Resilient Settlements for the Urban Poor (RISE UP)

Multilayered Vulnerability Profile Cobija, Bolivia

Climate, Urban, and Biodiversity Dimensions

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Acknowledgements
This project is funded by:
Spanish Agency for International Development Cooperation (AECID)

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Cover photo Aerial View of Cobija, Bolivia

This publication is supported by Spanish Cooperation through the Spanish Agency for International Development Cooperation (AECID). The content is the sole responsibility of UN-Habitat and does not necessarily reflect the position of AECID.

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Climate, Urban, and Biodiversity Dimensions Resilient Settlements for the Urban Poor (RISE UP)

Multilayered Vulnerability Profile: Cobija, Bolivia

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Abbreviations

ABT	Authority for Supervision and Social Control of Forests and Land
AEVIVIENDA	State Housing Agency
AMT	Mother Earth Plurinational Authority
CAF	Development Bank of Latin America and the Caribbean
CBO	Community-Based Organization
CIPCA	Peasant Research and Promotion Center
DRR	Disaster Risk Reduction
GADP	Autonomous Departmental Government of Pando
GAMC	Autonomous Municipal Government of Cobija
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
IIED	International Institute for Environment and Development
ILO	International Labour Organization
IADB	Inter-American Development Bank
MMAyA	Ministry of Environment and Water
MPD	Ministry of Development Planning
MOPSV	Ministry of Public Works, Services and Housing
NGO	Non-Governmental Organization
NUA	New Urban Agenda
OBSC	Bolivian Observatory of Citizen Security
PDES	The Economic and Social Development Plan
PNDIC	National Policy of Integral Development of Cities
WWF	World Wildlife Fund

Glossary

Central and Business District: A central business district (CBD) is the commercial and business center of a city, in this case, Cobija.

Districts: Refers to the municipality first division or an area of a city, especially one regarded as a distinct unit because of a particular characteristic.

Municipality: Is the territorial unit, politically and administratively organized, in the jurisdiction and with the inhabitants of the Provincial Section, the basis of the territorial organization of the unitary and democratic Bolivian State.

Neighborhood: Area of a town that surrounds someone's home, or the people who live in this area. In relation to districts, these are frequently sub divided by neighborhoods.

Executive Summary

This report is part of the "Accelerating the Implementation of the Paris Agreement by Building the Climate Resilience of the Urban Poor" RISE UP project. It presents a comprehensive analysis of the vulnerability profile of Cobija, Bolivia The RISE UP project, implemented in collaboration with the Spanish Agency for International Development Cooperation (AECID), seeks to confront the multifaceted and interrelated challenges posed by climate change, urbanization, and biodiversity loss, which are particularly acute in urban areas of the Global South.

As cities grapple with the escalating impacts of climate change — such as rising temperatures, increased flooding, and more frequent extreme weather events — it is crucial to assess the vulnerabilities faced by their inhabitants. Urban areas often exhibit complex socio-economic dynamics and infrastructure limitations that heighten these vulnerabilities, especially for the urban poor in informal settlements. This report focuses on selected secondary and tertiary cities within these five countries to highlight local contexts of multilayered vulnerability and identify critical intervention areas for enhancing climate resilience.

The selected cities were chosen due to their significant exposure to climate-related risks and the urgent need for enhanced adaptive capacity, particularly among the urban poor residing in informal settlements. By addressing the unique challenges faced by these communities, this analysis serves as a foundation for developing targeted strategies that foster systemic resilience, mobilize and allocate resources, and meaningfully engage stakeholders in coordinated actions.

By highlighting the current vulnerability landscape, the report aims to equip local and subnational governments, community organizations, and international partners with the data, insights and understanding needed to implement targeted and effective interventions that safeguard urban populations, infrastructure, and ecosystems, and promote sustainable urban development. The findings are anticipated to inform broader climate adaptation policies and practices, ultimately contributing to the long-term sustainability and resilience of urban environments.

Supported by the Spanish Agency for International Development Cooperation (AECID), RISE-UP's assessment in Bolivian cities Cobija and Charagua aligns with the New Urban Agenda's vision for an inclusive and sustainable urban future. The assessment also supports the achievement of the 2030 Agenda for Sustainable Development, where 65% of the Sustainable Development Goals (SDGs) relate to urban and territorial development, specifically SDG 11 on sustainable cities and communities. This focus is additionally tied to compliance with the Paris Agreement, connecting the New Urban Agenda to the broader frameworks of the 2030 Agenda.

Cobija is the "capital of Bolivia's Amazon" and has been chosen by the RISE-UP project to be the first city in Bolivia where this study is undertaken. It is a municipality of less than 100 thousand inhabitants that has historically been forgotten by national development policies. Despite this, UN-Habitat has been working with the municipality for years, including it in the development of the National Policy for the Comprehensive Development of Cities (PNDIC), also highlighting that it was one of the first Bolivian municipalities to develop its Local Urban Agenda.

In addition to the already mentioned urban planning management instruments, there is a very important aspect for Cobija: risk management. Located in the Bolivian Amazon, Cobija is exposed to several climate threats and hazards that are exacerbated each year by climate change. The main threat is flooding, which makes the population highly vulnerable. The Acre River, which is the natural limit between Cobija and the Brazilian cities of Brasilea and Epitaciolândia, overflows and generates large-scale flooding that was recorded as particularly severe in 2006, 2012 and 2015. At the beginning of 2024, there was a flood that generated major disasters, affecting many people and specifically impacting 5 neighborhoods of Cobija directly.

The RISE-UP project has developed a multilayered analysis in Cobija, having identified a study subject that, in the case of the city, is comprised of two areas: Area 1 is made up of the Mapajo, Junín, Villamontes and Puerto Villarroel neighborhoods; Area 2 is made up of the Cataratas neighborhood. Those 5 neighborhoods were severely affected by the aforementioned flooding. The neighborhoods' selection was validated by local, important stakeholders.

Existing information in the municipality of Cobija was reviewed and used. To fill gaps, survey work was carried out in the neighborhoods. The assessment included the dimensions Urbanization, Climate Change and Biodiversity, analyzing each of them through maps, which are the main products of this work. Those maps did not exist in the municipality and will now help the local government in coordinated work with local actors to find "hotspots" where actions must be prioritized to turn Cobija into a municipality more resilient to climate change hazards.

Urban Dimension

Cobija is a city with low density within each of its districts, including the two study areas located next to the River Acre border, and are among the oldest neighbourhoods of the city. Here, land use consists of residential, commercial, administrative and social services. There is one private university, local and regional government dependencies and important markets.

According to Cobija´s Local Urban Agenda the city will grow in direction to the city´s southern zone, to more secure sites away of the river border. A list of projects has thus been identified, based on new infrastructure projects and services. It is expected that new neighbourhoods would emerge in the southeastern and southwestern parts of Cobija. Within the study areas, water, electricity and sewage are present. However, garbage collection is not consistent, especially at the Cataratas´ neighbourhood.

Cobija is considered a young city since people under 20 years of age represent 45% of the total urban population. Homes are built with wood (48.4% of homes), bricks (30.1%) and mixed materials (21.5%). 78% of households have roofs made of calamine. A new, adaptive development in home construction in the area has been the use of stilts which directly counteracts the impacts of flooding. At the two study areas, 24% of the households have 4 people; 22% have 5 people; 15% 6 people living there.

Cobija has an employment rate of 59.3%, which is equivalent to two thirds of its working-age population, well below the optimal level; on the other hand, 58.5% of employment in Cobija is informal, which implies a high proportion of workers without long-term security, health insurance or the right to retirement.

Climate Change Dimension

Climate change poses a substantial threat to Cobija, heightening the risks of disasters such as flooding, landslides and temperature rise, especially in vulnerable areas near the river Acre border. The municipality has developed the Plan of Risk management and adaptation to Climate change 2022-2030 and has been working with entities such as the Red Cross to develop reactive activities towards disasters. However, preventive measures are the current challenges that need to be overcome despite a lack of human, economic and financial resources. Projections indicate significant increases in temperature from the current 38°C maximum by 3.7%. In terms of precipitation, the increment is up to 26% from the current 1,774 mm to 2,218 mm per year. Those changes would affect human welfare, food security and services provision.

Climate change hazards make vulnerable groups of society even more vulnerable. The elderly, people with disabilities and children are among the populations most at risk. For instance, 85% of the elderly are dependants and unemployed. 48% of the people of Cobija are female, who have, based on past disasters, developed early warning systems. For example, neighbours use WhatsApp groups to alert citizens of rising water levels after heavy precipitation. This basic solution could be understood to be a palliative solution to the more robust and comprehensive warning systems that are needed.

Biodiversity Dimension

Cobija's biodiversity is under threat from unplanned urbanization, which disrupts habitats and ecosystems. The lack of a cohesive ecological structure hinders conservation efforts and increases vulnerability to habitat loss. Arroyo Bahia is the most important natural reserve near the city. While laws exist to protect the reserve, enforcement is lacking. Another hazard that is affecting biodiversity in the Cobija jurisdiction are human-caused fires used to extend the agricultural frontier for farmers. This issue is reflected around the country. This year, 10 million hectares have been lost due to this activity, causing harmful smoke that affect population directly.

The Amazon is the richest ecosystem on the planet, and it includes a massive presence of animal species and trees that, due to the expansion of agricultural and urban frontiers, places additional strain on key ecosystems. In Cobija, there is an increasing number of local, national and international NGOs and multilateral organizations that are starting to work in the field of biodiversity preservation.

Overlapping Vulnerabilities

The interconnections between urban, climate change, and biodiversity vulnerabilities create multi-layered challenges which is described in this assessment. These layers, put together, have formed hotspots that clearly show the areas of highest risk. With this information, interventions can be prioritized and focused on key areas.

Other than the maps that were produced, one of the most important outcomes of this work has been the participation of the stakeholders who include not only government officials but also those from civil society. They have helped to understand the territory and its nuances. This information will evolve to become actionable projects that has community buy-in and increases Cobija's resilience in the face of these threats.

01
INTRODUCTION

Background and Context

Climate Change, Urbanization and Biodiversity

The climate emergency is fundamentally an urban crisis, affecting every aspect of city life. With over 55% of the global population living in cities—expected to exceed 67% by 2050—urban areas face increasing vulnerability to climate change. Rising temperatures, sea levels, and extreme weather events are straining infrastructure, disrupting services, and impacting housing, livelihoods, health, and wellbeing. These pressures are exacerbated by rapid urbanization, population growth, migration, rising poverty, inequality, and biodiversity degradation. Addressing these interconnected issues through urban climate adaptation and resilience building remains one of the most significant challenges faced by cities, particularly in the Global South.

Over 90% of cities lie within the world's 36 global biodiversity hotspots, where urban expansion threatens both biodiversity and climate resilience. The loss of natural habitats accelerates as human settlements expand, further exacerbated by climate hazards. Cities are increasingly recognizing the importance of spatial planning and urban land management in safeguarding ecosystems and natural assets. These strategies not only support biodiversity but also enhance climate resilience, delivering co-benefits for both people and nature. Effective spatial planning is crucial to prevent the degradation of settlements that rely on the ecosystem services that biodiversity provides. Targeted pro-biodiversity interventions are urgently needed, both within and beyond urban areas, backed by robust tools and strategies.

UN-Habitat emphasises the necessity of a multidimensional, multidisciplinary approach to understanding and addressing these overlapping challenges in cities, with a focus on building resilience for the one billion urban poor in informal settlements. These marginalized communities are particularly vulnerable to climate hazards and disaster risks, living in fragile areas where unplanned urban growth encroaches on natural habitats. Informal urbanization deepens their vulnerability, while also intensifying the challenges of climate change, urban poverty, and biodiversity loss.

Addressing urban poverty, spatial inequality, and informality is crucial to building systemic climate resilience and promoting sustainable urban futures.

Resilient Settlements for the Urban Poor Programme

In a rapidly urbanizing world facing the climate emergency, RISE UP is UN-Habitat's flagship programme, driving critical investments to build climate resilience and create sustainable urban futures. Supported by key partners such as the Adaptation Fund, Green Climate Fund, the Spanish Agency for International Development Cooperation (AECID), and the Swedish International Development Cooperation Agency (SIDA), RISE UP has mobilized over USD 150 million to accelerate global climate action, particularly in cities most vulnerable to climate change.

RISE UP projects range from constructing flood-resistant infrastructure in South-East Africa to enhancing green spaces in Malaysia and restoring mangrove ecosystems in urban Cambodia. These efforts underscore the interconnectedness of climate resilience and biodiversity. Urban ecosystems like wetlands and green spaces play a critical role in mitigating climate impacts and providing essential services for human wellbeing. Since 2019, RISE UP has worked in over 28 countries, reinforcing UN-Habitat's commitment to urban resilience and biodiversity conservation.

RISE UP delivers impact through the following key pillars:

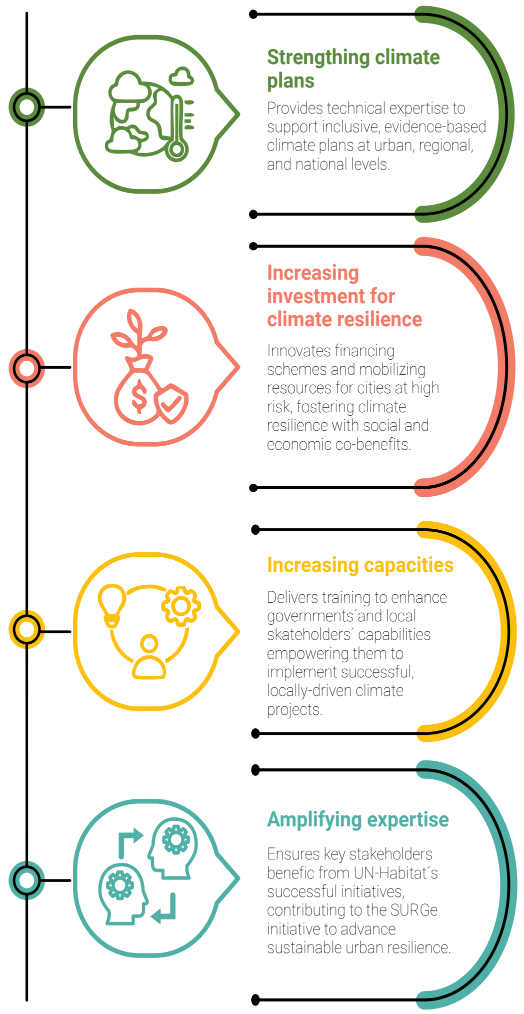


Fig. 1: RISE UP objectives
Source: UN-Habitat, 2024.

Through these initiatives, UN-Habitat fosters transformative urban resilience and impactful climate action for a sustainable, inclusive future.

Assessing Multilayered Vulnerabilities in Cities and Urban Areas

Multilayered vulnerabilities in urban environments encompass various interconnected challenges that extend beyond physical infrastructure to include spatial, social, economic, climatic, environmental, political, and technological dimensions. Issues like income inequality, environmental degradation, inadequate housing, and insufficient emergency preparedness contribute to a city's multidimensional vulnerabilities.

In this context, multilayered vulnerability refers to the extent to which an urban system, community, or ecosystem is exposed to, sensitive to, and unable to cope with the adverse impacts of interrelated climate change, urbanization, and biodiversity loss. Factors such as geographical location, socio-economic status, infrastructure quality, and governance structures influence this vulnerability. The aggregation of multiple and cascading vulnerabilities exacerbates the overall susceptibility, risk, and adaptive capacity of people, infrastructure, and the environment.

Addressing these challenges to strengthen urban resilience requires comprehensive urban planning and management strategies. Policymakers and practitioners face several obstacles in conducting multilayered vulnerability assessments, including:

- The fragmentation of climate change, biodiversity, and urbanization in policy and practice.
- A lack of evidence-based approaches to mapping multidimensional and interrelated vulnerabilities.
- Limited capacities and resources for conducting comprehensive assessments.
- The urban poor and residents of informal settlements being the most affected yet least engaged in decision-making processes.
- Insufficient tools for predicting future land-use changes and urban growth patterns.
- A lack of coordination and cooperation in transboundary and multidisciplinary planning.
- Minimal application of coherent, prioritized interventions and solutions.

These challenges highlight the need for a more integrated approach to vulnerability assessment and management. To address this, UN-Habitat's RISE UP programme has developed the Multilayered Vulnerability Assessment (MVA) tool, whose purpose is to help communities, cities, and local leaders to comprehensively map and assess multilayered vulnerabilities. The tool addresses the nexus between climate change hazards and risks, urbanization and spatial trends and characteristics, and biodiversity loss and land degradation to identify vulnerability hotspots arising from spatial overlaps and conflicts.

By deploying the MVA tool in communities, cities and urban areas, local and national leaders and policymakers in climate-vulnerable cities and communities can better plan and deliver inclusive, sustainable, and resilient urban development strategies for human and non-human inhabitants. This enables decision-makers to make informed choices about urban expansion and adapt to urgent climate-related challenges.

Implementation of the Multilayered Vulnerability Assessment Tool

This report is part of the "Accelerating the Implementation of the Paris Agreement by Building the Climate Resilience of the Urban Poor in Bolivia, Colombia, Ethiopia, Jordan, and Tunisia" RISE UP project in collaboration with the Spanish Agency for International Development Cooperation (AECID). It presents the vulnerability profiles of the selected project cities, detailing the outcomes of Stages 1 and 2 of the MVA, including preparation, and mapping and analysis, that will inform Stage 3: action planning.

The project engages communities in Cobija and Charagua in Bolivia, San Juan de Pasto in Colombia, Debre Birhan in Ethiopia, Sahab Municipality in Jordan, and Kerkennah in Tunisia. The selection of these locations was guided by several critical factors:

- High vulnerability: Each area is characterized by significant vulnerability and exposure to the impacts of climate change, urbanization trends, and biodiversity loss, highlighting the need for intervention.
- Community engagement: There is a demonstrated need and interest from local communities in enhancing their adaptive capacity, ensuring that project efforts align with local resilience priorities.
- Government collaboration: Each location benefits from established governmental structures and policies, facilitating effective collaboration among local stakeholders and the RISE UP headquarters team for a coordinated approach.
- Implementation capacity: The Regional and Country Offices possess the capacity to support activity implementation and manage component funds, which is essential for executing the project effectively and maximizing the impact of interventions.

The MVA implementation in Bolivia, Colombia, Ethiopia, Jordan, and Tunisia lays the groundwork for targeted climate resilience interventions. With a focus on high-risk areas, strong community engagement, and collaboration with local governments, the project leverages local capacities for effective action.

Climate Change, Urbanization and Biodiversity in Cobija, Bolivia

While the Andes are a large part of the country, Bolivia's territory is mostly covered by the Amazon, consisting of extensive jungles in all the country´s north and eastern zones. Cobija is the capital of the Bolivian Northern Amazon.

Everything that is said about the Amazon is relevant, extensive, challenging and often incommensurable; past and future challenges are imposed in the present. To act for the benefit of this region, it is essential to know its peculiarities and characteristics. The Amazon covers 6% of the planet's surface and occupies 40% of the territory of Latin America and the Caribbean. Its 7.5 million square kilometers are continental in size. Its rivers discharge approximately 20% of the world's fresh water into the oceans, more than the Missouri-Mississippi, Nile and Yangtze rivers combined. Its basin has 25,000 kilometers of navigable rivers. The Amazon River is the longest in the world at 6,900 kilometers. It has more than a thousand tributaries and discharges nearly 220,000 cubic meters per second. At least 40 thousand plant species have been identified in the Amazon basin. Of this total, 2,000 were classified as useful for food, medicine or other purposes. The Amazon is a natural unit and functions as such, it has strategic ecosystems and is a real core of biodiversity.

The challenge is particularly broad from the point of view of Amazonian towns in Bolivia. They are not the most important cities in any of the Amazonian countries. On the contrary, they are human settlements with high levels of underdevelopment and a significant disconnect from the main cities and the centers of political and economic decisions. Cobija, an Amazonian city that is the capital of the department of Pando, is located far from the administrative capital, La Paz. Cobija has its urban model as a concentrated city that, due to external factors, is experiencing rapid expansion.

Cobija is affected by climate change in several ways, ranging from potential changes in stream flow levels and extreme events, to other threats affecting the biological diversity of the many river-dependent ecosystems. This is exacerbated by disorganized urban expansion that lacks sound urban planning. The effects are dire for the surrounding habitat and biodiversity.

Climate change will continue to affect Cobija, especially in relation to heavy precipitation and extreme precipitation. The predicted increase in temperature variability will have a negative effect throughout the country, but stronger in Pando, where local flora and fauna are accustomed to very stable temperatures.

Source: Vice Presidency of Bolivia

Context Analysis

Location and Geography

Cobija is in South America's Amazon rainforest. The city lies on Bolivia's northern border with Brazil and is located between the meridians 11°8' and 10°58' S and 68°44'05' W. The municipality has an area of 449.14 km^2 and is located at 280 meters above sea level.

Cobija is a border city and is the department capital. It is classified as an agglomerate-type settlement. It is located adjacent to the urban areas of Brasileia and Epitaciolândia, in neighboring Brazil, with which it shares close socioeconomic, physical, and environmental ties. This connection with the Brazilian cities presents an opportunity for joint development, fostering shared development strategies. Additionally, both regions share responsibilities for addressing common territorial challenges, such as the management of the Acre River's water resources.

Cobija is the capital of the Department of Pando, Bolivia. The Municipality of Cobija is made up of the capital city of Cobija and 18 dispersed rural communities. Cobija is administratively divided into 6 Urban Districts and 66 Neighborhoods.

Parque Piñata
Source: GAMC

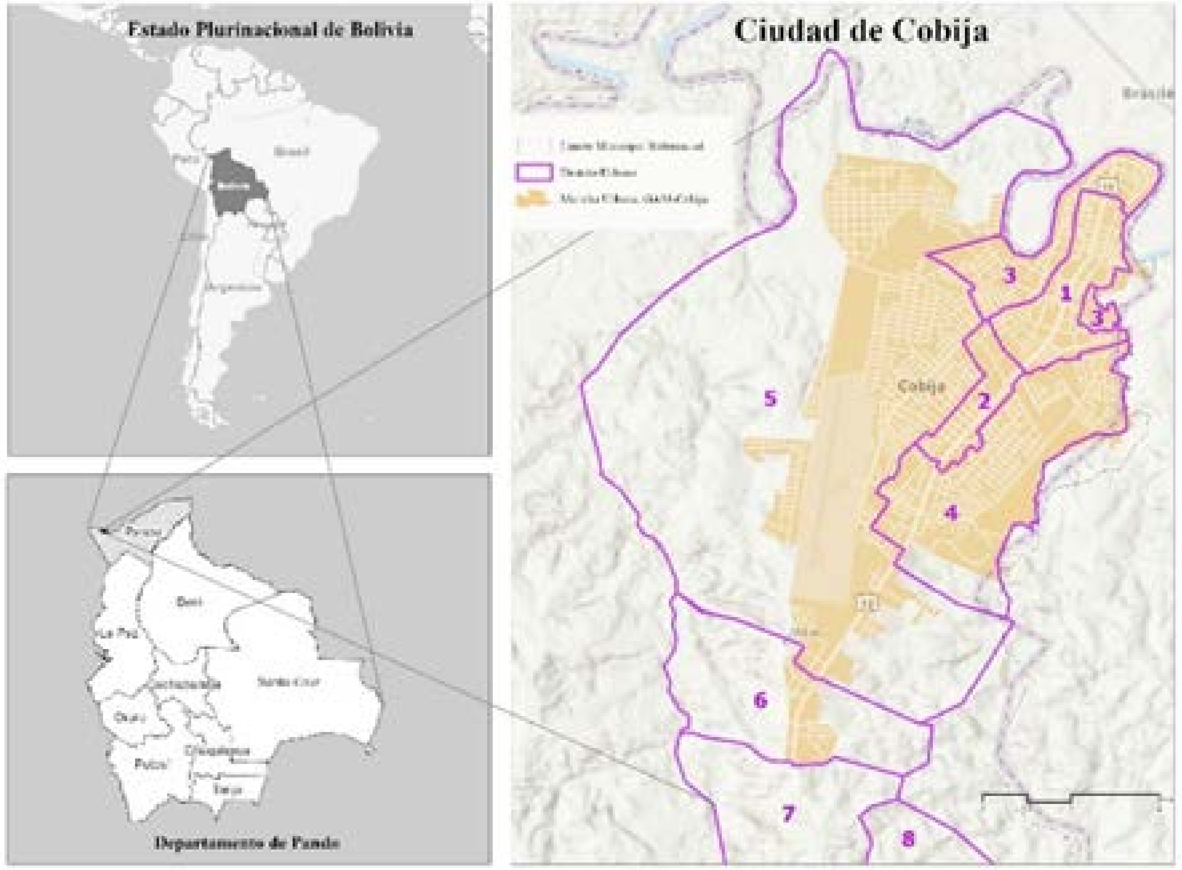


Fig. 2: Location of Cobija
Source: UN-Habitat

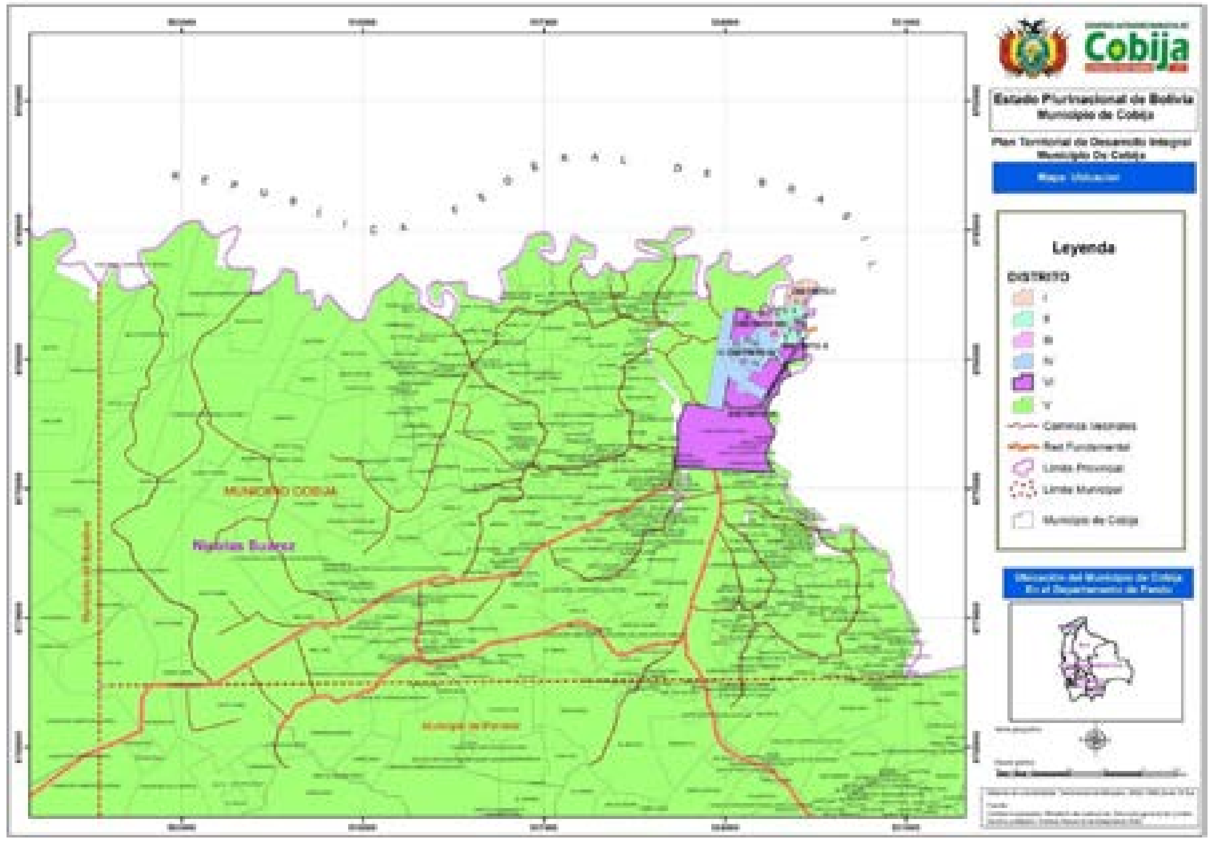


Fig. 3: Map of Cobija, Bolivia
Source: PTDI Cobija

History of City Development and Growth

During the colonial era and in the first decades of republican life, the Amazon region was mainly occupied by indigenous populations and occasional explorers. The region was considered harsh because of its demanding physical environment. It was not until after the Pacific War, in which Bolivia lost territory bordering the Pacific Ocean, that national administrations identified the capabilities of the river system in the country. It allowed passage first to the Amazon River and then on to the Atlantic Ocean.

