

**Asia-Pacific Environmental Innovation Strategies (APEIS)
Research on Innovative and Strategic Policy Options (RISPO)
Good Practices Inventory**

**Sustainable traditional coastal resource management (shrimp harvesting):
Gei wai at Mai Po and Inner Deep Bay Ramsar Site, Hong Kong, China**

Summary of the Practice

Keywords: Coastal resource management; local/indigenous knowledge-based management; biodiversity conservation

Strategy: Promoting local/indigenous knowledge-based sustainable resource management

Environmental areas: Ecosystem and biodiversity conservation; rural environment; water resources management

Critical instruments: Design, planning and management, organisational arrangements, partnerships

Country: China

Location: Mai Po and Inner Deep Bay Ramsar site, Hong Kong, China

Participants: Non-governmental organization; individual local people; local authority

Duration: 1993-present

Funding: Non-governmental organization; local government

Background:

Wetlands in China contain valuable biodiversity resources but they have increasingly suffered from the pressure of development. The area of wetlands in China has decreased rapidly in the past three decades in particular and their productivity and ecological function significantly reduced. One estimate suggested that 40 percent of the country's most important ecosystems were threatened by degradation, with coastal provinces reporting the heaviest losses: Over the past three decades, for example, Hainan's mangrove area was reduced by 52 percent; in Guangxi it was cut by 66 percent; and in Guangdong it was drastically diminished by 83 percent.¹ The destruction of the natural ecosystems not only affects their productive capacity but also has major impacts on biodiversity because the habitats of animals and plants are destroyed along with the deterioration of the ecological environment.

The reduction of mangrove forests has been caused by three major factors: enclosure of coastal waters for farmland (in the 1960s) and for aquatic tanks (in the 1980s); industrial pollution associated with the proliferation of coastal projects since the 1980s; and mangrove deforestation for the production of timber and firewood. These threats have remained unresolved, despite the promulgation of policies and regulations by the Central Government that highlighted the importance of maintaining biodiversity conservation. In many coastal areas, there are clear conflicts between the Central Government's emphasis on the need to improve the maintenance and protection of wetlands and the local authorities' priority in sponsoring development projects to help secure local food security and promote economic growth.

Between the time that China became a contracting party to the Ramsar Convention in July 1992 and the end of 1999, the number of wetland natural reserves has increased to 260. Among them, seven nature reserves have been recognized as Internationally Important Wetlands, and the Mai Po Marshes Nature Reserve in Hong Kong is one such site. The Mai Po reserve covers an area of about 1,500 hectares and comprises of intertidal mudflat, mangrove forest, tidal aquaculture ponds and freshwater fish ponds

¹ Pei, Xiaofei and Li Diqiang, 2001, "Ecological Protection in China," background paper prepared for the World Bank, which is included in the CD-ROM of a book entitled *China, Air, Land, and Water; Environmental Priorities for a New Millennium*, Washington, D.C., The World Bank, 50 pp.

along the Deep Bay coast in the northeastern part of Hong Kong (Figure 1a).² It was, in 1976, designated by the then Hong Kong colonial government as an SSSI (Site of Special Scientific Interest) and then declared a Ramsar site in 1995. The reserve consists of an outer mangrove belt and an inner stretch of ponds enclosed by earthen dykes (known as *gei wais*) (Figure 1b). These *gei wais* are important feeding, breeding and wintering grounds for both migratory and resident birds who feed on the mudflats exposed at low tides.³ The Mai Po marshes are of particular interest to botanists because they contain the widest range of mangrove genera of any site in Hong Kong.

