Local Awareness, Watershed Action (LAWA): A Grassroots Governance Strategy to Leptospirosis Prevention in Laguna de Bay

Khristine L. Sandoval[1*], *Jomari C.* Dizon[2], *Diosa Marie M.* Marundan[7], *Rodel Victor D.* Dimasin[3,5], *Jose Marie T.* Taller[7], *Kristel Joy S.* Cada[6], and *Ryan V.* Labana[3,4]

[1]School of Arts and Sciences, National University, Philippines, Manila, Philippines
[2]Office of the Executive Director, National University, Philippines, Pasay City, Philippines
[3]Department of Biology, College of Science, Polytechnic University of the Philippines, Manila, Philippines
[4]Center for Health Sciences, Research Institute for Science and Technology, Polytechnic University of the Philippines, Manila, Philippines
[5]Meycauayan National High School-Senior High School, Meycauayan, Bulacan, Philippines
[6]Biology Department, College of Arts and Sciences, New Era University, New Era, Quezon City, Philippines
[7]Independent Researcher, Philippines

Abstract. Leptospirosis remains a persistent yet underestimated public health threat in the Laguna de Bay region—the Philippines' largest freshwater lake and a vital socio-ecological system. Seasonal flooding, rapid urbanization, poor sanitation, and close human–animal–water interactions heighten the area's vulnerability to disease transmission. Conventional control measures have proven insufficient, underscoring the need for more inclusive and sustainable strategies. This study introduces the Local Awareness and Watershed Action (LAWA) framework, a grassroots governance model for leptospirosis prevention. LAWA empowers fisherfolk, barangay leaders, health workers, and Local Government Units (LGUs) to co-lead disease prevention and watershed management, linking public health with ecosystem care. Grounded in participatory and transdisciplinary principles, it integrates local knowledge, environmental education, and citizen science. Key interventions include mapping flood-prone zones, documenting environmental change, co-developing water quality monitoring tools, and conducting capacity-building workshops for adaptive behavior. Implementation increased hazard awareness, community participation in flood preparedness, and created barangay eco-health committees. LAWA also strengthened coordination between municipal health and environmental offices, fostering integrated water and health governance. By embedding disease prevention within sustainable water governance, LAWA promotes environmental justice, community resilience, and equitable health outcomes.

* Corresponding author: klsandoval@nu-moa.edu.ph

1 Introduction

Leptospirosis remains a neglected yet persistent public health threat in the Philippines, primarily transmitted through water contaminated by the urine of infected animals, particularly rodents. In the Laguna de Bay region, home to the country's largest inland freshwater lake and a densely populated socio-ecological system, this risk is exacerbated by rapid urbanization, environmental degradation, and climate-induced flooding. Epidemiological data estimate an average of 680 cases and 40 leptospirosis-related deaths annually, with a prevalence of 10 per 100,000 person-years [1]. Thousands of lakeshore households depend on fishing for their livelihoods, yet flooding frequently disrupts their daily routines, and the very waters that sustain them are often polluted with domestic waste, agricultural runoff, and flood-borne contaminants [4]. Limited awareness among fisherfolk and agricultural workers further heightens vulnerability to infection [13].

Globally, the World Health Organization (WHO) reports endemic leptospirosis rates of approximately 5 cases per 100,000 people per year, with epidemic surges reaching up to 14 cases per 100,000 [14]. In the Philippines, outbreaks are typically associated with typhoons and monsoon rains, when floodwaters carry pathogens into homes, farms, and fishing zones. This recurring pattern highlights the tight coupling between environmental exposure, social inequality, and health vulnerability in low-lying lakeshore communities. Studies confirm that extreme rainfall and flood events significantly increase the risk of infection [12].

These complex interconnections reveal the inadequacy of traditional, top-down interventions and underscore the need for holistic, participatory, and place-based governance approaches. In this context, the Local Awareness and Watershed Action (LAWA) framework is introduced as a grassroots strategy for leptospirosis prevention and adaptive water governance. LAWA mobilizes fisherfolk, barangay officials, health workers, and local government units (LGUs) to co-lead actions that bridge ecosystem management and public health. The Water Governance and Management Framework (Fig. 1) illustrates this systems-based approach, emphasizing the value of transdisciplinary collaboration in addressing the ecological and social roots of disease transmission rather than treating it as an isolated biomedical issue.

