented in grey and dark grey) and are extremely vulnerable to both flooding and, in many areas, saltwater intrusion (represented by stippled areas). Given the environmental hazards in this region, these areas have generally been more politically and economically vulnerable than the alluvial and coastal regions. Two smaller geologic features in the delta include areas of peat soil (indicated by cross-hatching) and a group of granitic mountains (indicated in black) that spans across the modern border with Cambodia.

Although the region's population today exceeds 18 million, for most of the delta's history it was relatively sparsely inhabited, estimated to be close to 1 million at the beginning of the 20th century. Archaeological excavations undertaken with the aid of aerial photography during the 1930s revealed canals and settlements in the Long Xuyen Quadrangle, in the upper part of the delta, that were built sometime between 300 BCE and 700 CE.[1] The fact that this society disappeared rather suddenly after 700 CE suggests the precarious nature of this building process, where early society in the delta was vulnerable to flood damage, silted waterways and bays, diseases, piracy and competition from other trading ports in the region. For the next 1000 years, the delta was a sparsely settled coastal frontier of the Khmer Empire with its capitals upstream at Angkor Wat and later Phnom Penh. Early modern water management accompanied the expansion of Vietnamese and ethnic-Chinese groups into the delta region, with a consequent contraction of Khmer interests as the region by 1800 had fallen under Vietnamese political authority. Especially after 1800, waves of settlers and trading interests helped to bring about a 'water frontier' in the Lower Mekong Basin where Thai, Khmer, Viet, Lao, Chinese, Malay and European groups intermixed (Cooke and Tana, 2004). In this pre-colonial period, major canal projects such as the Vinh Te Canal (1820 to 1825) both expanded the reach of the Vietnamese state and further separated

historic Khmer settlements downstream from a weakened kingdom at Phnom Penh. After several decades of continuing unrest into the 1850s, the French navy then commenced a campaign to conquer the delta and achieved control over the Vietnamese portion of the delta in 1867.

Under French colonial rule and with the introduction of steam-powered dredging in the 1880s, the delta's population quickly rose from some 500,000 in 1860 to over 4 million in 1930. From 1890 to 1930, more than 165 million cubic metres of earth were dredged and the total area put under cultivation rose fourfold to over 2 million hectares (Inspection des Travaux Publics, 1930, p20). From 1930, combined economic, political and environmental troubles stalled further colonial reclamation projects; the escalation of military conflicts in the region after 1945 continued off and on for three decades, so for over 40 years very few new canal projects were undertaken. Nevertheless, as we will see, the war period (1945 to 1975) was important for incubating new strategies of water use that often involved reverting to relying on local resource management, especially in resistance zones controlled by Vietnamese revolutionaries. This period also saw the emergence of internationally supported delta-wide master-planning by the US (Development Resources Corporation, 1969) and The Netherlands under the auspices of the Mekong Committee (Netherlands Delta Development Team, 1974).

Following the end of the Second Indochina War in 1975, the reunified Vietnamese government immediately embarked upon a number of new reclamation projects in war-torn areas, but with little overall effect on raising productivity. It was not until the relaxation of collectivization strategies and the privatization of agriculture in 1986 that production levels and industrial intensification of agriculture began to increase rapidly. Since then, the Mekong Delta has become one of the most productive zones for rice and aquaculture in the world, supplying more than 70 and 50 per cent of Vietnam's foreign export amounts of these staples. However, this increased productivity has come at great environmental and social costs as water resources are often degraded and many farmers cannot keep up with the costs of living. Since 1986, the Vietnamese government has moved to shift the cost of maintaining canals and other infrastructure away from the central government to provincial governments and private landowners as part of a broader strategy of (fiscal) decentralization. Such decisions have challenged sub-national and local authorities to find new cooperation models that can sustain and improve their systems. Second, in an attempt to widen the consideration of water resources management from the historical focus on irrigation development, control over the development of waterways and irrigation has shifted from the single domain of a Ministry of Agriculture and Rural Development (MARD) to shared responsibility with the Ministry of Natural Resources and the Environment (MoNRE) (Molle and Hoanh, 2008).

Total management schemes

The first issue that has played a major role in the development of water use policy in the delta is a long history of delta-wide and basin-wide 'total' water management plans. While increasing communication between the riparian states in such organizations as the Mekong River Commission is generally viewed as a positive step towards encouraging international cooperation towards sustainable water use, the ways in which delta master plans and basin management schemes have been established in the past have produced trends towards technocratic management and solutions that favour major modifications to the river's hydrology. It is these modifications that continue to remain problematic. The Mekong Committee, formed in 1957, initially focused on building a cascade of mainstream dams on the Mekong River south of the Chinese border. The conceptual division of the basin into upper/Chinese and lower/Southeast Asian regions in the 1950s especially reflected US concerns in containing Chinese economic and political influence by focusing development initiatives solely on the lower part of the Mekong Basin located outside Chinese territory. The changing relationship of the US with China after 1949 played a major role in the type of support given to Mekong projects and the Mekong Committee. Before the Communist Chinese military victory over the Nationalists in 1949, US and Chinese engineers worked extensively on projects such as a proposed dam at Three Gorges on the Yangtze (Biggs, 2006). Only after the establishment of the People's Republic of China (PRC) did US agencies pay closer attention to the Lower Mekong Basin. While no mainstream dams have been built in the lower valley,[2] this period of intense international involvement in the development of water resources in the Mekong has had an enduring influence on development planning, as the surveys and feasibility studies produced continue to attract the interest of individual states and private firms lured by the promise of electricity generation and water control. The idea of such developments continues to influence development discourse and negotiations between riparian countries and underpins the recent groundswell of water projects in the basin (see Chapters 1 and 2).