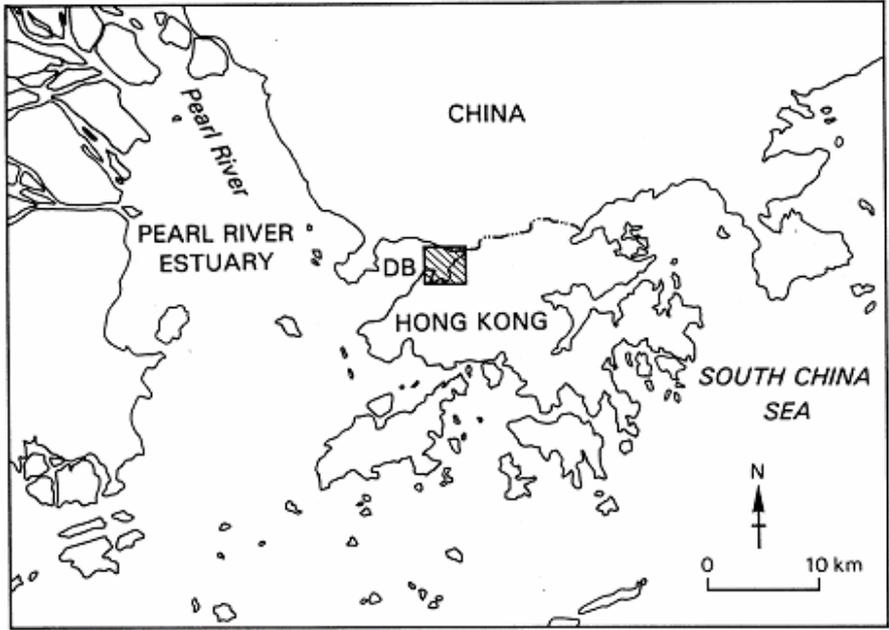


Figure 1a
Location of Mai Po Reserve

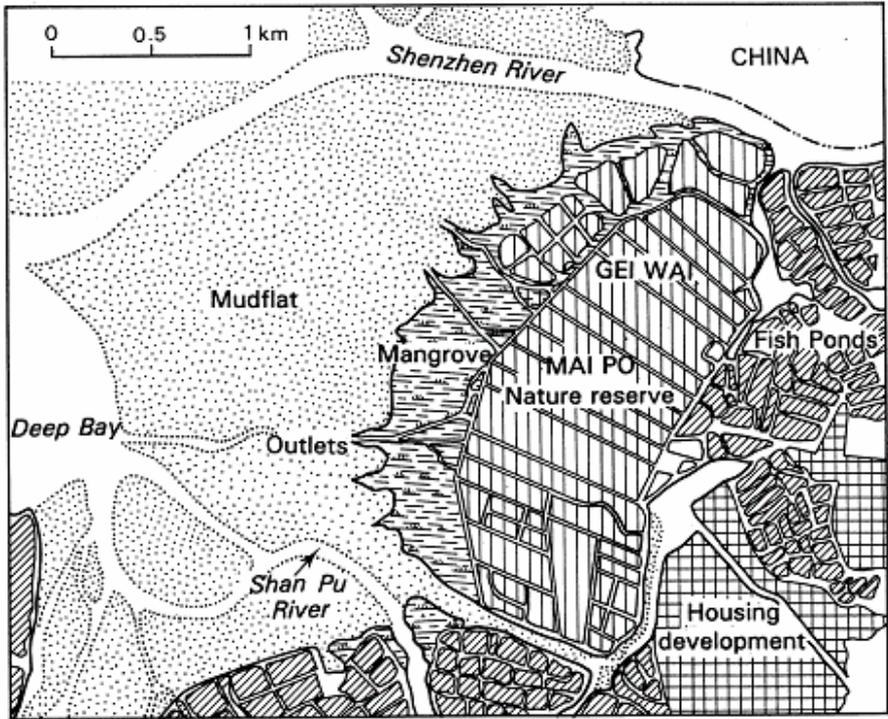


Figure 1b
Land use pattern in and near
Mai Po Reserve

² Li, M.S. and S.Y. Lee, 1998, "Carbon Dynamics of Deep Bay, Eastern Pearl River Estuary, China. I: A Mass Budget and Implications for Shorebird Conservation," *Marine Ecology Progress Series*, Vol. 172, pp. 73-87.

