EJSIT
European Journal of Science, Innovation and Technology
ISSN: 2786-4936
www.ejsit-journal.com
Volume 6 | Number 1 | 2026

A Proposed Master Development Plan for Conservation-Based Ecotourism at Tikub Lake, Tiaong, Quezon

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ABSTRACT

Rapid tourism growth, expanding settlements, and resource-based livelihoods are exerting increasing pressure on many small freshwater landscapes in the Philippines. In sensitive crater-lake environments, even modest disturbances can trigger water-quality decline, shoreline erosion, habitat loss, and long-term ecological imbalance. These conditions underscore the need for planning approaches that safeguard natural systems while supporting local economic opportunities. This study responds to that challenge by examining the environmental, spatial, and governance conditions affecting Tikub Lake and formulating a conservation-based Master Development Plan (MDP) that aligns ecotourism development with ecological protection. The research evaluates the lake's physical characteristics, land use patterns, stakeholder perspectives, and management issues to determine the requirements for a sustainable development framework. It also assesses existing zoning provisions, aquaculture practices, visitor behavior, and infrastructure gaps that influence the lake's carrying capacity. The proposed MDP consolidates these findings into a structured set of planning strategies that include: (1) a spatial framework composed of a conservation core, protected shoreline strip, and ecotourism support zones; (2) refined land use and zoning designations to regulate development intensity; (3) access and circulation systems that minimize slope disturbance and manage visitor flows; and (4) facility planning standards for sanitation, waste management, trails, viewing areas, community markets, and low-impact eco-lodges. Together, these components create an integrated approach that strengthens environmental safeguards while enabling small-scale, community-driven ecotourism that is both economically viable and ecologically responsible.

Keywords: conservation-based ecotourism, lake management planning, spatial analysis, sustainable infrastructure, environmental assessment

INTRODUCTION

Across many emerging ecotourism destinations in the Philippines, natural lake systems are increasingly exposed to unregulated visitation, informal development, and insufficient environmental controls. These pressures often lead to declining water quality, disturbed shorelines, unmanaged waste, and safety risks, conditions that compromise both ecological stability and the quality of visitor experience. As demand for nature-based recreation grows, the challenge for local communities is to support tourism without allowing development to overwhelm sensitive freshwater environments.

Tikub Lake in Tiaong, Quezon reflects this growing tension. Despite its ecological significance and recreational potential, the lake lacks a guiding development framework that balances conservation with community-based tourism opportunities. Incremental human activities, informal access routes, and overlapping land uses have begun to place stress on the lake's rim, shoreline, and waterbody. At the same time, stakeholders express strong interest in

improving facilities, organizing visitor flows, and ensuring that future developments remain environmentally responsible. These conditions underscore the need for a conservation-based planning approach that protects the lake's natural systems while providing clear direction for sustainable ecotourism development. This study responds to that need by systematically assessing Tikub Lake's physical context, land-use conditions, stakeholder perceptions, and infrastructure requirements to establish a Master Development Plan rooted in ecological protection and local community priorities.

OBJECTIVES

This study was guided by the following objectives:

- Identify existing land use patterns and zoning practices and evaluate their impact on Tikub Lake's conservation and ecotourism potential, in order to propose a zoning framework that supports ecological protection and sustainable tourism development.
- Examine the key environmental challenges affecting Tikub Lake and assess how these influence the feasibility and long-term viability of conservation-based ecotourism initiatives.
- Propose sustainable infrastructure concepts that enhance accessibility, visitor experience, and environmental resilience, without compromising the lake's ecological integrity.
- Develop land use planning and development guidelines that support the formulation of a conservation-based Master Development Plan, ensuring alignment with ecological protection, tourism goals, and community needs.

MATERIALS AND METHODS

The study adopted a mixed-method research design integrating quantitative surveys and qualitative approaches to capture both measurable patterns and contextual stakeholder insights. This combination ensured a comprehensive understanding of environmental challenges, land use conditions, and ecotourism priorities necessary for formulating a conservation-based Master Development Plan.

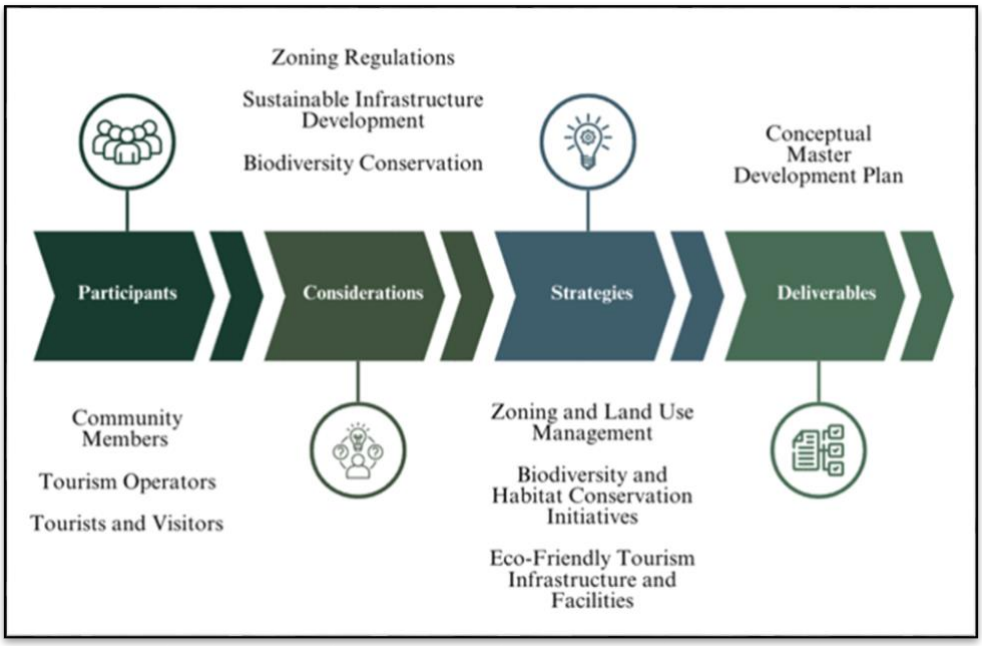

Figure 1. Research Model

Research Instruments

To generate a comprehensive assessment of Tikub Lake's ecotourism and conservation conditions, the study utilized multiple research instruments, each contributing distinct forms of evidence to inform the proposed Master Development Plan.

