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Thematic and Multicriteria Analyses of the Readiness, Factors, and Strategies for Successful Implementation of Nature-Based Solutions Initiatives in Victoria, Laguna

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Abstract

Nature-based solutions (NbS) are strategies that utilize nature to address various environmental and societal challenges while simultaneously benefiting human-ecological systems. They are cost-effective and scalable approaches that have the potential to address climate change, support biodiversity, and contribute to achieving the Sustainable Development Goals (SDGs). Despite these benefits, several factors challenge their widespread implementation, particularly in developing countries. This study aims to determine the essential elements needed to implement the NbS initiatives successfully in rural communities. Taking the case of Victoria, Laguna, this research conducted Key Informant Interviews with local stakeholders and policymakers and applied thematic and multicriteria analyses to evaluate their readiness, factors to be considered, and strategies for the successful implementation of NbS initiatives in the municipality. Results revealed that the locals have limited knowledge of NbS and utilizing NbS initiatives stood as a secondary priority, compared to more preferred gray infrastructure/hard engineering projects. The financing, enforcement, and knowledge components determined the readiness of Victoria for its NbS initiatives. In terms of the factors for the successful implementation of NbS initiatives, the most prevalent themes were the criteria for an inclusive, transparent, and empowering governance process, net gain to biodiversity and ecosystem integrity, and design informed by scale. Furthermore, the NbS initiatives in Victoria were observed to adhere to the IUCN Global Standard, with biodiversity net gain and economic feasibility as their strongest areas. In terms of strategies, local stakeholders placed substantial importance on its sustainability and mainstreaming in appropriate contexts, as well as on evidence-based adaptive management. Findings provided recommendations focusing on creating an NbS assessment mechanism, strengthening the existing NbS governance structure, information and education campaigns, and formulating proposals that utilize NbS to address other issues faced in the municipality, such as flooding and climate change.

Keywords— *climate change, developing country, IUCN Global Standard, nature-based solutions, rural community*

1 Introduction

The decline of nature has been evident at an unprecedented rate, with the forest biomes and marine ecosystems reaching irreversible tipping points, consequently affecting society, economy, and life in general [1]. Among the abundant systemic risks constantly faced by the population are remarkably environment-related such as natural hazards, extreme weather, biodiversity loss, and human-made environmental disasters [1]. As conveyed by the United Nations Office for Disaster Risk Reduction (UNDRR), these rising risks can be attributed to increased human activity resulting in global environmental degradation [2]. The intensified rate of climate change is also a challenge faced by the global population and the environment, driving increased incidents of disasters that harm and kill people, damage ecosystems, and destroy infrastructure—threatening sustainable development [3].

When communities are faced with the negative impacts of climate change such as severe flooding and more frequent typhoons, repercussions on agricultural yield, livelihoods, and human health are most likely to be anticipated; if unmanaged, this may derail the socio-economic progress of the country along with severe long-term impacts, substantially hindering the attainment of sustainable development [4, 5]. The call for the advancement of proper ecosystem management is essential for the planning and implementation of disaster risk reduction (DRR) and climate change adaptation (CCA) strategies [3].

Conventional engineering methods, usually referred to as "hard engineering" or "gray infrastructure", top the list among the multiple solutions that can be considered. Gray infrastructures provide municipalities and residents with services such as energy, roads, buildings, flood protection, stormwater drainage, and wastewater treatment centered on serving human society and the industrial economy [6]. While they are historically justified as an engine for many economies, they often lead to more imbalances in ecosystems and system services due to a lack of overall ecological considerations, damage to the original natural life system, single function, and repeated construction [6, 7].

Nonetheless, ecosystems are imperative in developing timely and sustainable solutions to global challenges such as nature-based solutions (NbS). NbS, as defined by the International Union for Conservation of Nature (IUCN), are the actions aimed at protecting, sustainably managing, and restoring natural or modified ecosystems to effectively address challenges in society (e.g., negative effects of climate change, food, and water insecurity, biodiversity loss) while providing benefits to both human well-being and biodiversity [8]. From a human ecological perspective, NbS provides several ecosystem services categorized into provisioning, regulating, supporting, and cultural services to humans and the environment [9, 10]. Advantages beyond the project's main goal are among the benefits NbS offers, which may be creating more green jobs, enrichment of local flora and fauna and coastal habitats, and easier access to public green spaces [11]. NbS provides innovative responses for promoting adaptation and building resilience in tackling global challenges such as increasing disaster incidence and decreasing water security brought by flooding, coastal erosion, rising seas, and extended dry periods [12].

The IUCN has created a global standard operating on a dynamic framework in designing and verifying NbS initiatives that will generate the desired outcomes. The standard contains eight (8) criteria and 28 indicators, covering a wide range of societal challenges that are anticipated to yield multiple benefits, wherein a single intervention can address several challenges [8]. Similarly, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) also developed an NbS implementation guide focusing on monitoring and evaluation measures. It contains four broad steps forming a foundation for a robust system, namely: step (1), to develop a results framework; step (2), to define indicators and set a baseline; step (3), to operationalize the monitoring and evaluation system; and step (4), to use and communicate the results [13]. However, UNDRR [2] noted that although there is a growing scientific and operational base for NbS, its implementation is always

contextual and site-specific, requiring the active participation of the key players—government sector, communities (e.g., women, youth, children) and the private sector—for it to be successful.