The presence of productive national enterprises in the region began during the latter years of the 19th century. This caused that the national administration attempted to impose taxes on the exploitation of the natural resources, leading to a violent reaction from Brazilians and, thus, the beginning of the Acre War which lasted from 1899 to 1903. During the war, limited national presence led to the occupation of large parts of Bolivia by Brazilian exploiters. They were eventually arrested in several war-like actions. One, in the Gomera barracks in Bahía was particularly noteworthy. There, the rubber-tap workers defended the territory, allowing, in the following months, the beginning of peace negotiations and the recognition of the current city limits. In the place where the Bahía barracks was located, on February 9, 1906, "Puerto Bahía" was founded by order of President José Manuel Pando, whose name was changed the following year to Cobija. The goal was to establish sovereignty in the area and to become a lake commercial port, which is why it lodged commercial houses and all that was required for the business of extraction. Economic prosperity allowed the installation of public lighting and a drinking water distribution system from sources located at elevations that guaranteed its natural drinkability. The population, according to the censuses of the colony territory, indicates that in 1917 there were 1,700 people settled and in 1925 just over 3,000.

In 1938, President Germán Busch ordered the creation of the department of Pando and in 1945, during the government of Gualberto Villarroel, Cobija became the departmental capital. Only in the 1970s were improvements made in the city by widening streets, bricking them and constructing new public buildings in addition to the first bridge that linked Cobija with Epitaciolândia, Brazil.

Since 1983, Cobija has had the status of Industrial and Commercial Free Zone, whose essential features are: a) exemption from taxes created or to be created for any natural or legal person established in its jurisdiction; b) the principle of extraterritoriality customs, of a legal type, from which it is assumed that the merchandise will not pay any type of tax; and c) a jurisdiction that includes the entire urban area of the city of Cobija.

In the last decade of the previous century, a new process of urban improvement occurred, changing brick for tile on the roads and establishing new institutions, such as the Amazonian University of Pando.

Demographics

Since 2009, migration has been an important factor for urban expansion and demographic growth. According to the National Census of Population and Housing in 2012, there was an urban population of 46,297 and 13,290 homes. It is estimated that by 2024 there will be more than 90,000 inhabitants. That is, Cobija's population has double in just a decade. The ethnic origin in the municipality comes from the Yaminahua indigenous tribe. It is the only tribe that lives in the northern area where the municipality of Cobija is located.

Municipality	Town	Population Total	Male	Female
Cobija	**Cobija**	43.402	22.302	21.100
	Avaroa	295	152	143
	Bajo Virtudes	94	52	42
	Bella Vista	624	315	309
	Nueva Esperanza	139	89	50
	Villa Fatima	89	45	44
	Alto Bahia	111	64	47
	Nuevo Triunfo	134	83	51
	Mejillones	128	80	48
	Villa Busch	734	478	256
	Villa Rosario	120	68	52
	17 de Mayo	134	72	62
	Sujal	124	71	53
	Ponton	40	30	10
	Marapani	44	29	15
	Belmonte	4	2	2
	Nueva Santa Cruz	51	41	10
	Limera	-		
Total Population		**46.267**	**23.973**	**22.294**

Table 1: Cobija´s Population by districts (Last official census)
Source: PTDI 2020-2025

The common language in all the communities in the territory of the municipality is Spanish. There is also a lot of Portuguese influence given its proximity to Brazil.

As part of a binational urban agglomeration, Cobija is the largest city. 58% of this urban agglomeration lives in Cobija while 24% live in Brasileia and 18% live in Epitaciolandia.

Cobija is considered a young city. People under 20 years of age (See figure 3) represented 45% of the total urban population in 2012 (National Institute of Statistics, 2012). The city has a high population of working-age adults, still faces machismo culture, high rates of poverty, and very little forethought is given to the potential of the 20-39 age group. What results is limited spaces for cultural and creative recreation, poor job prospects, low human development, and little attention given to early childhood development and skills

According to data from the 2012 National Population and Housing Census, 85.9% of the population aged 0-5 years did not attend an educational center for early childhood development. In relation to the dependency of elder population, 85% of elder inhabitants are considered as dependents. The Unmet Basic Needs (UBN) index calculated for Cobija showed that in 2012, 30.1% of its population was categorized as poor or that did not have its basic needs satisfied (National Institute of Statistics, 2012). It was one of the highest rates of unsatisfied needs in Bolivia. Cobija has a low socio-spatial inequality index of 38.7, which is reflected in the proliferation of slums or informal settlements that lack basic services.

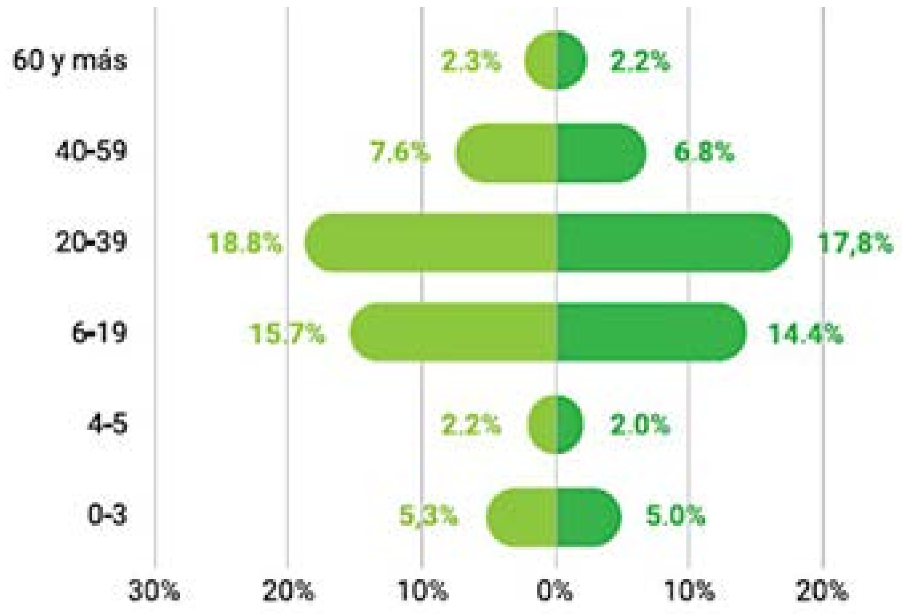


Fig. 4: Population Pyramid of Cobija
Source: Local Urban Agenda of Cobija

Cobija demarcates a critical situation regarding the integral development of women. The modified gender inequality index, which considers access to health, empowerment and the labor market in the department of Pando, is 5.18, which represents one of the lowest departmental indices in the country. For reference, a score of 100 represents no difference between men and women. Gender inequality often leads to domestic violence. There are high rates of pregnancy among adolescent and even pre-adolescent women , deepening gender gaps in relation to educational, employment and human development opportunities.

Key Economic Sectors

Cobija is a border city with high potential in the logistics sector, due to its geographical location and the competitive advantages integrated into regional and international marketing chains. However, it is highly dependent on air-transportation. There are limited connections by river, but the Acre River is not suitable for larger vessels due to its depth and the need to dredge certain portions on a recurring basis. It has a competitive disadvantage compared to Riberalta or other areas with access to major waterways. The land connection of the municipality with the rest of the country is only possible through the Cobija - Puerto Copacabana trunk road, which connects in Beni with Peña Amarilla and El Chorro, continuing through Santa Rosa and Yucumo towards the city of La Paz. Several sections of this road are impassable, especially during the rainy season. One can also reach the Brazilian city of Río Branco (230 km), capital of the State of Acre, by paved road. These circumstances limit integration with the rest of Bolivia.

Commerce is the bulk of the economic activity of the city. There is a wide potential for eco-tourism and industries that require intact, native ecosystems. The top economic activities that take place in and around Cobija include chestnut harvest and gum extraction. Three economic sectors have been identified: a) primary sector (agriculture, livestock, extractives); b) secondary sector (transformation activities); and c) tertiary sector (services).

Cobija has an employment rate of 59.3%, which is equivalent to two thirds of its working-age population. This rate is far below the optimal level. On the other hand, 58.5% of employment in Cobija is informal, implying that there are a high proportion of workers without long-term security, health insurance or the right to retirement. In the National Population and Housing Census (2012), the municipality of Cobija presented a GDP value per person of USD 4,464, a figure higher than only two departmental capitals, Potosí and Trinidad. This fact reflects a weak performance of the local economy.

The GDP per employed person in Cobija was USD 363 per employed person per month in the last census. This is an indicator of productivity and can also be assigned to the measurement of monetary poverty because it provides a vision regarding the possibility of achieving income for the workforce. Cobija's production per employed person ranks 18th among the largest 20 Bolivian cities, implying low productivity of its workforce and therefore limited possibilities of improving the conditions of monetary poverty.

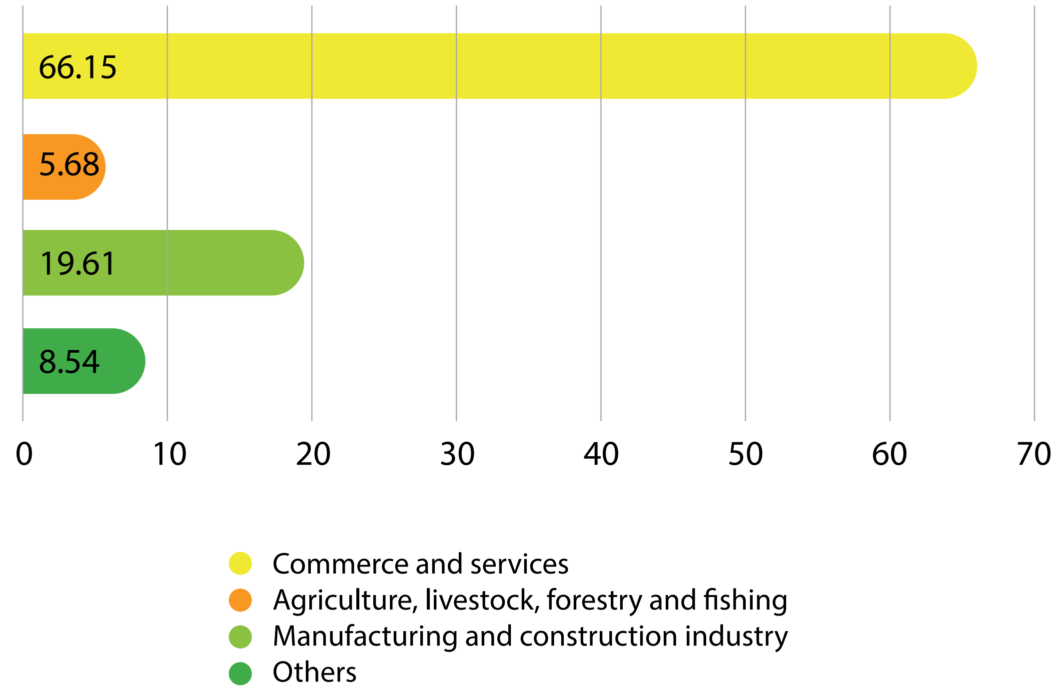


Fig. 5: Economic activity of Cobija´s population
Source: Local Urban Agenda of Cobija

Environment, Biodiversity and Climate

The municipality of Cobija is in a heterogeneous area, of variable altitudes, ranging between 160 to 260 meters above sea level; The City of Cobija is at an average altitude of 200 meters above sea level. The generally flat landscape is dotted by occasional undulating hills.

The urban area of the municipality of Cobija still occupies a small area of the municipality. Most of the municipality is rural in nature, which is modified by changes in land use, from forests to agriculture. This has occurred more intensely in recent years.

The following picture shows the evolution of land use in Cobija. Land-use changes, spawned by increasing migration, have occurred rapidly. The surrounding areas, which have historically been forested, are now used for agricultural purposes.

Land-use maps in the years 1985 and 2022 show a large decrease in forested areas and a large increase in urban infrastructure. The characteristic vegetation in the surrounding region is the humid mainland forest. The existing floristic types develop in deep, moderately well to well-drained soils. Among the typical tree species commonly found in the plains are the chestnut (*Bertholletia excelsa*), the syringa or gum tree (*Hevea brasiliensis*), the red isigo (*Tetragastris altissima*) and nui (*Pseudolmedia laevis*).

Amazon Rainforest
Source: GAMC

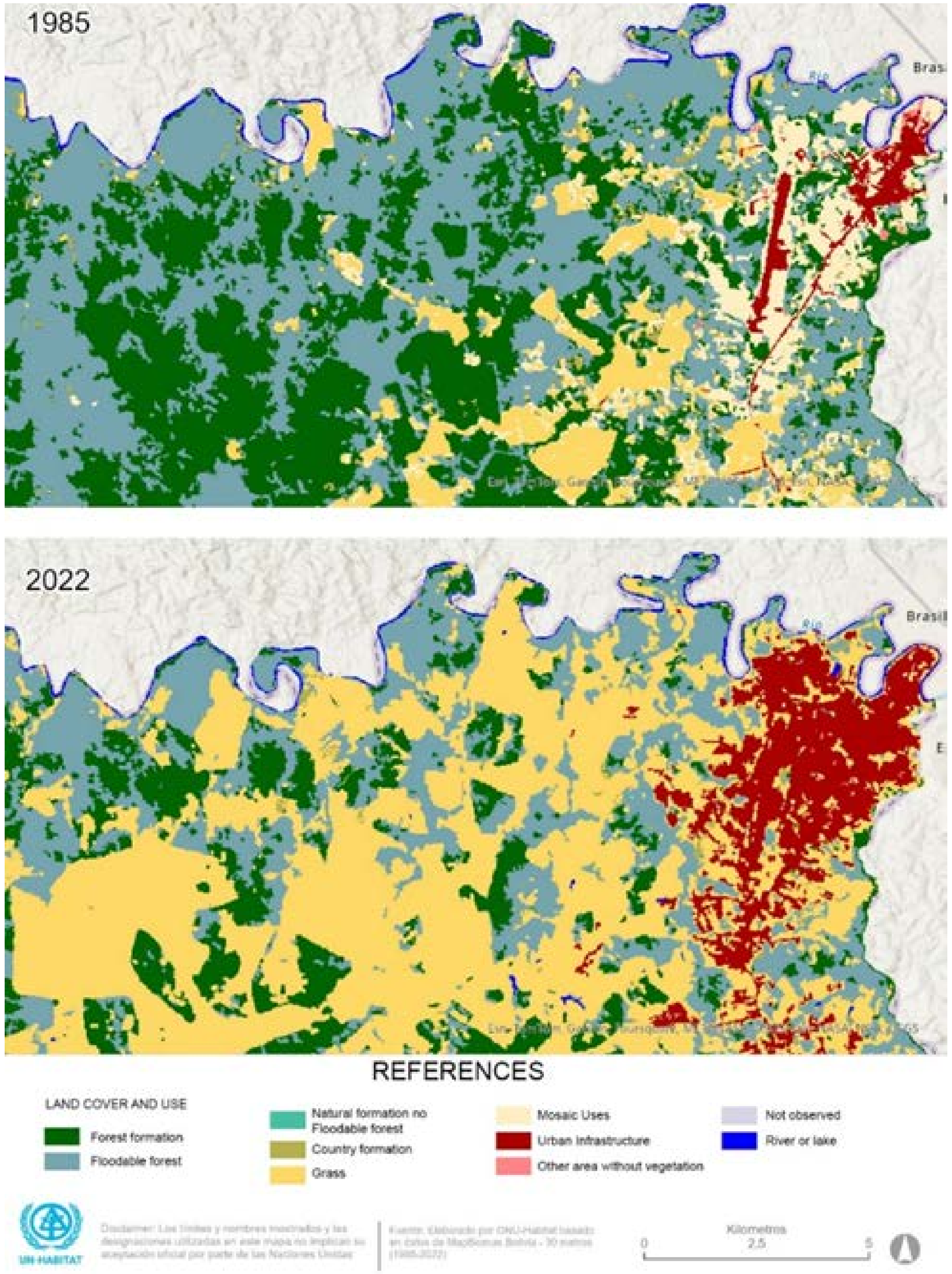


Fig. 6: Land use in Cobija (1985-2022)
Source: UN-Habitat

The municipality is made up of floodplain forests (*riparian forests*). Found in the valleys along the main rivers, these areas are annually affected by flooding.

Secondary forests have been formed due to intense human activity in the areas closest to the urban area of Cobija and along its main and secondary roads. They are dominated by pioneer species such as ambaibo (*Cecropia gallinaceae*), palo balsa (*Ochorma pyramidale*) and chaquillo (*Physocalymma scaberrimum*) (*Becky Miranda*, 1989). In addition, the existence of some palm trees such as motacú (*Attalea phalarata*) and cusi (*Attalea apeciosa*) that have a high resistance to fire.

The average temperature of the municipality is between 25.5ºC and 26.8ºC. Extreme maximum temperatures reach 38º C, with average maximums of 31ºC. In winter, cold fronts frequently occur, lasting 2 to 3 days and causing a sudden drop in temperature which can occasionally amount to a drop of 12ºC.

The rains are seasonal, intensifying between the months of September to April. The months of May, June and July are considered the dry, winter period characterized by sporadic rains. There is an average of 2 to 3 days of precipitation in those months. Average annual precipitation varies from 1,774mm in the east to 1,834mm in the west. One of the outstanding consequences of Climate Change is reflected in the variability of the hydrological cycle. The data recorded at the A.A.S.A.N.A meteorological station reports a maximum rainfall in 2009 of 3,479mm per year. That amount of precipitation can affect the level of use within a forest. It can cause erosion of vegetation cover, flooding in highly vulnerable districts, and the clogging of sewers in micro-basins due to the dragging of solid and organic waste.

In the last 10 years (2009-2020), Cobija reported an average annual precipitation of 1,978mm per year, reflecting a greater amount of precipitation in the months of November, December, January, February and March.

Cobija's precipitation has the highest rates in the months of January to March with an average of 75% and then decreases and has the lowest percentage in the months of June, July and August, with percentages between 12% and 21%.

Likewise, almost-normal humidity was reported in the territory at 65%, and moderate humidity at 13%.

Flooding causes, among other things, economic damage to agroforestry, agriculture, increase in disease transmission, and loss of homes and critical infrastructure. In February 2024, a large flood occurred, affecting 16 neighborhoods of Cobija. The water level at the height of the Friendship Bridge, which connects Cobija with Brasileia, Brazil, reached 17 meters, an unprecedented height that exceeds that of 2015 when it reached 15.5 meters, according to the Bolivian Risk Management Unit.

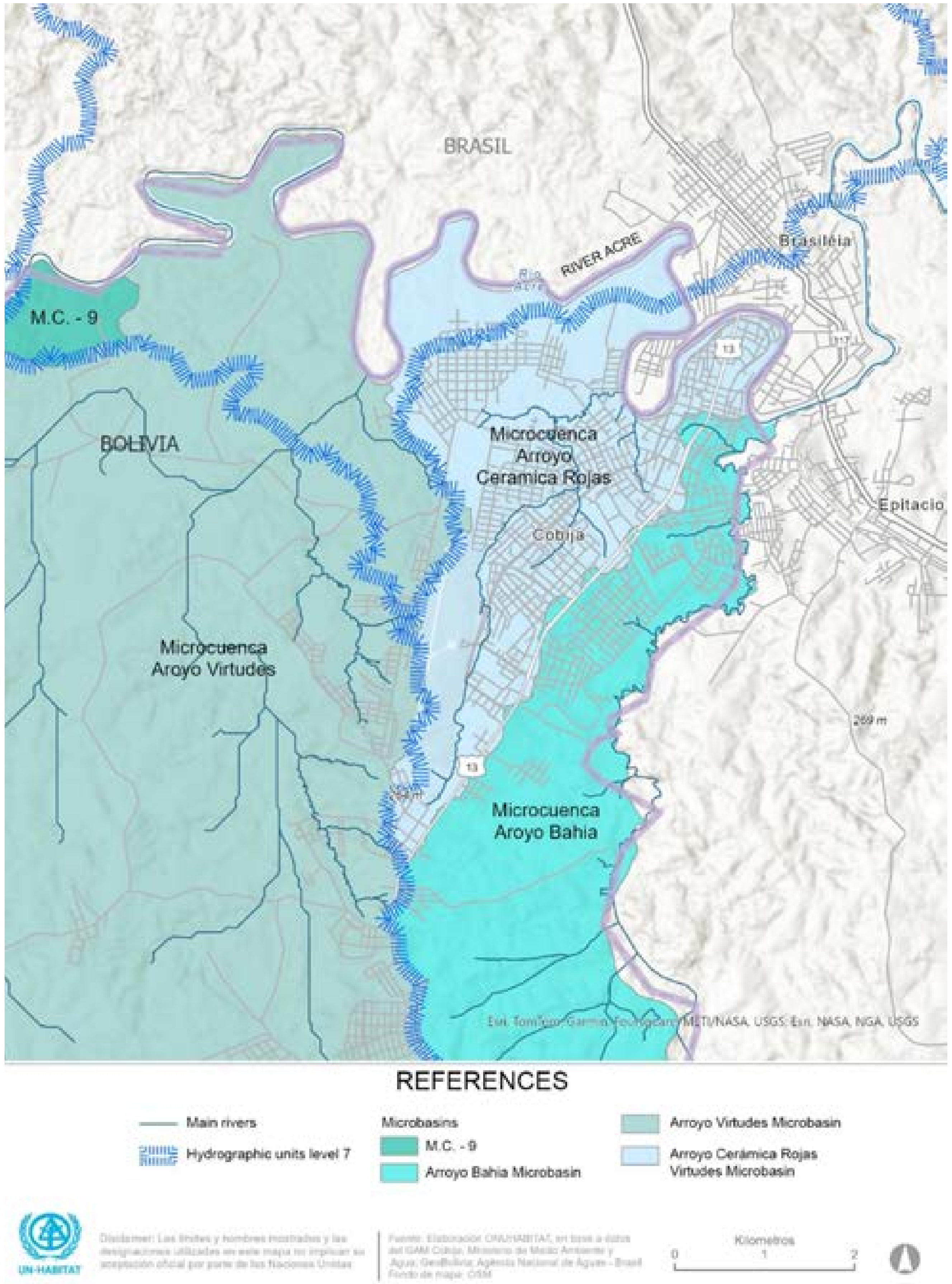


Fig. 7: Water basins in Cobija
Source: UN-Habitat, 2024.

Urbanization Trends

The accelerated and disorderly growth of the urban area has generated substantial problems in Cobija. There exists a very low demographic density of 3,283 inhabitants per square kilometer (National Institute of Statistics, 2012). The urban area is not compact nor efficient in its land use. As the Urban local agenda points out, this situation implies that there is a trend of real estate speculation and proliferation of disjointed informal settlements, inside and outside the urban radius, marked by the lack of access to land with adequate and balanced provision of urban services.

Urban zoning for construction within Cobija amounted to 0.4% between 2009 and 2018. That is, the speed of approvals is lower than the growth of the urban area. There is a need to organize, generate capacities and implement land management instruments that reverse this situation. With those changes comes the possibility of recovering urban capital gains and generating greater financial self-sufficiency within Cobija. Urban porosity in Cobija, which measures and compares the ratio of surfaces free of public use (without buildings) with respect to the surface covered by buildings, was 11.79% in 2019, far below the urban planning criterion of 50% free surface.

Cobija's "urban area" grew 4.6% between 2001 and 2012, particularly in the northwest and east of the city. The precariousness of urban occupation is also evident in consolidated urban land and in urban centralities of the city that have the potential to highlight socio-territorial vocations, especially in the old town, the central axis of the city.