- The *stakeholder survey* served as the primary quantitative instrument, capturing measurable insights on governance issues, land use conflicts, tourism impacts, and conservation priorities. The questionnaire employed Likert-scale and categorical items to quantify perceptions on zoning strategies, policy enforcement, and sustainable development needs. Prior to distribution, the survey was subjected to expert validation by practitioners in environmental planning and tourism development to ensure reliability and relevance. Responses were then analyzed statistically to support evidence-based decision-making.
- The *focus group discussion* functioned as a qualitative instrument designed to obtain collective perspectives from key stakeholders, including local officials, residents, tourism operators, and visitors. The FGD facilitated interactive dialogue on zoning inconsistencies, infrastructure requirements, environmental concerns, and ecotourism opportunities. The discussions allowed the study to identify common challenges, stakeholder-driven solutions, and areas of consensus relevant to conservation-focused development.
- *Document analysis* involved reviewing municipal ordinances, planning documents, environmental regulations, ecotourism case studies, and technical reports. These materials were examined to establish policy benchmarks, compare best practices, and contextualize local planning frameworks. Relevant scholarly literature and regional tourism policies were also analyzed to strengthen the theoretical basis of the development proposal.
- *Field observations* were conducted to assess existing land use patterns, access conditions, infrastructure limitations, slope stability issues, and environmental risks. A site inventory checklist documented features such as erosion-prone areas, informal access paths, vegetation cover, facilities, and waste accumulation. Photographs, sketches, and mapping notes supported the visual and spatial evaluation of on-site conditions.
- *GIS-based spatial analysis* was employed to map slope categories, zoning boundaries, access points, settlement patterns, aquaculture areas, and conservation-sensitive zones. Geospatial outputs were used to evaluate environmental constraints and suitability conditions, refine zoning delineations, and support spatial decision-making for the Master Development Plan.

Data Gathering Procedure

The data-gathering procedure followed a structured sequence to ensure ethical compliance, stakeholder representation, and methodological rigor. Formal permissions were first secured from municipal offices, barangay leaders, and tourism organizations, establishing the legitimacy of the research process and enabling access to stakeholders involved in Tikub Lake's conservation and ecotourism activities.

- *Survey* administration was then conducted over a two-month period, distributed both physically and via digital platforms to maximize reach across residents, visitors, and local interest groups. The surveys collected quantitative and qualitative responses on governance issues, conservation concerns, and ecotourism preferences using Likert-scale, categorical, and open-ended items.
- *Structured interviews* were carried out with local government officials, environmental officers, tourism personnel, aquaculture operators, and community representatives. These interviews provided detailed insights on zoning implementation, infrastructure

needs, regulatory gaps, and environmental risks, serving as qualitative reinforcement to the survey findings.

- *Focus group discussions* were organized to facilitate collective dialogue among key stakeholder groups. The discussions explored zoning constraints, access challenges, infrastructure proposals, and governance practices. The FGD sessions enabled the identification of shared concerns, community expectations, and consensual strategies relevant to a conservation-based development plan.
- *Field observations and site inventory* were conducted to document on-site conditions, including land use patterns, lakeshore access, informal paths, slope instability, vegetation cover, and existing tourism facilities. Photographs, sketches, and field notes captured physical attributes essential for zoning refinement and design decision-making.
- *GIS-based spatial analysis* complemented field observations by mapping slope categories, settlement clusters, aquaculture areas, access routes, and ecologically sensitive zones. These spatial outputs informed the delineation of zoning subareas, identification of constraint zones, and evaluation of development suitability.

Data Analysis Methods

The study adopted a combination of quantitative and qualitative analytical techniques to ensure a comprehensive interpretation of stakeholder perspectives, spatial patterns, and environmental conditions.

- *Descriptive statistics* were applied to the survey data, computing frequency distributions, percentages, weighted means, and standard deviations to quantify perceptions of tourism impact, conservation practices, zoning adequacy, and facility needs. These statistical measures provided a clear numerical foundation for evaluating support for the development plan and identifying priority interventions.
- *GIS spatial analysis* was employed to classify land use, assess slope constraints, delineate ecological buffers, and evaluate zoning compatibility. The spatial outputs helped identify areas suitable for ecotourism nodes, locations requiring shoreline protection, and segments where visitor access needed regulation.
- *Content analysis* was used to examine qualitative responses from interviews, FGDs, and open-ended survey items. Statements were categorized into thematic clusters such as governance issues, environmental risks, accessibility constraints, tourism opportunities, and community expectations. This method enabled the extraction of recurring insights aligned with planning and conservation priorities.
- *Thematic analysis* further organized qualitative narratives to produce policy-relevant themes that informed the planning framework. Themes related to slope vulnerability, waste accumulation, aquaculture pressure, and visitor management contributed to zoning refinement and infrastructure recommendations.
- *SWOT analysis* synthesized all data sources to evaluate Tikub Lake's strengths, weaknesses, opportunities, and threats. Strengths such as scenic beauty and community interest were contrasted with weaknesses such as limited facilities and environmental risks, guiding strategic directions for the Master Development Plan.

RESULTS

Physical and Environmental Context

Findings show that Tikub Lake sits within a steep volcanic basin where many rim slopes exceed 15 percent, restricting development to only a few stable areas. Class B water quality limits allowable water uses to non-motorized recreation, supporting low-impact tourism. The

lake's enclosed hydrology, sensitivity to erosion, and past overturn events underscore the importance of strict easement protection, vegetative buffers, and slope stabilization.