Similar to most approaches, implementing NbS also comes with accompanying challenges. A study by Nelson et al. [12] examined the emergent challenges that hinder the potential of NbS, which include (1) the socio-political context, which comprises factors such as participation and equity, governance, and valuation—all influencing the behaviors, decisions, and actions being made; (2) the infrastructures within landscapes domain, affecting infrastructure integration or material changes and consequently the adaptation decisions and scenarios; and (3) the socio-hydrological risk and benefits, which largely alter the scale and feedbacks within the system. GIZ [13] also examined the common challenges faced in implementing NbS, whether completely green or hybrid. These include (1) context-dependent and the lack of universal indicators to measure performance; (2) difficulty in tracking progress of "shifting baselines" and "moving targets"; (3) long process and varied time horizons about climate change; (4) complex relationships between the factors and attributes; (5) complications in defining a model of comparison and in measuring probable impacts; (6) adaptation strategies that span diverse scales and sectors; and (7) the absence of a universal standard defining "successful" adaptation. Velasco et al. [14] suggested that the successful adoption of NbS would require a policy guide in the assessment and implementation, with local stakeholders' support and national funding. As suggested by Browder et al. [15], for NbS approaches to be appropriately implemented, they must be carefully designed within their specific locales and rigorously evaluated such as in the case of conventional gray infrastructure projects. Furthermore, Agaton & Guila [16] identified factors for the successful implementation of the NbS projects including government support, good governance, and public support, while the challenges for implementation were improper maintenance, funding, and climate-related uncertainties, including natural calamities, flooding, earthquakes, and sea level rise.

Yet, we identified a research gap in evaluating the factors for the successful implementation of NbS projects from the perspective of rural communities in developing countries. This study aims to bridge this gap by taking the case of Victoria, Laguna to determine the essential elements needed to successfully implement NbS initiatives addressing the local environmental problems in the locality. Specifically, this study aims to describe the readiness of the local government to implement its NbS initiatives, identify the factors that guide the implementation of NbS initiatives in the Municipality of Victoria, Laguna, and recommend strategies for the effective implementation of NbS initiatives.

2 Methodology

2.1 Research Locale

Victoria is a 4th class municipality in the province of Laguna, Philippines with a population of 46 thousand people living in 9 barangays. It lies in the southeast of Laguna de Bay and is bounded by three municipalities, namely Calauan in the southwest, Nagcarlan in the southeast, and Pila in the northeast [17]. As shown in Victoria's existing Land Use map (see Figure 1), the majority of land in the municipality is appropriated for agriculture, as it is recognized as a major rice producer in the CALABARZON region.

Tagged as the "*duck raising capital of the Philippines*" where the Itik festival is annually held, the municipality of Victoria is also known for its diverse local livelihoods encompassing farming, fishing, boating, and duck raising [17]. However, just like any other local government unit (LGU) in the country, Victoria also experiences the adverse effects of climate change and disasters aggravated by the COVID-19 pandemic.

As indicated in the municipality's Comprehensive Land Use Plan (CLUP), the issues and challenges that Victoria faces include the lack of a proper solid waste management system, coastal and

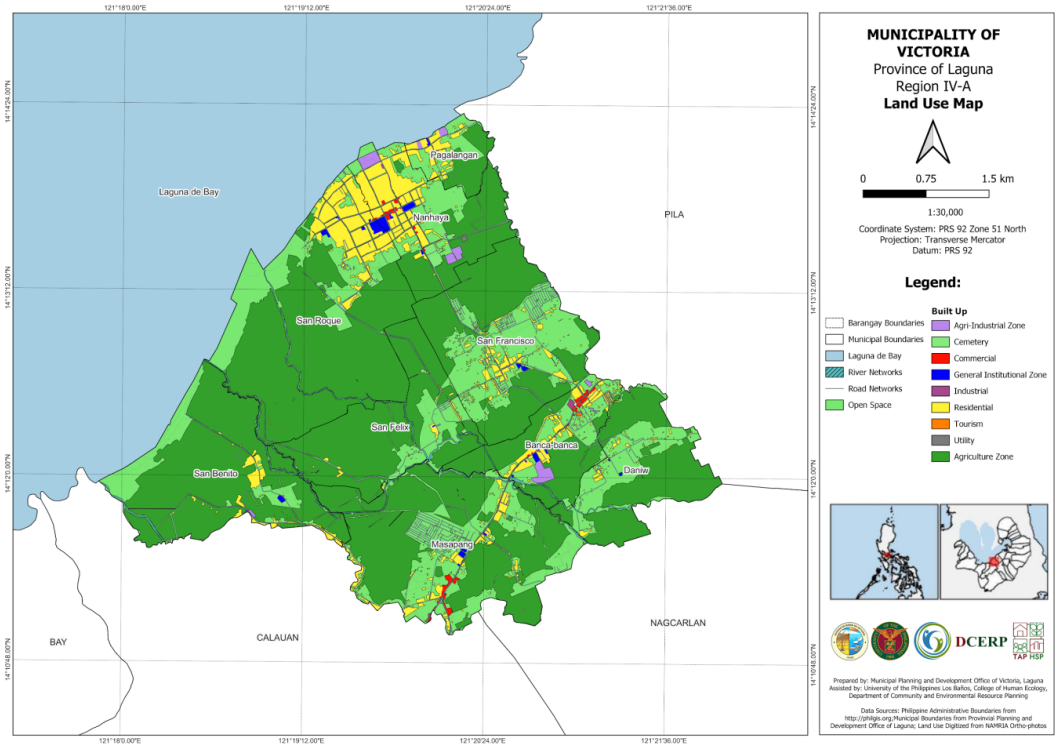

Figure 1.
Existing Land Use Map of Victoria, Laguna (Victoria CLUP [17])