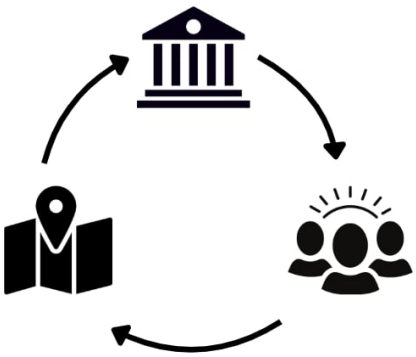

Fig. 1. The Water Governance and Management Framework.

1.1 Environmental and Socio-Cultural Drivers of Risk

Leptospirosis risk in the Laguna de Bay region is shaped by both ecological disruptions and the lived realities of lakeshore communities. Seasonal flooding intensified by climate change, upland deforestation, and inadequate urban drainage that leads to prolonged waterlogging in

residential and agricultural zones. For fisherfolk and lakeshore dwellers, water contact is a daily inevitability, embedded in economic livelihood and cultural practice [2]. Activities such as hauling nets, wading in floodwaters, and cleaning fishing gear result in direct exposure to contaminated waters. These behaviors reflect not only necessity but also intergenerational ties to lake-based livelihoods and limited access to alternative income sources.

Behavioral studies indicate that younger and lower-income groups are less likely to adopt preventive practices, underscoring the need for culturally responsive and locally grounded awareness strategies. Conversely, agricultural workers with higher education levels tend to demonstrate stronger adherence to preventive behaviors [15]. Within the LAWA framework, this understanding of *intergenerational wisdom and community-led environmental management* (Fig. 2) is essential. It acknowledges the role of traditional ecological knowledge, cultural values, and community leadership in designing inclusive, sustainable, and locally meaningful health-environment interventions.

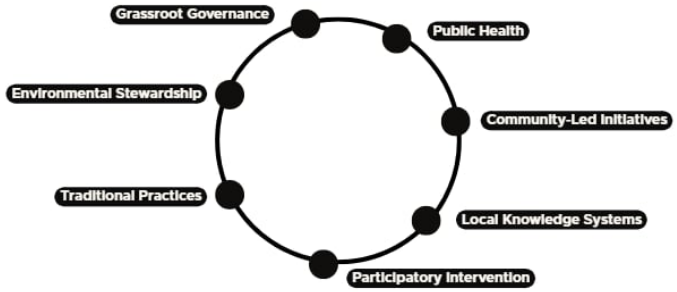

Fig. 2. Intergenerational Wisdom in Community-Led Environmental Management.

1.2 Research Gap and the Promise of the LAWA Approach

Leptospirosis persists as a complex and under-addressed public health challenge in the Laguna de Bay region—the Philippines' largest inland freshwater system and a critical socio-ecological landscape supporting fisheries, livelihoods, and urban settlements. Despite ongoing surveillance and awareness campaigns, the recurrence of outbreaks reveals enduring structural and ecological gaps: fragmented governance, insufficient inter-agency coordination, and the limited integration of local knowledge in formal health interventions. While numerous studies have examined the epidemiological and environmental dimensions of leptospirosis, few have advanced a framework that systematically links watershed governance, community participation, and public health prevention within a unified system of action.

Existing public health strategies remain predominantly sectoral anchored in biomedical models that prioritize treatment and information dissemination, while environmental management institutions address pollution and flood control in isolation. This fragmentation overlooks the socio-ecological realities of lakeshore communities where human, animal, and water interactions are interdependent, and where disease risks are inseparable from livelihood, land use, and watershed conditions [4]. Consequently, efforts to mitigate leptospirosis have often lacked sustainability, failing to embed prevention within the daily practices and ecological stewardship of local communities.

The Local Awareness and Watershed Action (LAWA) approach directly responds to this governance and research gap. Conceived as grassroots, transdisciplinary governance strategy, LAWA integrates ecological knowledge, participatory learning, and community-

based environmental action into a coherent model for leptospirosis prevention and watershed resilience. It reframes disease control not as a discrete medical intervention but as part of an eco-health continuum, where community well-being is inseparable from the ecological integrity of shared water systems.

