



Regional Flyway Initiative · Site Study

May 2026

RFI Priority Site · Lake Mainit

Prepared by Ding Li Yong & Mike Crosby, with additional input from Billy Fairburn, Kelvin Peh, Evelyn Pina-Covarrubias, Stefano Barchiesi and Radhika Bhargava

BirdLife International, University of Southampton, University of Singapore

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General Site Information

Country	Philippines		
RFI Site Name	Lake Mainit	ID119	
City/ Municipality, Province, Region	Municipalities of Mainit, Alegria, Jabonga, Kicharao in Surigao del Norte, Agusan del Norte. Caraga region		
Geographical coordinates	9.46° N, 125.52° E	Area (has)	13,996 ha
Key species	Endemic fish species, <i>Glossogobius giurus</i> and <i>Ophieleotris aporos</i> , dependent on Mainit's lentic ecosystems. Tufted Duck.		
Key habitats (biomes)	Lentic ecosystems		
Key ecosystem services	Provisioning services (fisheries)		
Key drivers of change	Unsustainable fishing, agricultural expansion, logging		
Conservation status (mark all that applies)	<input type="checkbox"/>	Protected Area	<input checked="" type="checkbox"/> Flyway Network Site
	<input type="checkbox"/>	Ramsar Site	<input type="checkbox"/> Others _____
IBA/ KBA name (and number) and other designations	Lake Mainit KBA, and proposed protected area		
Management Stakeholders	Lake Mainit Development Alliance (LMDA), PENRO, LGUs		
With management plan?	Yes		
Project concept themes	Ecotourism, watershed and fisheries management, water pollution management		
Length of project	5-8 years		
Sector/s	Pollution control, water management		
No. of potential beneficiaries	Approximately 59,246 people		
Indigenous Peoples	<input type="checkbox"/>	No	<input checked="" type="checkbox"/> Yes, <u>Mamanwa communities</u>
Anticipated Implementation Risks	Income loss for fisherfolk through fisheries regulations, possible disturbance and further pressures to Lake Mainit from infrastructure development and tourism operations, security given the wetland location		
Estimated Project Budget (US\$)	10,400,000 for five years		
Potential Source/s of Financing	<input checked="" type="checkbox"/>	Loan (to be identified)	<input type="checkbox"/> Private Sector
	<input checked="" type="checkbox"/>	Grant (to be identified)	<input type="checkbox"/> Public-Private Partnership

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Abbreviations

ADB	Asian Development Bank
AWC	Asian Waterbird Census
CARAGA	Regional division in Mindanao, consisting of the provinces of Agusan del Norte, Agusan del Sur, Dinagat Islands, Surigao del Norte, and Surigao del Sur
CSR	Conservation Status Review
DMC	Developing Member Country
EAAFP	East Asian-Australasian Flyway Partnership
ECA	Ecologically Critical Area
IBA	Important Bird and Biodiversity Area
KBA	Key Biodiversity Area
LMDA	Lake Mainit Development Authority
LGU	Local Government Unit
NGO	Non-governmental Organization
OECM	Other effective area-based conservation measures
PES	Payment for ecosystem services
RFI	Regional Flyway Initiative
SLR	Sea Level Rise
TESSA	Toolkit for Ecosystem Services Assessment
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
USD	United States Dollars

Executive Summary

Lake Mainit is the fourth largest (14,014 ha), and deepest lake in the Philippines (-223 m) and is located on a narrow plain between hill ranges in northern Mindanao, east of the city of Butuan. The lake is fed by at least fourteen (14) small rivers and streams, and it has one outlet, the Kalinawan River, which flows south into Pagusi Lake and the Tubay River, and eventually into Butuan Bay. Lake Mainit is recognized as a KBA on account of the highly endemic plant and aquatic diversity in its watershed, and a high concentration of threatened species associated with Mindanao's forest landscapes. The lake also supports possibly the largest wintering congregation of the migratory Tufted Duck *Aythya fuligula* in Philippines (ahead of Lake Naujan in Mindoro) and the Southeast Asia region, with a recent census detailing over 33,000 individuals, or well over 13% of the EAAF population. Recent surveys have identified a total of 41 species of fish, 5 crustaceans, 8 molluscs and 14 species of aquatic plants. Lake Mainit supports an important fishery, and fishing has been identified to be the primary livelihood of the communities around the lake, with a focus on two species, *Glossogobius giurus* and *Ophieleotris aporos*, alongside various introduced fish. A sustainable fisheries management programme has been developed for the lake. The economy of the municipalities around the lake is heavily dependent on agriculture, mining and the timber industry.

In recent years, the productivity of Lake Mainit has become increasingly vulnerable to pressures arising from rapid economic development and unsustainable use in the lake's watershed. Several exotic fish species (e.g. tilapia, carp and catfish) have been introduced into the lake while floating plants such as the common water hyacinth *Eichhornia crassipes* and lotus *Nelumbo nucifera* has formed large expanses on the Kalinawan, which drains into the lake. Mining and agriculture have also led to an increase in water pollution, alongside limited management and control of sewage, mining and agricultural effluents that drain into the lake.

To strengthen management and conservation of the Lake Mainit wetlands and its watershed, there is considerable scope for (1) ecotourism development, through the creation of new infrastructure managed by local stakeholders and a tourism plan to guide capacity building activities at the municipal level, (2) strengthening watershed management and protection measures, with a focus on addressing water pollution arising from agriculture, logging and mining activities on the lakeshore and surrounding hills, and (3) improved biodiversity monitoring. Declining fisheries of locally important species is of major concern through consultations with local fishers, and if left unaddressed, would not only disrupt the lake's aquatic ecosystem, but also impact local livelihoods. There is a need for improved management of fisheries, through updating and better implementation of the sustainable fisheries management programme, and investment into training on sustainable fishing techniques. This intervention is expected to be implemented against targeted work to manage invasive plants that has affected parts of the lake and inflowing rivers.

