STRENGTHENING THE CLIMATE RESILIENCE AND RESTORATION OF WETLANDS AND LAKES IN THE YANGTZE RIVER FLOODPLAIN

DECEMBER 2024

ASIAN DEVELOPMENT BANK

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1. In this publication, "$" refers to United States dollars. CNY refers to yuan. Unless otherwise stated, the exchange rate used is $1.00 = CNY7.1030.
2. ADB recognizes "China" as the People's Republic of China and "Hong Kong" as Hong Kong, China.

Cover design by Edith Creus.
On the cover: Aerial view of the Xiaohe Zui fisher village, which offers ecotourism in the vicinity of South Dongting Lake (photo by Christian Fischer, ADB).

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Foreword

The importance of natural capital, particularly wetlands and lakes, cannot be overstated. These ecosystems are essential buffers against climate change, serving as crucial carbon sinks and mitigating the impacts of extreme weather events. Wetlands also provide vital habitats for diverse species, supporting local economies and communities. The preservation and restoration of these natural assets are paramount for promoting local, regional, and global environmental health.

Lakes and wetlands of the Yangtze River Basin, among the most ecologically vital regions in the People's Republic of China (PRC), play a critical role in preserving biodiversity, regulating the climate, sustaining food security, and supporting the livelihoods of millions. However, these invaluable ecosystems face severe threats from habitat degradation, pollution, and the accelerating impacts of climate change.

Significant strides have been made to restore and protect lakes and wetlands in the PRC through ambitious and integrated conservation efforts. Two notable examples are the successfully completed Jiangsu Yancheng Wetlands Protection Project and the ongoing Hunan South Dongting Lake (SDL) Wetland Ecological Restoration and Sustainable Development Project. These projects, supported by the Asian Development Bank (ADB), demonstrate the power of comprehensive ecosystem management in reversing environmental degradation and building resilience against climate change.

The Jiangsu Yancheng Wetlands Protection Project, cofinanced by ADB and the Global Environment Facility, stands as a landmark achievement in wetland conservation. By implementing engineering interventions, forest rehabilitation, and capacity building initiatives, the project has successfully restored thousands of hectares of critical habitats. The outcomes have been profound, including a significant increase in bird populations and the enhancement of ecosystem services that protect against coastal erosion and support local livelihoods. The success of the Jiangsu Yancheng Wetlands project, culminating in its designation as a United Nations Educational, Scientific and Cultural Organization World Heritage site, provides a powerful example for wetland restoration across the PRC and beyond.

Building on the success of the Jiangsu Yancheng Wetlands project, the Hunan SDL Wetland Ecological Restoration and Sustainable Development Project extends these conservation principles to the heart of the Yangtze River Basin. This project, the first major investment under the Regional Flyway Initiative, integrates climate resilience, biodiversity conservation, and sustainable livelihoods into a cohesive strategy. With the restoration of almost 12,000 hectares of wetlands, the development of a smart decision support system for real-time environmental monitoring, and the establishment of an eco-compensation mechanism, the SDL project aspires to become a model of sustainable wetland management.

This report on Strengthening Climate Resilience and Restoration of Wetlands and Lakes in the Yangtze River Floodplain draws on some of the experiences and lessons primarily from SDL and other lake ecosystems. It provides a comprehensive framework for addressing the complex challenges facing the Yangtze River Basin's

lakes and wetlands. The strategies outlined, including ecological restoration and the promotion of sustainable livelihoods, offer a pathway toward a future where lake and wetland ecosystems continue to thrive and support both biodiversity and human well-being.

As the PRC continues to confront several challenges, including climate change, an economy in transition, and biodiversity loss, the insights and guidance provided in this report are timely and essential. By learning from past successes and bottlenecks, we can ensure that the wetlands of the Yangtze River Basin and beyond remain resilient, vibrant, and capable of sustaining future generations.

Alongside the 2024 United Nations Climate Change Conference (COP29), the report provides a critical lesson: robust nature-based solutions must play a central role in global climate strategies. To meet the ambitious goals of the Paris Agreement and safeguard a sustainable future for all, it is imperative that we incorporate the conservation of natural capital into international commitments.

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Over the years, ADB's work in the Yangtze River Basin has been made possible through the collaboration and dedication of many individuals and organizations committed to the protection and restoration of the basin's critical ecosystems.

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The team's appreciation also goes to the national, provincial, and municipal governments of the People's Republic of China, including the Hunan, Jiangxi, and Anhui provincial governments, for their ongoing commitment to the preservation and sustainable management of the Yangtze River's wetlands and lakes, notably SDL, Poyang Lake, and Chao Lake, which are featured in this report.

The team is particularly grateful to the Yuanjiang Municipal Government and the Hunan Provincial Government for their leadership and close collaboration throughout the SDL project. The local government officials and nature reserve management staff have demonstrated exceptional dedication to the preservation of SDL, contributing their time, knowledge, and experience to support the success of this ambitious initiative.

The team is also deeply grateful to the local communities, particularly the farmers, fishers, and residents living near the lakes and wetlands of the Yangtze River Basin, who have been active participants in the planning and implementation of these projects. Their engagement, insights, and willingness to embrace sustainable practices have been key to building resilient ecosystems that benefit both biodiversity and local livelihoods.

Abbreviations

ADB	Asian Development Bank
AFD	Agence Française de Développement
EAAF	East Asian–Australasian Flyway
GEP	gross ecosystem product
ha	hectare
PRC	People's Republic of China
RFI	Regional Flyway Initiative
SDL	South Dongting Lake
WWF	World Wildlife Fund

Executive Summary

This report focuses on integrating biodiversity conservation with climate resilience and sustainable livelihood strategies, drawing primarily from the Hunan South Dongting Lake Wetland Ecological Restoration and Sustainable Development Project. The report provides actionable insights for wetland management in the broader Yangtze River floodplain and beyond.

It serves as a comprehensive resource for wetland managers and government stakeholders, highlighting the vital role wetlands play in mitigating climate change, supporting biodiversity, and delivering ecosystem services, as well as providing actionable recommendations on how to manage wetlands effectively.

Wetlands and lakes, like those in the Yangtze River Basin, provide essential services, including water purification, carbon sequestration, and flood control, while also sustaining local economies through agriculture, aquaculture, and ecotourism. However, these ecosystems face significant threats from climate change, pollution, habitat fragmentation, and unsustainable resource use. The report proposes solutions through nature-based interventions and the restoration of critical habitats that can enhance climate resilience, conserve biodiversity, and support sustainable livelihoods.

Key strategies outlined in the report include enhancing institutional capacity, restoring wetland ecosystems through targeted interventions (such as tree and reed management, and soil and water conservation), promoting eco-compensation schemes to incentivize sustainable practices, and leveraging ecotourism to generate local livelihoods. In addition, the report emphasizes the need for cross-sector coordination, participatory planning, and improved data management to ensure effective conservation and management of lakes and wetlands.

Introduction

Context

Climate change is significantly impacting global ecosystems, heavily affecting the ecosystem services that they provide.[1] Ecosystem services can be split into three main categories: provisioning, regulating, and cultural. Provisioning services consist of the goods provided by nature, such as food, fresh water, and fuel. Regulating services involves natural processes, such as purifying water, regulating climate, and pollinating plants. Cultural services offer nonmaterial benefits, enriching human well-being and supporting economic activities like tourism.

Healthy ecosystems are also essential in mitigating climate change by stabilizing weather patterns, reducing greenhouse gases, and supporting biodiversity, all of which are critical for adapting to environmental shifts. Wetlands are invaluable in this process. They serve as natural carbon sinks, filter and purify water, and offer flood control, while also supporting biodiversity. These functions not only help maintain ecological balance, but also strengthen resilience against the impacts of a changing climate.

Wetlands are among the ecosystems most impacted by climate change, land use change, and pollution. Many wetlands are at risk of shifting from carbon sinks and biodiversity hotspots to carbon sources with low species diversity. This underscores the urgent need for targeted conservation and restoration efforts to address climate change and biodiversity loss.[2] Implementing ecosystem-based solutions tailored to the specific vulnerabilities of wetlands can significantly mitigate climate risks and support adaptation strategies. These interventions prioritize the preservation of the unique ecological characteristics of wetlands and the conservation of vulnerable species. Establishing effective management strategies for these interventions ensures that wetlands can continue to deliver their critical services, contributing significantly to environmental stability and protection.

This report outlines some of the approaches in the Yangtze River floodplain that combine biodiversity conservation with adaptation approaches to actively strengthen ecosystem resilience. It primarily draws on the Hunan South Dongting Lake (SDL) Wetland Ecological Restoration and Sustainable Development Project. This is the first investment project under the Regional Flyway Initiative (RFI), a program of the Asian Development Bank (ADB) that supports the restoration and sustainable management of priority wetlands along the East Asian–Australasian Flyway (EAAF). The project was requested by the Yuanjiang Municipal Government, and it will be

1 Intergovernmental Panel on Climate Change. 2023. *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.*

2 S. Salimi, S. Almuktar, and M. Scholz. 2021. Impact of Climate Change on Wetland Ecosystems: A Critical Review of Experimental Wetlands. *Journal of Environmental Management*. 286. 112160.

cofinanced by ADB and Agence Française de Développement (AFD). Secondly, the report provides an overview of the ongoing technical assistance project for the Poyang Lake Climate Change Adaptation Action Plan.[3] Thirdly, it highlights the two-phase Anhui Chao Lake Environmental Rehabilitation Project.[4]

Moreover, this report provides guidance on interventions aimed at managing climate risk through the sustainable management of wetlands. These interventions also help build the capacity of related agencies to effectively manage climate risk. It is intended for different levels of government involved in wetland management and for wetland site managers. It outlines the main issues and, where relevant, signposts readers to more detailed guidance and existing research.

Importance of Wetlands and Wetland Ecosystem Services

Wetlands contribute to human welfare in many ways. They deliver vital provisioning services like fresh water, food, and medicinal resources, and support local economies through fisheries and agriculture. They regulate environmental health by purifying water, sequestering carbon, and controlling floods, while also maintaining soil quality through nutrient cycling. Additionally, wetlands offer cultural benefits, providing recreational spaces, supporting tourism, enhancing community well-being, and playing a key role in many cultures and religions.

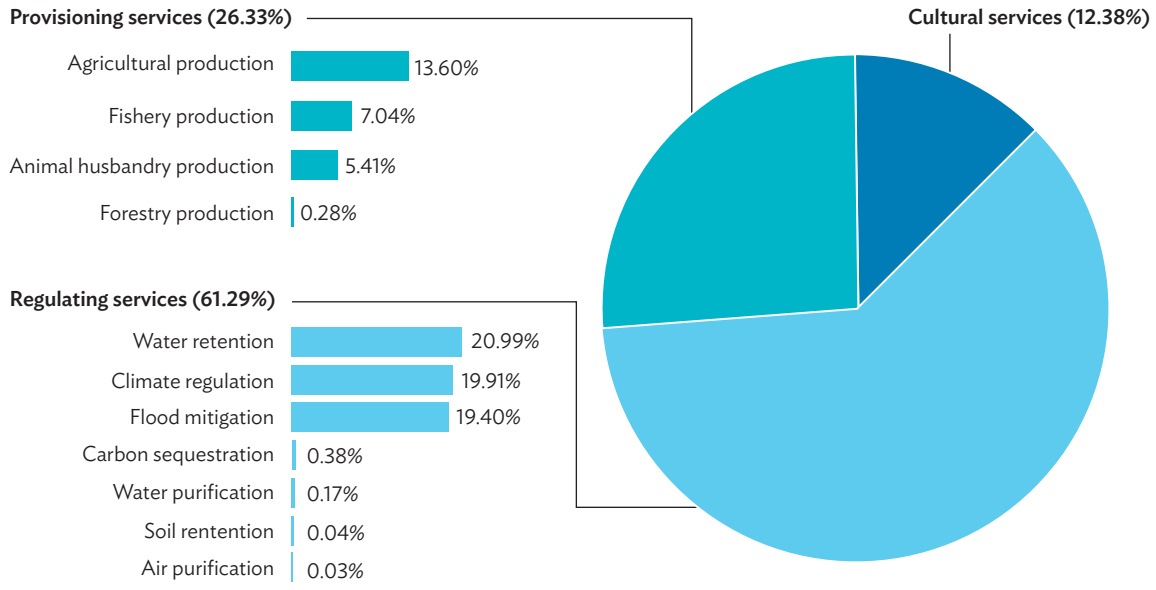
Many of these benefits contribute directly to the market economy. Others are freely enjoyed by society, but their economic value can still be estimated on a case-by-case basis, and it is usually very large. In 2014, the value of wetlands ecological services worldwide was estimated to be $125 trillion per year, using values and areas for 2011.[5]

In 2023, a gross ecosystem product (GEP)[6] baseline assessment was undertaken for SDL, Hunan Province. The results suggest that SDL generated $6.9 billion (CNY48.9 billion) in ecosystem services in 2023. Regulating services were the most valuable component, contributing $4.2 billion (CNY30.0 billion, 61% of total GEP), followed by provisioning services (26%) and cultural services (12%) (Figure 1).

Measured by area, the GEP per square kilometer was $3.2 million (CNY23.0 million), highlighting the significant economic value that the SDL ecosystems provide. On a per capita level, the GEP stood at $12,454.3 (CNY88,453.9), illustrating the substantial economic benefit that the ecosystem services generate. Results also show the untapped potential of cultural services, including ecotourism, which provides co-benefits and livelihoods.

[3] Asian Development Bank. 2023. *Technical Assistance to the People's Republic of China for the Poyang Lake Climate Change Adaptation Action Plan.*
[4] ADB. People's Republic of China: Anhui Chao Lake Environmental Rehabilitation Project (Phase 2).
[5] R. Costanza et al. 2014. Changes in the Global Value of Ecosystem Services. *Global Environmental Change*. 26 (1). pp. 152–158.
[6] GEP is a metric that quantifies the total economic value of the benefits (or ecosystem services) that nature provides to humans. It is analogous to gross domestic product, but instead of measuring the value of goods and services produced by human activity, it measures the value of services provided by ecosystems. GEP is typically calculated by identifying and valuing various ecosystem services, then aggregating these values.

Figure 1: Gross Ecosystem Product of South Dongting Lake



Source: Asian Development Bank. Gross Ecosystem Product Baseline Assessment Report. Unpublished.

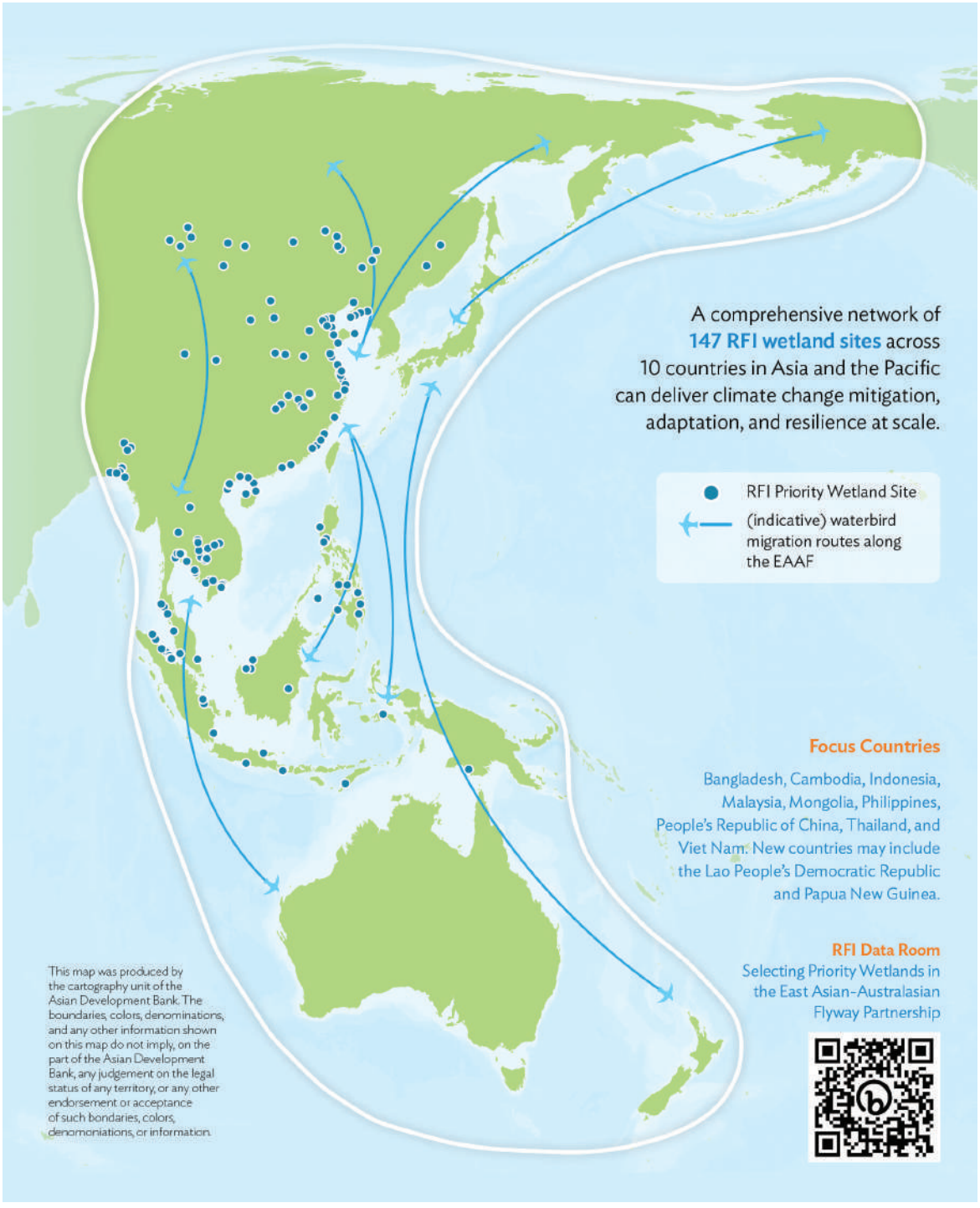
Regional Flyway Initiative

The EAAF is one of the world's most important and most threatened avian migration routes. It stretches from the Arctic Circle to Australia and New Zealand, covers 22 countries, and encompasses hundreds of wetlands. This flyway supports more than 50 million migratory waterbirds, including several threatened and endangered species, making it a critical corridor for global biodiversity conservation. While many of the migrating birds are only seen on passage in the People's Republic of China (PRC), a large suite of important species stays in the country throughout the winter before migrating back to northern breeding sites in the spring. Wetlands are essential to the EAAF, providing critical stopover points where millions of migratory waterbirds rest, feed, and breed. Locations like the Yellow Sea wetlands are renowned for their role in supporting large populations of migratory birds, including several threatened and endangered species. These ecosystems are indispensable, not only for bird species, but also for the resilience and well-being of the 200 million people in adjacent communities and the region.