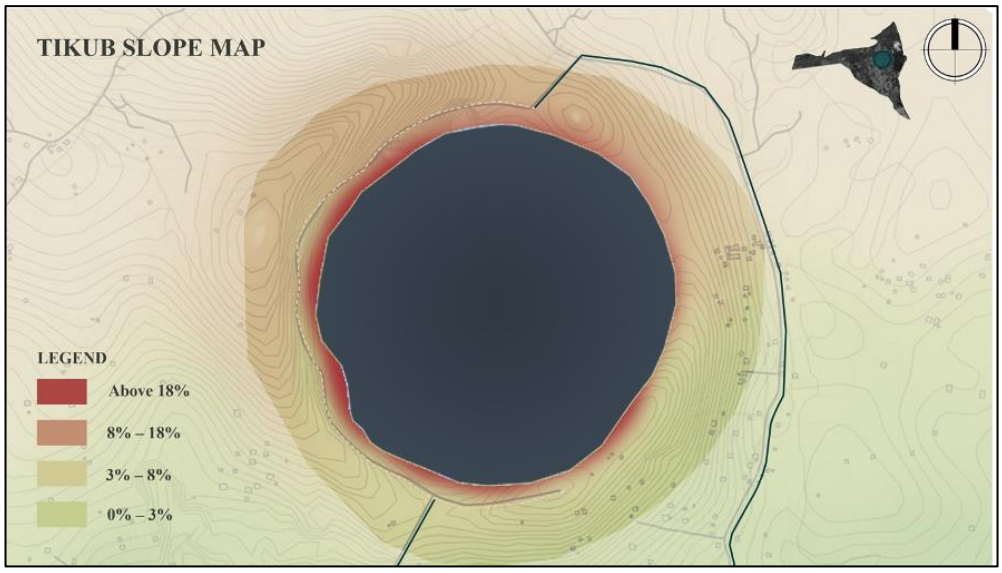

Figure 2. Slope Map

Land Use and Zoning Framework

Review of the CLUP, Zoning Ordinance, and CDP indicates that the area surrounding Tikub Lake is designated for Water Use and Tourism, with an Ecotourism Overlay requiring low-rise, light-material structures and compliance with a 20-meter easement. Field observations show partial consistency: scattered informal structures encroach near the easement, fish cages exceed the preferred consolidated configuration, and enforcement markers are absent. These inconsistencies highlight the need for refined, lake-specific zoning.

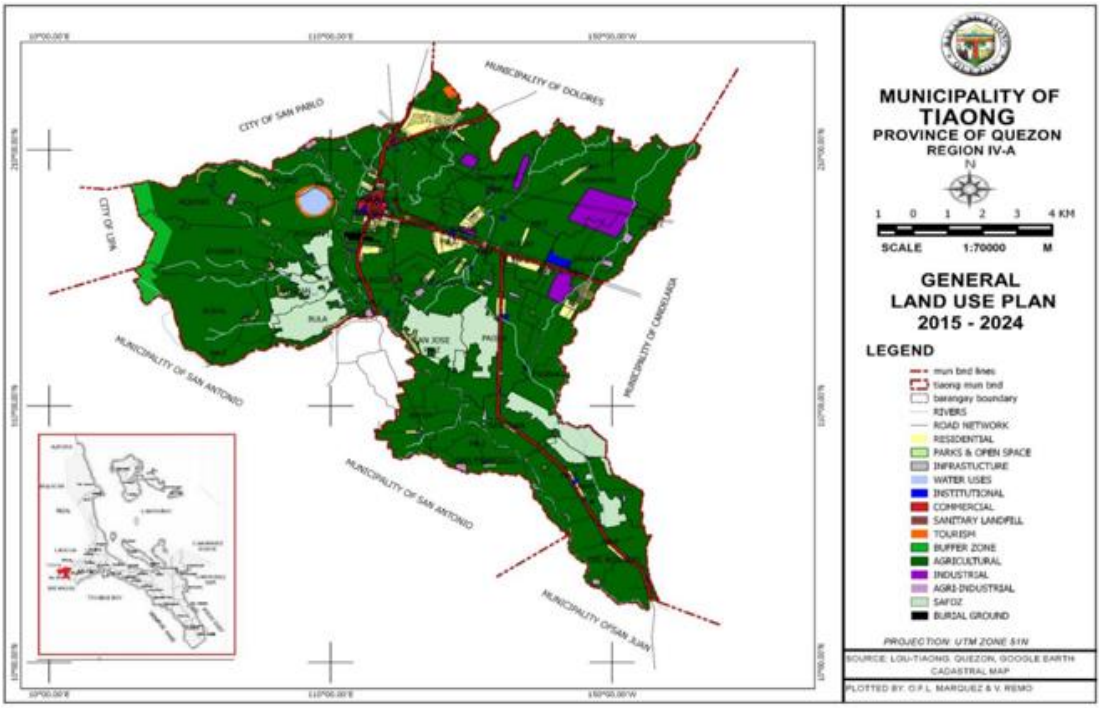

Figure 3. Tiaong General Land Use Plan
Source: Tiaong CLUP

Sustainable Infrastructure and Accessibility

Current access is limited to a single stairway on the San Pedro side, resulting in congestion and unmanaged waste during peak periods. Facilities such as toilets, wayfinding signs, viewing decks, and designated parking areas are insufficient or absent. Stakeholders prefer lightweight, low-footprint structures, improved drainage, distributed waste bins, and safer circulation paths aligned with conservation standards.