1. Background of the Regional Flyway Initiative

In July 2021, the Asian Development Bank made a commitment to develop a long-term Regional Flyway Initiative (RFI) in the East-Asian Australasian Flyway (EAAF) (Sovereign Project 55056-001) to protect and restore priority wetland ecosystems and the associated ecosystem services they provide in the EAAF, the most threatened migratory bird flyway globally. The Initiative is slated for implementation in nine ADB developing member countries (DMCs) in East, South and Southeast Asia: Mongolia, People's Republic of China (PRC), Bangladesh, Viet Nam, Cambodia, Philippines, Thailand, Malaysia and Indonesia. In 2023, the geographic scope of the RFI was further extended to two DMCs in Southeast Asia and the Pacific respectively, Lao PDR and Papua New Guinea.

The primary aim of the RFI is to enhance and expand the existing efforts in conserving and managing wetlands of the highest priority for migratory birds within the EAAF through innovative loan and grant financing, and at scale. Consultations and analyses over the development period help identify key interventions to strengthen the management of wetlands, enabling the implementation of nature-based solutions while strengthening biodiversity protection. Over time, the RFI seeks to leverage collaborative opportunities by developing partnerships among important stakeholders including national governments, civil society organizations, communities, regional organizations like the East Asian-Australasian Flyway Partnership (EAAFP), development agencies, the private sector, and other relevant entities.

Through the RFI Technical Assistance (TA) implemented over the RFI's development phase from 2021 to 2024, BirdLife International takes the lead in providing and coordinating technical support for development of the RFI. This is carried out in collaboration with the EAAFP and a consortium of international non-governmental organizations including Wetlands International and the Paulson Institute, as well as two universities, namely the University of Southampton, UK and the National University of Singapore. Over the development phase, the TA team undertook a site selection analysis to identify priority wetland sites in all 10 countries based on recent bird data benchmarked against internationally accepted criteria under the Convention on Wetlands of International Importance (or Ramsar Convention), EAAFP Flyway Network Sites and Important Bird and Biodiversity Areas (IBAs). The team further developed ecosystem services profiles for prioritized wetlands using a multi-pronged approach used the TESSA ecosystem services assessment tool, and data-driven modelling of water-based ecosystem services and stored carbon.

In the Philippines, a total of 20 wetland sites, including many Asian Waterbird Census count sites, were initially assessed through data analysis and expert consultation, of which twelve (12) were defined and identified to be RFI priority sites on the basis that they support more than 1% the flyway population of at least one EAAF migratory waterbird species. The majority of the RFI wetlands prioritized for the Philippines are coastal wetlands, a consequence of the country's long coastline, with the largest cluster of priority sites being North Manila Bay, which constitutes three sites across the provincial jurisdictions of Bataan, Pampanga and Bulacan. 28 EAAF species exceeded the 1% threshold at the site level, with species such as Chinese Crested Tern, Chinese Egret and the Tufted Duck.

2. Site profile of Lake Mainit

Location: Lake Mainit is located near the extreme northern tip of Mindanao Island in the Municipalities of Mainit, Alegria, Jabonga, and Kicharao, on the boundary between Surigao del Norte and Agusan del Norte Provinces.

Area: The Lake Mainit RFI site has an area of 13,996 ha.

Altitude: 27 m asl.

Geographical coordinates: 9.46° N, 125.52° E

Description of site: Lake Mainit is the fourth largest lake in the Philippines and is located on a narrow plain between hill ranges in northern Mindanao. The lake is fed by at least fourteen (14) small rivers and streams, and it has one outlet, the Kalinawan River, which flows south into Pagusi Lake and the Tubay River, and eventually into Butuan Bay. The shoreline is steeply shelving, and the maximum depth of the lake is about 219-223 m, making the lake the Philippine's deepest water body. Lake Mainit is a highly productive and diverse wetland ecosystem which supports a thriving, but declining, freshwater fishery.

Site administration, management and land tenure: Lake Mainit is not a formally designated as a protected area but is being proposed as one, but the Lake Mainit Development Alliance (LMDA) has been formed in 1999 to promote the sustainable development and management of the lake. The leading organizations in the LMDA are the Provincial Governments of Surigao del Norte and Agusan del Norte and their member municipalities, plus the following government agencies: the Department of Environment and Natural Resources (DENR), Bureau of Fisheries and Aquatic Resources (BFAR), National Economic Development Authority (NEDA), Philippine Information Agency (PIA), Department of Tourism (DOT), and Department of Agriculture (DA). The LMDA also engages with other partners, including the academe (Surigao Norte College of Arts and Technology), the business sector, NGOs, and people's organizations through the Lake Mainit Civil Society Network. An Environmental Management Plan has been compiled for the lake by the LMDA funded by the Region 13 CIDA-Local Government Support Program (LGSP)¹. Currently, LMDA has not convened due to conflicting political priorities of local leaders.