Cobija's Urban Form Index score is 62.6, a moderate rating. The historic center has a better score compared to recently developed areas.

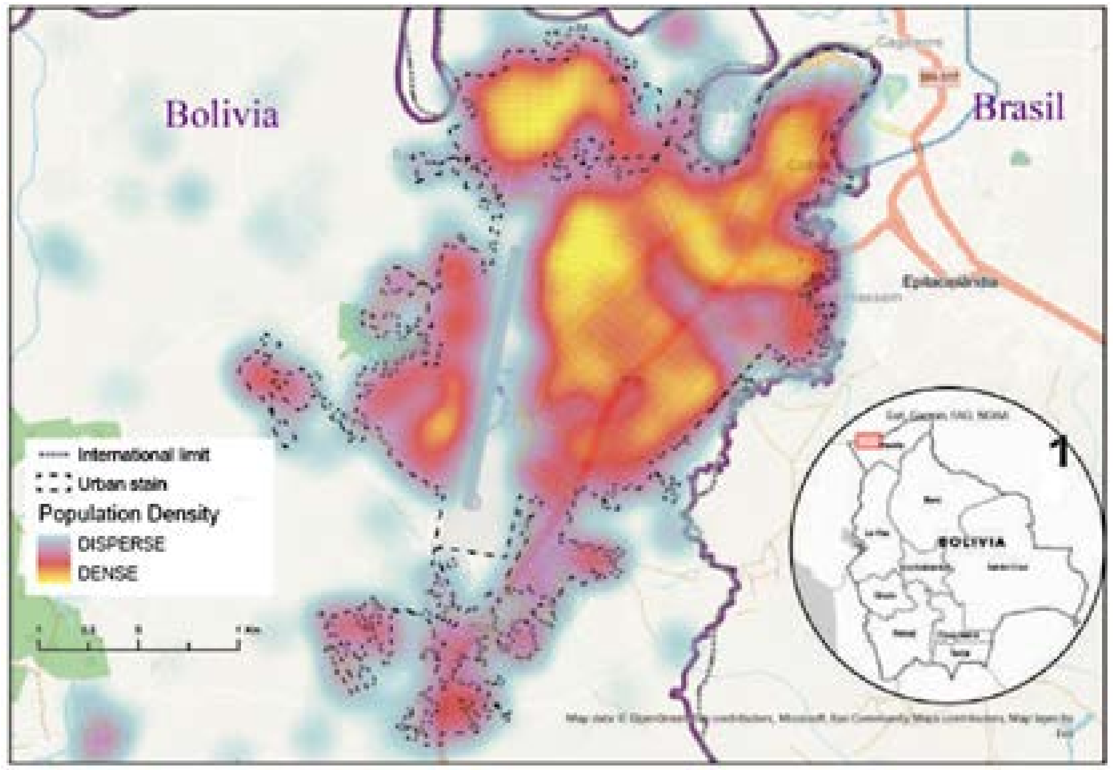


Fig. 8: Demographic density of Cobija
Source: Local Urban Agenda of Cobija

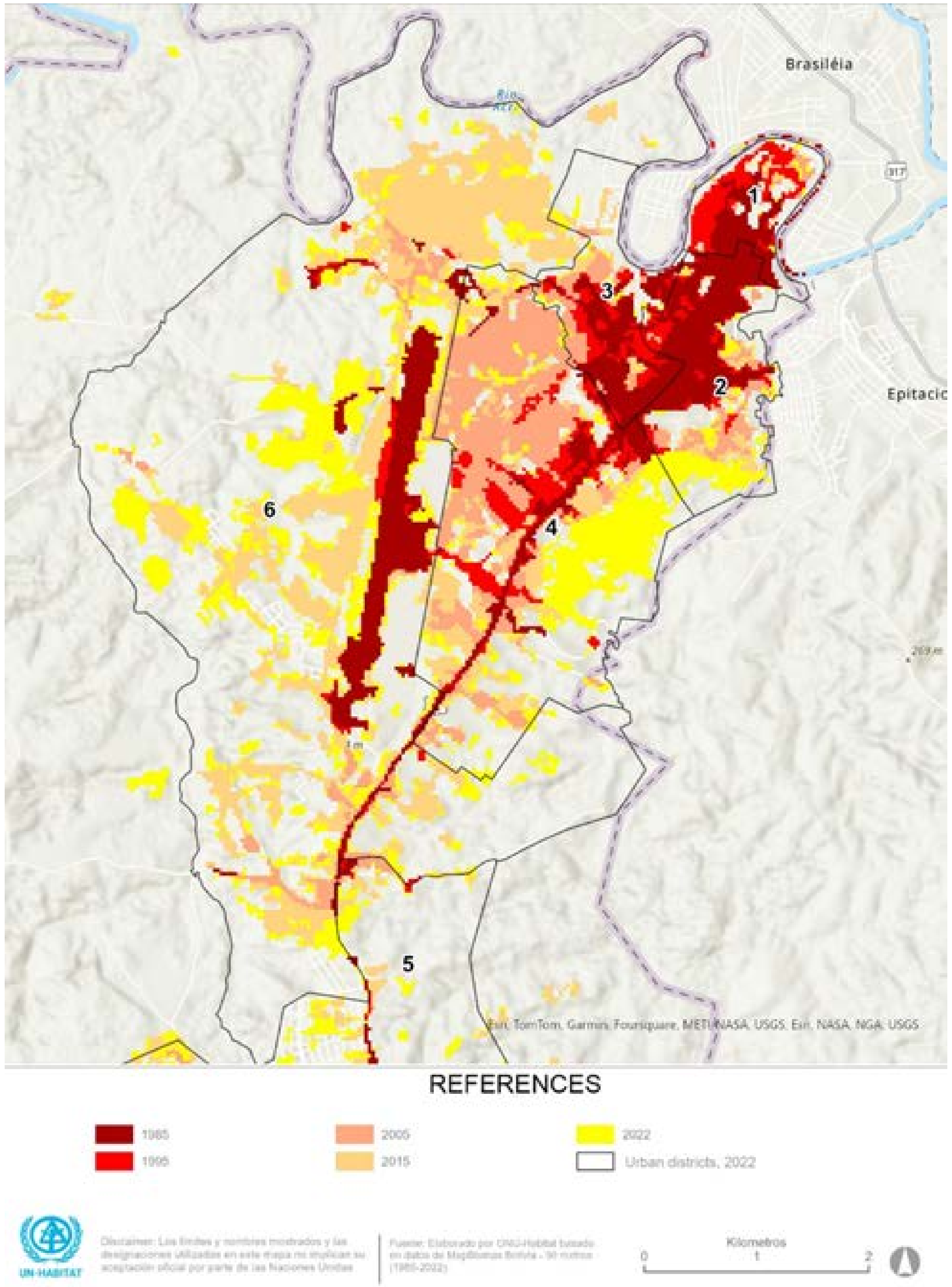


Fig. 9: Local Urban Agenda of Cobija
Source: Source: UN-Habitat

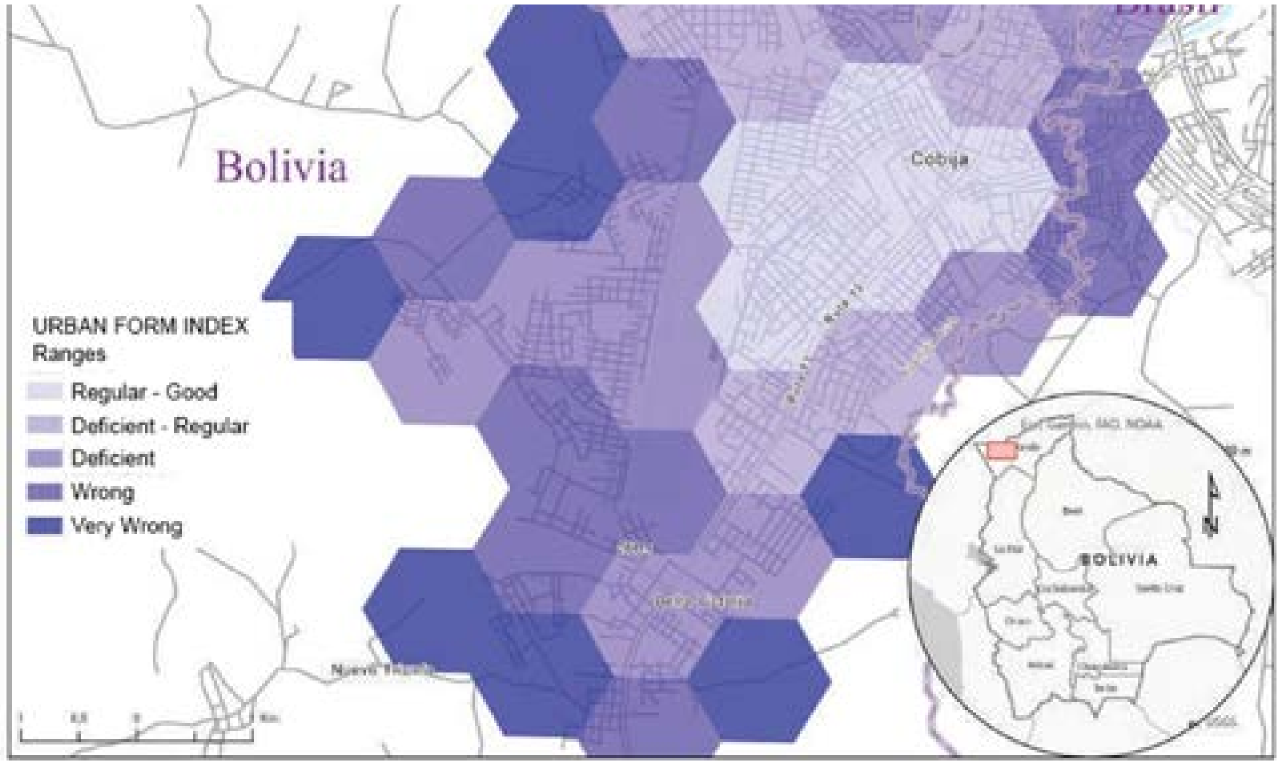


Fig. 10: City of Cobija Urban Form Index
Source: UN-Habitat Bolivia

Physical and Social Infrastructure Assets

The situation regarding basic sanitation and internet access in Cobija is critical. However, access to safe drinking water and electricity is stronger. But electricity costs remain high because it is disconnected from the National Integrated Electrical Energy System.

Regarding educational services, Cobija´s population that lives in peripheral areas experiences restrictions of access to innovative educational equipment that promotes quality learning, enhancing technical capabilities in line with a city with a large young population.

Cobija has 2.4 doctors per 1,000 inhabitants (UN-Habitat Bolivia, 2021a) and insufficient health infrastructure in operation, so the inhabitants prefer to receive care in neighboring Brazilian cities. The Santa Clara Health Center, though, stands out. There remains a need for youth-oriented services as Cobija has a high rate of youth pregnancy and a high mortality rate for children under 5 years old.

It is estimated that more than half of all roads in Cobija are gravel, leaving some impassable during the rainy season. Communities on the urban periphery are thus far more vulnerable to threats that damage roadways. Additionally, public transportation is monopolized by motorcycle taxis which, despite being a travel option according to the local context of Cobija, can become an unsustainable problem as the growth of the vehicle fleet increases. The affordability index for public transport among the population of Cobija stands at 35.4%. Additionally, traffic accidents account for 13% of the leading causes of disability in the municipality (INE, 2016).

Main urban facilities

In the current urban area of Cobija there is a deficit of public space in both quantity and quality. The accessibility index to public space is 46.6% (UN-Habitat Bolivia, 2021a). Additionally, it is perceived that the city is not friendly to pedestrians, a situation worse for people with disabilities and reduced mobility. The commercial use of public space typically occurs without a license by merchants. There is a rule (O.M. 27/2012) that allows merchants commercial use of public space for 3 months, but merchants often go beyond this.

Citizen insecurity is a recurring social concern. It entails alterations in the rules of coexistence, putting citizens at risk. Particularly at risk are populations in vulnerable situations. The public perception is that various factors influence the increase in citizen insecurity. Those factors include an absence of work opportunities, cultural development and forms of distraction particularly for adolescents and young people, lack of lighting in public spaces, abandonment of areas that become eventual shelters for criminals, streets and avenues without sidewalks and in poor condition, heavy vehicle traffic in pedestrian areas. It is evident that there are not large public spaces or parks. Despite the fact that Cobija is in the middle of the Amazon, there are few ways to enjoy it. The problem is clearly identified in the following map, which also describes unsafe areas.

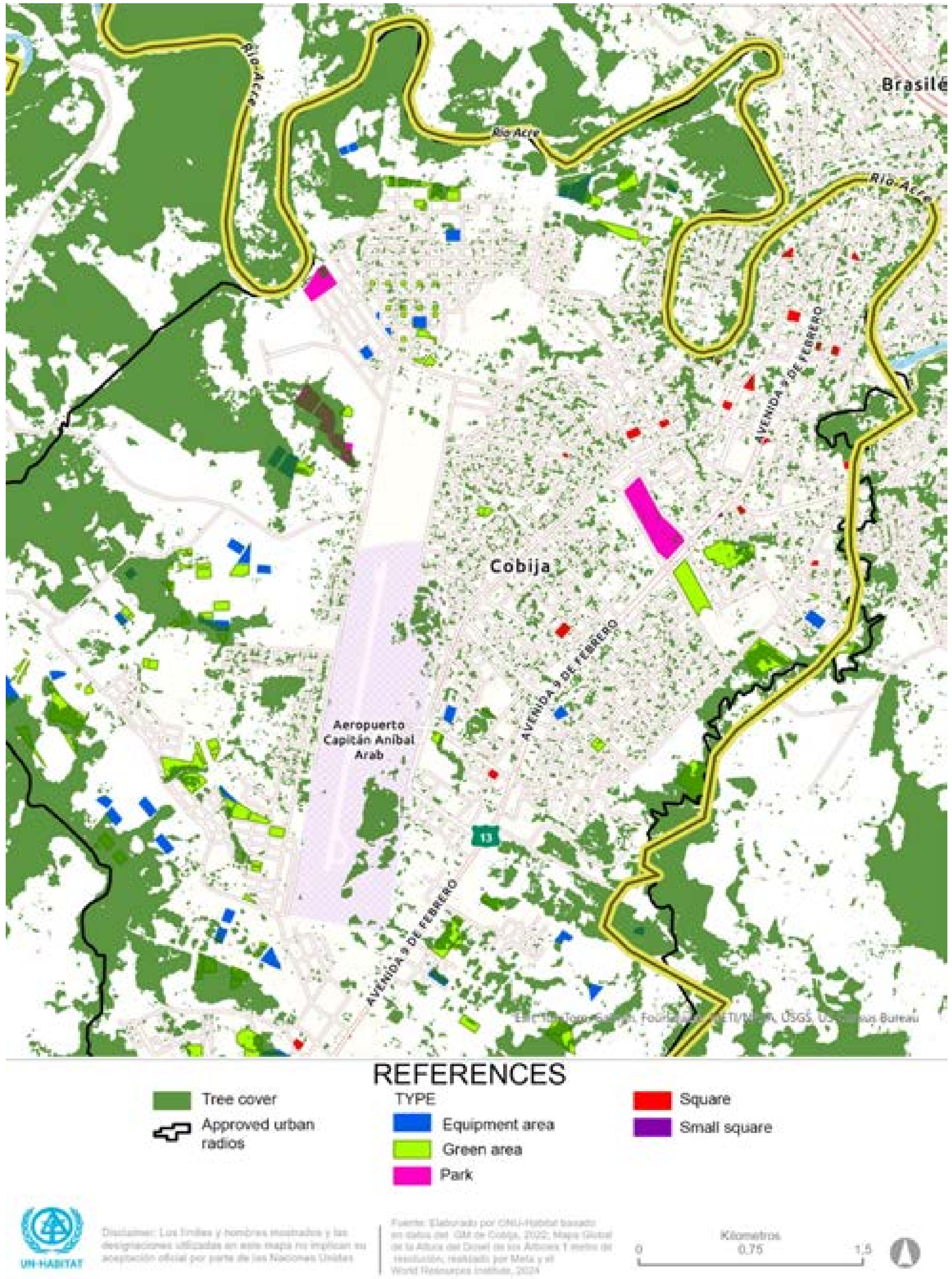


Fig. 11: Cobija´s Urban infrastructure
Source: UN-Habitat

Institutional and Policy Frameworks

The Plurinational State of Bolivia has adopted decentralization processes to give the 9 different departments autonomy to reach their own sustainable development.

The Political Constitution of the state is the maximum law in the country, defining the general agreements for the functioning of the state. Based on this, the most relevant laws for the definition and organization of the territory and the activities, environmental management and climate change carried out within it are:

- Law 1580 (1994). Approves and ratifies the Convention on Biological Diversity, signed by the Government of Bolivia on 06/10/1992 during the 1992 United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil.
- Law 031 – Framework Law of autonomies and decentralization "Andrés Ibáñez" (2010). Establishes competencies of the regional and municipal governments in the framework of their jurisdictions.
- Law 777 – Framework Law of Integral Planning System of the state (2015). This law aims to establish the Comprehensive State Planning System (SPIE), which conducts the planning process for the comprehensive development of the Plurinational State of Bolivia within the framework of "Living Well."
- • Law 300 – Framework Law of Mother Earth and Integral Development of Living Well (2012). This Law establishes the regulatory framework for the preservation of the environment (Mother Earth), guaranteeing the continuity of the regeneration capacity of the components and habitats.
- Law 1333 – Law of Environment (1992). The purpose of this Law is the protection and conservation of the environment and natural resources, regulating the actions of man in relation to nature and promoting sustainable development with the aim of improving the quality of life of the population.
- Law 602 – Law of Risk management (2014). Its objective is the institutional framework and regulations that govern risk management, which includes prevention, mitigation and recovery and attention to disasters or emergencies through preparation, alert, response and rehabilitation in the face of disaster risks caused by threats. Natural, socio-natural, technological and anthropic, as well as social, economic, physical and environmental vulnerabilities. The Law lists and defines the principles that govern risk management, which contemplate priority in care and priority care for vulnerable populations.
- Law 835 (2017). It ratifies the "Paris Agreement" that was adopted on December 12, 2015, during the Twenty-First Conference of the Parties (COP 21) of the "United Nations Convention on Climate Change".
- Policy Plurinational Climate Change (2016). Its objective is promoting the management of the climate crisis at all levels of state, which implies promoting mitigation, adaptation and resilience actions, as well as response measures to the impacts, damages and losses caused by said crisis, all of this within the framework of comprehensive development to "Live Well" in harmony with Mother Earth.

Within this regulatory framework, the municipality of Cobija has the PTDI 2020-2025. Other important municipal regulations related to the consultancy are:

- Autonomic Municipal Law 001/2022 – Transfer of municipal property located at Urb Castañal to 105 beneficiaries affected by natural disaster
- Acre River overflow.
- Autonomic Municipal Law 002/2022 – Regularization of Bella Vista urbanization.
- Autonomic Municipal Law 003/2022 – Risk Management in the Municipality of Cobija.
- Autonomic Municipal Law 004/2022 – Exceptional Regularization of amnesty for buildings outside of the law in the municipality of Cobija.
- Autonomic Municipal Law 005/2022 – Creation of Municipal Districts.
- Autonomic Municipal Law 008/2022 – Declaration of Natural Area of integral management called "Natural area of integral management of the river basin "Arroyo Bahía – ANGICAB".

Regarding risk management:

- Management plan of risks and climate change for Cobija 2022-2030.

Administratively, the municipality of Cobija is organized into 3 secretariats that include 11 directorates. The major one has 17 entities that directly depend upon it. Political control is exercised by the Municipal Council of Cobija, that has two advisors. Finally, there are 3 "deconcentrated areas" that are municipal entities. They are responsible for waste management and water.

02 METHODOLOGY

Approach and Methodology

The Multilayered Vulnerability Assessment (MVA) tool employs a three-stage methodology designed to help countries, cities, and communities effectively incorporate, adapt, and operationalize the assessment. This structured and phased approach facilitates improved resilience planning and decision-making. Each stage comprises specific steps and activities, outlined as follows:

Stage 1: Preparation. This stage focuses on establishing the groundwork for the MVA and the framework for the assessment process. Key contributors are identified, and relationships necessary for completing the MVA and analysis are established. This initial phase is crucial for ensuring that the assessment is comprehensive, well-organized, and aligned with the goals and objectives of the organization or community involved. Stage 1 consists of three steps (e.g., Step 1.1: Set up delivery team and steering committee; Step 1.2: Conduct rapid diagnostic of the city or urban area) and eight activities.

Stage 2: Mapping and Analysis. This stage involves sourcing and applying data to provide a detailed analysis of vulnerability hotspots within urban areas, examining factors related to climate change, biodiversity, and urban dimensions. The maps produced in this stage are key outputs of the MVA, allowing for the overlaying of outputs to identify and analyze areas of conflicting vulnerabilities and vulnerability hotspots. Stage 2 is articulated in five steps (e.g., Step 2.2: Data acquisition and collection; Step 2.3: Mapping historic, current, and future vulnerabilities; Step 2.5: Interpretation and analysis of vulnerability hotspots) and encompasses 19 activities.

Stage 3: Intervention Planning . In this final stage, the findings from Stage 2 are transformed into bankable projects aimed at enhancing resilience to current and future climate, urban, and biodiversity shocks and stresses. Collaborating with a diverse range of stakeholders, this stage involves developing 10 to 12 resilience-building actions that are both financially and technically feasible, addressing the intersecting vulnerabilities identified in the MVA. Stage 3 comprises three steps (e.g., Step 3.1: Visioning and objective setting; Step 3.2: Develop resilience action plans) and includes 12 activities.

The MVA provides a clear, phased methodology that guides countries, cities, and communities through effective resilience planning. The tool's three-stage approach—preparation, mapping and analysis, and intervention planning — provides a clear framework for systematically identifying urban vulnerabilities and transforming insights into actionable, bankable projects. This method ensures that resilience-building actions are well-targeted, feasible, and aligned with local priorities, making it a critical tool for addressing the complex challenges posed by climate change, urbanization, and biodiversity loss.

Customization to Local Context & tailoring to local context

The methodological framework was carefully customized to address Cobija's specific local conditions, considering both existing municipal resources and previously initiated planning efforts. Recognizing that Cobija is a small city with historically limited urban planning capacities and resource constraints, customization efforts focused on four key areas:

1. Recognition of Municipal Administration: Acknowledging municipal administration as a central actor in territorial planning, climate adaptation, and biodiversity conservation, ensuring their active participation and leadership throughout the process.

2. Engagement with Local Stakeholders: Understanding that territorial dynamics are inherently influenced by residents, the methodology emphasized collaboration with local communities, academia, non-governmental organizations, private sector entities, and various governmental levels (municipal, departmental, and national). A diverse institutional steering committee was established to guide the process, facilitate inclusive decision-making, and ensure broad stakeholder involvement. Workshops and surveys were conducted to gather primary data and inform the assessment.

3. International Collaboration and Knowledge Exchange: Promoting dialogue and knowledge exchange with international partners and stakeholders, particularly leveraging experiences from Spanish partners. Insights from these collaborations provided valuable methodological strategies and practical lessons for addressing local challenges effectively.

4. Addressing Data Gaps and Leveraging Global Datasets: Given the lack of accessible and accurate geospatial data and local information for the development of some indicators and the construction of maps, significant efforts were made to overcome data gaps. Primary data collection was prioritized through local surveys and stakeholder engagement.

Global datasets were also utilized to enhance assessment accuracy:

- Urban dimension: The Global Human Settlement Layer was used in the population density indicator development
- Climate change dimension: Landslide and fluvial flooding indicators used data from the Coalition for Disaster Resilient Infrastructure and Google Earth Engine; temperature change indicators were derived from Iowa State University's DataShare and WorldClim datasets.
- Biodiversity dimension: Mean Species Abundance (MSA) indicators utilized data from the Global Biodiversity Model for Policy Support (GLOBIO).
- Recognizing that quantitative information must be contrasted and validated by the actors, considerable efforts have been made to complement it with qualitative information collection mechanisms through a series of structured dialogues, community-based interviews with residents, local leaders, community organizations, and civil society, participatory vulnerability mapping, field-based data collection, site visits, and other methods.
- The methodology was adapted to accommodate the data limitations of Cobija, a small city with a historically weak planning culture and limited resources for urban development. To address these challenges, the project activities were supported by the following adaptations:
- The lack of available information was mitigated through primary data collection, including workshops and surveys.
- The approach began with an in-depth understanding of Cobija's unique context as binational frontier city located in the Amazon. A Steering Committee was formed, bringing together diverse institutions to contribute ideas and ensure broad stakeholder participation.
- On major challenge was accessing official data, as editable baseline information for the assessment was scarce.
- To overcome this, gathering firsthand information was prioritized, primarily through surveys of the local population. Additionally, an official UN-Habitat mission facilitated collaboration among the Steering Committee stakeholders. Community maps were collectively designed and social cartography was applied across the three dimensions: urbanization, climate change and biodiversity.

Geographic Scope

The geographic scope of the assessment has focused on the most flood-prone areas. The two selected areas are formed of five neighborhoods that were affected by flooding in February 2024. It is important to note that the selected areas were decided in coordination with the Autonomous Municipal Government of Cobija and the residents of the affected area. In addition, the selected areas were chosen to act as "quick wins," functioning as cases that would be the beginning of a more resilient Cobija based on pilot projects. The selected areas´ decision has the legitimacy of a participatory process adopted by the Steering Committee.

The hotspot area 1 is formed by the neighborhoods Mapajo, Puerto Alto, Junín and Villamontes. The hotspot area 2 is formed by the neighborhood Cataratas.

The five named neighborhoods are the oldest in Cobija, located close to where the city was founded.