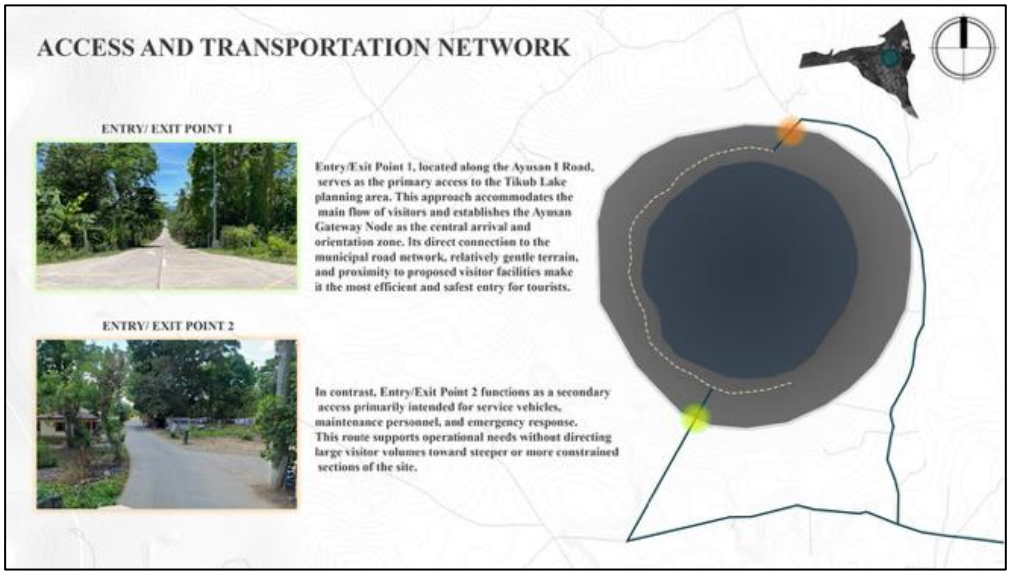

Figure 4. Access and Transportation Network

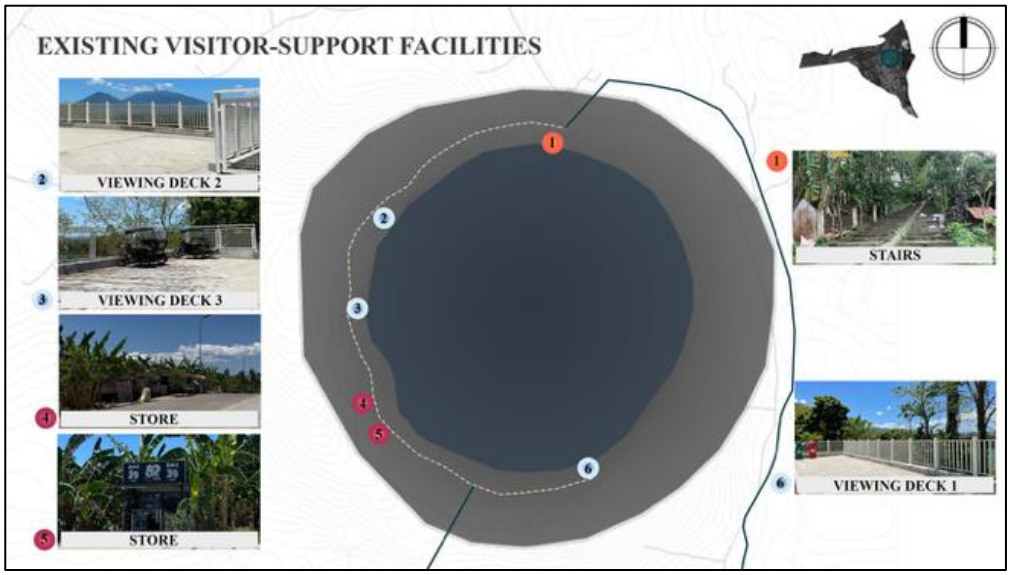

Figure 5. Existing Visitor Support Facilities

Planning and Development Framework

The proposed plan aligns with Sustainable Development Goals, national development directives, and provincial environmental frameworks by emphasizing clean water protection, climate resilience, responsible tourism, and community-based livelihoods. These frameworks guide the prioritization of protected zones, low-impact ecotourism nodes, aquaculture regulation, and environmentally responsive infrastructure.

DISCUSSION

Spatial Structure

The spatial structure of the Master Development Plan (MDP) establishes a clear hierarchy that balances ecological sensitivity with sustainable visitor use. At the center of the structure lies the Conservation Core, which encompasses the entire lake surface and is designated primarily for ecological processes, water-quality preservation, and limited non-motorized recreational activity. This core ensures that the heart of the lake remains undisturbed and continues to function as the ecological engine of the broader landscape.

Surrounding the waterbody is the Protected Shoreline Strip, which consists of the twenty-meter legal easement mandated by the Water Code and an additional twenty-meter ecological buffer. Together, these zones form a 40-meter continuous protective ring that absorbs runoff, stabilizes slopes, minimizes erosion, and preserves lakeshore vegetation. Only low-impact, reversible structures such as footpaths and small viewing decks are allowed in this strip. This dual-layer protection system addresses the environmental risks identified in the study, including shoreline encroachment, slope degradation, and unmanaged foot traffic.

Beyond the Protected Shoreline Strip are the land- and water-based ecotourism nodes, which consolidate infrastructure into compact, clearly defined development clusters. Concentrating facilities in these nodes avoids scattered development along the rim and maintains the natural character of the crater landscape. Through this spatial arrangement, the MDP provides a defensible structure that protects ecological assets while supporting controlled, education-oriented visitor experiences.