Social and economic values: Lake Mainit supports an important fishery, and fishing is the primary livelihood of the communities who live around the lake and consume and trade two fish species found there, "pedianga" *Glossogobius giurus* and "buguan" *Ophieleotris aporos*. A sustainable fisheries management program has been developed for the lake². The economy of the municipalities around Lake Mainit is heavily dependent upon agricultural production in the land around the lake, which is intensively cultivated with rice, corn and bananas. Timber companies operate in the lake's catchment area, and several local industries are dependent on the forest resources of the area. The regional office of the Department of Environment and Natural Resources has a reforestation programme which aims to

¹ https://essc.org.ph/content/wp-content/uploads/2011/03/essc-pwg_report_lake_mainit_development_alliance_agusan_del_norte_surigao_del_norte1.pdf

² <https://lmda.wordpress.com/wp-content/uploads/2008/08/sustainable-fisheries-management-program-for-lake-mainit.pdf>

restore land where the natural forests have been lost or degraded by illegal logging activities. A hydroelectric power plant was recently constructed at Lake Mainit, which began commercial operation in March 2023, which has been pointed out as the main reason for the residing water level of Lake Mainit.³

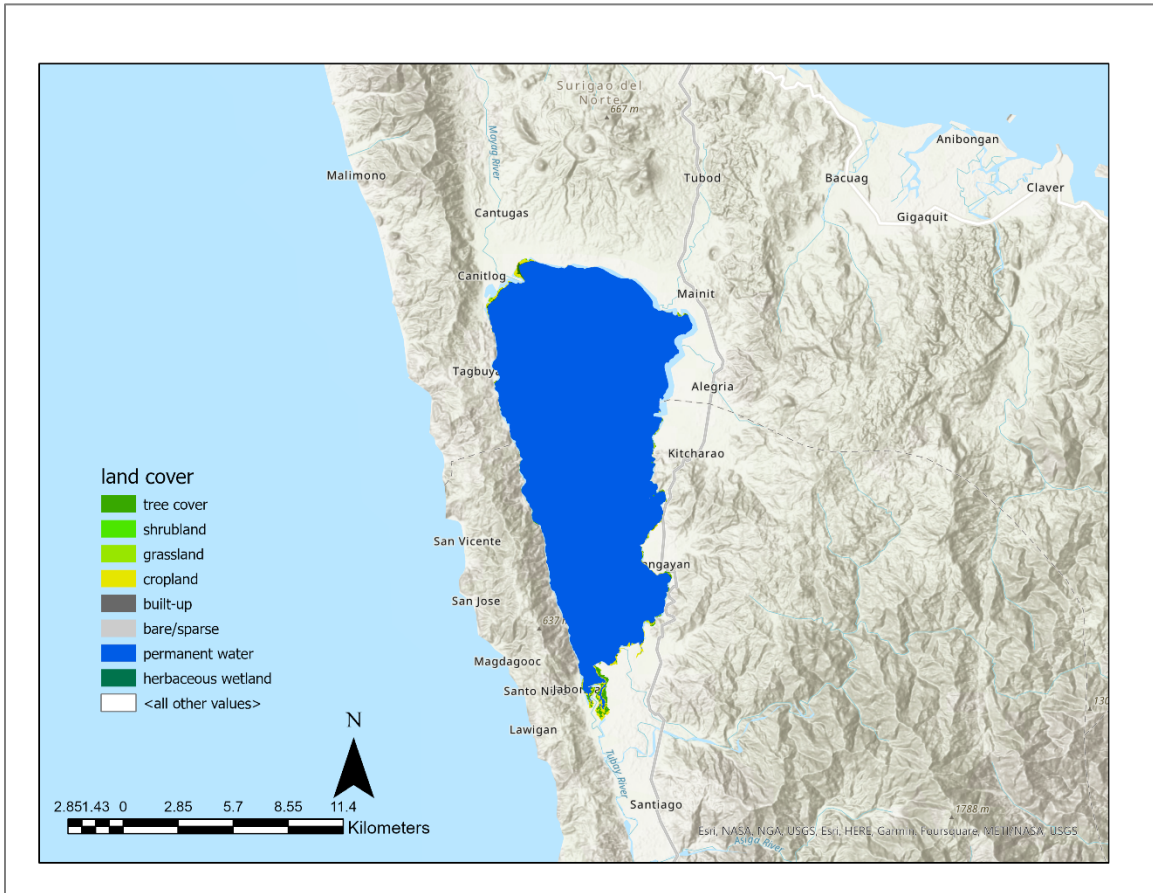


Figure 1 Map of Lake Mainit, the Philippines' third largest, and deepest water body. (Map: Radhika Bhargava).

³ https://www.jpowers.co.jp/english/news_release/pdf/news230719e.pdf

3. Biodiversity value of Lake Mainit

3.1 Key habitats

Lake Mainit is the fourth largest lake in the Philippines and is located on a narrow plain between hill ranges in northern Mindanao. The lake is fed by at least fourteen (14) small rivers and streams, and it has one outlet, the Kalinawan River, which flows south into Pagusi Lake and the Tubay River, and eventually into Butuan Bay. The shoreline is steeply shelving, and the maximum depth of the lake is about 219-223 m, making the lake the Philippines' deepest water body. Lake Mainit is a highly productive and diverse wetland ecosystem which supports a thriving, but declining, freshwater fishery.

3.2 Importance of Lake Mainit to migratory waterbird species

Lake Mainit supports a diversity of migratory waterbirds, including ducks, herons and egrets, shorebirds and terns. Waterbird count data from the 2019, 2020, and 2021 Asian Waterbird Census were used in the RFI priority sites analysis for this site. The counts from these three years were averaged and then compared against the CSR1 1% population estimates to calculate a score for each species. The Tufted Duck (*Aythya fuligula*) is the only migratory waterbird found to exceed the 1% population estimates (Table 1), and the exceptionally large population of this species provided the overall RFI score for this site.

Table 1 List of migratory species (based on the EAAFP list of species) with globally significant congregations in the Lake Mainit Basin.