In the Mekong Delta, historically, the pivotal form of water control and management has been the 'Dutch dike' strategy, which involves construction of encircling dikes for settlement, flood control or prevention of seawater intrusion to provide the favourable freshwater conditions for agriculture. The first projects to build such dikes and saltwater dams began under colonial rule in the 1930s as hydraulic engineers and agricultural development cadres sought to clear new lands to raise the colony's production of rice, as well as to defuse mounting social tensions by resettling many thousands of poor tenants to the new lands. French colonial officials, influenced largely by the dike-enclosed landscapes encountered in the Red River Delta – a landscape of distinctly different historical, geophysical, climatic and demographic features – drew up massive plans to relocate farmers from the

Red River Delta into the broad depressions such as the Long Xuyen Quadrangle and Plain of Reeds, as well as the coastal region (see Figure 8.1).

One of several tests to the soundness of the colonial hydraulic infrastructure came in 1937 when higher than normal floods destroyed much of the rice planted in the flood depressions. In an aftermath punctuated by frequent acts of peasant violence aimed at plantation owners, colonial engineers and planners debated development strategies. Rather than reconsider plans to build in flood zones, they instead decided upon greater flood control structures and, simultaneously, the elimination of areas that had grown a flood-tolerant variety of 'floating rice' in favour of faster-growing short-stem varieties. In 1943, during the Japanese military occupation, Vichy Governor-General Decoux created a new budget category entitled 'Aid to rice farmers' that called for 5 million piaster to send entire villages of peasants down the recently completed Trans-Indochinese Railway to populate the first enclosed settlements called '*casiers*' and effectively ended the hydraulic conditions necessary to grow 'floating rice' (Decoux to the Governor of Cochinchina, 1942; Service du Génie Rural, 1943); but these works did not concern the deeply flooded areas of the northern part of the delta and were soon discontinued by warfare.

After the 1954 Geneva Accords brought an end to the First Indochina War, the Republic of Vietnam with US technical and financial support continued this settlement and 'Dutch dike' strategy, especially in politically contested areas such as Long Xuyen and the Plain of Reeds. From 1968 to the war's end in 1975, Vietnamese and many foreign advisory teams continued conducting feasibility studies, developing regional management schemes, and publishing many reports for large-scale settlement and agricultural development initiatives in the delta. As part of President Lyndon B. Johnson's initiative to 'win hearts and minds', David Lilienthal, known during the 1960s as the architect of the Tennessee Valley Authority and in the press as 'Mr TVA', accepted a contract in 1966 to organize with Vietnamese officials a Mekong Delta Development Programme (Development and Resources Corporation and Republic of Vietnam, 1969), as part of the larger Lower Mekong Scheme (Jenkins, 1968). As a 'true believer' in the promise of high technology and regional planning and development to empower grassroots participation, Lilienthal quickly grew sceptical upon seeing the apparent disconnects between the US 'pacification' mission, the violence of the counterinsurgency experiments, and the military conduct of the war. Upon seeing Vietnamese farmers passing his boat travelling on canoes with a modified 'long-tailed' outboard engine, he reflects in his journals that 'even on many technical matters it is *we* who have a lot to learn' (Lilienthal, 1976). With the increasing levels of military violence, however, this proliferation of international consulting firms and management planning initiatives did not coalesce into major effective projects.

Two US moves, the creation of the Asian Development Bank (ADB) and President Nixon's policy of 'Asian regionalism' that involved contracting with

local Asian companies instead of US ones to carry out development projects, had a lasting effect on the international nature of water and land-use planning in the Mekong Delta. One Asian firm, in particular, Nippon Koei, exemplified the return of Japanese technicians and investors after the Japanese military had evacuated from the region in 1945. Formed in 1946 during the US occupation of Tokyo, Nippon Koei took some of the more dangerous projects in the Mekong Delta that typically required field surveys and the placement of construction teams in non-secure areas.

Beginning with surveys conducted in 1957, the company sent its engineers to a series of salt intrusion barriers abandoned by the French in 1946. Intermittently into the 1970s, Nippon Koei then fulfilled contracts to redevelop the works, and in 1972 actually completed construction of anti-salinity dikes and barriers through the Tiep Nhut Project, southeast of Soc Trang Province. Funded by the World Bank, the project aimed to protect some 50,000ha of farmland from salt intrusion in the dry season in order to allow the double-cropping of rice. The Go Cong 'pioneer agricultural project', similarly focused on salinity intrusion control, was funded by the ADB. Both projects faced numerous technical, environmental and socio-institutional challenges. For example, Nippon Koei's engineers continued visits to the Tiep Nhut site as late as 1974, when they noticed almost immediately that the new project had stopped saltwater from intruding but had created other problems due to stagnating water inside the dikes in parts of the project.