Through participatory mapping, oral history documentation, co-designed monitoring tools, and capacity-building workshops, LAWA operationalizes the co-production of knowledge among fisherfolk, barangay councils, health workers, and local government units (LGUs). These processes mobilize citizen science and traditional ecological knowledge to identify contamination pathways, track environmental changes, and design behaviorally realistic preventive measures. The result is a participatory framework where communities become co-managers of watershed health, translating local experience into actionable governance.

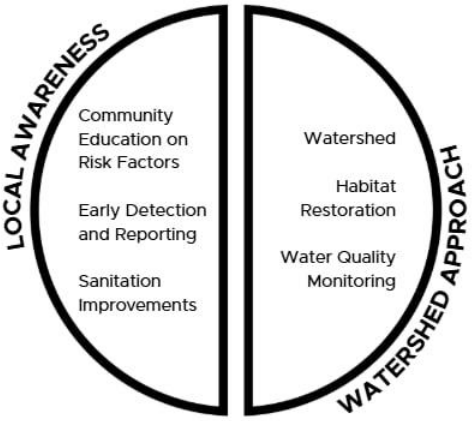

Fig. 3. A Community-Watershed Approach to Leptospirosis Prevention.

1.3 Distinction from the LAWA Thailand Model and Its Localization

While LAWA Philippines draws conceptual inspiration from Thailand's LAWA initiative, which centers on health promotion through local hospitals and village health volunteers, it diverges significantly in orientation and scope. The Thai LAWA model primarily operates within the public health system, emphasizing sanitation, hygiene, and behavioral change through structured health promotion networks [10]. In contrast, the Philippine LAWA (Local Awareness and Watershed Action) framework redefines the approach as an *ecohealth governance model*, explicitly integrating watershed management, zoonotic disease prevention, and environmental justice.

This localized adaptation expands the model's reach beyond the health sector, situating it within the socio-ecological realities of lake-based and flood-prone communities [11]. Instead of adapting an existing guidebook, LAWA Philippines evolves organically from community collaboration and environmental fieldwork in the Laguna de Bay region, grounded in local ecological memory, livelihood patterns, and indigenous environmental cues. It thus positions leptospirosis prevention as an outcome of collective watershed stewardship rather than top-down disease control.

1.4 Relevance to Sustainable Development Goals

The LAWA strategy directly contributes to multiple Sustainable Development Goals by embedding public health within the broader context of participatory water governance and

ecosystem care. This integration offers a concrete pathway for localizing global sustainability targets through community-driven action:

- SDG 3: Good Health and Well-Being

LAWA reduces leptospirosis and other waterborne diseases through proactive, community-led prevention, participatory mapping of high-risk zones, citizen science tools, and grassroots health education—transforming awareness into sustained behavioral and environmental change.

- SDG 6: Clean Water and Sanitation

By promoting waste reduction, riparian restoration, and community-based water quality monitoring, LAWA addresses the root causes of contamination, protecting freshwater ecosystems and reducing pathogen transmission.

- SDG 11: Sustainable Cities and Communities

Through co-designed flood preparedness and adaptive watershed planning, LAWA enhances resilience to climate and water-related hazards in densely populated lakeshore settlements.

- SDG 13: Climate Action

Integrating traditional ecological knowledge with scientific risk assessment, LAWA strengthens local capacity to anticipate and adapt to climate-driven flood and health risks, reinforcing resilience and sustainability at the watershed scale.

2. Literature Review

This review synthesizes current literature on leptospirosis, environmental health, and grassroots governance to establish the theoretical foundation for the Local Awareness and Watershed Action (LAWA) framework. It builds on the premise that leptospirosis is not merely a biomedical problem, but a *socio-ecological governance challenge* shaped by environmental change, livelihood dependency, and institutional fragmentation. Understanding these intersections provides the conceptual grounding for LAWA as a systems-based, participatory approach to eco-health resilience.

2.1 Leptospirosis and Vulnerable Lake Communities

Leptospirosis is a globally recognized zoonotic disease that disproportionately affects low-income, water-dependent populations in tropical and subtropical regions. Caused by *Leptospira* bacteria, it thrives in moist environments and spreads through direct or indirect contact with water, soil, or food contaminated by the urine of infected animals [7]. In the Philippines, incidence peaks during the monsoon season, when floodwaters mix with animal waste and overflow into residential zones, farmlands, and fishing areas.