Scientific name	IUCN	Average count	CSR1	CSR1 score
Tufted Duck <i>Aythya fuligula</i>	LC	33,163	2,400	13.8

3.3. Other notable biodiversity

Several studies have been conducted of the fishes in Lake Mainit, e.g. Pauly et al. (1990), Biña-de Guzman et al. (2013). Forty-one (41) species of fish, 5 crustaceans, 8 molluscs and 14 species of aquatic plants have been reported in the lake in a recent survey. Notably, Lake Mainit's immediate watershed is rich in plant diversity, of which 41 species are of high conservation priority, including *Rafflesia mixta*, a critically endangered species that was only recently described (Barcelona et al. 2014). Plant endemism in Mainit's watershed forests is high, which 40% of the known flora being endemic to Mindanao (Apdohan et al. 2019). A recent assessment of the site's importance show that the lake is highly irreplaceable (Apdohan et al. 2019).

4. Ecosystem services

4.1. Ecosystem services provided by Lake Mainit

Lake Mainit site provides diverse ecosystem services, including provisioning, regulating, and cultural services (Figure 2), which are vital to communities within, adjacent to, and distant from the site (Table 2). The results from the RFI workshop⁴ highlight the top ecosystem services provided by the site, emphasizing their essential and non-substitutable nature (Table 2). Provisioning services, particularly fresh water, are critical, benefiting communities both within and adjacent to the site. Food provision benefits communities at all distances. Genetic resources, essential for the site's biodiversity, also benefit all community ranges. Regulating services such as flood hazard regulation are crucial for both on-site and adjacent communities. Cultural services, particularly recreation and ecotourism, are of great importance, benefiting communities at all distances.

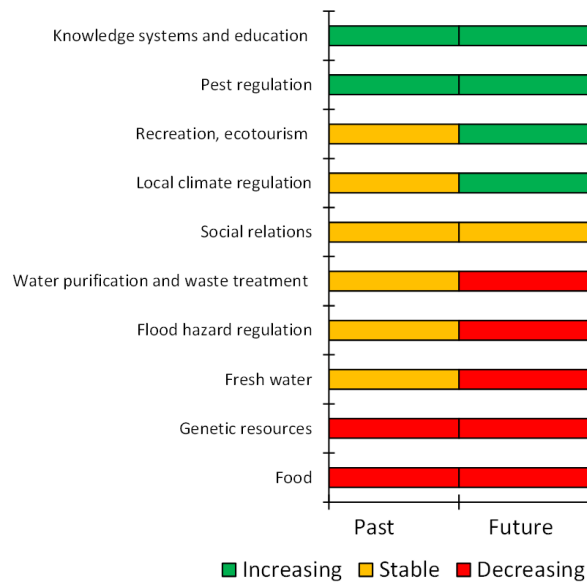


Figure 2 List of ecosystem services provided by Lake Mainit, as identified through stakeholder consultation at the Regional Flyway Initiative workshop.

⁴ Asian Development Bank. (2023, June 27–30). *Philippines: Wetland Ecosystem Services Workshop* [Workshop]. Asian Development Bank Headquarters, Manila, Philippines. <https://events.development.asia/learning-events/philippines-wetland-ecosystem-services-workshop>

Table 2 List of top ecosystem services provided by Lake Mainit.

Ecosystem services	Essential or non-substitutable	Benefits to communities			Change	
		Within the site	Adjacent to the site	Distant to the site	Past	Future
<i>Provisioning services</i>						
Fresh water	Yes	✓	✓		No change	Decrease
Food	Yes	✓	✓	✓	Decrease	Decrease
Genetic resources	Yes	✓	✓	✓	Decrease	Decrease
<i>Regulating services</i>						
Flood hazard regulation	Yes	✓	✓		No change	Decrease
<i>Cultural services</i>						
Recreation, ecotourism	Yes	✓	✓	✓	No change	Increase

4.3 Flood mitigation services

The flood mitigation services provided by Lake Mainit were assessed using biophysical values only (see Table A1 and Annex 1 for details). When compared to both the average of the three RFI inland sites and the average of all other inland wetlands in the Philippines (Table A2 in Annex 1), Lake Mainit show some partly mixed results in terms of benefits and beneficiaries:

(1) for the average green storage capacity per sq. km of wetland, Lake Mainit is below average (412 Giga Liters or GL of water per km² vs. 562 GL/km² for RFI inland sites and 448 GL/km² for all other inland wetlands);

(2) for the average population uniquely benefitting from influential green storage upstream per sq. km of wetland, Lake Mainit is above the average of RFI inland sites (181 vs. 165 people/km²) but well below average compared to all other inland wetlands (181 vs. 624 people/km²); and

(3) for the average built-up area uniquely benefitting from influential green storage upstream per sq. km of wetland, Lake Mainit is also well below average (0.83 ha vs. 2.97 ha/km² for RFI inland sites and 5.35 ha/km² for all other inland wetlands).

5. Drivers of change and their potential impacts

5.1. Current drivers of change and their level of impact

Stakeholders from the RFI workshop⁵ identified 32 drivers of change impacting Lake Mainit and their corresponding levels of impact on the wetland site (Table 3). Medium-impact drivers include agricultural and forestry effluents, which contribute to nutrient loading and water quality degradation. Erosion and siltation/deposition further alter the habitat structure, affecting both terrestrial and aquatic species. In 2015, a major fish kill was observed by local communities in Lake Mainit, lasting several weeks while an assessment of the lake's water quality in 2016 noted that the rivers draining into the lake was rated as 'rather dirty to average' (Apdohan et al. 2019).

Fishing, killing, and harvesting of aquatic resources represent additional threats to biodiversity within the lake. Household sewage, garbage, and solid waste from areas outside the wetland site add to the medium impact, posing pollution and contamination risks. Development within the site, particularly housing and settlement, also contributes to habitat loss and fragmentation. Industrial mining and military effluents, along with hunting of terrestrial animals, intensify the medium-level threats to Lake Mainit's ecological integrity.

