Integrating Natural and Cultural Heritage in Urban Transitions:

The Case of *Gei Wais* in Mai Po Wetland and San Tin Technopole, Hong Kong

1. Introduction

In twenty-first-century urban development planning, heritage conservation and environmental governance have become integral dimensions, particularly in response to the growing pressures of market-driven exploitation of heritage, mass tourism, and climate change. To safeguard both natural and cultural assets, it is essential to integrate historic urban area conservation, management, and planning techniques into local development strategies and urban planning frameworks, especially given the pace and often unregulated nature of urban expansion (UNESCO, 2011). International organizations have undertaken a range of initiatives to advance this shared agenda. For instance, the World Heritage Convention (WHC), adopted by the United Nations (UN) in 1972, has linked the protection of cultural and natural heritage while establishing obligations for its 196 State Parties (World Heritage Convention, 2023; 2024). Similarly, the World Bank issued its *Environmental and Social Framework for Investment Project Financing (IPF) Operations* in 2018, identifying as one of its objectives "to address cultural heritage as an integral aspect of sustainable development". The European Union (EU) also launched the *European Framework for Action on Cultural Heritage* in 2019, concluding the *European Year of Cultural Heritage* (2018). This framework stresses the risks facing heritage and proposes measures such as enhancing resilience to natural disasters through conservation-based approaches (European Parliamentary Research Service, 2024). Collectively, these initiatives underscore the global recognition of the need to preserve both

natural and cultural heritage as a cornerstone of sustainable urban development.

However, despite this global momentum and growing joint efforts, there remains a lack of case studies offering concrete guidance on how cities can effectively integrate natural and cultural heritage conservation. While international frameworks provide overarching principles, local contexts often lack detailed models that translate these into actionable practices. This gap is particularly pressing in rapidly urbanizing regions, where the tensions between development, cultural identity, and ecological sustainability are most acute.

Against this backdrop, the present study examines the Mai Po Wetland in Hong Kong as a focused case, considering both ecological and cultural dimensions. By analyzing conservation practices on these fronts, the study seeks to identify areas of convergence among diverse stakeholders that may strengthen heritage preservation in future urban and rural contexts. Moreover, by assessing existing collaborative and innovative governance approaches, this research aims to embed natural and cultural heritage conservation within ongoing urban development agendas, thereby contributing to a more substantive green transition in Hong Kong and, by extension, other cities.

2. Case Study: Hong Kong’s Context and Research Questions

Hong Kong is located on the southern coast of China, at the mouth of the Pearl River flowing from Guangdong Province into the South China Sea. The city's subtropical climate is marked by distinct seasonal variations, while the western waters are estuarine owing to the Pearl River discharge (Lenderink et al., 2011). Geographically, more than 95 percent of Hong Kong's land

boundaries are surrounded by the sea, encompassing approximately 1,640 km^2 of territorial marine waters contributed by over 250 islands. Although Hong Kong covers an area of 1,114 km^2, flat land remains scarce and densely populated, particularly due to rapid demographic growth from the late 1960s to the early 2000s (Lands Department, 2025; Warren-Rhodes & Koenig, 2001).

As a global metropolis, Hong Kong is famous for its diverse natural and cultural resources. Its identity as a port city is closely tied to its abundant coastline (Barber & Chung, 2023), estimated at 462 km across the Kowloon Peninsula and New Territories, and 727 km around Hong Kong Island, Lantau Island, and numerous smaller islands (EPD, 2014). The abundance of coastal areas has historically supported the development of fishing and aquaculture. In the early twentieth century, approximately 3,650 people were distributed across 20 villages and hamlets, while another 2,000 fishermen lived aboard boats in sheltered harbors (Jones, 2022). Although local fisheries have declined since the 1990s, exacerbated by increasing seafood imports from Mainland China (AFCD, 2013), fishing culture continues to hold an enduring role in Hong Kong's social identity.

In addition to marine fishing, local fishermen developed the traditional practice of Gei Wais, or intertidal shrimp ponds, introduced to the northwestern New Territories in the mid-1940s (Hong Kong Intangible Cultural Heritage, 2021). Beyond its cultural value, Gei Wais carries critical ecological functions (Young, 2004), making it a unique heritage system of both cultural and natural significance.