Not only were such 'Dutch dike' schemes (and the advice of Dutch engineers) employed by the colonial and Saigon governments, but after 1975, the reunified Vietnamese government commenced a 'rice everywhere' campaign due to severe food shortages in the country, especially in the north (Netherlands Delta Development Team, 1974). Saline water was, in the state's point of view, a constraint to agriculture rather than a resource for aquaculture, as farmers view it today, and flood a threat and constraint to intensification. This 'all rice strategy' was intensified following the severe flood of 1978, when more than 700 people lost their lives in the delta and floating rice crops were devastated, which served to justify investment in flood-protection dikes, canals and pumping stations. This strategy was further strengthened in the 1980s, as the country continued to experience food shortages (Hoanh et al, 2003b; Tuong et al, 2003). Such schemes to manage water across vast territories were first realized slowly, with mainly earthworks and small sluices dug by hand, and it was only after the *doi moi* (renovation) period with market liberalization starting in 1986 that the government was financially able to invest in large-scale plans again. Local authorities determined that people would need to adopt dry season double-cropping across the region. While the relatively easy 'closing off' of the coastal areas continued, huge investments in the diking of polders in the traditional floating rice area of the Long Xuyen Quadrangle were initiated as a means of providing homesteads for the growing population and water control schemes that would allow a shift to high-yielding varieties and multiple cropping.

During the first few years of market-oriented policy after 1986, rice farmers in the Mekong Delta were at first happy with surplus rice production that improved their livelihoods compared with farmers elsewhere. However, since the mid 1990s, the limited income of rice farmers, especially small landholders, has not helped them to keep up with the high speed of economic growth; hence, they have become one of the poorest groups in their communities. Even with the soaring rice price, increasing by 76 per cent between December 2007 and April 2008, several analyses indicate that the high price may not necessarily improve the income of rice farmers – only that of rice-related trading companies.

With *doi moi* policies that stopped the use of quotas in rice production and allowed diversification, some farmers have switched to more high-income crops such as fruit trees and aquaculture. This has only been possible, however, in areas where agro-hydrological conditions allow diversification away from rice and where people have access to necessary credit, knowledge, expertise and markets for non-rice products. Except in the intermediate zone under tidal management, where the expansion of orchards on raised beds has been spectacular, the current water management system through dikes was primarily designed for rice irrigation. Diversification to non-rice crops requires significant modifications – full protection for trees and pumping to highlands for vegetables or fruit. The state faces the increasingly difficult challenge of continuing another cycle of investment into new infrastructure at the same time that it attempts to maintain older works.

While these works were carried out quite independently from events unfolding at the level of the Mekong Basin, this wider scale has recently regained relevance as ideas of harnessing the river water resources at a large scale have resurfaced (see Chapter 2). The high demand of energy for economic development in the Mekong countries, together with increased concern over climate change and rising fuel costs have fuelled a renewed emphasis on infrastructural solutions that aim to 'climate proof' local economies by ensuring the security of water and energy supply. Mainstream and tributary dams in the lower basin are now back on the planning board after a period when increased awareness of the environmental and social implications of such dams led to limited international multilateral investment in such projects.

China, in particular, is steadily and determinedly pursuing the construction of eight dams on the upper length of the Mekong (Lancang) River (two completed, two under construction), while Laos has 77 dam projects in its pipeline. From the formation of the Mekong Committee until the 1990s, Vietnam was an advocate of Mekong mainstream dams, seeing the potential flood control and dry season flow augmentation function of dams as beneficial to agricultural production in the delta. Environmental impacts such as changes in water flow and quality were of less concern than possible benefits from flood mitigation and regulated supply of water during the dry season. During the mid 1990s, Vietnam turned to opposing Mekong mainstream dams, fearing the impact of projects such as the Thai Khong-Chi-Mun on dry-season salinity intrusion in the delta (Hori, 2000). This attitude

has, in recent years, shifted again, as the delta's coastal areas are increasingly protected and energy generation has become a priority over food production.

With estimates that as much as 50 per cent of the Mekong River's sediment originates in the upper basin, however, the impending decline in sediment loads in the lower basin is likely to have severe implications for bank erosion, and stream and floodplain morphology throughout the basin, notably in the delta where the river deposits much of its sediments (Chapter 9). Many farmers in the Mekong Delta are dependent upon the sediment and nutrients brought by the seasonal floodwaters to maintain soil fertility and, thus, crop productivity.

Even more important is the role of sedimentation in protecting the delta from coastal erosion, as can be seen by retreating deltas, from the Nile to the Yellow Sea. On top of that, the spectre of climate change is likely to put ecological and social systems under increased stress: the predicted impacts on the delta include a rise in sea level that will compound problems of coastal erosion, worsening salinity intrusion in the river's main arms, as well as increases in the incidence of severe floods, droughts, storms, tropical cyclones and heat waves, including unknown ecological changes (Hoanh et al, 2003a; Wassmann et al, 2004). Experts estimate that with a sea water rise of 1m, Vietnam will suffer a loss of 12.3 per cent of its cultivated land, including 170,000ha of coastal land in the Mekong Delta region (*Vietnam News Briefs*, 2008). They conclude that the country must 'upgrade its sea dyke system, which is downgrading and unable to combat the sea level rise', with US$606 million needed from now until 2020. One expert stated that building sea dykes was part of an economic and 'national defence security strategy', and that the minimum width of each dyke should be 5m to 6m to cope with the 9.10 degree storms.

At a conference on 24 March 2008, MARD revealed its continued preference for 'engineered solutions' with a proposal for new plans to raise around 10.7 trillion Vietnamese dong (US$676 million) to further extend and upgrade dikes in 15 vulnerable provinces along the Vietnamese coast, including seven in the Mekong Delta. Moreover, after Cyclone Nargis devastated the Irrawaddy Delta in Myanmar/Burma during early May 2008, some Vietnamese officials proposed to strengthen the infrastructure in the Mekong Delta, concerned about the possible damages of a similar cyclone, although cyclones of such intensity are very rare in the Mekong Delta. These new developments represent the latest step in a long history of state efforts to further human control over the natural flow of water between the delta and the sea. The costs of all these infrastructural solutions, however, may also become unbearable.