Further stakeholder consultations held in February 2025 showed that unsustainable fishing practices and intensive farming increased in recent years as the water level of Lake Mainit receded drastically, which they attribute to the recently operational hydropower plant. The receding water level that exposed foreshore land has resulted to conflicts among local communities. It should be noted that other industrial developments are being explored in and around Lake Mainit, such as floating solar panels and wind turbines.

⁵ Asian Development Bank. (2023, June 27–30). *Philippines: Wetland Ecosystem Services Workshop* [Workshop]. Asian Development Bank Headquarters, Manila, Philippines. <https://events.development.asia/learning-events/philippines-wetland-ecosystem-services-workshop>

Table 3 Drivers of change and their potential impact on the integrity of Lake Mainit based on consultations with stakeholders.

Driver of change	Impact
Agricultural and forestry effluents	Medium
Annual and perennial non-timber crop production	
Erosion and siltation/deposition	
Fishing, killing and harvesting of aquatic resources	
Garbage and solid waste	
Household sewage and urban waste water from outside the wetland site	
Housing and settlement	
Hunting, killing and collecting of terrestrial animals	
Industrial, mining and military effluents	
Invasive animal species	
Sewage and waste water from wetland site facilities	
Collecting terrestrial plants or plant products (non-timber)	
Commercial and industrial areas	
Dams within or upstream of the wetland site, which alter the hydrological regime	
Dams, hydrological modification and water management/use	
Energy generation, including from hydropower dams, wind farms and solar panels	
Habitat clearing	Low
Invasive plant species	
Livestock farming and grazing	
Loss of cultural links, traditional knowledge and/or management practices	
Loss of keystone species	
Marine and freshwater aquaculture	
Mining and quarrying	
Ports with large scale loading and unloading of goods	
Recreational activities and tourism	
Research, education and other work-related activities	
Restoration for conservation	
Roads and railroads	
Storm and flooding	
Tourism and recreation infrastructure	
Utility and service lines	
Water extraction/diversion within the wetland site or catchment	

5.2. Potential alternative state of Lake Mainit under current drivers of change

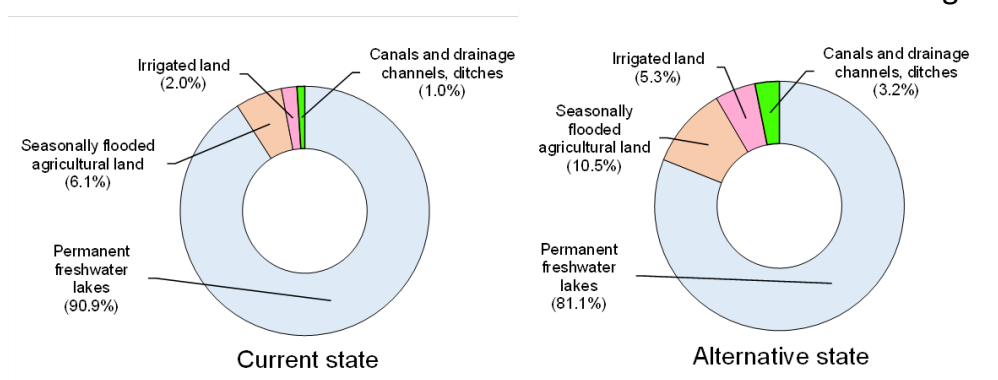


Figure 3 The proportional change in the extent of different habitat types between the current and alternative states of Lake Mainit.

Stakeholders at the RFI workshop⁶ defined the most plausible future alternative state (to 2035), and how this will translate to a net change in the cover of different types of wetland habitat within this site (current habitat cover vs future alternative cover; Figure 3). The alternative state of the site assumes there will be no changes in the current drivers of change impacting the site, and the current management regime.

⁶ Asian Development Bank. (2023, June 27–30). *Philippines: Wetland Ecosystem Services Workshop* [Workshop]. Asian Development Bank Headquarters, Manila, Philippines. <https://events.development.asia/learning-events/philippines-wetland-ecosystem-services-workshop>

5.3. Expected changes in the ecosystem services of Lake Mainit

Stakeholders at the RFI workshop⁷ documented the future trends in the provision of ecosystem services in Lake Mainit, indicating if the ecosystem services provided by this site (to 2035) will increase, decrease, or will remain stable, assuming that the current drivers of change impacting this site will continue in their present condition, with the intervention remains unchanged.

Figure 2 and Table 2 shows that the provisioning of fresh water has remained unchanged in the past but is expected to decrease in the future. Food provision has already seen a decline, with further decreases anticipated. Genetic resources have experienced a past decline with a predicted future decrease. Regulating services such as flood hazard regulation, have not changed in the past but is projected to decrease in the future. Cultural services have remained stable in the past but are expected to increase in the future.

A net gain of 560 hectares of seasonally flooded agricultural land as presented in Table A5, however equivalent to 4.0% of the total land use for the site, is expected to result in an effective increase of 8.5% or 12.8 Giga Liters in green storage capacity per km² of wetland. This increase, calculated relative to the current green water habitat base, may amount to nearly 11 people and 0.17 hectares of built-up areas gaining enhanced flood mitigation benefits per km².

⁷ Asian Development Bank. (2023, June 27–30). *Philippines: Wetland Ecosystem Services Workshop* [Workshop]. Asian Development Bank Headquarters, Manila, Philippines. <https://events.development.asia/learning-events/philippines-wetland-ecosystem-services-workshop>

6. Capacity needs in Lake Mainit

Stakeholders for Lake Mainit assessed capacity needs for identified priority areas for wetland management (Table 4) and highlighted major capacity gaps and needs (rated 0) for most site-level management priorities ranging from wetland monitoring to invasive species management and ecosystem services (value) assessment. There is limited capacity for most other aspects of wetland management (rated 1), notably awareness promotion and participatory management, of which existing frameworks and structures already exist through the LMMA.