In the Laguna de Bay region, the country's largest inland freshwater lake and a vital socio-ecological landscape, exposure risk is amplified by ecological degradation and livelihood dependence. The lake sustains tens of thousands of fisherfolk and aquaculture workers, yet also receives runoff from domestic, industrial, and agricultural sources. Daily subsistence activities such as hauling nets, wading, and cleaning fishing gear entail direct contact with flood-prone waters, often without protective equipment or access to immediate medical care.

Earlier studies (e.g., [8]) identified occupational exposure and inadequate sanitation as key transmission pathways, while recent researches [6, 10] highlights climate variability, watershed degradation, and governance gaps as amplifying factors. Despite periodic government-led information drives and cleanup campaigns, interventions remain short-term and disconnected from community livelihoods. This study responds to this persistent gap by reframing leptospirosis as a *socio-environmental and governance issue* rooted in structural

exposure, ecological vulnerability, and the need for participatory, place-based solutions such as LAWA.

2.2 Environmental Health in Socio-Ecological Systems

Laguna de Bay functions as a complex socio-ecological system where environmental processes, economic livelihoods, and health outcomes are interlinked. Rapid urban expansion has replaced natural wetlands with concrete surfaces, reducing drainage capacity, while upland deforestation and intensified agriculture accelerate sedimentation and nutrient loading, degrading both water quality and ecosystem resilience. These cumulative impacts heighten the risk of pathogen survival and transmission in flood-prone zones.

From *Ecohealth* and *One Health* perspectives [6, 10], human, animal, and environmental health are deeply interconnected. Seasonal flooding, once part of a balanced hydrological cycle, now serves as a vehicle for pathogen transport, carrying *Leptospira* from animal reservoirs to human settlements. This paradigm underscores the necessity of integrated interventions that operate across scales: improving sanitation and waste management, restoring riparian buffers, and embedding public health considerations in watershed and land-use planning.

Top-down environmental policies alone cannot account for the spatial and behavioral complexities of exposure in lakeshore settlements. Effective prevention thus depends on *local participation*, where ecological knowledge and community agency inform adaptive governance. LAWA situates itself precisely at this intersection, translating ecohealth principles into community-led action that bridges health, ecology, and livelihood systems.

2.3 Grassroots Governance in Public Health

Grassroots governance decentralizes authority and empowers local actors, those most exposed to environmental and health risks, to co-create solutions. In public health, such participatory governance enhances relevance, ownership, and sustainability by aligning interventions with local contexts and cultural norms [11].

In the Laguna de Bay context, grassroots governance manifests in barangay-led cleanup drives, fisherfolk-initiated flood mapping, and locally timed health campaigns synchronized with fishing and agricultural cycles. Rather than viewing residents as passive recipients of health services, this approach recognizes them as *co-managers of the health–environment interface*.

International precedents strengthen this argument. Community-based water surveillance in Indonesia [9], participatory flood monitoring in Vietnam, and locally managed sanitation programs in Sri Lanka demonstrate that when communities lead both water resource management and disease risk reduction, outcomes improve in both environmental and health domains. Yet, few of these models explicitly integrate *zoonotic disease prevention* within freshwater lake ecosystems, precisely the gap that LAWA seeks to fill by merging watershed governance with ecohealth action.

2.4 The LAWA Strategy: Integrating Local Knowledge into Disease Prevention

The **Local Awareness and Watershed Action (LAWA)** strategy represents an innovative governance-based model that embeds leptospirosis prevention within a broader framework of watershed stewardship and environmental justice. It extends beyond conventional water, sanitation, and hygiene (WASH) or disaster-risk initiatives by positioning disease control as

a *collective outcome* of community participation, ecological restoration, and adaptive learning.

Table 1. The strategy operationalizes participation through four core components.

