

**Biodiversity and Cities:**  
**An Approach to Urban Biodiversity Management**

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# Executive Summary

## Introduction

This report is a place-based framework of suggestions for Leticia on how to implement and ensure biodiversity management and conservation as the city works towards a more sustainable future. The strategies in this proposal are rooted in fieldwork conducted in the city of Leticia and conversations with Stakeholders. Sustainable growth and biodiversity protection will improve Leticia for residents, businesses, and tourists for decades to come.

## Vision for Leticia

Given the position of Leticia as an urban center in the Amazon and gateway for tourists, it has the potential to become a model for urban biodiversity integration and sustainable land use practices.

## Problem Statement

- 1) How, in a rapidly urbanizing society, can economic development and the conservation of biodiversity exist in harmony?
- 2) How can we incorporate indigenous and local knowledge into scientific data collection, analysis and management practices to create a city at peace with nature?
- 3) How can design and planning strategies offer participatory and sustainable paths forward for the city?

## Proposed Approach

In this report, we aim to reframe urbanization as an opportunity for both inclusive economic development and

biodiversity conservation, rather than a problematic threat to biodiversity.

## Principles

- 1) *Biodiversity*: Proposed strategies aim to foster the creation and proliferation of habitats for wildlife, manage the ratio of natural areas to inhabited areas, encourage habitat restoration and develop food security resilience.
- 2) *Inclusivity*: Proposed strategies strive to give greater agency to the local communities in both urban development decision making process and project deployment.
- 3) *Open-Source Deployability*: Proposed strategies intend to be useful to local communities and citizen initiatives, not just national and regional stakeholders.

## This Work's Contribution

We aim to create a highly adaptable nexus of models that can be deployed both individually and collectively, in the context of rapidly developing urban environments. Additionally, we build on the important work initiated by SINCHI to leverage and integrate indigenous knowledge systems and desires to improve the sustainable future of Leticia.

## Stakeholders

The stakeholders involved and who we met with during our field work include the Ministry of Environment, the Mayor's office of Leticia, SINCHI, Corpoamazonia, representatives from the Ticuna community, leaders from the Isla de Fantasia community, the local youth network Red Nacional Jovenes de

Ambiente, local architects, academics, and others.

### **Proposed Strategies**

A) *Green-Business Development Protocols (GBDP)*:

Focuses on establishing a stewardship economy and local ownership models. This strategy involves facilitating a green certification processes, developing local business strategies, exploring business incubation opportunities, and accessing local, national, and international markets.

B) *Habitat Restoration (HR)*:

A sustainable environmental management strategy that strives to empower local governance and communities to restore critical ecosystem services in the urban context. The stewardship economy approach promotes sustainable land-use practices, empowers Indigenous Peoples and local communities (IPLC), and generates economic opportunities through sustainable tourism and eco-friendly businesses.

C) *Community-based Biodiversity Management (CBBM)*:

Aims to involve local community stakeholders in participatory planning approaches. SINCHI can facilitate the engagement of various stakeholders to promote inclusive community development and biodiversity resource management.

### **Strategies in Practice: Port and Market of Leticia**

We identified the Port/Mercado Municipal area of Leticia to implement our strategies as it is a critical meeting point of issues related to biodiversity, inclusion, and economic development. We

describe a detailed practical application of context specific proposals.

A) *Boosting Local Entrepreneurship Models (GBD)* aims to address the problem of low visibility and lack of incentives for green certification among local self-owned businesses. The focus is on boosting local and sustainable entrepreneurship models in the port and market area.

B) *Marsh Wetland Restoration (HR)* focuses on addressing the problem of annual flooding in the market and port area, which affects businesses and residents. The proposal aims to restore the marsh wetland in the port area to sustain biodiversity and mitigate the risks associated with natural disasters, while enabling commerce to continue during seasonal river variations. The approach involves implementing a community-driven waste collection and management program to incentivize local residents and business owners to use inorganic waste disposal facilities and reduce the use of non-biodegradable plastics.

C) *Community Management Association Meeting Space* proposal aims to address the lack of a designated community stakeholder meeting space in Leticia for representatives of local businesses and consumers. The goal is to create a physical space near the market area that promotes local engagement, participatory planning, and inclusive decision-making.

## Introduction

Leticia is a city uniquely positioned as a portal into the Amazon rainforest in the south of Colombia and is home to a bountiful web of species and habitats that are unique to our world. However, during unprecedented times of population growth and the subsequent resources needed to address this growth, calls for consistent efforts to ensure that our natural world stays protected are rising. The following report is our attempt to answer this call and is motivated by the need to better understand how urbanization processes and economic growth can occur in harmony with biodiversity conservation efforts. We see Leticia as the ideal place to pilot strategies that combine growth and conservation in an urban area.

Our team completed a diagnostic assessment of biodiversity management in Leticia and identified three major areas for improvement: small business centered economic growth, inclusionary development practices, and waste management. Considering these areas of need, we put forth three strategies to boost Leticia's biodiversity management in these areas. This report centers the principles of biodiversity, inclusion, and open source deployability to provide input on how sustainable growth and enhanced biodiversity can be achieved in Leticia, and it builds on the similar inventories created by SINCHI as well as other national and local organizations. Our goal is to build on existing initiatives in Leticia for optimal implementation. The strategies we propose center around community-based biodiversity management, (including citizen science data collection and community organization structures), green business development protocols, including green certification and waste management, and habitat restoration, including species identification and water management.

This report is a place-based framework of suggestions for Leticia on how to implement and ensure biodiversity management and conservation as the city is already working towards a more sustainable future with programs relating to biodiversity tracking and compositing, among others. We see this report as adding value to continuing initiatives as well as suggesting new projects that could be undertaken by SINCHI, resident groups, the mayor's office, and other interested stakeholders. Given the position of Leticia as an urban center in the Amazon and gateway for tourists, it can act as a model city for others that are similarly situated near or in the Amazon or even other biodiversity hotspots around the world. Growing sustainably and increasing biodiversity health will improve Leticia for residents, businesses, and tourists for decades to come.

## **Vision for Leticia**

The city of Leticia boasts a vibrant cultural heritage deeply rooted in the diverse ecosystem that defines it as the "City in the Amazon." Its unique blend of political, cultural, and natural features positions it as a thriving center for promoting and preserving biodiversity. Leticia's urbanization amidst the vast expanse of the Amazon Rainforest should create a striking image of an oasis brimming with life. As the capital of the Amazonas state and the largest city for miles around, Leticia is well-suited to be a gateway to the Amazon, as well as a champion and protector of its remarkable biodiversity.

By embracing this identity and implementing strategies that reflect it, stakeholders can transform these resources into sustainable benefits for both inhabitants and wildlife. We look forward to continuing this dialogue to ensure that strategies align with the community's needs and pave the way for Leticia to serve as a positive model for other Amazonian and Colombian cities.

## **Problem Statement**

Historically, the exploitation of resources, labor and culture in the Amazon has upheld environmental power dynamics that prioritize economic growth and territorial control over the sustainable management and protection of biodiversity. As a result, conserving biodiversity presents significant challenges; it is difficult to imagine an approach to holistic biodiversity management practice that aligns with capitalist notions of production. How do we leverage the economic and community based attributes of biodiversity in Leticia, a city in the Colombian Amazon, as it grapples with the question of how to promote a genuine care for the natural environment? These challenges are compounded by complex social, cultural, and economic needs, differentiating value systems for the natural environment, and the cultural and traditional diversity of the different communities that call Leticia home. The city of Leticia is critically positioned to be a leader in urban biodiversity integration and sustainable land use practices. We ask how, in a rapidly urbanizing society, can economic development and the conservation of biodiversity exist in harmony? How can we incorporate indigenous and local knowledge into scientific data collection, analysis and management practices to create a city at peace with nature? And finally, how can design and planning strategies offer participatory and sustainable paths forward for the city?



## Proposed Approach

In this report, we aim to reframe urbanization as an opportunity for both inclusive economic development and biodiversity conservation rather than a problematic threat to biodiversity. Multiple urban theories are now calling for biodiversity-inclusive urban development and design, including biodiversity sensitive urban design<sup>1</sup> and earlier theories that have called for the decolonization of environmental justice in favor of different epistemologies that reposition human relationships with nature from the Western, extractivist approach.<sup>2</sup> Building on these theories, we propose an inclusive methodology that foregrounds accessibility, collective decision making, and sustainable biodiversity management practices as guiding principles for our proposal. All data should be public and collected by both experts and local citizens. Decisions will be informed and shaped by grassroots and citizen participation. Businesses are incentivized to become more environmentally conscious and economic development encouraged to occur concurrently with environmental preservation.

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<sup>1</sup> Kirk, Holly, Georgia E. Garrard, Thami Croeser, Anna Backstrom, Katherine Berthon, Casey Furlong, Joe Hurley, Freya Thomas, Anissa Webb, and Sarah A. Bekessy. "Building Biodiversity into the Urban Fabric: A Case Study in Applying Biodiversity Sensitive Urban Design (BSUD)." *Urban Forestry & Urban Greening* 62 (July 1, 2021): 127176. <https://doi.org/10.1016/j.ufug.2021.127176>.

<sup>2</sup> Álvarez, Lina, and Brendan Coolsaet. "Decolonizing Environmental Justice Studies: A Latin American Perspective." *Capitalism Nature Socialism* 31, no. 2 (April 2, 2020): 50–69. <https://doi.org/10.1080/10455752.2018.1558272>.

## **Principles**

Our approach to the development of this document—which includes an analysis of the current state of Leticia and a series of strategies for the sustainable management of biodiversity in a rapidly developing urban context—was guided by the three principles outlined below.

### **Biodiversity**

Leticia is located in one of the most biodiverse regions on the planet, and this presents both a series of challenges and important opportunities for the city. Reflecting on the context of the city, biodiversity, defined as the variety of lifeforms in a habitat or ecosystem, is foundational to our approach. Our assessment focused on understanding the critical relationship between biodiversity and urban development. We carefully consider strategies that foster the creation and proliferation of habitats for wildlife, manage the ratio of natural areas to inhabited areas, encourage habitat restoration and develop food security resilience.

### **Inclusivity**

Leticia does not only have the potential to be a biodiverse city, it is also home to a multiplex of cultures, communities and residents, all with unique resource requirements and complex value systems. Therefore, the analysis and strategies in this document center around equity. We ask: who is the city for? Who does it privilege through access (economic, physical)? The proposed strategies are purposefully inclusive across stakeholder groups, intended to give greater agency to the local communities in both urban development decision making process and project deployment. Our analysis and strategies focus interventions that benefit local communities first while still engaging with a larger economy, resource management and utilization, national urban planning protocols and data management structures.

### **Open-Source Deployability**

Strategies aim to be both deployable and accessible in the context of complex socio-economic diversity and rich biodiversity. The complexity and requirements for infrastructure and technology are carefully considered to be accessible to all potential stakeholders and open source in their incorporation of community participation. Proposed strategies are intended not to be exclusively executable by national and regional stakeholders (government and municipalities), but also by local communities and citizen initiatives.

## **This Work's Contribution**

The strategies proposed in this document are aimed to critically build on and strengthen work currently in development by local and national stakeholders. More specifically, we aim to create a highly adaptable nexus of models that can be deployed both individually and collectively, in the context of rapidly developing urban environments. The strategies in this proposal are rooted in fieldwork conducted in the city of Leticia and conversations with Stakeholders. This group is not proposing one specific solution to increase biodiversity in Leticia. Instead, we aim to provide a set of strategies that can be used for stakeholders in the city's future to explore ways of combining bio-economic development, community decision making, and biodiversity conservation. Previous biodiversity management proposals have failed to engage with the larger context, focusing on a specific task or scientific method. Our work is further set apart by centering inclusivity of different stakeholders and knowledge systems. We build on the important work initiated by SINCHI to leverage and integrate indigenous knowledge systems and desires to improve the sustainable future of Leticia.

## Using this Document

This document is intended as a guiding set of feasible frameworks that SINCHI, and its partners, collaborators and residents of Leticia, can use to steer the city towards a more **inclusive and biodiverse** future.

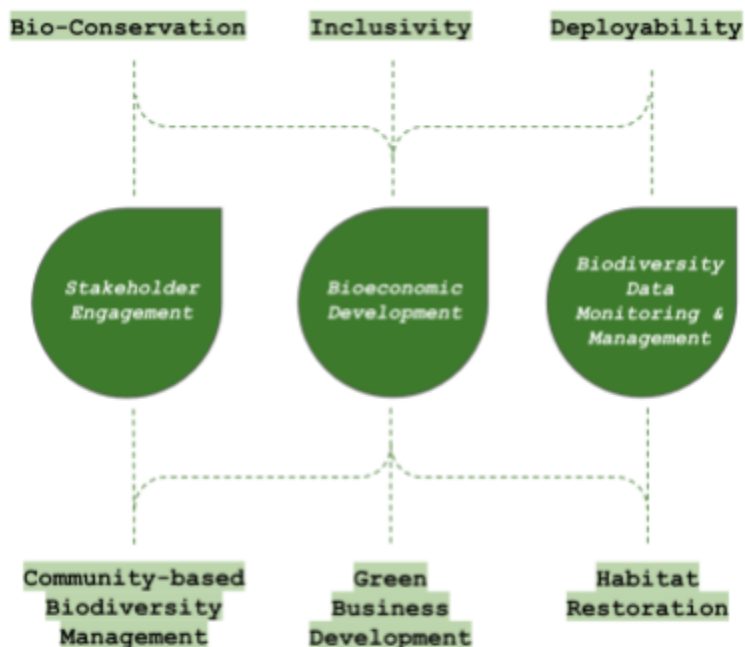
Built on the work done by SINCHI, this document includes an analysis of the current conditions as seen through **three diagnostic lenses** of:

- Bioeconomic Development: How to utilize and protect biodiversity in the city's economic development plans
- Biodiversity Data Monitoring and Management: How to assess the state of biodiversity to ensure effective conservation
- Urban and Environmental Planning: How to design cities that conserve and incorporate biodiversity.

These three diagnostic lenses rely on and are collectively underwritten by a focus on Multi Stakeholder-Engagement.

This work translates into **three strategic frameworks** which form a foundation for Biodiversity and Inclusion:

1. Community-based Biodiversity Management (CBBM)
2. Green-Business Development Protocols (GBDP)
3. Habitat Restoration (HR)



**Figure 1:** Strategic framework diagram for biodiversity and inclusion  
Source: Author

## **The Role of SINCHI and Primary Stakeholders**

SINCHI plays a pivotal role in the region and the city's biodiversity conservation landscape. As one of the most prominent non-government agencies in the region, it is deeply invested in multiple projects and partnerships with the local government, local communities, and domestic and international research partners. Long-term partnerships with different stakeholders endow SINCHI with major advantages of political credibility and social influence in addition to technical capability to take on different roles that the institute deems appropriate to its interest/priority and availability of resources.

Other local actors such as Corpoamazonia, the Mayor's Office, indigenous groups, youth groups, business owners, residents, and friends of Leticia all have roles to play in Leticia's biodiversity conservation. SINCHI can play a role as both a convener and facilitator through their already well established local network and resources; creating opportunities for other local actors to contribute to implementation practices, data collection, and education.

To assist each group in making decisions on whether and how to engage with this subject matter, we suggest the following steps:

1. Evaluating your interests and availability of resources (time, funding, personnel, network, etc.) to identify the most desirable roles;
2. Surveying other stakeholders' perception of the role best suited for you to manage any potential disagreement/conflict/dispute;
3. Assessing the recommended role(s) for different stakeholder groups in each of the strategies below using the first two steps.

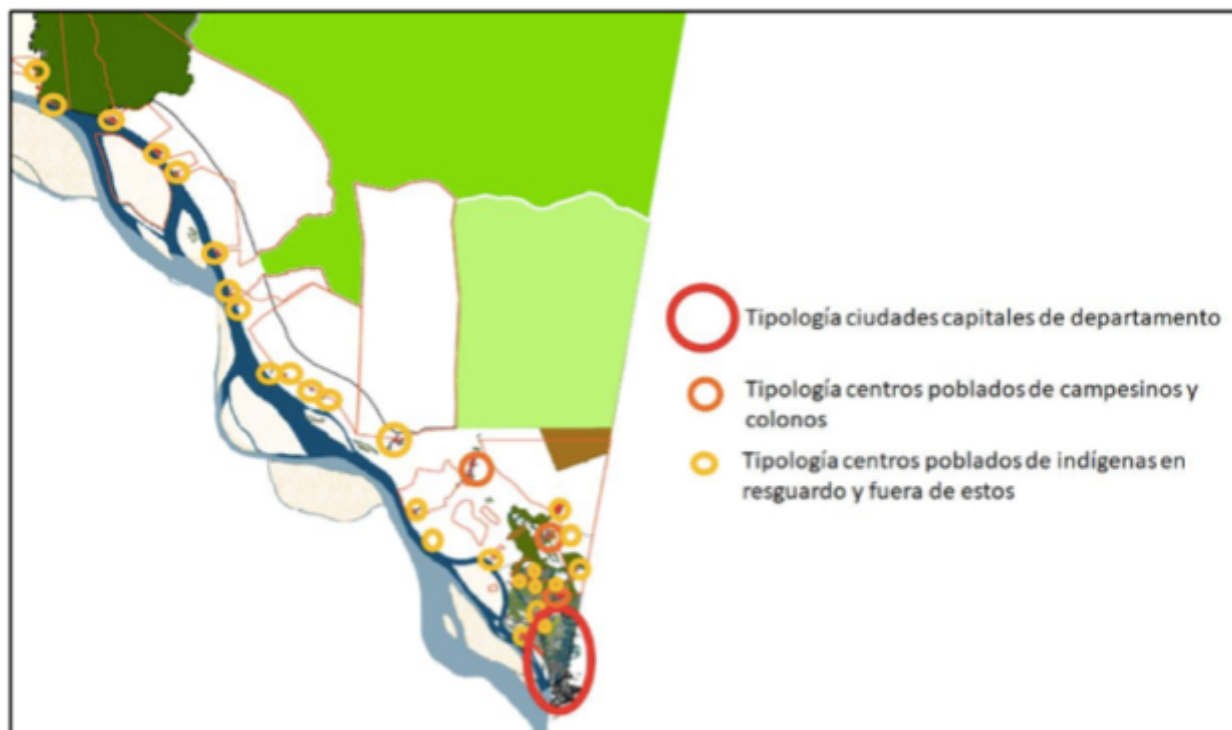
The role of SINCHI and other potential partners are outlined in further detail in the Strategies described below.

## Context

### Environmental and Geographic Features

#### Urban Growth and Land-use Policies

Colombia has experienced significant urban growth in recent years. According to the United Nations, Colombia's urban population grew from 69.9% in 2000 to 80.8% in 2020, with an annual urbanization rate of 1.3%. This rapid growth has led to changes in land use patterns, as more land is converted from agricultural or forested areas into urban or suburban areas. This has resulted in environmental degradation, including deforestation, soil erosion, and loss of biodiversity.