urban flooding, electric fishing and overfishing, continuous deterioration of the lake (Laguna de Bay), and food insecurity. To aid in solving some of the aforementioned issues, the LGU, headed by the Municipal Planning and Development Office (MPDO), initiated projects such as the conversion of the open dumpsite into a materials recovery facility (MRF) as stipulated in section 32 in Republic Act 9003 otherwise known as the Ecological Solid Waste Management Act of 2000; the strict implementation of existing ordinances to encourage waste segregation in both household and commercial wastes and to settle the electric fishing and overfishing problems; and the use of agricultural innovations including the conversion of rice straw waste into biogas and animal feeds.

Furthermore, the MPDO identified and proposed a green-gray infrastructure integrating NbS interventions to address issues faced by the municipality by establishing an eco hub facility for plastic waste and an MRF for biodegradable waste to resolve the waste management issue. As a hybrid NbS project, the facility will utilize green infrastructure, particularly a green roof, acting as an effective rainwater buffer and indoor temperature regulator through vegetation. The eco hub facility has already been approved with the LGU municipal council's Resolution No. 54, Year 2023. This facility will be located at an existing Material Recovery Facility (MRF) in one of the barangays in the municipality. This project is under a tripartite agreement (public-private partnership) between a funding agency, a private component for the provision of equipment, and the LGU Victoria itself.

Moreover, this is one of the pioneer initiatives in the municipality in terms of climate-proof infrastructure. The facility aims to collect the plastic waste accumulated in the municipality and convert it into various eco brick products, such as eco blocks, which will substitute for the usual hollow blocks used in construction projects. This will also entail a strict implementation of the "no segregation, no collection" policy in the LGU, particularly at the household level, to collect sufficient plastics for its operation. Moreover, it will aid in generating employment within the municipality as local jobs will be available once the facility is in operation.

The second hybrid NbS in Victoria is a proposed project to establish an MRF for various biodegrad-

able waste. Similar to the eco hub facility, it is also planned to adopt a green roof technology, including bioswales within its surrounding area. The proposed facility will also be housed in one of the existing MRFs in the municipality. Given that the approved eco hub facility will focus on plastic waste, this proposed facility will consequently target biodegradable waste to address the waste management issues holistically faced by the municipality. The plan is to convert the ample waste accumulated from the itik industries, poultries, and piggeries within Victoria into beneficial products such as liquid fertilizers, soil conditioners, and biogas which are all essential in the agriculture industry. Since a proposal has already been made for this project, the LGU is currently looking for funding agencies to help shoulder the project costs, as the municipality cannot cover the required capital.

In sum, the Municipality of Victoria, Laguna was selected as the case study for this research due to the following reasons: (1) Victoria faces several environmental management problems from both natural and anthropogenic sources, (2) as a fourth-class municipality, financial resources are limited to addressing these problems with huge infrastructure and development projects, (3) the municipality has a huge potential in utilizing NbS as an alternative solution, and (4) there are already plans for NbS projects yet, the challenge lies in their successful implementation as clear NbS guidelines, particularly in the local context, are still non-existent.

2.2 Research Instrument and Data Collection

The study utilizes both primary and secondary sources for data collection. The primary data comprised of the key informant interview (KII) with the municipality's department heads, as well as a scoring survey from the representatives of the municipal department offices (8), barangay representatives (7), and municipal civil society organizations (16) as shown in Table 1. These data were gathered through a convenience sampling method from April to June 2023. On the other hand, the secondary data included the existing pertinent documents of the municipality such as the CLUP and socio-economic profile to complement the KII and scoring results.

Table 1. Participants of surveys and key informant interviews

Level	Representatives	Number of Participants
Municipal	Municipal Planning and Development Office Municipal Engineering Office Municipal Disaster Risk Reduction and Management Office Municipal Social Welfare and Development Office Municipal Treasury Office Municipal Assessor's Office Municipal Agriculture Office Municipal Public Employment Service Office	8
Barangay	San Roque Daniw Masapang Pagalangan San Benito San Felix San Francisco	7
Civil Society Organizations	Women's Association Overseas Filipino Workers Association	16

The municipality's readiness to implement NbS initiatives in the KII guide was adapted from the study of Conti et al. [18] from the Nature Conservancy, wherein the operationalization of NbS in the private sector was examined. The questionnaire was divided into five parts: (1) the preliminaries,

including the purpose of the study, written consent, and ethical considerations; (2) the demographic profiles of the participants; and the knowledge and experiences of the stakeholders in implementing NbS initiatives in Victoria, Laguna; (3) the identification of potential benefits and opportunities of NbS initiatives in the municipality; (4) the engagement of key stakeholders in the design and implementation of NbS projects; and (5) considerations for the successful operationalization of NbS initiatives.

Specifically, the questions asked were the following:

Opportunities

- What benefits of NbS are well-established and connected to the operations of the LGU?
- What are the most immediate planning and engineering needs within the LGU?
- What benefits (or costs) could be realized in the implementation of NbS that would not be realized with a gray infrastructure alternative?

Engagement of Stakeholders

- What project proposals already have capital secured for the project implementation?
- What local conditions must be considered for successful project implementation (e.g., native plants, climate, topography)?
- What regulatory requirements and/or deadlines is the LGU under that could impact the timing or design of the NbS?