³ Lai, D. C-Y., 1979, "The Mai Po Marshes in Hong Kong: Speculative Development versus the Environment," *Pacific Viewpoint*, Vol. 20, No. 1, pp. 74-84. About 80 percent of some 380 species recorded in Hong Kong are migratory or wintering birds.

Objectives:

Gei wais are traditionally managed intertidal shrimp ponds. They are built in coastal wetland areas and their operation is carefully designed to minimize adverse impacts upon the environment. At the Mai Po and Inner Deep Bay Ramsar Site in Hong Kong, a series of intertidal shrimp ponds were first constructed in the 1940s in the coastal mangroves. During the 1970s, the sluice gates of some of these *gei wais* were blocked and the ponds converted into fish rearing areas because fish were commanding a higher price than shrimp at that time and also because the water quality of Deep Bay was in decline. Nevertheless, in the mid-1980s, *gei wai* shrimp farming became profitable again and the blocked sluice gates were re-opened.⁴

This type of environmentally sound shrimp cultivation and harvesting is commonly recognized as a sustainable coastal resource management system that has been successfully implemented in the southern part of China and several other countries of southeast Asia such as the Philippines and Indonesia. The practice, however, is now vanishing rapidly due to increasing pressure from coastal area development projects designed for industrialization and urbanization purposes. In the case of Mai Po, a non-governmental organization (NGO), the World-Wide Fund for Nature Hong Kong (WWF Hong Kong), with the consent of the Hong Kong government, took over the active management of the site and implemented a preservation program which effectively turned it into an educational site in 1993.

Description of the activity:

Each *gei wai* pond is a rectangular impoundment with drainage channels and remnant mangrove stands. There are about 240 hectare of *gei wais* in operation, each with an average area of 9 to 10 hectare. The operation of the *gei wai* at Mai Po has traditionally relied on the supplies of natural shrimp larvae/post-larvae from Deep Bay for stocking and fertilizers. Therefore, the successful operation of the *gei wais* is highly dependent on the command of traditional knowledge such as the timing of the occurrence of shrimp larvae and post-larvae. A sluice gate was built into each of these ponds to allow water exchange and the entry of prawn larvae from Deep Bay. Young shrimps flushed into each *gei wai* by strong currents stemming from large tidal range in the spring tide period are fed only natural food, e.g., leaves of mangrove planted in the *gei wais*. Shrimp harvesting is conducted at night time between April and November. With water in the *gei wai* maintained at a high level by prior spring tide flooding, the removal of the sluice board in each pond led to a draining current which carries the shrimps toward a net placed across the sluice gate. The draining current is carefully controlled to allow effective flushing of the shrimps but not to injure those already caught. Any undersized shrimp are returned to the *gei wais*. That is, the success of *gei wai* operation also relies on a good command of the timing of flooding and draining, which is again derived primarily from a base of traditional knowledge.⁵



Gei Wai Shrimp Cultivation Practice, Mai Po, Hong Kong, China ©Takashi Otsuka, IGES

While the *gei wai* system has been revived and put into active practice in the Mai Po and Inner Deep Bay Ramsar Site by WWF Hong Kong, it was no longer maintained as a major source of local livelihood but primarily as a tool for environmental education and training. Moreover, the *gei wai* landscape has also been increasingly recognized as a precious habitat for water birds and other wildlife. Notwithstanding its status as a protected site, however, much of the traditional landscape and sites of ecological significance in Deep Bay have, in recent years, come under increasing pressure emanating

⁴ Young, L., 1999, "Mangrove Distribution in the *Gei Wais* at the Mai Po Marshes Nature Reserve," in Shing-Yip Lee, Editor, *The Mangrove Ecosystem of Deep Bay and the Mai Po Marshes, Hong Kong*, Hong Kong, Hong Kong University Press, pp. 117-130. In the early 1990s, there were 24 *gei wais* being maintained on a total of 17.5 ha of mangrove in Mai Po.