To address this continued degradation of ecosystems along the flyway and to support local livelihoods and climate resilience, in the 2021 United Nations Climate Change Conference (COP26), ADB, in collaboration with the EAAF Partnership and BirdLife International, launched the RFI. The vision of the RFI is to mobilize $3 billion in investment for the protection and sustainable management of priority wetlands along the EAAF (Map 1).

The long-term vision is to deliver projects across the region that support the protection and sustainable management of at least 50 priority sites along the EAAF. A sustainable financing mechanism will run in parallel to these investments, ensuring that key capacity issues are addressed, and site maintenance and monitoring continues.

Map 1: Regional Flyway Initiative Priority Sites

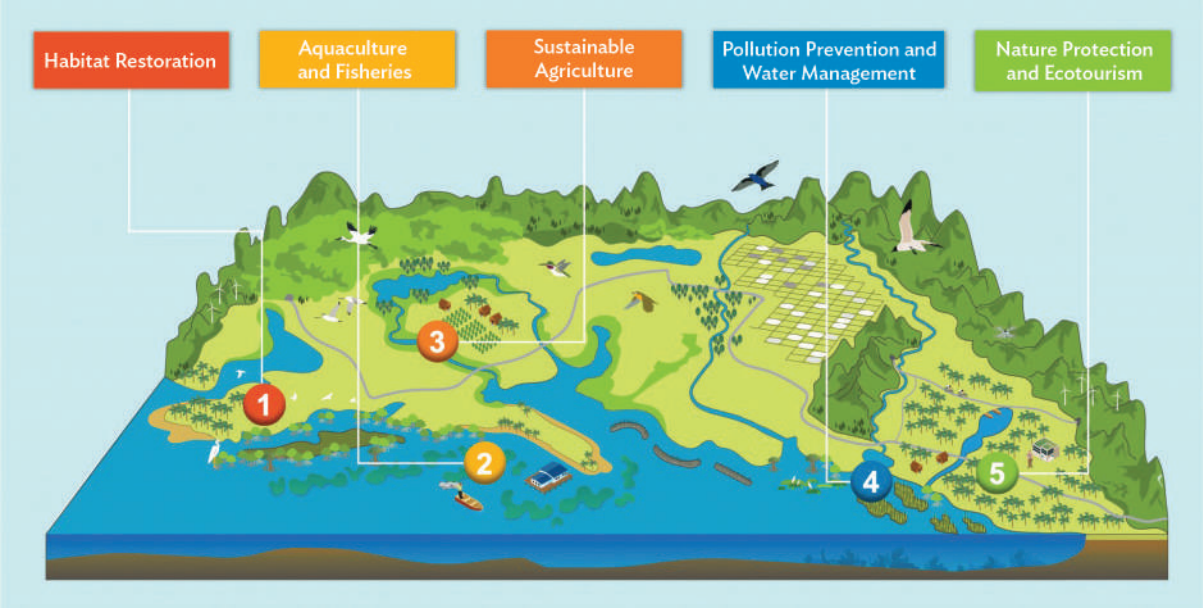


EAAF = East Asian–Australasian Flyway, RFI = Regional Flyway Initiative.
Source: Asian Development Bank.

The RFI is a flagship program, and it provides an ideal platform for ADB to deliver on its commitment as a cosignatory to the Multilateral Development Bank Joint Nature Statement to scale up nature-positive finance.[7] The RFI will support delivery of ADB's Strategy 2030, which includes a focus on tackling climate change, building climate and disaster resilience, and enhancing environmental sustainability.

Drawn from actual project experiences, five model investment concepts are being considered through the RFI, as illustrated in Figure 2. These models show how projects can deliver for biodiversity, local communities, and climate through (i) habitat restoration, (ii) sustainable aquaculture, (iii) sustainable agriculture, (iv) pollution prevention and water management, and (v) nature protection and ecotourism. The SDL project provides an example of a project that includes components from a number of these model investment concepts.

Figure 2: Nature-Positive Strategy



Source: Asian Development Bank.

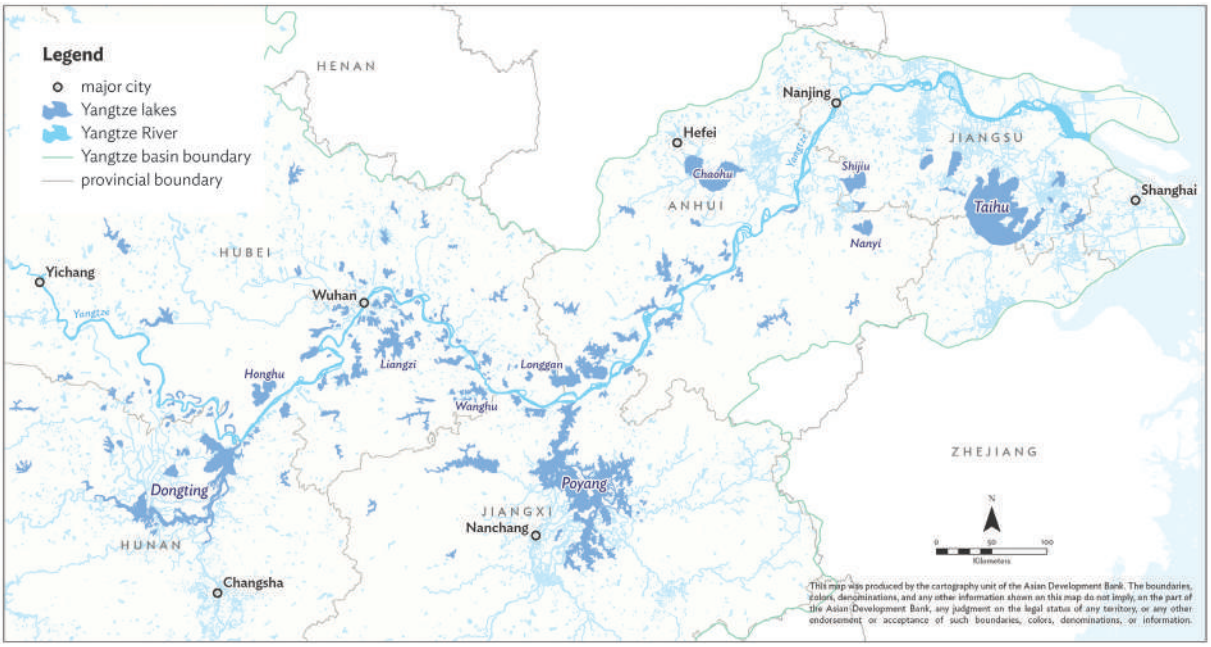
The Yangtze River

Overview

The Yangtze River, Asia's longest river, and its extensive floodplain harbor a heterogeneous network of wetlands, including large natural lakes, extensive marshes, seasonally inundated forests, riparian corridors, and human-managed rice paddies (Map 2). This wetland complex is a significant landscape feature in the

[7] United Nations Climate Change Conference United Kingdom 2021. 2021. Joint Statement by the Multilateral Development Banks: Nature, People and Planet. MDB Joint Nature Statement. 2 November.

Map 2: Yangtze River Basin



Source: Asian Development Bank.

central PRC, renowned for its biodiversity and ecological significance. Large freshwater bodies like Poyang Lake or Dongting Lake provide critical wintering habitats for globally significant populations of migratory waterfowl, including cranes, storks, ducks, and geese species.

The Yangtze River floodplain contains high level of species diversity, which plays a vital role in ecosystem resilience,[8] including many endemic and iconic species, such as the critically endangered finless porpoise (*Neophocaena asiaeoriantalis*), Yangtze giant softshell turtle (*Rafetus swinhoei*), Chinese giant salamander (*Andrias davidianus*), and the now-believed-extinct Yangtze River dolphin (*Lipotes vexillifer*).

The Yangtze River floodplain also serves as a critical link within the EAAF, with the wetlands along the floodplain providing essential staging and wintering areas for millions of birds. Of all the sites across the entire flyway covered by the RFI, the highest priority site is Poyang Lake, located within the Yangtze River floodplain. Conservation of these sites is, therefore, critical to support species that can be considered as regional public goods. Efforts delivered locally can transcend national boundaries and deliver regional impact. Coordinated international efforts will, however, be essential.

[8] K. S. McCann. 2000. The Diversity-Stability Debate. *Nature*. 405 (6783). pp. 228–233.

The Yangtze River floodplain is not only a biodiversity hotspot, but also plays a crucial role in the societal well-being and economic growth of the PRC. It is of significant cultural and economic relevance, functioning as a vital waterway for transportation and a source for irrigation, which sustains agricultural activities of millions of people. Additionally, the Yangtze River is critical for hydroelectric power generation, with several major dams, including the Three Gorges Dam found along the river.

However, climate change poses significant challenges to the Yangtze River floodplain, its vast ecosystem, and the millions who depend on it. Rising temperatures, altered rainfall patterns, and increased frequency of extreme weather events have exacerbated flooding and droughts, disrupting traditional agricultural practices and threatening biodiversity.

Threats Facing the Yangtze Wetlands

The Yangtze Wetlands are facing many threats because of natural changes, changing climate, and a range of human activities (Table 1).

Table 1: Threats to the Yangtze Wetlands

Threat	Description
Habitat loss and fragmentation	Historically, the wetlands of the Yangtze valley have been reduced by more than 60% because of agricultural encroachment, building of new towns, and construction of drainage and flood defense dikes.[a] Compounding the loss of wetland habitat is that remaining wetlands are becoming increasingly fragmented and isolated. This leads to increased losses in species numbers and diversity. Most of the valley lakes have water gates cutting them off from the main Yangtze River, whose floods have acted as a great connecting period for all aquatic species in the valley.
Pollution and habitat creation	The development of the PRC's industry, agriculture, and construction has raised millions of people out of poverty, but has come at a high cost in the form of pollution, including the following: • up to 300 million people in the PRC drink contaminated water every day; • 190 million suffer from water-related illnesses each year; • one-third of the length of all the PRC's rivers are highly polluted, as are 75% of its major lakes and 25% of all its coastal waters; • nearly 30,000 children die from diarrhea because of polluted water each year; and • the waste piles from the PRC's mining industries are also the point sources for a wide range of toxic pollutants.[b] Agriculture is responsible for 44% of the nation's chemical oxygen demand (the main measure of organic compounds in water), 67% of phosphorus, and 57% of nitrogen discharges.[c]

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Table 1 *continued*

Threat	Description
	The Yangtze wetlands are negatively affected by various sources of pollution. Pollution levels in the Yangtze valley are very serious, with significant impacts on the health and abundance of aquatic vegetation, invertebrates, fish and (indirectly) birds, and human health. A number of pollutants affect the Yangtze wetlands, including the following: • discharge of untreated wastewater, resulting in eutrophication problems and the death of plankton, benthic animals, fish eggs, and larvae; • mining for the rich range of metals in the hills on either side of the Yangtze valley, especially with poorly maintained waste piles; • sediment release, underwater noise pollution, and pollution associated with sand mining; • industrial waste, because many industries have developed in cities and towns throughout the Yangtze valley, resulting in the discharge of a wide range of toxic wastes; and • agricultural discharge, excessive use of artificial fertilizers, and field runoff that contains high levels of phosphorus and nitrogen, leading to eutrophication of water systems; as well as excessive use of weed killers and insecticides, leading to some dangerous chemicals flowing into the river systems.
Loss of water table	Managing wetlands is largely a matter of maintaining optimal water levels and, where possible, approximating original natural levels and seasonal variations. A great difficulty in many areas is that the water table has been lowered because of agricultural or industrial extraction by bore pumps or diversions from upstream sources. The PRC's shallow groundwater extraction grew from 55.7 billion m^3 in 1980 to 108.1 billion m^3 in 2008, with the increase in northern PRC accounting for 90% of the total.[d] The extraction in many areas has exceeded the maximum limit for extraction, leading to a continuous decline in groundwater levels to bring about many environmental and geological problems. The planting of some water-greedy tree species, such as willows and poplars, can locally lower water tables and compete with wetlands for water. The lowering of water tables is largely caused by the inefficiency of water diversions for agriculture. It is estimated that 60%–80% of water diverted for agricultural use is lost from evaporation or leakage from pipes and channels.[e] As agriculture is the largest water-using sector, it accounts for about 40% of all the PRC's water resources. One hectare of irrigated rice field uses an estimated 20,000–30,000 m^3 of water (with innovative technology).[f]
Eutrophication	Eutrophication is the process in which lakes receive excessive nutrients (phosphorus and nitrogen) and sediments from the surrounding watershed and become more fertile and shallower. This can lead to rapid blooms of algae and some toxic phytoplankton. The algae can increase turbidity, block waterways, and may choke the habitats of wildlife, such as fish and birds. When the algal bloom decays, excessive bacterial action depletes the oxygen and may lead to the death of fish and other creatures, whose decay also leads to the spread of toxic and dangerous bacteria and viruses. Eutrophication is difficult to reverse, but can be slowed by reducing nutrient and sediment addition to water bodies.

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Table 1 *continued*

Threat	Description
Loss of oxygen	Aquatic animals (e.g., fish, insects, crustaceans, worms, mollusks) need oxygen to breathe; oxygen levels in water bodies are a critical control of how much fauna each site can support. Oxygen is released into water by photosynthesis of aquatic plants and by physical agitation of moving or falling water (e.g., artificial aerators). Cold water can hold more oxygen than warm water. Activities that increase temperature (such as loss of shade, slowing water flow, and changing climate) will tend to reduce oxygen levels in each water body and cause loss or damage to the aquatic plants because of pollution, eutrophication, siltation, or physical overgrazing.[g] Oxygen is consumed in the process of decomposition of dead materials. Lakes that are overrun by water hyacinths (see "Alien invasive species" below) may also show loss of oxygen. Submerged native plants become shaded and often die. The resulting decay process depletes dissolved oxygen in the water and leads to fish deaths. High faunal richness can only be retained if oxygen levels are kept high and the wetland manager can avoid or minimize factors that would reduce oxygen levels.
Loss of connectivity: dams and barrages	Dams on the Yangtze River alter the natural flow patterns, reducing peak flows and trapping sediments.[h] This disrupts the connectivity and continuity between the upstream and downstream sections of the river and between the river and floodplain wetlands, impacting habitat sizes, migration routes of species, and overall ecosystem health.
Poaching and hunting	Poaching and hunting pose persistent pressures on the Yangtze's biodiversity, targeting semiaquatic mammals, waterbirds, amphibians, and reptiles for food, traditional medicine, and the pet trade.[i] Illegal and indiscriminate hunting methods, such as trapping, snaring, and poisoning, threaten nontarget species and contribute to ecosystem degradation. Better law enforcement and compensation for crop damage have reduced such effects.
Overfishing	Classic signs of overfishing include overall reduction in yield, reduction of yield per unit of fishing effort, reduced mean size of caught fish, reduced proportion of high-value fish in total catch, loss of key species, and reduction of fish indicators (such as fish-eating birds).[j] Overfishing can lead to a dangerously accelerating and vicious cycle. As fish resources are reduced, the fishing community tries to compensate for this loss of revenue by increasing fishing efforts. This is the exact reverse of what is needed to rectify overfishing and leads instead to even faster depletion of stocks. Strong central action to preserve fish stocks is then required, as demonstrated by the 10-year fishing moratorium introduced in 2021.
Alien invasive species	Invasive alien species disrupt the ecological balance of the Yangtze River Basin.[k] Aquatic plants like water hyacinth and water lettuce, along with invasive mollusks, crustaceans, and fish, outcompete native flora and fauna, impeding navigation and exacerbating hypoxia. Managing alien invasive species requires early detection, rapid response, and integrated approaches to control their spread.

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Table 1 *continued*

Threat	Description
Infrastructure development	Infrastructure developments, such as wind turbines, power lines, and airports, pose risks to the Yangtze River Basin ecosystem.[l] Birds, particularly large-bodied species and those prone to flocking, are at risk of collision. Strategic siting, visibility markers, and route adjustments can help reduce such impacts. Effective strategic environmental assessment is an important policy element needed to support sustainable development.
Climate change	Climate change acts as a threat multiplier, exacerbating existing challenges in the Yangtze River Basin.[m] Warming trends favor invasive species, alter species ranges, and disrupt phenological synchrony. Climate change also increases the frequency and severity of floods and droughts, adding stress to wetlands, threatening life and livelihoods, disrupting ecosystems and the services they provide, and complicating conservation efforts. Building ecosystem resilience and implementing adaptive management strategies are essential to address these impacts. The complex and interconnected threats facing the Yangtze River Basin endanger its remarkable biodiversity and the ecosystem services upon which millions of people depend. A science-based, adaptive approach grounded in a deep technical understanding of these threats is essential for developing effective mitigation, management, and restoration strategies. Solutions will require addressing the root causes of habitat degradation, promoting sustainable land use and resource management practices, strengthening regulatory frameworks, and fostering regional and international cooperation for the conservation of shared migratory species.

m^3 = cubic meter, PRC = People's Republic of China.