LAWA Component	Core Activity	Purpose	Key Outputs	Example in Study Area
Mapping	Participatory flood and risk mapping	Identify exposure zones and community assets	Risk maps, local data layers	Fisherfolk delineated high-risk fishing zones in Barangay Palingon
Storytelling	Sharing lived experiences of floods, illness, and coping	Preserve indigenous knowledge and build collective memory	Oral histories, risk narratives	Elders narrated 2018–2020 flood events and responses
Monitoring	Community-based observation of environmental and health indicators	Strengthen local surveillance and early warning	Local monitoring forms, reporting network	Volunteers tracked floodwater quality and rodent sightings
Workshops	Co-learning sessions with LGUs and health workers	Translate awareness into coordinated action	Joint action plans, protective gear distribution	Barangay health workers co-led LAWA education drives

LAWA's originality lies in its integration of *grassroots governance*, *ecohealth principles*, and *local livelihood systems* into a single adaptive framework. By embedding public health action within watershed governance, LAWA reframes leptospirosis as a manifestation of broader socio-ecological vulnerability rather than a discrete medical event. This integrated approach advances multi-functional resilience—improving sanitation, strengthening governance capacity, and sustaining local economies.

Compared with similar initiatives in Southeast Asia, LAWA places stronger emphasis on *traditional ecological knowledge*, *place-based risk mapping*, and *co-produced solutions* rooted in the Philippine context. It prioritizes community autonomy, equity, and long-term sustainability, aligning with the emerging paradigm of participatory environmental governance as a cornerstone of both health security and ecosystem resilience.

3. Methodology

3.1 Research Design

This study employed a qualitative, exploratory design to examine how grassroots governance mechanisms contribute to leptospirosis prevention in lakeshore fishing communities around Laguna de Bay. Conducted between January and May 2025, this design was chosen to capture the lived experiences, local knowledge, and community practices shaping health–environment interactions. Given the emphasis on context-specific, participatory, and culturally grounded strategies, a qualitative approach was deemed more appropriate than quantitative or mixed methods at this stage of LAWA's conceptual development.

3.2 Study Area

The research was undertaken in purposively selected lakeshore barangays in Calamba City, Laguna, representing a microcosm of the Laguna de Bay socio-ecological system. These areas are characterized by dense human–water–animal interaction, seasonal flooding, and reliance on fishing and aquaculture for livelihood. Houses are commonly built along the shoreline, where limited sanitation and infrastructure heighten exposure to contaminated waters. Despite these vulnerabilities, the communities display strong social cohesion and ecological memory, shaped by intergenerational fishing practices and collective coping mechanisms.

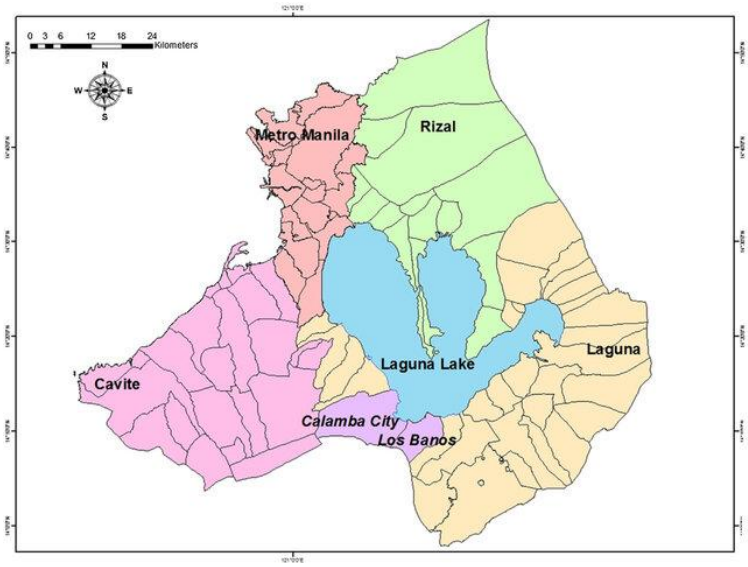

Fig. 4. Study area map. Laguna Lake is located north of Calamba City, Laguna. (Adapted from the study of Jago-on et al., 2025).

3.3 Participants and Sampling

Participants included fisherfolk, barangay officials, and community health workers selected through purposive sampling. Inclusion criteria emphasized individuals with direct exposure to lake-based livelihoods, familiarity with local health risks, and involvement in community governance or health initiatives. Sampling aimed to ensure diversity across gender, age, and fishing roles. Recruitment was facilitated through barangay referrals and local health offices. Data collection continued until thematic saturation was reached when no new insights emerged from additional interviews.