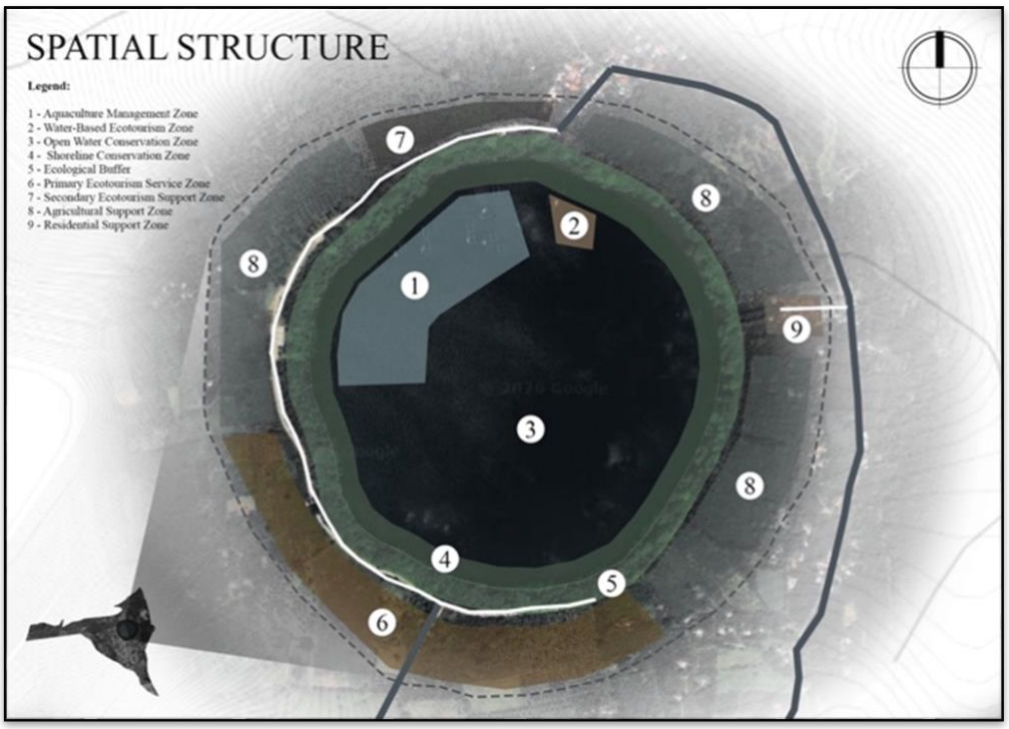

Figure 6. Spatial Structure of Tikub Lake

Access and Circulation

The access and circulation framework reinforces the conservation-based hierarchy by directing most of the visitor movement into controlled pathways and nodes. The Ayusan Gateway serves as the primary entry point due to its gentler terrain and wider developable area.

It accommodates parking, comfort rooms, orientation spaces, and visitor information, forming the main staging zone for ecotourism activities. This approach reduces pressure on more sensitive portions of the crater rim and improves safety by managing arrivals before visitors move into steeper terrain.

On the opposite side of the lake, the San Pedro stair acts as the regulated descent to the lakeshore. While historically the only formal access route, its steep alignment and erosion-prone sections necessitate safety upgrades, handrails, intermediate landings, and improved surface treatments. The plan retains this stair because it allows controlled lakeshore access without introducing additional cuts into the crater slopes.

A future rim trail integrates these two access points and connects viewing decks, interpretive spaces, and resting areas. This loop distributes visitor movement across stable terrain and discourages the creation of informal footpaths that damage vegetation and erode soil. The circulation plan thereby improves safety, enhances visitor experience, and supports long-term conservation efforts.

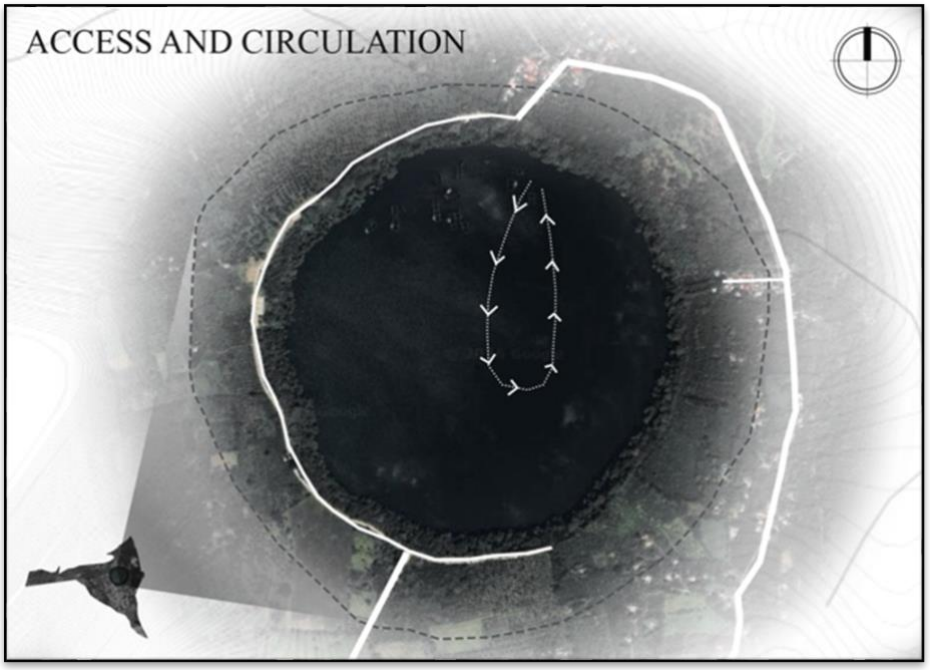

Figure 7. Access and Circulation Plan

Node Development Strategy

The node development strategy ensures that facilities remain compact, low impact, and consistent with ecotourism design principles.