**Figure 2:** Typologies of human settlements in the municipality of Leticia.

Source: (Grupo Dinámicas Socioambientales y Culturales. SINCHI, 2022)

The Colombian government has implemented various policies to manage land use and urban growth aiming to promote sustainable urban development and regulate the impacts of urban growth on the environment. The BiodiverCities Initiative, for example, is a multi stakeholder initiative that supports city governments, businesses and citizens to reimagine urban development with nature and people at its core. Its vision is to create

nature-positive and climate-resilient cities, where every urban activity leaves the Earth enriched and not depleted, by 2030<sup>3</sup>. The government has also implemented policies to protect forested areas, such as the Amazon rainforest, through the creation of national parks and reserves. At the local level, the current Colombian policies ensure the development of development plans and land management plans in each municipality. Agriculture is a significant economic sector in the country and contributes around 6% of the country's gross domestic product (GDP) and employs approximately 20% of the population. Additionally, the government, on the national level, has launched initiatives to promote sustainable agriculture practices, such as reducing pesticide use and promoting the use of organic fertilizers.

According to the assessment of existing conditions as outlined in the Municipal Development Plan 2020 - 2023 of Leticia<sup>4</sup>, the urban area is 1490.6 ha while rural land occupies 595,309.4 ha, covering 0.25% and 99.75% of the total area of the municipality of Leticia respectively. The main population centers in Leticia are distributed as shown in Figure 1. The rural area is mainly made up of conservation and protection zones defined by the National Law, such as the Amacayacu National Natural Park, the Forestry of the Amazon and indigenous reservations. The modest size and low density occupation of the urban and peri-urban areas may indicate the possibility of further development in adjacent parcels of land that are undeveloped or underutilized [ref to literature on developable land bank]. According to SINCHI, “the surface built in the urban area of Leticia saw an increase of 47% during the period between 2005 and 2015, and this growth momentum is expected to continue in the coming years.<sup>5</sup> Hence, it is important to acknowledge the environmental and institutional constraints that Leticia may encounter pertaining to land use conversion while accommodating economic development and urban growth. These constraints may include environmental and social impacts such as increased traffic congestion, air and water pollution, habitat loss for native species, reduced access to green spaces, and increased level of inequality and social exclusion. Leticia is also surrounded by multiple indigenous reserves who face displacement or loss of ancestral land as the city expands.

## **Biodiversity**

Leticia is world-renowned for its fauna, particularly for its avian species. SINCHI recently compiled a thorough analysis, detailing the flora and fauna present in urban Leticia and the

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<sup>3</sup> Mejía, M. A., Amaya-Espinel, J. D. (eds.). *BiodiverCities by 2030: Transforming Cities with Biodiversity*. Bogotá. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. 2022. 288 pages.

<sup>4</sup> Municipality of Leticia: *Plan De Contingencia Para La Prevención Y Atención De Emergencias Por Temporada De Lluvias En El Municipio De Leticia-Departamento De Amazonas*. 2020. URL: [https://leticiaamazonas.micolombiadigital.gov.co/sites/leticiaamazonas/content/files/000594/29668\\_plan-de-contingencias-inundacion-leticia2020.pdf](https://leticiaamazonas.micolombiadigital.gov.co/sites/leticiaamazonas/content/files/000594/29668_plan-de-contingencias-inundacion-leticia2020.pdf)

<sup>5</sup> Riaño., E. (June 2020). *URBAN HIERARCHY 2020*. Bogota.

surrounding areas, in the report 'Actions for the Management of Urban Ecosystem Services (SEU) in Urban Planning - Leticia - Amazonas'. In this section quotes and information is gathered from this document to provide an overview of the current biodiversity in Leticia.

Leticia's urban bio-fauna has a huge diversity of birds with 263 species and 48 families<sup>6</sup>. Moreover the city has 51 species of bats belonging to six families which constitutes 24% of the species registered for Colombia (217)<sup>7</sup> and 37% of the bat species registered for the Colombian Amazon (137).<sup>8</sup> Many of these birds and many animals rely on the native plants for eating and for movement throughout the area.<sup>9</sup>

As per Leticia's Urban Development Plan, there are 109 species of mammals that could potentially be found in the municipality, out of which less than half are non-flying mammals. Overall, going by the databases of specimen records of GBIF (2022), the collection of the Institute of Natural Sciences of the National University (2022) and the inventories developed on the UNAL campus, there are 39 species of medium and large mammals in the Leticia area. Much of it is primarily concentrated in the urban green spaces around the city (such as the campus of the National University). "11 species of terrestrial mammals (small and medium-sized) have been recorded, among which the presence of an ocelot stands out. adult (*Leopardus pardalis*) and the taira (*Eira bárbara*), both mesopredators of forest ecosystems, in addition to the regular sighting of the guara (*Dasyprocta fuliginosa*)."<sup>9</sup> There is also a large amount of lizards, snakes, frogs, and other amphibians in Leticia.

Leticia also offers unparalleled flora diversity, with many endemic species represented. Many of the "most emblematic species of the surrounding Amazonian ecosystem have been incorporated into Leticia's urban decoration, such as the case of the açai (*Euterpe precatoria*), bacaba (*Oenocarpus minor*) and canangucho (*Mauritia flexuosa*) palms." However in the center of the city, "the inventory of the trees and shrubs present reveals that around 85% of the ornamentation of the city corresponds to introduced exotic plants - species that come from other localities and ecosystems, and are not endemic to the Amazon ecosystems around Leticia."<sup>9</sup> Thus there is great potential to incorporate more native species into Leticia's urban decoration which would also serve to enrich urban habitats and ecological niches for a range of fauna.

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<sup>6</sup> Leticia-Amazon. Actions for the Management of Urban Ecosystem Services (SEU) in Urban Planning. (Grupo Dinámicas Socioambientales y Culturales. SINCHI, 2022)

<sup>7</sup> Rodríguez-Posada ME, M.-MD-C.-M.-A. (2021). A new species of Long-eared Brown Bat of the genus *Histiotus* (Chiroptera) and the revalidation of *Histiotus colombiae*. . *Caldasia*, 43(2): 221-234 .

<sup>8</sup> Martínez, M. &. (2021). Mammals (Mammalia) of the Colombian Amazon.

<sup>9</sup> Leticia-Amazon. Actions for the Management of Urban Ecosystem Services (SEU) in Urban Planning. (Grupo Dinámicas Socioambientales y Culturales. SINCHI, 2022)

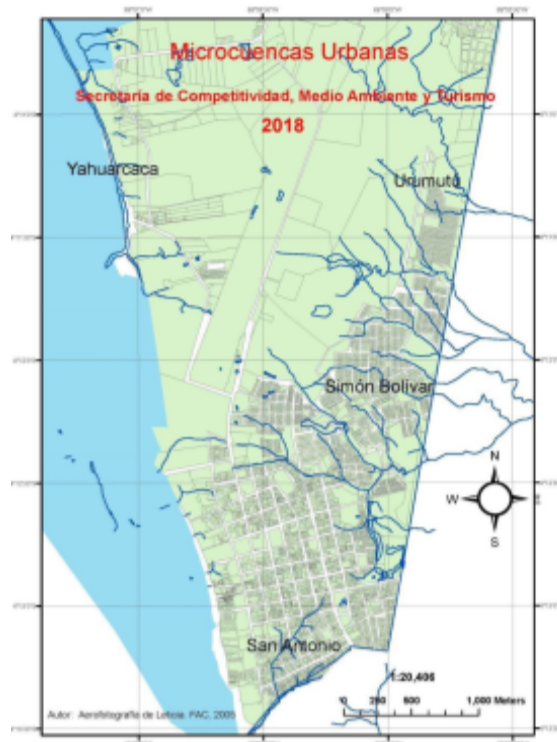


## Climate and Water Features

Leticia is located in a tropical rainforest climate where there is little variance in the average temperatures throughout the year. Average daily temperatures range around 28°C with an annual precipitation of about 3,200mm per year. March is the month with the most rainfall which is more than twice the precipitation experienced in July, the driest month.<sup>10</sup> It has an elevation of 96 meters (315 feet) above sea level and is located on the Amazon river at the point where the borders of Colombia, Brazil and Peru meet.

One of the greatest advantages of Leticia city is its proximity to the Amazon river which provides Leticians with not only generous water supply for production and consumption but also livelihoods. That said, being located within the Amazon river basin, the city is highly susceptible to annual flooding, at times extreme, which causes severe damages to people and properties. While we were in Leticia, we witnessed tensions regarding the relationships with water and flooding, because some inhabitants do not see flooding as a risk but as a traditional, indigenous occupation model. According to DANE (2022), 16% of households in the Amazonas region were affected by flooding and overflow from rivers or streams in 2021, 6th highest number recorded nation-wide.<sup>11</sup>

In terms of local hydrology, important water systems in Leticia are: Yahuarcaca stream and its 22 lakes, Tacana river, Calderón river, Urumutú stream, Simón Bolívar stream and Porvenir stream (Figure 2). The Yahuarcaca stream is the most important water source in the area as it provides for a third of the population of the municipality of Leticia.<sup>12</sup> During



**Figure 3:** Hydrology in Leticia.  
**Source:** Secretaria de Competitividad, Medio Ambiente y Turismo (2018)

<sup>10</sup> <http://bart.ideam.gov.co/cliciu/leticia/precipitacion.htm>. (n.d.). Retrieved March 15, 2023, from <http://bart.ideam.gov.co/cliciu/leticia/precipitacion.htm>

<sup>11</sup> DANE. (May 2022). Retrieved from [dane.gov.co](https://www.dane.gov.co): <https://www.dane.gov.co/files/investigaciones/planes-departamentos-ciudades/220502-InfoDane-Leticia-Amazonas-fin.pdf>

<sup>12</sup> Municipality of Leticia: *Plan De Contingencia Para La Prevención Y Atención De Emergencias Por Temporada De Lluvias En El Municipio De Leticia-Departamento De Amazonas*. 2020. URL: [https://leticiaamazonas.micolombiadigital.gov.co/sites/leticiaamazonas/content/files/000594/29668\\_plan-de-contingencias-inundacion-leticia2020.pdf](https://leticiaamazonas.micolombiadigital.gov.co/sites/leticiaamazonas/content/files/000594/29668_plan-de-contingencias-inundacion-leticia2020.pdf)

the low water season between September and October, the water level of Yahuaraca reaches its lowest point and the flow is not enough to cover the water demand of Leticians. The local authority addressed this issue by constructing a dam to ensure stable water supply. This dam, however, changes the physical and chemical conditions of the stream affecting the local aquatic ecosystem that the biodiversity and local population depend on. The dam also disrupts the ability of the local population to use the stream for transportation.

Besides securing its water supply from the local hydrological system, Leticia also harvests rainfall as a complementary water source, especially for daily usage in areas where there is no clean water supply infrastructure. Having year-round rainfall (Figure 3) is favorable for agricultural cultivation as it reduces the need for irrigation systems and the risks of drought, but there is a deficit of storm sewers for wastewater, causing flooding of contaminated waters during storms.<sup>9</sup> That said, recent increased temperature due to climate change and deforestation have impacted precipitation levels, and thus, could result in more frequent and severe drought and or severe climate events.

### **Access to Leticia**

Leticia is accessible currently by air and by boat; there are no national or international ground transportation systems that service the area. Although this is an accessibility obstacle, the absence of highway development may benefit the area's biodiversity by limiting vehicle-wildlife collisions. The Amazon River provides an important point of access for tourists, services and products in the region. The Vásquez Cobo International Airport is the largest in the south of Colombia. In addition to being the Colombian jungle region gateway, it also serves as the major airport in the triple-border region (Colombia, Brazil and Peru). An increase in air service from this airport has been a major cause of the recent travel and ecotourism to the city. Currently there is not much industry central to Leticia; however, it historically had economic activity from rubber manufacturing.<sup>13</sup>

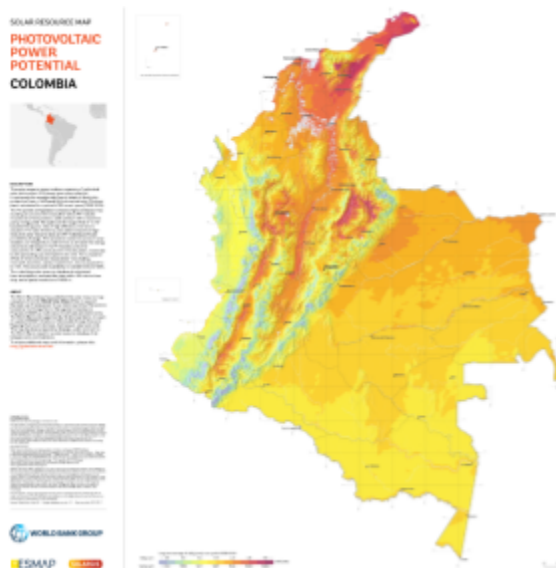
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<sup>13</sup> Inicio—Instituto de Estudios Urbanos. (2017). <http://ieu.unal.edu.co/>

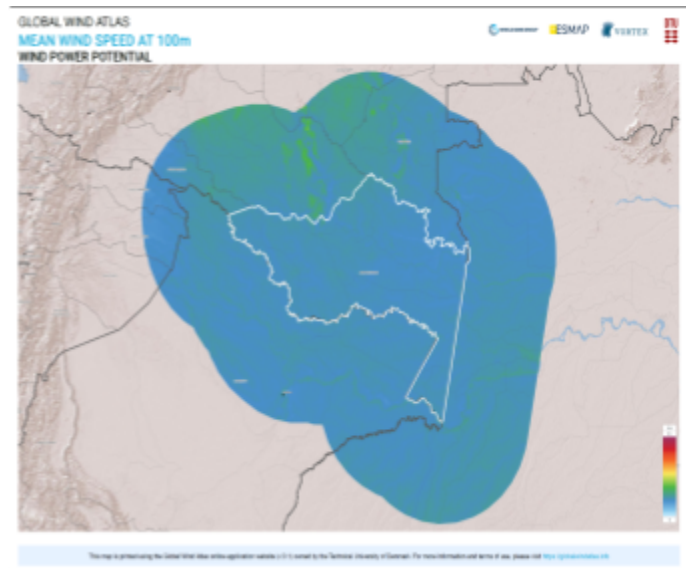
## Energy

Leticia is one of 24 municipalities in the Non-Interconnected Zones (NIZ) that are not connected to the national electricity grid due to their geographical location. Access to energy services is crucial for almost any activity, especially economic development. A study by Colmenares-Quintero (2022) on ‘Data Analysis of Electricity Service in Colombia’ found that although Leticia provides an average of 23 hours of electricity per day, the statistical analysis carried out shows the city’s residents can experience lack of energy service for days at a time.<sup>14</sup>

Power supply instability is undesirable for economic activities, especially industrial production and services. Thus, it is important to stabilize local power supply with alternative sources, preferably renewable ones, to avoid negative impacts on the Amazon ecosystem. However, according to the World Bank’s assessment of renewable energy potential, the climate conditions of Leticia are not favorable for solar or wind power production (Figure 4 and Figure 5). Understanding the future demand for energy and identifying renewable sources of energy continues to be a challenge for the region.



**Figure 4:** The photovoltaic power potential of Leticia for solar power production is at low to medium level.  
**Source:** Global Solar Atlas (2023)



**Figure 5:** The wind power potential of Leticia for solar power production is low  
**Source:** Global Wind Atlas (2023)

<sup>14</sup> Colmenares-Quintero, Ramón Fernando, Gina Maestre-Gongora, Marieth Baquero-Almazo, Kim E. Stansfield, and Juan Carlos Colmenares-Quintero. “Data Analysis of Electricity Service in Colombia’s Non-Interconnected Zones through Different Clustering Techniques.” *Energies* 15, no. 20 (October 17, 2022): 7644. <https://doi.org/10.3390/en15207644>.

## Population and Governance Features

### Demographics

As per recent estimates, the population of Colombia increased from 48,144 (in 2018) to 51,516,562 (in 2021), with a growth rate of 1.8% per year.<sup>15,16,17</sup> About 70% of the population are urban dwellers while the remaining 30% are dispersed in rural areas.<sup>11</sup> 43.7% of Leticia's population is indigenous;<sup>17</sup> indigenous groups present include the Witoto, Inga, Tucano, Ticuna and Nukak.<sup>18</sup> Demographically, men make up 48.8% and women make up 51.2% of the population. Approximately 60.7% of the population are within the average legal working age (15 - 59 years old) according to DANE (2022).<sup>11</sup> The dependency ratio of Leticia is fairly high, meaning that every 3 working persons support 2 'economically dependent' persons besides themselves.<sup>11</sup> In Leticia, only 13% of the existing working population are recognised as officially employed or self-employed; there is no data on how the remaining portion of the labor force make their living (however, this section of the labor force is engaged in informal economic practices). Additionally, the skill level of the labor force is limited given that only 19.6% of men and 21.1% of women between the age of 15 and 64 attend school. Limited skilled labor force is a significant constraint for economic growth implications on social welfare and progress.

### Governance

The current political system in Colombia is a democratic republic with a presidential system based on the constitution which dates back to 1991. The president of the republic is elected by universal suffrage every four years and it is a non-renewable term. When elected, the president appoints the government, which is approved by the Congress. Colombia is divided into 31 departments and a capital district, based in Bogotá. Every department has a governor which is elected by direct suffrage. The two main political parties in Colombia are:

- The Liberal Party (*Partido Liberal Colombiano*): This is one of the oldest political parties in Colombia, founded in 1848. It is considered to be center-left in its political ideology and has historically been associated with policies promoting individual freedoms, social welfare, and economic liberalism.

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<sup>15</sup> World Bank (2021): <https://data.worldbank.org/indicator/SP.POP.TOTL?locations=CO>

<sup>16</sup> World Population Review (2023): <https://worldpopulationreview.com/countries/colombia-population>

<sup>17</sup> Departamento Administrativo Nacional de Estadística - DANE (2019): *Información Capital, Departamento Administrativo Nacional De Estadística - DANE*. URL: <https://www.dane.gov.co/files/varios/informacion-capital-DANE-2019.pdf>

<sup>18</sup> Latin America & Caribbean Geographic (2020): Port Town of Leticia: Amazonas Department (Colombia). URL: <https://lacgeo.com/port-town-leticia-amazonas-colombia>

- Conservative Party (*Partido Conservador Colombiano*): Founded in 1849, the Conservative Party is one of the oldest political parties in Colombia. It is considered to be center-right in its political ideology and has historically been associated with policies promoting strong government, traditional values, and conservative economic policies.

There are also many smaller parties and independent candidates who participate in elections at the national, regional, and local levels.

At the local level, Leticia is a city in the state of Amazonas, Colombia. As a Colombian municipality, it has a local government structure consisting of a mayor and several administrative departments. Additionally, Amazonas has a Departamental Assembly which provides representation on the legislative branch.

The mayor of Leticia is the chief executive of the city and is responsible for implementing local policies and managing the city's resources. The mayor is elected by popular vote for a four-year term and can be reelected for one additional term. The administrative departments of Leticia are responsible for carrying out the policies and programs developed by the mayor and city council. There are several departments, including finance, public works, education, health, and environment, among others. The main planning instruments the local governments utilize include the 4-year Development Plan, 12-year Land-Use Plan (POT), and the Integral Climate Change Plan (PICC).

In addition to the local government structure, Leticia is also administered by the regional government of Amazonas, which is responsible for overseeing the department and coordinating with the municipalities within its jurisdiction. The regional government is led by a governor who is elected by popular vote for a four-year term. Overall, the governance structure of Leticia and the Amazonas department reflects the broader system of government in Colombia, which is a democratic republic with a decentralized system of government that includes national, regional, and local levels of government.