[a] R. Sun et al. 2017. Assessment of Wetland Ecosystem Health in the Yangtze and Amazon River Basins. *ISPRS International Journal of Geo-Information*. 6 (3). p. 81.

[b] Organisation for Economic Co-operation and Development. 2007. *OECD Environmental Performance Reviews: China*.

[c] Government of the PRC, Ministry of Environmental Protection, National Bureau of Statistics, and Ministry of Agriculture. 2010. *The First National Survey of Pollution Sources Bulletin* (in Chinese).

[d] J. Liu and C. Zheng. 2016. Towards Integrated Groundwater Management in China. In A. J. Jakeman et al., eds. *Integrated Groundwater Management*. Springer Open. pp. 455–475.

[e] A. S. Samir et al. 2023. Water Losses from Irrigation Canals and Their Modern Sustainable Solutions – A Review. In *Proceedings of the International Conference on Smart Cities*. pp. 861–886.

[f] M. Mallareddy et al. 2023. Maximizing Water Use Efficiency in Rice Farming: A Comprehensive Review of Innovative Irrigation Management Technologies. *Water*. 15 (10). 1802.

[g] M. Álvarez-Cobelas et al. 2010. A Story of the Wetland Water Quality Deterioration: Salinization, Pollution, Eutrophication and Siltation. In S. Sánchez-Carrillo and D. Angeler, eds. *Ecology of Threatened Semi-Arid Wetlands*. pp. 109–133.

[h] L. Cheng et al. 2018. Managing the Three Gorges Dam to Implement Environmental Flows in the Yangtze River. *Frontiers in Environmental Science*. 6 (64).

[i] D. Liang and L. Dan. 2023. Poaching a 'Major, Overlooked Threat' to Biodiversity in China, Study Finds. *South China Morning Post*. 26 October.

[j] R. Froese and D. Pauly, eds. 2019. Overfishing. In *FishBase*.

[k] H. Wu and J. Ding. 2019. Global Change Sharpens the Double-Edged Sword Effect of Aquatic Alien Plants in China and Beyond. *Frontiers in Plant Science*. 10 (787).

[l] T. Zhai et al. 2021. Identification and Prediction of Wetland Ecological Risk in Key Cities of the Yangtze River Economic Belt: From the Perspective of Land Development. *Sustainability*. 13 (1). p. 411.

[m] Z. Yu et al. 2018. Effect of Projected Climate Change on the Hydrological Regime of the Yangtze River Basin, China. *Stochastic Environmental Research and Risk Assessment*. 32. pp. 1–16; and Q. Ju et al. 2014. Response of Hydrologic Processes to Future Climate Changes in the Yangtze River Basin. *Journal of Hydrologic Engineering*. 19 (1). pp. 211–222.

Source: Asian Development Bank.

Bridging Climate Resilience, Biodiversity Conservation, and Livelihood Opportunities

Addressing the diverse environmental challenges facing the Yangtze wetlands requires a multifaceted approach. Four key intervention areas can build resilience, support adaptation, and sustain livelihoods:

(i) strengthening institutional capacity for integrated wetland management,
(ii) promoting ecological restoration of wetlands,
(iii) enhancing climate resilience and supporting sustainable livelihoods, and
(iv) improving knowledge and capacity among local and regional stakeholders.

In addition to promoting climate resilience and adaptability in a rapidly changing world, these intervention areas seek to integrate biodiversity and ecosystem restoration with the creation of livelihood opportunities.

Strengthening Institutional Capacity for Integrated Wetland Management

Wetlands and lakes face significant threats from a wide range of sectors, including industry, agriculture, construction development, mining, hydropower, and shipping. As such, the protection of wetlands relies on multisector change. However, the coordination of policy, government departments, and the many stakeholders and users involved presents a significant challenge.

In response to the many ecological and climate challenges affecting communities and the biodiversity and ecosystems they depend upon, the PRC has developed a complex organizational, policy, and regulatory framework for biodiversity, protected areas, and Yangtze River health.

The Government of the PRC has made significant policy changes to deliver support to wetlands and lakes, although these still need to be implemented.

Several different ministries have issued their own laws and regulations that relate to the use of waterways and wetlands. The National Forestry and Grassland Administration is mandated by the State Council to protect the wetlands (wildlife, protected areas, and wetland reserves). This administration is organized at the national and provincial levels. Practical activities are cascaded down to the provincial level and delegated to county-level departments or management bureaus of specific nature reserves or parks. The Anhui Provincial Government established the Chao Lake Management Authority as one of the first agencies in the PRC with the authority to manage and enforce all aspects of lake water quality and uses. Responsibilities include land use planning, water quantity and quality, water conservation, fisheries, navigation, and tourism.

However, regulations of other agencies also apply—e.g., the Ministry of Ecology and Environment (pollution issues, standards, and overall coordination of biodiversity issues); the Ministry of Water Resources (dams, reservoirs, diversions and water extractions, and flood defenses); the Ministry of Agriculture and Rural Affairs (fisheries and use of chemicals in agriculture); the Ministry of Transport (ships, boats, channels, and bridges); and the National Development and Reform Commission, overlooking all sectors. Nature reserve and lake management involves multiple departments across different sectors and administrative levels and bureaus (at the county, municipal, and provincial levels). Usually, horizontal and vertical coordination mechanisms for policy coordination are weak, resulting in poor management. There is also a disconnect between city administrations and nature reserves, whose roles and responsibilities for the management of nature reserves and surrounding urban areas are unclear. This overlap of mandates can lead to poor governance that results in ineffective wetland management.

Other issues related to effective conservation are the lack of technical support, capacity, awareness raising on the importance of wetlands, and knowledge sharing for peer-to-peer learning. For instance, the entire Dongting Lake is protected in four nature reserves: East Dongting Lake National Nature Reserve, Hengling Lake Provincial Nature Reserve, South Dongting Provincial Nature Reserve, and West Dongting National Nature Reserve. Each reserve falls under the management of a different bureau of forestry at the county level. Different regulations apply to different reserves. For example, within the Hengling Lake Provincial Nature Reserve, sand mining is still allowed, and SDL is home to a shipbuilding industry. The risk of maladaptation remains significant, given the conflicting interests of biodiversity when contrasted against the interests of farmers, fishers, reed users, foresters, tourism, urban developers, and users, together with a lack of coordination or cooperation between different administrative units.

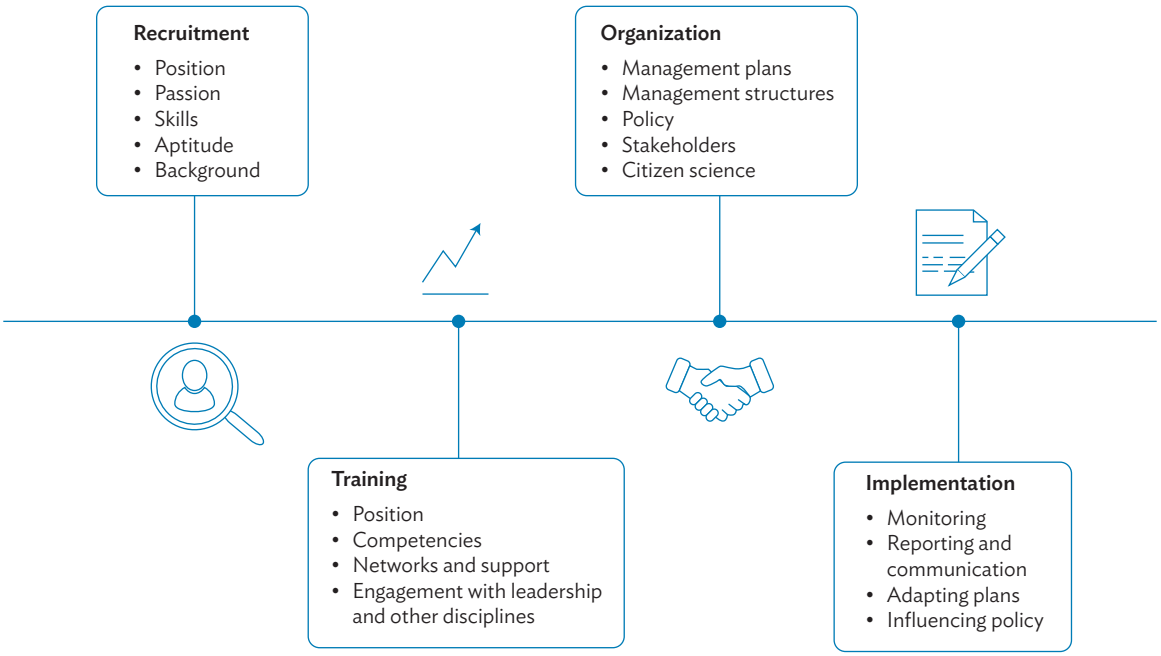
The successful management and development of the protected areas network that can deliver climate resilience, sustainable livelihoods, enhanced biodiversity, and ecosystem functioning depend crucially on the quality, training, and skills of the people involved. Equally, the development of organizational structures to manage the overlapping, and often contradictory, responsibilities and functions of the many parties involved is vital to the successful delivery of wetland management.

Failure to develop suitable organizational structures is a significant delivery risk. Conversely, where organizational structures, policy, and regulatory gaps have been addressed, significant progress on wetland management has been achieved.[9] This was the case for East Dongting Lake, which is part of the Dongting Lake wetland system, where vertical and horizontal communication between municipal, provincial, and national bodies has been reinforced. The main elements for enhancing institutional capacity, which can be applied elsewhere for more effective and integrated wetland management, are recruitment, training, organization, and implementation (as summarized in Figure 3).

In terms of recruitment, passion and commitment are important in any post, but particularly in positions that require multiple technical and social skills, may be physically demanding, are dangerous, and require unsocial hours. This is true for site managers and their staff, but also for those in the various levels of organizations that seek to build relationships with other disciplines and departments to support and restore wetland protected areas. Site managers may come from many backgrounds, and while there is an increasing trend of managers being drawn from academia, many highly skilled and passionate site managers or rangers are drawn from local communities and have experience and skills from other trades.

[9] Food and Agriculture Organization of the United Nations. 2022. Securing Biodiversity Conservation and Sustainable Use in China's Dongting Lake Protected Areas. GCP/CPR/043/GG Terminal Report (accessed 30 August 2024).

Figure 3: Elements for Enhancing Institutional Capacity



Source: Asian Development Bank.

Role of the Wetland Manager

Wetland site management teams play a critical role in implementing the necessary measures for successful wetland restoration. To achieve this, managers must leverage every available argument and alliance, as biodiversity alone often is not sufficient to secure broad government support for wetland protection.

To gain a wider mandate, managers need to highlight the economic benefits of ecosystem services; the significant costs of alternative engineering solutions, if wetland health declines; and the added value wetlands provide for public health, recreation, flood protection, and climate resilience. Engaging municipal and provincial governments, along with the key leaders and teams responsible for delivering these outcomes, is essential for achieving long-term restoration success. The general competence categories identified for the site management team by the International Rangers Federation are presented in Table 2.[10]

Rangers and, particularly, senior site managers should use every opportunity to engage with those organizations and personnel that overlap with the management of wetland sites. It is far easier for senior officials and politicians to fight for resources and develop agreements if they know and understand what is being done on wetland sites to meet the climate resilience and sustainable livelihoods challenges. Similarly, an understanding of the priorities and challenges faced by other departments is important in helping site managers develop partnerships.

[10] International Ranger Federation and the Universal Ranger Support Alliance. 2023. *Global Ranger Competences: A Concise Summary of Skills, Knowledge and Personal Qualities Needed by a Competent, Professional Ranger.*

Table 2: Protected Area Management Competencies

Competence Category	Competence Related To
A. The Ranger's Workplace, Role, and Job	Knowing about the place where a ranger works: the place's cultural, historical, and biological values; the people who have rights in and use the area; the threats it faces; and the management strategies and plans that guide their work Knowing the specific duties, responsibilities, legal rights, and obligations of rangers
B. Planning, Administration, and Documentation	Planning, documenting, and reporting on the work of rangers and ranger teams Keeping records of ranger activities and preparing reports
C. Managing and Leading People and Activities	Leading, supervising, and managing individual rangers and ranger teams and operations
D. Conducting Practical Field Work	Undertaking routine field tasks, including navigation, use of equipment, routine collection of information related to values and threats, and emergency response
E. Crime Prevention, Law Enforcement, and Security	Detecting, identifying, and responding to illegal, unauthorized, and harmful activities in operations Using, where relevant, firearms and less lethal weapons
F. Interacting with Stakeholders	Collaborating and communicating with individuals and groups, and with rights holders within the area of operations
G. Visitation and Education	Working with tourists, other visitors, and educational groups
H. Personal Conduct and Attributes	Working professionally, responsibly, and ethically with due care for oneself and others

Source: International Ranger Federation and the Universal Ranger Support Alliance. 2023. *Global Ranger Competences: A Concise Summary of Skills, Knowledge and Personal Qualities Needed by a Competent, Professional Ranger*.

Site Management Plans

Within the broader policy and organizational strategy, the key documents for delivering wetland management at the site level are the site management plans. Good site management plans help to identify not only the valuable biodiversity and ecosystems within the site, but also the significant threats and opportunities for the site. The process of stakeholder engagement is important in building relationships with local communities and interested parties, tapping into local knowledge, and identifying potential volunteers and support.

A good management plan should cover the following:

- description of the site;
- identification of conservation values, key ecological services delivered, and key threats needing attention for restoration and conservation activities;
- justification of the category of natural protected area registered;
- clarification of protective management objectives in order of priority;
- description of boundaries and zones, with any revisions proposed;
- outline of subplans for site and species protection and monitoring; management-oriented research needs; any habitat modification, management, restoration, or species management; controls that may be appropriate (e.g., control of alien invasive species); communication, educational, and awareness responsibilities; visitor management; human–wildlife conflict management, where appropriate; and contingency measures for firefighting and other disaster management, such as flooding;
- development of a program for engagement of and benefit sharing with local communities;
- plans and justification for infrastructure investments or equipment purchases;

- details of staff development needs, including training and other capacity needs;
- details of investment budget, staff costs, and operational budget requested; and
- proposals for use of any funds raised through methods, such as user fees and compensation mechanisms.

Implementation of plans should be based on a good baseline inventory and identification of the important features of the site and main pressures upon it, with clearly defined objectives, actions, and targets. To be effective, this requires careful monitoring of the state of the site and the effectiveness of the site plan in responding to the pressures on the site. Tracking the progress of the site plan actions and the extent to which they deliver on the targets and objectives of the plan should be subject to regular monitoring, usually annually, for reporting and for review every 5 years of the site management plan. Monitoring and review should, therefore, be an integral part of the management plan.

Increasingly important is the need to effectively disseminate information about protected sites and the results of monitoring, not only to institutional stakeholders, but also to the wider public. Citizen science, in carefully designed programs, can play a major role in the monitoring and evaluation of wetland sites, as in building broader public support and involvement.[11]

Management plans are still often poorly developed in the PRC, although there are notable exceptions, e.g., the Mai Po Management Plan.[12] Managers often have no technical background in wetlands conservation, hence the need for competency-based training. No system of expert review and approval is in place and there is little follow-up supervision or performance appraisal. The government is aware of these weaknesses, and reforms of the way protected areas are managed and funded are in the pipeline. There is considerable supportive literature on management planning. The Ramsar Convention Secretariat published a tool kit for managing Ramsar sites,[13] which is also relevant for wetland sites in the PRC.

Promoting Ecological Restoration of Wetlands

There are many detailed manuals on wetland management and this overview cannot provide tailored guidance for every wetland site in the Yangtze River floodplain. It does, however, identify common issues and action points for site management teams, including senior administrators in municipal and provincial governments.

Trees

Trees are usually naturally absent from floodplain wetlands and are generally undesirable in natural wetlands. They obstruct the open areas that many bird species need to feel safe from predators. They are often an indicator of successional change in wetlands that may threaten the existence of the water body. There has been an extensive policy of planting mainly alien poplars, often within wetland areas, for commercial and cosmetic reasons. This both disrupts the ecology of those wetlands and reduces the flood storage capacity and drought resistance of such wetlands. The government has initiated a program to remove these trees, felling several million,

[11] D. C. McKinley et al. 2017. Citizen Science Can Improve Conservation Science, Natural Resource Management, and Environmental Protection. *Biological Conservation*. 208. pp. 15–28; and S. Y. Cheung, Y-F. Leung, and L. R. Larson. 2022. Citizen Science as a Tool for Enhancing Recreation Research in Protected Areas: Applications and Opportunities. *Journal of Environmental Management*. 305. 114353.

[12] WWF-Hong Kong. 2024. *Mai Po Nature Reserve Management Plan: 2024–2029*.

[13] Ramsar Convention Secretariat. 2010. *Managing Wetlands: Frameworks for Managing Wetlands of International Importance and Other Wetland Sites*. Ramsar Handbooks for the Wise Use of Wetlands. 4th edition, vol. 18.

but continues to encounter challenges with sprouting stumps and striated landscapes caused by the remaining drainage ditches. For the removal process to be fully successful, it requires significant mechanical work to extract stumps, fill ditches, and reprofile the land.