Against this background, Gei Wais in Hong Kong provide a suitable case through which to investigate the following research questions:

1. How can more authentic transitions toward sustainable urban development be advanced through the integration of cultural and natural heritage conservation?
2. In what ways can integrated preservation strengthen community resilience, particularly when confronted with environmental challenges?
3. What objectives do different stakeholders-including government authorities, academics, civil organizations, and local communities-prioritize in urban heritage conservation? What innovative and cooperative governance strategies have emerged in relation to these projects?
4. Considering the imperatives of contemporary urban development, how can integrated conservation address existing challenges in urban planning and growth?

The subsequent sections of this study outline the research methodology, examine cultural heritage within designated natural conservation areas, and analyze current strategies for both natural and cultural heritage preservation. Building on these findings, the paper explores pathways for integration into future urban transitions. The concluding section proposes a collaborative model for multi-stakeholder engagement and reflects on the broader implications of Hong Kong's experience for other urban contexts.

3. Methodology and Research Aim

This study employs a qualitative research design, combining an extensive review of relevant documents with semi-structured interviews involving key stakeholders. The documentary review covers planning schemes, policy reports, governmental action agendas, academic

publications, and analytical commentaries from organizations. Semi-structured interviews, each lasting approximately 30 minutes, followed a pre-designed set of questions to ensure consistency while allowing flexibility to accommodate interviewees' expertise and professional backgrounds (Figure 1). The interviewees were carefully selected to represent diverse perspectives, including government officials, organizational representatives, social workers engaged in site-related initiatives, and local community members (Appendix I).

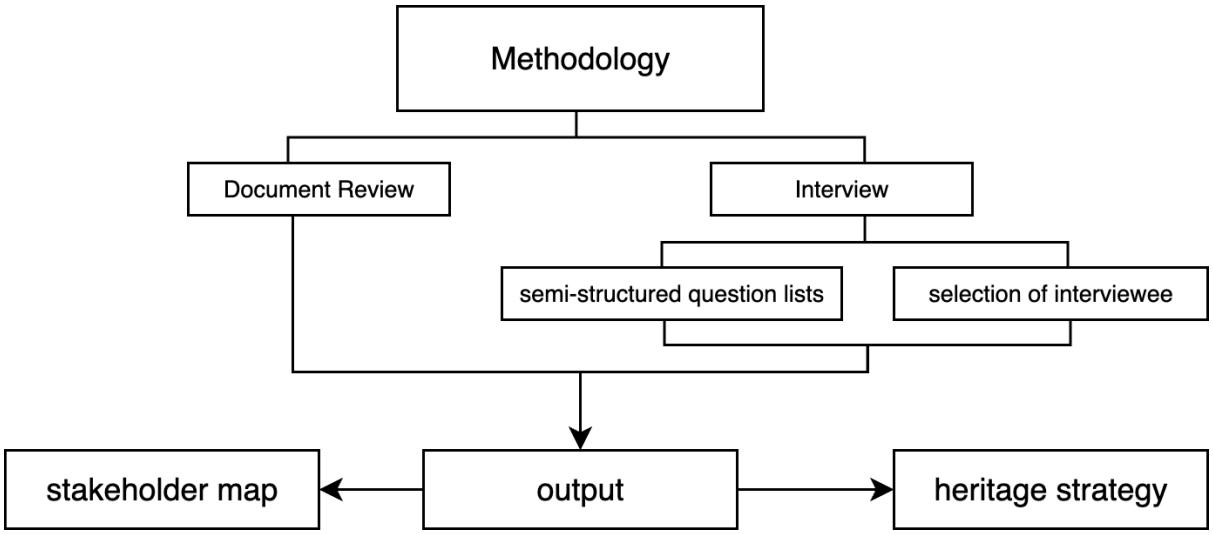

Figure 1: Methodology Workflow

This methodological approach enables the study to capture and synthesize feedback from all parties concerning current challenges, strategies, solutions, and priorities for the conservation of Gei Wais in the Mai Po Wetland, Hong Kong. The research outputs include (i) a stakeholder mapping that highlights interrelationships and opportunities for more effective cooperation, and (ii) a proposed "heritage strategy" with two aims:

1. To integrate Gei Wais into the urban design and development of the San Tin Technopole as a critical blue-green element.
2. To extract transferable knowledge on integrated natural and cultural heritage conservation

within built environments, thereby contributing to broader sustainability objectives.