⁵ Lee, Shing-yip, 1988, *The Ecology of a Traditional Tidal Shrimp Pond in Hong Kong, the Production and Fate of Macrodetritus, and Implications for Management*, unpublished PhD thesis, Hong Kong, The University of Hong Kong, 321 pp.

from land-use changes associated with urban growth and related infrastructure projects. The water quality in Deep Bay has continued to deteriorate as a result of increasing pollution associated with the discharge of agricultural wastes, domestic sewage and industrial effluent, primarily coming from the city of Shenzhen and secondarily from Hong Kong. The long-term viability of the Mai Po reserve is also threatened by over 30 major development projects proposed by developers based in Hong Kong alone.⁶ Moreover, the pressure on the reserve will in all likelihood escalate further as the economy in the Pearl River Delta continues to grow, leading to increasing land-use changes in its vicinity due to urban development and associated infrastructure as well as an increasing volume of cross-border traffic between Hong Kong and jurisdictions across the border. All of these development trends may translate into a reduction of the ecological value of the Mai Po reserve if they are not actively guided and controlled by the local authorities.

Critical Instruments

Design, planning and management

The conservation value of the Mai Po marshes is both locally and internationally recognized. From an operational perspective, the *gei wai*, constituting the bulk of the marsh area, requires careful design and management in order to sustain the quality of this important wildlife habitat because it is derived by artificial diking and channelization of the indigenous mangroves. In this semi-artificial system, several elements have to be carefully managed to govern the proper functioning of the habitat: (i) the landscape of the *gei wai*—which includes the type and composition of vegetation cover, the interaction between water and land, and the ratio of open water to vegetated areas; (ii) water quality—which strongly affects *gei wai* secondary productivity as *gei wai* relies on incursing water for larval stocks of commercial species and organic matter subsidy; (iii) traditional management protocols—which pertains to water level management and flooding frequency; and (iv) the interplay between fishery and conservation objectives.

From a broader planning and managerial perspective, while the *gei wai* system has been revived and put into active practice in the Mai Po and Inner Deep Bay Ramsar Site by WWF Hong Kong, it was no longer maintained as a major source of local livelihood but primarily as a tool for environmental education and training. Every summer, during the shrimp harvesting season, WWF Hong Kong organizes specially guided tours to allow the public an opportunity to see how *gei wai* shrimps are harvested and to learn about this unique form of land-use, which is part of Hong Kong's traditional coastal heritage.

Organisational arrangements

Protection of coastal natural resources and fragile environments requires the government to implement planning and zoning through integrated coastal area management, environmental impact assessment, and monitoring and mitigation of pollution. It also requires the government to promote and undertake ecologically sound farm management techniques, conservation of mangroves and institute effective regulatory and institutional frameworks. In the case of Mai Po, the Hong Kong government, urged by prominent environmental groups, designated the marshland site in 1976 as a Site of Special Scientific Interest. Started in 1985, the Mai Po nature reserve had been managed by a WWF Hong Kong, which assumed a custodian's role and organized an education programme to help promote its conservation efforts among the general public. With three full-time education officers and an army of about fifty voluntary, part-time guides, WWF Hong Kong received an average of about 35,000 visitors every year. Of these, about one-third were primary and secondary school students visiting the area as part of their class or extracurricular activities. In 1993, the government then formalized an agreement with WWF Hong Kong to allow the latter to take active management of the site and implemented a comprehensive preservation program.

⁶ Chan, Chung-san, 1997, *The Future of the Deep Bay Wetlands*, unpublished MSc thesis, Hong Kong, The University of Hong Kong, 115 pp.

Such an arrangement is innovative because the Hong Kong government in effect hands over the responsibility of management of a piece of public land of immense conservation value to an NGO for the purposes of protecting and preserving both endangered species and an indigenous method of coastal resource management. The NGO, in turn, relies on the goodwill of and donations from the public and the corporate sector to finance the day-to-day operation expenses of the Mai Po nature reserve.