NbS Operationalization

- What are the primary NbS that the LGU should focus on going forward?
- How can the LGU better advocate for these solutions internally and with regulators, businesses, and non-profits?
- What are the primary areas of uncertainty or risk about NbS implementation? How do you think they will be addressed?
- How do you create a culture that sustains NbS implementation with the LGU, including performance metrics, alignment around the vision, complementary sourcing and procurement, and communications?

2.3 Data Analysis

After gathering the primary and secondary data, the results were assessed through thematic analysis and a multicriteria analysis (MCA) tool from the IUCN. Thematic analysis was applied to identify the factors influencing the successful implementation of NbS initiatives in the municipality. For the MCA, a scoring scheme accounting for the eight NbS criteria from the IUCN [8] was utilized to craft a suitable criteria framework (see Table 2). Subsequently, the results formed the basis for the recommendation of strategies to be presented to the municipality. The recommendations highlighted the vital elements for successful NbS implementation, including appropriate mechanisms for its monitoring and evaluation.

The scoring system was created to rank each criterion based on its importance and applicability in implementing NbS in the municipality. Therefore, the ranking was based on a scoring system, with eight (8) being the highest score and one (1) being the lowest. Moreover, according to IUCN [8], all eight NbS criteria were inferred to have equal weight; thus, no additional steps and computations were necessary. The tool contains guiding questions to assess whether a specific indicator has been addressed into four scales based on percentages, namely: insufficient (1 or <25%), partial (2 or 25% & <50%), adequate (3 or 50% & <75%), or strong (4 or 75%). For the NbS intervention to adhere to the IUCN Global Standard, each criterion must generate a strong, adequate, or partial scale; otherwise, it would not comply with the standard. For this assessment, only the establishment of an

Table 2. Scoring sheet for the 8 IUCN Criteria [19]

Nature-based Solutions (NBS) Criteria (IUCN, 2020)	Scoring (1-8) *1-lowest, 8-highest*
1) **Address societal challenges** *(Mabisang tinutugunan ng NbS ang mga hamon sa lipunan.)*	
2) **Design is informed by scale** *(Ang disenyo ng NbS ay alam ayon sa sukat.)*	
3) **Net gain to biodiversity and ecosystem integrity** *(Nagreresulta ang NbS ng mga pakinabang at integridad sa kapaligiran.)*	
4) **Economically viable** *(Ang NbS ay nakatutulong sa lokal na ekonomiya.)*	
5) **Inclusive, transparent, and empowering governance process** *(Ang NbS ay nakabatay sa inklusibo at transparent na proseso ng pamamahala.)*	
6) **NbS equitably balance trade-offs between the achievement of their primary goal(s) and the continued provision of multiple benefits.** *(Pantay na nababalanse ng NbS ang mga trade-offs sa pagitan ng pagkamit ng kanilang (mga) pangunahing layunin at ang patuloy na pagbibigay ng maraming benepisyo.)*	
7) **Managed adaptively and evidence-based** *(Ang NbS ay ginagawa ayon sa mga pag-aaral at iba pang ebidensiya.)*	
8) **Sustainable and mainstreamed in appropriate contexts** *(Ang NbS ay pangmatagalan at naaangkop ayon sa konteksto.)*	

eco hub facility was considered as it was already approved and contained the necessary information required for the tool. The other NbS initiative, which is the MRF for biodegradable waste, is still in its early proposal stage and thus lacks relevant information needed for the assessment.

2.4 Research Ethics

The study adhered to ethical considerations following the Declaration of Helsinki on research involving human participants. Participants were informed about the objectives of the study. A free-prior informed consent was obtained from all participants with the option to be identified by full name, pseudonym, or completely anonymous. The researchers ensured the participants' data confidentiality and the study's academic purpose.

3 Results and Discussion

3.1 Readiness to Implement NbS Initiatives

To describe the Municipality of Victoria's readiness to implement its NbS initiatives, a key informant interview (KII) was conducted with the available department heads of the municipality, particularly those who have prior knowledge and background about NbS. After various consultations and inquiries, two (2) final key informants were drawn using the same questionnaire format. Only these two department heads consented during data collection and were aware of the proposed NbS initiatives to be deliberated and implemented in the municipality. Table 3 presents the summary results of the performed KII.

In terms of the opportunities of NbS in the municipality, participants appreciated the benefits of NbS that are (not) well-established and connected to the operations of the LGU. "*The LGU to have a functioning MRF; existing facilities were discontinued and operations were unmaintained due to changing administration and other contributing factors.*" Additionally, "*The practice of backyard*

Table 3. Key informant interview summary results

PART 1. IDENTIFICATION OF OPPORTUNITIES	
Questions	**Answers**
1. What benefits of NbS are well-established and connected to the operations of the LGU?	• The LGU to have a functioning MRF; existing facilities were discontinued and operations were unmaintained due to changing administration and other contributing factors. • The practice of backyard gardening and the use of organic fertilizers should also be strengthened, especially at the household-level.
2. What are the most immediate planning and engineering needs within the LGU?	• Flooding is one of the issues that could be addressed using NbS. Initiatives such as planting of bamboo within riversides for flood control may be explored. • The proliferation of water hyacinth in freshwater bodies, especially in Laguna Lake, is also a concern. These aquatic plants may be used as a raw material for the production of possible products. • The eventual lake level rise of Laguna Lake is evident, especially during heavy and continuous rains. This lake also acts as a drain in Manila Bay through Pasig River. The rise of water level is a problem not just in Victoria, but also to other lakeside municipalities in the Laguna province, as well as other affected areas in the CALABARZON region.
3. What benefits (or costs) could be realized in the implementation of NbS that would not be realized with a gray infrastructure alternative?	• NbS is not an alternative, but it is hoped that the locals can see that it can be a solution in itself to address multiple problems (e.g., aside from addressing floods, it can also be used as an advantage such as a source of livelihood for additional income and tourism). • NbS is incomparable with gray infrastructure (GI) —there are advantages and disadvantages on both sides. Matter of weighing where the community will benefit the most. Also, GI costs are really higher; for NbS, it is more on sustaining (maintenance costs). Assessments for specific projects should be done to evaluate which is better (e.g., riprap vs. greening of riverbanks).