Barrio Junín
Source: GAMC

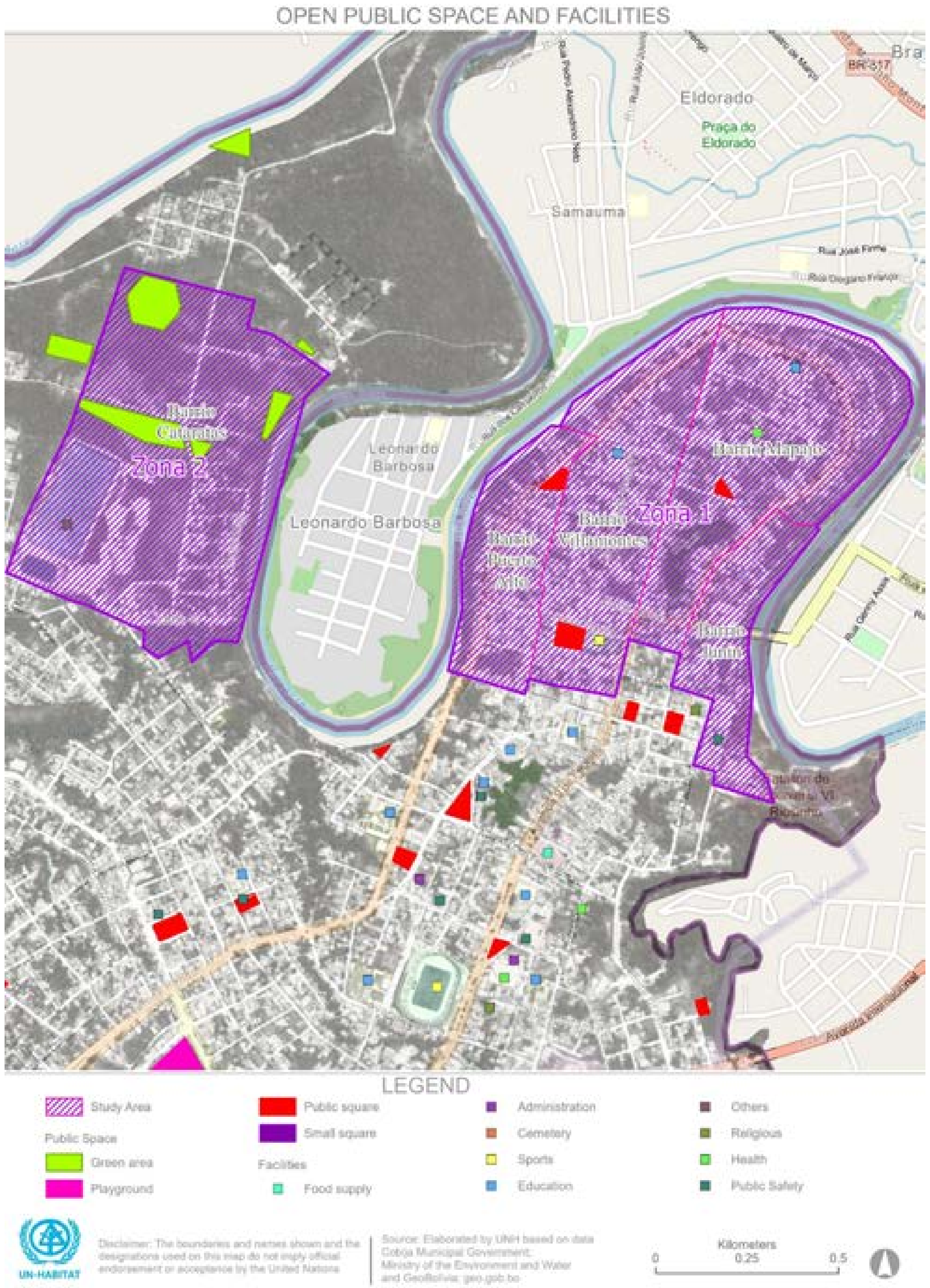


Fig. 12: Open and public spaces and facilities in the 2 study areas in Cobija
ource: UN-Habitat

03

VULNERABILITY DIMENSIONS

Climate risk, biodiversity loss and rapid urbanization are intrinsically linked. The following assessment provides an integrated analysis of current and future vulnerabilities related to climate change, urbanization and biodiversity for the city of Cobija..

Urban Dimension

The urban dimension of the Multilayered Vulnerability Assessment (MVA) for the city of Cobija encompasses a series of indicators that reveal the vulnerability of the city to the challenges of urbanization, population growth and socioeconomic pressures. This dimension reflects the complex interaction of factors such as population density, urban growth and poverty, which influence the capacity of the Municipality of Cobija to adapt to the pressures of urban growth and respond to the urgent risks of climate change.

Bolivia is undergoing a rapid urbanization, with 70% of its population now living in cities. UN-Habitat supported the development of the National Policy of Comprehensive Development of Cities, which was approved in 2024, following a participatory process involving 339 municipalities. At the national level, the government plays a key role in shaping policies and development strategies. The Ministry of Development Planning (MPD) coordinates between international donors, financial institutions, and governmental bodies to ensure that development projects are funded and implemented according to national priorities. The Vice Ministry of Housing and Urbanism (VMVU) oversees the planning of municipalities and urban policies. VMVU operates under the Ministry of Public Works, Services and Housing which, oversees major infrastructure projects such as housing, roads, railways, and airports.

At the local level, the Autonomous Municipal Governments (GAM´s) are responsible for planning their territories within their jurisdiction. The GAM of Cobija is the entity that, despite financial issues, has a mayor with strong leadership and who prioritizes sustainable urban development. Therefore, Cobija, with the support of UN-Habitat, was one of the first cities in the region to develop a Local Urban Agenda (LUAC). Cobija, as well as other Bolivian municipalities, has built its Territorial Plan of Comprehensive Development (PTDI), which has axes of development that ensure sustainable urban development.

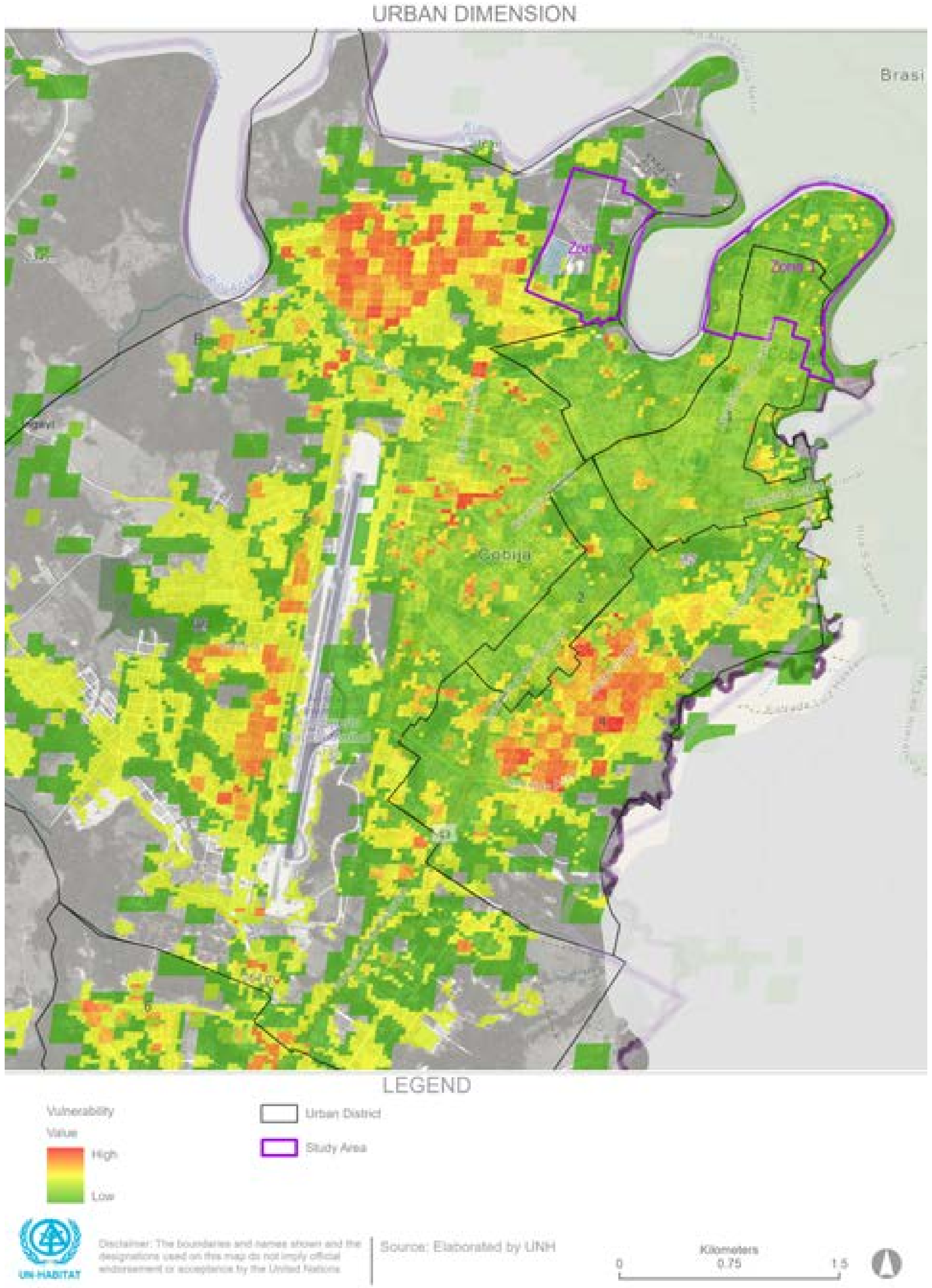
Cobija benefits from a small urban footprint, and a higher population density compared to other cities. As a result, infrastructure costs are lower, and residents have better access to public services. However, significant challenges persist, including weak governance and limited resources, which have led to a gap between the needs of inhabitants and the services currently available. Additionally, the enforcement of laws promoting sustainable development is insufficient, and tax revenue generation remains low. Addressing these issues is essential for advancing urban development reforms.

Indicators

Indicator 1: Population Density. This indicator was chosen to assess how population pressure influences urban growth, provision of and access to services and goods. High population density can exacerbate problems such as insufficient public services, housing, and income, among others, which contributes to increasing vulnerability. Understanding population distribution is key to planning future urban infrastructure and services and addressing the socioeconomic needs of residents.

High population density amplifies the vulnerability of cities and communities to the adverse impacts of climate change. Densely populated areas encounter challenges such as increased exposure to extreme weather events, overburdened infrastructure, limited green spaces, poor air quality, heightened heat stress, high concentrations of marginalised communities, and competition for basic services.

The population density indicator shows the number of people in a specific area. The indicator observation unit



is called a block, and covers approximately 100 x 100 m. To normalize the indicator, the maximum and minimum values of the records were used, in such a way that the result of the population density gradient for the city and the study area was obtained.

Indicator 2. Urban Growth. This indicator reflects changes in land cover and urban growth. Urbanization and urban growth are fundamental to understanding how the municipality of Cobija has expanded and transformed. A comparison of satellite images from 2005 and 2023 was made revealing increasing changes in size in urban coverage.

The spatial expansion of cities and the concentration of built-up infrastructure further exacerbate urban vulnerability. Rapid and extensive urbanization increases exposure to natural hazards, leading to the loss and fragmentation of natural ecosystems and biodiversity, and reduces the capacity of infrastructure to accommodate growing populations or withstand the impacts of climate change.

The indicator's limitation lies in its classification of urban growth horizontally rather than vertically. Vertical urban growth is a significant and important component of urban growth and is not counted here.

Indicator 3. Socioeconomic Vulnerability. This indicator captures the degree of exposure of the population to economic and social risks. It assesses disparities in income, employment and access to services, which are essential to understand how vulnerable populations can cope with different urban development scenarios.

At the same time socioeconomic vulnerability refers to the susceptibility of communities or populations to the adverse impacts of climate change, based on their social and economic characteristics. It is determined by various factors, including income levels, poverty rates, employment levels, education levels, access to healthcare, race/ethnicity, age, disability, and housing tenure.

In Bolivia, socioeconomic vulnerability is measured using the UBN index that measures unmet basic needs. This allows for the evaluation of the conditions of housing infrastructure, energy inputs, educational levels and health care of the population. The limitation of the indicator is that it uses data from 2012.

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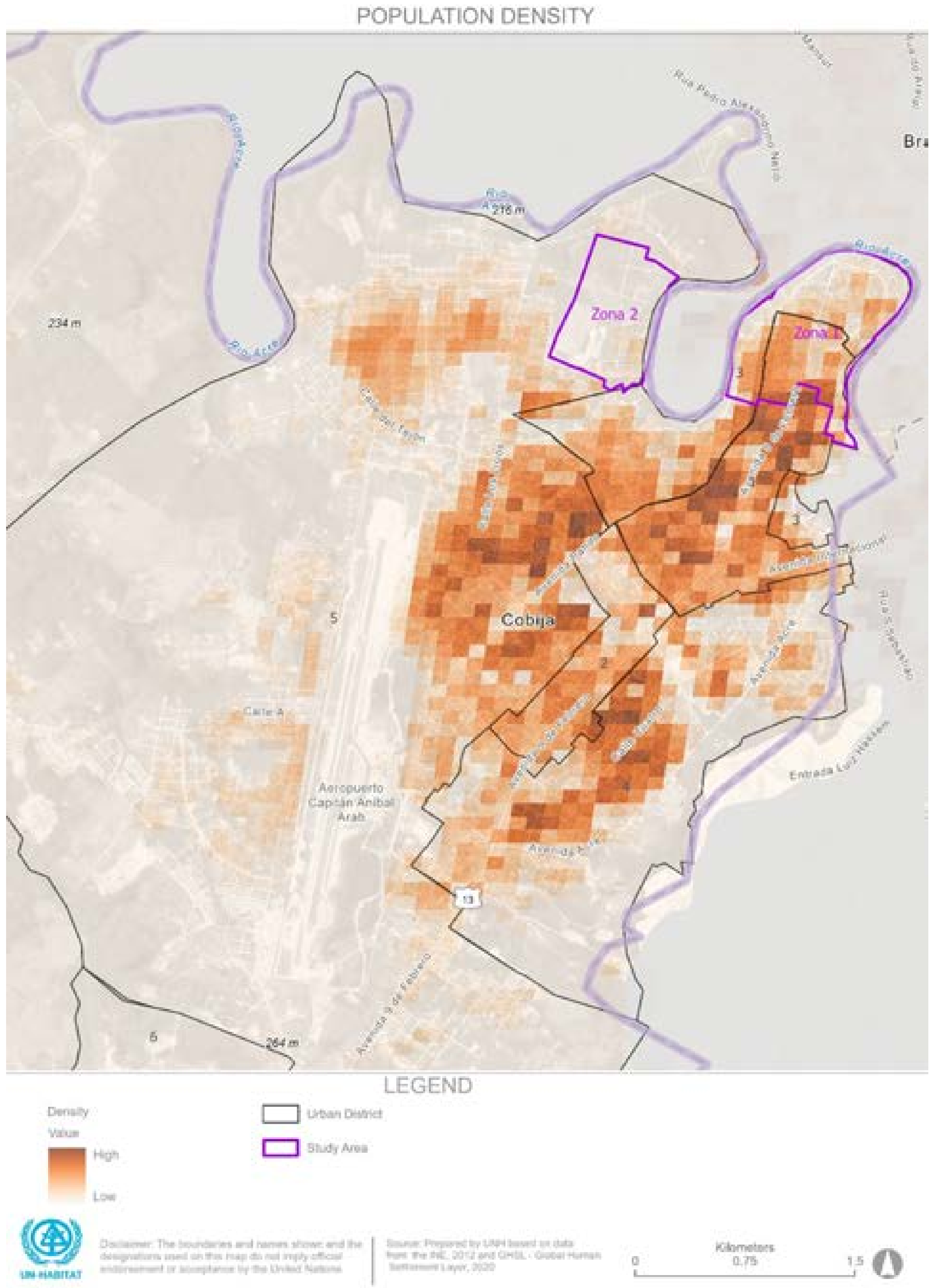

Fig. 13: Population density in Cobija
Source: UN-Habitat

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A number of areas in Cobija stand out as highly populated (Figure 13). In study area 1, Puerto Alto and Villamontes have greater density than Mapajo and Junín. Thus, Puerto Alto and Villamontes have a greater exposure to climate extremes such as flooding (as a higher number of people would be living in direct exposure to the hazard). In study area 2, the Cataratas neighborhood is among the least densely populated in Cobija. Areas of the city like this may have a lower exposure to the impacts of climate extremes. Densely populated areas of the city (such as Amistad, Perla del Acre, Primavera), also have higher concentrations of housing as well as infrastructure, including schools. Those neighborhoods have low density of households in terms of infrastructure water supply and sewage are covered but the garbage collection is deficient. With higher densities of housing, it is also likely that these areas have sacrificed green and open spaces which offer fundamental services to the residents including recreation, cooling, water absorption and supporting biodiversity. Without such spaces, residents are also more sensitive to climate hazards and therefore more vulnerable. In the case of Cobija´s outskirts, they are covered with informal settlements.

Family size is an important factor when assessing vulnerability, particularly in the context of socio-economic, environmental, and health-related challenges. The size and structure of a family can significantly influence its resilience or susceptibility to various risks. The family size in Cobija is 4.1 members, so it means that families are medium size in the town, so having fewer dependents, could reduce the economic burden on the household.

In the southern part of Cobija (an area that has been occupied by migrants) the size of families tends to be larger reaching 5 members as an average. That means that these families are more vulnerable as children and parents caring for children are more vulnerable.

As seen at Figure 13, neighborhoods located at the center (e.g. Barrio Belén) and southern part of Cobija (e.g. Urb. Bolivar) have the town´s most dense areas where the average of 5 members per family is present.

Regarding the priority areas of this project, the difference of density between study areas 1 and 2 could be explained by the fact that Cataratas is mainly inhabited by small families consisting of few members. In addition, the fieldwork showed that in Cataratas the quality of home construction is poor. Materials used to build houses consist mainly of wood, which does not allow vertical growth, thus inhibiting densification.

Indicator 2 – Urban growth

There has been significant urbanization in Cobija, with land conversion between 2005 and 2023. This trend has been observed across the city, particularly in the North, West and Eastern areas. According to the municipality, the city has grown in 34% in that period of time.

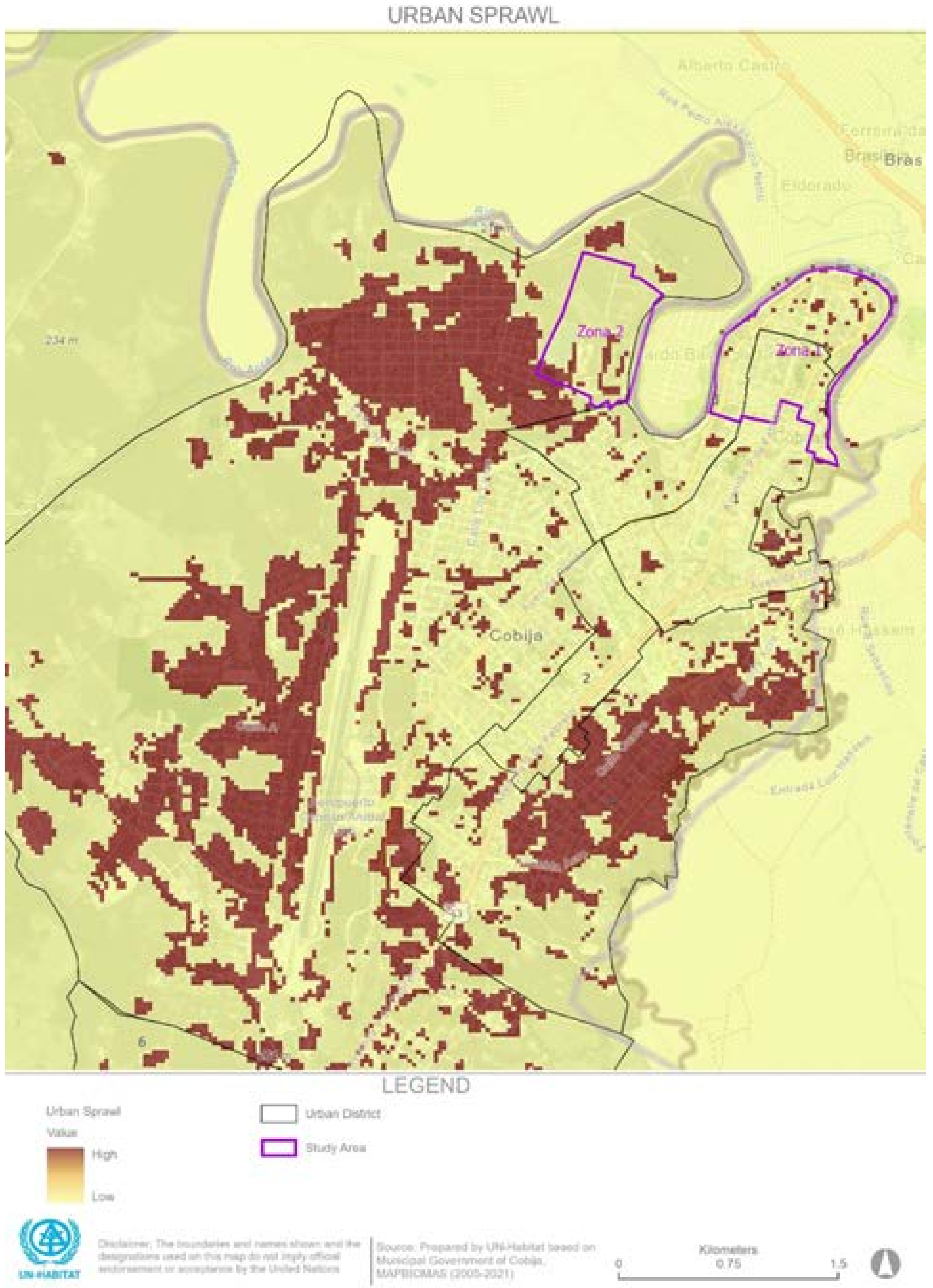


Fig. 14: Urban growth in Cobija
Source: UN-Habitat

The two study areas have experienced some limited urban growth during the period (Fig. 13). However, they lie in stark contrast with other parts of Cobija where there is rapid urbanization.

In the case of study area 2, the neighborhood of Cataratas, the urban growth is proportionally lower than in study area 1. In situ surveys from the area suggest that low urban growth may be caused by a lack of public services. It is also in an area prone to climate extremes.

The picture shows that urban growth has happened to the north-east part, and south-east and south-west in Cobija. That expansion has put pressure to public services provision and public infrastructure. That not adequate provision of services and infrastructure means that those "new" neighborhoods have more vulnerability.

Indicator 3 – Socioeconomic Vulnerability

Across Cobija there are areas which have a very high vulnerability in terms of unmet basic needs (representing socioeconomic vulnerability), these can be found firstly in the North-West of the city (Barrio Amistad), with other pockets found in some of the peripheries of the city for example 6 de Enero and dispersed across the central areas of Cobija. Based on the factors reviewed in this indicator (including overcrowding, sanitation, education, health care, dependency ratio), these areas have a very high socioeconomic vulnerability. Likely, these areas have a high number of dependents (children and elderly), lower education levels, lack access to some basic services including sanitation and have multiple occupants within houses. They have a higher poverty prevalence. As such, the residents will have lower adaptive capacity, and a higher sensitivity to climate hazards. With lower education they may have a lower awareness and understanding of hazards and actions which should be taken to minimize risks, they may lack the financial resources to invest in resilience activities (such as housing upgrades) and a higher number of dependents would decrease the motility of the population during hazards. The southern zone of Cobija has been populated by migrant population coming from other departments of Bolivia, specially from La Paz and Oruro.

According to the map, at municipal scale, Barrio Amistad and 6 de Enero are among the most vulnerable since they do not have adequate public services and both have problems as well as effective infrastructure. That factors make them more vulnerable in absolute terms. However, if we focus in the most affected neighborhoods during floods, they are located in study area 1 and 2.

Study area 1, which represents the oldest part of the city, receives the majority of services, including water distribution, electricity, and waste collection (Fig. 14). However, some infrastructure services are lacking, such as storm drainage which has always been deficient. Despite low vulnerabilities based on the socioeconomic vulnerability indicator, the area is often the worst affected during flood events.

Study area 2 is a more modern are than study area 1. Therefore, service availability is not as regular or reliable as for Study Area 1. For example, garbage collection is not as frequent in study area 1. In study area 2, the service is every two or three days.

Sewage systems are crucial during flood events for several reasons, as they play a key role in public health, safety, and disaster management. Flooding can overwhelm existing infrastructure, leading to various challenges that a properly functioning sewage system can help mitigate. Thus, surveys conducted at the two study areas have shown that every flood experienced by Cobija, has created that the sewage system of those neighborhoods collapses.

Access to housing, quality education and health services are concerns of the population. In Addition, the formal employment rate is significantly lower in Cobija and in Pando in general than elsewhere in Bolivia.