## Indigenous Territories

There are 15 legally constituted indigenous reservations (an additional 3 are in the process of being constituted), 23 councils (representative administrative authority of the indigenous community), 28 indigenous communities and 6 indigenous organizations with administrative jurisdiction in the municipality. The diversity of indigenous communities contributes to Leticia's cultural landscape and makes it an important space for different ethnic and indigenous groups to come together, converge and interact.

Approximately 120 indigenous reserves can be found within the Amazonas department. After 1977, a legal concept for the indigenous territories or reserves was created.

Colombian laws state that indigenous reserves correspond to collectively owned territories of the indigenous people, which are governed by councils formed and regulated according to their traditions.

The functions of the council range from the preservation of natural resources to the exercise of the rights of autonomy and self-determination.

## International Relations

Leticia is located on the southern bank of the Amazon River, bordering Brazil and Peru. The city's proximity to the border has historically played an important role in its development and relations with neighboring countries. Leticia and the nearby Brazilian city of Tabatinga are located on the northern bank of the Amazon River, while the Peruvian town of Santa Rosa de Yavarí is situated on an island south of Leticia and Tabatinga. A cross-border initiative, "Action Plan Amazon Triple Border: Colombia-Brazil-Peru", facilitated by United



**Figure 6:** Map of legally constituted indigenous territories in Leticia.

**Source:** Secretary of Competitiveness, Environment and Tourism, Leticia Mayor's Office (2019) in Municipal Development Plan 2020 - 2030 of Leticia (Year Unknown)

Nations Resident Coordinators is a joint initiative between Colombia, Brazil, and Peru to promote sustainable development and regional integration in the Amazon Basin.<sup>19</sup>

The relationship between Leticia, the Brazilian border, and the Peruvian border, has been marked by both cooperation and conflict. On the one hand, the cities share a common cultural heritage and have a long history of economic and social exchange, particularly in the areas of trade, tourism, and transportation. On the other hand, there have also been tensions and conflicts between Leticia and the Brazilian border, particularly in relation to issues of security, territorial disputes and more pertinent to this work: biodiversity management plans. The region has been a hot spot for drug trafficking, illegal mining, and other criminal activities, which have contributed to social instability and political tensions between the three countries.

### **Economic and Environmental Vulnerabilities**

Irrespective of its importance, the Amazon River and its surrounding ecosystems face a range of environmental threats, including deforestation, pollution, and climate change. Leticia, along with other cities and communities throughout the Amazon Basin, is working to address these challenges through a range of initiatives, including sustainable tourism, conservation programs, and efforts to promote sustainable development and economic growth. Deforestation, forest degradation, and climate change have significant implications for the health and well-being of both the forest and the communities that depend on it.

To address these challenges, Leticia and other cities and communities throughout the Amazon region are working to promote sustainable development and conservation initiatives. These include reforestation programs, sustainable agriculture practices, and eco-tourism initiatives that support both economic development and forest conservation. Many indigenous communities in the region are also working to promote traditional land-use practices and strengthen their voice in local and regional decision-making processes. Despite these efforts, there are ongoing challenges to protecting the Amazon forest, including illegal logging, mining, and agriculture activities. Addressing these challenges requires a multi-faceted approach that includes effective governance, law enforcement, international cooperation, and economic incentives for sustainable land use practices.

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<sup>19</sup> *Action Plan Amazon Triple Border: Colombia-Brazil-Peru (August 2020) - Brazil* | ReliefWeb. (2020, September 3). <https://reliefweb.int/report/brazil/action-plan-amazon-triple-border-colombia-brazil-peru-august-2020>

## **Fieldwork**

In January 2023, in the capacity as MIT students from the MIT Biodiversity and Cities practicum visited the City of Leticia, during this visit we engaged with local, regional and national stakeholders, participated in numerous community conversations and presentations, and partook in a series of site visits.

### **Stakeholders**

The Ministry of Environment, Mayor's office of Leticia, SINCHI, Corpoamazonia, Ticuna community representatives, Isla de Fantasia community leaders, local youth network Red Nacional Jovenes de Ambiente, local architects, academics, and others.

### **Site Visits**

Water management facilities, waste management facilities (landfill and composting pilot project), indigenous community centers (urban maloca, Ticuna community at kilometer 19 and Nazareth community), urban farming initiative, Parque Santander, Leticia central market and port, Isla de Fantasia, Tabatinga port (Brazil), Nazareth, Macedonia and Puerto Nariño.



## Detailed Itinerary

|  |  |
|--|--|
| <p><b>Welcome greeting from Andrea Corso, Director of DAASU or Mario López, Coordinator of Urban Environmental Management (GAU)</b></p> <ul style="list-style-type: none"> <li>• Presentation of the strategy of BiodiverCiudades and Urban Environmental Policy, DAASU</li> </ul>   | <p>Urban Environmental Management Group (Director, Coordinator, Yuri Murcia, Pilar Beltrán, Adriana Marcela Solano Pita, Juan Camilo Herrera, Edgar Linares, Mauricio Gaitán)</p> <ul style="list-style-type: none"> <li>• Luz Marina Mantilla, SINCHI</li> </ul>  |
| <p><b>Visit in the Amazon</b></p> <ul style="list-style-type: none"> <li>• Visit to the indigenous women's association in the Maloca de Agustina, Kilometer 11</li> </ul>  | <p><b>Directed by:</b></p> <ul style="list-style-type: none"> <li>• Juan Felipe Guhl, SINCHI</li> </ul> <p><b>Accompanied by:</b></p> <ul style="list-style-type: none"> <li>• Yuri Murcia, MADS</li> <li>• Mario López, Coordinator of Urban Environmental Management MADS</li> </ul>   |
| <p><b>Discussions with researchers and tour of SINCHI laboratories</b></p> <ul style="list-style-type: none"> <li>• Socio-Environmental Dynamics Research Group. Presentation Juan Felipe Guhl</li> <li>• Ecosystems and Natural Resources Research Group. Presentation on the flora of Leticia</li> <li>• Research Group Operating and Sustainability Models. Presentation on waste and biopackaging by Clara Peña</li> </ul>   | <p><b>Leader:</b></p> <ul style="list-style-type: none"> <li>• Luz Marina Mantilla, SINCHI</li> </ul> <p><b>Participants:</b></p> <ul style="list-style-type: none"> <li>• Juan Felipe Guhl, SINCHI</li> <li>• Clara Peña, SINCHI</li> </ul>   |
| <p><b>Presentation on Indigenous Leticia and meeting with indigenous communities</b></p> <ul style="list-style-type: none"> <li>• Introduction - William Yucuna and Divar Hernandez and community members</li> <li>• Presentation by Juan Alvaro Echeverri - <i>"Indigenous Leticia: Indigenous Territorial Construction in the City"</i></li> <li>• Presentation by Capiul Organization</li> </ul>  | <p><b>Presentations by:</b></p> <ul style="list-style-type: none"> <li>• Juan Alvaro Echeverri</li> <li>• Abel Antonio Santos, Doctor Indígena Maguta</li> <li>• Edgar Bolívar, Profesor de UNAL</li> <li>• Alfredo Bora</li> <li>• TIWA</li> <li>• Citacoi</li> </ul>   |
| <p><b>Series of guided visits to areas prone to climatic risks and prioritized for urban acupuncture projects and BiodiverCiudades.</b></p> <ul style="list-style-type: none"> <li>• Plaza de Mercado - separation of organic resources</li> <li>• Fantasy Island (harbor and waterfront)</li> <li>• Quebrada Calderón (occupation problem - new neighborhood wetland)</li> <li>• Landfill - composting (problem of garbage in landfill and circular economy)</li> </ul> | <p><b>Leader:</b></p> <ul style="list-style-type: none"> <li>• Juan Felipe Guhl, SINCHI</li> </ul> <p><b>Participants:</b></p> <ul style="list-style-type: none"> <li>• Rubiela Pereira, president of Isla Fantasia</li> <li>• Fernanda Perez, Mayor</li> <li>• Maryory Pantevis Girón, Territorial Director of Corpoamazonia.</li> <li>• Arturo Samuel Gomez Insuasti, UNAL</li> <li>• Angela Hooz, UNAL</li> </ul> |

|  |  |
|--|--|
| <p><b>Workshop with Corpoamazonia - Climate Change Efforts and Environmental Planning</b></p> <ul style="list-style-type: none"> <li>• Presentation on the comprehensive climate change management plan and projections for the department and the city of Leticia - Maryory Pantevis Girón, Territorial Director of Corpoamazonia.</li> <li>• Presentation on the environmental determinants for Leticia and environmental approach for the PBOT - Maryory Pantevis Girón, Territorial Director of Corpoamazonia.</li> <li>• Presentation on biodiversity conservation efforts - Juan Carlos Bernal, Specialized Professional of Corpoamazonia</li> </ul> | <p><b>Leader:</b></p> <ul style="list-style-type: none"> <li>• Juan Carlos Bernal, Specialist - Corpoamazonia</li> </ul> <p><b>Participants:</b></p> <ul style="list-style-type: none"> <li>• Maryory Pantevis Girón, Territorial Director of Corpoamazonia.</li> <li>• Mayor's Office, Secretary of Planning</li> </ul>   |
| <p><b>Series of Guided Visits to Peri-urban Areas.</b></p> <ul style="list-style-type: none"> <li>• Spontaneous growth and altered ecosystems (wetlands, protected areas).</li> <li>• Growth to Humarizal (border with Tabatinga) and Urumutu (area of potential expansion).</li> <li>• Observation of Battalions as forest reserves</li> <li>• Co-urbanization with Tabatinga - Tour of San Antonio ravine, differences in port infrastructure, trees, infrastructure, fair, river frontage</li> </ul>  | <p><b>Leader:</b></p> <ul style="list-style-type: none"> <li>• Mayor's Office</li> </ul> <p><b>Participants:</b></p> <ul style="list-style-type: none"> <li>• Juan Felipe Guhl, SINCHI</li> </ul>  |
| <p><b>Workshop with the Mayor's Office, the Territorial Planning Council, Corpoamazonia, and the Associations of Traditional Indigenous Authorities of the Amazon.</b></p> <ul style="list-style-type: none"> <li>• Presentation on the Basic Land Management Plan of Leticia, and the vision for a sustainable city.</li> <li>• Workshop: Recommendations for the new administration for the new municipal development plan - short, medium and long term priorities for biodiversity management.</li> </ul>  | <p><b>Leaders:</b></p> <ul style="list-style-type: none"> <li>• Fernanda Perez, Mayor's Office</li> <li>• Departments of the Mayor's Office (Planning, public services, etc.)</li> </ul> <p><b>Participants:</b></p> <ul style="list-style-type: none"> <li>• Technical Teams of CORPOAMAZONIA and</li> <li>• Juan Felipe Guhl, SINCHI</li> <li>• Citizens of Leticia and Tabatinga (?) (Facilitated by SINCHI)</li> <li>• Territorial Planning Council</li> <li>• Representatives Associations of Traditional Indigenous Authorities of the Amazon</li> </ul> |
| <p><b>Visit to Riverside Communities</b></p> <ul style="list-style-type: none"> <li>• Beach Community, Nazareth, Macedonia, Mocagua</li> <li>• Guided tour in Puerto Nariño</li> <li>• Settlement model</li> <li>• Cocoa processing plant (binational project)</li> <li>• Waste management - separation system</li> </ul>  | <p><b>Leader:</b></p> <p>Juan Felipe Guhl, SINCHI</p>  |

## Research Diagnostic

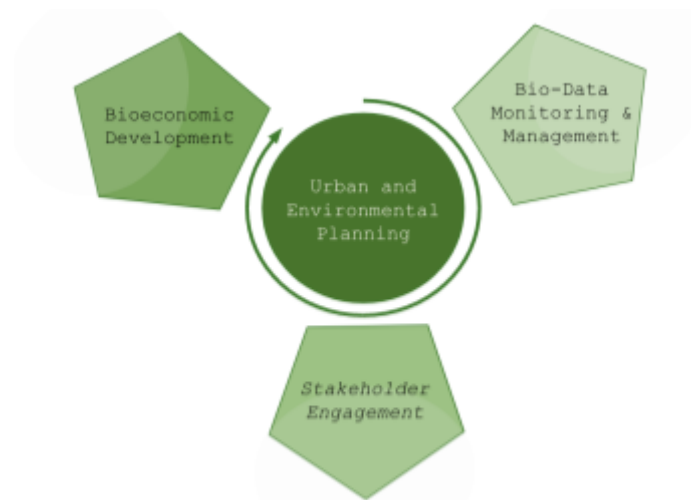


Figure 7: Diagnostic Framework for Leticia  
Source: Author

Our approach to Leticia is informed by our knowledge and expertise in the field of Urban and Environmental Planning and a site visit to Leticia in January, 2023. Urban planning involves a diverse range of subjects, but in this case, we focus on biodiversity and inclusivity, establishing a three pronged approach that incorporates an analysis of existing bio-economic factors, biodiversity management practices, and multi-stakeholder engagement. We evaluate each of these aspects to determine their impact on biodiversity and the critical relationships with local communities in the Leticia municipality.

### Urban and Environmental Planning

Effective urban and environmental planning plays a crucial role in shaping the urban environment towards a more sustainable direction. The involvement of multiple stakeholders is essential in identifying key areas of opportunity for urban planning and design improvements that can contribute to the maintenance of biodiversity. Current urban design strategies in Leticia are focused on infrastructural development, particularly the redevelopment of roads, sidewalks and stormwater management systems. However, SINCHI calls for “corrective and mandatory measures for the conservation of urban biodiversity, specifically the *delimitation of wildlife circulation corridors and reforestation with native species*, especially on the main road axes and within the neighborhoods in green areas, prioritizing the development of participatory strategies in the design of solutions based on nature, together with the communities where the greatest environmental risk is identified within the city” (emphasis added).<sup>9</sup> The current urban development plans present promising opportunities for planned human and non-human movement,

greenspace prioritization, the organization of retail, and the intentional shaping of urban space to support and promote biodiversity. However, the involvement of stakeholders in urban planning and design processes, particularly the indigenous communities in Leticia, is limited. Resolving this issue, could foster a sense of ownership and responsibility, leading to greater support and participation in strategy and project implementation.

### **Bioeconomic Development**

Bioeconomic development in Leticia requires a comprehensive strategy that considers inclusive and sustainable management of the tourism, service provision and consumer market industries, collectively the largest contributors to local GDP. These sectors have a significant impact on renewable biological resources and processes to produce goods and services, as well as contribute to waste production and environmental impact. The success of bioeconomic modeling efforts in the municipality of Leticia is predicated on a highly articulated relationship between local, national and international stakeholders; To this end, there are various opportunities to develop effective multi-stakeholdership engagement strategies that address the interests and needs of various entities, including local businesses, community groups, government agencies, environmental organizations, and citizens.

### **Biodiversity Data Monitoring and Management**

Biodiversity data monitoring and management is an essential component of the strategy for maintaining and increasing biodiversity in Leticia. Currently, biodiversity, ecosystem services, and their association with the city and communities in Leticia present an opportunity to create dynamic data management systems. However, current data collection and monitoring programs do not sufficiently involve the multitude of local stakeholders, resulting in incomplete, inaccurate, and inconsistent data that does not account for diverse perspectives and experiences. There are gaps in existing data collection methods, such as community-driven species identification, tree cover analysis, and waste management, which are critical for the long-term monitoring of environmental management strategies and their impact.

### **Multi-Stakeholder Engagement**

The importance of engaging diverse stakeholders in the development and implementation of effective biodiversity management strategies is often overlooked. Top-down decision makers tend to assume a cooperative attitude from all actors involved, without considering the perspectives, experiences, motivation and capacity of local businesses, community groups, government agencies, and environmental organizations. Involving these stakeholders in the planning process can lead to the creation of comprehensive and feasible strategies that address their diverse needs and concerns.

In planning the Municipal Development Plan of Leticia 2020 to 2030, the Mayor's Office organized five events to engage 11 subgroups of approximately 90 stakeholders in co-developing 3 development strategies. While this participatory process helped align the interests and concerns of stakeholders and led to the formulation of three major strategies - (1) Social security, Good governance and Border; (2) Social Well-being and Environmental Sustainability; (3) Productivity, Competitiveness, and Local Economy - it stopped short of identifying the role, responsibilities, capabilities (resources availability), as well as motivation of relevant stakeholders to contribute to these strategies. Without clearly identifying these factors, the proposed strategies become the *interest of everyone but the responsibility of no one*, increasing the likelihood of implementation failure.

Contemporary planning approaches have recognised the importance of participatory and interactive planning procedures in gaining recognition, support, and participation, which can ensure a smoother implementation.<sup>20</sup> By adopting a more collaborative and coordinated approach to biodiversity management through multi-stakeholder engagement, Leticia can increase the likelihood of successful project implementation and achieving long-term sustainability.

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<sup>20</sup> Bryson, John M. "What to Do When Stakeholders Matter." *Public Management Review* 6, no. 1 (March 1, 2004): 21-53. <https://doi.org/10.1080/14719030410001675722>.

# Strategies

## Introduction to Strategies

We propose three strategies to promote inclusive, sustainable development and biodiversity conservation in the context of bioeconomic development in Leticia: **Community-based Biodiversity Management (CBBM), Green-business Development, and Habitat Restoration.** These strategies are aligned with the principles outlined in the previous section. Community-based biodiversity management seeks to involve local stakeholders in managing biodiversity resources through community management organizations. Habitat restoration aims to restore and protect habitats through ecosystem service analysis, replanting and rewilding programs, and waste management. Green business development protocols aim to establish sustainable extraction protocols, local business strategies, and opportunities for business incubation and market expansion. Implementing these strategies effectively requires multi-stakeholder engagement, collaboration, and resource stewardship to ensure a sustainable and inclusive development approach for Leticia.



**Figure 8:** Depiction of how the diagnostic informed the three proposals.  
Source: Author

### **Community-based Biodiversity Management - CBBM**

To promote community-based biodiversity management plans, it is important to encourage local community stakeholders to utilize participatory planning approaches. SINCHI has the capacity to convene a range of stakeholders including, but not limited to, market sellers, consumer groups and community management organizations (either existing or proposed, eg: Market management organization, local youth group) to promote biodiversity resource management through inclusive community development.

### **Green-Business Development Protocols - GBDP**

Focused on developing a stewardship economy and local ownership models, this strategy establishes a green certification process, local business strategies, potential business incubation, local, national and international market share and export market opportunities. SINCHI can play a pivotal role in facilitating relationships between local, regional and national business, and in establishing protocols that promote sustainable practices for both the economy and environmental management.

### **Habitat Restoration - HR**

Habitat restoration is a sustainable environmental management strategy that emphasizes the concept of 'stewardship economy' in Leticia, Colombia. The goal is to equip local governance and local communities with the tools and tactics needed to re-establish critical ecosystem services in the urban context. Ecosystem services are the "benefits that society receives for the proper functioning of healthy and resilient ecosystems."<sup>9</sup> The stewardship economy approach promotes sustainable land-use practices and processes that empower Indigenous Peoples and local communities (IPLC) to manage and protect natural resources, while preserving their cultures and traditions and generating economic opportunities through sustainable tourism and eco-friendly businesses. SINCHI has the opportunity to facilitate the planning and development of these critical habitats by bringing together the necessary parties, providing important ecosystem data and methods for monitoring the changes in the ecosystems.