PART 2. ENGAGEMENT OF KEY STAKEHOLDERS AND DESIGN AND IMPLEMENTATION OF PILOT NBS PROJECTS	
Questions	**Answers**
1. What project proposals already have capital secured for the project implementation?	• The establishment of an eco-hub facility, wherein plastic waste—as raw materials—are used for manufacturing building materials such as bricks. • Aside from the MRF for biodegradable waste, a sanitary landfill is also proposed.
2. What local conditions need to be considered for successful project implementation (e.g., native plants, climate, and topography)?	• It would be based on the specific NbS project, such as for flood control or for greening programs. It is, however, essential that the flora and fauna species that will be utilized or will be affected are applicable to the local environment such as climate and soil condition.
3. What regulatory requirements and/or deadlines is the LGU under that could impact the timing or design of the NbS?	• None, as there are no deadlines. Project implementation is whole year- round. Only concern during the timing of projects is the local weather conditions. But this is still dependent on the type of NbS to be implemented.

PART 3. NBS OPERATIONALIZATION	
Questions	**Answers**
1. What are the primary NbS that the LGU should focus on going forward?	• Those that will address the main concerns of the municipality, which is flooding and the lack of proper waste management. • Backyard composting is hoped to be implemented within the municipality at the barangay and household level. Implementation for proper solid waste management (no segregation, no collection policy) is still not that strong. Also, waste treatments of poultry by-products, especially to the *itik* businesses, should be present.
2. How can the LGU better advocate for these solutions internally and with regulators, businesses, and non-profits?	• In any project implementation, it is imperative to think about who the beneficiaries are, such as the local communities and CSOs—women's group, senior citizens, farmers, tricycle drivers' association, among others. The LGU works together with the NGOs and municipal CSOs as they can be tapped to head and implement the projects, which is also a matter of coordinating and assessing if the project to be implemented fits the profile of the organization. • Provision of incentives can also be done to encourage participation within the organizations. One example is from the Department of Education (DepEd) wherein the school that can produce the most plastics will be awarded with WASH stations. This is related to the implementation of the regulation on the use of plastics, particularly single-use ones. • For the eco hub facility, outsourcing of raw materials (plastics) can be done through coordination with factories and nearby municipalities, particularly in the 1st district of Laguna. Aside from disposing their rejected plastics and/or packaging, they can instead bring them to Victoria.
3. What are the primary areas of uncertainty or risk in relation to NbS implementation? How do you think will they be addressed?	• For the eco hub facility: (1) if the stringent "no segregation, no collection" policy will fail, the daily target number of plastic waste to be collected may not be met; and (2) negative feedback coming from the private entities and also to the locals. • One contingency plan is to coordinate with other municipalities as their plastics waste may be brought to Victoria, as Victoria is spearheading the eco hub project in the province of Laguna. • Other areas of risk may also emanate from the other partners—financing agency and manufacturing corporation; thus, risk mitigation shall be carefully planned.
4. How do you create a culture that sustains NbS implementation with the LGU, including performance metrics, alignment around the vision, complementary sourcing and procurement, and communications?	• In terms of sustainability, it is hoped that the concept of *ningas kugon* will be avoided, wherein the projects may only be effective and/or compliant at the start, but will eventually fail. • The LGU cannot always provide incentives. There needs to be an internal change in the mindset of individuals—to alter the current notion of the locals in terms of waste. They should be motivated because it is the right thing to do, and that these actions will help everyone (i.e., environment, current and future generations), not because it is convenient or since there are available incentives.

gardening and the use of organic fertilizers should also be strengthened, especially at the household level".

Participants also identified the most immediate planning and engineering needs within the LGU that could be addressed using NbS. "*Flooding is one of the issues that could be addressed using NbS. Initiatives such as planting bamboo within riversides for flood control may be explored*." Another respondent mentioned that "*the proliferation of water hyacinth in freshwater bodies, especially in Laguna Lake, is also a concern but could be used as a raw material for producing possible products*". In the Philippines and other countries, water hyacinths have been found to have potential uses as paper, fiber, animal fodder, organic fertilizer, and biogas production [20].

Additionally, "*The eventual lake level rise of Laguna Lake is evident, especially during heavy and continuous rains. This lake also acts as a drain in Manila Bay through Pasig River. The rise of water level is a problem not just in Victoria, but also in other lakeside municipalities in the Laguna province, as well as other affected areas in the CALABARZON region*". Moreover, "*Backyard composting is hoped to be implemented within the municipality at the barangay and household level. Implementing proper solid waste management (no segregation, no collection policy) is still not strong. Also, waste treatments of poultry by-products, especially to the itik businesses, should be present*".