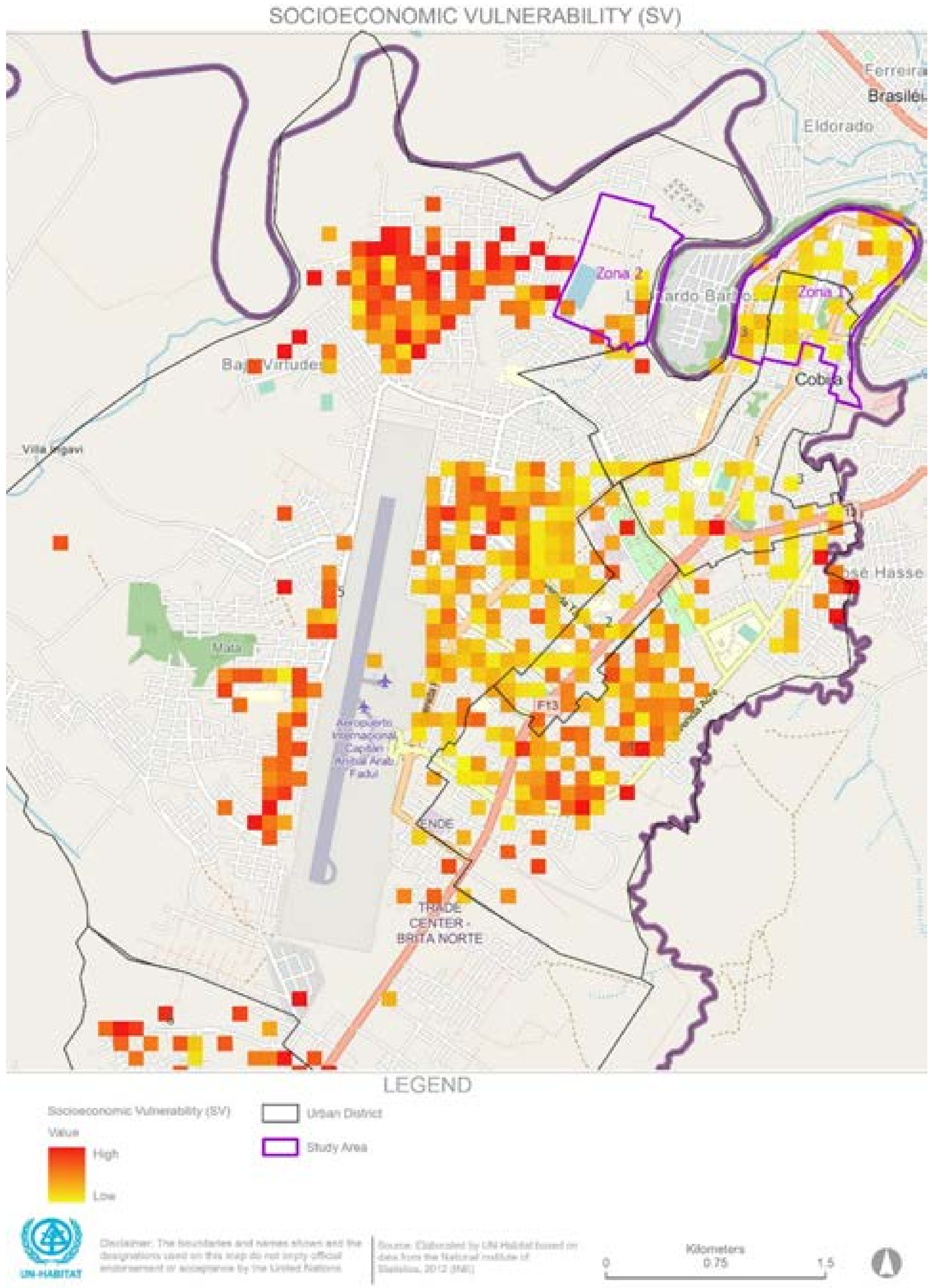


Fig. 15: Socioeconomic vulnerability in Cobija
Source: UN-Habitat

Urban Dimension Analysis

The following urban dimension analysis includes the 3 components of vulnerability: exposure, sensitivity and adaptive capacity.

Exposure

The analysis aims to identify how Cobija is currently affected by climate change and how it may be impacted in the future, particularly in urban areas.

Description of current and future changes

The city of Cobija is projected to experience changes in its climate that would affect urbanization. Rainfall would increase up to 26% in relation to current precipitation levels. Temperature is projected to increase by 3.7%.

Flooding is the primary climate hazard impacting urbanization in Cobija, particularly as the city expands southward away from the River Acre. Increased precipitation in the coming years will likely exacerbate flooding. These climate hazards can lead to biophysical effects, such as landslides in specific study areas, which could displace residents and alter the urban configuration and land use of neighborhoods. According to survey data, more than a dozen households are directly affected by landslides each year.

Identification of people, places, institutions and sectors that are exposed to climate hazards

The following table summarizes identification of climate hazards and exposed features and sectors.

Climate Change Hazard	Current Weather Data	Climate Scenario Projections	Impacts	Exposed features and sectors
Flooding/ Landslides	Annual Precipitation: 1,774 mm in the east to 1,834 mm in the west.	IADB projections: • Precipitation increase: 26% • Temperature increase: 3.7%	Displacement from households	Inhabitants of the neighborhoods Mapajo, Pto Villarroel, Junín, Villamontes and Cataratas
			Disruption of regular functioning of services and administrative tasks	Government institutions (Local, regional and branches from the national gov.)
			Disruption of health services	Health services and critical infrastructure
			Disruption of education services	Education institutions (University and schools)
	Temperature: Between 25.5ºC and 26.8ºC. Extreme maximum temperatures reach 38ºC.		Reduced supply of products and foodstuffs	Stores, markets and restaurants
			Reduced garbage collection, etc.	Public services
			Closing	Banks, offices, etc.

Table 2: Identification of climate hazards and exposed features and sectors for urban dimension
Source: Own elaboration

Fig. 16: Cobija´s flood affected zone in 2024
Source: UN-habitat elaboration in base of Herencia map

Figure 16 displays the extent of flooding in Cobija during an intense storm in February 2024. Several of the study sites were affected.

Sensitivity

The objective of the sensitivity analysis is to identify how people, places, institutions, and sectors in Cobija are susceptible to the impacts of climate change in its urban dimension, as well as the extent of potential future impacts. Four key considerations are considered: demographics, housing, welfare and human development, and production and investment.

Demographic

Regarding gender, the latest National Population and Housing Census (CNPV, 2012) reports that the Municipality of Cobija has a population of 46,267, comprising 23,978 men (51.83%) and 22,289 women (48.17%). The population is growing at a rate of 6.5% per year, with most residents concentrated in urban areas.

In terms of age distribution, 33.16% of the population are children (aged 0-14), while 4.43% are elderly individuals (aged 60-99). Together, these groups represent 37.59% of Cobija's total population. This means that out of every ten people, four are dependents. Children and the elderly are more sensitive to climate hazards as they have a higher susceptibility to heat-related illnesses and respiratory issues, and greater dependence on caregivers for protection and emergency response.

Regarding literacy, Cobija has a literacy rate of 98.9% for residents aged 15 and older. The rate is 99.3% for men, 98.4% for women, and 98.9% overall.

In terms of education levels, 20.5% of the population has completed primary school, 44.33% has completed secondary school, and 33.57% has obtained higher education levels.

When examining economically active household members, 99.36% of those interviewed are engaged in some form of work. However, 17.83% of these individuals work at home, often without pay. Therefore, we can conclude that 82.17% of working household members would likely face income loss in the event of a disaster. Unemployed people are more vulnerable because they lack the resources and financial means to prepare for and recover from hazards and likely lack access to some basic services.

Informal workers that as stated before are the vast majority in Cobija´s work force can be considered even more sensitive since they lack of security of income and insurance and other benefits that formal labor force has.

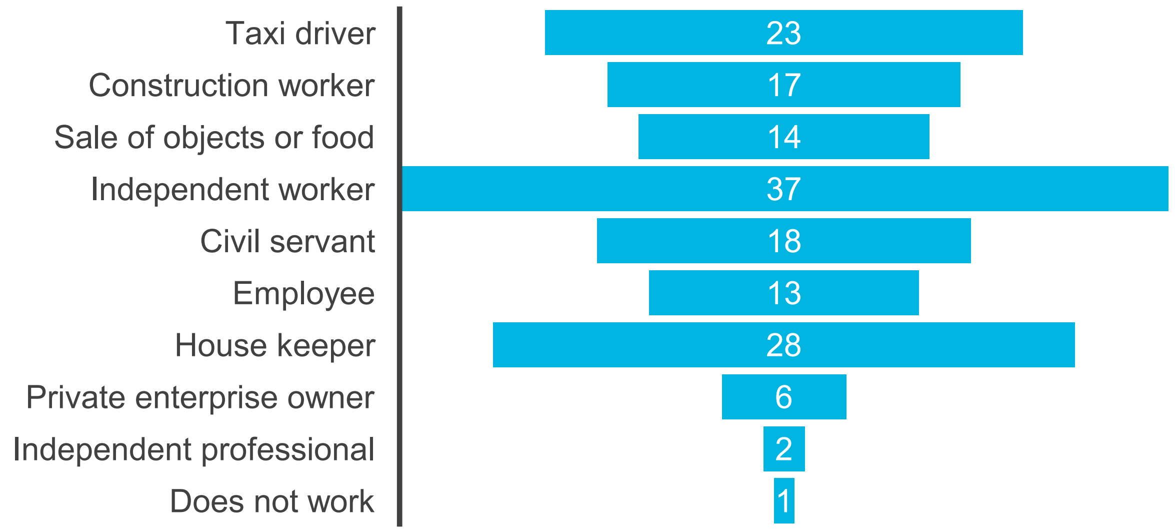


Fig. 17: Number of Housing Units with poor quality and their per centage relation to total housing 2005-2024

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
Demographics	Gender	The male population in Cobija may be more at risk from certain climate change impacts, particularly those related to economic vulnerability (such as agriculture and resource extraction) and physical labor (e.g., heat stress). However, gender alone does not determine sensitivity to climate change. The level of vulnerability depends on a combination of social roles, access to resources, health risks, and economic activities. Both men and women may face unique challenges depending on their roles in the community, with women being more vulnerable in certain areas (e.g., water collection, caregiving) and men being more vulnerable in others (e.g., agriculture, physical labor). Addressing gender-sensitive climate adaptation strategies that account for these different vulnerabilities is crucial for ensuring resilience in the face of climate change.
	Proportion of children and elderly	Cobija´s population is mainly young. Thus, people under 15 years old are more vulnerable. Elderly people are also a group of society that is particularly vulnerable.
	Household literacy	Household literacy plays a critical role in shaping how families in Cobija respond to climate change. Literate households are generally better equipped to adapt to climate-related challenges due to increased access to information, better resource management, and greater participation in adaptation strategies. They are more likely to engage in sustainable practices, diversity their livelihoods, and respond effectively to climate risks. In contrast, illiterate households may struggle to access vital information and resources, making them more vulnerable to the socio-economic impacts of climate change.
	Education levels	Educational levels significantly affect socio-economic sensitivity to climate change in Cobija. Households with higher levels of education are generally more resilient and adaptable to climate impacts due to their ability to access information, make informed decisions, adopt adaptive strategies, and diversify income sources. On the other hand, households with lower educational attainment may have more difficulty responding to climate risks, which increases their vulnerability. It is an advantage that educational levels in Cobija are higher than the national average.

Table 3: Socio-economic sensitivity variables (Demographics) for urban dimension
Source: Own elaboration

Housing

Regarding housing materials, 48.4% of respondents from the surveyed households reported that their homes are constructed entirely of wood. 30.1% are made of bricks and cement, and 21.5% are built with a mix of materials (wood and bricks).

In terms of housing conditions, most households (72%) are in fair condition, although all interviewees agree that regular maintenance is needed.

For access to bathrooms, only 45.2% of households have a bathroom connected directly to the sewage system. Additionally, 25.8% have bathrooms connected to a septic tank, 21.5% use a blind well, and 2.15% have bathrooms with pipes that direct waste to the river.

Regarding the number of occupants, 24% of households have four residents, 22% house five, 15% contain six, 11% have three, 10% are occupied by seven, 6% by eight, 5% by two, and 3% of households are home to only one person (Fig. 18).

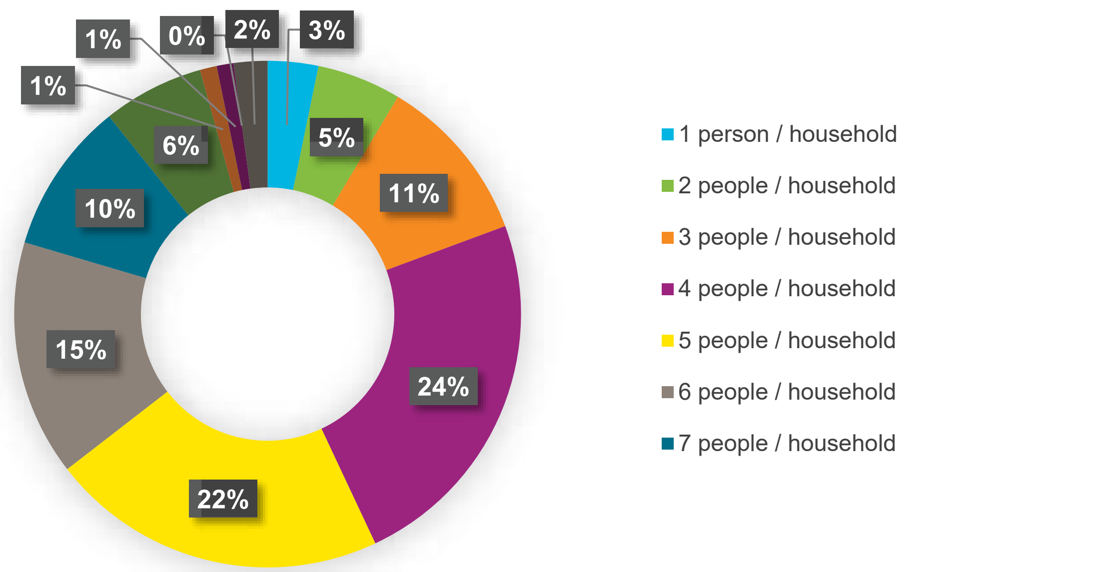


Fig. 18: Households occupants
Source: Own elaboration

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
Housing	Materials	In the study, 30.1% of households have walls made of bricks, 48.4% are constructed from wood, and 21.5% use a combination of wood and bricks. Additionally, 78% of households have roofs made of calamine. In Area 2, the building materials are generally more precarious, with wood being the predominant material used. In contrast, Area 1 primarily features homes made of bricks, which appear to be more resistant and durable.
	Condition	Most households (72%) are in fair condition, although all interviewees agree that more regular maintenance is necessary. Additionally, only 45.2% of households have a bathroom connected directly to the sewage system.
	Number of occupants	24% of the households have 4 people; 22% have 5 people; 15% 6 people living there, etc.

Table 4: Socio-economic sensitivity variables (Housing) for urban dimension
Source: Own elaboration

Welfare and human development

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
Welfare and human development	Average income (per capita or household)	The average income in Cobija is Bs. 3,294 (USD 473), which is 8.5% lower than the national average of USD 517. As a result, the residents of Cobija are poorer than the national average and, consequently, more sensitive to climate hazards.
	Life expectancy at birth	The average life expectancy in Cobija is 80.6 years, compared to the national average of 67.4 years. This means that residents of Cobija can expect to live 13 years longer than the national average. As a result, older individuals may have better incomes or more savings, which can help them live with reduced vulnerability. There are more elderly people who are more sensitive to climate hazards.
	Literacy rates (as proxy measure)	The literacy rate in Cobija is 98.9%, surpassing the national average of 93.85%. This higher literacy rate indicates that the residents of Cobija have a better awareness of risks, preventive measures to take and to recover more quickly from shocks.

Table 5: Socio-economic sensitivity variables (Welfare and human development) for urban dimension
Source: Own elaboration

Production and investment

The following table shows considerations between land-use areas (Residential; Commercial; Industrial; Commercial; and Infrastructure) and land values.

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
Production and investment	Land-use areas residential, commercial, industrial, Infrastructure	Area 1 includes mixed-use land, with residential and commercial uses being the most prevalent. Additionally, the area features various government institutions, offices (such as banks), and numerous stores and markets. In contrast, Area 2 primarily consists of residential land, with only a small number of commercial activities present.

Table 6: Socio-economic sensitivity variables (Production and investment) for urban dimension
Source: Own elaboration

Fig. 19: Percentages of affected neighbourhoods of the study areas towards flooding
Source: Own elaboration based in Herencia information

To summarize the findings expressed at the previous tables, we can conclude the following

- The most sensitive to the variables are vulnerable groups of society (Elderly, people with disability, children)
- Places that are sensitive are scattered throughout of Cobija, however none of them have are more exposed to floods than Cataratas and Mapajo. However, if we agree that the factors that make a place sensitive include: a) Poor quality of housing and/ or infrastructure; b) Lack of green spaces or depleted ecosystems; and c) Demographics factors (poverty, age, gender, migrants etc.), it is clear that Cobija as a town is having sensitive areas in the central and southern zones, that even though they are not the selected areas of this project, they need attention and can be considered in sub sequent phases.
- Institutions that are the most sensitive are: Regional and local Government, since their facilities are located at sites near to floods.
- The sectors that are the most sensitive are: Education and health.

Coping capacity

The goal is to understand the capacities people, places, institutions, and sectors in Cobija have to adapt to, prepare for and recover from climate hazards and impacts within its urban context. The city's ability to respond to specific climate change effects depends on its level of awareness, knowledge, resources, and skills.

City plans and policies to adapt to climate hazards

According to Cobija's risk management and climate change adaptation plan, the vision is clear: "Resilient town, with adaptation and mitigation mechanisms to change climate, which comprehensively manages risk and its environment, is a municipality organized, coordinated, inclusive, planned, progressive, self-sustainable, safe, committed, with high quality and standard of living its citizens and with safe environments (…)". The strategic lines of the mentioned plan are as follows.

N°	STRATEGIC LINES	OBJECTIVE
LE1	Territorial development	Integrate the climate change scenario as a variable of the determinants of territorial planning for vulnerable sectors and areas
LE2	Water security	Ensure the provision of water in quantity and quality for human consumption and irrigation throughout the municipality of Cobija
LE3	Food safety	Promote the improvement and productive sustainability, by strengthening the food security of the population of the municipality of Cobija in its dimensions of access and availability, so that the family can have local and imported foods to improve the diet.
LE4	Education	Implement a management model to build capacities in the face of threat, vulnerability and the level of exposure of educational units.
LE5	Environmental health	Promote and strengthen environmental health as a preventive measure against climate and bio sanitary risks.
LE6	Sustainable Forests	Implement management models for urban and rural forests, which allow their protection, conservation and management, which allow them to strengthen their ecosystem and social functions.
LE7	Sustainable agricultural and forestry systems	Implement sustainable agricultural and forestry systems that are in harmony with the biodiversity of the Amazon and that are adapted and resilient to the effects of climate change and that guarantee sustainable production.
LE8	Sustainable construction	Develop a set of eco -efficiency actions in construction that guarantee the efficient use and sustainable use of resources and improve the quality of life
LE9	Urban ecologic corridors	Implement urban corridors that allow us to strengthen the ecological connection with the Amazon and maximize the ecosystem functions of urban vegetation.
LE10	Comprehensive solid waste management	Generate a minimum amount of RRSS through its comprehensive management, supported by responsible production and consumption, promotion of separation at the source of origin and recycling
LE11	Energetic efficiency	Reduce energy consumption by implementing efficient systems
LE12	Sustainable mobility	Reduce the emission of greenhouse gases by promoting the use of bicycles and the construction of bicycle lanes in the city's green corridors.
LE13	Preparation and response to emergencies due to climatic and anthropic events	Prepare the urban and rural population, prioritizing the vulnerable population, to face emergencies and reduce the negative impact of climatic events that occur in the Municipality of Cobija.
LE14	Prevention and risk reduction considering climatic and anthropic events	Prevent and reduce climate risk with sustainable management actions of natural resources and protection of the vulnerable population, with the participation and benefit of the local population.
LE15	Research, technology and information for risk management and climate change	Use and revalue appropriate technology and research in Risk Management and Climate Change to reduce the negative impact of climate risks in the municipality, with the participation and benefit of different organized groups of civil society for adequate and timely decision-making. participatory.
LE16	Institutional, local strengthening and social participation	Strengthen the institutionality of the GAMC and social participation, which allows the development of mechanisms of co-responsibility, appropriation, promotion of behavioral changes towards sustainable practices to face the risk and negative effects of climate change.

Table 7: Cobija´s strategic lines of the Plan of Risk management and climate change adaptation
Source: Own elaboration in base of the disaster management and climate change adaptation plan

Respond to extreme climate events and disasters

In the case of flooding, one of the most dangerous hazards associated with climate change, is the limited response from the Municipal Government of Cobija (GAMC). The lack of equipment and human resources is a recurring challenge. Consequently, local authorities often require assistance from the national government to manage these risks.

According to residents, the major flooding events in 2006 and 2015 necessitated support from authorities in La Paz, as Cobija lacked the capacity to effectively plan for and respond to these disasters.

The 2024 flooding event in Cobija, Bolivia, was a catastrophic disaster caused by torrential rainfall that led to the Acre River exceeding its historical maximum of 17 meters. This triggered severe flooding, affecting 16 urban sectors and 3 rural communities – Bajo Acre, Bajo Virtudes, and Velmonte – resulting in the displacement of at least 3,710 people. On 28 February, the municipal government declared a disaster situation, which was followed by the declaration of a Flood Emergency by the

Departmental Government of Pando on 29 February. Emergency response efforts were swiftly mobilized, with 279 military personnel deployed for rescue operations, cleaning homes, and restoring infrastructure. As water levels gradually receded in March, residents began to return, but local authorities continued their recovery efforts, focusing on reconstruction, sanitation, and the prevention of waterborne diseases. The flood highlighted the need for enhanced flood management strategies to protect Cobija's vulnerable communities from future events.

The 2024 flood in Cobija not only demonstrated the devastating impacts of heavy rainfall but also exposed the municipality's low adaptive capacity to respond effectively. The severity of the flooding overwhelmed the region's inadequate infrastructure and flood management systems, revealing critical gaps in preparedness. The municipality lacked essential early warning systems (EWS), sufficient machinery to manage the floodwaters, and enough trained personnel to execute an effective response. Furthermore, there was a severe shortage of financial resources to address the immediate crisis and support long-term recovery efforts. These deficiencies severely hindered the municipality's ability to manage the disaster, leaving communities vulnerable and underscoring the urgent need for improved disaster preparedness, infrastructure development, and capacity-building for future flood events.

Fig. 20: 2024 Flood in Cobija´s northern part
Source: GAMC

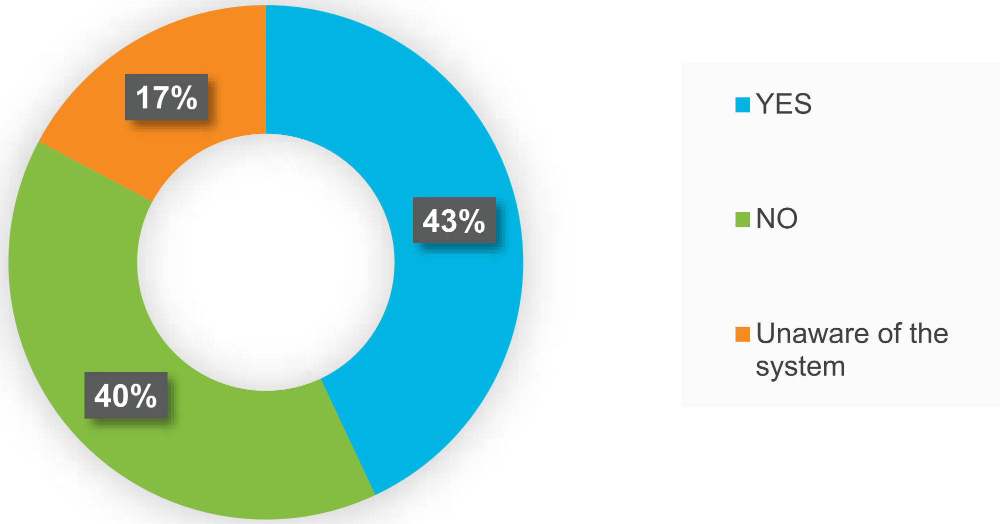


Fig. 21: 2024 Flood in Cobija´s northern part
Source: GAMC

Determinant	Description	Relation to climate vulnerability	Status in Cobija
Economic wealth and financial capital	Municipal financial resources, resident incomes and wealth distribution, economic marginalization, fiscal incentives for climate risk management.	Climate change adaptation with internal funding or external support	Currently, the city of Cobija is facing a lack of economic resources, which hampers its ability to implement measures for resilience against climate change hazards. However, Cobija does have a Local Urban Agenda that outlines a critical path of programs and projects for sustainable urban planning. These initiatives require funding to be realized.
Access to information and technology	Communication networks, computing tools, freedom of expression, technology transfer and data exchange	Technical data, data modelling capability, sharing and distribution information to Climate change adaptation	Cobija's higher education institution is the Amazonian University of Pando, which offers programs in engineering and architecture. While there is no specific degree in urban planning, urbanism is included in the architecture curriculum. The university emphasizes the importance of data management and modeling, requiring students to use GIS resources and software. The Municipal Government of Cobija (GAMC) has access to open data related to climate change through its collaboration with SENHAMI; however, it lacks access to real-time information.

Material resources and infrastructure	Transport, water infrastructure, buildings, sanitation, energy supply and management	Designed, constructed, sited, and managed infrastructure and services to be more adaptable or easier to adapt to climate change impacts and risks	Urban infrastructure in Cobija has not been designed with resilience in mind, making transport, sanitation, and energy supply systems particularly vulnerable during disasters. As a result, these infrastructures are often heavily impacted when such events occur.
Human resources and capacity	Knowledge (scientific, "local," technical, political), education levels, labor.	Scientific understanding and knowledge, local knowledge, and human resources to undertake climate change planning work.	There is a lack of effective integration of risk management into urban planning in Cobija. Additionally, there is a shortage of trained professionals in risk and climate change management. These individuals require training to effectively address climate change hazards.
Organizational and social capital	State-civil society relations, non-governmental and community-based organizations, relationships between institutions.	Stakeholders (government, non-government, vulnerable groups, etc.) that work together.	A distinctive feature of Cobija is the increasing presence of several NGOs. Both national and international organizations are focusing their efforts on the Amazon, using Cobija as a base for their activities. In Cobija, 30.9% of the population is considered poor, compared to the national average of 36.6% in Bolivia. This suggests that, in absolute terms, residents of Cobija have more individual resources to cope with climate change hazards.
	Modes of governance, leadership, participation, decision and management capacity.	Functioning local government that is capable and willing to enforce municipal laws, plans and regulations.	The mayor of Cobija is a proactive leader focused on enhancing capacity building within her team, encouraging civil servants to collaborate for better urban planning outcomes. Additionally, the Municipal Government of Cobija (GAMC) is developing regulations related to sustainable urban planning.

Table 8: Determinants of adaptive capacity and their relation to climate vulnerability for urban dimension
Source: UN-Habitat. 2025.