# **Community-based Biodiversity Management**

## **Introduction**

The Community-based Biodiversity Management strategy aims to create a partnership nexus between local stakeholders and community organizations towards a sustainable urban biodiversity resource management approach in the city of Leticia. The strategy builds on the premise that local knowledge is crucial for ensuring biodiversity conservation and hence proposes for a community-based decision and data collection mechanism. Citizen led project management and stakeholder engagement forms the second building block of this strategy which aims to ensure participation and inclusivity through stakeholder engagement protocols and enhanced communication between all involved parties. Further, a community based ecotourism association is proposed as a way to institutionalize community participation and decision making process for furthering the sustainable business goals of the ecotourism sector.

## **Proposals**

### **Community-Based Data Collection and Decision Making**

Community-based data collection is an invaluable biodiversity monitoring tool in Leticia for two key reasons. First, residents in Leticia, specifically indigenous residents, hold in-depth traditional and experiential knowledge related to the region's land, residents, flora, and fauna. This type of knowledge cannot be captured with satellites and other technologies and thus engaging communities is essential in understanding the full scope of biodiversity in Leticia. Second, citizen science will benefit participants by enhancing their understanding of biodiversity, expanding their economic prospects, developing their skills, and providing opportunities for research and education. The incorporation of citizen science in biodiversity monitoring can be an effective tool for building community amongst residents who are passionate about conservation. Establishing a framework for integrated citizen science will not only inspire further conservation efforts in Leticia, but provide residents with the tools and knowledge they need for future success.

The development of an integrated feedback system where citizens can input data to be displayed and used in informing urban development and biodiversity management strategies is recommended. Examples of data reported by citizens include species identification, locations with concentrated waste, and areas of cultural and social importance for local residents. The information provided by citizens will help local authorities know which areas in urban Leticia should be targeted for rapid response, waste management, biodiversity and bioeconomy based strategies.



## **Suggested Methodologies:**

### *Species Identification and Management*

An established baseline of flora and fauna inventory is needed for effective biodiversity management and monitoring strategies for Leticia. Engaging members of the Leticia community into the process of classification of local flora and fauna can have a significant impact on urban greening policy and public perception of the urban and extra-urban biodiversity. There are ongoing flora and fauna monitoring projects such as Bioblitz that could benefit from the further integration of community members, particularly students in biology and science programs, into data collection projects.

Engaging the community is an effective way to inform the local residents about the existing species in the area and generally how to interact with them. Involving local communities and stakeholders in decision-making processes ensure that conservation efforts are culturally appropriate and effective in meeting the needs of both people and the environment. A citizen science approach that leverages local knowledge and allows for a blend of all age groups and socioeconomic classes will further facilitate the indexing, restoration and maintenance of urban habitat and, by extension, biodiversity in Leticia.

Habitat restoration and sustainable environmental management in Leticia involves identifying and protecting ecologically sensitive zones. These areas may include wetlands, forests, riparian zones and other important habitats for flora and fauna. Strategies for protecting these zones may include limiting human access, implementing sustainable land-use practices, and creating incentives for IPLC to participate in conservation efforts. This practice would require a reporting mechanism for citizens to report findings either to SINCHI or other overseeing bodies, such as the local or national governments.

Species identification practices will leverage local and indigenous knowledge of the urban and surrounding areas. Traditional knowledge can be leveraged in developing an understanding of how long particular flora has existed in the local community and for identifying effective seed saving and storage to lessen the possibility of native flora extinction. Incentivising monitoring practices by showing value in their cultures and traditions will keep community members engaged and dedicated to the proper inventory of native flora and fauna.

Education about this program would also be necessary to encourage residents to participate and to inform them of proper identification practices. Risks of this proposal are related to the motivations of both citizens and other entities. A lack of funding for an

integrated citizen science program, oversight by SINCHI or a lack of political will to implement and enforce regulations regarding habitat conservation could be obstacles to the successful implementation of this proposal. If properly motivated and developed, however, this idea could increase the approval of biodiversity conservation schemes and increase knowledge sharing between groups of people.

Citizen science can be effectively harnessed to contribute to current estimates of species and their populations. Data collected by citizen scientists will provide important insights for species quantification within the urban bounds. Citizen reports can be cross validated and give more confidence to collected data. LiDAR based classification of local flora and fauna gives local ecologists a highly accurate current state to draw conclusions from. Outlined below are the possible opportunities for the further integration of citizen science and analysis of collected data.

1. *Citizens should be encouraged to use systems such as iNaturalist or similar to identify local species.*
2. *Camera traps could be distributed to local communities to document wildlife.*
3. *A neural net should be used to identify species in images taken from camera traps*
4. *The location information from images to further describe species location densities*

SINCHI can play a pivotal role in ensuring a diverse group of participants for the study to encourage interactions amongst the community. Data collection drives can also be good opportunities for SINCHI to engage in public forums. Overall, creating a platform for the community to contribute to this important data collection work will allow locals to take ownership over the land they inhabit, increasing the longevity of habitat restorations and will build support for biodiversity management programs in the future.

## Citizen-led Project Management, Stakeholder Engagement and Connectivity

One way to promote biodiversity resource management is by creating a nexus between local stakeholders, including market sellers, consumer groups, and community management organizations (market management organizations and local youth groups). This can be achieved through inclusive community development. To do this, facilitation of capacity building for local citizen-led projects can be provided, along with the establishment of stakeholder engagement protocols and a framework to create better communication between all involved parties. This will help to ensure that all stakeholders are involved and have a say in the management of biodiversity resources in their local community. By fostering community-led initiatives, it is more likely that biodiversity conservation efforts will be effective and sustainable in the long term.

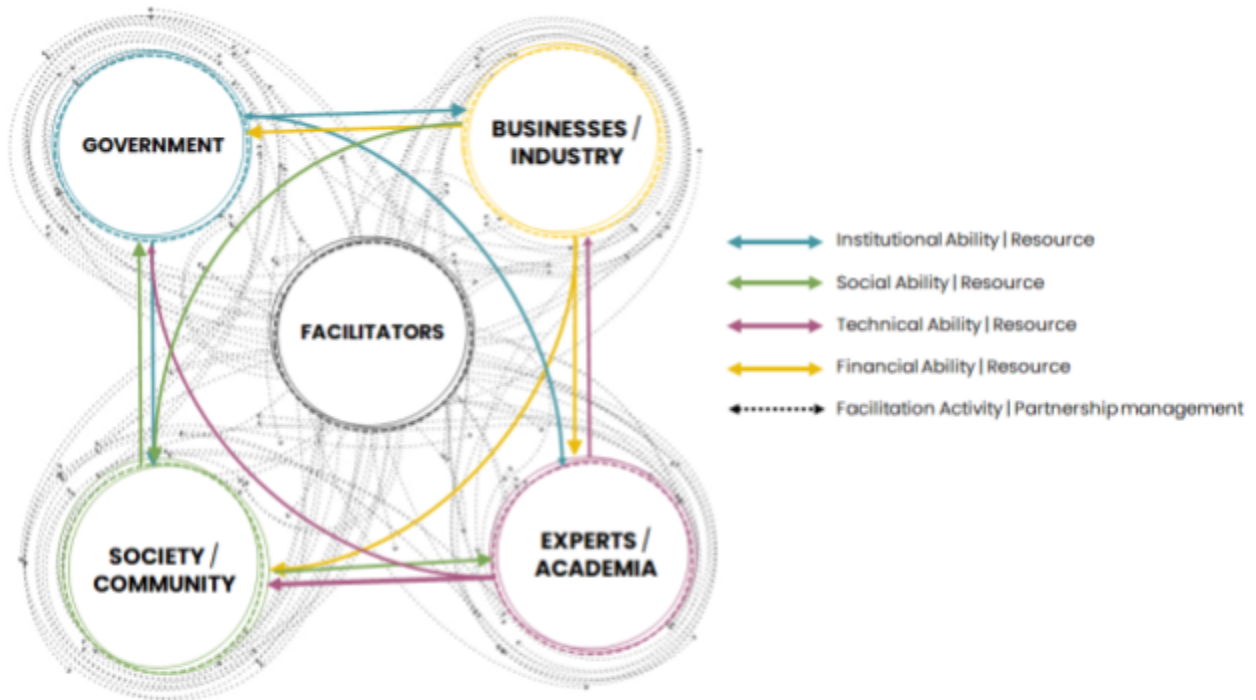
The implementation of a project requires the provision of resources and enabling conditions, these are distinctive to each stakeholder group and afforded by not one but many stakeholders. It is crucial that all relevant stakeholders are included, their roles, motivation and abilities are clearly identified and understood, especially in the implementation phase. To assist responsible agencies in pinpointing the above factors, a multi-stakeholder engagement framework that adds a fifth component to the Quadruple Helix Innovation System<sup>21</sup> and the integration of the Motivation and Abilities framework<sup>22</sup> is proposed.

The Quadruple Helix Innovation System outlines four key stakeholder groups in fostering innovation and driving development, in which each group has a distinctive capacity and motivation to action. Our proposed model includes the fifth actor, which is the facilitator who is responsible for the coordination of collaboration between these actors. The Motivation and Abilities framework is supplemented to help decision-makers assess the level of motivation and capacity to implement the intended plan and develop appropriate engagement or partnership strategies (consensus building or capacity building) for each group, which enhances the likelihood of successful implementation.

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<sup>21</sup> Schütz, Florian, Marie Lena Heidingsfelder, and Martina Schraudner. "Co-Shaping the Future in Quadruple Helix Innovation Systems: Uncovering Public Preferences toward Participatory Research and Innovation." *She Ji: The Journal of Design, Economics, and Innovation* 5, no. 2 (June 1, 2019): 128–46. <https://doi.org/10.1016/j.sheji.2019.04.002>.

<sup>22</sup> Phi, Ho Long, Leon M. Hermans, Wim J.A.M. Douven, Gerardo E. Van Halsema, and Malik Fida Khan. "A Framework to Assess Plan Implementation Maturity with an Application to Flood Management in Vietnam." *Water International* 40, no. 7 (November 10, 2015): 984–1003. <https://doi.org/10.1080/02508060.2015.1101528>.



**Figure 9:** Quintuple Helix Model for Multi-stakeholder Mapping (source: author)

Based on this model, each stakeholder can self-identify their role, ability and, thus, responsibility in the interested project.

- *Actors in Government groups*, often state agencies from the national to the local level, have the *Institutional Ability* which is the power to provide enabling conditions in which the project is implemented through law and policy making, state or municipal budgeting, and command of society's resources at large.
- *Actors in the Businesses or Industry groups* have the *Financial Ability* which is the ability to help execute, sustain and scale up the project through different financial mechanisms and market insights. This stakeholder group is also a credible informant on the feasibility of a project at large scale.
- *Actors in the Experts/Academia group*, such as SINCHI, MIT, other research institutions and international organizations specialized in biodiversity management, have the *Technical Ability* which includes knowledge and technology to solve problems. Actors in this group often take advisory expert roles or facilitators.
- *Actors in the Society or Community groups* include the general public, civil societies or associations, local residents and communities, who represent the interests of the masses. This group has the *Social Ability* to mobilize human resources through community networks to either support or oppose, help implement or sabotage the project. Particularly in Leticia, actors in the Society or Community group also have the ability to generate and provide *local knowledge* in conjunction with the Expert/Academic group.

- *Facilitator* can be a single actor or a group of actors drawn from each group which then become a steering committee for implementation. To operate effectively, a steering committee must establish and agree on a set of ground rules on how the group operates, makes decisions, resolves conflicts or failures to fulfill their commitments, and so on during the project implementation.

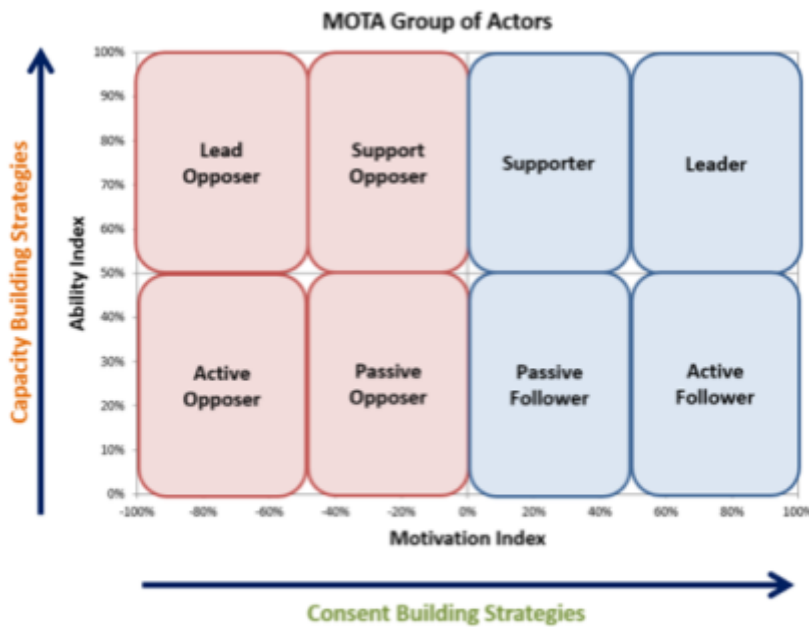


Figure 10: MOTA framework on stakeholder's motivation and ability analysis (Phi et al, 2015)

It is important to note that actors in each of these groups can take up multiple roles, including facilitators, depending on their capacity to provide required resources or technical skills.

After mapping out all interested stakeholders and their capacities, it is recommended that stakeholder interests and abilities are surveyed and evaluated using the Motivation and Ability (MOTA) framework. This framework helps facilitators and decision-makers predict the motivation and abilities

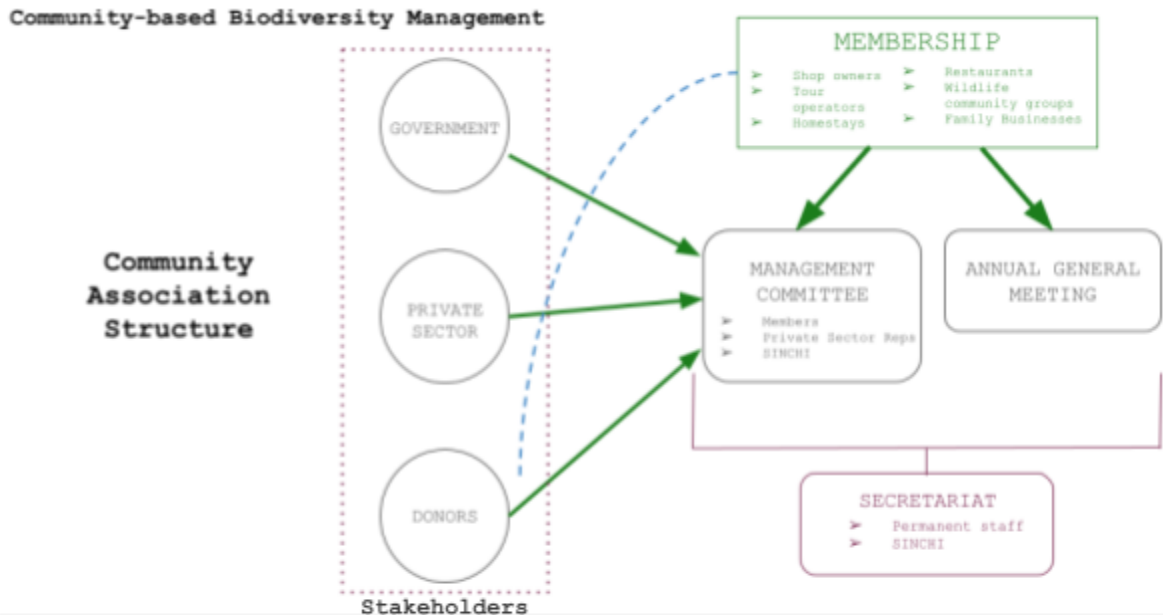
informing the actions of each actor. When certain actors perceive that the project could potentially impact their interests negatively, they will form a negative opinion and motivate themselves to oppose the project. The magnitude of their opposition commensurates with the ability to bring motivation to action (i.e through policy ban, withdrawal of funding, causing property damages, out-voting decision makers, etc.). In contrast, if actors see the benefits in supporting the project, they will become positively motivated to help bring the project into fruition through their contribution depending on abilities. The insight drawn from this analysis is used to strategise appropriate engagement approaches (i.e capacity building or consensus building). The goal is to gain more support from all stakeholders and increase their abilities to participate and help implement the project.

## **Citizen-led and Managed Ecotourism Association (CME)**

The central premise of eco-tourism is to sustainably manage the utilization of natural resources for economic development. Local communities should be incentivized to conserve the natural environment, minimize destructive activities and maximize economic return. In the past, tourism has pushed local citizens into marginalization<sup>9</sup>, and this proposal actively seeks to undo this dynamic. Citizen-led and community managed ecotourism (CME) is a framework for eco-tourism that is managed and owned by the community. Unlike general tourism approaches where tourist visits are often marketed and organized by private travel companies and the bulk of profits go to the private companies and government enterprises, CME ventures will be managed and run by the community itself, management decisions will be made by local people and profits shall directly go to the community. SINCHI and other local actors should facilitate the formation of an association to act as a guiding foundation for all subsequent forms of eco-tourism oriented initiatives in the city. SINCHI can play a significant role in ensuring that this association is set up, guided, imparted with skills and knowledge to operate in the long term, as an institution which promotes local businesses and promotes biodiversity conservation efforts.

A similar initiative by the local chamber of commerce in Leticia was started in 2020-21 and under the pressure of the COVID pandemic, subsequently lost traction. There are also smaller community based ecotourism associations like the Tikuna community's Asociación Intercomunitaria Painü (*Painü*) that would greatly benefit from skill sharing and guidance navigating the global and national tourism markets. There is compelling evidence to establish a local community association which is participative, inclusive, community owned and operated, and plays a strategic role in the overall ecological conservation and eco-tourism promotion landscape in the city.

Stakeholders should be encouraged to utilize a participatory planning approach to establish a CME association to institutionalize and foster a deeper community participation in the decision making process, where service provision, consumer groups and community management organizations work collectively to focus on biodiversity resource management through inclusive community development.



**Figure 11:** Eco-tourism community association structure (proposed)  
Source: Author

The association configuration presented in Figure 11 is just one example of how a local association might be structured. The association should be a membership-based non-profit association set up by the communities who have a direct stake in the development of robust tourism enterprises in the city of Leticia. It should aim to increase participation, ownership, conservation and sustainable ecotourism initiatives in the city by providing services which motivates communities and local business entities to become its member. The initial activities could include information sharing, training and skill development, branding, business development, establishing partnerships and networks with the government etc. In due course, once the association gets stronger it could venture into strategic initiatives like setting up joint venture partnerships, and advocacy and policy recommendations.