The delta as machine: A work without end

From very early in the colonial period, hydrographers and engineers were confronted by the physical and ecological complexity of the water environment in the Mekong

Delta. The extreme flatness of the delta, combined with high sediment content in the rivers, produced hogsback ridges (*lung tom*, *dos d'âne*) in newly constructed canals that soon interrupted most water traffic when the tide was low. French observers generally saw such areas as 'dead zones' because here the water stilled, and most deeper-hulled boats were forced to wait for the high tide to pass (Direction Générale des Travaux Publics, 1911, p34). In local society, however, such places were traditionally known as 'meeting points' (*giap nuoc*, or water interface). Inhabitants frequently built markets at these intersections of opposing currents because of low flow velocity.[3] The village of Thu Thua, located on a cut between the two branches of the Vam Co River, or the Phung Hiep floating market at a junction of seven canals were such places where people travelling from different places with different goods met to trade (Nguyen Hien Le, 1989, pp23–28).

This tidal ebb and flow of water in the delta was also an important source of clean water and fertile sedimentation. Especially in the four depressions discussed in Figure 8.1, if water in the fields was not routinely exchanged, high levels of acid sulphate would soon dissolve aluminium and iron ions and stunt plant growth. This condition was especially severe in newly established fields and along newly dredged canals, only relenting after three to five years of irrigation (Phong et al, 2007). To prevent the build-up of 'alum', farmers frequently exchanged water by draining water from the paddy, opening their bunds and letting water escape while the tide was out. When the tide rose again, freshwater from the river filled the ditches and returned clean water to the paddy. Nature provided a system of irrigation that required almost no extra labour and little organized cooperation between individuals and communities on shared waterways. Engineers, standing in one of the flattest deltas in the world, were sometimes blind to these local functions of terrain and micro-topography and confused by a tropical hydrology that was, to them, exotic; and those who did pay attention to the natural regulation of the river system were often forced to implement water control projects under political pressures (Nguyen Huu Chiem, 1994; Vo Tong Xuan and Matsui, 1998).

Why have local and state governments over the years continued to favour mechanical approaches to water management over projects that work off of the natural ebb and flow of the rivers (seasonally) and tides (daily)? In part, the answer stems from the modern global experience of a population explosion and agricultural intensification; however, a significant factor in the ways in which new technology became embedded in the Mekong Delta was the region's unique political ecology. The introduction of steam-powered dredging machines to the Mekong Delta in the late 1880s fit the political and technical needs of the colonial state by replacing thousands of labourers needed for traditional canal or dike projects. Through the monopoly enterprise that operated these machines, the colonial state also ensured that most of the money spent on this work benefited French interests rather than local ones.

This colonial pattern of funding and organization of infrastructure projects continued into the 1960s as the US Agency for International Development

(USAID) replaced colonial agencies and continued support for big-ticket purchases of US-made equipment, such as a fleet of new diesel-powered dredges eventually operated by US construction firms undertaking no-bid development contracts. During the late 1950s, the US Operations Mission in Saigon even hired the old French dredging enterprise to operate its dredges and train new crews. Amidst frequent scepticism both in Saigon and Washington that such aid was merely enriching US and French interests at the expense of the waterway system, the US advisory mission in Saigon continued to call for more expensive equipment as the war intensified (Biggs, 2008). After 1960, US construction firms such as DMJM (now AECOM) and RMK-BRJ (now part of Halliburton) entered Vietnam to fulfil these development contracts to build highways, dredge canals and (after 1965) military bases. For reasons of security and politics in Washington, these firms typically worked with heavy diesel-powered equipment and they tended to propose projects that made use of these machines (Department of the Army, 1972, p133).

Again in the present era of rapid economic growth, concerns about the powerful influence of politically connected contractors over that of local water users have resurfaced, although the politics and technologies of construction have changed considerably. Their interest in capital-intensive methods is shared by hydraulic bureaucracies that seek to expand their budget and power and fulfil professional inclinations towards infrastructures. Infrastructure development plans in ecologically sensitive areas such as the Ca Mau Peninsula (Tuong, 2003) are often driven by planning and engineering departments in Hanoi and Ho Chi Minh City, with the sole goal of increasing export rice production; however, construction at different levels is often shared between national, provincial and local firms. State companies typically build principle and primary canals, while secondary and tertiary canals are allocated to provincial firms and on-farm systems, to local firms and farmers themselves.

The following case study (Miller, forthcoming) on dredging politics in Luong Hoa Commune, Tra Vinh, illustrates that operation and maintenance of this 'mechanical' hydrologic system remains a deeply political issue involving complex negotiations between local government, outside construction firms and local water users. Irrigation infrastructure in the commune was initially developed under the Tam Phuong Project, with the assistance of Australian aid in 1985. Yet, from the late 1980s onwards (as the aid dried up), secondary and tertiary canals gradually deteriorated as a result of neglect of essential operation and maintenance (O&M) by the district irrigation enterprise and local farmers, respectively. Farmers were annoyed that the government did not properly fulfil its responsibility in maintaining the secondary canals, so they neglected the maintenance of tertiary canals. This made water access difficult for poor farmers who tended to have land far from canals or on higher land. Recently, 'public service labour' contributions (*lao dong cong ich*) have been phased out in favour of charging a fee and replacing manual dredging with the hire of mechanical dredgers to keep secondary canals

clear. Concerns continue with regard to the quality of work undertaken by different dredging companies, as well as (uncompensated) loss of individual farmers' land due to the placement of the dredged material on paddy fields. While most people preferred mechanical dredging to those dug by hand, many poor farmers could not afford the cash fee for canal dredging and wished to contribute labour instead.