Table 4 Capacity needs at site-level management of Lake Mainit (0 for limited capacity, and 3 for high capacity).

Site-level capacity area	Score: Wetland Protected Areas	Score: Wetlands with no formal protection
Wetland research and monitoring	0	0
Invasive species control	0	0
Establishing positive incentives for wetland conservation	0	0
Communication, Education and Public Awareness for wetland conservation/sustainable use	1	1
Cross-sectoral/participatory management for wetlands	1	1
Wetland ecosystem services/values assessment	0	0
Wetland management planning	1	1
Project management	1	1
Climate change and disaster risk reduction	0	0
Eco-tourism	1	1
Sustainable livelihoods	1	1
Waterbird flyway conservation	1	1
Waterbird monitoring	1	1
Wetland management for waterbirds	1	1

7. Opportunities for RFI interventions

7.1 Recommended Interventions

Two of the most important challenges facing Lake Mainit is the unsustainable use and management of freshwater resources, especially in the rivers draining into the lake and has increasingly exposed the lakeshore, which is now heavily cultivated. Meanwhile, this has also generated waste management – agro-chemical pollution, with broader implication for the long-term integrity of the lake, alongside a planned hydropower project to link the lake with waterbodies downstream through an engineered tunnel through the mountains.

Proposed interventions to improve the sustainable management of the lake needs to address, (1) unregulated water usage and water pollution, (2) declining fisheries, and (3) also tackle encroachment of the forests in the wider Lake Mainit watershed, where small-scale mining and (illegal) logging has increased soil erosion and pollution.

Table 5 Key interventions recommended for the sustainable management of Lake Mainit and its intervening watershed.

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
<i>Component 1. Enhanced sustainable forest and wetland-based ecotourism</i>					
Developing a coordinated nature-based tourism plan for the Lake Mainit basin	<p>Cohesive and inclusive nature-based tourism implementation in Lake Mainit</p> <p>Nature-based tourism strategy and plan developed with inputs from key stakeholders</p>	<p>Feasibility studies related to nature-based (eco) tourism completed.</p> <p>One nature-based (eco)tourism plan developed for the Lake Mainit basin and disseminated to key stakeholders in Agusan del Norte and Surigao del Norte</p> <p>Number of stakeholders engaged for the development of the nature -based (eco)</p>	200,000.00	1.5 years	<p>Department of Environment and Natural Resources</p> <p>DENR PENRO Agusan del Norte</p> <p>DENR PENRO Surigao del Norte</p> <p>Department of Tourism</p> <p>National Commission on Indigenous People</p> <p>People Organizations</p>

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		tourism plan for the Lake Mainit basin			Concerned provincial and municipal government units Conservation organizations (including bird and community-focused NGOs)
Build the capacity of small-scale tourism operators	<p>Training and capacity needs for nature-based tourism assessed</p> <p>Relevant training modules developed and implemented with key stakeholders (e.g., DENR, LGUs, provincial government, DoT, tourism operators)</p> <p>Improved capacity of key stakeholders about nature-based tourism</p>	<p>Training Needs Assessment on nature-based tourism completed and disseminated to concerned stakeholders</p> <p>Number of training modules developed based on the results of training needs assessment</p> <p>Number of capacity-building activities administered with concerned stakeholders</p> <p>Number of tourism operators (target of up to 20) benefitting from the capacity-building activities</p>	100,000.00	5 years	Lake Mainit Development Alliance
Improving ecotourism infrastructure including viewing platforms, boardwalks, shelters on the lakeshore.	Stronger (and functional) infrastructure to host tourists, including platforms, boardwalks, and shelters	Number of infrastructure established/ improved (i.e., substation for rangers and tourists, at least 0.5	100,000.00	5 years	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		km boardwalks and hides) constructed			
<i>Component 2. Improved wetland habitat and watershed management</i>					
Update the watershed management plan for Lake Mainit basin	<p>Cohesive and inclusive watershed management interventions for the Lake Mainit basin</p> <p>Watershed-level strategy and plan developed with inputs from key stakeholders</p>	<p>Baseline studies completed to guide management planning for the Lake Mainit basin</p> <p>Updated Lake Mainit Management Plan developed and disseminated to key stakeholders in Agusan del Norte and Surigao del Norte</p> <p>Number of stakeholders engaged for the development of the watershed management plan for the Lake Mainit basin</p>	500,000.00	2 years	<p>Department of Environment and Natural Resources</p> <p>DENR PENRO Agusan del Norte</p> <p>DENR PENRO Surigao del Norte</p> <p>Department of Tourism</p> <p>Department of Agriculture</p> <p>National Commission on Indigenous People</p> <p>People Organizations</p> <p>Concerned provincial and municipal government units</p> <p>Conservation organizations (including bird and community-focused NGOs)</p> <p>Lake Mainit Development Alliance</p>
Establishing a wastewater treatment facility to control the discharge of wastewater and sewage into Lake Mainit.	Pollution discharges into the lake better controlled.	<p>Baseline assessments and stakeholder consultations for establishing a wastewater treatment facility completed and presented with key stakeholders, including vulnerable groups</p> <p>One wastewater treatment facility established on the</p>	100,000.00	5 years	<p>Conservation organizations (including bird and community-focused NGOs)</p> <p>Lake Mainit Development Alliance</p>