The broad activities of the association could be planned as per Table 1 below which is an overview of the non-profit institutional framework that the association shall operate in within the ecotourism landscape in Leticia<sup>23</sup>:

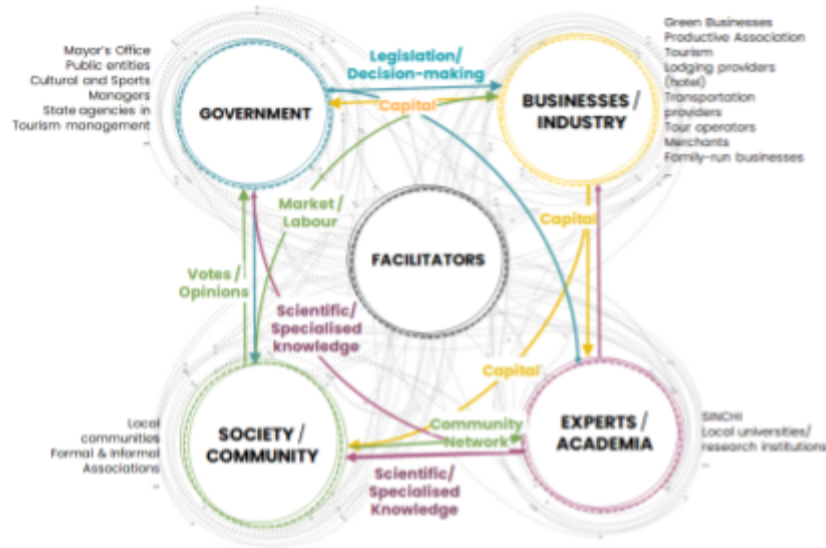
<sup>23</sup> Inspired by Romero-Brito TP, Buckley RC, Byrne J. NGO Partnerships in Using Ecotourism for Conservation: Systematic Review and Meta-Analysis. PLoS One. 2016 Nov 28;11(11):e0166919. doi: 10.1371/journal.pone.0166919.

| Main driver           | Organization's role   | Activities  |
|-----------------------|-----------------------|---|
| NGO                   | Lobbyist / Promoter   | Promotes ecotourism through campaigns, code of conducts, protests, marketing, environmental education and policy making   |
| NGO                   | Land owner or manager | Manages and safeguards an entire protected area, private or public, and incorporates tourism components   |
| NGO                   | Champion              | Principal driver of community-based ecotourism projects   |
| NGO                   | Ongoing manager       | Operates its own tours, mostly associated with scientific research for conservation   |
| NGO                   | Founding manager      | Operates its own tours initially, but intending to hand over management to a local community once established   |
| NGO                   | Certifier             | Creates certification, awards, and monitoring mechanisms for ecotourism ventures and hotels   |
| Local community       | Advisor / facilitator | Assists and advises in the creation or re-organization of community projects.   |
| Local community       | Networker             | Links various existing community projects together and with other stakeholders, e.g., local government and private tour operators, and/or assists them with promotion strategies.   |
| Private tour operator | Broker                | Supports ecotourism enterprises carried out by private tour operators that supports conservation and social initiatives, and may link them with local communities and/or government |

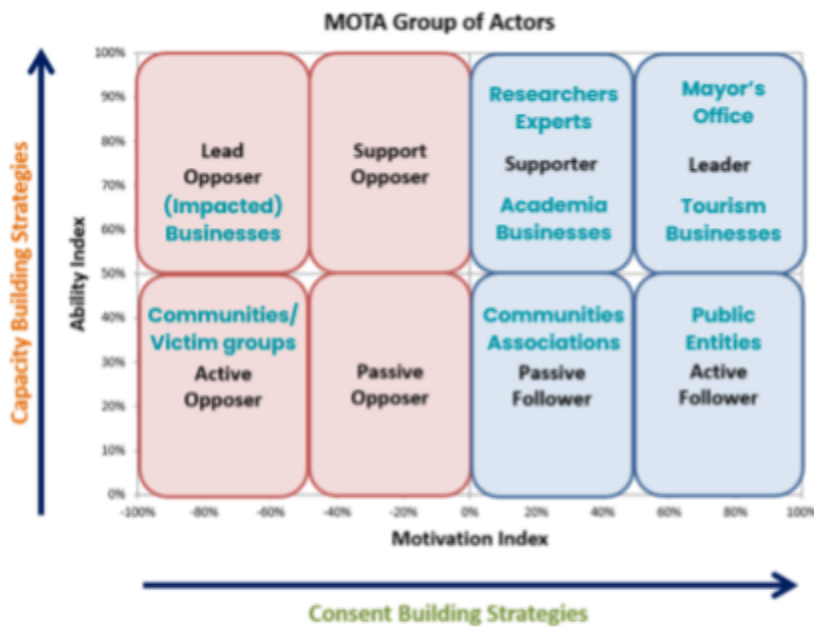
**Table 1:** Broad activities of the association

Stakeholders that could potentially benefit from and be interested in participating in this association should be identified. SINCHI can facilitate this process by producing a designed questionnaire and interviews, an assessment using the MOTA framework to identify which actors can take the leading roles in the Management Committee, advisory roles in Secretariat, and followers as Members. An example is illustrated as below:





**Figure 12:** An example of multi stakeholder mapping to identify interested actors to be engaged in Eco-tourism community association.  
Source: Author



**Figure 13:** An example of stakeholder motivation and ability analysis to strategise engagement approach as well as suitable roles for each in the Eco-tourism community association.  
Source: author based on MOTA framework by Phi et al, 2015

Based on the example analysis demonstrated in Figure 10, the facilitator will need to adopt more consensus building engagement to change the opposing motivation of the negatively impacted groups while other actors who support the project such as communities and government agencies may need capacity building training to strengthen their support and abilities to contribute more effectively.

## Participatory Planning Process

In 2019, the Ministry of Environment and Sustainable Development, initiated regional dialogues “with the aim of incorporating ecological systems into planning and territorial ordering, promoting the bioeconomy and guaranteeing connectivity between the urban and rural areas, in order to conserve natural heritage and involve citizens in the protection of ecosystems and sustainable development (Minambiente, 2020). In accordance with these dialogues, SINCHI’s Socio-Environmental and Cultural Dynamics program has been carrying out dialogues with citizens, promoting reflection and exchange for the construction of "Sustainable Cities and Settlements in the Amazon" through the workshops: "Conversations in the park" (2019) , "Biodiverciudades Minambiente" (2020), "Livable and healthy Leticia" (2021) and Actions for the Management of Urban Ecosystem Services (SEU) in Urban Planning (2022), with the aim of identifying joint actions that contribute to the restoration and recovery of ecosystems in urban areas prioritized by citizens.”<sup>9</sup>

Building on these ongoing regional dialogues to establish a participatory planning process will empower stakeholders to be co-designers and co-researchers of community-based biodiversity management strategies which, in turn, will support each of the proposals in this report. This approach is based on the “Participatory Action Plan Development” methodology, which aims to “foster negotiation and dialogue to develop the conditions for power sharing between citizens and the institutions that influence their lives.”<sup>24</sup> The goal of this planning approach is to achieve a negotiated agreement between stakeholders and have the community produce knowledge relevant to sustainable development. Notwithstanding, participatory planning cannot solve all issues a community is experiencing. It is meant to focus on issues that can be negotiated, and in the context of Leticia, where there are uneven power relations between indigenous and non-indigenous peoples as well as other social divisions, we believe a participatory approach to planning is essential for stakeholders without a seat at policy-making levels to raise concerns. Given the competing visions for economic development and biodiversity in Leticia, community-based biodiversity management is a topic that would benefit from participatory planning.

Based on the experience of other efforts in the Global South, the following multi-step process can serve as a model for participatory processes.<sup>24</sup> In this process, the proposals mentioned above could easily serve as potential topics for negotiation (i.e. community-based data collection, citizen-led project management, citizen-led ecotourism).

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<sup>24</sup> Broto, Vanesa Castán, Emily Boyd, and Jonathan Ensor. “Participatory Urban Planning for Climate Change Adaptation in Coastal Cities: Lessons from a Pilot Experience in Maputo, Mozambique.” *Current Opinion in Environmental Sustainability* 13 (April 1, 2015): 11–18. <https://doi.org/10.1016/j.cosust.2014.12.005>.

**Suggested Methodologies:**

| Step           | Activity   | Estimated timeline |
|----------------|--|--------------------|
| <b>Step 1</b>  | <i>Map out stakeholders and social groups according to their degree of inclusion in decision-making as well as risks / role in terms of biodiversity management</i>                | 1-2 months         |
| <b>Step 2-</b> | <i>Hold several facilitated community meetings to workshop three approaches to tackling biodiversity management (data collection, project management, ecotourism).</i>             | 6 months to 1 year |
| <b>Step 3</b>  | <i>Input community feedback into biodiversity management proposals and share with secondary stakeholders</i>   | 1-2 months         |
| <b>Step 4</b>  | <i>Hold workshops with secondary stakeholders to prepare a local action plan that can be implemented by a central government actor in conjunction with community organizations</i> | 3-6 months         |

**Table 2:** Multi-step process model for participatory planning.

This process can range from several months to several years, from initiation to conclusion. Given the limited planning capacity of the Leticia city government and its distance from national planning actors, participatory planning should be considered as an essential for the local community stakeholders to feel empowered in decision-making regarding their environments and to sustain any community-based biodiversity efforts.

There are potential risks inherent to the process of transferring the responsibility of services the government should normally provide to communities on the ground. This approach is an attempt for the state to engage in more democratic decision-making in a context where it is largely absent (taking a more “user-lens” approach).

Throughout the participatory planning process, SINCHI could play a critical role by serving as the node between different community stakeholders. As a non-partisan, autonomous government entity, SINCHI could also serve as a “trustee” for the participatory planning process and ensure it moves forward despite the inherent challenges.

## **Conclusion**

To ensure a participative model of planning and biodiversity conservation efforts in the city, it is important that the process embodies community ownership and is institutionalized in the city's decision making landscape. Community-based data collection and decision making, citizen focussed decision making processes, citizen led ecotourism management associations embedded within the participatory decision making process will empower stakeholders to be co-designers and co-researchers of community-based data and biodiversity management strategies. In all the proposed strategies, SINCHI and other primary stakeholders should play the role of an ambler, hand holder and technical knowledge service provider.

# Green-business Development Protocols

## Introduction

The green business strategy focuses on building on the current regional and local programs to boost the businesses in the city of Leticia to adopt green businesses practices and achieve “green certification” (outlined below). The proposals described in this section focus on development methods for local entrepreneurs engaged in the sale of regional products (handcrafts, prepared food, etc) and strategies for these entrepreneurs to understand the importance of establishing, or transitioning to, green businesses, gradually implementing practices to reach a formal green certification. The consumption of local goods, harvested and produced in the region should directly support local entrepreneurship models.

Solid waste management was identified by SINCHI as of critical importance to the city of Leticia and its respective communities. Local businesses and their patrons are directly implicated in production and mismanagement of both organic and inorganic waste. “Regarding the management of solid waste, Leticia is the main marketer and distributor of disposable packaging in the department. It produces approximately 25 tons of solid waste per day, of which its main components are organic waste (39%), and plastics -between 12 and 23%.<sup>9</sup> According to statistics in recent years, there is a "growing consumption and generation of waste with less degradability,"<sup>9</sup> within which polystyrene packaging is included as unusable waste. The PGIRS document indicates that there is a low civic culture and education for recycling.”<sup>9</sup> Integrating sustainable waste management practices into the framework for “Green Certification” is a strategic opportunity to simultaneously reduce the impact on biodiversity and improve the image of the city.

The proposals outlined below build on the existing sustainable economic practices led by the local government and organizations such as SINCHI.

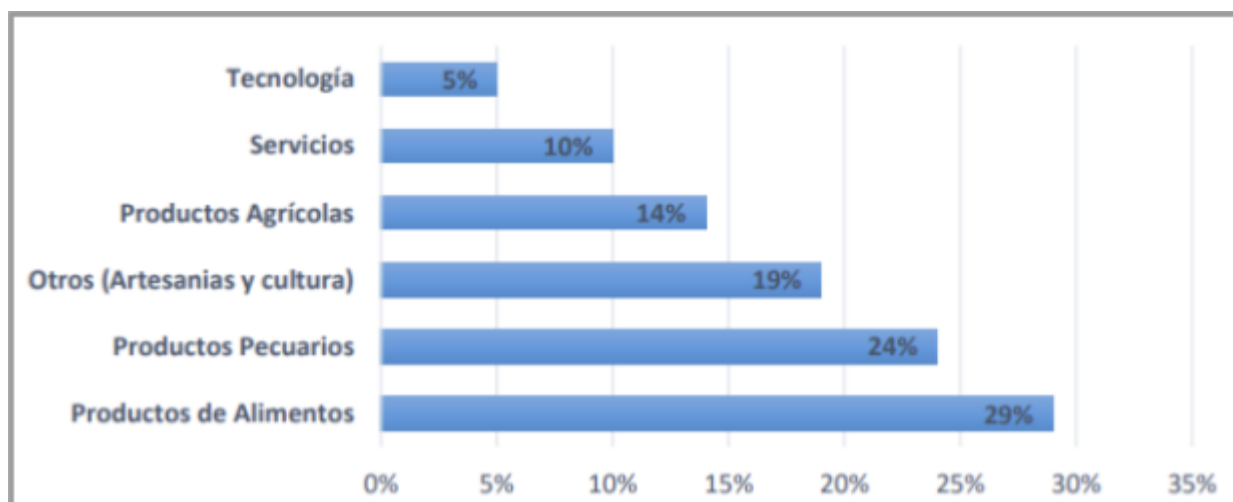
## Proposals

### Framework for Green Certification

“A circular bioeconomy offers a conceptual framework for using renewable natural capital to transform and manage our land, food, health and industrial systems, with the goal of achieving sustainable wellbeing in harmony with nature” (WEF, 2020). While the circular bioeconomy needs technology and innovation as well as traditional knowledge to succeed, biodiversity forms the foundations of this framework. Biodiversity is the key factor that determines the capacity of biological systems to adapt and evolve in a changing environment, and therefore is crucial for ensuring the resilience and sustainability of our biological resources (WEF, 2020).

The city of Leticia is home to a vast number of artisans and entrepreneurs who create a diverse range of products utilizing natural inputs and that are highly skilled in the use of the city’s wide variety of flora and fauna. SINCHI has led various initiatives focused on the topic of circular bioeconomy in the Amazonas region, where many of the businesses making use of biodiversity are located. For instance, an inventory of plants sold in the Leticia market place is being carried out, in order to learn about the type of native forest products that are commercialized in the city.<sup>9</sup>

SINCHI has also been able to identify successful businesses that make use of biodiversity in their production process. In particular, the Naichi ventures stand out, for Amazonian flavored ice creams, Amaflora for Amazonian fruit tisanes, and the Amazonas brewery that processes lager-type beer with flavors, asaí, camu camu, and cupuaçu, among others [...] These businesses are mainly supported by local funds and investments and they are key players in creating supply and distribution chains for the amazonian fruit pulp. This supply chain involves more than 200 families that provide the fruit pulp on a recurring basis.<sup>9</sup>



**Figure 14:** Type of economic activity of Leticia’s entrepreneurs. Source: “Diagnóstico del mercado laboral del municipio de Leticia. Observatorio regional del mercado del trabajo (ORMET), 2018.

According to the 2018 report from “Observatorio Regional del Mercado del Trabajo” (ORMET),<sup>25</sup> Leticia has 2,974 registered enterprises, out of which 1,254 are self-owned businesses and 263 are cooperatives. Figure 15 below shows the type of activity done by Leticia’s entrepreneurs. The largest proportion of businesses is related to food production, followed by the manufacture of livestock products, handicrafts, agricultural products, services and technology.

The 2018 ORMET’s report suggests that the main obstacle relates to legal and administrative procedures, followed by need for innovation, economic resources, business experience and knowledge on publicity. Additionally, the report reveals that 90% of the business owners have very low earnings with incomes that lie in the range of 1 to 2 minimum wages.

<sup>25</sup> Observatorio Regional del Mercado Laboral (Ormet), Amazonas, and Servicio Nacional de Aprendizaje Sena. “Diagnóstico del mercado laboral Municipio de Leticia. Línea: emprendimiento y emprendimiento,” January 1, 2018. <https://publicacionessampl.mintrabajo.gov.co/handle/123456789/78>.



**Figure 15:** Main reasons for the limited growth of entrepreneurship in Leticia. Source: “Diagnostico del mercado laboral del municipio de Leticia. Observatorio regional del mercado del trabajo (ORMET), 2018.

Considering that the largest number of business owners are dedicated to production of food and handicrafts with limited earnings, the promotion of green certifications among Leticia’s entrepreneurs is a way to improve their business’ practices and part of a broader strategy of product diversification. Many entrepreneurs are already producing nature-based products with very high production standards, making the necessary changes to obtain the above-mentioned certifications may require limited additional effort. In addition, these certifications would allow them to sell their products at much higher prices and even reach markets in other regions of the country.

Local businesses should be encouraged to achieve certification from Fairtrade International, USDA Organic, Rainforest Alliance or local certifications such as Global GAP (Buenas Practicas Agricolas) promoted by the Colombian Agricultura Institute and Sello Nacional de Alimento Ecologico created by the Ministry of Agriculture.



### ***Leticia Green Certification - “Leticia Verde”***

The creation of a local green certification label that would allow Leticia to position itself in both the Colombian and international markets as a city committed to sustainable production practices and inclusive community engagement. Furthermore, a local certification could increase local consumers' level of trust in entrepreneurs' products, be easier and less expensive for local business to obtain than international or national certifications, foster a strong identity for the community and even boost the local economy.

It is critical to encourage green certification through appropriate financial incentives. It is highly likely that many businesses will not be able to afford the cost of certification, providing subsidies could be one of the mechanisms to overcome economic barriers. Additionally, taking into account that one of the key findings of the 2018 ORMET report is that legal and bureaucratic processes are the main impediment for growth, providing access to information and advice on the legal and administrative steps to obtain a green certification will be a key component for a successful strategy.

SINCHI, or other interested parties such as the Leticia Chamber of Commerce, should consider providing a series of green certification workshops on a regular basis or making a team of independent or municipal consultants available to respond to entrepreneurs and business owners' inquiries. A crucial final step will be to raise awareness about green certifications and the importance of sustainable practices to the wider public as a means to encourage more people to make environmentally conscious choices and support businesses that prioritize sustainability.

## **Boosting the Consumption of Local Goods**

Currently, a large proportion of goods consumed in the city in Leticia are transported into the area by water and air. Transportation activity is known to have a negative impact on biodiversity and the environment reflected on air and water pollution. While it will be hard to end the heavy dependence of locals and visitors on importation goods, boosting urban agriculture to encourage the consumption of produce and products locally grown and harvested in Leticia will ultimately reduce the percentage of goods that are currently being transported into Leticia.

### ***Suggested Methodologies:***

Businesses who choose to buy and sell locally may fulfill some level of the *Leticia Verde Certification* or other green certification processes and should be encouraged to continue and expand their sustainable practices.

1. The initiative to localize the consumer market should start at a small scale, ie: the port market sellers should be encouraged to only purchase and sell locally grown produce. This step can be facilitated by mapping out the relationships, and lack thereof, between local sales and production markets.
2. An informational campaign for sellers and producers should be initiated to explain why consuming local goods promotes the conservation of the environment, boosts Leticia's economy by creating jobs, increases the value of local produce and incentivizes the collective quality of locally grown produce and manufactured products.
3. An in-depth documentation of the goods that are produced year-round in Leticia, which can be supported by local research organizations such as the SINCHI, Humboldt Institute and CorpoAmazonia have developed in the past, is fundamental for the creation of a list of these goods and their characteristics.
4. The identification of the local *chagras* or urban gardens and the communities that manage them, can be connected to the sellers in the markets to introduce their products.
5. Finally, an information campaign for the general public must be developed to communicate why consumers should prioritize local goods and their consumption to support the creation of local jobs and reduce the negative effect that excessive transportation has on biodiversity.