Urban Future Vulnerabilities

According to the Local Urban Agenda for Cobija (LUAC), the city is expected to expand to the south, there land is far more available and is not as burdened by the threat of climate change. In terms of densification it will occur in established areas and revitalization in historic locations, such as the Central Business District (CBD). The plan envisions the emergence of at least four new urban centers to stimulate development in various parts of Cobija.

One key recommendation from UN-Habitat that the city has adopted is the implementation of comprehensive urban interventions, encompassing 14 selected projects aimed at improving the quality of life in Cobija. In the two intervention areas of this assessment, two primary activities have been identified: i) Comprehensive risk management related to flooding, and ii) Regeneration and revitalization of established areas.

The Urban Development Plan (PTDI) highlights 20 axes of development, with a focus on sustainable environmental development and risk management. Regarding sustainable development, the plan states:

"Develop and preserve the environment in the municipality of Cobija by strengthening the environmental unit responsible for monitoring, controlling, and tracking sources of environmental pollution, as well as certifying economic activities and promoting good environmental practices."

In terms of risk management, the plan emphasizes:

"Municipal management should reduce vulnerability by promoting early warning systems that are integrated into the national system."

Focusing on the selected areas, it is clear that rapid urbanization trends may exacerbate flooding risks from the River Acre, particularly affecting the two areas assessed. Therefore, proactive measures are necessary to mitigate impacts on residents. Cobija's Local Urban Agenda indicates that growth should logically occur to the south, based on accessibility, new services, and urbanization trends. This would result in a decrease in population density in Areas 1 and 2, presenting an opportunity to repurpose land for public spaces or other uses.

It is understood that residents of the five study neighborhoods may consider relocating to more secure areas of Cobija, provided that new housing locations and conditions meet their needs for service access and security of tenure. GAMC is exploring this relocation option with community participation. According to GAMC, the best approach would involve collaboration with AEVIVIENDA, the national agency responsible for social housing provision.

Due to flooding, the older neighborhoods of Cobija are not growing vertically, hindering densification processes. As a result, the CBD is not attracting new activities, leading to only modest growth and the potential for new urban centers to develop in other parts of the city. The southern part if Cobija has grown because around ten thousand of migrants from the western part of Bolivia have come to Cobija in the last 20 years, searching for opportunities.

The average life expectancy in Cobija is 80.6 years, compared to the national average of 67.4 years. This means that residents of Cobija can expect to live 13 years longer than the national average. However elderly people in Cobija only represent 4,5% of the total population. Nevertheless, older individuals may have better incomes or more savings, which can help them live with reduced vulnerability.

Another trend in demographics is the bi-national aspect of Cobija. The city attracts temporary urban dwellers from the Brazilian cities. For instance, the two universities in Cobija have tens of students from Brazil. That does not mean they leave in Cobija, but they only come for studying purposes. Another example are commerce and gastronomy, locals from Cobija usually go to restaurants in Brasilea or Epitaciolândia and Brazilians shop frequently in Cobija. Workers frequently have two nationalities of both countries so that employment gets easier.

04

CLIMATE CHANGE DIMENSION

The climate change dimension of this MVA provides a clearer understanding of how climate change is affecting the city's population, infrastructure and resources. It focuses on key indicators such as floods, landslides, drought and temperature rise. These insights will help guide targeted interventions to improve the city's resilience to future climate challenges.

Bolivia is experiencing the effects of climate change, including food and water insecurity, more frequent and severe disasters like droughts and flooding, an increase in forest fires, and the spread of vector-borne diseases to new areas.

Despite a medium level of exposure, Bolivia is one of the most vulnerable countries in Latin America to climate change due to its inadequate adaptive capacity. This low capacity stems from a high economic dependence on agriculture, a low gross domestic product, poor inter-institutional coordination, generally weak institutions, high levels of poverty and inequality, and a medium Human Development Index (HDI), according to the Vulnerability and Adaptation Index for Climate Change in the Latin American and Caribbean region (CAF, 2014). Some of these issues were discussed in the urban dimension.

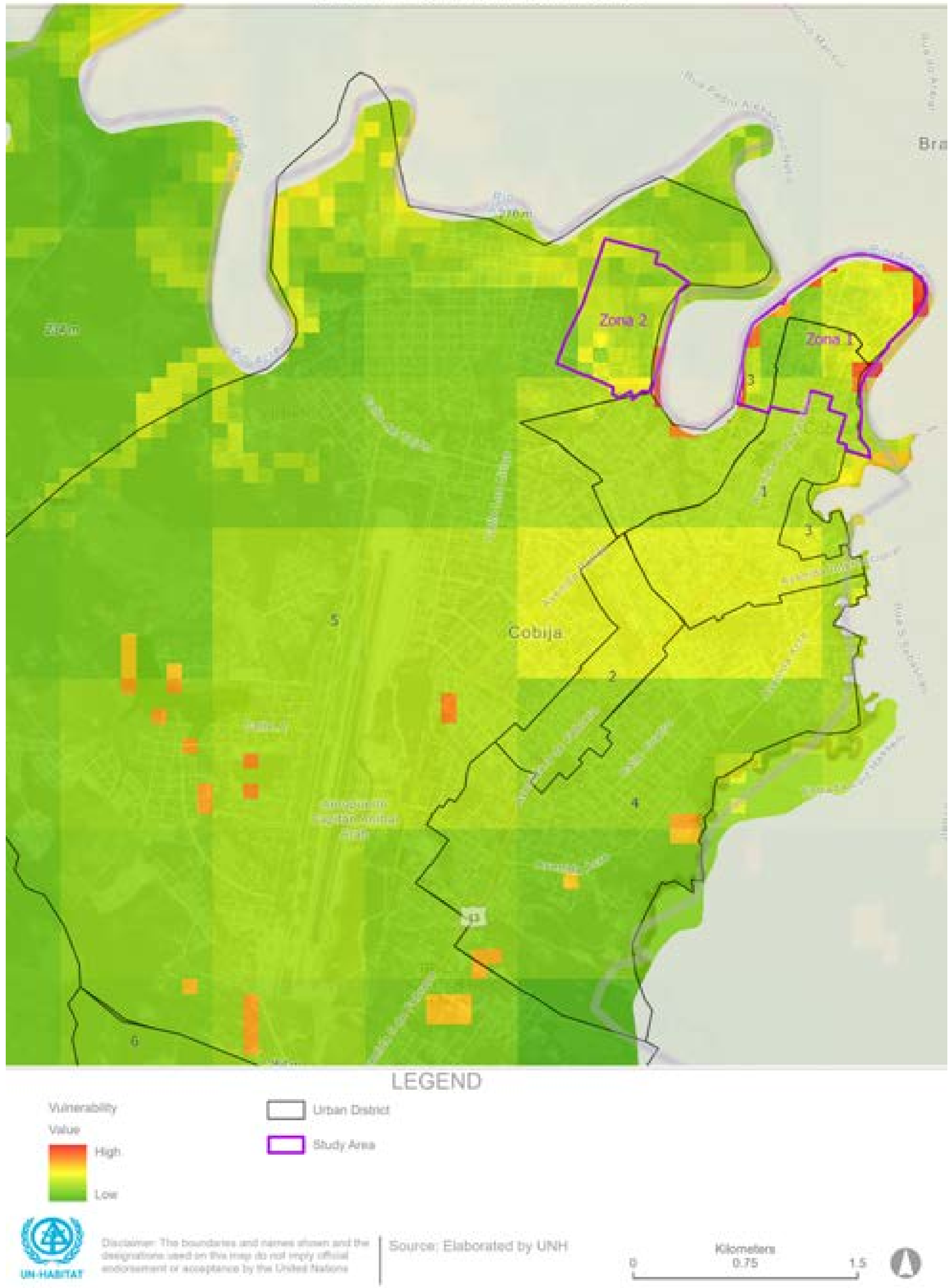
At the national level, the Ministry of Environment and Water (MMAyA) manages environmental policies and climate change initiatives, ensuring their integration into national planning efforts. The Plurinational Authority of Mother Earth is responsible for developing the Plurinational Plan for Climate Change and monitoring Bolivia's Nationally Determined Contributions (NDCs).

At the local level, environmental and climate change issues in the Autonomous Municipal Government of Cobija are handled by an organizational structure that includes the Environment Department, the mayor's office, and the Secretary of Public Works.

One example of this effort is the collaboration with UNICEF to map vulnerabilities and develop climate change adaptation strategies, which has helped identify best practices and innovative ideas to make Cobija a more resilient city. This collaboration resulted in the Management Plan for Risks and Climate Change for Cobija 2022-2030.

However, challenges remain, particularly in implementing national climate change instruments at the local level and coordinating municipal actions with other areas of development.

CLIMATE CHANGE DIMENSION



Indicators

Indicator 1. Fluvial Flooding. This indicator shows the occupation by water of areas that are normally dry, as a result of the unusual or sudden contribution of a quantity of water greater than the riverbed itself can drain. Fluvial flooding, also known as river flooding, occurs when excessive rainfall or snowmelt causes a river, stream, or other waterway to overflow its banks, inundating the surrounding land

River flooding was selected as a key indicator for the climate change dimension in the Cobija MVA due to its far-reaching and unpredictable impacts.

Fluvial flooding poses significant risks to communities living near rivers due to its unpredictable nature and wide-reaching impact. Flooding has the potential to inundate large areas, cause loss of life and injury, disrupt property and infrastructure systems, and damage urban services, economies, and agricultural land. It can also displace people, resulting in significant social and economic consequences.

For this indicator, we used the 10-year Flood Risk: Existing Climate map from the Coalition for Disaster Resilient Infrastructure, which uses the Continuum model (Silvestro et al. 2013 and 2015). It is a continuous, distributed, physically-based hydrological model capable of reproducing the spatiotemporal evolution of soil moisture, energy fluxes, soil surface temperature, evapotranspiration, and streamflow. In order to generate flood hazard maps, resulting discharge estimates are input to a hydraulic model based on the Manning equation that compute channel uniform flow depth. This simplified approach fits to determine flood maps on large areas.

Indicator 2. Landslides. This indicator shows areas that are more prone to precipitation-induced landslides under current climate conditions. The Coalition for Disaster Resilient Infrastructure's precipitation-induced landslide susceptibility map was used for the indicator. Mass movement of rock, debris, soil, or mud down a slope is one of the hazards that occur in the city and can be exacerbated by changes in precipitation.

Landslides present significant risks to public safety, as they can cause injury, loss of life, and severe property damage. Critical infrastructure—such as roads, bridges, utilities, and buildings—are also vulnerable to landslides, which can disrupt transportation networks, water supply systems, and energy distribution. Disadvantaged populations, such as low-income communities and residents of informal settlements, are disproportionately affected by landslides, compounding their existing vulnerabilities.

The landslide susceptibility is based on the model developed by NGI (Nadim et al., 2006, 2013; Jaedicke et al., 2013) but with improvements and refinements. The precipitation-induced landslide susceptibility map for the present climate classifies the terrain into five susceptibility classes by combining slope, vegetation, lithology and rainfall history information from global datasets.

Indicator 3. Temperature Rise. This indicator shows the areas with an increase in temperature values, based on temperature variations over time, taking as a reference the average annual temperature of a recent year compared to the historical annual average.

Rising temperatures can disrupt precipitation patterns and increase evaporation, negatively affecting the availability and quality of water resources. Higher temperatures can also be associated with an increase in the frequency of heatwaves, which are understood as an unusually hot, dry or humid period, day or night, that begins and ends abruptly, lasting at least two to three days, with a discernible impact on humans and natural systems (World Health Organization and World Meteorological Organization), endangering human health and well-being. They can disrupt ecosystems, alter biodiversity patterns, and cause heat stress, which may damage critical infrastructure.

The indicator uses the global daily temperature dataset for the period 2003-2020 from A global 1 km resolution daily near-surface air temperature dataset (2003-2020) by Iowa State University.

Indicator 1 – Fluvial Flooding

Flooding is the most significant climate hazard facing the city.

In Cobija, as in many other flood-prone regions, certain areas are more susceptible to flooding due to a variety of environmental, geographical, and human factors. The following are the main reasons why specific areas in Cobija may be more prone to flooding than others:

Geographical Location and Topography

Proximity to rivers: Cobija is located near the Acre River, and areas close to rivers or other water bodies are naturally at higher risk of flooding, especially during periods of heavy rainfall or rapid snowmelt upstream. Riverbanks can overflow and flood surrounding areas, particularly low-lying regions.

Low-lying areas: Areas situated at lower elevations are more prone to flooding because water naturally flows downhill. If the drainage systems in these areas are insufficient or poorly maintained, floodwaters may accumulate and cause widespread flooding.

Flat terrain: Cobija's flat terrain, common in floodplains, makes it difficult for floodwaters to drain quickly. As a result, even moderate rainfalls can lead to flooding, as water stagnates and has fewer natural outlets.

Climate and Weather Patterns

Heavy rainfall: Cobija is located in the Amazon Basin, where seasonal rainfall can be intense, particularly during the rainy season. Prolonged heavy rains can overwhelm drainage systems and rivers, leading to flooding.

Tropical climate: The tropical climate of the region is characterized by heavy and frequent rainfall throughout the year. Seasonal shifts in rainfall patterns can increase the risk of flooding, especially when the region experiences exceptionally wet periods, such as during El Niño or La Niña events, which alter weather patterns.

Global climate change: Changes in global climate patterns have led to more erratic weather, including heavier rainfall and stronger storms. This can exacerbate flooding risks in Cobija and other parts of the Amazon Basin.

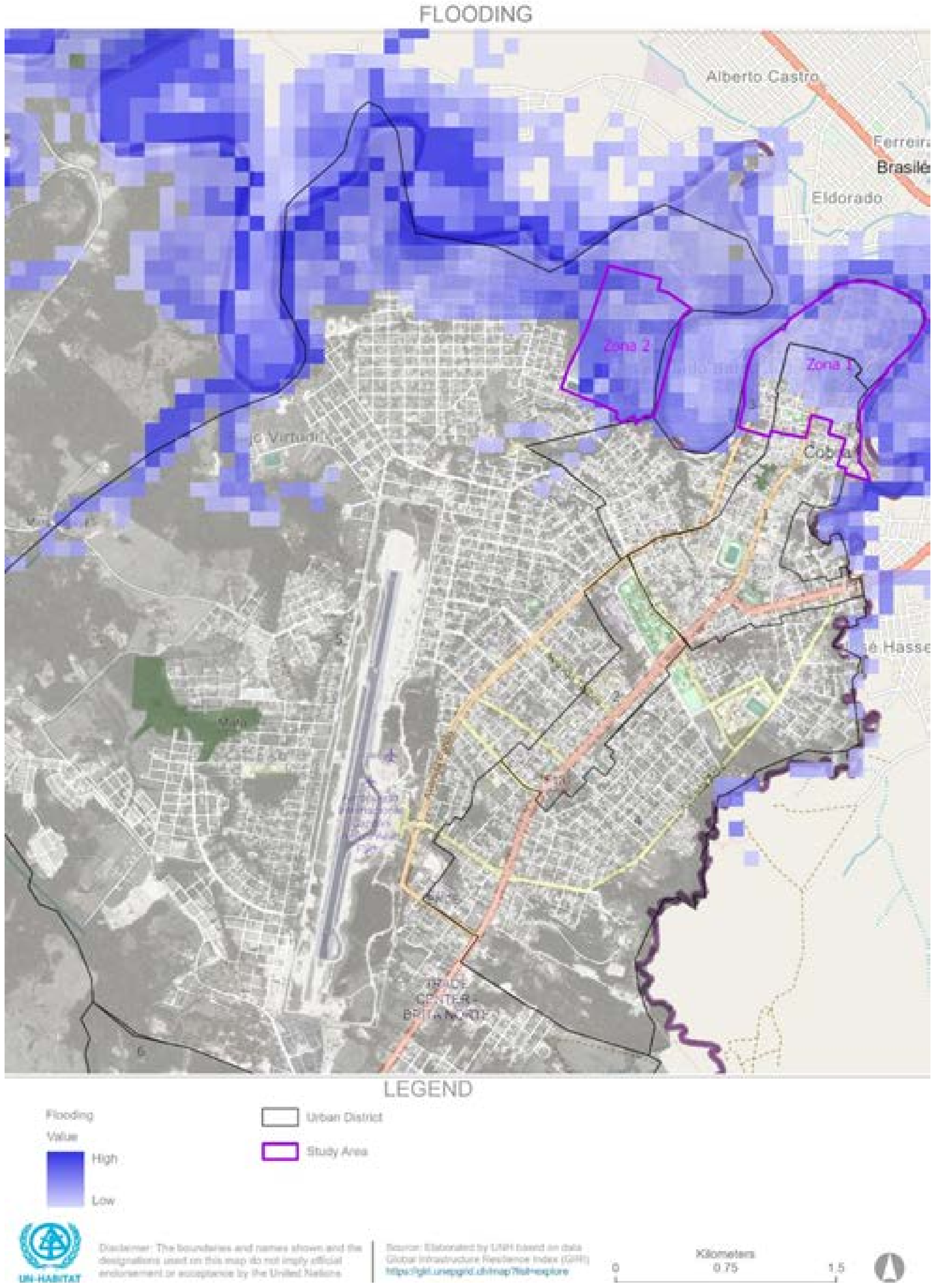


Fig. 22: Riverine flooding map
Source: UN-Habitat, 2024

River Behavior and Management

River overflow: Cobija sits near the border with Brazil, where the Acre River runs through both countries. The river's flow can be unpredictable, and during the rainy season, it can overflow its banks, submerging nearby areas.

Dam and water infrastructure issues: If upstream water management systems such as dams or reservoirs are poorly managed, they can contribute to rapid increases in water levels downstream, exacerbating flooding in Cobija. Poorly designed or outdated infrastructure may not be able to handle large-scale water surges during extreme weather events.

Inadequate Drainage Systems

Limited or poorly maintained drainage: In urban areas like Cobija, inadequate or poorly maintained drainage systems can lead to flooding. Blocked or undersized drains often cannot carry away the excess water, causing water to accumulate on streets and properties, particularly during heavy rains.

Increased impervious surfaces: As Cobija urbanizes, more areas are paved with concrete and asphalt, reducing the ground's ability to absorb water. This leads to more surface runoff, overwhelming drainage systems and increasing the risk of flash flooding in certain areas.

Deforestation and Land Use Changes

Deforestation: The Amazon Rainforest surrounding Cobija plays a key role in regulating rainfall and absorbing water. Deforestation in the region, whether for agriculture, logging, or urbanization, can lead to increased surface runoff and soil erosion. This disrupts the natural water absorption capacity of the land, leading to higher flood risks.

Urban expansion: Rapid urbanization, especially in areas not designed with flood management in mind, can contribute to increased flood risks. Buildings, roads, and other infrastructure in flood-prone areas can exacerbate drainage problems and contribute to localized flooding.

Soil Composition and Vegetation Cover

Soil permeability: The type of soil found in specific areas can also affect flood susceptibility. Clayey soils, for example, absorb water slowly, leading to higher chances of surface runoff. Sandy or loamy soils, in contrast, tend to absorb water more efficiently. Poorly drained soils in Cobija's floodplains contribute to stagnant water and flooding.

Loss of natural vegetation: Vegetation, particularly trees and plants, help to slow down water runoff and promote water absorption into the soil. When natural vegetation is removed for urban development or agriculture, the area becomes more vulnerable to floods.

Floodplain and Wetland Areas

Floodplain areas: Much of Cobija lies within the Amazon basin, and many parts of the region are floodplains. These areas naturally experience seasonal flooding, especially when rivers like the Acre River overflow their banks during the rainy season.

Wetlands: Wetlands in and around Cobija, including swamps and marshes, are prone to flooding, especially during periods of heavy rainfall. These wetlands help absorb excess water, but when they are disturbed or developed, they lose their ability to manage floodwaters effectively.

Human Settlements and Infrastructure

Unplanned settlements: Informal or unplanned settlements often develop in flood-prone areas with limited flood protection infrastructure. People living in these settlements are particularly vulnerable during flood events, as the areas may not have adequate drainage systems or flood barriers.

Poor urban planning: Lack of proper urban planning can lead to construction in flood-prone zones. Without proper flood management infrastructure (such as embankments, flood barriers, or drainage systems), these areas face an increased risk of flooding.

Changes in River and Flood Patterns

Shifts in river course: Rivers can change their course over time due to natural events like erosion or sediment deposition. These changes can create new flood risks for areas that were previously safe.

Dams and reservoirs upstream: Human interventions such as the construction of dams and reservoirs upstream can change the natural flow patterns of rivers, creating a sudden buildup of water that causes downstream flooding in areas like Cobija.

In conclusion, specific areas in Cobija are prone to flooding due to a combination of natural and human factors. The region's proximity to the Acre River, low-lying floodplains, heavy rainfall, deforestation, poor drainage systems, and unplanned urban expansion all contribute to the area's vulnerability to floods. Addressing these factors through improved infrastructure, better urban planning, and environmental protection efforts can help reduce flood risks in the future. The five neighborhoods in this study are in the flood risk zones within Cobija (Fig. 22). The southern portion of Cobija faces little flood risk. The map shows that flooding affects not only Cobija's neighborhoods but also areas in the Brazilian cities of Brasileia and Epitaciolândia.

Indicator 2 - Landslides

Landslides are one of the biggest climate hazards facing the city.

Certain areas in Cobija are more prone to landslides due to a combination of geological, environmental, and human factors. Understanding these factors is important for mitigating the risks associated with landslides. Below are the main reasons why some areas in Cobija are more prone to landslides than others:

Steep Slopes and Terrain

Hilly or mountainous terrain: Cobija is located in the Amazon Basin, and certain areas in the surrounding region feature steep hills and slopes. Steep terrain is particularly prone to landslides because gravity exerts more force on the soil and rocks, making them more likely to slide down in response to certain triggers (such as heavy rainfall).

Lack of stability on steep slopes: When the slope is too steep for vegetation or adequate soil compaction, the ground becomes unstable and is more likely to experience landslides, especially during adverse weather conditions like intense rainfall.

Soil Composition and Weakness

Clay-rich soils: In areas with a high clay content, the soil tends to become slippery and loses its cohesion when it becomes saturated with water. This makes clay-rich soils more prone to sliding during heavy rainfall or rapid snowmelt. Clay soils are common in many regions of Cobija, increasing landslide risk in these areas.

Loose or unconsolidated soils: Areas where the soil is loose and not well-compacted (e.g., sandy soils or loose sediment) are more prone to erosion and sliding when water infiltrates. Cobija's surrounding areas, particularly in hilly or mountainous zones, may have soil that is easily eroded or dist urbed, making these areas more vulnerable to landslides.

Rocky terrain: In areas with fractured or weathered rocks, such as the slopes of hills and mountains, landslides can occur as the rocks become loose over time. Rainwater can seep into these fractures, weakening the rocks and triggering landslides.

Heavy Rainfall and Water Saturation

Intense rainfall: Cobija experiences a tropical climate with significant rainfall, particularly during the wet season. Prolonged or heavy rainfall can saturate the soil, reducing its stability and increasing the likelihood of landslides, especially in mountainous or hilly areas. The Amazon region often experiences seasonal rains that can lead to rapid increases in water volume on slopes, triggering landslides.

Flash floods: Flash floods, which occur due to intense and rapid rainfall, can quickly erode slopes and weaken the soil, making landslides more likely. In regions where rainfall intensity is high and drainage is poor, the rapid accumulation of water on steep slopes can trigger the movement of earth and debris.

Deforestation and Land Use Changes

Loss of vegetation: Deforestation, which is a significant concern in the Amazon region, reduces the natural protection against landslides. Trees and plant roots help anchor the soil in place, and when forests are cleared, the soil becomes more vulnerable to erosion. In areas around Cobija where deforestation has been prevalent, landslides are more likely to occur, particularly in regions with steep slopes.

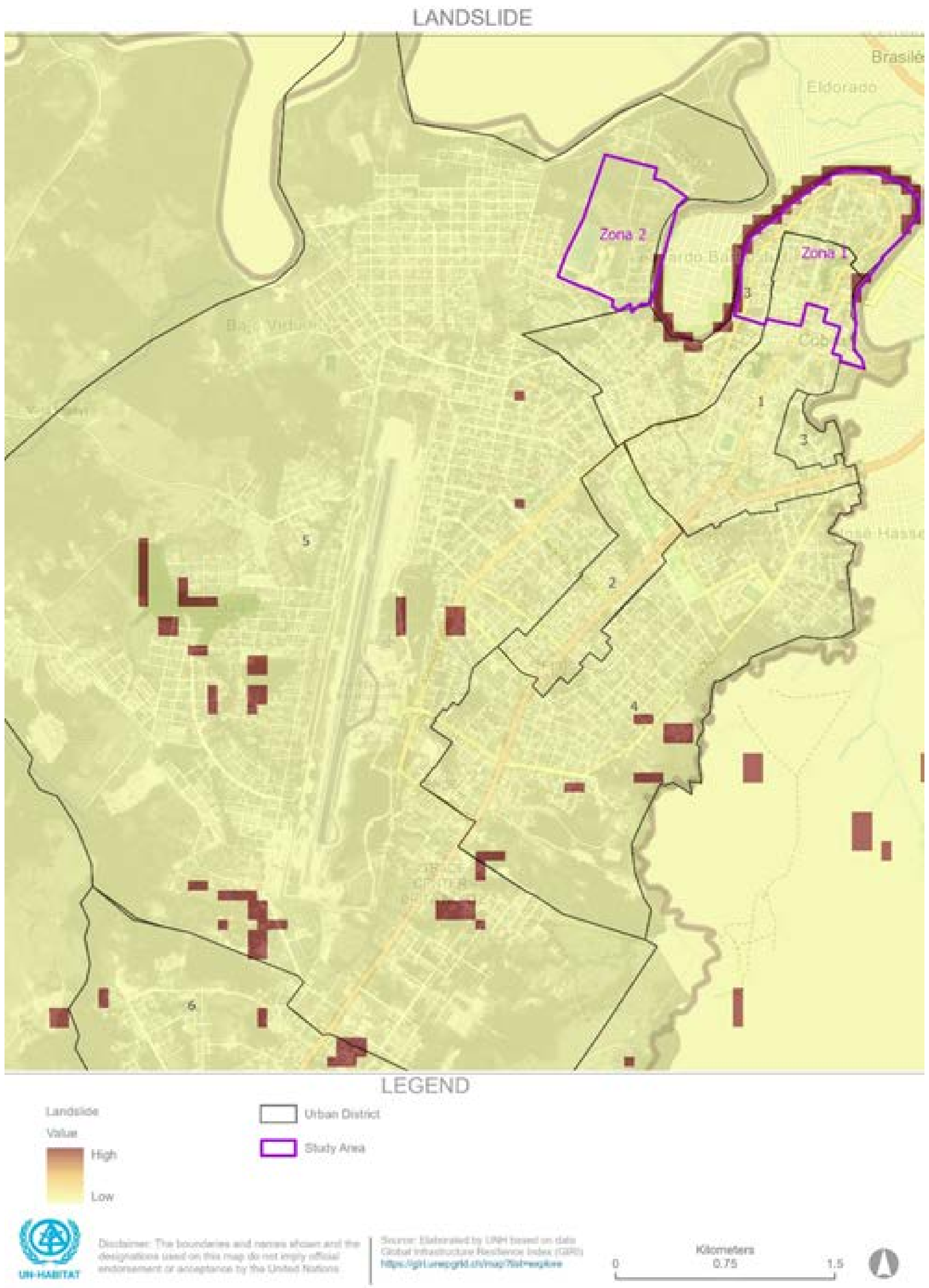


Fig. 23: Landslides in Cobija
Source: ONU-Hábitat

Agricultural expansion: The conversion of forests or natural vegetation into agricultural land (such as for farming or cattle grazing) can also contribute to soil instability. The removal of trees and soil disturbance during land preparation can lead to weaker soil structure, increasing the risk of landslides, especially in the slopes of the foothills around Cobija.