4. Gei Wais in Mai Po Wetland

According to the Agriculture, Fisheries and Conservation Department (AFCD, 2025), aquaculture in Hong Kong is consisted of marine fish farming, pond fish farming, and oyster cultivation. In 2024, the sector produced 2,089 tons of output, valued at HKD 119 million. Currently, 1,119 hectares of fishponds are in operation, concentrated in the northwestern New Territories. *Gei Wais* (intertidal shrimp ponds), also located in this region, are comparable to fishponds but operate on distinct ecological principles. As explained by one of the interviewees (Michael Lau) and Cheung (2004), Gei Wais are tidal ponds that utilize the high productivity of estuarine environments for aquaculture, particularly in rearing shrimp and fish.

This aquaculture practice was introduced by immigrants from Mainland China in the mid-1940s and soon became the dominant form of land use and aquaculture production in the Deep Bay area until the 1960s. During the 1970s, however, Hong Kong's rapid urbanization spurred population growth and increased demand for freshwater fish, which were more affordable than marine species. Consequently, many Gei Wais were converted into freshwater fishponds, an artificial system that yielded higher productivity. Following the opening of Mainland China, the influx of cheaper imported fish into Hong Kong markets further undermined the viability of local operators, intensifying economic challenges. At the same time, the ecological role of Gei Wais declined markedly, particularly as roosting and feeding habitats for waterbirds (Wei et al., 2017).

Dr. Lau emphasizes that Gei Wais represent a cost-efficient and productive semi-natural system that harnesses tidal cycles while supporting rich biodiversity. These ponds are equipped with sluice gates— “the most important structure” —that connect directly to the sea. At high tide, fishermen open the gates to allow water containing shrimp larvae and fish fry to enter, enabling natural growth of shrimp, fish, and crabs by taking advantage of the estuary’s abundant food resources. At low tide, particularly during warm nights, fishermen harvest shrimp by netting them as they exit the ponds with the receding water (Figure 2)

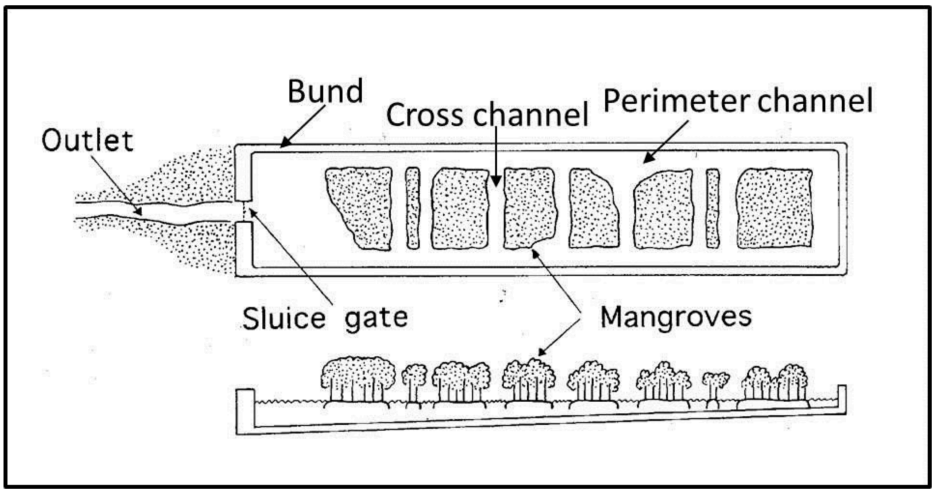

Figure 2: Structure of a gei wai
Source: Lord Wilson Heritage Trust, 2016

4.1 Discussion: Ecological Value

Within the Mai Po Nature Reserve (MPNR), which covers 380 hectares inside the Mai Po Inner Deep Bay Ramsar Site on the southern bank of the Pearl River estuary, 24 Gei Wais have been identified (Wei et al., 2017). Of these, 21 have been managed by WWF-Hong Kong since 1983 due to their exceptional biodiversity (Figure 3). The MPNR, together with the broader Ramsar Site, constitutes a critical staging and wintering habitat for numerous species of migratory waterbirds along the East Asian–Australasian Flyway, including several that are globally

threatened. Occupying approximately 70 percent of the Reserve's total area, Gei Wais play a pivotal ecological role (WWF-HK, 2024).