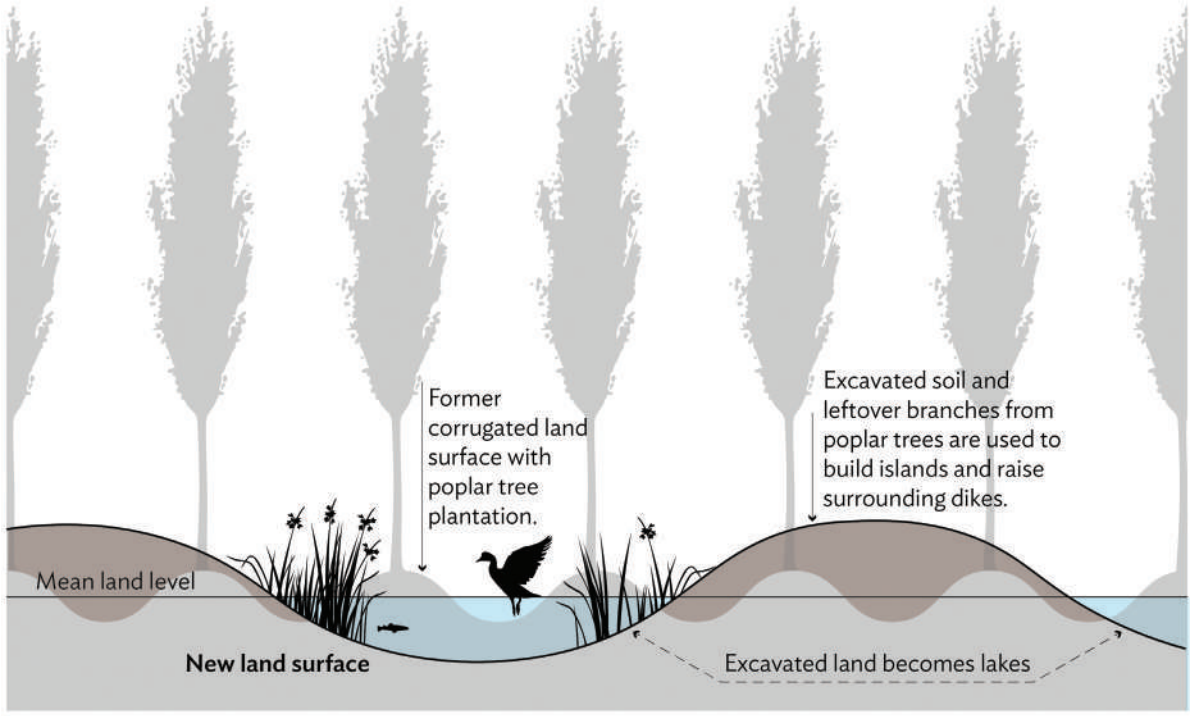
However, trees in appropriate places can play a positive role in catchment areas by conserving and protecting soils, reducing erosion, slowing water flows from land to river, and providing valuable habitat for many species. Trees can also provide shade along waterways that helps to reduce the effects of climate warming on water temperatures.[14] Agroforestry, incorporating trees in agricultural production, is increasingly seen as an important climate adaptation that could be incorporated into the agricultural hinterland of wetlands.

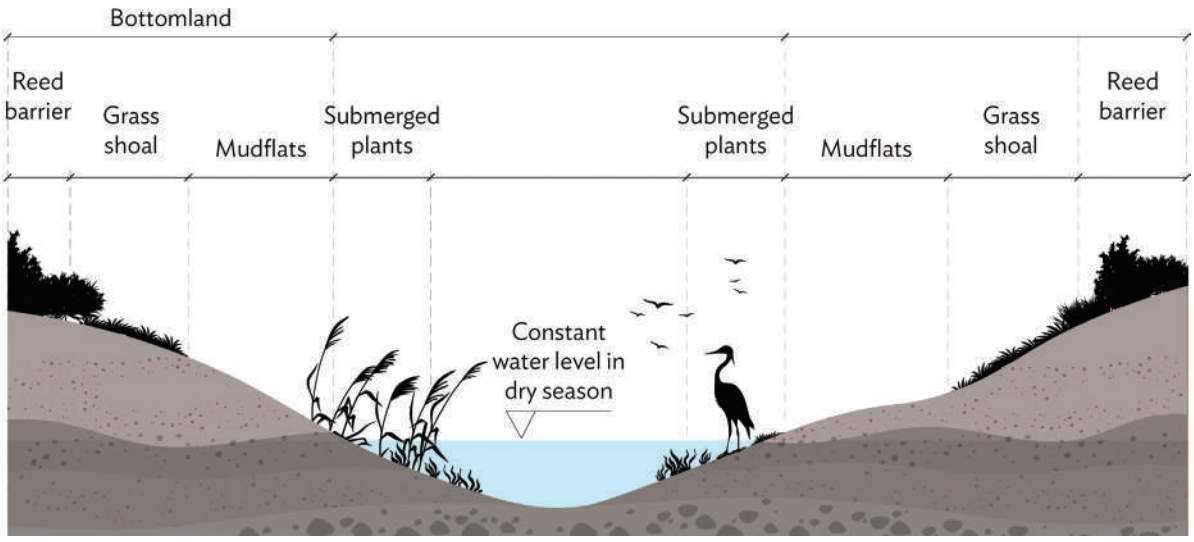
Restoration step by step. Top left: Poplar plantation before removal. Top right: Poplar tree, as viewed from above, during removal at the South Dongting Lake. The corrugated land surface is visible among the freshly cut poplar trees. Bottom: Exemplary wetland after poplar tree removal and restoration process (photos by Christian Fischer, ADB).

For instance, Figure 4 illustrates the range of habitats and natural drawdown zone of a recontoured poplar tree bed. Poplar stumps are buried in situ to provide buffer edges. During July–September, the area floods, thereby increasing summer flood storage capacity. As the dry season advances (January–February), water drawdown exposes the different vegetation zones and mudflats. Control of water levels to prevent too rapid drawdown during drought conditions may be considered, although care is needed to maintain connectivity with surrounding wetlands and watercourses.

[14] S. J. Dugdale, I. A. Malcolm, and D. M. Hannah. 2024. Understanding the Effects of Spatially Variable Riparian Tree Planting Strategies to Target Water Temperature Reductions in Rivers. *Journal of Hydrology*. 635. 131163.

Figure 4: Restored Wetland Post Tree Clearance and Recontouring





Source: Asian Development Bank.

Action Points

- **Remove non-native trees.** Develop a plan to remove alien tree plantations, especially poplars, from wetlands. Use heavy machinery for stump extraction and recontouring to restore the natural hydrology.
- **Avoid tree planting in wetlands.** Refrain from planting trees in natural wetlands to prevent their conversion to dry land. Focus on restoring hydrology and allowing native vegetation to grow naturally.
- **Create and maintain open spaces.** Ensure wetlands have wide open areas free of trees to support bird species that require clear sightlines. These spaces promote safety and encourage a diverse bird population.
- **Recontour the landscape.** After removing trees, recontour the landscape to create large water-holding lakes and islands, which attract waterbirds. This approach helps restore wetlands and provides suitable habitats for birds (Figure 4).
- **Diversify planting.** Avoid monocultures and use a variety of local species to create a more resilient and ecologically valuable habitat.
- **Examine disease vectors.** Do consider implications of wetland creation in relation to disease vectors, such as snails and Eastern schistosomiasis and the potential need to manage such conflicts.

Reeds

Reeds are a naturally occurring and valuable component of wetlands, providing habitat for reedbed species, such as the marsh grassbird *Helopsaltes pryeri* and reed parrotbill *Calamornis heudei*, water purification and carbon storage services, and a harvestable resource supporting local livelihoods. However, the management of reeds presents certain challenges. In some areas, large-scale planting of reeds for papermaking and other industries has impacted the ability of sites to support wetland species, such as cranes and wildfowl, that require open areas, while removing much-needed water storage capacity. Industrial harvesting methods reduce the ability of reedbed species to use such areas.

Internationally, most nature reserves that manage reeds do so by cutting a proportion (generally up to one-third of the area) each year on a rotational basis, so that there is a variety of habitats from low new-sprouting reeds, 1- and 2-year-old beds, and some mature stands. Many nature reserves follow up cutting by allowing large-grazing animals, such as cattle, water buffalo, or horses, to feed there. In the case of the Yangtze River floodplain, water buffalo, cattle, and milu deer (also known as the Père David's deer) could be encouraged. The creation of fish-rich pools and channels within such reed systems can significantly improve their ability to support breeding rail, bittern, and heron species.[15] Cutting is traditionally done by hand, but there are now very effective cutting machines, such as petrol-powered finger-bar mowers and large harvesters. Hand cutting has the advantages of very accurate treatment, low levels of disturbance, and the ability to cut reeds in soft soil or ponds, although it is very labor-intensive and slow.

Action Points

- **Manage vegetation heights.** Control the periodicity of water submergence to balance tall and short grasslands and use grazing or reed cutting to maintain habitat diversity.
- **Restore natural hydrology.** Focus on restoring natural hydrological patterns to support a healthy wetland ecosystem, removing obstructive structures and excessive reed areas that disrupt the water flow.

[15] A. Brown, G. Gilbert, and S. R. Wotton. 2012. Bitterns and Bittern Conservation in the UK. *British Birds*. 105 (2). pp. 58–87.

- **Manage reed density.** Control reed growth through rotational cutting or grazing with water buffalo and milu deer. This maintains a balance between tall reeds and open spaces, supporting a variety of bird species.
- **Promote biodiversity.** Maintain a mix of tall reeds and open areas to attract diverse bird species, providing clear views for waterbirds and controlling reed growth through appropriate methods.
- **Support habitat creation.** Create pools and wetlands within the reedbed to enhance habitat diversity.
- **Collaborate with experts.** Engage with hydrologists, ecologists, and engineers to promote effective habitat restoration, and consult with conservation specialists to guide restoration efforts and future management.

Shrubs, Grasses, and Herbs

A significant factor in managing wetland vegetation is understanding and balancing the role of various plants. Grasses, tuber-forming plants, sedges, and rushes support a range of waterbird species within the many lake areas of the Yangtze River floodplain. Shrubs in wetlands play an important role in maintaining ecosystem diversity, providing food and shelter for various species. It is also those intermediary types of vegetation that are the most relevant for managing herbivore species.

The periodic flooding and drainage cycles determine the height and density of these plants. Shorter vegetation tends to emerge during prolonged winter submergence, attracting plant-eating waterbirds like geese and cranes. Conversely, shorter inundation periods lead to tall summer growth, which suits some birds, but may require control through grazing by milu deer, water buffalo, or human interventions like reed cutting.

Floodplain wetlands are naturally devoid of trees and should largely remain so. Tree seedlings are usually limited by regular water inundation. Wetland birds seek areas with wide clear views. They feel safer there where they can see any approaching predator. Only on higher mounds and hillocks would trees naturally be found, and these wooded spots can serve as refuges for shade-seeking animals, such as deer or those resident birds that prefer trees as roosts or nest sites (e.g., cormorants and herons).

Herbivores also play a crucial role in controlling vegetation in wetlands. The density and type of herbivores present in an area can significantly affect the structure of herbs and grasses. In places where natural herbivores have been depleted, grasslands may become overrun with bushes and trees, requiring increased herbivore populations through managed grazing by domestic animals. Additionally, wetland managers must maintain a balance to prevent overgrazing, which can lead to habitat degradation. The strategic use of herbivores helps preserve the ecosystem's natural balance and promotes sustainable wetland management practices.

Action Points

- **Plant fruit-bearing shrubs.** Shrubs, like *Rubus* and *Sambucus*, provide a suitable habitat for fruit-eating birds. This encourages natural seed dispersal and helps sustain the shrub population.
- **Manage grasses and reeds.** Control the height and density of grasses in wetlands by adjusting water levels according to the needs of specific waterbird species. Use grazing by milu deer, water buffalo, or human interventions like reed cutting to maintain the desired vegetation structure.
- **Implement grazing management.** If natural herbivores are scarce, allow grazing by domestic animals to maintain optimal herb densities and prevent overgrowth by bushes and trees. Ensure the grazing pressure is controlled to avoid habitat degradation.

- **Strengthen plant–animal dynamics.** Use trees and shrubs sparingly and in natural locations to provide shelter for herbivores and safe roosts and nesting sites for species that use tree perches, such as herons and egrets.
- **Monitor invasive plant species.** Keep a close watch for the spread of invasive plant species that may compete with native shrubs and grasses. Implement early control measures, including manual removal or biological controls, to prevent these invasive species from disrupting the natural balance in wetlands.

Soils

Managing soil effectively involves balancing human activities and natural processes to maintain the ecological health of wetlands and the surrounding or upstream areas. Soil erosion is a significant concern, especially considering the various human interventions that have altered the natural landscape. Appropriate reed and tree management has positive impacts by helping to control soil erosion and improving wetland health. Additionally, constructing physical or living bunds, such as bamboo lines and building check dams in erosion-prone gullies, provides support to stabilize the terrain.[16]

Importantly, afforestation, not of wetland areas, but of upstream areas and steep slopes, can reduce landslides, control soil erosion, and slow down sedimentation of wetlands. Many forests have suffered from logging, clearing, and conversion to farmland, impacting downstream wetlands and their water sources. Restoring these ecosystems requires reducing pressure from human activities like firewood harvesting and grazing, as well as reestablishing forest cover on steep slopes to prevent soil erosion and protect wetlands from sedimentation.

Restoration of wetland flood storage areas previously damaged by planting of poplars and reeds can involve considerable movement of soil to reduce the corrugated surface and create large shallow lakes with raised islands and dikes that provide safe refuge for birds and allow water management.

Action Points

- **Reforest steep slopes.** Quickly covering land scars with vegetation stabilizes soil, reducing further erosion (landslides are getting more frequent with changing climate). Increasing water penetration through agroforestry, which involves introducing trees, improves soil structure and water retention. During fallow periods, vigorous green manure cover protects the soil while replenishing nutrients. Planting windbreaks is another effective strategy, reducing the impact of strong winds on soil and crops.
- **Control soil erosion.** Build physical or living bunds, such as bamboo lines, to slow water flow and reduce erosion on the slopes' surrounding lakes. Implement check dams in erosion-prone gullies to stabilize the terrain.
- **Minimize soil compaction.** Limit or avoid soil compaction during physical works to prevent anaerobic conditions and buildup of methane, a potent greenhouse gas.
- **Restore natural hydrology.** Focus on restoring the natural water flow by removing non-native poplar plantations, filling drainage ditches, and recontouring the landscape. This process supports a healthier soil structure and enhances water retention.
- **Encourage sustainable practices.** Promote sustainable approaches to wetland management, focusing on natural restoration methods rather than artificial planting. Engage with local communities to ensure buy-in and support for soil-friendly practices.

[16] Queensland Government; Department of Employment, Economic Development and Innovation. 2011. *Wetland Management Handbook: Farm Management Systems (FMS) Guidelines for Managing Wetlands in Intensive Agriculture*. Queensland Wetlands Program.

Water Management and Climate Change Adaptation

Wetland restoration often involves reversing the damage caused by drainage and impoundment. Reintroducing water into dried wetlands by blocking drainage ditches can help restore natural habitats and the ecosystem functions they support. This not only benefits the environment, but also supports local agriculture by providing water for crops, drinking water for livestock, and habitats for insect-eating species like frogs and birds. It is often possible to leave some permanent or seasonally marshy areas in corners of a farming landscape. These can be valuable miniature nature reserves, providing biodiversity and ecosystem services for farmers.

Wetland management of existing or restored water bodies primarily focuses on controlling water levels to maintain a suitable habitat regime. When the natural hydrological regime of a wetland is intact, the best conservation practice is to understand and preserve the existing hydrology. However, many wetlands have undergone significant alterations because of human activities like water diversions, dam construction, and other changes that affect water tables. This often requires wetland managers to use engineering techniques to manage water levels.

Understanding when to raise or lower water levels in different areas of the wetland requires a deep knowledge of the local ecology and a clear plan for desired outcomes. This is critical because it impacts which species can thrive. For example, waders and shorebirds prefer shallow waters, while ducks and geese need deeper water. The timing of flooding or drainage also affects plant growth, requiring managers to plan well in advance to promote suitable conditions for wildlife.

Where wetland birds are the target feature, water levels should be lowered gradually so that there is always a zone of wet mud for the waders to feed in, and gradually releasing land where the *Carex* (sedges) and other grasses can start growing from their submerged tubers. These tubers and the short young grass are the prime food source for the visiting cranes, geese, swans, and some ducks. If the water is released before the birds start to arrive, the *Carex* and grass meadows will be too long and tough for the birds, and the ground will be too dry and hard for use by waders and cranes.

Training in appropriate techniques and close cooperation with hydrologists, engineers, local communities, and stakeholders are all vital to managing wetlands sustainably.

Action Points

- **Assess hydrological regimes.** Evaluate the current hydrological regime to understand the natural water flow and identify any artificial modifications that are needed and those that can be removed.
- **Address climate impacts.** Based on hydrological and elevation surveys, identify any additional actions required to address predicted climate change impacts.
- **Monitor and adjust habitat conditions.** Continuously monitor water levels and habitat conditions, adjusting as necessary based on seasonal changes, migratory bird patterns, and other ecological factors.
- **Control water levels.** Use engineering solutions, where needed, such as building sluice gates or other structures, to manage water flow and maintain desired water levels.
- **Recontour landscapes to create water bodies.** After removing unwanted trees and other structures, recontour the landscape to create large water-holding lakes and smaller ponds. These new water bodies attract a range of wildlife and improve overall wetland functionality.

- **Understand the local ecology.** Adjust water levels based on the needs of different species and the timing of their presence in the wetland.
- **Promote ecological connectivity.** Address connectivity issues caused by water gates or other structures that could impede fish movement or other ecological interactions.

Visitor Management

Wetlands offer a unique draw for tourists with their diverse wildlife and distinct landscapes. However, these sensitive ecosystems require careful management of tourism impacts to ensure tourism contributes to the long-term sustainability of wetland habitats and species and supports local livelihoods and communities.