3.4 Data Collection Methods

Data were collected through semi-structured interviews, key informant interviews (KII), and non-participant observation. Fisherfolk interviews explored perceptions of leptospirosis risk, coping strategies, and adaptive behaviors. KIIs with barangay leaders and health workers examined governance dynamics, coordination mechanisms, and health campaign practices. Observations at fish landing sites, flood-prone zones, and communal spaces provided contextual insights into environmental exposure and routine practices. All interviews were

conducted in Filipino or local dialects, audio-recorded with consent, and supplemented with detailed field notes.

3.5 Data Analysis

Data were analyzed through inductive thematic analysis. Transcripts were coded manually to identify emerging concepts and group them into thematic clusters (e.g., "risk perception," "collective adaptation," "community innovation"). Cross-theme analysis was then applied to interpret how grassroots governance and participatory practices, core to the LAWA approach, shape disease prevention and ecological stewardship. This iterative process allowed for reflexive interpretation and contextual sensitivity.

3.6 Ethical Considerations

Ethical approval was obtained from the National University, Philippines. Informed consent was secured from all participants, and confidentiality was maintained through coded identifiers. Data were stored securely in encrypted formats. The study prioritized cultural sensitivity, observing local customs and consultation protocols to build trust and ensure respectful engagement with participants and barangay authorities.

4. Results

Field interviews and observations revealed four interrelated themes that operationalize the Local Awareness and Watershed Action (LAWA) framework in practice : participatory mapping, community storytelling, co-designed monitoring tools, and capacity-building workshops. Together, these illustrate how grassroots governance and ecological knowledge converge to enhance adaptive public health behavior.

4.1 Participatory Mapping

Participatory mapping emerged as a key mechanism for bottom-up risk assessment. Fisherfolk used their generational knowledge of lake hydrology to identify high-risk zones, seasonal flood paths, and contamination points. This co-production of maps transformed residents from data subjects into co-analysts, producing locally grounded risk information often overlooked by external experts. Such maps informed barangay-level flood preparedness and early warning systems, consistent with community-based mapping practices observed in Genoa, Italy.

4.2 Community Storytelling and Ecological Memory

Storytelling provided a means of transmitting ecological memory, collective recollections of environmental change, land use, and waterway transformations. Through oral histories, communities connected past deforestation, drainage alterations, and urban expansion with increased flood severity and disease exposure. Recognizing these narratives validated the lived experience of fisherfolk as community scientists, aligning with [15], who highlight the role of storytelling in sustaining plural ecological futures.

4.3 Co-designed Monitoring Tools

The LAWA framework bridged scientific monitoring with indigenous ecological indicators. Residents integrated water color changes, fish behavior, and vegetation cues with basic scientific tools to track contamination and water quality trends. This hybrid monitoring system democratized environmental data collection and strengthened community accountability. The approach mirrors the participatory ethos of Thailand's LAWA model, where local Health Promoting Hospitals (HPHs) and village health volunteers co-manage surveillance, though the Philippine adaptation extends beyond health to watershed governance.

4.4 Capacity-Building Workshops

Capacity-building workshops provided platforms for knowledge exchange and technical training while reinforcing local practices. Activities included training on low-cost water testing, sanitation measures, and flood mitigation using indigenous materials. These sessions emphasized behavioral adaptation without undermining cultural norms, aligning with [15], who advocate holistic systems care integrating human, institutional, and ecological wellbeing.

5. Discussion

5.1 Community Resourcefulness as a Governance Asset

Findings affirm the adaptive capacity of fisherfolk communities as active agents in health–environment governance. Self-built infrastructure, such as footbridges and drainage channels—demonstrates bottom-up innovation addressing both ecological and health vulnerabilities. This resourcefulness parallels adaptive governance patterns identified by [15], underscoring how local agency can complement formal systems. Recognizing and institutionalizing such community innovations within municipal frameworks could enhance sustainability and cost-effectiveness in public health planning.

5.2 Risk Behaviors and the Livelihood-Health Trade-off

Economic imperatives often force fisherfolk to engage in risky practices, such as wading in floodwaters, despite awareness of health dangers. These behaviors reflect structural constraints rather than ignorance, consistent with findings among agricultural workers in Kenya. The LAWA model addresses this by promoting context-specific, co-designed interventions, protective gear compatible with fishing activities, localized sanitation measures, and safe fish-pen modifications—balancing livelihood security with health protection.