This cash fee is just one of the many rising costs associated with water, which has increased considerably with the rise in oil prices due to people's reliance on diesel-powered pumps for irrigation. While these tensions were temporarily resolved by a recent large cash injection into development of irrigation by a Japanese aid project, they indicate continuing challenges between state and local authorities to find a long-term solution to high water costs and maintenance of irrigation infrastructure that ensures fair and efficient water access for small rice farmers reliant on timely water availability (Miller, forthcoming).

Looking at the flows of funding – especially the unusual infusion of cash from Japan in this case – and the actors involved, one issue not yet resolved is what safeguards exist to ensure that contractors respond to the needs of water users. Again, examining the past, historic records reveal that even 100 years ago, determining state and contractor liability to water users was a complicated subject for courts and administrative bodies. During construction of one of the first major colonial projects, Xa No Canal, a group of native landowners in 1901 brought a law suit against the government seeking indemnities for damages to land after a dredger cut the village off from the existing waterways. The matter, pitting a group of relatively wealthy and legally recognized Vietnamese landowners against the colonial Department of Public Works, eventually reached the desk of the Governor General in Hanoi in 1901, who decided the value gained in having property bordering the new canal outweighed the damages done through the destruction of existing irrigation structures (Nguyen Ngoc Chan, 1901). Since then, especially with Vietnamese independence and reunification, government accountability and response to local complaints have improved considerably; however, administrative mechanisms for resolving local grievances continue to lag behind local expectations.

One crucial reason why both resource managers and water users continue resorting to mechanical rather than adaptive 'fixes' to their problems is the endless need to maintain them once established, after settlements and activities have attuned to the changes induced by past constructions. A French inspector studying the colony's early plan to build new infrastructure in the delta in 1881 called such projects '*oeuvres de Penelope*' (works without end). Visiting the colony on a fact-finding mission in 1880 to 1881, Charles Combier assessed the colony's proposal to build canals and elevated railways throughout the delta and criticized the plans on numerous grounds, first on the ethical basis that funding for the projects was to come partly from state-controlled sales of opium and then on technical grounds as engineers had not yet solved the problem of hogs-back ridges – dredges would thus be constantly returning to clean silt out of the new canals (Combier, 1881).

When economic and political events after 1930 prevented the dredges from keeping up with their routine schedule of clearing channels, large portions of the irrigation infrastructure became degraded and many people abandoned such newly opened areas as the Ca Mau Peninsula, the Plain of Reeds and the Long Xuyen Quadrangle. Considering the story in Tra Vinh described above, replacing public service labour with mechanical dredging will likely require mechanical dredging in the future to maintain deeper channels; thus, by shifting the method of maintaining the waterways to construction equipment, the state and local authorities increase their dependence upon such firms in the future, making them vulnerable to the availability of heavy equipment, spare parts and changing fuel prices.

More crucially, the constant dredging of canals and drains, construction and maintenance of dikes and sluice/control structures, and consolidation or raising of embankments to face higher level of risks or coastal erosion translate into ever-increasing and non-ending financial costs. The nature of waterscape transformations is such that the state eventually has to cope with the maintenance of this hydro-agricultural 'machine' as people withdraw from earlier works and do their best to adapt to the new conditions that have been created. Thus, what has continued in the Mekong Delta is something French engineers such as Combier (see above) over a century ago worried would become an '*oeuvre de Penelope*': a work without end.

Efforts have been made to decentralize financial responsibility for O&M of irrigation systems; but many provincial and district agencies are barely able to cover the most basic maintenance works from local fees and taxes. Underpinning the entire irrigation system, its construction *and* maintenance is also a larger dependence upon aid from international agencies: aid which entails the imposition of agencies' own contingencies and requirements (such as the purchase of donor country equipment and software). As access to soft aid monies becomes increasingly difficult for Vietnam, funds for maintaining system efficiency are likely to be sourced increasingly from international loans, which transfers the debt burden to future generations. A crucial implication of past choices is the recurring costs for maintaining an ever-more complicated array of hydraulic works: from colonial power to (partly) people, then the state, then, more recently, to provinces, foreign aid and future generations. The challenge with increasing costs is to allocate this cost and the 'political game' is to shift it to other parties.

Local adaptivity and responses to disasters

While most of this chapter has considered state responses to issues of development and disaster response, this final section addresses the very important ways in which individuals have responded to adversity – social and natural – and to the constraints/opportunities brought about by large-scale state interventions, as well as the problems that this poses in a place governed by top-down policies.

Especially in the current era of market liberalization, historic disconnects between individual action and state projects continue to inform present-day conflicts. Those disgruntled by the government's inability to provide suitable water infrastructure can refer back to a long history of negative experiences with state authorities that did little to support farmers' needs and, instead, encouraged settlers to clear forests and drain swamps. French historian Pierre Brocheux describes how colonial land policies and the all-consuming demand for wood to supply the need for steam engines produced what he terms a colonial frontier society in the delta. Individuals followed in the wake of the steam dredges, unloading their sampans (*ghe tam ban*) with tools, supplies and basic building materials. They built huts, burned down sections of the forest beyond, and began the back-breaking work of clearing stumps and forming fields. Once land was cleared and agriculturally productive, however, they often found that landlords had already claimed rights to the land. They then either left to clear new unclaimed lands or else worked out some tenancy arrangement (Brocheux, 198, p123). As economic and social conditions for farmers worsened with the Great Depression after 1930, many living in marginally productive, flood-prone areas joined the nationalist campaigns of the Indochinese Communist Party, forming protests that called for lower interest rates, food for the starving and land to the tiller.