A key element of managing tourist numbers and behaviors is to understand the protected area's carrying capacity. This refers to the maximum number of visitors a wetland can sustainably accommodate without suffering irreversible damage. Assessing carrying capacity involves monitoring signs of overuse, including

- habitat damage;
- litter accumulation;
- altered wildlife behavior (e.g., reduced populations, shifts in distribution); and
- conflicts with the local communities.

Such carrying capacity is closely linked to the sensitivity of the site, the accessibility of the site, and the infrastructure provided for visitors. This includes the capacity of local businesses and communities to provide services and tolerate visitors.

A precautionary approach is best, starting with conservative visitor limits and increasing them gradually only if continued monitoring suggests minimal negative impacts. Management options arising out of such carrying capacity assessments include (i) strategic zoning of the area to protect sensitive habitats and species; (ii) implementation of seasonal closures for islands, isolated lakes, or other areas to limit disturbance; and (iii) quotas to reduce overcrowding during peak times. Additionally, minimizing disturbances with designated visitor areas, provision of ranger and educational services, campaigns promoting responsible behavior, thoughtfully designed infrastructure (such as boardwalks and blinds), and careful consideration of transport options and parking locations all contribute to sustainable tourism practices.

Action Points

- **Assess and manage the carrying capacity as part of the sustainable tourism study.** Establish a carrying capacity for the wetland to prevent overuse. Use a precautionary approach to set visitor quotas, adjusting as necessary based on monitoring and assessments.
- **Manage visitor disturbance.** Create zones to limit visitor access to sensitive areas. Attract visitors to areas where they will get the most enjoyment of nature with the least disturbance. Control damaging activities by developing codes of conduct and enforcement, such as the waterborne wildlife watching codes, e.g., Vancouver Island's responsible marine mammal viewing.[17]
- **Educate visitors on responsible behavior.** Develop educational programs to promote responsible behavior among visitors. Encourage quietness, proper waste disposal, and respect for wildlife through signage and information centers.

[17] Tourism Vancouver Island. Marine Mammal Viewing Best Practices.

- **Provide adequate infrastructure.** Build boardwalks, observation blinds, and pathways to guide visitors through the wetland. Ensure that these structures are designed for safety, low environmental impact, and proper blending with the natural surroundings. Do not treat timbers with toxic chemicals.
- **Implement sustainable practices.** Promote ecotourism principles that support conservation and minimize negative impacts on the wetland. Encourage local involvement and ensure effective waste management and litter collection.
- **Improve visibility of wetland rangers.** Wetland site rangers and volunteers should be visible on the ground and engage with visitors and local communities routinely, including providing guided walks and other educational programs.

Enhancing Climate Resilience and Supporting Sustainable Livelihoods

The introduction of the Yangtze River Protection Law of the PRC in 2021 and the closely linked Wetland Protection Law of the PRC in 2022 have given legislative backing to this shift in policy and approach.

Most of the PRC's poorest people live in rural areas, depending directly on local ecosystem services for their livelihoods and well-being, including food production, freshwater availability, and protection from hazards, among other services. Degradation of these services can even lead to starvation and loss of life. Investments in ecosystem service maintenance and restoration can enhance rural livelihoods and be a stepping stone out of poverty.

Restoration and protection of wetlands play an integral part in the delivery of a healthy, climate-resilient Yangtze River, which can support existing and new livelihoods. However, strategic local government action to support the transition to more sustainable practices within the broader landscape where those wetlands occur is also needed.

Eco-compensation

Ecological compensation, or eco-compensation, involves providing financial incentives to landowners, farmers, or users to address losses incurred by refraining from damaging activities and encouraging instead the adoption of practices that contribute to environmental conservation and sustainability. This concept is particularly relevant in the context of wetland management, where balancing human activities with ecological preservation is crucial.

"...we must proceed from the long-term interests of the Chinese nation to put restoring the ecological environment of the Yangtze River at a dominant position, making all-out efforts to protect it, and forbidding large-scale development of the river."

Chinese President Xi Jinping
26 April 2018
Symposium on Deepening the Development of the Yangtze River Economic Belt
Wuhan, Hubei Province, PRC

Diffuse pollution from agriculture and aquaculture has long been recognized as a major contributor to wetland degradation and eutrophication in the PRC, particularly in Chao Lake and Tai Lake.[18] Excessive chemical control and nutrient loading depress the natural ecosystem services that pollinators and pest predators can provide,[19] and contribute to declines in water quality and safety. Crops may also be attractive to wetland birds and other species, resulting in human–wildlife conflict.

Eco-compensation offers a solution by financially rewarding practices that reduce input intensity and pollution. For example, farmers can be compensated for adopting more sustainable practices that limit nutrient runoff into wetlands, such as using fewer fertilizers and pesticides, implementing buffer zones, or converting to organic farming.

Shifting from input-intensive, high-yield agriculture and aquaculture requires incentives, technical support, marketing, and mechanisms for verification. However, following this transition, it can be equally profitable, if not more profitable, than conventional chemical-based farming because of the significantly reduced input costs. It can also be integrated into ecotourism through product branding, homestay, and activity experiences.

Action Points

- **Consult stakeholders.** Conduct stakeholder consultations with farmers, local communities, government agencies, and other relevant stakeholders to gather input and feedback on potential sustainable practices.
- **Involve experts.** Collaborate with experts and specialists in relevant fields, such as agronomy, fisheries, and environmental science, to develop technical guidance and recommendations.
- **Build capacity.** Organize training workshops and capacity building sessions for beneficiaries to learn about sustainable practices and gain practical skills for implementation.
- **Provide continuous support.** Provide ongoing technical support and advisory services to address challenges and promote successful adoption of sustainable practices.
- **Develop a brand.** Develop a comprehensive marketing strategy to promote the eco-products and enhance brand visibility.
- **Establish cooperative structures.** Design and establish a cooperative structure or enterprise to create opportunities for production linkages, centralized product distribution, packaging, and marketing activities.
- **Monitor and evaluate.** Conduct regular monitoring of the transition to ecological and sustainable practices.
- **Raise awareness.** Design and produce communication materials, such as brochures, flyers, posters, videos, and social media content to convey key messages effectively. Organize awareness-raising events. Figure 5 illustrates the process for delivery of an eco-compensation scheme.

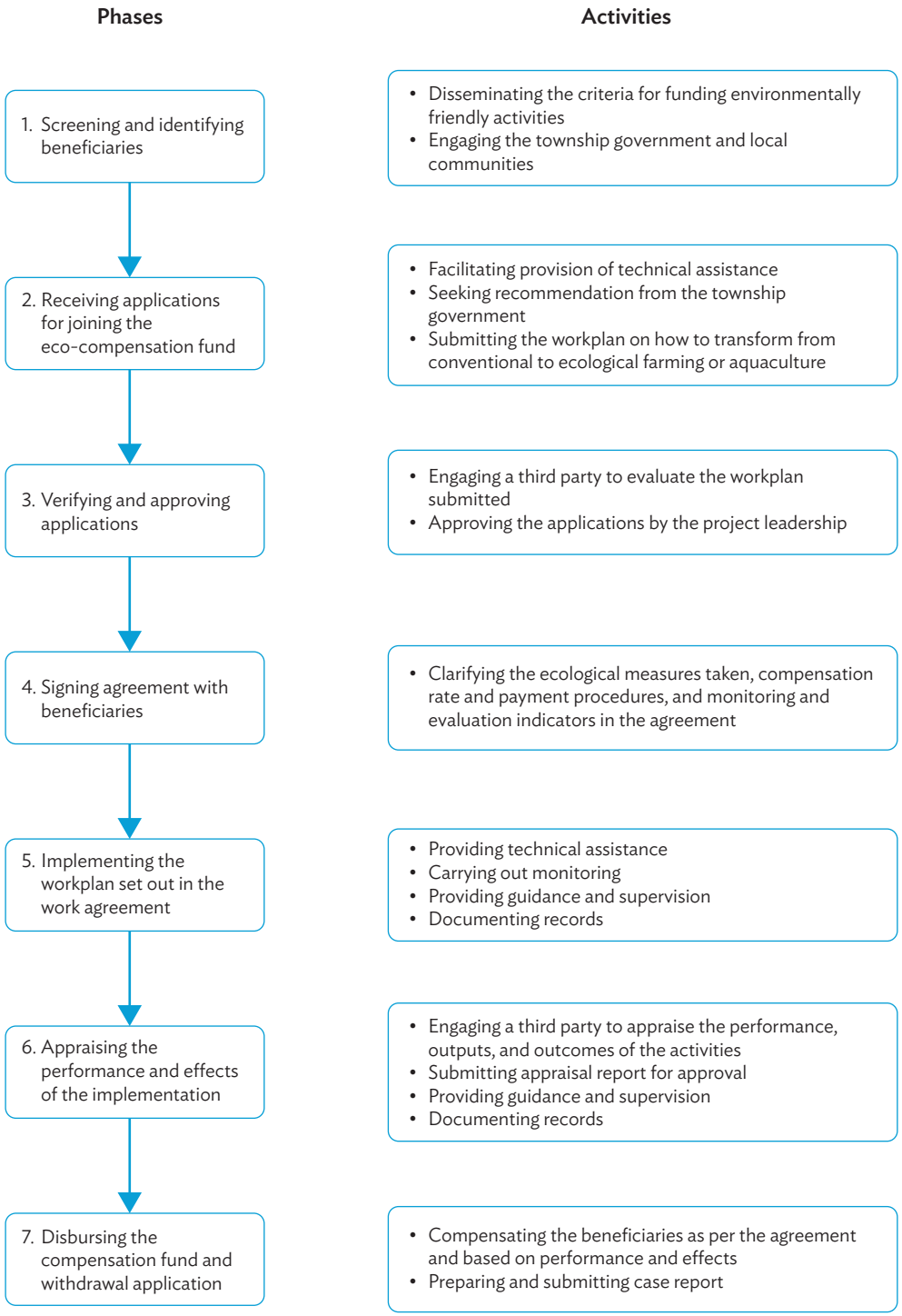
Ecotourism

The Ramsar Convention Secretariat produced guidance on managing tourism in wetlands and suggested the following:

Successful tourism depends on getting the right balance between visitors, businesses, local communities, the destination, and what the environment can support. Achieving that balance involves dialogue among the stakeholders to determine what the destination can offer sustainably, what its communities will accept, and what its businesses can offer in relation to the market demand for tourism and visitor satisfaction.[20]

[18] WWF China. 2020. *Living Yangtze Report 2020: Summary*.
[19] L. Ancillotto et al. 2024. A Bat a Day Keeps the Pest Away: Bats Provide Valuable Protection from Pests in Organic Apple Orchards. *Journal for Nature Conservation*. 78. 126558.
[20] Secretariat of the Ramsar Convention on Wetlands and World Tourism Organization. 2012. *Destination Wetlands: Supporting Sustainable Tourism*.

Figure 5: Illustration of an Eco-Compensation Process



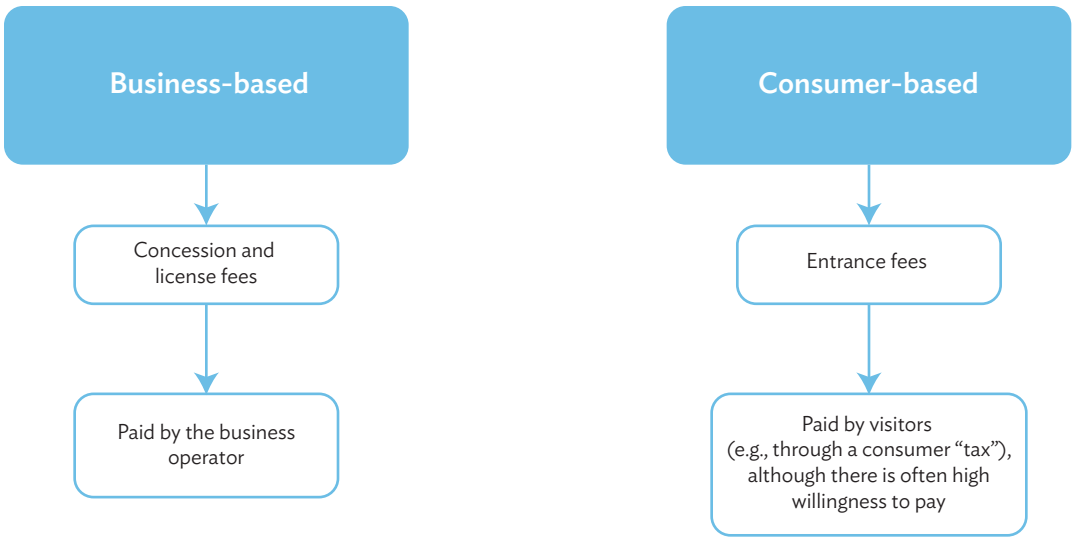
Source: Asian Development Bank.

Therefore, a successful tourism plan needs (i) to consider how revenues will be generated and disbursed, (ii) to build and support nature-based businesses, (iii) to provide low-impact supporting infrastructure, and (iv) to have a clear visitor management strategy. In relation to revenues, there tend to be two main income streams: business-based and consumer-based (Figure 6).

There now exists a large body of information and guidance on successful sustainable tourism, including certification schemes (such as the global sustainable standards in travel and tourism by the Global Sustainable Tourism Council)[21] and protected area-specific guidance (such as the United Nations Educational, Scientific and Cultural Organization's sustainable tourism tool kit).[22] There is also research available that helps understand where and how carrying capacity affects protected areas.[23]

The SDL project not only developed visitor management as part of the restoration of resources and support of ecotourism, but also built on Yuanjiang City's proposed application for Ramsar Wetland City Accreditation. The ecotourism plan is central to the project, as it is the focus on locating resources primarily in the city where people live and visit, reducing the carbon footprint of tourism through building design and a transition to green transport infrastructure. Revenue from tourism is designed to not only support livelihoods, but also the wider eco-compensation program.

Figure 6: Tourism Income Streams



Source: Asian Development Bank.

[21] Global Sustainable Tourism Council.
[22] United Nations Educational, Scientific and Cultural Organization World Heritage Convention. Sustainable Tourism Toolkit.
[23] G. Deng et al. 2020. Understanding Human and Nature Interaction Outcomes for Sustaining Tourist Destinations: An Example of Jiuzhaigou Nature Reserve, China. *Aquatic Ecosystem Health & Management*. 23 (3). pp. 373–384.

Action Points

- **Analyze tourism activity.** Conduct a comprehensive analysis of current tourism activities in the area and those that could be developed within the ecotourism framework.
- **Collaborate with experts.** Use tourism specialists, supported by other specialists, such as geographers, ecologists, and economists, as necessary.
- **Compile data.** Compile relevant data relating to the development of the tourism sector, including future projections (e.g., numbers of tourists, related tourism spending capacity, tourism activities, price points).
- **Map relevant actors.** Map the key actors operating in the tourism sector, including tourism operators, hotels, small entrepreneurs, and local governments. Define their sector of activities, revenue streams, and roles.
- **Analyze agreements.** Analyze any existing tourism concession agreements, including their terms and conditions.
- **Define revenue.** Define the potential revenue generated by different tourism revenue sources.
- **Consult stakeholders.** Consult with stakeholders, particularly businesses and local communities, to assess capacity for tourism services and most appropriate locations.
- **Engage with ecotourism provider.** Consider regular contact and oversight of commercial ecotourism providers, including the operation of permitting systems and codes of conduct.
- **Monitor and evaluate.** Build in adequate monitoring and evaluation of tourism activities and their impact on wetland features and ecosystem functioning.
- **Integrate eco-compensation.** Where appropriate, identify how tourism revenues could support broader eco-compensation mechanisms and reserve management.

Improving Knowledge and Capacity Among Local and Regional Stakeholders

Good communication is an essential component of good wetland protected area management. A serious barrier to achieving the aims of good protection of critical wetlands is the low level of awareness of the value of those wetlands. Throughout the PRC, at the central and local levels, there is a widespread misperception of an inherent conflict between economic development and biodiversity. At all levels of government, the link between healthy wetlands, biodiversity, and quality of life is misunderstood, as is the link between successful economic development and well-being.

Improving knowledge, understanding, and capacity of local and regional stakeholders is, therefore, essential to wetland conservation. Key target groups for such interventions are the following:

- Governments, decision-makers, and local agencies and officials, especially around the wetland sites;
- The general public, such as youth (through formal education and student debate groups) and groups with an interest in wildlife and conservation (such as bird watching societies); through mass media and web sites; and local communities living around the wetlands; and
- Intermediaries and partners that help broadcast environmental messages to the first two target groups, but need some capacity enhancement. These include journalists of key media agencies (press and TV broadcasters), social media, and teachers to deliver new materials on the importance of wetlands.

The involvement of stakeholders is important in the delivery of some of the broader sustainable development goals, such as re-skilling and supporting poorer income households, and engaging with women and disadvantaged groups. It also allows the harnessing of the skills and support of the growing number of citizen scientists, many of whom increasingly have access to high-quality recording apps or websites. Capacity building programs, involving both technical and financial assistance, are essential to building capacity for the following individuals and groups:

(i) **Site managers and staff**
   (a) Develop capacity and skills among site staff and managers in integrated wetland management;
   (b) Provide patrol and monitoring infrastructure to assist staff in reserve and visitor management; and
   (c) Support site managers and staff, including rangers, in providing environmental education, including training and tools.

(ii) **Local communities**
   (a) Support volunteers and volunteer leaders, including skills training;
   (b) Provide opportunities in ecotourism to retrain those displaced from traditional activities;
   (c) Provide training and testing of alternative, less harmful methods of agriculture and aquaculture; and
   (d) Build outreach programs to engage with communities and user groups.