Partnerships

With regard to the long-term viability of protected wetland sites such as Mai Po, the role of the government is the most crucial in terms of reinforcing planning and zoning measures through integrated coastal area management, implementation of environmental impact assessment, monitoring and regulation of pollution sources. To ensure the optimal and sustainable use of coastal natural resources and a high level of biodiversity and conservation of critical habitat, the government has to play a proactive role in promoting and undertaking ecologically sound farm management methods. At the same time, as demonstrated in the discussion of the institutional arrangement of the Mai Po nature reserve site, it is imperative that the major stakeholders be involved as partners in the process of reaching a consensus on the need to protect the wetland site as well as establishing a common operational framework to manage the site properly for conservation purposes. The partnership structure formed between the Hong Kong government and WWF Hong Kong aptly reflects a high degree of mutual understanding and trust between the public sector and the voluntary sector, allowing both parties to concentrate their respective efforts to achieve the common goal of conserving an ecologically important coastal resource.

Impacts

Gei wai shrimp cultivation has been practiced in Hong Kong for over sixty years without creating any social conflicts or adverse environmental impacts. Although the harvest yield is relatively low, the *gei wai* operation has been studied by university researchers and found to be sustainable over a long period of time.⁷ The modus operandi of *gei wai* is proof that indigenous people have developed their own effective “scientific” method to utilize natural resources and to live in a sustainable manner within the mangrove system.

For instance, the impact of aquaculture on the environment is primarily related to issues of feed management, with overfeeding the most common cause of such problems. Even the best pellets lose about 20 percent of their protein and most of their other nutrient contents within the first hour of immersion, leading to increased organic load that worsens water quality and causes harm to the shrimps. The *gei wai* system has the advantage of maximizing the use of natural food. Evidence has been generated to show that highly intensive closed systems such as the *gei wais* may offer the shrimps a wide variety of natural organisms for food. The introduction of natural food into the practice of modern aquaculture, as demonstrated by the *gei wai* system, could help reduce the protein content of feeds, improve the food conversion ratio, and reduce the operating costs of shrimp farms, given that feeds sometimes amount to half of their total operating expenses. Moreover, whereas the widespread use of chemicals in some parts of Asia has led to mortalities and morphological deformities in shrimp larvae, *gei wai* operation has been found to be immune to large-scale diseases and infections.

Lessons Learned

Traditional *gei wai* practice has been proven to be an environmentally friendly and sustainable aquaculture method because it helps reduce stocking density, which improves water quality, avoids over-feeding and the misuse of chemicals, and provides natural food for the shrimps. Research has suggested that the eco-cultural principles associated with traditional methods of utilization of natural

⁷ Ku, Wa, 2001, *Is Mai Po Gei Wai Shrimp Cultivation Sustainable? A Comparative Study with a Commercial Shrimp Farm*, unpublished MSc thesis, Hong Kong, The University of Hong Kong, 54 pp.

resources could be successfully adapted to larger-scale operations, provided that extra efforts are put into research and testing. Additional resources, however, are needed to help conduct further research and development to understand how important eco-friendly principles associated with the traditional, sustainable models could be incorporated into modern aquaculture production processes at the commercial level.

With regard to the long-term viability of the protected wetland sites such as Mai Po, the role of the government is the most crucial in terms of reinforcing planning and zoning measures through integrated coastal area management, implementation of environmental impact assessment, monitoring and regulation of pollution sources. To ensure an optimal sustainable use of coastal natural resources and a high level of biodiversity and conservation of critical habitat, the government has to play a proactive role in promoting and undertaking ecologically sound farm management methods.

Potential for Application

In recent years, government planners and environmental groups from the Asia-Pacific region as well as other parts of China have visited Mai Po to learn about its experiences and lessons. The research team intends to extend this study to areas where similar practices are still being used so that a comparative analysis could be conducted with Mai Po's case to help identify the necessary social, economic, political and institutional measures for reviving, preserving, promoting, and applying LINK (local/indigenous knowledge)-based sustainable resource management to coastal areas in other parts of the country.

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