## **Boosting Local Entrepreneurship Models**

In the city of Leticia, there are numerous local businesses that already have sustainable business models and can then be provided with a green certification; these businesses are particularly concentrated in the *Malecon/Mercado Municipal area*, but also in and around the highly touristic area *Parque Santander*.

By boosting already existing local and sustainable entrepreneurship models, the improvement of current local business projects and the creation of new sustainable business practices can be incentivized. Support from the local government of Leticia, the Chamber of Commerce and SINCHI would be important to promote entrepreneurship models such as local cuisine areas or shops with regional products.

Institutional support might include, tax exemption or reduction, subsidized service provision and informational campaigns about local businesses in exchange for enrolling in particular sustainable practices or achieving green certification (*Leticia Verde*).

Boosting local entrepreneurship should not only be limited to businesses engaged specifically in “green” or “sustainable” business practices; this framework should extend to all marginalized groups. In Leticia, there is an emerging collective of small and medium sized-up businesses owned by women which, if supported, could lead to the creation of a business-women association where they can find guidance, mutual support and even, in the future, access to financing from diverse governmental and non-governmental agencies. In turn, these special focus groups can be encouraged to engage in green business practices and ultimately achieve green certification.

## **Satellite Compost and Urban Farming Networks**

According to SINCHI, “only 4% of solid waste is used (per month), the rest is disposed of in the landfill.”<sup>9</sup> SINCHI in conjunction with the Public Services Unit of the municipality of Leticia, started a pilot project to collect and transform organic waste into bio-fertilizers as a way to reduce the problem of management and use of solid waste in the city. Through this project, an average of 17 tons per month are processed (5% of organic waste). The waste is mainly collected in the *Malecon/Mercado Municipal area of Leticia*, but also in hotels, restaurants in the city and the air force base. The biofertilizer is delivered to local producers to utilize in their production processes. Since the project was initiated, 56 local producers have received an average of 50 kilos of biofertilizer.

### ***Suggested Methodologies:***

Building on the efforts to mitigate the negative impact of businesses’ waste production on urban biodiversity and ecosystem services by SINCHI and the municipality of Leticia there is an opportunity to facilitate the development of a comprehensive waste management solution.

1. A comprehensive network of organic waste contributors should be established, this network should include produce sellers from the market area, local restaurants, hotels and eventually private residences. The network can be managed by local citizen-led associations in conjunction with SINCHI and other city wide or regional institutions.
2. To ensure efficient and effective composting, satellite locations for composting should be identified to increase the scale of the forward cycle composting network; creating more accessible, locally managed, composting initiatives would relieve pressure on the municipal services, reduce the cost of transporting waste materials and, in turn the cost of the composting process.
3. Currently most agricultural initiatives are either outside or on the periphery of the Leticia city boundary; the satellite composting locations can be developed in conjunction with urban farming initiatives.
4. The locations of these satellite composting and urban farming stations should be carefully considered to manage:
  - a. The impact of composting smell on quality of life for Leticia’s residents
  - b. The visibility of the farms and composting initiatives for the purposes of citizen participation and education
  - c. The distance from organic waste production hotspots
5. Building on existing efforts, a closed-loop system that promotes sustainability and reduces waste can be facilitated at a hyperlocal scale. By creating accessible and easy-to-understand information about the effects and benefits of proper organic

waste disposal and forward cycling, businesses and citizens alike will be encouraged to hold themselves and others to a high standard of waste disposal and management.

The role of agriculture and food production in the economic system of Leticia is evident and rational given the abundance of water and well established horticultural expertise of local communities. However, with the rise of businesses and by extension foot traffic, a design strategy to prevent unnecessary accumulation of waste is vital. Within the urban context food waste is largely disposed of in a way that limits its ability to become a step in the forward cycling process. A grassroots waste management system that equips families and residents with the skills and means to convert food scraps into value-add products such as compost will require inclusive and targeted design strategies in order to be successful, but has the potential to radically transform the perceptions regarding waste in the city. A visual campaign combined with a pedagogical approach and the design of city wide covered composting stations is necessary to effectively implement a forward cycle composting network.

By identifying a distributed network composting and urban farming sites within the boundaries of Leticia where residents and visitors can easily and cheaply bring their waste to compost is crucial. This proposal is intended to be supplementary to the current production of biofertilizer from urban organic waste programs. In conjunction with the inorganic waste and waterways management proposal described in the next chapter (Habitat Restoration, and with ongoing research into the "development of bio-packaging from renewable Amazonian resources Amazonas"<sup>9</sup>, this proposal would be an important contributing factor to biodiversity management in the region.

## **Conclusion**

Given the growing economy of Leticia, it is fundamental to address the importance of developing Green Businesses practices. By incentivizing the transformation of locally owned businesses into obtaining a green certification through sustainable, inclusive, environmentally conscious practices, the negative impacts businesses have on biodiversity can be significantly reduced. This four tiered proposal encompassing the development of Green Businesses in Leticia prioritizes (1) the need for a local certification that is inclusive and accomplishable for local small businesses, (2) boosts local entrepreneurship models, (3) provides recommendations to incentive the consumption of local goods, and (4) satellite compost and urban farming networks system, all of which can be integrated with ongoing research and projects facilitated by SINCHI. Through this comprehensive set of recommendations, the city of Leticia can boost its local economy with a sustainable development approach.

# Habitat Restoration

## Introduction

In the context of rapid urbanization, habitat, habitat availability, quality, usage and selection, Leticia is uniquely positioned in its proximity to the Amazonian biosphere as the boundaries between the urban environment and natural environment are increasingly blurred.

SINCHI calls for “corrective and mandatory measures for the conservation of urban biodiversity, specifically the *delimitation of wildlife circulation corridors and reforestation with native species*, especially on the main road axes and within the neighborhoods in green areas, prioritizing the development of participatory strategies in the design of solutions based on nature, together with the communities where the greatest environmental risk is identified within the city” (emphasis added).<sup>9</sup>

In this section a series of proposals that focus on habitat restoration and sustainable environmental management for intra-urban and peri-urban ecosystems in Leticia are described. These proposal strategies are based on the concept of ‘stewardship economy’, an approach that promotes sustainable land-use practices and processes that have the potential to empower Indigenous Peoples and local communities (IPLC) to manage and protect natural resources. Focused on habitat restoration and management for the unique variety of local flora and fauna, the proposals outlined below are dedicated to the preservation of cultures and traditions while generating economic opportunities through sustainable tourism and eco-friendly businesses.

## Proposals

### Plant Selection for Planning of Urban Spaces

Biodiversity enhancement should be a primary goal for future urban design and development. Through survey and continued monitoring, this proposal focuses on further establishing the baseline for the relationship between plant nativeness and animal biodiversity in urban areas. The selection process for plants in urban green space development and the promotion of native biodiversity in urban spaces should be considered through a combination of social and ecological function, guided by the three following principles.

#### **Suggested Methodologies:**

- 1) *Resource based approaches* - a greater density and distribution of urban green areas with a variety of native plant species will contribute to overall urban biodiversity. Resource-specific relationships between native flora and fauna are critical for biodiversity and should be carefully considered when developing urban green space. It is recommended that the plant selection process reflects, as closely as possible, species requirements in the local biosphere. Overpopulation of a single species of tree or plant may lead to undesirable outcomes in habitat utilization by local fauna.
- 2) *Planting Native* - Native species are acclimated to the existing climate patterns in the region and require less maintenance as a result. Further, plant origin is a likely indication that the species will be supportive to local fauna and fungi.
- 3) *IPLC Consultation* - Indigenous communities and local communities have an extensive knowledge of the Amazon ecosystem and should be included in the decision making process. During the planning phase, it is recommended that IPLC are directly involved in describing the requirements for new urban ecosystems.

The urban development of Leticia will require a complex set of considerations. In the context of habitat restoration and biodiversity management, flexibility with planting strategies and collected data to empower planting initiatives will be essential. Transparency between academic knowledge and the community members is critical. Local and tourist populations should be informed about the importance of native planting plans, resource availability and cultural importance of urban flora. An informed and engaged community will more likely assist in the management of biodiversity in the area.

Monitoring native species and growth succession is critical to intra-urban biodiversity conservation. In conjunction with information campaigns about the importance of urban biodiversity, spatial imaging data can be leveraged to map current plant species and populations inside and outside urban areas. These tools will enable the analysis tracking of metrics such as Normalized Difference Vegetation Index (NDVI) for overall green cover. The periodic analysis of species and populations to ensure plans are having intended effects.

The recommended steps are outlined below:

1. Acquire high resolution satellite image or LiDAR scans of the region of interest (both urban and non-urban environments)
2. Classify nearby non-urban ecosystems to identify critical land features and respective plant species
3. Segment images/LiDAR point clouds and use classification to identify plant species of identified objects based on existing botanical records.

## **Environmental Corridors and Land Use Monitoring**

In areas of concentrated natural resource activity (river, wetlands, woodlands, etc.), urban developments form barriers across ecosystems. The functionality of ecosystem services and general health and wellbeing of local flora and fauna is intrinsically linked to resource and environmental connectivity.

Urbanization has resulted in the fragmentation and loss of natural habitats, leading to the creation of isolated pockets of ecosystems. This has a significant negative impact on biodiversity and ecological processes. Integrating environmental corridors in the urban landscape, we can protect environmentally sensitive areas and create intentional linkages between isolated pockets of ecosystems, creating a more connected network of green spaces. This helps to mitigate the negative effects of habitat fragmentation and loss caused by urbanization. Additionally, environmental corridors can create buffer zones between natural and human communities, which can help to reduce the impact of urban development on surrounding ecosystems and maintain a healthy balance between human activity and natural environments.

In addition to the important environmental benefits, there are also economic benefits associated with constructing green corridors. These include minimizing the risk of development in areas with poor soil, lowering clean-up costs of waterways, providing flood protection, and reducing cost of streambank stabilization. Corridor placement and design can be used as a means of zoning, flood and wind protection, stormwater detention, and a potential site for environmental research to take place. In Leticia, given the challenges posed by urbanization, corridors should be considered for stormwater management.

### ***Suggested Methodologies:***

1. *Utilize spatial forecasting and prediction tools* to assess the positive and negative impacts of an ecological corridor; existing fauna population study data, geological and weather data and tree cover can be compared to understand these impacts.
2. *Quantify the habitat loss/fragmentation* relationship caused by urbanization
3. *Assess existing ecological zones* for disconnectivity and predict levels of connectivity provision by the proposed corridor.
4. *Consider their type, size, and intended functionality of the ecological corridor.* The ideal corridor is continuous rather than fragmented, is wide rather than narrow, is used to restore/preserve the existing natural linkages, and is structurally diverse in terms of shape and flora inclusion. (Source: NRCS Watershed Science Institute in Raleigh North Carolina)



5. *Establish an active plan for invasive species and weed management/monitoring in the corridor.*
6. *Manage or prevent the public from disturbing the natural occurrences of the corridors.*
7. *Create public awareness around the importance of corridors to foster a sense of responsibility among the community to preserve and maintain these corridors after their conception.*
8. *Establish local and intergovernmental agreements to ensure longevity and success from a biodiversity standpoint.*
9. *Monitor new and existing green corridors:*
  - a. *Acquire high resolution satellite image or LiDAR scans of the region of interest (both urban and non-urban environments)*
  - b. *Classify nearby non-urban ecosystems to identify critical land features and respective plant species*
  - c. *Segment images/LiDAR point clouds and use classification to identify plant species of identified objects based on existing botanical records.*

To help plan the locations of new green corridors, the forecasting of future flood zones and monitoring the tree canopy, satellite imaging should be used. Planning decisions can be reviewed for effectiveness against metrics including NDVI and urban tree counts from LiDAR. As LiDAR technology becomes more available, including integration into smartphones there is an opportunity for community driven efforts to help gather and validate data.

## **Waste And Waterways Management**

The chemical and physical land changes caused by urbanization negatively affect existing natural water systems. This is detrimental to local flora and fauna that rely on the waterway for survival. In the context of rapid urbanization in the Colombian Amazon and Leticia, there is an urgent need to understand the relationship between the current state of surface water management in urban Leticia and the effects of waste—specifically chemical pollutants and nonbiodegradable waste products such as plastics and metals. Current stakeholder investment in waterway management should be identified to better understand ways to empower these initiatives. Areas at risk of flooding were identified during community meetings led by SINCHI, as flooding affects people, plants, and animals.<sup>9</sup> The proposal describes methods for: (1) Adaptation of physical infrastructure to the unique flooding patterns of identified target area, (2) multilevel management of river pollutants by user groups such as oil leakages from boats, waste management and, but not limited to, abandoned fishing nets, (3) monitoring and analysis of relationships between surface water runoff and waste.

### ***Suggested Methodologies:***

Managing pollutants in the water systems in Leticia's urban area is a critical first step to establishing long-term habitat restoration practices. This will involve the proper execution of three main action items.

1. *Identify sources of pollution* including, but not limited to, industrial, inorganic, non biodegradable and agricultural waste runoff from the markets with the goal of implementing measures to reduce, redirect and manage these pollutants.
2. *Establish and implement policy changes* that incentivize or discourage water system waste practices. This approach also requires the delegation of responsibility to the existing stakeholders responsible for resource management, or to setting up a group of stakeholders that are able to enforce the policy.
3. *Identify the stakeholders for Waste And Waterways Management*, these groups should include local government, municipal services, the Chamber of Commerce, indigenous and local communities.

Satellite and LiDAR technologies can be used to assess the current state of Leticia's impermeable surfaces, surface water flow and accumulation of waste. A system to assess, monitor and forecast the amount of accumulated waste transported by surface water runoff to the larger surrounding ecosystem is described below:

1. Use LiDAR segmentation to identify accumulated nonbiodegradable waste locations and volumes

2. Analyze existing impermeable surface landscape and perform a fluid dynamics study to assess flow and transportation capacity of waste into surrounding ecosystems (this step should be integrated with stormwater management planning)
3. Use analysis to establish origin of waste, volume of flow based on surface area and weather patterns.
4. Quantify volume of waste transported into the local and regional ecosystem from surface water/storm water systems.

These tools will provide both a quantification of accumulated waste and a forecast of where the city of Leticia should prioritize waste management.

This proposal utilizes stewardship economics to emphasize the involvement of indigenous peoples and local communities in managing natural resources, and recognizes their knowledge as valuable contributions in promoting sustainable practices and protecting both the environment and local cultures.

By considering the recommendations above, the city of Leticia and its constituents can initiate a process of improving the quality of water resources in urban Leticia, ensure the provision of a clean urban Leticia, improve safety for human consumption whilst simultaneously supporting the overall health of the ecosystem and biodiversity.

## Financial Incentives for Habitat Restoration

To enable and sustain long-term habitat restoration efforts in Leticia, establishing a financial incentive mechanism can help activate the perception shift towards ‘environment stewardship’ at the community level and foster their commitment to protect, preserve, and restore the ecosystems from which they benefit. Such mechanisms can be designed to protect the environment and address social welfare issues such as poverty alleviation, public health, access to clean water, etc. while managing economic and urban developments.

Although economic and urban developments are currently considered the main engines of growth, through which prosperity and poverty eradication can be attained, prioritizing these at the expense of the environment suggests that the value of environmental assets in the long term is overlooked. Given that Leticia’s economy is highly dependent on the ecosystem and biodiversity of the Amazon<sup>26</sup> (agriculture, forestry, tourism, trading natural products, and so on), it is vital that they are properly protected and administered to maintain the flow of future benefits. Successful environmental protection needs to be grounded in sound economics, including explicit recognition, adequate allocation, and fair distribution of the costs and benefits of conservation and sustainable use of natural resources.<sup>27</sup>

Drawing from research literature and successful practices worldwide on economic tools to translate and capture the value of environmental assets, a *Payment for Ecosystem Services* (PES) and *Conditional Transfer* (CT) are most relevant and applicable for Leticia<sup>28</sup>.

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<sup>26</sup> For the year 2020, the municipality of Leticia presented an added value of 542 billion pesos, where tertiary activities (trades and services) represent 77.9% of the total added value, followed by primary activities (agriculture and mining) with 15.9%, and finally secondary activities (industry and construction) with a 6.2% share (DANE, 2021). Despite the report not detailing the value breakdown of tertiary activities, principal economic activities in Leticia reportedly involve trading of forestry products, agricultural produce, and tourism besides public services.

<sup>27</sup> TEEB (2010) *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.*

<sup>28</sup> Other potential financing tools for consideration include: carbon payments, direct payments, insurance schemes, biodiversity offsets, habitat-mitigation banking, etc. See: Rode, J. et al. (2016) and *Cities Climate Finance Toolkit*

### **Payment for Ecosystem Services (PES)**

PES is an instrument that is used to address the environmental externality and shortage of investment in ecosystem conservation management<sup>29</sup> through variable payments made in cash or kind to land users, providers or sellers of environmental services by private companies, non-governmental organizations (NGOs), or local or central government.<sup>30</sup> These payments or rewards will be made upon the fulfillment of pre-agreed actions (e.g. sustainable land use) with the expectation that such actions will enhance or protect specific ecosystem services (e.g. forest protection, improve water quality, etc.). *Monitoring ongoing compliance* is more important and most often conditional on these pre-agreed actions than the actual delivery of the ecosystem services.

### **Conditional Transfer (CT)**

CT is a programme used by governments to address welfare. They are usually targeted at individuals economically at risk, chronically poor and/or socially vulnerable.<sup>30</sup> CTs are designed to create short and long-term impacts, and potential multiplier benefits across the economy, such as pushing the demand for better education facilities. In the case of Leticia, CT can be designed to incentivise certain target groups to engage in long-term habitat conservation and restoration by rewarding cash or in kind upon the receivers' action.

### **Case studies**

*Piloting a carbon-PES scheme in Vietnam - the case of Bac Kan Province.*<sup>31</sup>

The project was piloted in Na Thau and To Dooc villages in Bac Kan, one of the most forested and poorest provinces in Vietnam. The pilot project was planned for 5 years.

- *Problems:* unsustainable land-use practices including slash-and-burn, illegal logging, monoculture cultivation on slopes and foreshores, and cattle grazing, all of which were the results of lacking agricultural land.
- *Solutions:* a 'bundle of incentives' (*Appendix XX - Table 01 & 02*) including forest land titles, financial support and technical assistance to change local farmers' attitudes, and thus behaviors, towards forest protection and sustainable agriculture. The scheme was designed to shift (i) unallocated protection forests (~ 100 ha of each village) to community-managed forests with temporary land titles, and (ii) maize monocropping in forest patches (about 40 ha of each village) to agroforestry.