(iii) **Governments and administrators**
   (a) Develop skills among key local and provincial administrators involved in integrated wetland management;
   (b) Establish monitoring, early warning, and response systems for flood and other disaster management; and
   (c) Develop communication teams and strategies.

There have been excellent examples of such capacity building in the PRC, including those delivered by World Wildlife Fund (WWF) through the Minjiang River Estuary Conservation Project[24] and the Zhangjiangkou Wetland Conservation Project.[25]

Action Points

- **Enhance capacity.** Develop a capacity building program through gap analysis of skills and infrastructure, socioeconomic analysis of community needs, and the requirements for building climate resilience through improved wetland management.
- **Consult with stakeholders.** This is particularly important to those most likely to be impacted by climate change and/or the measures needed to increase resilience, such as women and low-income households.
- **Improve infrastructure.** Enhance wetland management infrastructure and hardware capacity.
- **Educate the public on wetlands.** Promote public wetland education through the development of training materials and curricula, and the organization of wetland-related thematic practical activities for students, tourists, local communities, and relevant governmental agencies.
- **Engage citizen through science and volunteering.** Encourage citizens to get engaged as volunteers and to make use of publicly available open-source citizen science platforms (e.g., China Bird Report) to build interest, share data, and further encourage the growth of the birder community.

[24] WWF. Fujian Minjiang River Estuary Wetland Conservation Project, 2012–2017.
[25] WWF. Fujian Zhangjiangkou Wetland Conservation Project, 2005–2010.

- **Conduct training.** Provide technical and occupational training for fisherfolk, farmers, and those engaged in ecotourism, including further opportunities for learning on the job for managers, administrators, reserve staff, and tour guides.
- **Strengthen transparency.** Transparency regarding the state of the lake and its species based on good monitoring, as well as public and scientific engagement, also reduces the risks of maladaptive management mistakes. Another consideration, especially regarding climate change adaptation, should be opting for flexible interventions that will work under different changing climates, including floods or droughts of different intensity.

Hunan South Dongting Lake Wetland Ecological Restoration and Sustainable Development Project Case Study: Lessons Learned

Describing South Dongting Lake

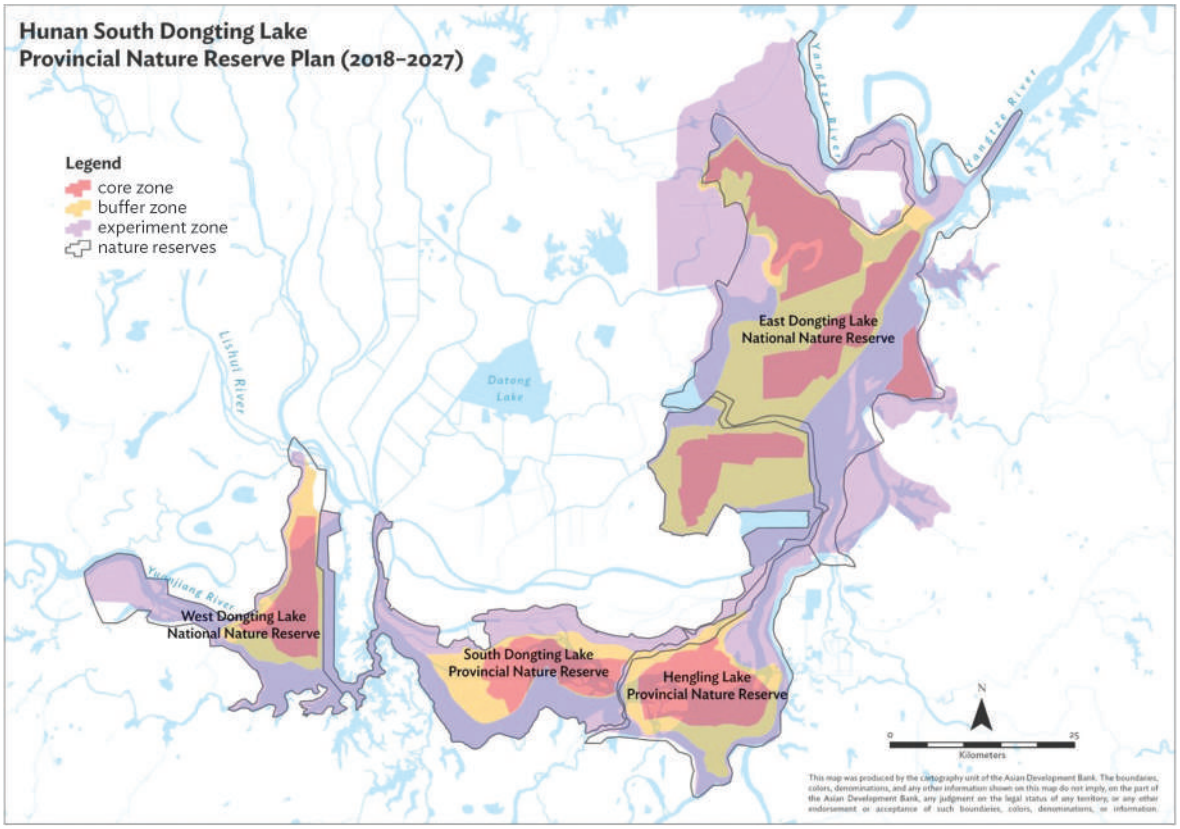
Dongting Lake, located in northern Hunan Province, feeds into the Yangtze River and is the second-largest freshwater lake in the PRC, after Poyang Lake. Situated within the Yangtze floodplain, it shares a similar latitude and warm temperate climate with Poyang Lake, experiencing most of its rainfall during the summer months. Recognized as an important bird and biodiversity area by BirdLife International, the Dongting Lake occupies a unique climatic transition zone between central and northern subtropical regions, marked by a mild, humid climate and distinct seasons.

The wetlands play a crucial role in regulating the Yangtze River's water levels. During the wet season, the shallow water area spans about 12,400 hectares (ha), while the deepwater area covers some 53,000 ha. Conversely, in the dry season, the shallow water area expands to 46,000 ha, with the deepwater area shrinking to 19,400 ha. The lake encompasses two national nature reserves—East and West Dongting lakes—and two provincial nature reserves in SDL and Hengling Lake. Designated as Wetlands of International Importance (Ramsar sites), the East, West, and South Dongting lakes are hydrologically connected, but managed independently because of their locations within three separate municipalities (Map 3). The lake basin is also a vital habitat for the endangered finless porpoise, the reintroduced milu deer, and several endangered fish species. The 168,000 ha SDL was recognized as a Ramsar site in 2002.[26]

The SDL wetland serves as a crucial breeding and wintering ground for migratory waterbirds and provides spawning and feeding grounds for fish. SDL supports a rich biodiversity, harboring 99 fish species, 109 bird species (including 49 waterfowl), and 35 nationally protected animals (of which 11 are classified as first-class protected).[27] Recognizing the lake's significance, the Government of the PRC listed SDL among the 23 wetlands of international importance in its National Biodiversity Strategy and Action Plan, 2023–2030.[28] In 2018, the Hunan Provincial Government readjusted the nature reserve's size to 80,125.28 ha.[29] About 99% of the SDL

[26] Ramsar Sites Information Service. 2008. Nan Dongting Wetland and Waterfowl Nature Reserve.
[27] These include the Père David's deer (*Elaphurus davidianus*), the Yangtze finless porpoise (*Neophocaena asiaeorientalis*), the Siberian crane (*Grus leucogeranus*), the yellow-breasted bunting (*Emberiza aureola*), the Baer's pochard (*Aythya baeri*), and the black stork (*Ciconia nigra*).
[28] Government of the PRC, Ministry of Ecology and Environment. 2024. *The National Biodiversity Strategy and Action Plan, 2023–2030.*
[29] In March 2023, the government requested the Ramsar Secretariat to revise the SDL site boundary. Feedback on this matter is pending. ADB considers the original Ramsar site boundary (168,000 ha) as still in place.

Map 3: South Dongting Lake Nature Reserves and Zoning



Source: Asian Development Bank.

Tree stump removal and land leveling. After poplars are cut, their stumps are removed with specialized diggers. Also refer to Figure 4 for cross-sections of pre- and post-recontouring (photos by ADB).

nature reserve is within the county city of Yuanjiang, Hunan, with a population of 0.7 million in 2022.[30] Yuanjiang sits within the center of Dongting Lake, surrounded by an extensive network of 16 rivers and lakes. Dongting Lake forms a U-shape to the east and west of Yuanjiang, while Datong Lake to the north creates a natural barrier. The city supports five urban lakes and one national wetland park (Qiong Lake).[31] The annual average temperature is predicted to rise by 1.9 to 2.6 degrees Celsius by 2050, which will likely increase droughts, raise water temperatures, and reduce oxygen levels in SDL, affecting fish and plant species. The average annual mean precipitation is projected to rise by 4.8%, increasing flood risks.[32]

Human activities in the area have contributed to degrading wetlands and driven habitat loss: (i) large-scale planting of monoculture poplar trees (especially in the southwestern part of SDL) has increased aridification of the wetlands, decreasing water storage and habitat for waterbirds;[33] (ii) historical reed farming for papermaking has reduced the open water area and degraded the habitats for water birds; (iii) land use changes, agricultural nonpoint source pollution,[34] overfishing,[35] and invasive plant species (e.g., the water hyacinth, *Pontaderia crassipes*) have led to ecological degradation in rural areas and decreased urban water quality; and (iv) the impoundment of the Three Gorges Dam upstream of the Yangtze (in 2003) has reduced river–lake hydrological and ecological connectivity, contributing to the seasonal decrease of water levels (especially during winter) and soil erosion. These interlinked issues are reducing the habitat for endemic and migratory species because of shrinking wetlands. Climate change-induced warming will likely increase drought risks, affecting women disproportionately because of their roles in water-dependent agriculture. Climate change and drought are expected to compound human-induced habitat degradation for migratory birds. The wetlands' natural sponge effect, which regulates and balances water flow during droughts, has deteriorated because of poplar plantations and reed farming. Without sufficient water flow during dry spells and droughts, migratory birds are unable to find rest areas and food.

Project Overview

ADB, together with cofinancier AFD, has been approached to support a proposed project by the Yuanjiang Municipal Government for SDL in Hunan Province, PRC.

The project recognizes the international importance of the Dongting Lake complex and addresses the threats and challenges facing SDL, including the following:

- Weak interagency coordination, planning, and capacity for wetland management;
- Climate change impacts, wetland ecosystem degradation, and biodiversity loss;
- Inadequate incentives for promoting sustainable and climate-resilient livelihoods;
- Insufficient knowledge and capacity for wetland management and protection; and
- Women's low representation in wetland management and decision-making.

[30] People's Government of Yuanjiang City. 2022. *Statistical Bulletin of National Economic and Social Development of Yuanjiang City in 2022.*
[31] Yanzhi, Haojiang, Liaoye, Xiaoye, Shangionq, Xiaqiong, and Shiji lakes.
[32] Climate Risk and Vulnerability Assessment Report (accessible from the supplementary documents).
[33] Poplar trees have been planted in the Dongting Lake area since the 1970s for papermaking. Since 2018, all the SDL paper mills have been shut down to protect the environment.
[34] From 2000 to 2020, the area of the natural wetlands decreased by 197,000 ha, with the conversion of natural wetland to human-made wetland (paddy field) contributing the most to this decrease. Of all the paddy fields around Dongting Lake, more than half (53%) are in the SDL basin.
[35] This impacted fish-eating species, such as the finless porpoise and the piscivorous bird. The 10-year fishing moratorium in the Yangzte River, implemented since 2021, is helping resolve the challenge.

The project will be the first investment undertaken that focuses on the RFI, and it will serve as a demonstration project to scale up future RFI wetland projects, both in the PRC and in Asia and the Pacific. It will also be a flagship project contributing to ADB's commitment through the Multilateral Development Bank Joint Nature Statement to scale up nature-positive investment.[36]

The project will support the government in operationalizing wetlands and migratory bird conservation with a landscape approach that enhances climate resilience of the wetland ecosystems and adaptive management of wintering waterbird habitats in SDL, supporting diversified, climate-resilient livelihoods in Dongting Lake.

It will also strengthen institutional capacity by improving overall local management of SDL, streamlining policy dialogue and leveraging cofinancing of AFD in the context of the RFI. The project will adopt nature-based solutions and introduce GEP accounting to quantify the economic benefits of ecosystem services and inform eco-compensation payments. It will scale up engagement of the private sector, volunteers, and inclusive community-based wetland management, combining protection goals with sustainable economic development.

The project will support and strengthen the PRC's regional efforts to strengthen biodiversity conservation, together with enhancing climate action and sharing knowledge with other countries along the EAAF through the RFI. ADB will leverage regional cooperation for the protection of public goods, foster partnerships, and promote knowledge-sharing platforms. ADB will invest $150 million, complemented by approximately $65 million from AFD and about $93 million in counterpart funding from the Government of the PRC.

The project was supported by several project visits on-site to establish relations with the various stakeholders, design the project components, and eventually validate the final project design. The project will be implemented from 2025 to 2031.

The original feasibility report was subject to extensive review by the ADB and AFD teams and supporting technical consultants. Project visits allowed opportunities to explore concerns and improve on the ambition and the technical design through several iterations.

Considerable effort was made in developing a detailed climate risk assessment and a wetland vulnerability assessment, which was shared with the Ramsar Secretariat. This supported more ambitious ecological restoration and habitat creation activities, though it raised concerns regarding the release of methane from restored wetlands and the need to mitigate those risks during construction.

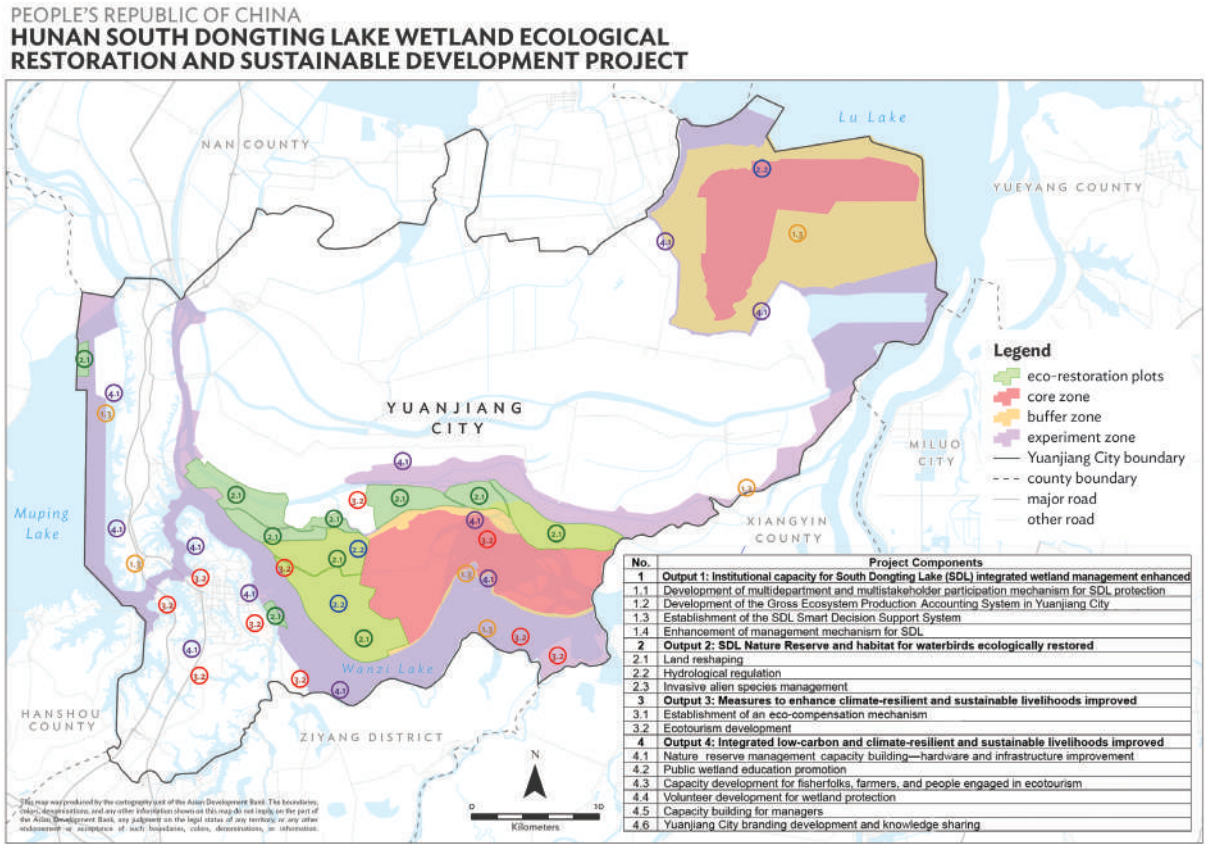
Considerable work was undertaken on eco-compensation, and this developed into a more integrated cyclical approach, including an element of cross-financing between measures that will allow finance to flow from tourism components into eco-compensation to promote sustainability in the long term. A greater focus on gender and low-income households was also developed. These, in turn, helped refine the capacity building and technical support mechanisms.

Main Outputs

The project will bring long-term environmental benefits to SDL through using nature-based solutions to support climate resilience, improve livelihoods, develop wetland management capacity, and promote nature-based tourism, driving sustainable social and economic improvement. Location of the project's main activities are illustrated in Map 4.

[36] ADB. 2021. ADB, Multilateral Banks Commit to Mainstreaming Nature at COP26. News release. 2 November.