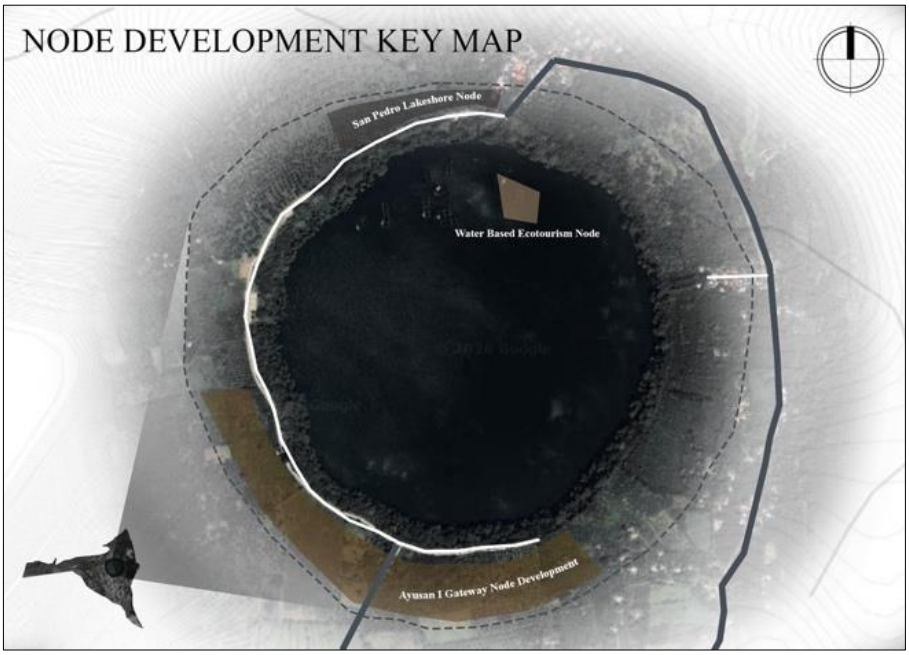

Figure 8. Node Development Key Map

The Ayusan Gateway Node functions as the primary activity center, hosting eco-lodges, food stalls, a small community market, comfort rooms, bicycle parking, and an interpretive center. These facilities create a complete arrival experience while remaining outside the Protected Shoreline Strip. Their clustering reduces landscape disturbance, improves walkability, simplifies waste management, and reinforces the educational and conservation messaging of the site.

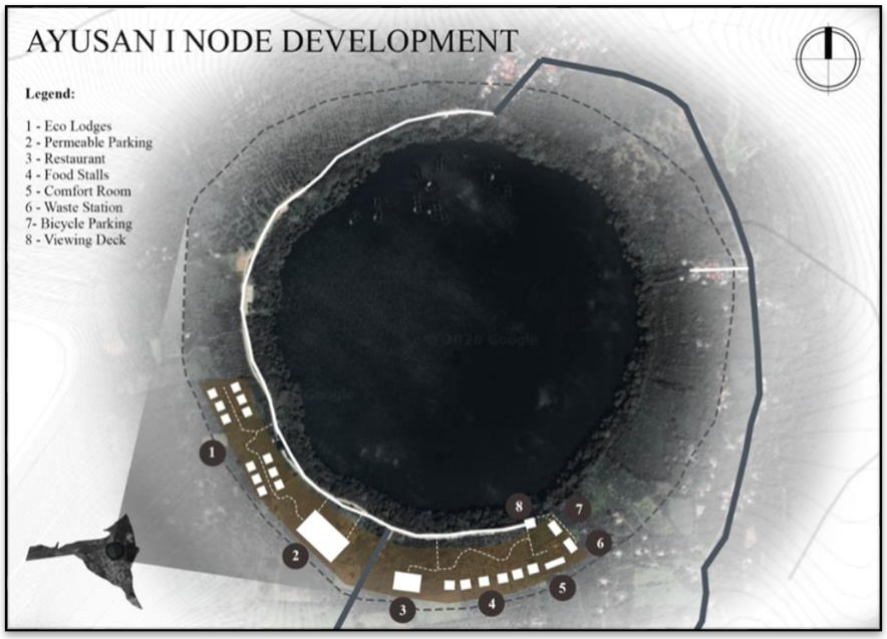

Figure 9. Ayusan I Gateway Node Development

The San Pedro Lakeshore Node is more limited in scale and focuses on lakeshore access, safety, and essential support facilities. Improvements prioritize stairway safety, stable landings, a lakeshore platform for orientation and rescue readiness, and a small sanitation facility. The node intentionally avoids commercial intensification to maintain the ecological function of the lakeshore and prevent overcrowding in a physically constrained area.

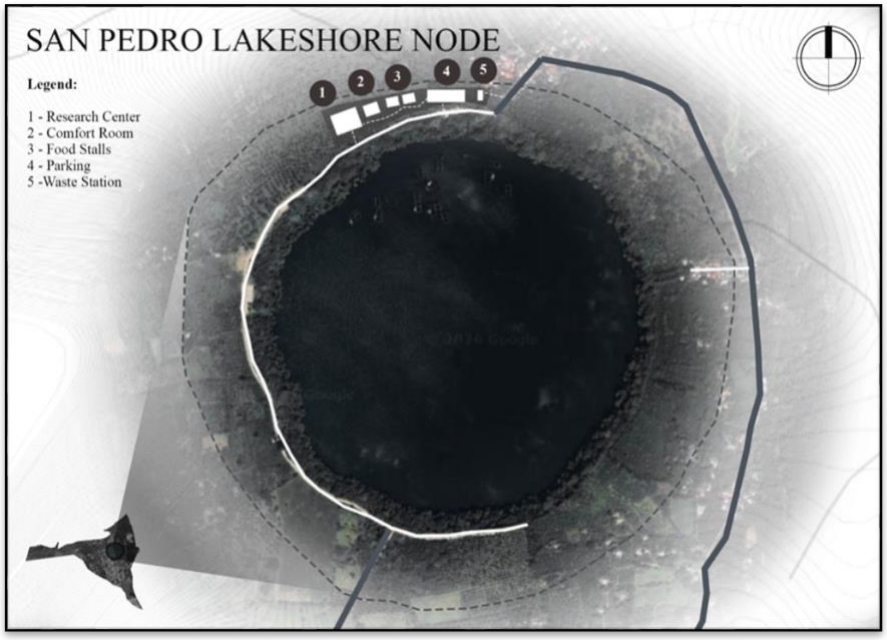

Figure 10. San Pedro Lakeshore Node Development

The Water-Based Ecotourism Node is defined within the allowable over-water limits established by BFAR and local ordinances. This node accommodates the floating restaurant and regulated non-motorized boating routes while maintaining separation from the aquaculture cluster. Its design ensures zero wastewater discharge, strict solid waste control, and minimal shading effects on lake ecology. By organizing water-based activities in a clearly bounded area, the MDP prevents conflicts between aquaculture, recreation, and conservation functions.