In terms of the benefits (or costs) that could be realized in the implementation of NbS, participants were negative about their readiness for NbS initiatives. One mentioned that "*NbS is not an alternative, but it is hoped that the locals can see that it can be a solution in itself to address multiple problems (e.g., aside from addressing floods, it can also be used as an advantage such as a source of livelihood for additional income and tourism)*". Another emphasized that "*NbS is incomparable with gray infrastructure—there are advantages and disadvantages on both sides, but it is a matter of weighing where the community will benefit the most. Also, their costs are higher; for NbS, it is more on sustaining (maintenance costs). Assessments for specific projects should be done to evaluate a better alternative (e.g., riprap vs. greening of riverbanks)*". This was mentioned as gray infrastructure, or traditional gray engineering methods, such as sewer pipe networks and deep tunnels for urban flood management, were already conventional solutions that have been known to work, despite their high costs [21].

For the planning and design of NbS, participants mentioned the importance of the utilization of endemic species of organisms as well as the timeline of implementation. "*For the NbS projects for flood control or greening programs, it is essential that the flora and fauna species apply to the local environment in terms of climate and soil condition.*" Further, "*project implementation is whole year-round. However, the only concern during the timing of projects is the local weather conditions but this is still dependent on the type of NbS to be implemented*".

In terms of operationalization, participants emphasized the importance of clearly identifying the project's beneficiaries and the initiative's sustainability in the long run. "*It is imperative to consider who the beneficiaries are, such as the local communities and CSOs including women, senior citizens, farmers, tricycle drivers' association, among others. The LGU works together with the NGOs and municipal CSOs as they can be tapped to head and implement the projects, a matter of coordinating and assessing if the project to be implemented fits the profile of the organization.*" Another mentioned the participation incentives: "*provision of incentives can also be done to encourage participation within the organizations". This also supports that accounting for the different stakeholders' perception of the co-benefits is key for reducing trade-offs and enhance the acceptability of NbS projects [22]. Furthermore, "for the eco hub facility, outsourcing of raw materials (plastics) can be done through coordination with factories and nearby municipalities, particularly in the 1st district of Laguna. Aside from disposing of their rejected plastics and/or packaging, they can instead bring them to Victoria*".

3.2 Factors Influencing NbS Implementation in Victoria, Laguna

The accomplished KIIs were able to assess the factors influencing NbS implementation in the Municipality of Victoria. These were organized into three themes, namely (1) financing, (2) enforcement, and (3) knowledge for better interpretation.

Financing

Regarding the necessary funds required for NbS implementation, only one project already has capital secured: the eco hub facility. As a PPP project, sufficient funds are already available for its establishment. However, for the other project, namely the MRF for biodegradable waste, the LGU is still seeking possible funders. The lack of the project's feasibility study also contributes to the scarcity of its prospective funders. These support the previous claim that the overarching barriers of NbS finance are coordination between private and public financiers and integration of NbS benefits into valuation and accounting methods [23].

Additionally, scaling up and mainstreaming NbS are challenged by information gaps, lack of financial resources for government units, low investment returns, lack of institutional capacity, perceived higher risk, policy failures, short-termism of investors, undefined financial responsibilities, undervalued natural capital, and reliance on voluntary commitments [24]. To address these financing issues, a wide spectrum of business models can be employed with a role for governments to support the processes that enable investments in NbS initiatives. These include expanding the knowledge base for NbS, enhancing synergies between the public and private sectors for financing NbS, fostering enabling governance and policy frameworks, and tapping the role of developed countries in supporting NbS uptake for climate resilience [25].

Enforcement

This theme mainly delves into the level of success that the project may obtain once it is implemented. The unanticipated issues, also known as uncertainty or risk, were specified for the eco hub facility, and subsequent contingency plans were provided. Moreover, partnerships with the local communities and municipal CSOs will be done to sustain the project. This result was highlighted in previous study that valuing co-benefits is crucial to support NbS mainstreaming and participatory activities to allow effective stakeholder involvement in NbS co-design [26]. The complexity of NbS calls for more innovative and transdisciplinary practices, including collaborative governance and a genuine engagement with diverse local communities that has been widely acclaimed to increase the relevance, fairness, acceptance, and sustainability of NbS initiatives [27].

Knowledge

The lack of knowledge about NbS was observed among the locals and the other department heads of the LGU. With this, there is still a need for necessary mechanisms to promote the use and relevance of NbS, mainly through the development of information, education, and communication (IEC) materials within the context of Victoria. This knowledge gap may also consequently affect the NbS initiatives once implemented. This supports previous claims that NbS confronts challenges including limited awareness, knowledge of its applications and effectiveness, insufficient understanding of costs and benefits, diverse stakeholder values and perceptions, and limited policy and economic instruments [12]. According to Grace et al. [28], the top-ranked knowledge needs for NbS implementation include i) a more precise definition of NbS, ii) specific NbS initiatives that are adapted to a certain location, iii) increase the adoption and use of NbS in urban plans, iv) integration of NbS in built environment to accommodate green infrastructure and v) cost-benefit analysis of urban green spaces. Moreover, Hagedoorn et al. [29] emphasized that awareness and behavior change campaigns can contribute to these efforts as higher participation levels strongly relate to the level of time contributions, raising awareness on the possible achievements and results of NBS,

and how households can effectively contribute to these initiatives, instead of exclusively focusing on the problem that the NbS aims to address.