Dissatisfaction with state action continued after independence, with many of the policies followed during 1975 to 1986, notably attempts to collectivize production and redistribute land, causing considerable hardship on the population. State authorities confiscated much of the privately held machinery for ownership by collectives and sent many thousands of people to dig new canals and build dikes by hand. Both collectivization and required labour were met with widespread resistance as many farmers refused to put the requisite care into water management and growing crops. Since the *doi moi* reforms in 1986, much of this resistance has subsided as the state government now tends to side more with large private development interests. The relationships between the state and the citizenry have therefore had a significant impact upon the way in which large-scale transformations of the landscape and local adaptation by rural populations have been interrelated and mediated. As this section shows, farmers have responded to economic pressure and waterscape transformations by counterstrategies, coping behaviours, opportunistic adjustments and innovations.

Past responses to social disasters, such as the destruction caused by the Indochina Wars, and natural disasters such as floods have had far-reaching effects on water management. Life in marginally productive acid-sulphate soil and flood-prone areas such as the Ca Mau Peninsula and the Plain of Reeds, held as 'cradles of the revolution', illustrate people's capacity to adapt to extreme conditions. U Minh's forests, for example, served for decades as an important base area for revolutionaries and guerrillas, which resisted repeated efforts by French, US and South Vietnamese military forces to drain and penetrate the swampy terrain using armoured dredges, napalm, Agent Orange (a powerful herbicide and defoliant used

by the US military in its Herbicidal Warfare Programme during the war), and B52 aerial bombing strikes. They built submerged barriers in the canals and creeks and waited at key bottlenecks to ambush French vessels. French forces, in turn, used flamethrowers and incendiary bombs to burn away the forest and French aircraft repeatedly bombed the earthen dams that the Viet Minh militias built in efforts to maintain the swamp forests. In his history of one base in U Minh Forest, Bui Van Thanh (1997) recognizes the role that such barriers played in protecting the base; the larger dams required hundreds of labourers working in often dangerous conditions to repair them.

Throughout most of the Second Indochina War (1959 to 1975), the floodplains and wetlands remained under the control of the National Liberation Front. Farmers living in these 'free fire zones' were routinely subjected to aerial bombardment and strafing; but they managed to develop a kind of extreme survivor mentality that required almost constant adaptation to changing environmental and social conditions. In 1971, after three years of intense US and Vietnamese bombing campaigns and operations in the base areas, one US survey estimated that roughly 63,000 people living in the U Minh Forest had fled their homes to request government assistance and relocation. Travelling in the Ca Mau Peninsula, the American provincial advisor to the survey described the waterways as 'wall-to-wall boats' where families had brought on their sampans stores of food, house frames and all personal belongings to re-establish homesteads elsewhere. Perhaps most interesting in the report was the general observation that the overwhelming majority reported that living conditions under National Liberation Front (NLF) in the flooded lands were 'reasonably good'. It was only the intensified combat and bombing that forced them to move (Pacification Studies Group, 1971).

The same individuals who, in their support for the Vietnamese Revolution, performed heroic measures to maintain flooded wetlands and swamps could not, however, as civilians or leaders in the post-war era control the actions of park managers or thousands of settlers hungry for land (Biggs, 2005). People in such severely flooded areas as Tam Nong District in the Plain of Reeds had traditionally practised flood season cropping of floating or deepwater rice in combination with wild-capture fisheries. While such systems accommodated often volatile environmental fluctuations in flood cycles, they became increasingly unable to support the growing population densities in the post-war period as tens of thousands of new migrants settled into these areas despite their susceptibility to flooding and marginal productivity. In the spring dry season of 2002, over 8000ha (roughly half) of one of the last remnants of cajuput mangrove and peat swamp in the U Minh forest area burned out of control (Sanders, 2002, p113). This points to the intense pressures of economic growth on the whole country where people had to find every way possible of increasing their immediate income to survive lest they become the 'poor' in society.

Although invasion and reclamation of marginal land is a response to economic needs, innovation has also provided a way out through intensification. Perhaps

one of the most important technological changes to occur in this period with longstanding effects on water management was the introduction of portable motors used for water pumping after 1960. Robert L. Sansom in *The Economics of Insurgency* (Sansom, 1970) describes how Pham Van Thanh, a former employee of the French dredging company in Saigon, accompanied a Republic of Vietnam (RVN) military engineer to watch a dredging project in progress nearby. Studying the old German and Japanese diesel engines powering the French dredges and the centrifugal pumps powering the newer US equipment, Thanh began experimenting with German-made impellers (reversed propellers to create suction, not propulsion) attached to the shaft of US-built engines sold as a 'shrimp-tail' boat motor. After developing a successful water pump, he sold, on average, 600 motors a month through Sansom's period of research in 1967. Sansom's interviews with farmers suggested a rapid farmer-motivated diffusion of the labour-saving devices even against the wishes of US, RVN and NLF authorities (Sansom, 1970).