Map 4: South Dongting Lake—Location of Main Activities



No.	Project Components
1	**Output 1: Institutional capacity for South Dongting Lake (SDL) integrated wetland management enhanced**
1.1	Development of multidepartment and multistakeholder participation mechanism for SDL protection
1.2	Development of the Gross Ecosystem Production Accounting System in Yuanjiang City
1.3	Establishment of the SDL Smart Decision Support System
1.4	Enhancement of management mechanism for SDL
2	**Output 2: SDL Nature Reserve and habitat for waterbirds ecologically restored**
2.1	Land reshaping
2.2	Hydrological regulation
2.3	Invasive alien species management
3	**Output 3: Measures to enhance climate-resilient and sustainable livelihoods improved**
3.1	Establishment of an eco-compensation mechanism
3.2	Ecotourism development
4	**Output 4: Integrated low-carbon and climate-resilient and sustainable livelihoods improved**
4.1	Nature reserve management capacity building—hardware and infrastructure improvement
4.2	Public wetland education promotion
4.3	Capacity development for fisherfolks, farmers, and people engaged in ecotourism
4.4	Volunteer development for wetland protection
4.5	Capacity building for managers
4.6	Yuanjiang City branding development and knowledge sharing

Source: Asian Development Bank.

Improved waterbird habitats in SDL wetland contributing to biodiversity protection and climate resilience. The project will restore 11,989 ha of wetland in SDL (involving the buffer zone and experimental zone of the nature reserve) through land reshaping, hydrological regulation, and wetland invasive species control. These measures represent an evolution of ambitions, ideas, and emerging understanding of regulatory constraints, including the withdrawal of measures within the core zone. Despite the presence of poplars, there is no regulatory mechanism to allow works in the core zone that would have been possible to meet within the project approval timeline. A total of 2,244 ha of shallow marshes and 127 ha of blister wetlands[37] will be developed to enhance water-retention capacity and provide open-water areas supporting roosting, feeding, and wintering of waterbirds in the dry season. About 29 kilometers of ditches connecting the distributed shallow marshes will be widened to improve the water connectivity among the depressions. The restored hydrological condition and burying of poplar trees stumps (7,908 ha) will improve the ecosystem structure and ecological function within the project area. The project aims to significantly enhance the climate resilience of the SDL wetland through a set of measures designed to mitigate the adverse impacts of climate change. Restoration

[37] Blister wetlands are small-scale depressions in high-elevation areas of flat reed beds and poplar stumps removal sites, which are unsuitable for shallow swamp development and distant from ditches and shallow marshes. Compared to mudflats, blister wetlands can intercept storm runoff or floodwater, contributing to water retention and flow regulation in the wetland area, especially during the dry season.

efforts, including land recontouring, will increase the wetland's water-storage capacity, making it more resilient to drought and heat. Hydrological restoration will improve surface water connectivity, restore natural hydrology, and increase open-water areas, thereby enhancing the wetland's ecological security.

Enhanced capacity of integrated wetland management by developing a smart decision support system for the SDL Provincial Nature Reserve. A smart decision support system will be developed to collect both climate and ecological data. Data collected by the monitoring equipment will be transmitted to a monitoring center for data storage, mining, analysis, and visualization to support decision-making on integrated wetland management. The data will support early detection of weather and climate risks, wildlife protection, ecosystem protection, epidemic prevention, and tourism resource management. In addition, compared to the previous heavy reliance on outsourced ecological and environmental monitoring, smart decision support system for SDL can enhance the capacity of real-time and continuous monitoring of wildlife in the nature reserve by staff and volunteers. It also provides opportunities to promote and support citizen science contributions to monitoring and management. The smart decision support system will provide early warnings and enable rapid reactions to extreme weather events. The monitoring system will be integrated into the reserve management plans developed as part of the project.

Enhanced coordination mechanism and institution capacity for integrated wetland management. The project will establish a vertical–horizontal institutional mechanism to (i) improve coordination among sector bureaus in the SDL; and (ii) enhance coordination among key national, provincial, municipal, and county agencies for SDL and the other lakes in the area. Training will be provided to persons involved in various industries, including wetland management, smart operation, and ecotourism, to enhance their capacity in wetland management and conservation. By integrating a multidepartment and multistakeholder participation mechanism, the project strengthens the management and protection of SDL, supporting coordinated and effective responses to climate risks.

Reduced nonpoint source pollution and aquaculture pollution in SDL through the eco-compensation mechanism. An eco-compensation mechanism will be established to provide financial incentives to farmers for switching to greener farming practices, and subsidies to aquaculture farms for adaptation of green aquaculture technologies. Effective financial incentives are expected to contribute to the reduction of chemical fertilizers and pesticides consumption in farmlands and the transition to more environmentally friendly practices of water management and aquaculture designed to conserve water and reduce pollution.

Built tourism facilities and promoted ecotourism development. The SDL project not only developed visitor management as part of the restoration of resources and support of ecotourism, but also built on Yuanjiang City's proposed application for Ramsar Wetland City Accreditation.[38] The ecotourism plan is central to the project, as it focuses on locating resources primarily in the city where people live and visit, and reducing the carbon footprint of tourism through building design and transition to green transport infrastructure. Revenue from tourism is designed to not only support livelihoods, but also support the wider eco-compensation program. Infrastructure improvements, such as enhanced patrolling facilities, coupled with extensive training and capacity building programs, will support the long-term resilience and adaptability of the SDL wetland to climate change.

Increased social and economic benefits. The primary project beneficiaries include (i) relevant government officials and SDL Provincial Nature Reserve management center staff who will receive project capacity building support and benefit from the more efficient and effective SDL coordination mechanism and improved work equipment and facilities; (ii) farmers and enterprises involved in the eco-compensation program; (iii) rural

[38] Yuanjiang Municipal Government and SIET Company Ltd. 2024. *Initial Environmental Examination: Hunan South Dongting Lake Wetland Ecological Restoration and Sustainable Development Project in the People's Republic of China* (prepared for ADB).

and urban residents, especially vulnerable groups, through access to the project trainings, project-generated job opportunities, and finance; and (iv) small and medium-sized enterprises and small business owners in the ecotourism industry with access to project fund and technical support. In total, 311,053 residents will be the targeted beneficiaries of the project, including 158,341 women and 25,000 low-income persons.

In addition, thousands of tourists will benefit from the project as the lake becomes an increasingly popular destination to travel to.

Key Transferable Lessons

Key lessons learned during the SDL project are summarized as follows:

- **Sharing both successes and failures is crucial.** The SDL project greatly benefited from the prior work of organizations like the Food and Agriculture Organization of the United Nations and nongovernment organizations, such as WWF, who have previously undertaken and reported on projects in the Dongting Lake system and the wider Yangtze River Basin.
- **Stakeholder and agency consultation is paramount.** The project was able to gather valuable information to fill data gaps, as well as receive insightful feedback from a broad range of stakeholders, including the Ramsar Secretariat, WWF, the EAAF Partnership, and the local design institute.
- **Cooperation between agencies and across administrative levels is essential, particularly during on-site visits.** Past project evidence shows that weak administration is a major threat to effective wetland management. ADB played a key role in convening stakeholders at the municipal, provincial, and national levels, including the Hunan Grassland and Forestry Administration and the National Grassland and Forestry Administration, even though these agencies were not directly involved in the project.
- **Cofinancing and collaboration between ADB and AFD are crucial.** These brought together different expertise, increased financial resources, and reduced the local share of county government counterpart funding.
- **Ambition is a game changer.** The government's initial restoration proposal was modest, and further negotiation was needed to maximize habitat restoration, enhancement, and ecological function.
- **Investing time and resources in eco-compensation can generate livelihood opportunities.** Changing established practices is challenging and requires significant support. It is essential to consult stakeholders and conduct a thorough analysis of both opportunities and challenges.
- **Detailed wetland vulnerability and climate change assessments are very important.** Climate change poses a major ecological, economic, and social threat to Dongting Lake and the broader Yangtze floodplain. Understanding these effects was crucial in advocating for more, better-connected habitat restoration to tackle issues like summer floods and winter droughts. It also raised the critical issue of wetlands potentially emitting methane and contributing to greenhouse gas emissions.
- **Conducting baseline surveys and planning early is highly recommended.** Collecting baseline data, especially on biodiversity, is often difficult and time-consuming. Early action in this area helps close data gaps, so identifying the necessary data, ensuring proper collection, and building capacity to do so should be an early priority.
- **Data-sharing issues need careful thought.** This helps ensure that the data collected is effectively shared and disseminated. Biodiversity recording apps can be a great tool for citizen engagement. The first attempt to calculate the GEP of a key Ramsar wetland on a yearly basis was built on an initial baseline assessment.
- **One of the project's main challenges is raising ambition at the provincial level.** This challenges stems from the fact that the county government lacks the mandate to implement activities beyond SDL. This is why developing a multistakeholder mechanism is key to sharing lessons and results beyond SDL.

Case: Poyang Lake

AREA: 464,664 ha
COORDINATES: 29°10'N 116°0'E
ALTITUDE: 12–30 meters

Located in Jiangxi Province, Poyang Lake is the largest freshwater lake in the PRC (Map 5). Five main rivers directly feed the lake, along with back-flooding from the Yangtze River. The water level fluctuates dramatically throughout the year, rising as much as 11 meters in summer compared to winter. During summer's peak, the lake swells, inundating the surrounding landscape. As autumn arrives and the waters recede, small, shallow lakes and grassy wetlands emerge from their submerged state.[39] The lake and its extensive wetland ecosystem play a crucial role in maintaining regional ecology, managing water resources, and supporting the livelihoods of surrounding communities. Known for its extraordinary biodiversity, the Poyang Lake wetland is also one of the largest overwintering grounds for migratory birds in the world and was identified as the highest priority site for the RFI for all countries covered.

Annually, the Poyang Lake wetlands attract more than 200 species and up to 750,000 migratory birds to stay and winter here, including many species that are classified as endangered or vulnerable (Table 3). Notably, Poyang Lake is a Ramsar site that provides a vital habitat for 95% of the critically endangered Siberian cranes (*Leucogeranus leucogeranus*), 90% of the white-naped cranes (*Grus vipio*), and 80% of the endangered Oriental storks (*Ciconia boyciana*), making it one of the world's important wetland ecosystems, especially significant for

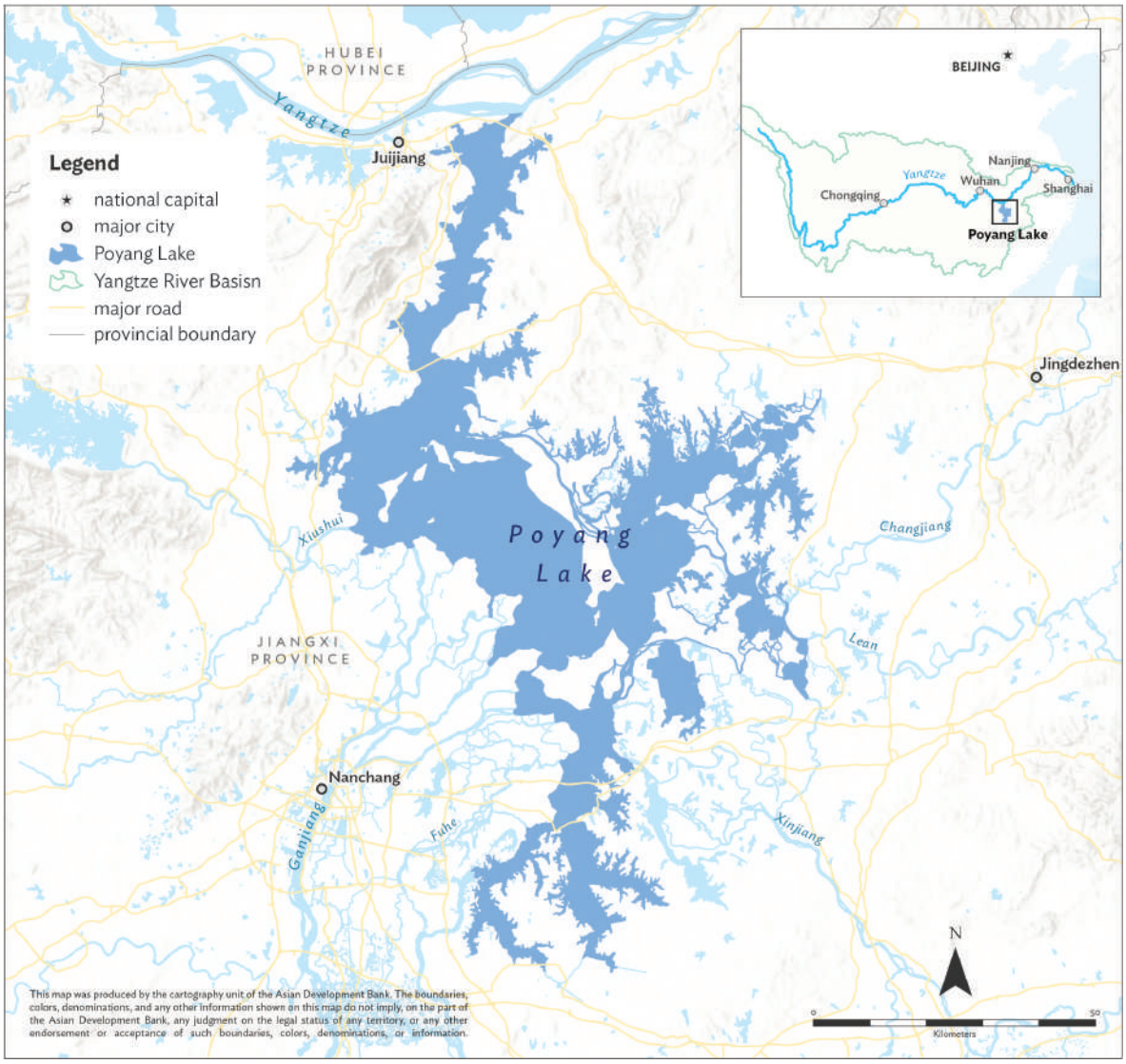
Table 3: Overview of Important Migratory Birds in Poyang Lake

English Name	Latin Name	Conservation Status
Siberian crane	*Grus leucogeranus*	Critically endangered (wintering population of more than 2,000 birds)
Oriental stork	*Ciconia boyciana*	Endangered (2,832 birds in 1998)
Swan goose	*Anser cygnoides*	Endangered (18,300 birds in 1998)
Scaly-sided merganser	*Mergus squamatus*	Endangered
Dalmatian pelican	*Pelecanus crispus*	Vulnerable
Lesser white-fronted goose	*Anser erythropus*	Vulnerable (3,100 birds in 1991)
Baikal teal	*Anas formosa*	Vulnerable
Baer's pochard	*Aythya baeri*	Vulnerable
Greater spotted eagle	*Clanga clanga*	Vulnerable
Eastern imperial eagle	*Aquila heliaca*	Vulnerable
White-naped crane	*Antigone vipio*	Vulnerable (3,716 birds in 1994)
Hooded crane	*Grus monacha*	Vulnerable (590 birds in 1996)
Swinhoe's rail	*Coturnicops exquisitus*	Vulnerable
Great bustard	*Otis tarda*	Vulnerable
Saunders's gull	*Chroicocephalus saundersi*	Vulnerable
Japanese marsh warbler	*Helopsaltes pryeri*	Vulnerable

Source: International Union for Conservation of Nature. Red List of Threatened Species.

[39] D. S. Melville. 1994. Management of Jiangxi Poyang Lake National Nature Reserve, China. *Internationale Vereinigung Für Theoretische Und Angewandte Limnologie: Mitteilungen*. 24 (1). pp. 237–242.

Map 5: Poyang Lake



Source: Asian Development Bank.

global migratory bird conservation and biodiversity maintenance. The grasslands and shallow lakes within the reserve are heavily utilized by residents for fishing, grass cutting, and livestock grazing. The lake is also the main stronghold of the endemic finless porpoise and several endangered fish species.

However, the ecosystem of the Poyang Lake Basin has been damaged by the dual effects of human activities and climate change, particularly because of the "drawdown" and "pushing" effects of the Yangtze River following the operation of the Three Gorges Reservoir, as well as changes in the inflow from its five feeder rivers, including especially the Gan and Xiu rivers. With the intensification of global climate change, Poyang Lake faces unprecedented challenges. There has been a noticeable increase in extreme weather events in the region surrounding Poyang Lake, including more frequent and intense heavy rains and droughts. This severely threatens

the survival of multiple species and further leads to a reduction in biodiversity. Moreover, these changes could also impact the lake's support for surrounding agriculture and fisheries, thereby affecting the economic welfare of local communities.

An ADB-funded technical assistance project for the Poyang Lake Climate Change Adaptation Action Plan[40] aims to enhance the climate resilience of the Poyang Lake Basin through a series of comprehensive measures. These measures include the development of a climate change adaptation action plan, submission of practical policy recommendations, targeted capacity building, and extensive knowledge-sharing and dissemination activities. The core goal of the project is to improve the policy framework and institutional capacities for climate change adaptation in the Poyang Lake area through these multifaceted efforts. Additionally, the project focuses on raising public awareness and understanding of the impacts of climate change, particularly enhancing community knowledge and awareness of nature-based climate adaptation solutions. In this way, the project hopes to increase the adaptive capacity and engagement of local communities, enabling them to better cope with various challenges brought about by future climate changes. Integrating these measures, the project's ultimate purpose is to create a more resilient environment for Poyang Lake and its surrounding communities.