5.3 NGOs as Intermediary Governance Actors

NGOs play a bridging role between communities and formal governance, providing education, insurance, and material support. However, their initiatives are often short-term or project-bound. Institutionalizing NGO–community partnerships through coordination with agencies like the Laguna Lake Development Authority (LLDA) can enhance policy coherence and sustainability. Similar co-management models in Southeast Asia demonstrate that structured partnerships can embed behavioral change at scale [15].

5.4 Perceptions and the Social Construction of Risk

Community perceptions of leptospirosis risk are shaped by cultural beliefs, local experience, and trust in authorities. Misalignments between biomedical messages and lived realities can hinder compliance, echoing Douglas and Wildavsky's (1982) "cultural theory of risk." Participatory methods such as mapping and storytelling are effective in aligning scientific and local understandings, consistent with [2, 13, 15], who advocate participatory learning to improve risk communication and community ownership.

5.5 Study Limitations

The study was limited to selected fisherfolk communities, excluding other vulnerable groups such as informal settlers and agricultural workers. Data were collected during the dry-to-wet transition period, potentially missing behaviors typical during peak flooding. Participant recall bias may have influenced responses, and the qualitative scope limits generalizability. Future research could address these through longitudinal and mixed-method designs.

5.6 Toward Scalability and Replication

The LAWA approach demonstrates strong potential for replication in other inland water systems where public health, ecology, and livelihood intersect. Its strength lies in flexibility, local ownership, and systems thinking. For scalability, enabling conditions include strong local leadership, institutional support from LGUs and NGOs, and formal recognition of community co-governance. Integrating digital mapping tools and participatory data platforms could further enhance replicability and impact.

6. Conclusion and Recommendations

This study underscores that leptospirosis prevention in the Laguna de Bay region requires transcending biomedical models and embracing an ecohealth governance paradigm. The Local Awareness and Watershed Action (LAWA) framework reframes disease prevention as a function of watershed stewardship, mobilizing local knowledge, participatory tools, and grassroots governance for sustainable resilience. For policymakers, it is recommended to institutionalize community-driven innovations—such as local flood barriers and sanitation systems—within municipal Disaster Risk Reduction and Management (DRRM) and public health plans. Multi-sectoral EcoHealth committees should be established to integrate fisherfolk, barangay councils, non-government organizations (NGOs), and local government units (LGUs) under a unified watershed management framework. Furthermore, targeted funding should be allocated for protective gear and adaptive infrastructure that simultaneously safeguard livelihoods and community health.

For NGOs, efforts should focus on expanding micro-insurance schemes and financial support mechanisms to help buffer fisherfolk against income loss due to health-related risks. Culturally grounded education programs that integrate local knowledge with environmental health awareness are also essential. NGOs are likewise encouraged to lead citizen science initiatives that promote participatory mapping, water monitoring, and data-driven community engagement.

For communities, strengthening collective action networks is vital to sustain shared infrastructures and advocate for local priorities. Preventive behaviors, such as consistent use of protective footwear and improved sanitation practices should be integrated into daily

routines. Continuous knowledge exchange that blends indigenous wisdom with scientific insights can further support adaptive governance and resilience.

Finally, future research should pursue longitudinal studies to track changes in infection rates, behavioral adaptation, and community resilience. Economic evaluations are also needed to assess cost-effectiveness and livelihood outcomes, thereby informing policy scaling. Moreover, the integration of digital tools—such as participatory Geographic Information Systems (GIS) and citizen reporting platforms—can enhance monitoring systems and feedback mechanisms for the continued refinement of the LAWA approach.

Acknowledgements

The authors acknowledge the facilities, scientific and technical support from LAWA PH Team, National University, Philippines, Polytechnic University of the Philippines, New Era University and Coastal Barangays through the Municipality of Calamba City, Laguna.

Author contribution

K L Sandoval contributed to the research conceptualization, data analysis, writing original draft. D M M Marundan, R V Labana, and K J S Cada contributed in conducting the research, data interpretation, draft revision, English translation and proofreading. J C Dizon, R V D Dimasin and J M T Taller contributed to writing original draft, data interpretation and proofreading. K L Sandoval and D M M Marundan prepared and illustrated the figures.

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