Other innovations have included the spread of mobile pumping operators (large pump sets on boats) offering collective pumping services to groups of farmers in the upper part of the delta (Lienhard et al, 2001), the acclimation of shrimps to fresh/low salinity water, and the development of raised-bed techniques to cultivate vegetable or fruit trees on lands with clay soils and poor drainage. This technique is best developed in the intermediate zone that takes advantage of tidal management. It has allowed diversification out of rice and much higher land productivity in a context of declining per capita endowments. More generally, Figure 8.2 shows how these areas, close to the city of Can Tho, have historically shifted from one flood-adapted traditional varieties to triple rice-cropping and orchards (for further insight on historical changes, see Chiem, 1994; Tanaka, 1995; Xuan and Matsui, 1998; Le Coq, 2001). This evolution is the combined fruit of landscape transformations, external innovations (e.g. high-yield rice varieties), and farmers' innovation. Similar changes unfolded in other agro-ecological parts of the delta, including the flood-prone areas of An Giang Province, where floating rice gradually disappeared in the 1990s due to works in dredging, diking, excavation of secondary canals and land levelling (Lienhard et al, 2001).

In other cases, farmers have worked to reverting negative effects from state projects. Coastal polders built by Nippon Koei Co (1966) during the 1960s resulted in severe drainage problems that were mitigated by farmers inside the area using an estimated 1000 portable water pumps to individually move water in or out of their fields. More recently, larger-scale water-control schemes funded by national funds and World Bank loans (in O Mon-Xa No, Quan Lo Phung Hiep and South Mang Thit) built during 1994 to 2001 for similar water-control objectives have faced identical problems of stagnant water, insufficient through-flow of freshwater into the system during the dry season, and inflexibility to multiple water uses, underlining the continuity of historical problems in contemporary settings (World Bank, 1999).

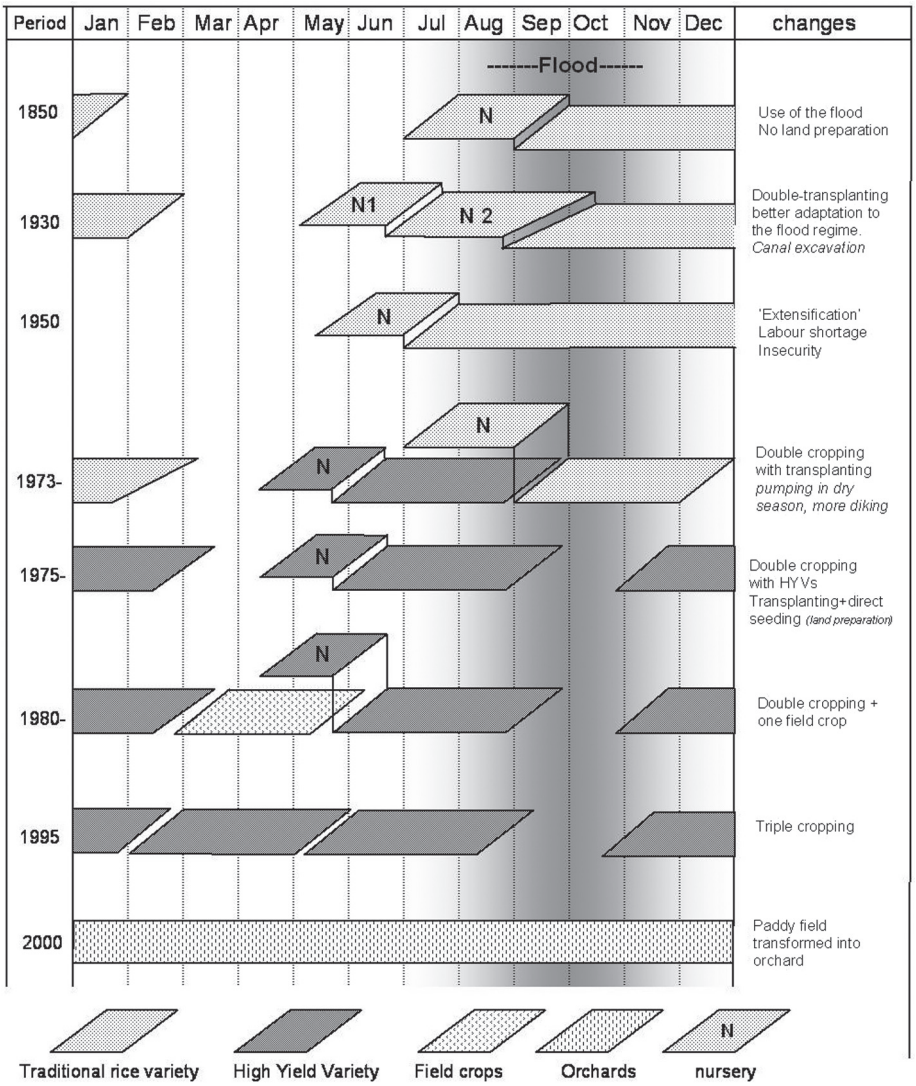

Figure 8.2 *Changes in cropping patterns in the tidal management zone of the delta*

Source: Adapted from Le Coq (2001)

In still other cases, farmers have fiercely resisted environmental changes resulting from state projects. For example, in February 2001, farmers in Bac Lieu Province broke the new Lang Tram salinity-control sluice dam that was planned to close off an area for rice production, while many farmers had already opted to take advantage of salinity and shifted to raising more profitable shrimp instead (Hoanh et al, 2003b). The state was not sufficiently flexible to respond to changing market

demands and local desires, thus illustrating the main conflict between adapting to natural resources versus resisting and controlling natural forces to achieve ends conceived by state officials.