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
		lakeshore, or along one of the major inlet rivers.			
Explore the feasibility of payments for ecosystem services (for downstream cities, e.g. Butuan)	<p>Feasibility of payment for ecosystem services, and other potential financing mechanisms assessed.</p> <p>Public and private financing mechanisms identified to sustain interventions for the Lake Mainit basin</p>	<p>Feasibility of PES scheme has been assessed and presented to key stakeholders</p> <p>Number of stakeholders engaged for the assessment of the PES scheme applicability</p>	100,000.00	1 year	
Establishing a local-led biodiversity and wetland monitoring scheme focusing on aquatic biodiversity and waterbirds.	<p>Biodiversity and wetlands monitoring framework and mechanism for the site established.</p> <p>Improved local biodiversity and wetland information for better site management.</p> <p>Formation of a locally led conservation monitoring group led by concerned LGUs</p>	<p>Biodiversity and wetlands monitoring framework identified and used for site monitoring</p> <p>Number of monitoring reports on the biodiversity and wetland status generated, especially during the migration season</p> <p>A locally led conservation monitoring group organized</p>	400,000.00	3 years	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
<i>Component 3. Strengthening wetland habitat and watershed protection</i>					
Securing legal protection for Lake Mainit including the establishment of a legally protected site under Philippine's Enhance Protected Area Act.	Boundaries expanded and delineated, in consultation with local communities. Increased legal wetland and watershed protection for the Lake Mainit basin	Number of facilitated national and international legislation to protect the Lake Mainit basin	100,000.00	3 years	Department of Environment and Natural Resources DENR PENRO Agusan del Norte DENR PENRO Surigao del Norte National Commission on Indigenous People
Strengthen the local capacities of concerned LGUs on watershed management, with a focus on addressing wastewater, solid waste pollution, deforestation, and waste management.	Training and capacity needs on watershed management assessed Relevant training modules developed and implemented with key stakeholders (e.g., DENR, LGUs, provincial government, local communities), including exchange visits Improved capacity of key stakeholders about watershed management	Training Needs Assessment on watershed management completed and disseminated to concerned stakeholders Number of training modules developed based on the results of training needs assessment Number of capacity-building activities administered with concerned stakeholders Number of people benefitting from the capacity-building activities, especially those from the vulnerable groups	500,000.00	2 years	People Organizations Concerned provincial and municipal government units Conservation organizations (including bird and community-focused NGOs) Lake Mainit Development Alliance

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
<i>Component 4. Invasive species management, with a focus on invasive water plants</i>					
Develop an invasive species management plan, in consultation with key stakeholders	Baseline information, with focus on invasive water plants, generated to manage invasive species in Lake Mainit.	Baseline information generated and presented to key stakeholders One invasive species management plan developed.	200,000.00	5 years	Department of Environment and Natural Resources DENR PENRO Agusan del Norte DENR PENRO Surigao del Norte People Organizations Concerned provincial and municipal government units Conservation organizations (including bird and community-focused NGOs) Lake Mainit Development Alliance
	Cohesive and inclusive invasive species management plan for Lake Mainit basin Invasive species management strategy and plan developed with inputs from key stakeholders	Up to 200 ha of the lakeshore and river inlets (across five highly infested areas) of the lake, managed yearly, alongside regular monitoring. Number of stakeholders engaged for the invasive species management plan development			
Implement and monitor activities to manage invasive species in Lake Mainit	Appropriate income-generating activities have been developed and tested with local communities Reduction of the volume of invasive species in Lake Mainit, particularly in the target areas	Number of invasive species management activities conducted Number of people engaged in managing the invasive species, with focus on the invasive plants Invasive species monitoring framework identified and used	500,000.00	5 years	

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
	Stakeholders are engaged in managing invasive species in the Lake Mainit basin	<p>for site monitoring</p> <p>Number of monitoring reports on the invasive species status generated</p> <p>A locally led conservation monitoring group organized, with member from vulnerable groups</p>			
<i>Component 5. Sustainable fisheries</i>					
<p>Develop fisheries plan for Lake Mainit, with guidance on fishing take quota over the fishing season.</p> <p>Promote sustainable fisheries practices for small-scale fishers</p>	<p>More sustainable fishing practices adopted by small fishers especially for native, declining fish species.</p> <p>Sustainable fisheries management plan developed to support selected LGUs to increase the capacity of small-scale fishers to undertake sustainable fishing practices</p> <p>Sustainable fisheries strategy and plan developed with inputs</p>	<p>Small-scale fisheries management plan developed for Lake Mainit and rolled-put to fisherfolk and other relevant stakeholders.</p> <p>Regular fish monitoring surveys carried out at selected priority fishing areas to determine recovery of selected declining fish species</p> <p>Glossogobius giurus and Ophieleotris aporos</p>	500,000.00	3 years	<p>Department of Environment and Natural Resources</p> <p>DENR PENRO Agusan del Norte</p> <p>DENR PENRO Surigao del Norte</p> <p>Department of Agriculture</p> <p>People Organizations</p> <p>Concerned provincial and municipal government units</p> <p>Conservation organizations (including bird and community-focused NGOs)</p>

Intervention	Outcome	Indicators	Cost (USD)	Timeframe	Potential Stakeholders
	from key stakeholders				Lake Mainit Development Alliance
Total investment for five years			10,400,000		

7.2 Potential Financing

The estimated project cost is USD 10,400,000 over a five-year period. This project budget supports the improvement of nature-based tourism, the development of wetland and watershed-level plans for sustainable fisheries, watershed management, and invasive species management, strengthening local capacities in wetland management, and the institutionalization of a biodiversity monitoring system.

Private investments may be available for Lake Mainit, particularly from mining companies, but a proper due diligence process is recommended to avoid possible greenwashing.

7.3 Proposed Institutional Arrangements

The proposed project is expected to be implemented over five years, minimally. In year 1, feasibility studies for tourism development will be conducted, alongside consultation with local communities (including indigenous people with ancestral domains in the surrounding watersheds). Major investments include the development of tourism infrastructure and a wastewater management facility, which is intended to address declining water quality in Lake Mainit, and address the discharge of raw sewage and other forms of water pollutants into the lake.