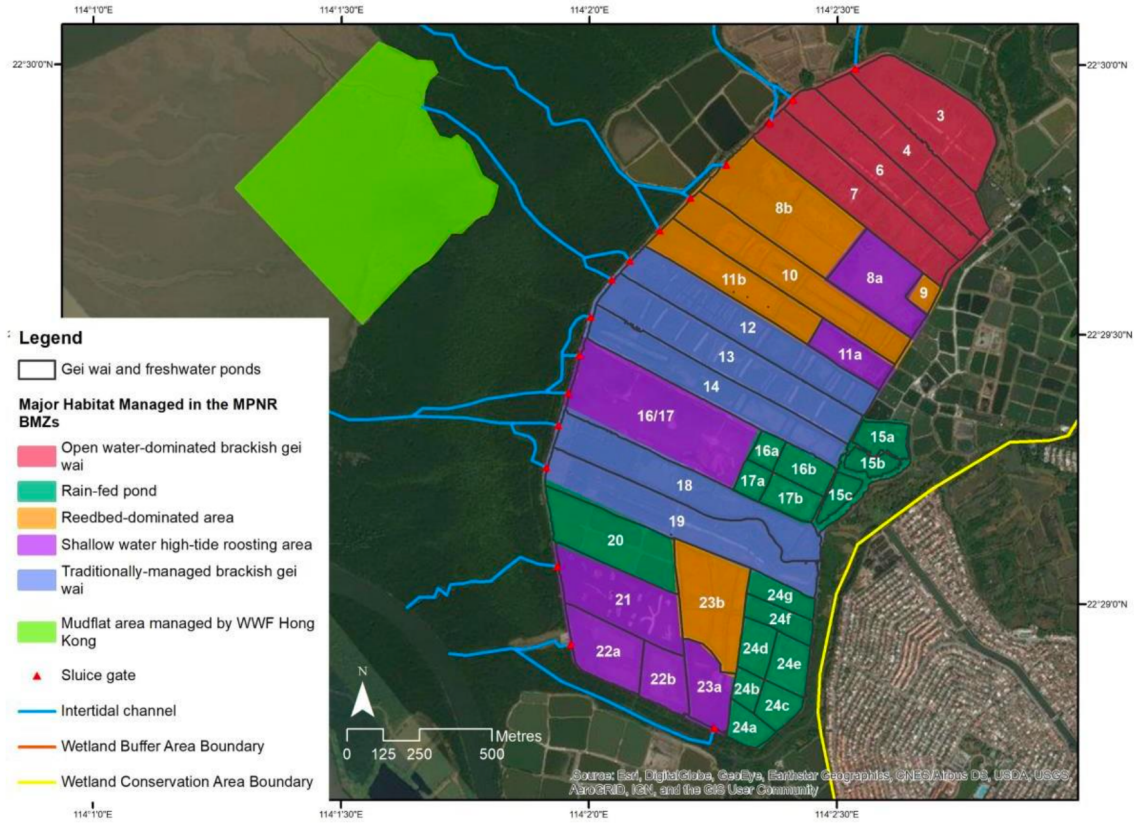

Figure 3: The gei wai and ponds in MPNR in 2024
Source: WWF-HK, 2024

According to WWF-HK (2024), the current MPNR management plan identifies two overarching objectives: (i) to sustain the traditional practice of Gei Wais operation as an example of the wise use of wetlands; and (ii) to serve as a regional hub for knowledge sharing, awareness-raising, and training in wetland conservation. These priorities underscore the ecological and educational significance of Gei Wais. Table 1 summarizes the major habitat categories identified under the plan, reflecting the ecological diversity maintained through Gei Wai management.