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<sup>29</sup> Grieg-Gran, M., Porras, I., & Wunder, S. (2005). How can market mechanisms for forest environmental services help the poor? Preliminary lessons from Latin America. *World Development*, 33(9), 1511-1527. <https://doi.org/10.1016/j.worlddev.2005.05.002>

<sup>30</sup> Porras I and Chacon-Cascante A. (2018). *Costa Rica's Payment for Ecosystem Services Programme: Case Study Module 2*. London: IIED. <https://www.iied.org/g04272>

<sup>31</sup> Do, Hoan, Bac Dam, and Delia Catacutan. "Piloting a Carbon-PES Scheme in Vietnam—the Case of Bac Kan Province," 1–9, 2017.

- *Result:* after 1 year, 11 out of the 15 forest-monitoring plots in the two villages, both diameter and the number of trees increased. Tree survival rate exceeded 90% in one village and nearing 60% in another (*Appendix XX - Table 03*).
- *Stakeholders:* World Agroforestry Vietnam (ICRAF-Vietnam), Pro-poor Partnerships for Agroforestry Development (3PAD), local state organisations (Commune People's Committees) facilitated community mobilisation, training, and fund transfers; and participated communities.

*Payment for carbon sequestration, biodiversity protection, water regulation, and landscape beauty in Costa Rica*

This program offers cash transfers to private landowners for five-year contracts which cover different modalities of forest protection, reforestation, sustainable forest management, and agroforestry. The National Forestry Fund (FONAFIFO) was established as a wholesale intermediary for the PES+CT administration. It purchases and manages ES rights from landholders, and makes up a portfolio of approved ES credits, which then be sold to its buyer, for more details see Porras et. al (2013).<sup>32</sup>

**Recommendations**

In many parts of the world, including Colombia, PES has been used as a means of integrating environmental conservation and development goals, to incentivise conservation management on both privately and communally held land.<sup>29, 33</sup> CT has proven particularly well-suited to the conditions facing marginalized and impoverished communities strongly dependent on natural resources, such as the low-income urbanites and indigenous peoples in Leticia, with advocates conceiving PES as a 'triple win solution for nature, private investors, and the poor'.<sup>34, 35</sup> For the mentioned benefits, bundling of *Payments for Ecosystem Services and Conditional Transfer* is specifically recommended as a strategy to (1) administer and mitigate the threats to biodiversity caused by urban development in Leticia, (2) improve social welfare, (3) mitigate the risk of inequity of benefit distribution from PES, (4) endorse the richness of local and indigenous wisdom and culture through incentivising and empowering 'environmental stewardship' in these communities.

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<sup>32</sup> Porras, I., Barton, D.N, Miranda, M. and Chacón-Cascante, A. (2013). Learning from 20 years of Payments for Ecosystem Services in Costa Rica. International Institute for Environment and Development, London.

<sup>33</sup> Wunder, S. (2013). When payments for environmental services will work for conservation. *Conservation Letters*, 6(4), 230–237. <https://doi.org/10.1111/conl.12034>

<sup>34</sup> McAfee, Kathleen, and Elizabeth N. Shapiro. "Payments for Ecosystem Services in Mexico: Nature, Neoliberalism, Social Movements, and the State." *Annals of the Association of American Geographers* 100, no. 3 (June 25, 2010): 579–99. <https://doi.org/10.1080/00045601003794833>.

<sup>35</sup> Corbera, Esteve, Katrina Brown, and W. Neil Adger. "The Equity and Legitimacy of Markets for Ecosystem Services." *Development and Change* 38, no. 4 (2007): 587–613. <https://doi.org/10.1111/j.1467-7660.2007.00425.x>.

## **Recommended Areas and Model of Application for Leticia**

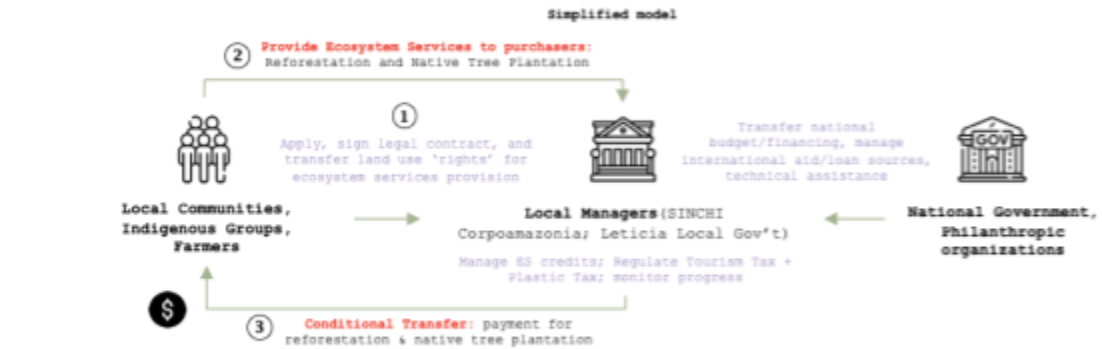
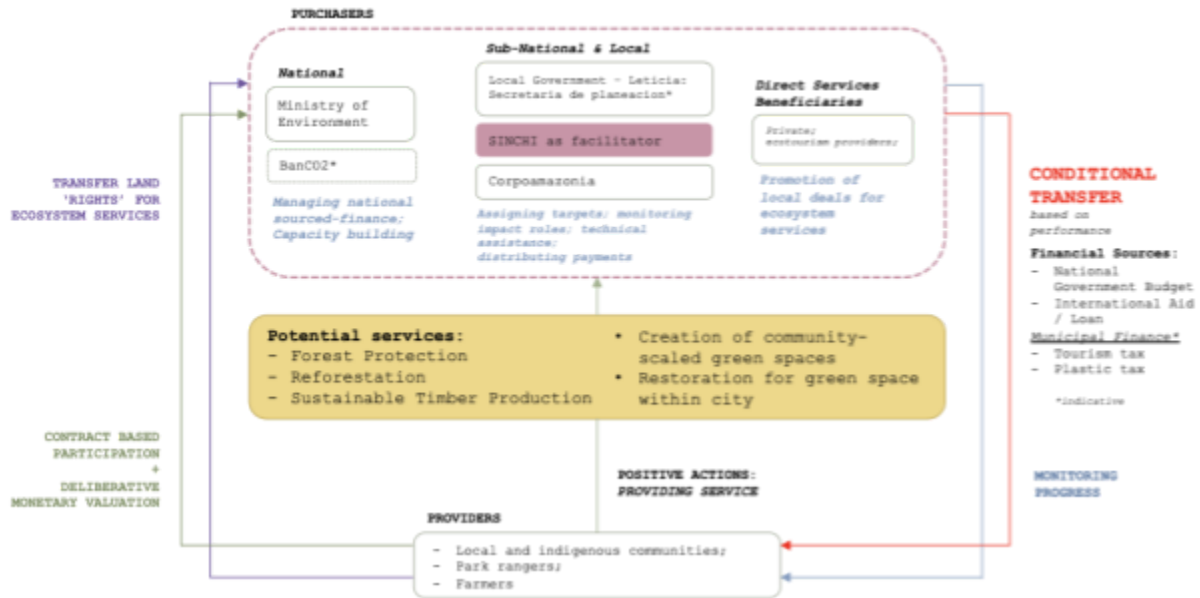
### *Areas of application:*

- *Tree Plantation in Leticia:* reforestation incentivised by PES and CT, which can be implemented at the port to prevent river bank erosion, revitalize aquatic ecosystems, etc.
- *Greener City:* turning gray (concrete) to green such as installing street planter boxes, planting sidewalk flower beds, urban trees, encouraging household garden/orchard, community garden, enhancing parks, birds feeds/bee hives, vertical garden for buildings, etc.) incentivised by PES and CT.
- *Native tree plantation* to support overall biodiversity
- *Sustainable agroforestry*

### **Model of application:**

Figure 16 describes the indicative model of PES and CT bundling recommendation in Leticia. A *governmental-based* PES is recommended with a dominant proportion of financing sources coming from and managed by the national and municipal governments to mitigate the risk of 'market valuation' that could encourage the threat of environmental commodification through further extractive activities. The type of services that can be provided by local communities in the early stages of implementation can start with the planting of native species as well as land coverage transitioned for reforestation to support Leticia's overall biodiversity.

The local government, specifically the Department of Planning, can work in coalition with Corpoamazonia, and SINCHI as the local facilitator to manage the credit and transfer of rights from 'land use' providers, distribute payments, fulfill monitoring functions, and provide supporting technical assistance.



**Figure 16:** Model for Leticia’s Bundling for Payment for Ecosystem Services and Conditional Transfer Mechanism Source: Author

Providers, in this case, local communities, indigenous groups, and farmers can apply, sign legal contracts and transfer their 'land use' rights to provide ecosystem services, such as reforestation and native tree plantation. Local managers provide payments as a return based on the level of 'performance' of actions in the ecosystem services provision (this performance based payment is what is meant by conditional transfer). To monitor performance and impacts, SINCHI can utilize remote sensing technology in long-term implementation which can reduce the complexity and cost of monitoring requirements. National government and philanthropic organizations play a role in providing financing from the annual budget, facilitating international aid and loan sources, and providing technical assistance. To support waste management efforts and encourage the actualization of ecotourism, the Leticia city government can start incorporating plastic tax and incremental increase of tourism tax as a form of contribution to environmental management.



## Stakeholder Engagement and SINCHI as the Facilitator

Similarly to the Citizen-led Ecotourism Management, a multi stakeholder engagement is also adopted to map relevant actors involved in PES and CT initiative. Depending on the nature and the goals of the chosen project, the actors can be identified more specifically.



**Figure 17:** An example of stakeholder mapping for PES and CT initiatives and their offerings determined by their ability and resources.

Source: Author

Based on this analysis, SINCHI can become the key institution to facilitate the design of the enabling environment of this strategy, which includes: mobilizing high-level political support, manage the cash transfer process from the government agencies to PES providers, provides expert knowledge in biodiversity management, Conditional Cash Transfer programme design, lean institutional set-ups, tools and systems for effective implementation, and so on

To succeed in this role, SINCHI requires support from the City of Leticia regarding these aspects in the design process:<sup>30</sup>

1. *Policy and legislation:* have some form of legal framework to enable the adoption of Payment for Ecosystem Services.
2. *Technical:* SINCHI to collaborate with relevant government agencies to explicitly identify ecosystem services, targeting eligible land uses/providers, and design of

payment type (uniform, differentiated, continuous, one-off, cash, in-kind), which require understanding opportunity costs and asymmetries of information (leading to information rents), designing monitoring strategies and feedback channels, and adjusting strategies.

3. *Implementation costs*: the municipality needs to budget and commit funding to the up-front costs to create mechanisms (setting up institutions, background studies, etc); payments/compensations/rewards to participants; transaction costs for project managers (promotion, administration, supervision, technical support, contracting) and for participants (investments, time, paperwork, technologies); monitoring and evaluation (M&E) of PES as well as the Conditional Cash Transfer.
4. *Governance*: the city to make decisions on property rights regimes, negotiation, solving disputes, legal issues.

### ***Alternative funding for Habitat Restoration***

In addition to PES and CT programme, some alternative recommendations on potential alternative funding resources that SINCHI or other interested parties in taking the facilitation role of habitat restoration can tap into to financially sustain the long-term effort in biodiversity management are described in the following table

| Financial Instrument                |  |   |  | Scope of Recommendations   |
|-------------------------------------|--|---|--|--|
| Category                            | Type   | Funding Sources   | Description  |  |
| <b>National Government Transfer</b> | <ul style="list-style-type: none"> <li>• Intergovernmental transfer;</li> <li>• Revenue support</li> <li>• Ecological fiscal transfer (EFT)</li> </ul> | National government budget (particularly channeled from the Ministry of Finance and the Ministry of Commerce)   | Financing capacity of the Municipalities of Leticia may be limited to support larger-scale, high cost intensive strategies. National government budget can be advocated to finance them, either as earmarked or unconditional grants. Moreover, EFT can be transferred based on ecological indicators as compensation for environmental conservation.  | <ul style="list-style-type: none"> <li>• Species identification and management (citizen-led)</li> <li>• Citizen-led and managed ecotourism association</li> <li>• Green certification</li> <li>• Community-based species identification</li> <li>• Inorganic waste waterways management</li> <li>• Local business entrepreneurship</li> <li>• Satellite composting and urban farming</li> <li>• Environmental corridors and land use monitoring</li> </ul> |
| <b>Land Value Capture (LVC)</b>     | <ul style="list-style-type: none"> <li>• Land banking and land readjustment</li> <li>• Tax/fee based LVC</li> <li>• Development based LVC</li> </ul>   | Private companies, communities, and individuals, supplemented with government & commercial bank sources (for banking & readjustment type)   | City government of Leticia can assemble or pool multiple privately owned land parcels to develop land use plans for environmental corridors. The municipality can also increase land or property value through raise in taxation or employ other types of interventions such as transfer of building density, joint redevelopment approach, or establish a cooperative entity to consolidate land for environmental corridors. | <ul style="list-style-type: none"> <li>• Environmental Corridors &amp; Land Use Monitoring</li> </ul>  |
| <b>Municipal Owned Sources</b>      | <ul style="list-style-type: none"> <li>• Development Charges</li> <li>• Taxation;</li> <li>• Taxation abatement for positive action</li> </ul>         | Annual municipal budgeting (direct and indirect tax, but taxation should be emphasized on direct tax): Property tax; tourism tax; introduction for plastic tax, sourced from private companies as well as individuals/communities | Due to financial capacity constraints, municipal owned sources can be especially allocated for smaller-scale recommendations or act as secondary/tertiary rather than primary sources.   | <ul style="list-style-type: none"> <li>• Plant selection for planning urban urban spaces</li> <li>• Campaign and system for boosting consumption for local goods</li> <li>• Local business entrepreneurship</li> <li>• Satellite composting and urban farming</li> </ul>   |

| Financial Instrument                                   |  |  |  | Scope of Recommendations   |
|--|--|--|--|--|
| Category   | Type   | Funding Sources  | Description  |  |
| <b>International Finance</b>                           | <ul style="list-style-type: none"> <li>• Aid or technical assistance grant</li> <li>• Concessional loan</li> <li>• Blended finance vehicles</li> </ul> | International financial institutions and development; <i>such as from GEF, GCF, World Bank, Inter-American Development Bank</i>  | International finance can be allocated for larger scale recommendations or those with a higher proportion of funding. International donors may provide technical assistance via grant funding. Blended international finance can also be established to mobilize additional finance from private and commercial sources.   | <ul style="list-style-type: none"> <li>• Species identification and management;</li> <li>• Citizen-led and managed ecotourism association (needs to be strongly 'branded' for biodiversity conservation efforts)</li> <li>• Environmental corridors and land use monitoring</li> <li>• Inorganic waste and waterways management</li> </ul> |
| <b>Individual, non-profit, and Community Financing</b> | <ul style="list-style-type: none"> <li>• Community Fund</li> <li>• Philanthropic organizations</li> <li>• Crowdfunding</li> </ul>                      | Private companies, communities and individual, philanthropic organizations such as <i>WWF, Humboldt Institute, Fundación Red de Árboles, Fundación Manos Verdes, Fundación Un Litro de Luz Colombia, Viva Idea, Conservación Internacional Colombia.</i> | Individual and community financing may be necessary for smaller-scale investments. If designed appropriately, this financing system may leverage local communities funding capacity particularly to sustain owned funding sources.   | <ul style="list-style-type: none"> <li>• Satellite composting and urban farming</li> <li>• Green certification for business</li> <li>• Campaign and system for boosting consumption of local goods</li> <li>• Citizen-led and managed ecotourism association</li> </ul>  |
| <b>Public-Private Partnership (PPP)</b>                | <ul style="list-style-type: none"> <li>• Management and 'operation and maintenance contracts'</li> <li>• Leases and affermage contracts</li> </ul>     | Private companies, which include <i>Natura Colombia, Argos S.A., BanCO2, Postobón (Hit Social Postobón program), Fundación Éxito</i>   | PPP can be employed to increase participation of private companies in biodiversity management and conservation efforts. Due to the nature of proposed strategies, shorter-term contracts may be preferred. Intention of PPP should be emphasized in supporting stakeholders' capacity in operation, management, and maintenance during the initial period of implementation. | <ul style="list-style-type: none"> <li>• Inorganic waste waterways management</li> <li>• Satellite composting and urban farming</li> <li>• Local business entrepreneurship</li> </ul>  |

**Table 3:** Funding strategy for habitat restoration

Source: Adapted from *Cities Financial Climate Toolkit (2023)*<sup>36</sup> and *Rode et al (2016)*<sup>37</sup>

<sup>36</sup> Cities Climate Finance Leadership Alliance. (n.d.). <https://citiesclimatefinance.org/financial-instruments/#>

<sup>37</sup> Rode, J., Wittmer, H., Emerton, L., & Schröter-Schlaack, C. (2016). 'Ecosystem service opportunities': A practice-oriented framework for identifying economic instruments to enhance biodiversity and human livelihoods. *Journal for Nature Conservation*, 33, 35–47. <https://doi.org/10.1016/j.jnc.2016.07.001>

## **Conclusion**

Habitat restoration is foundational to the long term economic, social and ecological sustainability of Leticia. Through the proposals the critical role of inward facing ecosystem resource management, science and monitoring (in conjunction with traditional habitat management in the Amazon biosphere) and financial incentivisation are highlighted. Effective habitat restoration can be facilitated most effectively through a grounded understanding of habitat availability, quality, typology, usage and selection in the urban environment by, and with, local communities, institutions and stakeholders in Leticia.

## Strategies in Practice: Port and Market of Leticia

### Why are we focusing on the Port and Market Area of Leticia?

We considered several biodiversity hotspot areas within the city to use as an example of applying strategies highlighted below:

- Urban Farm
- Border Road
- Port/Market Area
- Parque Santander
- Isla de la Fantasía
- Urban Maloca
- Greenway
- Landfill

To contextualize the various strategies we propose as a whole for Leticia, we have identified a site within the municipal borders where these ideas can be tested. This is an initial step to evaluate how these proposal strategies can be applied in other areas of significance around Leticia.

We identified the Malecon/Mercado Municipal area of Leticia as a critical meeting point of issues related to biodiversity, inclusion, and economic development. This is an area where the issue of biodiversity management is front and center. The market is a vehicle connecting food production, agricultural practices, and consumption in the area. On the other hand, the port represents the central point of traffic of commodities and people from and to Leticia from neighboring Colombian cities as well as Peru and Brazil. Its



Figure 18: Map of Leticia with market area highlighted  
Source: Google Earth

significance lies in its 2 main features: a port (for travelers from and to Leticia to travel along the Amazon river), and a main commercial hub for the city that includes the main market, shops along the Calle 8a and Calle 8, as well as the undefined commercial activities that extend from the market towards and on the river's edge. In addition, it is an area where the formally planned city meets its informal edge, the Isla de la Fantasía, and is thus an area of social as well as environmental conflict.

## **Applying Strategies to this Area**

The proposal strategies chosen for this case study project includes the following:

### **Boosting Local Entrepreneurship Models (GBD):**

**The problem we identified in the area:** Local self-owned businesses with low visibility lack incentives for green certification.

We identified various types of local businesses that operate under sustainable models and could be provided with a green certification, particularly concentrated in the port and market area. By boosting local and sustainable entrepreneurship models in the port and market area, we can incentivize the improvement of current local business projects and the creation of new ones. For example, one of the most notable business models located on the second level of the market are local majority women run kitchens who serve lunch everyday. Currently, these businesses are not easily located and they usually receive a few clients each day. Profitability is limited, revenue is only sufficient to keep their business running, cover their expenses and the rent.