Case: Chao Lake

Chao Lake is one of the key areas of focus for ecological environment management in the PRC, being one of the "Three Lakes and Three Rivers" under special attention. It is the county's fifth-largest freshwater lake. Situated in the lower reaches of the Yangtze River Basin (Map 6), the lake's basin area totals 13,544.7 square kilometers and its surface area is 780 square kilometers. Chao Lake is a natural U-shaped shallow lake with an average depth of 3.2 meters and 33 tributaries. The Yuxi River is the only outflowing river connecting to the Yangtze River. The upper reaches of the lake are surrounded by the Dabie Mountains in the west, the Jianghuai watershed in the north, and the Chuhe River valley in the northeast. The Chao Lake basin area[41] has a total population of 11.8 million, of which more than 60% are living in rural areas. Hefei is the largest prefectural-level city in the basin area, accounting for 54% of the total basin area. Chao Lake is a vital ecoregion in the Yangtze River Economic Belt.[42] The lake provides vital ecosystem services, including drinking water, freshwater for agriculture, fishing, industry, transport, recreation, and tourism. It serves as habitat to a large variety of aquatic biota and wetlands, including 46 endemic species. The northern forest areas near the Jianghuai hills are a buffer for soil erosion control, climate regulation, and water-related risk mitigation. The lake is recognized as a key region in national policies, including the Fourteenth Five-Year Plan for Comprehensive Water Environment Management Plan for Key River Basins.[43] Effective management of Chao Lake is of critical importance for its preservation as a beneficial resource for humans and nature. The basin has benefited from rapid development since the 1990s. However, population growth, land use changes, agricultural intensification, and rapid urbanization have also led to environmental degradation. Increasing nutrient loading (mainly nitrogen and phosphorus) associated

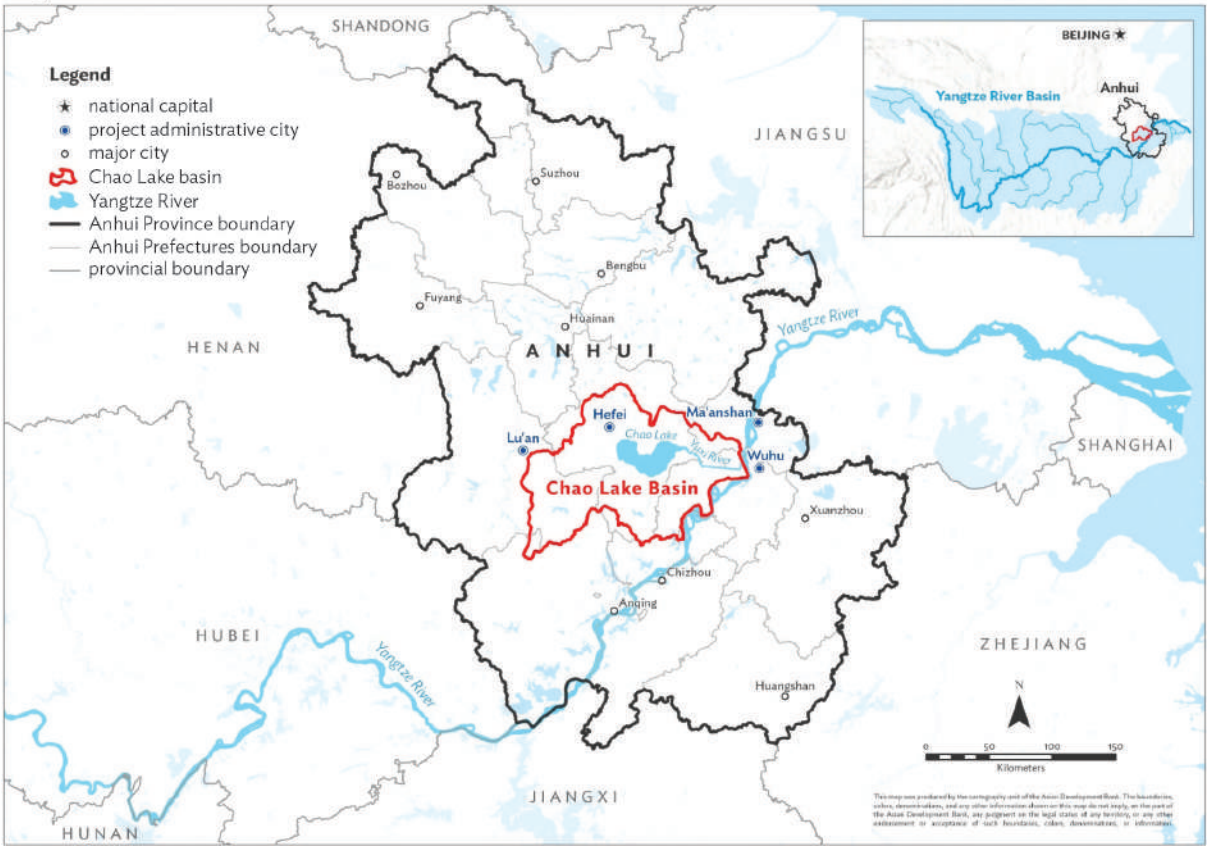
[40] ADB. PRC: Poyang Lake Climate Change Adaptation Action Plan.

[41] The Chao Lake basin area comprises 17 counties or districts in five municipalities encircling Chao Lake, including Feidong County, Feixi County, Lujiang County, Changfeng County, Chaohu City, Baohe District, Luyang District, Shushan District, and Yaohai District of Hefei Municipality; Shucheng County, Huoshan County, and Jin'an District of Lu'an Municipal City; Wuwei City; Jiujiang District of Wuhu Municipal City; Hanshan County and Hexian County of Ma'anshan Municipal City; and Yuexi County of Anqing Municipal City.

[42] The Yangtze River Economic Belt is a key economic engine in the PRC. The Government of the PRC formulated the Yangtze River Economic Belt Development Plan, 2016–2030. ADB supports the plan with a framework approach. Government of the PRC. 2016. *Outline of the Yangtze River Economic Belt Development Plan, 2016–2030.*

[43] Government of the PRC, National Development and Reform Commission. 2021. *Fourteenth Five-Year Plan for Comprehensive Water Environment Management Plan for Key River Basins, 2021–2025.*

Map 6: Chao Lake Basin



Source: Asian Development Bank.

with human activities have exerted great pressure on the lake's ecosystem, causing eutrophication,[44] with water quality in the main river sections fluctuating from class IV to class V.[45] Agricultural nonpoint source pollution and point source pollution from untreated wastewater are the main sources of water pollution in the basin.[46] Unsustainable small-scale farming is responsible for greenhouse gas emissions, soil degradation, and biodiversity loss. Flooding is also an increasing threat. A severe flood event that occurred along the Yangtze River in 2020 affected a population of 63.5 million people and caused damage of $25.2 billion (CNY179.0 billion)

[44] Eutrophication is a process wherein enrichment of aquatic systems by nutrients, usually phosphorous and nitrogen compounds, causes cyanobacteria algae blooms, with water becoming highly turbid and fish dying.

[45] Class I, class II, and class III means water is suitable for drinking; class IV water can be used for industrial purposes, while class V can only be used for agriculture. Government of the PRC, Ministry of Ecology and Environment. 2020. *2019 Report on the State of the Ecology and Environment in China*.

[46] Nonpoint source pollution sources are diffused and generally carried off the land by stormwater runoff. They originate from agriculture, forestry, urban areas, mining, construction, dams and channels, land disposal, and saltwater intrusion. Point source pollution is a discharge from a wastewater plant or industrial facility.

across the Yangtze River basin.[47] Annual precipitation in the basin is projected to increase about 10% annually by 2050, exacerbating flood risks.[48] Environmental degradation and climate change impacts constrain sustainable economic and social development.

ADB heavily invested to improve climate resilience, support rural livelihoods, and protect the ecosystem in Chao Lake basin with two projects. Phase 1 of the Anhui Chao Lake Environmental Rehabilitation Project significantly improved the water quality of the eight upstream rivers flowing into the lake, and an additional 1.42 million people in the basin area gained access to expanded wastewater collection in developed urban areas. The project also improved the institutional capacity of the Chao Lake Management Authority.[49] Phase 2 of the Anhui Chao Lake Environmental Rehabilitation Project, approved by the ADB Board in October 2023 and currently under implementation, is adopting an integrated lake management approach in the Chao Lake basin, which will help protect overall environmental health in the Yangtze River, and will strengthen Chao Lake ecosystems and benefit 2.85 million people living in the basin area (footnote 4). Phase 2 of the project will continue to enhance institutional capacity and pilot ecological compensation incentive mechanisms in the lake basin with the objective of protecting water sources from agricultural runoff and rural wastewater. An innovative climate-resilient investment fund will be established, marking the first private equity investment fund in the Chao Lake basin. The climate-resilient investment fund's primary aim is to foster private sector involvement, stimulating the local rural economy. The fund's investments will primarily target eligible subprojects that support low-carbon and climate-smart agriculture, technologies for waste pollution control, ecotourism, and renewable energy in the basin area. Funding priority will be given to small and medium-sized enterprises led by women. The project will facilitate the development of wetlands and ponds, strategically positioned to intercept and contain agricultural runoff, stormwater, and flooding. Simultaneously, the creation of walking trails, alongside the incorporation of native plants and trees, will serve to green the riverbanks of the Makou River. An advanced digital decision support system will also be established to enhance environmental and climate risk monitoring within the basin. The total project cost is $453 million, with $229 million counterpart financing from the government and other sources. It is expected to be completed in 2031. Activities from the project can be replicated in other provinces of the PRC and in other ADB developing member countries.

[47] Wang, Yi. 2020. This year's flood disasters have affected 63.46 million people and caused 219 deaths and missing persons. *China News Network*. 13 August (in Chinese).
[48] World Bank. 2022. Climate Change Knowledge Portal (accessed 8 June 2024).
[49] ADB. PRC: Anhui Chao Lake Environmental Rehabilitation Project.

Policy Directions

Introducing Flexible Reserve Zoning

Current zoning regulations may inadvertently restrict necessary ecological restoration efforts, such as tree removal or water management in core zones, even when these actions are critical for maintaining or restoring ecological balance.

Recommendations

- **Adaptive management approach.** Advocate for a shift toward adaptive management in core zones, where interventions are permitted based on rigorous scientific assessments. This approach should allow for dynamic responses to ecological changes, such as climate impacts or invasive species.
- **Regulatory revisions.** Propose revisions to zoning regulations that prioritize ecological integrity and resilience instead of a more binary approach. For instance, introduce a tiered zoning system where certain activities are conditionally permitted if they align with conservation goals.
- **Pilot projects and case studies.** Implement pilot projects in select reserves to demonstrate the effectiveness of flexible zoning. Document and share outcomes to build support for broader regulatory changes.

Strengthening Coordination Mechanisms

The lack of coordination among agencies and stakeholders with overlapping responsibilities can lead to conflicting decisions and inefficiencies in wetland management.

Recommendations

- **Formalized coordination platforms.** Establish multistakeholder platforms that include representatives from government agencies, local communities, nongovernment organizations, and the private sector. These platforms should meet regularly to coordinate activities, share information, and resolve conflicts.
- **Clear mandates and roles.** Develop a clear delineation of roles and responsibilities among stakeholders. This can be achieved through memorandums of understanding or formal agreements that outline each entity's responsibilities.
- **Joint decision-making frameworks.** Promote joint decision-making processes, particularly for issues that are cross-jurisdictional. Consider establishing a central coordinating body with the authority to mediate conflicts and enforce decisions.

- **Establishment of lake authorities.** A lake authority provides coordinated management, supporting consistent policy implementation, efficient resource allocation, and focused conservation efforts. It contributes to stakeholder engagement, resolves conflicts, and promotes sustainable development, balancing economic activities with environmental protection. Additionally, a centralized body enhances data collection and research, leading to better-informed decisions and long-term ecological health for the lake.

Improving Data Management and Sharing

The lack of a unified data management system results in fragmented and inaccessible information, impeding effective wetland management and decision-making.

Recommendations

- **Centralized data platform.** Develop a centralized, user-friendly data management platform that aggregates data from all relevant stakeholders. Design the platform so it is able to support various data types, including spatial, ecological, and socioeconomic data.
- **Standardized data collection.** Create standardized protocols for data collection and reporting to promote consistency and comparability. This may involve training programs for field staff and the adoption of common tools and technologies.
- **Data accessibility and transparency.** Make the centralized data platform accessible to all stakeholders, with appropriate data-sharing agreements and controls in place. Transparency should be a key principle, with data made available to the public, when appropriate.
- **Establishment of digital decision support systems.** These systems offer several advantages for lake management by improving data-driven decision-making. They provide real-time data on water quality, weather patterns, and ecological conditions, allowing managers to respond quickly to environmental changes and climate-related disaster risks. Digital support system tools can integrate data from multiple sources, offering comprehensive insights into the lake's ecosystem and enabling predictive modeling for issues like pollution or flooding. They also facilitate better coordination between stakeholders, supporting more effective communication and collaborative management.

Enhancing Stakeholder Participation

Limited engagement of local communities and other stakeholders in wetland management can lead to conflicts, reduced project effectiveness, and missed valuable local knowledge.

Recommendations

- **Participatory planning processes.** Implement inclusive planning processes that actively involve local communities, indigenous groups, and other stakeholders from the outset. Use tools like participatory mapping, community workshops, and public consultations to gather inputs.
- **Incorporation of traditional ecological knowledge.** Recognize and respect traditional ecological knowledge in management plans. This can involve comanagement agreements where local communities have a formal role in decision-making.

- **Capacity building.** Invest in capacity-building initiatives for local stakeholders, including training in conservation practices, governance, and sustainable livelihoods. Empower communities to take an active role in managing their natural resources.

Addressing Environmental Flows and Connectivity

Infrastructure, such as dams, disrupts natural water flows and connectivity, which are vital for maintaining wetland ecosystems and their biodiversity.

Recommendations

- **Environmental flow assessments.** Conduct comprehensive assessments to determine the environmental flow needs of key wetlands. These assessments should inform water management policies, ensuring that sufficient flow is maintained to support wetland health.
- **Restoration of connectivity.** Implement infrastructure modifications, such as fish passages, to restore connectivity for aquatic species. Consider managed releases from dams to mimic natural flow regimes. Habitat connectivity should be maintained between different protected areas.
- **Integrated water resources management.** Promote integrated water resources management approaches that consider the needs of wetlands alongside other water users. Engage with water managers, the agriculture sector, and other stakeholders to ensure wetland needs are integrated into broader water management strategies.

Scaling Up Climate-Resilient Nature-Based Solutions

The success of localized projects like the SDL initiative needs to be replicated and expanded across the Yangtze River Basin and beyond to address the broader impacts of climate change.

Recommendations

- **Promotion of the RFI.** Position the RFI as a model for wetland conservation and climate resilience across the Yangtze River Basin and beyond. Highlight its success stories and lessons learned to build momentum for similar initiatives in other regions.
- **Knowledge exchange and capacity building.** Facilitate regional and international knowledge exchange through workshops, conferences, and study tours. Share best practices, technical expertise, and lessons learned from successful projects.
- **Scaled-up nature-based solutions.** Encourage the adoption of nature-based solutions at a larger scale by integrating them into national and regional climate adaptation plans. Provide technical and financial support to local governments and communities to implement these solutions.

Conclusion

The evidence is increasingly clear that climate change and the need to adapt to it are not tomorrow's, but rather today's problem.

Wetlands provide significant ecosystem services (valued in SDL as $6.9 billion annually) and, when responsibly managed, can play a crucial role in mitigating and adapting to the challenges of climate change.[50] Healthy, diverse, and functioning ecosystems are needed to provide wetlands the needed resilience to threats, such as flooding, drought, food security, and accelerating biodiversity and bio-abundance loss. Lakes and wetlands provide the opportunity for transformational change in livelihoods, supporting the change from a production-focused to a more balanced mixed economy that includes services, such as ecotourism and enjoyment of nature and cultural heritage.

Dike flooded. During the flood in Hunan in 2024, floodwaters flow over a dike (photo from *Global Times*. 2024. Update: Closure Work Starts at Breached Dike of Dongting Lake in Central China. 6 July).

[50] L. Liu et al. 2024. Effectiveness Assessment of China's Coastal Wetland Ecological Restoration: A Meta-Analysis. *Science of the Total Environment*. 934 (4).

The management of wetlands to achieve climate resilience, stem biodiversity loss, and support sustainable livelihoods requires considerable effort. However, there is a growing body of experience and lessons learned from many organizations (e.g., WWF, the Food and Agriculture Organization of the United Nations, development banks, governments, and local authorities) to assist those engaged in wetland management in the Yangtze River Basin.

This report brings together those lessons and experience and organizes them around four major themes:

- strengthening institutional capacity for integrated wetland management,
- promoting ecological restoration of wetlands,
- enhancing climate resilience and supporting sustainable livelihoods, and
- improving knowledge and capacity among local and regional stakeholders.

The report cannot be a comprehensive handbook of wetland management, but it provides an overview of the key issues and the main action points to consider when addressing those issues, and signposts the reader to more detailed guidance, where relevant. It provides some of the lessons learned through ADB's work in SDL that may help future projects, as well as insights from other lakes in the Yangtze River floodplain. The SDL project is part of ADB's RFI. This initiative provides an opportunity to leverage investment in nature-based solutions and ecologically aligned management to address the twin challenges of climate change and biodiversity loss. It aims to restore and maintain the integrity of the flyway sites that support our shared heritage.

Strengthening the Climate Resilience and Restoration of Wetlands and Lakes in the Yangtze River Floodplain

This report shows how the wetlands and lakes of the Yangtze River floodplain of the People's Republic of China play a key role in supporting livelihoods and providing essential ecosystem services and offers actionable insights to increase its climate resilience. Taking its lead from the Hunan South Dongting Lake Wetland Ecological Restoration and Sustainable Development Project, the report highlights growing threats to the floodplain from climate change, habitat loss, and pollution. Designed to integrate biodiversity conservation with sustainable livelihood strategies, it shows how greater cross-sector coordination alongside nature-based interventions and eco-compensation schemes can help support effective ecosystem conservation and management.

About the Asian Development Bank

ADB is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 69 members —49 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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