Table 1. 2025 Major Habitats of Gei Wais

TYPE	TOTAL AREA	Gei Wais	MAJOR CONSERVATION GOALS
SHALLOW WATER HIGH-TIDE ROOSTING AREA	45.5 ha	GW#8a, GW#11a, GW#16/17, GW#21, GW#22, GW#23a	Brackish gei wai: shallow water providing open water habitat and low-profile islands for waterbird roosting at high tide.
REEDBED-DOMINATED AREA	44 ha	GW#8b, GW#10, GW#11b, GW#14 (landward side)	Wet reedbeds: inundated vegetation supporting related birds and insects.
TRADITIONALLY OPERATED BRACKISH GEI WAI	53.7 ha	GW#12, GW#13, GW#14, GW#18, GW#19	Fragmented mangroves: provide wildlife refuge and organic essentials.
Open water-dominated brackish gei wai	37.8 ha	GW#3, GW#4, GW#6, GW#7	Mangroves and reedbeds: winter habitat for waterbirds; Channels: habitat for aquatic life and food for waterbirds at times of low water.

Source: Mai Po Nature Reserve Management Plan: 2024-2029

Mr. Choi points out that proactive intervention and management are essential to preventing wetlands from being overtaken by uncontrolled terrestrial vegetation and sedimentation. He highlights several physical and technical challenges encountered in the preservation of Gei Wais. First, maintaining an open landscape requires regular vegetation management, including the removal of terrestrial plants, to ensure the area continues to function effectively as a habitat for migratory birds. Second, continuous desalination work is necessary to clear sediment and maintain adequate water depth and quality.

Another challenge, noted by both Mr. Choi and Dr. Lau, concerns the manual operation of sluice gates. In recent years, climate change has intensified extreme weather events such as sudden heavy rainfall, making it increasingly difficult to regulate water levels in ways that support both biodiversity and safety.

4.2 Discussion: Cultural Conservation

Fishing and aquaculture practices have historically diffused many aspects of daily life in Hong Kong (Lai and Lam, 1999; Cheung, 2010), and Gei Wais exemplify this tradition. Cheung (2004) argued that the fishing industry constitutes an important case for understanding the socio-historical development of Inner Deep Bay, which should inform the formulation of future natural heritage conservation policies. Currently, WWF-HK leads cultural conservation initiatives that focus on promoting ecotourism and providing public education (WWF-HK, 2019). Given that the Gei Wais in Mai Po are the last remaining examples in Hong Kong-and among the few traditionally managed shrimp ponds in Asia-they are increasingly regarded as models of harmonious coexistence between people and nature (Lord Wilson Heritage Trust, 2016). The operation technique has also been officially recognized by the Hong Kong government as an item of intangible cultural heritage.

Based on interviews conducted for this research, several key perspectives regarding the cultural significance and conservation of Gei Wais are summarized below:

1) Shift in Operational Objectives: Although WWF-HK continues to manage 21 Gei Wais within the MPNR using traditional methods, the focus is primarily ecological and educational rather than productive. Aquaculture is no longer considered a financially viable goal.
2) Loss of Traditional Knowledge: The current water exchange cycle within the Reserve is less frequent than in the past, as it now prioritizes biodiversity protection. Moreover, most skilled fishermen are already in their sixties or seventies, and younger generations rarely engage in this practice. As a result, traditional knowledge is rapidly disappearing.

3) Limited Government Initiative: Beyond offering financial support and encouraging public engagement, the government has shown limited direct involvement in the cultural conservation of Gei Wais, despite their recognized heritage value.
4) Potential for Smart Infrastructure: Introducing smart, environmentally friendly infrastructure-such as remote-controlled sluice gates-could enhance efficiency, improve safety, and reduce labor intensity in pond management.
5) Need for Multi-Stakeholder Collaboration: Beyond governmental leadership, stronger involvement is required from local communities, media, former fishermen, and other stakeholders. For instance, technology companies in newly urbanized areas nearby could channel financial resources back into wetland conservation through structured mechanisms.

5. From Tradition to Innovation: Integrating Gei Wais into San Tin Technopole

According to the Civil Engineering and Development Department (CEDD) and the Planning Department (PD) (2019), the proposal to further develop the New Territories North (NTN) into a contemporary new town-San Tin Technopole (STT)-was first advanced in 2014. The initiative aims to alleviate land shortages while establishing an accessible employment hub with a balanced job-to-population ratio, thus reducing directional traffic flows (CEDD, 2021). Given its geographical setting (Figure 3), the government has conducted an Environmental Impact Assessment (EIA) to evaluate the types and magnitudes of environmental impacts associated with construction and operation.