3.3 Multicriteria Analysis and Strategies for NbS Implementation

The self-assessment tool from the IUCN served as the final research instrument utilized in the study as it employed all the data collected from the prior tools. According to IUCN [8], the tool enables the users of the IUCN NbS Global Standard to (1) assess the intervention and/or proposal's adherence to the Standard; (2) advise internal and external stakeholders with the means of verification in place/used (or lack thereof) to measure the indicators; and (3) determine areas for improvement.

Table 4. Overall result of the assessment of the establishment of an Eco Hub facility in Victoria, Laguna according to the IUCN Global Standard for NbS self-assessment tool

CRITERION	CRITERION SCORE	MAXIMUM CRITERION SCORE	NORMALIZED CRITERION	FINAL OUTPUT OVERALL ADHERENCE (%)
1. Societal challenges	5	9	0.56	56
2. Design at scale	6	9	0.67	67
3. Biodiversity net-gain	9	12	0.75	75
4. Economic feasibility	10	12	0.83	83
5. Inclusive governance	10	15	0.67	67
6. Balance trade-offs	6	9	0.67	67
7. Adaptive management	5	9	0.56	56
8. Sustainability and mainstreaming	6	9	0.67	67
Total Percentage match				67
Is this in adherence with the IUCN Global Standard for NbS?			In adherence	

Legend:

KEY (IN %)				OUTPUT
	4	≥75	Strong	Intervention adheres to the IUCN Global Standard for NbS.
	3	≥50 & <75	Adequate	
	2	≥25 & <50	Partial	
	1	<25	Insufficient	Intervention does not adhere to the IUCN Global Standard for NbS.

Based on the scoring mechanism from the IUCN [8] tool, Table 4 displays the overall results of the assessment of establishing an eco hub facility in the Municipality of Victoria, Laguna. Moreover, to better illustrate the analysis results, a spider graph is shown in Figure 2, which will also aid in identifying possible areas for improvement.

For the scoring, criteria 1 (societal challenges) and 7 (adaptive management) garnered the lowest scores of 56%, although according to the assessment legend, this percentage is adequate and is still in adherence with the standard. In line with this, criteria 2 (design at scale), 5 (inclusive governance), 6 (balance trade-offs), and 8 (sustainability and mainstreaming) gained an adherence score of 67%, which is still on the adequate scale. Lastly, criteria 3 (biodiversity net-gain) and 4 (economic feasibility) obtained a score of 75% and 83%, respectively, already on the strong scale. The total percentage that matches the assessment of the eco hub facility is 67%, which is in adherence to the IUCN Global Standard for NbS.

The above results support previous claims that the concept underpinning the IUCN Global Standard for NbS could help improve the sustainability of a system by highlighting both their positive outcomes and issues requiring further examination concerning biodiversity benefits, socio-economic development, and/or governance [30]. In another study, three of the eight NbS principles stand out from other approaches: NbS can be implemented alone or in an integrated manner with

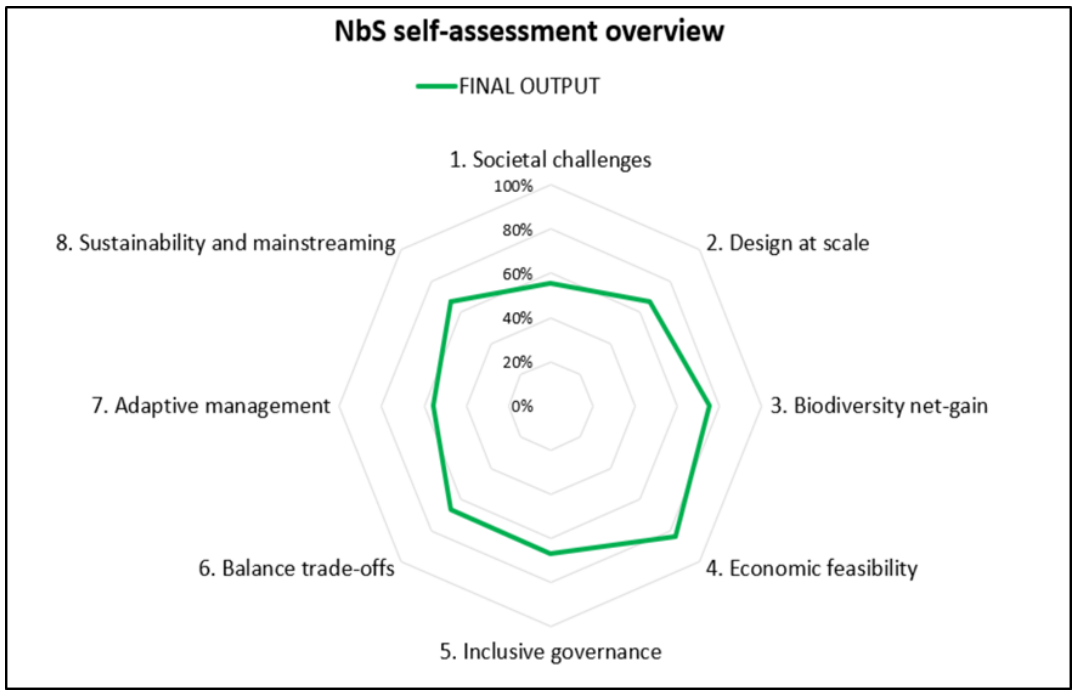

Figure 2.
Spider graph illustrating the overall results of the assessment of the establishment of an Eco Hub facility in Victoria, Laguna [19]

different solutions; NbS should be applied at a landscape scale; and, NbS is integral to the overall design of policies, measures and actions, to address societal challenges [31].