What these historical events suggest is, first and foremost, the intense determination of farmers to adapt to local environmental adversities independent of local or state authorities. The reasons for this common resistance to state-initiated projects, such as coastal dikes in the present, are complex; but in many cases they appear to be informed by deep historical distrust between farmers and state authorities over the best ways in which to 'improve' land, and high ingenuity and capacity of responding quickly to adversity. While such individualist approaches were key to survival during the wars and in times of natural disaster, they nevertheless pose new problems in post-war water management strategies. What appears to be lacking most in the present are the means for farmers and others directly involved in managing the delta's water resources to be involved in contemporary decision-making processes typically dominated by the state. So long as large projects such as coastal dikes or enclosed irrigation districts are conceived without this participation, it is likely that farmers will continue to act independently to realize higher levels of productivity regardless of the environmental consequences or implications for other resource users.

Conclusions

Returning to this chapter's objective to establish the usefulness of employing a critical historical perspective to better understand challenges to contemporary water management issues, there are two main ways in which historic events continue to influence contemporary decision-making processes in the Mekong Delta. First, there is a phenomenon of what might be called *institutional inertia*, where past institutional arrangements such as the reliance on private contractors to carry out public works since the 1880s have continued to shape the form of state decisions ever since. This first happened immediately following the formal end of colonial rule in 1954 when old French enterprises continued to carry out public works construction to 1960. Besides the political motivations for continuing this mode of public works with the lobbying interests of entrepreneurs and the large sums of money involved in securing foreign development loans, the bureaucracy formed around hydraulic works also became an entrenched power vying for its reproduction. Second, there is also a corresponding *physical inertia* in terms of the historic built landscape and aging technology that works against propositions to make major changes in water resource strategies. As the colonial inspector noted in 1880, past works such as canals and coastal dikes have become 'works without end' that require continuing attention to maintain them against rising sea levels, changing river conditions and fluctuating fuel prices. Entire communities have become dependent upon artificially maintained water levels, and it would be

technically and politically difficult, if not unfeasible, for state leaders to require people living in such areas to become 'friends with the flood',[4] particularly now that with more valuable assets they are physically much more vulnerable to their impacts. In sum, institutional and infrastructural path-dependency makes it close to impossible to remedy the past transformations of the waterscape.

However, in the more environmentally hazardous zones such as the Plain of Reeds and the Ca Mau Peninsula, where communities have always lived more on the edge separating prosperity from any number of natural and manmade disasters, perhaps there are more opportunities for state authorities to experiment with alternative small-scale and adaptive strategies for coping with fluctuating environmental conditions and, at the same time, maintaining more stable economic and social conditions. The willingness of many to switch from rice cultivation to aquaculture and the historic ingenuity of local people to evolve suitable and affordable technologies suggest that there may, in the future, be new economic and environmental opportunities to be gained from promoting rather than resisting such actions. Especially in these areas, there are numerous opportunities for developing new models of co-management. Sansom's (1970) story above of one inventor highlights both the rapidity with which delta farmers adopt a technology once proven and the enormous sums of money to be made, with no government subsidies involved, through the creation of new small-scale technologies. As the constant buzzing of gasoline and diesel-powered boat engines and the crowded rivers of road traffic today attest, the Mekong Delta today is already a richly productive, vibrant zone increasingly shaped by local entrepreneurs and increasing access to foreign capital.

Although living conditions have improved dramatically in the Mekong Delta as in other river deltas, the growing threats of climate change, closing agricultural frontiers and urbanization require new efforts to maintain standards of living and to avoid future catastrophes. Yet, the financial implications of the need to maintain and protect the 'delta machine' are awesome and the distribution of attendant costs has become a central issue of current politics, in general, and of the decentralization process, in particular. Given the physical and institutional inertia of the past, it may not be possible to completely escape the problems associated with aging infrastructure and old ways of doing things. New methods for democratizing water resources policy-making through state-local co-management are needed. These contemporary issues are not unique to Vietnam and the Mekong Delta, but may be found in other river deltas around the world. In the Mississippi Delta, for example, the US government is faced with similar problems in its efforts to rebuild the protective levee infrastructure around the city of New Orleans and to prevent further subsidence of the delta into the sea. The devastation wreaked by Cyclone Nargis in May 2008 in the Irrawaddy Delta in Myanmar is also a further reminder of the deeply political and social nature of disasters and their aftermath. By employing a more critical historical perspective on such issues, it may be possible to gain a clearer sense of both the institutional cum physical

inertia that informs such decisions and possibilities that may exist for tapping into the incredible resourcefulness and ingenuity of people who have for decades had to adapt with little government support. By finding ways to incorporate local water users into water resource management and, at the same time, to respond to changing environmental conditions, it may be possible for Vietnam – which relies so heavily on the Mekong Delta for food and commerce – to achieve more stable economic and environmental security.

Notes

1 One of the most comprehensive descriptions of the ancient material culture in the delta is provided by Malleret (1959, vol 1, pp27–33) who gives an excellent discussion of ancient hydraulic infrastructure and pre-Angkor settlements near present-day Chau Doc and the Vinh Te Canal.
2 Efforts have, instead, focused on dam construction and water diversions on major tributaries in southern Laos, northern and north-eastern Thailand, Central Vietnam and, more recently, Cambodia.
3 Since the conversion of domestic boat traffic from sail- and oar-powered to motorized vessels in the mid 1900s, the largest markets today are now located at the junctions of large canals and major rivers.
4 During the past years the government has adopted a strategy called *Living with Floods* (Thanh Lam, 2008). However it is apparent that the strategy merely emphasizes better preparedness and early warning, not a change in philosophy.

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