A critical challenge for STT, however, lies in flooding. The low-lying terrain and limited

capacity of existing drainage channels have rendered Shek Wu Wai in San Tin one of Hong Kong's most severe flood-prone blackspots, where medium-scale flooding affects more than 10 hectares or causes major property damage and traffic disruption (Drainage Services Department, 2024). As highlighted in Section 4.1, climate change may exacerbate these risks, while increased paved surfaces from urban development will further intensify flood hazards. Addressing this challenge requires the integration of adaptive mechanisms into urban planning and design.

In alignment with Hong Kong's Climate Action Plan 2050, STT will adopt Smart, Green, Resilient (SGR) strategies in three domains (CEDD and Planning Department, 2023):

1) Urban planning and design (e.g., blue-green networks, expanded greenery);
2) Infrastructure systems (e.g., revitalization of drainage channels with integrated green landscapes and flood attenuation facilities);
3) Sustainable mobility (e.g., green and smart transport modes).

Building on these objectives, this study proposes incorporating Gei Wai practices into STT's development framework through joint efforts among relevant stakeholders. The Hong Kong Institute of Landscape Architects (HKILA) has already advocated for nature-based solutions (NbS) to enhance flood resilience by preserving watercourses, creating floodable river parks, and converting fishponds into retention ponds (HKILA and WWF-HK, 2022). This project extends the concept by proposing the design of multifunctional retention ponds that integrate traditional Gei Wai practices with advanced technologies to achieve four goals:

1) Mitigate flooding and improve water quality;
2) Restore partial wetland ecological functions;

3) Create diverse urban green spaces that contribute to sustainability;

4) Safeguard the cultural tradition of Gei Wai operation.

Beyond retention ponds, NbS strategies may further adapt the Gei Wai principle to establish multifunctional systems that allow manual regulation of water cycles and the symbiosis of plants and animals. A modernized Gei Wai system would incorporate smart sluice gates connected to watercourses, enabling remote or automatic control. During dry seasons, gates would remain closed to retain water, thereby sustaining wetland biodiversity and urban landscapes. In appropriate locations, low-density shrimp production could be encouraged, marketed as a distinctive Hong Kong product, while simultaneously serving educational and cultural purposes. Such practices would also generate local employment opportunities and engage younger generations. During extreme weather events, smart infrastructure would enable timely release of floodwaters, thus increasing STT's stormwater storage capacity.

Interviewees generally recognized the potential of this initiative, though they also offered important recommendations. Dr. Lau, who has previously advocated this concept, emphasizes the necessity of pilot projects to demonstrate its feasibility and strengthen governmental confidence. For fishpond operators, evidence of tangible economic value could encourage their cooperation. Mr. Choi underscores that where local geography and hydrological conditions permit, the integration of blue-green infrastructure could be highly beneficial. He also suggests supplementary measures such as mobile pumping systems. Nevertheless, he cautions that final decisions concerning land allocation for natural processes ultimately rest with the government. For the successful implementation of this system, a comprehensive collaboration mechanism involving multiple stakeholders is indispensable (Figure 4). The government occupies a central

role, yet effective coordination across departments and leadership in engaging external actors are essential. NGOs provide expertise and policy advocacy while also shaping public awareness and amplifying community voices to ensure local concerns are not marginalized. The local community benefits from governmental support, such as ecotourism initiatives, and exchanges knowledge with NGOs to sustain natural and cultural heritage. Although tensions often arise between residents and developers over land use and cultural preservation, cooperation becomes feasible when shared interests are aligned through inclusive governance mechanisms.