Road construction and urban development: The expansion of roads and urban areas into hilly regions can destabilize slopes. Construction activities often involve cutting into the side of hills or mountains, which can disturb the natural slope stability. In Cobija, poorly planned infrastructure development in steep areas may exacerbate the risk of landslides.

Human Activity and Improper Land Management

Inadequate land use planning: If urban areas or rural settlements are built in areas that are inherently unstable (such as steep hills or riverbanks), these locations are more susceptible to landslides. Cobija, as it expands, might face challenges in land use planning, particularly in high-risk areas.

Uncontrolled mining or quarrying: Mining operations or quarrying activities, particularly in mountainous or hilly areas, can weaken the integrity of the soil and rock, increasing the risk of landslides. In regions like Cobija, where there is some mining activity, human interventions like excavation or digging may destabilize the landscape, making landslides more likely.

Lack of Proper Drainage and Erosion Control

Insufficient drainage systems: In areas of Cobija that lack proper drainage infrastructure, water can accumulate on slopes during heavy rainfall. Poorly managed drainage systems can cause water to infiltrate the soil, weakening it and increasing the likelihood of landslides. For example, improper water management in urban or rural areas can lead to flooding that triggers landslides in vulnerable locations.

Erosion-prone areas: If erosion control measures are not in place, such as retaining walls or proper vegetation, soil erosion can weaken slopes and lead to landslides. Cobija's rapid urbanization could lead to areas without proper erosion control, increasing the risk of landslides, especially in vulnerable areas.

Climate Change and Increased Rainfall Variability

Changing weather patterns: Climate change is expected to increase the frequency and intensity of extreme weather events, including heavy rainfall and storms. This can exacerbate landslide risk in regions like Cobija that are already prone to flooding and intense rainfall. Sudden, extreme rainfall events, which may be more common due to climate change, can lead to faster saturation of slopes, triggering landslides in previously stable areas.

Increasing rainfall: Over time, patterns of rainfall may change due to climate shifts, leading to prolonged rainy seasons or intense storms that create conditions more conducive to landslides.

In conclusion, specific areas in Cobija are more prone to landslides due to a combination of geological factors (e.g., steep slopes, soil composition), climatic conditions (e.g., heavy rainfall), human activities (e.g., deforestation, road construction), and infrastructure issues (e.g., poor drainage). Areas located on steep hillsides, with loose or clay-rich soils, and near urban expansion or agricultural areas, are particularly vulnerable. Proper land use planning, erosion control, sustainable agriculture, and robust infrastructure can help mitigate the risk of landslides in these areas. Landslide risk exists in several parts of the city, particularly in the central area of Cobija (Fig. 23). Local experience and recorded events indicate that some neighborhoods near the river have suffered from landslides. In certain areas of the Cataratas neighborhood, landslides are still visible today.

Indicator 3 – Temperature Rise

Specific areas in Cobija may experience different levels of temperature rise due to a combination of geographical, climatic, environmental, and human factors. These factors can either exacerbate or mitigate temperature increases in certain areas. Here are the main reasons why some areas are more prone to temperature rise than others in Cobija:

Urbanization and the Urban Heat Island Effect

Urban heat island effect (UHI): Urban areas tend to be warmer than surrounding rural areas due to the concentration of buildings, roads, and other structures that absorb and retain heat. In Cobija, as the city expands, urban areas may experience higher temperatures compared to surrounding forests or rural areas. This is because materials like concrete, asphalt, and metal used in construction absorb and store heat during the day and release it at night, leading to higher nighttime temperatures.

Lack of green spaces: Green areas such as parks, trees, and vegetation help cool the environment through processes like evapotranspiration. In densely developed areas of Cobija, a lack of sufficient green spaces and vegetation can contribute to higher local temperatures.

Deforestation and Land Use Changes

Loss of vegetation: Cobija is located in the Amazon Basin, an area known for its tropical rainforest. Deforestation and land use changes, including agriculture and urban development, reduce the amount of tree cover and natural vegetation. Forests play a crucial role in cooling the environment by releasing moisture into the atmosphere and absorbing sunlight. When forests are cleared, the heat-absorbing and cooling effects are diminished, contributing to increased local temperatures.

Change in land cover: When natural forests are replaced by agriculture or urban infrastructure, the landscape becomes more prone to temperature rise. Agricultural fields and cleared land have a lower capacity for heat absorption compared to forests, which means these areas experience higher temperatures, especially during the dry season.

Geographical Location and Elevation

Elevation and topography: Cobija is located in the lowland region of the Amazon Basin at relatively low altitudes. Areas at lower elevations typically experience higher temperatures because they are closer to sea level, where air pressure is higher, and the atmosphere tends to trap heat. In contrast, higher elevations generally have cooler temperatures because they are farther from the Earth's surface and experience less atmospheric heat trapping.

Proximity to water bodies: Cobija is near the Acre River, and areas located near large bodies of water or wetlands may experience moderate temperatures due to the cooling effect of water bodies. However, areas farther from water sources or situated in drier zones may experience greater temperature fluctuations and higher overall temperatures, particularly in the absence of significant vegetation or moisture sources.

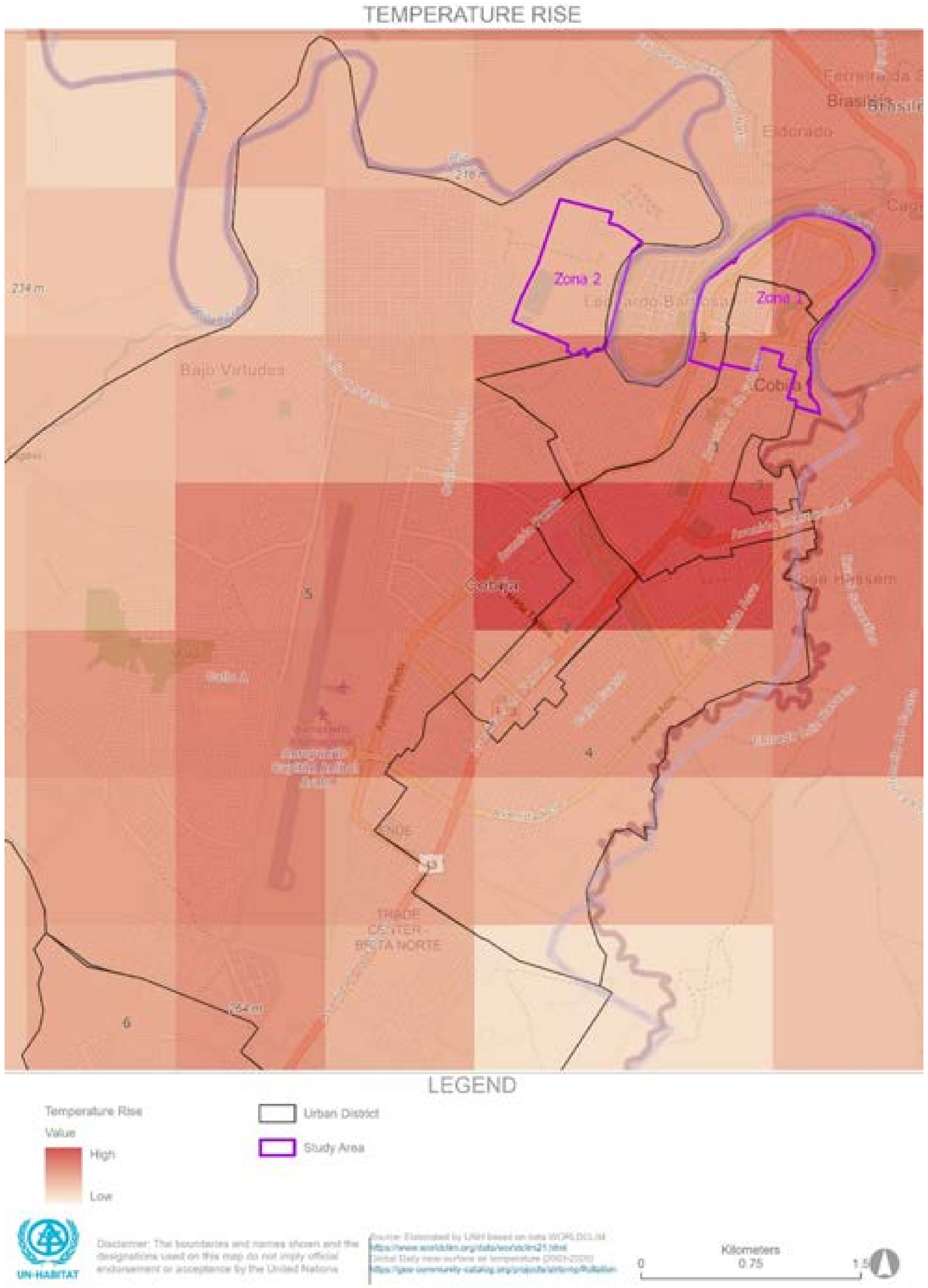


Fig. 24: Temperature Change map (rise)
Source: UN-Habitat, 2024

Climate and Seasonal Variability

Seasonal weather patterns: Cobija experiences a tropical climate with significant rainfall during the wet season and a dry season. During the dry season, temperatures tend to rise, especially in areas with minimal vegetation. The intensity of rainfall and the timing of the wet season can influence temperature variation across different areas. Areas with better access to water sources or natural cooling mechanisms (e.g., forests, wetlands) may experience less of a temperature rise during the dry season compared to drier, deforested areas.

Climate change: The impacts of climate change, including shifts in rainfall patterns and more extreme weather events, can lead to higher temperatures in certain areas. As global temperatures rise, the frequency and intensity of heatwaves may increase, and areas with limited natural cooling mechanisms (e.g., deforested zones or urban areas) will be more vulnerable to temperature increases.

Soil Composition and Surface Properties

Soil type: The type of soil in a given area can affect how much heat is absorbed during the day. Areas with dark, dense soil or materials tend to absorb more heat, whereas lighter-colored, reflective surfaces (such as water or sand) can reflect more sunlight and reduce local temperature increases. If areas around Cobija have exposed soil or impervious surfaces like concrete or asphalt, these areas can trap more heat during the day and experience a higher temperature rise.

Land degradation: Degraded land with compacted soil or reduced vegetative cover may absorb more heat and have limited capacity for moisture retention. As a result, these areas are more likely to experience rapid temperature increases, particularly during dry periods.

Local Wind Patterns and Airflow

Wind exposure: Wind can have a cooling effect by dispersing heat and bringing cooler air from other regions. Areas in Cobija that are sheltered by hills or dense forests may have reduced airflow, which can lead to higher localized temperatures. Conversely, areas with better wind exposure and airflow may experience more moderate temperature fluctuations.

Microclimates: Cobija, like many other regions, may have microclimates—small, localized areas that have distinct weather patterns due to factors like elevation, vegetation, and proximity to bodies of water. These microclimates can result in certain areas being warmer or cooler than the surrounding environment.

Water Availability and Moisture Levels

Water scarcity: Areas that have limited access to freshwater or are more affected by drought conditions may experience higher temperatures because water bodies (rivers, lakes, wetlands) tend to have a moderating effect on temperature. In regions of Cobija where water sources are scarce or overexploited, temperature increases can be more pronounced due to the lack of evaporative cooling and moisture availability.

Evapotranspiration: Areas with more vegetation have a cooling effect due to the process of evapotranspiration, where plants release moisture into the air, which cools the surrounding environment. In contrast, areas with less vegetation or more bare soil experience higher temperatures because the cooling effect of evapotranspiration is diminished.

Human Activity and Infrastructure Development

Land clearing for agriculture and development: As Cobija expands, urban and agricultural development can contribute to local temperature increases. The construction of buildings, roads, and other infrastructure absorbs and retains heat, which can elevate temperatures in developed areas. The process of land clearing itself, especially in tropical regions, increases the amount of heat absorbed by the ground.

Waste heat from industrial or residential areas: In areas of Cobija where industrial or residential activities are concentrated, additional heat can be generated through human activities. This "waste heat" can further exacerbate temperature rise, particularly in densely populated urban centers.

Forest Fragmentation and Landscape Connectivity

Forest fragmentation: The fragmentation of forests into smaller, isolated patches reduces the overall cooling effect of the forested landscape. Fragmented forests are less effective at providing temperature moderation, and isolated patches are more susceptible to temperature increases compared to larger, contiguous forested areas. This can lead to higher temperatures in areas where forest cover has been reduced or fragmented.

In conclusion, in Cobija, certain areas are more prone to temperature rise due to a combination of urban heat island effects, deforestation, geographical features, climatic patterns, and human activities. Urban areas, deforested regions, and areas with limited vegetation or water sources tend to experience higher temperatures, particularly during the dry season. Managing urbanization, increasing green spaces, and protecting natural ecosystems like forests and wetlands are key strategies for mitigating temperature rise and its associated impacts in these areas. The northern part of the city has experienced the largest increase in temperature (Fig. 24), with Area 1 being particularly affected. Other parts of Cobija, especially the central area, are also significantly impacted by rising temperatures. However, the southeastern part of Cobija is expected to experience less of an impact from temperature increases.

Climate Change Dimension Analysis

The following climate change dimension analysis includes the 3 components of vulnerability: exposure, sensitivity and adaptive capacity.

Exposure

Exposure identifies how Cobija is exposed to changes in the climate today and how it could be in the future in the climate change dimension.

Description of current and future changes

As shown on the maps, Cobija's two study areas are highly exposed to flooding, particularly Pto. Alto, Cataratas, and Villamontes, which are located near the border next to the River Acre.

In the case of landslides, the map indicates a lack of exposure to this climate hazard. However, consultations with residents in Cataratas revealed that there have been landslides affecting households and roads near the riverbank.

Regarding temperature rise, both Study Area 1 and the center of Cobija are directly impacted by increasing temperatures, which generally affect the most vulnerable populations. In contrast, Study Area 2 experiences a proportionally lower temperature increase, resulting in lower exposure. Since having lower temperature increase makes it more comfortable for dwellers to live in this area. Moreover, children and elder people would be less exposed suffering heat strokes.

SENHAMI predicts that precipitation will increase by 4% in the coming years, leading to higher river levels and more flooding in Cobija. Additionally, the temperature is expected to rise by approximately 3.7%, further affecting the city in various aspects of climate change.

Identification of people, places, institutions and sectors that are exposed to climate hazards

The following table summarizes the identification of climate hazards and exposed features and sectors.

Climate Change Hazard	Current Weather Data	Climate Scenario Projections	Impacts	Exposed features and sectors
Flooding	**Precipitation (annually):** 1,774mm in the east of the municipal jurisdiction of Cobija to 1,834mm in the west of the municipal jurisdiction of Cobija. **Temperature:** Between 25.5ºC and 26.8ºC. Extreme maximum temperatures reach 38ºC.	IADB projections: • Precipitation increase: 26%. • Temperature increase: 3.7%	Displacement from households	Inhabitants of the neighborhoods Mapajo, Pto Villarroel, Junín, Villamontes and Cataratas
			Disruption of regular functioning of services and administrative tasks	Government institutions (Local, regional and branches from the national gov.)
			Disruption of health services	Health services
			Disruption of education, energy, water and sanitation services	Education institutions (University and schools), electricity, gas, potable water, sewage, etc.
			Impacts on livelihoods, income and employment	Less economic activities that could cause unemployment and minor income levels
			Reduced supply of products and foodstuffs	Stores, markets and restaurants
			Reduced garbage collection, etc.	Public services
			Closing	Neighborhoods common rooms and headquarters, daycare and elderly facilities houses.

Table 9: Identification of climate hazards and exposed features and sectors (Flooding) for climate change dimension
Source: Own elaboration

Climate Change Hazard	Current Weather Data	Climate Scenario Projections	Impacts	Exposed features and sectors
Landslides	**Precipitation (annually):** 1,774mm in the east of the municipal jurisdiction of Cobija to 1,834mm in the west of the municipal jurisdiction of Cobija. **Temperature:** Between 25.5°C and 26.8°C. Extreme maximum temperatures reach 38°C.	IADB projections: • Precipitation increase: 26%. • Temperature increase: 3.7%	Displacement from households	Inhabitants of the neighborhoods Mapajo, Pto Villarroel, Junín, Villamontes and Cataratas
			Disruption of regular functioning of services and administrative tasks	Government institutions (Local, regional and branches from the national gov.)
			Disruption of health services	Health services
			Disruption of education, energy, water and sanitation services	Education institutions (University and schools), electricity, gas, potable water, sewage, etc.
			Impacts on livelihoods, income and employment	Less economic activities that could cause unemployment and minor income levels
			Reduced supply of products and foodstuffs	Stores, markets and restaurants
			Reduced garbage collection, etc.	Public services
			Closing	Neighborhoods common rooms and headquarters, daycare and elderly facilities houses.

Table 10: Identification of climate hazards and exposed features and sectors (Landslides) for climate change dimension
Source: Own elaboration

Sensitivity

The objective is to identify how climate change is currently impacting exposed individuals, places, institutions, and sectors in Cobija, as well as the extent to which they may be affected in the future. There are four key considerations: i) Demographic; ii) Housing; iii) Welfare and human development; and iv) Production and investment.

Demographic

Regarding demographic considerations, the data is the same as that presented in the urbanization dimension, with the key difference being that the climate change dimension incorporates specific factors relevant to climate change for this analysis.

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
	Gender	In the climate change dimension, the female population is particularly affected as hazards lead to the loss of safe housing. In absolute terms female workers earn less money than male population, making women far more vulnerable to respond to climate change menaces.
	Proportion of children and the elderly	In the climate change dimension, vulnerable groups in society, including people with disabilities, are particularly affected by the loss of safe housing and accessible infrastructure. In that matter, mobility is another factor, since inexistent of adequate public transportation services, pedestrian infrastructure, only private vehicles can access facilities and services, thus magnifying inequality. Finally, these vulnerable groups (children and elderly) of society are more susceptible to illness and depend on economically active adults to get help.

Table 11: Socio-economic sensitivity variables (Demographic) for climate change dimension
Source: Own elaboration

In addition of to the above, the following statements are also related to this dimension:

- Institutions that are the most sensitive are: Regional and local Government departments which facilities are located at areas subject to flooding.
- The sectors that are the most sensitive in the study areas are education and health. Since flooding affect not only the building where they function but the overall accessibility. However in a wider scope, all sectors are proportionally affected during and after flooding, since the city does not function regularly and experience overall disruption, affecting specially the most vulnerable groups of society.

Housing

Regarding housing considerations, the data is the same as that presented in the urbanization dimension, with the key difference that the climate change dimension incorporates specific factors relevant to climate change for this analysis.

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
Housing	Materials	In the climate change dimension, households with brick walls and calamine roofs are more resistant and have better resilience to climate change hazards (such as flooding) compared to those made of wood.
	Condition	In the climate change dimension, households that lack maintenance and have preexisting issues such as cracks, holes, and structural problems are less resilient to climate change hazards. Immoral settlements in the south such as La Orquídea are among the zones that have appeared as invasions. In the southern part of Cobija nearly 45% of all houses are in poor conditions.

Table 12: Socio-economic sensitivity variables (Demographic) for climate change dimension
Source: Own elaboration

Welfare and human development

Regarding welfare and human development considerations, the data is the same as that which is presented in the urbanization dimension. However, in the climate change dimension, the maps used for this analysis iincorporate specific factors relevant to climate change.

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
Welfare and human development	Life expectancy at birth	Life expectancy average that is higher than the national one may decrease if population is exposed to climate change hazards that are harmful for their lives, causing deaths and injured population. In relation to infant and maternal mortality, climate change can exacerbate challenges to maternal and child health. Increased temperatures and extreme weather events can lead to complications during childbirth or inadequate healthcare access, negatively affecting life expectancy, that in the case of Cobija is particularly sensitive for its health system, since there are not third[1] level hospitals.
	Poverty rates	Poor communities tend to live in areas more susceptible to climate-related disasters, such as flood-prone regions (e.g. the stud areas of this project), or informal settlements lacking solid infrastructure (e.g. Cobija´s southern zone). Because of this, they are more vulnerable to the effects of climate change. Because of climate change hazards, the poverty rates could worsen since the loss of households and belongings would need an additional budget that would affect people´s economy.

Table 13: Socio-economic sensitivity variables (Demographic) for climate change dimension
Source: Own elaboration

Production and investment

Regarding production and investment consideration, the data is the same as presented in the urbanization dimension, except in the climate change dimension, the information for this analysis includes specific considerations of the climate change dimension.

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
Production and investment	Land-use areas residential, commercial, industrial, Infrastructure	Residential areas: Due to vulnerable communities and people Commercial areas: Due to reduced productivity and income loss. Industrial areas: Due to closing would cause employment loss. Agriculture areas: Due to climate change hazards would affect food production. Forest reserve areas: Due to climate change, biodiversity would be severely affected.

Table 14: Socio-economic sensitivity variables (Production and investment) for climate change dimension
Source: Own elaboration

Coping capacity

The goal is to assess how well people, places, institutions, and sectors in Cobija can adapt to climate hazards and impacts, focusing on coping capacity. The city's ability to respond to climate change impacts depends on its level of awareness, knowledge, resources, and skills.

At the local level, environmental and climate change issues are managed by the Autonomous Municipal Government of Cobija, specifically by the Environment Department, the mayor's office, and the Secretary of Public Works. Despite limited resources, these municipal entities are actively addressing climate change hazards and striving to transform Cobija into a resilient city. Current activities include designing infrastructure projects that incorporate resilience to climate change hazards. For example, schools are being located away from the river, and parks are being constructed in elevated areas.

It is important to note that individuals who do not belong to vulnerable groups are aware of how to respond to disasters. Many people plan to temporarily relocate until water levels decrease. Families often move their most valuable furniture to higher rooms in their homes to prepare for potential flooding. In some cases, inhabitants of Cobija tend to build their households as stilt houses, using wood, so there are always stairs to reach the first level of the household that is actually located at the se-

Determinant	Description	Relation to climate vulnerability	Data in Cobija
Economic wealth and financial capital	Municipal financial resources, resident incomes and wealth distribution, economic marginalization, fiscal incentives for climate risk management.	Climate change adaptation with internal funding or external support	Currently, the city of Cobija is experiencing a lack of economic resources which makes it impossible to implement measures to make it resilient to climate change hazards.
Access to information and technology	Communication networks, computing tools, freedom of expression, technology transfer and data exchange	Technical data, data modelling capability, sharing and distribution information to Climate change adaptation	There is lack of access to information, few civil servants are fully conversant with climate change adaptation strategies.

Material resources and infrastructure	Transport, water infrastructure, buildings, sanitation, energy supply and management	Designed, constructed, sited, and managed infrastructure and services to be more adaptable or easier to adapt to climate change impacts and risks	Because of lack of economic resources, GAMC has few material resources to deal with climate change hazards (e.g. there are only two bulldozers and one mechanical shovel).
Human resources and capacity	Knowledge (scientific, "local", technical, political), education levels, labor.	Scientific understanding and knowledge, local knowledge, and human resources to undertake climate change planning work.	There is only one office that is in charge of environment and climate change with few personnel. There is not an updated map of risks in the city of Cobija.
Organizational and social capital	State-civil society relations, non-governmental and community-based organizations, relationships between institutions.	Stakeholders (government, non-government, vulnerable groups, etc.) that work together.	One distinctive feature is that several NGO´s are starting to work in Cobija. National and international organizations are focusing on working in the Amazon with a base in Cobija. Climate change resilience is a topic more frequently discussed in the programs and projects that are being undertaken. The community adaptive capacity functions based in the level of organization between community leaders with the basis in trust and coordination efforts. However, actions seem to be ex-post and not prior to disasters.
	Modes of governance, leadership, participation, decision and management capacity.	Functioning local government that is capable and willing to enforce municipal laws, plans and regulations.	GAMC has developed its plan to manage climate change and risk management with a horizon until 20230.

Table 15: Determinants of adaptive capacity and their relation to climate vulnerability for climate change dimension
Source: Own elaboration

cond level. Thus, in case of a flood, the household would be protected if the water level does not reach above 3 m.