### ***Our proposal to approach this problem:***

1. Creation of a local cuisine market section, highlighting majority women-ownership, in which locals and tourists can try regional recipes created with local goods at affordable prices.
2. Development of a participative planning process led by the local government and facilitated by SINCHI. The initial phase should aim to understand the concerns and needs of the businesses in the area. Objectives can then be established to reach need based short and long term solutions. The local government of Leticia, in collaboration with SINCHI and the Chamber of Commerce can provide insights on which projects are financially viable with current resources while searching for additional financing mechanisms.
3. Accessibility to the local cuisine market section is an essential part of the transformation process of the area. Providing exposure to the small restaurants located in the second level of the market using visual signage and media drives to highlight the local cuisine section will increase foot traffic. Improvement of lighting and seating areas is also recommended.
4. The local government and the Chamber of Commerce can include the market section in the existing list of touristic areas of Leticia, so it can gain exposure.
5. A negotiation process can be facilitated between the restaurant section in the market that are in need of ingredients and materials for their production for them to access local-based ingredients at lower prices.

**Precedents/Examples:**

We considered local cuisine market sections as inspiration for the proposal in Leticia's market. In the examples below, we highlight the accessibility options that provide marketing exposure for these businesses. The availability of devoted seating areas, signage of different food options, prices and other relevant information to the customer, along with the proper lighting are major components that could increase visitors to this area in Leticia's market.

**Mercado de la Perseverancia, Bogotá**



**Market in Cape Town, South Africa**





**Stakeholdership:**

|                          | <b>Government</b>  | <b>Businesses</b>  | <b>Facilitators</b>  | <b>General Public, communities, groups</b>   | <b>Researchers, academia, professional experts</b>            |
|--------------------------|--|--|--|--|---|
| <b>Recommended roles</b> | Enabling the project through institutional ability (policymaking + help mobilize large resources i.e finance). | Provide to the project the local experience to guide the participative planning process. | Guide the process and benchmarks of success of the initiative. | Active participants of the process which can share their experiences through the participative planning process. | Provide evidence and information that can inform the process. |
| <b>Participants</b>      | Chamber of Commerce, local government of Leticia, CorpoAmazonia  | Local businesses in the port and market areas  | SINCHI   | Consumers of the market and port area and the general community of Leticia                                       | Local University, Humboldt Institute                          |

**Table 4:** Stakeholder participation and roles.

## **Marsh Wetland Restoration (HR):**

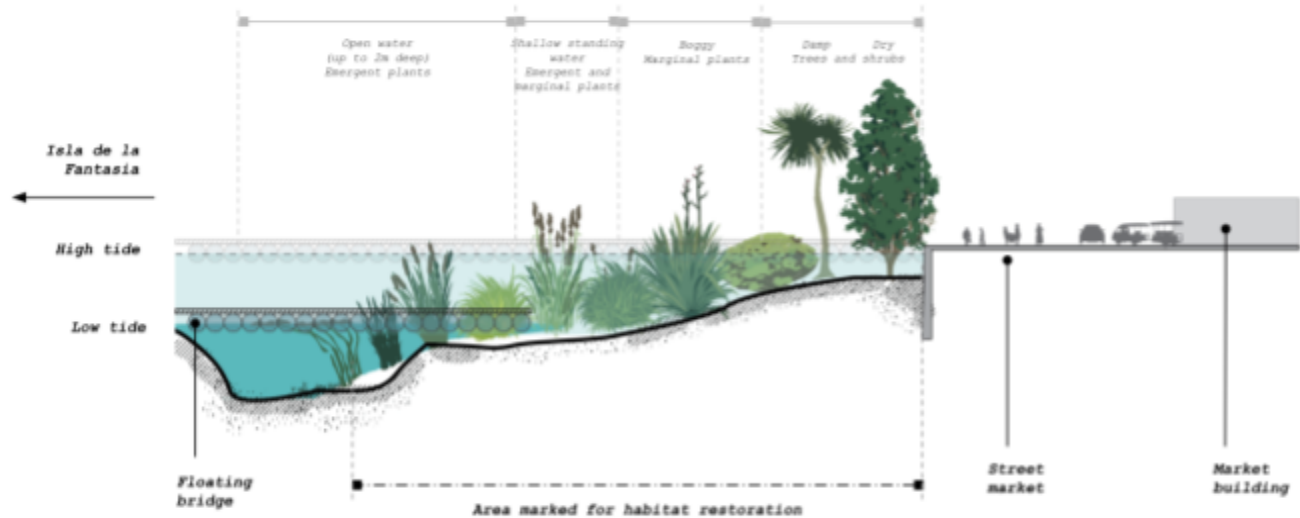
**The problem we identified in the area:** Annual flooding of the market and port area affects businesses and residents. This area is subject to heavy traffic from people, vehicles and wildlife. Various forms of biodiversity exist in this transitional zone between land and water (amphibious, mammalian, and flora). A comprehensive marsh wetland restoration plan of the port area will sustain important biodiversity present in this area as well as mitigate the risks associated with natural disasters whilst enabling commerce to carry on during the seasonal variance of the river.

### **Our Proposal to Approach this Problem:**

1. Community driven waste collection and management program in which local residents and business owners are incentivized to utilize inorganic waste disposal facilities provided by the city and reduce the use of non-biodegradable plastics in the local economy.
2. Establish a planting plan for the riparian zone to limit the impact of annual flood waters into the market and port area.
3. We suggest leveraging the use of spatial data to map current plant species and populations at the port. These tools will enable the analysis tracking of metrics such as Normalized Difference Vegetation Index (NDVI) for overall green cover. The periodic analysis of species and populations to ensure plans are having intended effects. We outline the steps needed below:
  - a. Acquire high resolution satellite image or LiDAR scans of the region of interest (both urban and non-urban environments)
  - b. Classify nearby non-urban ecosystems to identify critical land features and respective plant species
  - c. Segment images/LiDAR point clouds and use classification to identify plant species of identified objects based on existing botanical records.
4. Satellite and LiDAR technologies can be used to assess the current state of the port's impermeable surfaces, surface water flow and accumulation of inorganic waste. We describe a system to assess, monitor and forecast the amount of accumulated waste transported by surface water runoff to the larger surrounding ecosystem.
  - a. Use LiDAR segmentation to identify accumulated inorganic waste locations and volumes
  - b. Analyze existing impermeable surface landscape and perform a fluid dynamics study to assess flow and transportation capacity of waste into surrounding ecosystems
  - c. Use analysis to establish origin of waste, volume of flow based on surface area and weather patterns.
  - d. Quantify volume of waste transported into the local and regional ecosystem from surface water/storm water systems.

- Design and deploy low-tech solutions that respond to flooding conditions of the site. Examples include floating barrels for the several pavilion-like structures along the water's edge that rise and fall with the river.

**Precedents/Examples:**



**Figure 19: Marsh Restoration Planting Plan and Floating Bridge**  
Source: authors

**Stakeholdership:**

|                          | <b>Government</b>  | <b>Businesses</b>                                    | <b>Facilitators</b>   | <b>General Public, communities, groups</b>                                    | <b>Researchers, academia, professional experts</b> |
|--------------------------|--|--|---|---|--|
| <b>Recommended roles</b> | Approvals, financing, viability gap funding, quality check | Financing contribution, Implementation               | Partnerships, Advocacy and expediting approvals and implementation, | Implicit in the decision making process, contribute native planting knowledge | Technical know-how, species identification         |
| <b>Participants</b>      | Ministry of Environment, Local Government of Leticia       | Business owners of the port, market and nearby areas | SINCHI, Market Managerial Association, CorpoAmazonia                | Communities of Leticia, consumer market users, indigenous user groups         | Local University, Humboldt Institute, SINCHI       |

**Table 5:** Stakeholder participation and roles.

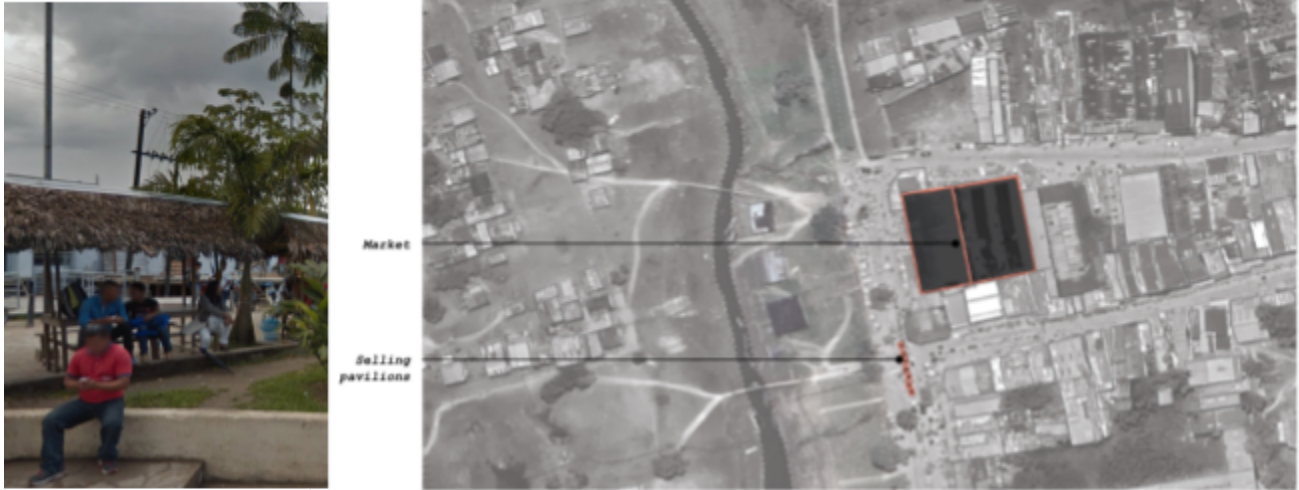
### **Community Management Association Meeting Space:**

**The problem we identified:** Currently there is no designated community stakeholder meeting space for representatives of local businesses and consumers, these may include traders, drivers, shopkeepers, sanitation persons, restaurant owners and the respective patrons of these industries. Through the provision of a physical space near the market area for local engagement, the city and SINCHI can develop a more participatory and inclusive approach to planning. By the creation of physical spaces where different community groups can meet, this can lead to citizen-led initiatives around multiple issues.

#### **Our Proposal to Approach this Problem:**

1. *Consult with local constituents* - SINCHI has the capacity to facilitate conversations with both local market and port users, the Chamber of Commerce and the local government in Leticia in the decision making process.
2. *Find a centrally located space* - we established a centrally located space, accessible to users of both the market and port.
3. *Envision multiple use cases for the space* - We envision this space as a cooperative pavilion dedicated to community meetings, group performances and public information sharing. The space is intended to assume alternative programming when it is not being used for community participatory planning events.
4. *Find alternative spaces* - Establish alternative meeting spaces - these could also be programmed from existing spaces in and around the market area, for example the food court floor of the market, or the selling pavilions on the concrete pier.
5. *Secure funding for the development* - funding could be subsidized by the Chamber of Commerce, contributed to by community-based management associations, local businesses, tourism tax revenues and donations from citizens. If framed in terms of biodiversity management and sustainable development, international funding agencies or development banks may potentially show interest in exchange for visibility or content development.
6. *Approach local Architects and Urban Planners* - Local architects and urban planners are well positioned to design and develop the community meeting space, and may provide affordable design alternatives and sustainable development models.

The market pavilions in the port next to the open market, is one of the areas which we identify as possible physical spaces to be used as a meeting space by the community. With a scheduling plan that complements the programming of these two spaces and capitalizes its periods of inactivity, these spaces can be activated for monthly, annual, or even weekly community meetings, and workshops.



**Figure 20:** Market pavilions in case study area  
Source: authors

**Stakeholders:**

|                          | <b>Government</b>   | <b>Businesses</b>   | <b>Facilitators</b>   | <b>General Public, communities, groups</b>                                 | <b>Researchers, academia, professional experts</b>   |
|--------------------------|---|---|---|--|--|
| <b>Recommended roles</b> | Provide a scheduling plan to organize community activities. | Occupy the public space to meet with fellow business-owners and support the scheduled activities. | Support the process and provide an initial agenda to organize the activities. | Meetings will be open to the general public to include the whole community | Support the process with documentation of the activities held and proposals to boost community-led initiatives |
| <b>Participants</b>      | Chamber of Commerce, local government of Leticia            | Business owners of the port, market and nearby areas  | SINCHI  | Communities of Leticia   | Local University, Humboldt Institute   |

**Table 6:** Stakeholder participation and roles.

## Conclusion

Leticia boasts a vibrant cultural heritage deeply rooted in the diverse Amazon ecosystem that surrounds it. Its unique blend of natural, cultural, and political features positions it as a thriving center for promoting and preserving biodiversity. We are excited and encouraged by the lively community of environmentally considerate urban residents who inspired us and are grateful for the opportunity to produce this work. We look forward to continuing this dialogue to ensure that strategies align with the community's needs and pave the way for Leticia to become a positive model for other Amazonian and Colombian cities.

The nexus between Community-based Biodiversity Management, Green-business Development, and Habitat Restoration offer a comprehensive framework for promoting inclusive practices, sustainable development models for biodiversity conservation in Leticia. By involving local stakeholders in managing biodiversity resources, restoring and protecting habitats, and establishing sustainable business practices, Leticia can leverage its unique cultural and natural resources to build a sustainable and thriving economy. Aligning with these principles will ensure that Leticia can become a positive model for other cities in the region and beyond.

Importantly, successful implementation of these strategies requires ongoing collaboration and multi-stakeholder engagement. By working together to identify and address community needs and priorities, Leticia can create a sustainable and equitable future for all residents while protecting the unique biodiversity of the region. It is crucial to recognize that these strategies do not exist in isolation and require a coordinated effort to ensure their success. Therefore, we encourage continued investment and engagement in these efforts to ensure a bright future for Leticia and the region as a whole. Through the proposed strategies, Leticia can create a model for sustainable development that benefits both the community and the environment. It is our hope that through ongoing collaboration and resource stewardship, Leticia can serve as a positive example for other cities in the Amazonian region and beyond.

# Appendix

## Appendix: Financial Incentives For Habitat Restoration

### Piloting a carbon-PES scheme in Vietnam - the case of Bac Kan Province

(Hoan, D. T., Dam, V. B., Catacutan, D., 2015, pp.82-92).

**Table 01:** Comparison of pilot incentive scheme design and the existing national Payment for Forest Ecosystem Services (PFES) programme

| PFES (nation-wide)   | Pilot incentive scheme  |
|--|---|
| Incentives to individual land holders  | Incentives to the whole community (village)   |
| Cash incentives only (flat-rate payment)   | Mainly in-kind incentives, only a small portion of cash incentives  |
| A LURC in the form of a Red Book (*) is a prerequisite                             | LURCs in the form of a Green Book (**) or even Red Book (in a longer-term vision) are rewards for collective efforts  |
| Forestland only  | Carbon-rich land uses   |
| Input-based (forest area, forest type, quality, and origin)                        | Input-based (tree seedlings, technical support) AND performance-based (tree survival rate, forest violence reduction) |
| Unclear or top-down monitoring and reporting                                       | Participatory (bottom-up) monitoring and reporting  |
| Compulsory payment of 'ES users' to forestland holders for forest protection alike | Co-investment for landscape conservation  |

(\*) Red Book: Long-term (50 years) land allocation for forestry land

(\*\*) Green Book: Temporary land title for forestland, often in the form of a forest protection contract (1-5 years)

**Table 02:** Benefits provided to communities and individual households for carbon sequestration and enhancement through forest protection and tree planting

| Targeted land uses  | Service providers   | Intervention  | Rewards/benefits   |
|---|---|---|--|
| Poor-quality forest currently under the CPC (Commune People's Committee) administration | Na Thau village community use/access rights protection and production forest granted by the CPC<br><br>To Dooc village community obtained the Red Book before our pilot started | <ul style="list-style-type: none"> <li>• Forest patrolling</li> <li>• Assisted regeneration of poorly protected forest</li> </ul> | <ul style="list-style-type: none"> <li>• Financial benefits for forest patrolling and tree plantation in the forest (based on local labour cost)</li> <li>• (Forest) land-use rights for community forest</li> <li>• Technical training for forest protection and participatory carbon monitoring</li> </ul> |
| Maize monocropping on sloping land, managed by individual households                    | Individual households practicing maize monocropping   | Establishment of agroforestry on individual farms inside the forest protection zone   | <ul style="list-style-type: none"> <li>• 1-year establishment cost for Melia + fruit trees + maize agroforestry system</li> </ul>  |
|   |   |   | <ul style="list-style-type: none"> <li>• Financial benefit for tree survival rate &gt;80%</li> <li>• Technical training for agroforestry development</li> </ul>  |

**Table 03:** Changes in key indicators of the piloted incentive scheme in Na Thau and To Dooc villages after one year of implementation

| Indicators   | To Dooc village                               | Na Thau village                              |
|--|---|--|
| Tree survival rate on agroforestry plots   | 92%   | 58%  |
| Number of monitoring plots with increased tree diameters (out of total)                        | 6/7   | 8/8  |
| Community forest land-use right certificates obtained  | Yes (before the incentive scheme was piloted) | Yes (after the incentive scheme was piloted) |
| Improved attitude towards practicing community forest management in general*                   | 38%   | 67%  |
| Improved attitude toward economic benefit of community forest management to household*         | 72%   | 64%  |
| Improved attitude toward economic benefit of community forest management to the whole village* | 60%   | 66%  |
| Improved attitude toward roles of community forest in capturing carbon in timber*              | 17%   | 45%  |
| Improved attitude towards individual capacity to protect community forest*                     | 31%   | 45%  |

\* of improved households



### **Conditional Transfer and Payment for Forest Restoration in Chiapas, Mexico**

Selva Lacandona, Chiapas, **Mexico**: This projects utilizes the bundling of PES and CT schemes for forest restoration, which has been evaluated as relatively successful including for its poverty alleviation and environmental stewardship intentions: “Results reveal widespread joint PES and CCT coverage, and patterns of specialization between different household members regarding the management and spending of program revenues. Results also show positive, multilevel policy interactions as participants combine resources to pursue individual and collective socioeconomic strategies.” (Izquierdo-Tort, 2019)<sup>38</sup>;

### **Payment for Watershed Conservation in Colombia**

Western slope of **Colombia’s** central cordillera, in La Vieja river watershed: “Short-term payments facilitated the adoption of SPS leading to a significantly greater increase in tree cover, which is still visible on participant farms a decade later. The results highlight the potential of short-term PES as a tool to facilitate the permanent adoption of SPS and to support restoration efforts in pasture-dominated landscapes” (Calle, 2020)<sup>39</sup>

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<sup>38</sup> Izquierdo-Tort, S. Payments for ecosystem services and conditional cash transfers in a policy mix: Microlevel interactions in Selva Lacandona, Mexico. *Env Pol Gov.* 2020; 30: 29– 45. <https://doi.org/10.1002/eet.1876>

<sup>39</sup> Calle, A. (2020). Can short-term payments for ecosystem services deliver long-term tree cover change? *Ecosystem Services*, 42, 101084. <https://doi.org/10.1016/j.ecoser.2020.101084>

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