Figure 11. Water Based Ecotourism Node Development

Land Use and Zoning Refinement

The land use and zoning framework refines existing municipal policies by translating them into spatially precise subzones that respond directly to Tikub Lake's physical conditions and environmental sensitivities. The plan designates specific areas for Aquaculture Management, Water-Based Ecotourism, Open Water Conservation, Shoreline Conservation, Primary and Secondary Ecotourism Zones, Agricultural Support Zones, and Residential Support Zones. These subzones establish clear boundaries for permissible activities and development intensities and provide guidance on acceptable building footprints, heights, and materials.

Table 1. Proposed Land Use and Zoning Categories

Zone Category	General Location / Extent	Primary Intended Uses	Key Development Controls / Notes
Aquaculture Management Zone	Portion of lake surface with consolidated fish-cage area	Regulated aquaculture; maintenance of existing 50 cages	Total structural coverage kept well below BFAR 10% limit; no new cages allowed under local ordinance.
Water-Based Ecotourism Zone	Small delineated area within allowable structural limit	Floating restaurant or platforms; non-motorized recreation (kayak, paddle boat)	Strict wastewater and solid-waste controls; limited footprint; no motorized boats; compliance with BFAR and LGU.
Open Water Conservation Zone	Remaining lake surface outside aquaculture and ecotourism zones	Open water habitat; non-motorized recreation; research and monitoring	No permanent structures; prohibition of motorized recreation; priority for water-quality and biodiversity goals.
Shoreline Conservation Zone (Protected Shoreline Strip)	Continuous 40-meter band from lakeshore (20 m legal easement + 20 m ecological buffer)	Riparian vegetation; nature trails; lightweight viewing decks; safety and rescue points	No new permanent buildings; only reversible or lightweight structures; slope, erosion, and runoff management.
Primary Ecotourism Service Zone (Ayusan Gateway Node)	Ayusan-side gateway area on relatively gentle slopes	Visitor reception; parking; toilets; food stalls; community market; interpretive center	Maximum 40% building footprint; low-rise height; permeable surfacing; landscape buffering to nearby uses.
Secondary Ecotourism Support Zone (San Pedro Lakeshore Node)	San Pedro stair-access area and immediate surroundings	Access and stairways; small viewing platform; basic toilets; safety and rescue post	Very limited building footprint; focus on access and safety; improvements to existing stair and landings.
Agricultural Support Zone	Existing farm parcels within planning boundary	Continuation of agricultural production compatible with conservation objectives	Soil and runoff management measures; restrictions on agrochemicals near buffer; promotion of agroforestry.

Residential Support Zone (Existing Settlements)	Existing clusters of households within Barangays San Pedro and Ayusan I, located outside the 20 m legal easement and outside the 20 m ecological buffer, and within stable, developable terrain.	Continued residential living; home-based livelihood activities; small-scale, low-impact community services compatible with conservation objectives.	Development in this zone shall remain low-rise and low-density, with no expansion allowed toward the Protected Shoreline Strip. New construction must follow slope suitability and drainage requirements and use permeable surfaces, improved drainage, and vegetated setbacks.

Facility Demand and Sizing

Facility demand and sizing were derived from the projected peak-day visitor load of 1,027 visitors, ensuring that proposed facilities remain within environmental limits and are adequate for future tourism growth. Computations were guided by established standards from the Department of Tourism, the Tourism Infrastructure and Enterprise Zone Authority, the United Nations World Tourism Organization, the Bureau of Fisheries and Aquatic Resources, the Department of Public Works and Highways, and the National Association of City Transportation Officials. These references provide internationally and nationally recognized benchmarks for estimating capacity requirements, circulation efficiency, accessibility, sanitation needs, and water-based facility restrictions.

The resulting facility program reflects a development pattern that is both technically sound and environmentally responsible. Visitor-oriented structures, including comfort rooms, waste collection points, parking areas, viewing decks, eco-lodges, and interpretive facilities, were sized to meet safety, comfort, and operational needs without exceeding the carrying capacity of the site. All major facilities are clustered in the Ayusan Gateway and San Pedro Lakeshore nodes to minimize slope disturbance, maintain compact footprints, and reduce pressure on ecologically sensitive portions of the crater rim.

For water-based structures, the floating restaurant and associated platforms occupy only a small portion of the allowable over-water limit established by the Bureau of Fisheries and Aquatic Resources, ensuring compliance with regulatory thresholds. The sizing approach therefore supports conservation-based tourism operations while maintaining the integrity of the lake's ecological functions.

Table 2. Facility Demand, Capacity, and Area

Facility Type	Standard / Basis	Demand Computation	Required Quantity / Capacity	Area Requirement
Comfort Rooms (CRs)	1 unit per 50 visitors (DOT Guidelines; UNWTO Facility Standards)	Peak-day: 1,027 ÷ 50	21 units (14 Ayusan, 7 San Pedro)	21 × 7 sqm = 147 sqm
Parking Area	1 slot per 5 visitors; 12.5 sqm per slot (DPWH)	1,027 ÷ 5	206 slots	206 × 12.5 sqm = 2,575 sqm