The Asian Development Bank submitted the Phil Flyways Projects, which include Lake Mainit, with grant financing from the GEF. This project can pave the way for the development of a larger loan-based project focused on livelihood development, watershed management and wastewater management. Under this project, DENR is the executing agency that leads the project implementation, while ADB provides technical oversight and procurement support for year 1.

7.4 Project Beneficiaries

The estimated 59,246 beneficiaries are based on the population indicated for the barangays in the four municipalities in the Lake Mainit Management Plans.⁸ Currently, there are two Lake Mainit Management Plans, one for Agusan del Norte and one for Surigao del Norte.

Mamanwa indigenous people live across the Caraga region, and there are established communities with ancestral domains in the hills and mountains of the Mainit watershed. Livelihood opportunities are limited and impacted by existing logging and mining. There are opportunities to create livelihoods for Mamanwa communities through small-scale, indigenous-led tourism initiatives.

Recent discussions with the National Commission on Indigenous Peoples (NCIP) showed that there are three Certificate of Ancestral Domain Titles (CADTs) covering Lake Mainit alone, namely 048, 254, and 253. The number of covered CADTs will likely increase if the scope is expanded to the watershed level.

7.5 Anticipated Implementation Risks

Climate: Climate-related risks include both the short-term and long-term disruption of habitat restoration and biodiversity conservation efforts due to extreme weather events, and coastal/ riverine flooding can affect access to ecotourism facilities. Adaptive management strategies can be further studied and integrated into the project implementation.

Social Safeguards: The implementation of improved fisheries management practices such as fishing quotas and avoidance of catching small fish may limit local people's capacity to harvest fish at specific timeframes, resulting in income loss. Scoping studies will be needed to assess the impact of these regulations on domestic incomes and the challenges of implementing these restrictions in a complex environment.

Security: Most provinces in Mindanao, including Agusan del Norte and Surigao del Norte, are red-tagged provinces for security reasons. It is recommended to consider this when implementing any nature-based tourism activity.

Environment: Nature-based ecotourism has been identified as a key project concept theme. The proposed interventions include new infrastructure, possibly shelters and boardwalks, that would enhance the tourism experience in Lake Mainit. Building these infrastructures, however, would induce noise that may disturb the wildlife in the area. Moreover, operating tourism facilities may result in further pressures (i.e., siltation) to Lake Mainit. Planning with stakeholders would be necessary before any infrastructure development and operations happen.

⁸ DENR (2022). *Lake Mainit Wetland Site Management Plan 2022 – 2026: Municipalities of Kitcharao and Jabonga, Agusan del Norte.*

DENR (2023). *Lake Mainit Wetland Management Plan 2024 – 2033: Municipalities of Alegria and Mainiy, Surigao del Norte.*

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Annex 1. Supplementary information on flood mitigation services

To further validate the identification of the top ecosystem services by means of stakeholder consultation, an expectedly essential or non-substitutable regulating service across all RFI sites, namely coastal protection and flood mitigation (i.e., storm and flood hazard regulation), was assessed based on a combination of globally available datasets supplemented by web-based tool Co\$tingNature (Mulligan, 2022). Estimates for flood mitigation were spatially inferred in QGIS from a selection of metrics expressing different biophysical values modelled online by the WaterWorld component of this tool. Equivalent data to assess monetary values similarly to coastal protection were not available for the RFI region.

The key metrics selected for biophysical values (Table A1) were the average green storage capacity, which is the volume of water stored by each square kilometer of wetland itself as well as its soil and vegetation, and the direct influence of this storage capacity on beneficiaries found downstream of the wetland, both as the average number of people and the average built-up area that are uniquely benefitting from the resulting flood mitigation (and not from other green storage found upstream).

Table A1. Contribution of the wetland habitats to flood mitigation in Lake Mainit based on site-level (biophysical) values inferred from Mulligan (2022) and expressed as ranges to represent the resulting uncertainty.

Influence of the wetland on flood mitigation (metrics)	Benefit/Beneficiaries
Average green storage capacity per sq. km of wetland in million cubic meters (Gigalitres/km ²)	362 - 461
Average population uniquely benefitting from influential green storage upstream per sq. km of wetland (n/km ²)	162 – 199
Average built-up area uniquely benefitting from influential green storage upstream per sq. km of wetland (ha/km ²)	0.75 – 0.91

Table A2. Biophysical benefits from and beneficiaries of RFI inland wetland sites (expressed as ranges to represent the resulting uncertainty) and at the national level.

Site name	Green storage capacity (Gigalitres/km ²)	Downstream population (n/km ²)	Downstream built-up area (ha/km ²)
Agusan Marsh Wildlife Sanctuary	967 (±30)	186 (±6)	1.74 (±0.06)
Candaba Wetlands	309 (±33)	129 (±13)	6.35 (±0.64)
Lake Mainit	412 (±49)	181 (±18)	0.83 (±0.08)
Philippines RFI average	562	165	2.97
Philippines national average	448	624	5.35

Table A3. Key habitat types in Lake Mainit based on stakeholder-based assessment at the Regional Flyway Initiative workshop in June 2023.

Habitat type	Current state		Alternative state (2035)	
	Area (ha)	Cover (%)	Area (ha)	Cover (%)
Permanent freshwater lakes	12596.6	90.0	10777.1	77.0
Seasonally flooded agricultural land	839.8	6.0	1399.6	10.0
Irrigated land	279.9	2.0	699.8	5.0
Canals and drainage channels, ditches	140.0	1.0	419.9	3.0
Aquaculture ponds	140.0	1.0	699.8	5.0
Total	13996.2	100.0	13996.2	100.0