The results of the multicriteria analysis for the eco hub facility found that biodiversity net gain and economic feasibility were among the strongest criteria for the IUCN global standard. In contrast, social challenges and adaptive management were the weakest ones. Thus, the recommended strategy will focus on both of these aspects. First, the indicator under the societal challenges criterion with the lowest score pertains to the presence of benchmarking tools to periodically assess the human well-being outcomes that NbS offers. However, appropriate assessment measures for the facility are still absent. With this, the project implementers should formulate a benchmarking mechanism that would enable a regular monitoring and evaluation system to assess the impacts, including a feedback structure, particularly for the locals and other affected stakeholders of the project. This is also highlighted by Sowińska-Świerkosz & García [32] that a clear delineation of impacts of NBS, of synergies and trade-offs between different types of impacts, and robust, flexible and cost-effective methods for their monitoring and evaluation are essential to building an evidence base for their performance of NbS initiatives. In another study, it was advised that the project implementers formulate a benchmarking mechanism that would enable a regular monitoring and evaluation system to assess the impacts, including a feedback structure, particularly to the locals and other affected stakeholders of the project [31]. Moreover, a learning framework highlighting the significance of adaptive management can be developed and integrated into the monitoring and evaluation plan.

It is irrefutable that administrative powers are essential to a project's success. Thus, for the eco hub facility, it is suggested that stronger partnerships, especially between the private and public sectors, should be prioritized to ensure a successful project implementation. This indicates a decision-making process allowing an inclusive, transparent, and empowering governance system responsive to the rights and interests of participating and affected stakeholders. The clear identification of the rights and responsibilities of all parties shall also be established. This can also assist

in reducing inequalities, avoiding conflicts, and decreasing the occurrence of risks once the project has been implemented. NbS interventions can be improved by precise planning and design before implementation, engaging multiple stakeholders, comparing alternative solutions, and periodic monitoring of environmental and societal impacts [33]. Finally, NbS implementation should emphasize the need for citizen participation in the process of co-designing and co-monitoring towards place-based ownership and increase of sense of belonging within the NbS projects in practice [31].

4 Conclusion and Recommendations

Nature-based Solutions are anticipated to provide innovative and sustainable solutions to the challenges faced by the population and environment. The benefits and utilization of NbS have been discussed in a range of literature focusing on the economic, environmental, and technical lenses. This study aimed to contribute to the literature by applying thematic and multicriteria analyses for the successful implementation of NbS initiatives from the perspective of a rural community in a developing country. Taking the case of Victoria, Laguna, key informant interviews were conducted with local stakeholders on their readiness for NbS, factors to be considered in its adoption, and the strategies for implementing NbS initiatives in the municipality.

Currently, there are two hybrid NbS initiatives in the locality including the (1) approved establishment of an eco hub facility for plastic waste, and the (2) proposed material recovery facility (MRF) for biodegradable waste, wherein both will utilize a green roof technology and possible bioswales. The KII provided other opportunities for NbS initiatives such as backyard gardening with organic fertilizers; utilization of water hyacinths in the lake for economic purposes such as paper production, fiber, animal fodder, and organic fertilizer; flood control and biodiversity preservation through the use of vegetation as temporary water storage; and other projects that address the local weather conditions. In terms of multicriteria analysis, the IUCN Global Standard for NbS self-assessment tool revealed that biodiversity net gain (criterion 3) and economic feasibility (criterion 4) were the two primary elements that the Municipality of Victoria deem essential for the implementation of its NbS initiatives, particularly with the eco hub facility. On the other hand, the proposed material recovery facility (MRF) cannot be extensively analyzed using the MCA tool since it is still in its early proposal stage, hence lacking sufficient information from the project-making body and the stakeholders for its assessment.

The findings of this study provided recommendations for the successful implementation of NbS initiatives in the municipality of Victoria, Laguna. The planning and design stage should involve various stakeholders representing different sectors, allowing a more inclusive representation in polishing the project goals and objectives and devising the most workable NbS initiatives within the locality's context. Suitable monitoring and evaluation mechanisms should be done through timely documentation of NbS, which may open avenues for sharing ideas and best practices among stakeholders and other municipalities and cities interested in applying NbS in their localities, especially in lakeside and flood-prone areas. Information dissemination should be done through IEC campaigns and community consultations to better appreciate the holistic and human ecological benefits of NbS initiatives. Lastly, the utilization of NbS in the Philippine context to address other environmental challenges such as climate change, pollution, flooding, wastewater, and solid waste management must be explored to achieve safer, inclusive, resilient, and sustainable communities.

Statements and Declarations

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Data Availability

The data in this study are available upon request from the authors.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Free, prior, and informed consent (FPIC) was sought from the participants, who were also explained the purpose of the study, their voluntary participation in the study, and how the collected data would be used.

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Competing Interest

The authors declare no conflicts of interest.

Author Contributions

C.D.L.L.: conceptualization, methodology, formal analysis, investigation, resources, data curation, writing - original draft, writing - review & editing, visualization; **E.M.R.Jr.**: conceptualization, methodology, validation, resources, writing - review & editing, supervision, project administration; **C.B.A.**: conceptualization, validation, writing - original draft, writing - review & editing, supervision; **K.S.A.C.B.**: conceptualization, validation, writing - review & editing, supervision. All authors have read and agreed to the published version of the manuscript.

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