Viewing Decks	20 persons per deck (IUCN Visitor Use Framework)	10% of 1,027 = 103 ÷ 20	5–6 decks	6 × 25 sqm = 150 sqm (plus existing decks: VD1 444.935 sqm, VD2 575.580 sqm, VD3 225.597 sqm)
Walking Trails / Boardwalks	1 person per meter (UNWTO Trail Manual)	10% simultaneous use = 103 users	Capacity met by 2.75 km rim trail	Linear facility (no land footprint)
Eco-Lodges / Small Cottages	30% of peak-day visitors seek overnight stay; 4 persons per cottage	(1,027 × 0.30 = 308.1) ÷ 4	77-unit demand, but 8–12 units feasible (40% node footprint rule)	8–12 units × 50 sqm = 400–600 sqm
Educational / Interpretive Center	Benchmark 150–200 sqm for small lake ecotourism sites	—	1 center	150–200 sqm
Docking / Boating + Safety Station	15–25 sqm dock + 12–15 sqm safety room (BFAR & PAWB small-waterbody standards)	—	1 docking/safety station	≈ 40 sqm
Signages & Information Boards	1 sign every 200–300 m; trail length = 2.75 km (UNWTO)	2,750 ÷ 250 ≈ 11; + 3 node signages	≈ 14–15 signages	Minimal (post-mounted)
Designated Parking for Bicycles	1.2 sqm per slot (NACTO Guidelines)	30 bike users × 1.2 sqm	30 slots	36 sqm
Waste Management Stations	1 station per 200–300 visitors (DENR–EMB)	1,027 ÷ 250 = 4.10	4 stations	4 × 20 sqm = 80 sqm
Community Market / Souvenir Area	10 sqm per stall + equivalent circulation (DTI)	5–6 stalls	5–6 stalls	6 × (10 + 10) = 120 sqm
Local Food Stalls / Eco-Friendly Restaurants	1 stall per 10 active buyers; 5% of visitors buy (DTI)	(1,027 × 0.05 = 51) ÷ 10 = 5.1	5–6 stalls	6 × 20 sqm = 120 sqm
Floating Restaurant	30–50 pax; 150–300 sqm footprint (BFAR Floating Structure Standards)	Within BFAR 10% limit	1 unit (40 pax)	≈ 200 sqm

Conceptual Master Development Plan

Figure 12. Conceptual Master Development Plan

The Conceptual Master Development Plan integrates spatial structure, zoning, circulation, and facility design into a cohesive planning framework. It presents a development configuration that protects the lake's ecological foundation while enhancing visitor experience. Conservation zones, ecotourism nodes, rim trails, regulated aquaculture, and controlled water-based recreation interact harmoniously within the MDP's spatial logic.

Figure 13. Conceptual Aerial Perspective

The aerial perspective illustrates the balanced distribution of uses, showing how built facilities remain clustered, slopes remain vegetated, shoreline buffers remain intact, and the water surface retains its ecological integrity. The plan demonstrates how conservation-based planning can transform a vulnerable landscape into a resilient ecotourism destination.

CONCLUSIONS

The study concludes that Tikub Lake possesses strong potential for conservation-based ecotourism, supported by a favorable policy environment, community approval, and a still largely intact ecological setting. However, environmental pressures, from shoreline encroachment and unmanaged waste to erosion and informal access, require urgent intervention. The conservation-based Master Development Plan responds to these pressures through a structured spatial system anchored on a protected shoreline buffer, compact ecotourism nodes, regulated water use, and a circulation plan that manages visitor flow. Through these strategies, the MDP creates a balanced framework that enhances visitor experience while safeguarding the ecological processes that sustain Tikub Lake. The study affirms that responsible tourism and conservation are not opposing objectives but can reinforce each other when guided by thoughtful planning, community participation, and evidence-based decision-making.

RECOMMENDATIONS

The implementation of the conservation-based Master Development Plan should begin with formal LGU adoption and integration into local planning instruments such as the CLUP, Zoning Ordinance, and Comprehensive Development Plan. Clear demarcation of the Protected Shoreline Strip is essential to guide on-site enforcement and prevent further encroachment. Node-based development should be advanced through detailed site development plans, prioritizing the completion of essential facilities at the Ayusan Gateway Node and safety-oriented improvements at the San Pedro Lakeshore Node. Waste management systems, septic solutions, and drainage improvements should be established early in the process to address current environmental risks.

The study recommends the strengthening of a dedicated Tikub Lake management body composed of LGU offices, barangays, fish cage operators, and community groups. This body should oversee zoning enforcement, environmental monitoring, visitor management, and ongoing maintenance of facilities. A systematic monitoring framework should be institutionalized to track water quality, shoreline conditions, visitor traffic, and compliance with regulations, enabling adaptive management and timely interventions.

Social considerations must also be integrated into implementation, particularly for households located near the protected shoreline buffer. Relocation or structural adjustments should be undertaken gradually, with full community engagement, livelihood support, and coordination with social welfare agencies. To sustain conservation objectives, community participation in ecotourism enterprises, such as guiding, food stalls, handicraft production, and maintenance, should be prioritized.

For long-term planning, further research is recommended on hydrological dynamics, slope stability, visitor carrying capacity, economic feasibility, and climate resilience. These studies will strengthen the scientific foundations of the MDP and support more precise adjustments to land use and infrastructure planning. Through sustained governance, community empowerment, and environmental stewardship, Tikub Lake can become a model of conservation-based ecotourism development in the region.

ACKNOWLEDGEMENTS

The completion of this study, *A Proposed Master Development Plan for Conservation-Based Ecotourism at Tikub Lake, Tiaong, Quezon*, was made possible through the support, guidance, and encouragement of many individuals and institutions. The researcher expresses deep gratitude to the academic mentors whose expertise, critical insights, and guidance strengthened the development and direction of this work. Appreciation is likewise extended to faculty and administrators who provided valuable perspectives that enriched the study.

The researcher also acknowledges all individuals who generously shared their time, knowledge, and assistance throughout the preparation of this proposal. Their contributions, whether through consultation, participation, or feedback, were essential to the completion of the research.

Above all, the researcher offers sincere thanks to God Almighty for the wisdom, clarity, and strength that sustained her from beginning to end.

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