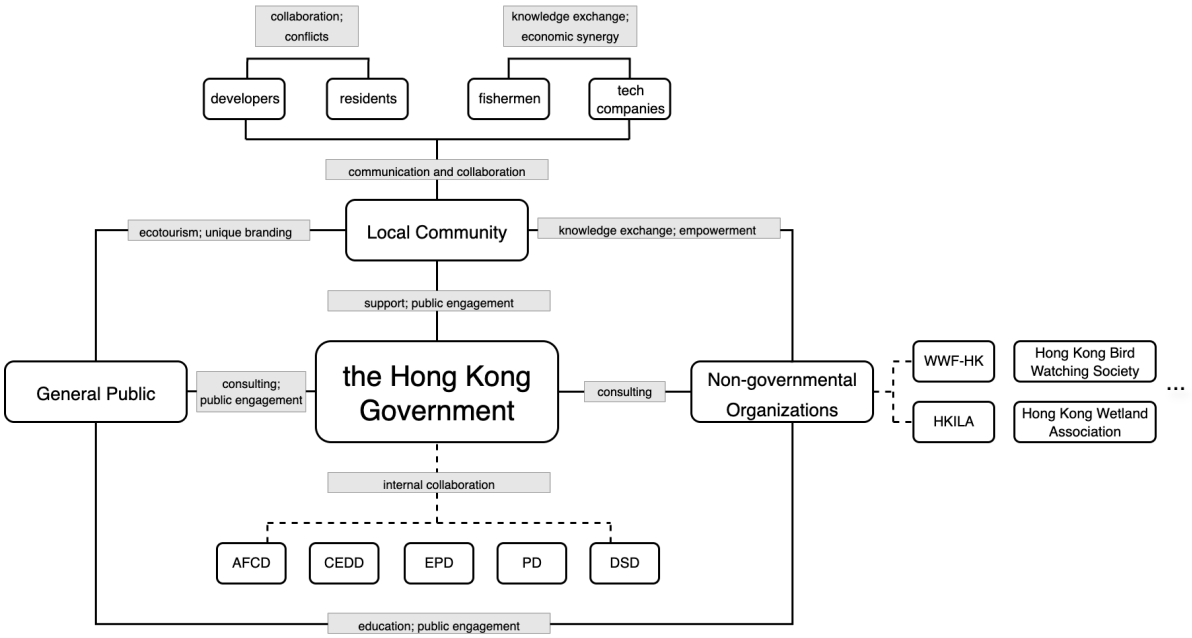

Figure 4: Cooperative Stakeholder Map of STT Natural and Cultural Conservation

6. Conclusion and Future Research Outline

This report has examined the integration of natural and cultural heritage conservation through the case of Gei Wais in Mai Po Wetland, with particular attention to their ecological significance, cultural value, and potential incorporation into Hong Kong's ongoing urban

development projects, San Tin Technopole. Through reviewing documentary evidence and incorporating insights from semi-structured interviews, the study has demonstrated that Gei Wais represent not only a unique socio-ecological system but also an opportunity for innovative and merged governance approaches that align with contemporary sustainability goals. The findings highlight the need for multi-stakeholder collaboration, the relevance of nature-based solutions in urban planning, and the role of heritage conservation in promoting resilience under the pressures of climate change and urbanization.

Meanwhile, this research is only a preliminary phase within a broader and evolving inquiry. While the current stage has relied on document analysis and a few stakeholder perspectives, further investigation will involve more in-depth interviews with other stakeholders, focus group, and fieldwork to capture more nuanced local knowledge and technical considerations. These forthcoming studies will allow for a more comprehensive evaluation of governance models, community engagement mechanisms, and design practices that could facilitate the authentic integration of cultural and natural heritage into sustainable urban transitions. In this regard, the present report should be understood as both a foundation for continued research and a step toward a more inclusive and resilient model of development in Hong Kong and beyond.

APPENDIX I

Interviewees for Semi-structured Interviews

Name	Title\Position	Interview method	Progress
Dr. Michael Lau	WWF-Hong Kong's Assistant Director in Conservation; Founding Member Hong Kong Wetlands Conservation Association	Online	Interviewed
Mr. Caleb Choi	Assistant Manager, Wetlands Habitat, WWF-HK; "Wetland Guardian"	Online	Interviewed
Prof. Sidney C.H. Cheung	Expert in freshwater fish farming in Hong Kong	Online	Corresponded, waiting for interview
Prof. Qiu Jianwen	Non-official member of STT Environmental Committee	Online	Waiting for interview
Related Government Official	AFCD, CEDD, Planning Department, etc.	Online	Waiting for interview
Onsite fishermen, residents, and fishpond operators.	Part-time Conservation Field Technician	Online\Face-to-face	Waiting for interview

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