According to the survey, flooding impacts are recurring, despite the development of strategies for managing risks and disasters based on past experiences. Of the total area affected by floods in 2024, 81% was flooded in 2015, and 50% was flooded in 2006 (Fig. 25 and Fig. 26). This

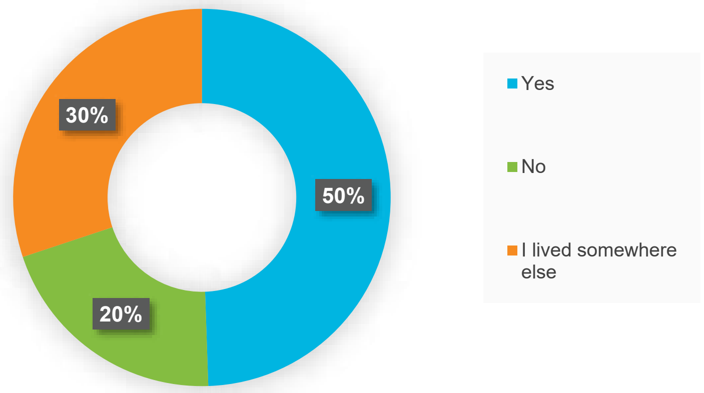


Fig. 25: In the 2006 flood, was your house affected by the flood?
Source: Own elaboration

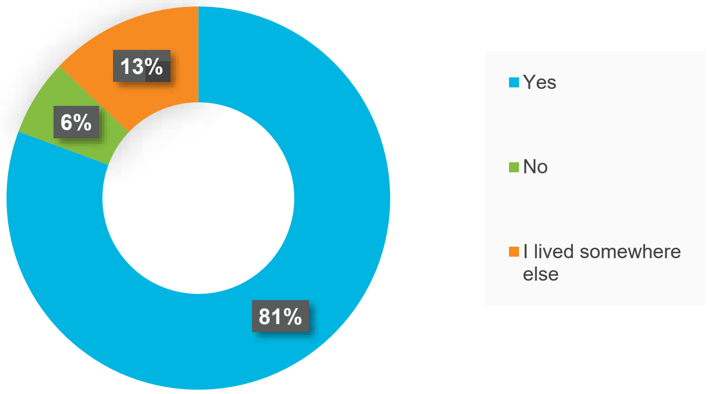


Fig. 26: In the 2015 flood, was your house affected by the flood?
Source: Own elaboration

means that each flood increasingly affects the neighborhoods located near the Acre River.

In the event of a flood, support generally comes from family members and neighbors, according to surveys. Volunteers from the university and local government also support the efforts (Fig. 27).

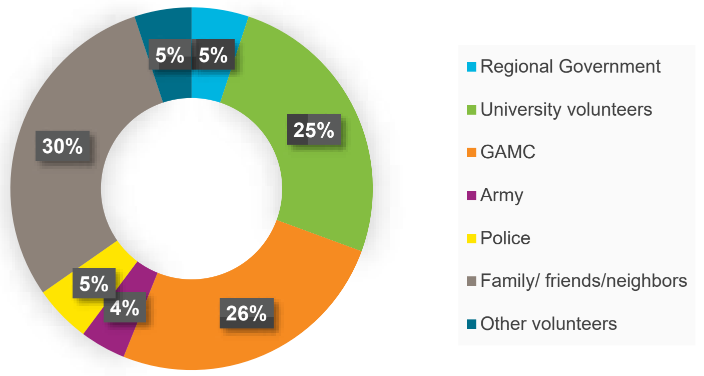


Fig. 27: Who helped your family during the flood?
Source: Own elaboration

Climate Change Future Vulnerabilities

In terms of climate change, vulnerability hotspots in Cobija will increase in the future due to projected climate scenarios in the region. Specifically, considering the scenario SSP5 , when the world would experience higher global temperatures and extreme weather events. Although the technological solutions available may help mitigate some of the worst effects, they would not be sufficient to keep global temperatures within safe limits (i.e., the 1.5°C or 2°C target set by the Paris Agreement). Then the maximum average soil temperature will rise from 26.89°C in 2025 to 31.85°C in 2100, a rise in 5°C.

Among these, flooding caused by the rising levels of the Acre River will be exacerbated by climate change, making study areas 1 and 2 more exposed to this frequent event. Currently, flooding occurs once a year, particularly in the first trimester. However, according to predictions from the General Directorate of Climate Change, the coming decade may see more than one stationary rainy season, which would further increase Cobija's vulnerability to flooding.

There is a direct relationship between flooding and landslides in Cobija. Landslides develop when water accumulates quickly in the soil following intense precipitation or rapid thaws, transforming the terrain into a river of mud. This mud can flow rapidly down hillsides or ravines, striking with little or no warning. Consequently, in the near future, all neighborhoods located along the river's edge will be vulnerable to landslides, leading to the loss of homes and urban infrastructure.

Regarding rising temperatures, Cobija is expected to experience heat waves that will not only affect the city but also the surrounding areas. This excessive temperature rise could impact human welfare and even alter the hydrologic cycle.

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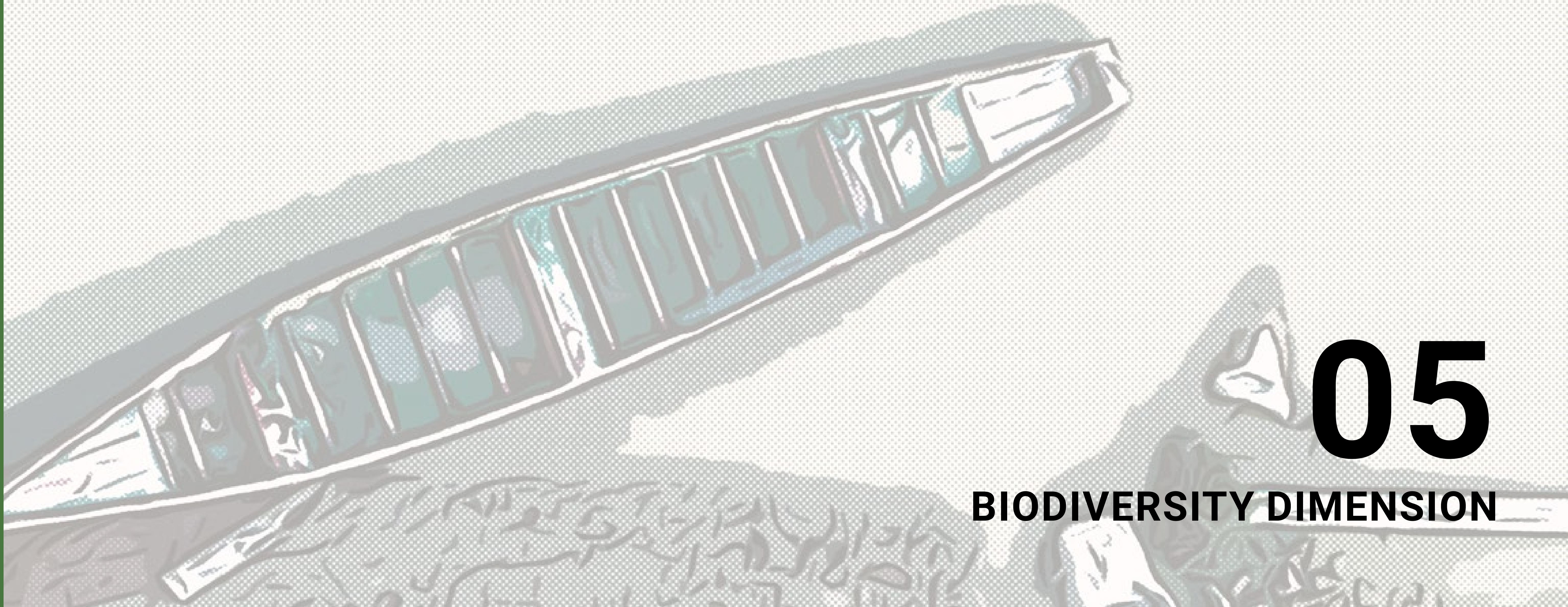
Biodiversity dimension of the MVA refers to the susceptibility of ecosystems, plant and animal species and



05
BIODIVERSITY DIMENSION

biodiversity in general to the impacts of climate change, urbanization and other development pressures.

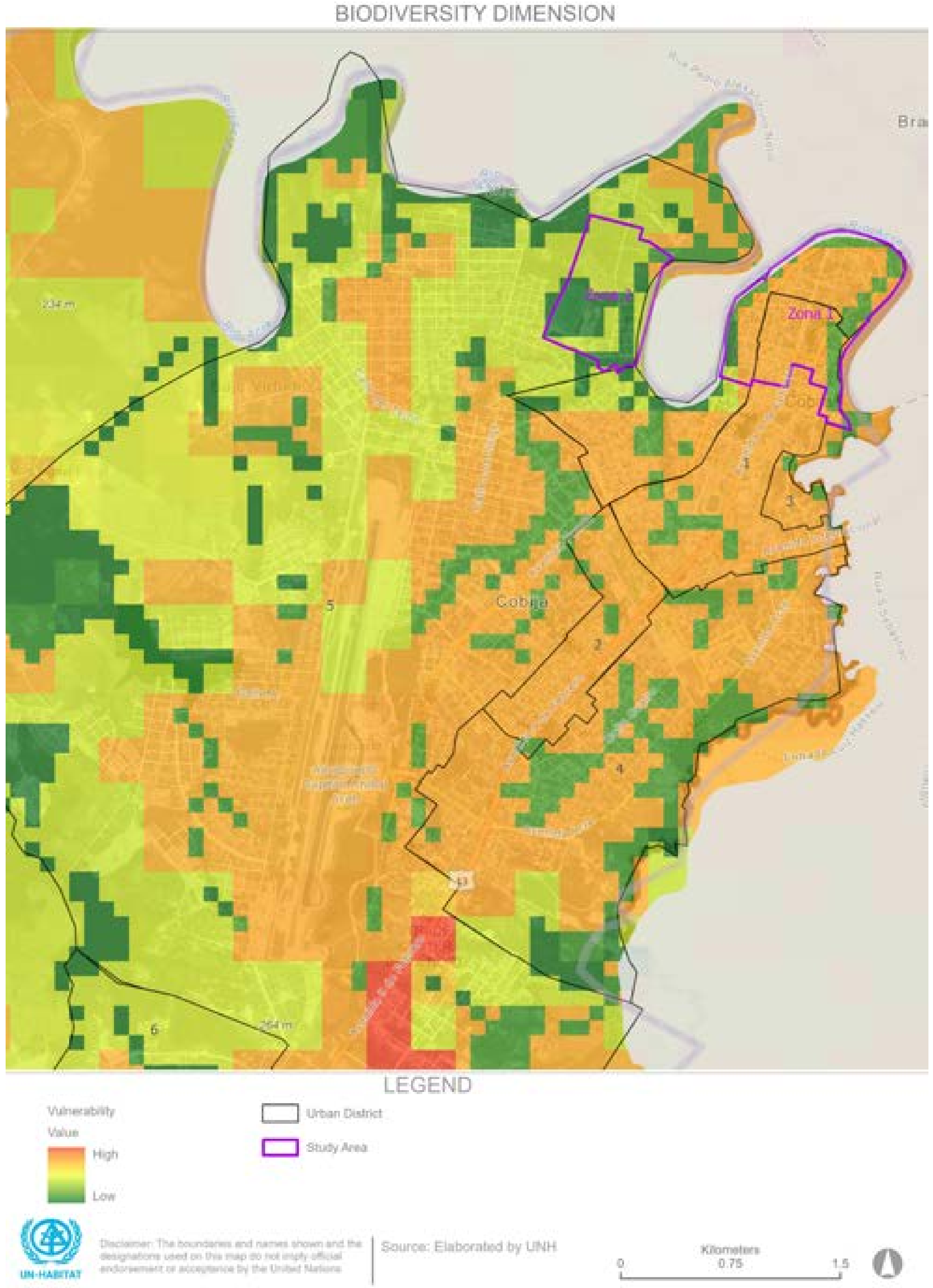
Bolivia represents 0.2% of the world's surface and is home to approximately 40% of the world's biological diversity. Its complex topography and geographic location have made it one of the countries with the greatest diversity of ecoregions.

The country has a policy and strategy for the comprehensive management of biodiversity, complemented by an Action Plan for 2019–2030.

The Ministry of Environment and Water (MMAyA) manages environmental policies, climate change plans, and programs, including those for biodiversity conservation. In this regard, MMAyA oversees the Authority for Inspection and Social Control of Forests and Land (ABT), an institution dedicated to promoting comprehensive sustainable rural development. The ABT focuses on sustainable forest management, democratizing access, supervising and controlling the use of forest resources and land, and ensuring benefits for forest and land users. It contributes to the sector's economic growth and the Plurinational State while upholding principles of transparency, effectiveness, efficiency, equity, and social and environmental responsibility.

At the local level, the Autonomous Municipal Government of Cobija, understanding its Amazonian context, is making efforts to preserve biodiversity through laws and regulations that support the protection of the Amazon rainforest. Activities such as colonization, logging, and extensive livestock farming are identified as primary causes of biodiversity loss. One of the most significant municipal laws regarding biodiversity preservation is Law 08/2022, which declares the Natural Area of Integrated Management for the basin of Arroyo Bahía in Cobija.

Additionally, it is essential to develop and fully implement a comprehensive local action plan for biodiversity preservation in Cobija.



Indicators

Indicator 1. Protected / Conservation Areas. This indicator shows the areas of the municipality declared for the protection and conservation of nature at national, regional and municipal levels. The protected and conservation areas reflect the surface area of natural spaces conducive to biodiversity development.

The location, characteristics, and conditions of protected and conservation areas within or near urban centres influence vulnerability to climate change and urbanization. These areas often contain diverse ecosystems—such as forests, wetlands, and grasslands habitats—that offer essential ecosystem services, enhancing climate resilience. They act as natural infrastructure for climate adaptation, providing crucial services like flood protection, water purification, cooling and erosion control.

This indicator was selected to assess the natural areas that are part of the main ecological structure, including rivers and riverbed, and forests within the city.

This indicator shows areas of high biodiversity value where the mean species abundance serves as an indicator of the overall health, richness and integrity of biodiversity and ecosystems in and around urban areas. It is related to the mean species abundance (MSA) index, which measures the integrity of local biodiversity.

The indicator uses the GLOBIO4 model to produce spatial datasets with results for overall mean abundance (MSA) by Global biodiversity model for policy support.

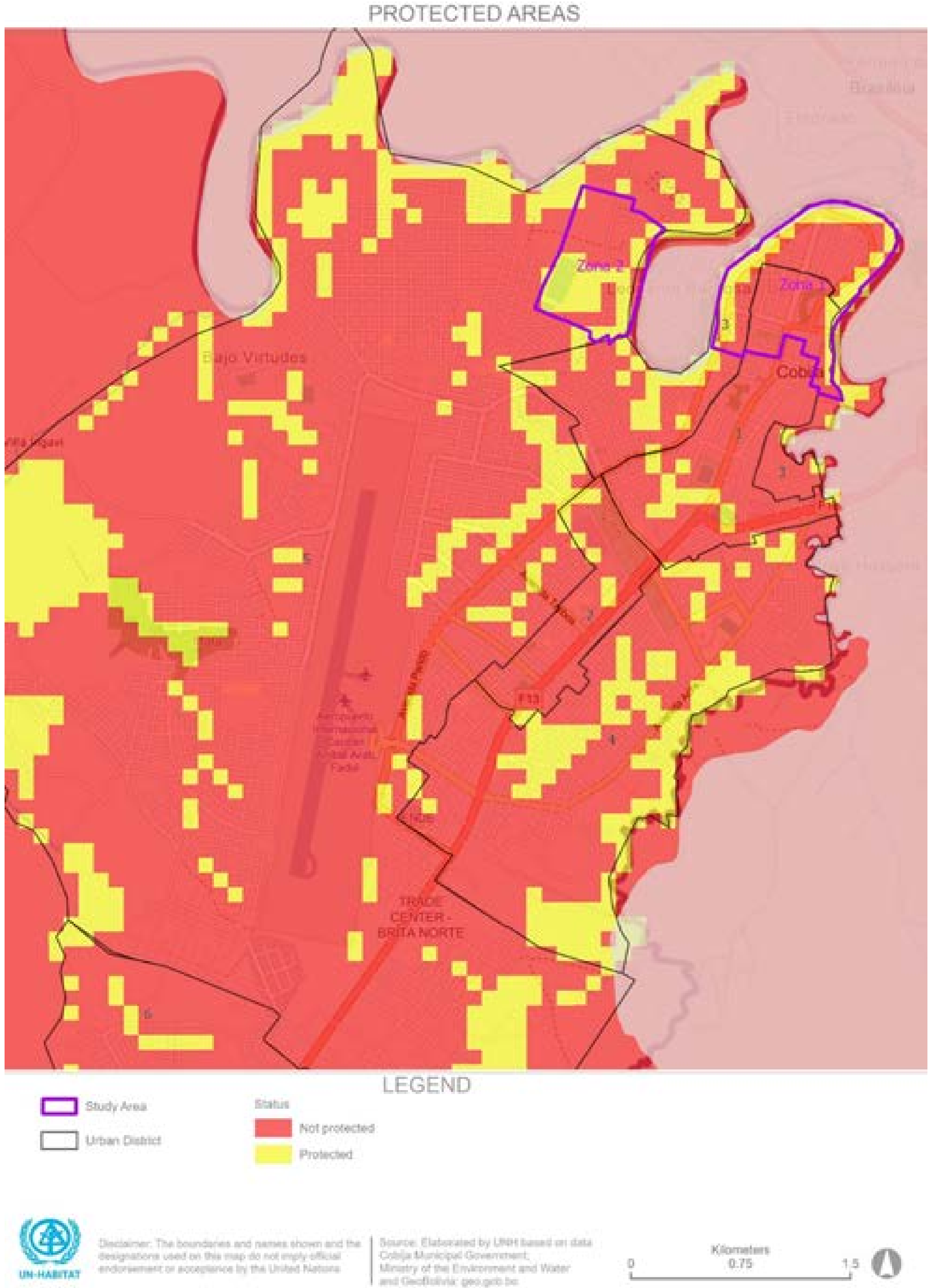


Fig. 28: Protected / conservation areas in Cobija
Source: UN-Habitat

There are several protected areas around Cobija such as Arroyo Bahía Stream at the southeastern part of the city (Fig. 28). Many of these protected areas exist along the river border.

Arroyo Bahía is an important watercourse in Cobija. This small stream, located in the Amazonian region, plays a crucial role in the local water system, supplying water for domestic and agricultural use to the city and surrounding areas.

Arroyo Bahía runs through the city of Cobija, contributing to the local ecosystem and serving as a critical source of water for its population. It stretches approximately 6 kilometers in length, making it an essential feature in the region's hydrological network. Due to its location within the city, the stream is directly affected by urban expansion, which has raised concerns about its management and sustainability.

Arroyo Bahía has the following environmental and urban challenges:

Contamination: As urbanization in Cobija has increased, the Arroyo Bahía has suffered from contamination due to improper waste disposal, lack of waste management infrastructure, and the surrounding informal settlements. This contamination is a growing concern because it affects the quality of the water, which directly impacts the health of the local population.

Flooding Risks: The Arroyo Bahía is prone to flooding, especially during the rainy season. In 2024 and 2025, intense rainfall caused the stream to overflow, leading to floods in neighborhoods such as Petrolero, Bahía, and Evo Morales. The flooding affected approximately 100 families, highlighting the vulnerability of urban areas situated near the stream.

The flooding and environmental degradation of Arroyo Bahía have raised alarms about the need for better urban planning and improved water resource management in Cobija. Authorities have been taking steps to address these issues, but there is still much to be done.

Efforts include studying the socioeconomic and environmental conditions of the stream, conducting assessments of water quality, and promoting sustainable water management practices in the city.

Several local organizations, such as Fundación Natura Bolivia, have carried out environmental studies to assess the stream's health and propose solutions. These studies focus on improving water quality, managing the river basin, and reducing the risk of floods in the area. There is an ongoing effort to improve infrastructure and ensure better waste management systems to prevent further contamination and mitigate the risk of floods.

Arroyo Bahía is an essential water resource for Cobija, but it faces significant challenges due to pollution and flooding risks. Addressing these issues requires coordinated efforts between local authorities, environmental organizations, and the community to ensure sustainable water management and urban planning to protect this vital water source.

Indicator 2 - Mean Species Abundance

While specific MSA data for Cobija, Bolivia, is limited, the region's rich biodiversity suggests a potentially high MSA, since the city´s location is known for its high levels of species richness and endemism.

A high biodiversity value refers to the richness and variety of species, ecosystems, and genetic diversity in a given area, and it indicates the overall health and resilience of the environment. Areas with high biodiversity value are typically home to a large number of species across various taxonomic groups (e.g., plants, animals, fungi, and microorganisms), with many of them often being endemic (unique to that region). High biodiversity is crucial because it helps ecosystems function properly, supports ecological balance, and provides various ecosystem services essential for human well-being. That is actually what has been observed at study area 1 that is considered to have medium MSA, while Area 2 is in a zone with low MSA, indicating a significant likelihood of not finding abundance of species in that area (Fig. 29).

In relation to species richness, a high biodiversity value is often associated with areas that have a large number of species across different groups (e.g., mammals, birds, plants, insects, etc.). Then at area 1 and Cobija´s eastern and central areas, the MSA shows as a medium level. That is due to the fact that urban areas have grown in areas of tropical rainforests where in ancient times there was a prevalence of high species richness that has been reduced to urbanization processes.

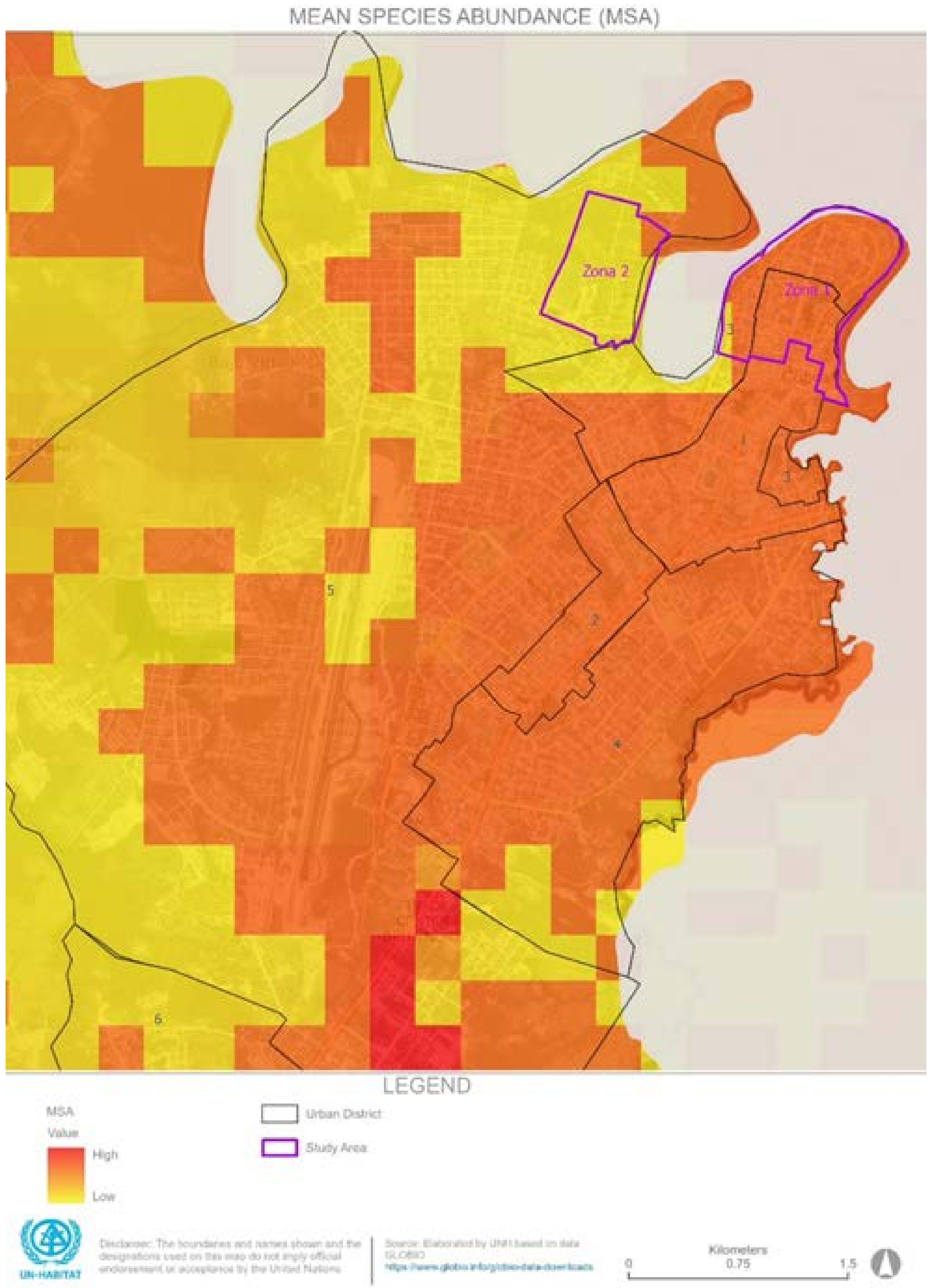


Fig. 29: Abundance in Cobija
Source: UN-Habitat

Biodiversity Dimension Analysis

The following biodiversity dimension analysis includes the 3 components of vulnerability: exposure, sensitivity, and adaptive capacity.

Exposure

Exposure identifies how Cobija is exposed to changes in the climate today and how it could be in the future in the biodiversity dimension.

Description of current and future changes

In area 1, nearly half of the Pto. Alto and Junín neighborhoods are located in conservation areas, which are protected areas along the riverbank composed of natural spaces. This indicates that urban growth is encroaching on biodiversity areas. Additionally, the northern parts of the Mapajo and Villamontes neighborhoods are also intruding into protected areas. Therefore, we can conclude that biodiversity is increasingly exposed to the growth of human settlements.

In area 2.40% of the Cataratas neighborhood is encroaching on a protected area, putting the local biodiversity at risk due to the expansion of that part of Cobija.

Regarding the abundance indicator, area 1 exhibits lower abundance, indicating less favorable conditions for maintaining biodiversity. Conversely, area 2 has higher abundance, suggesting better conditions for sustaining biodiversity. Thus, area 1 is more exposed to biodiversity loss than area 2.

Identification of people, places, institutions and sectors that are exposed to climate hazards

The following table summarizes identification of climate hazards and exposed features and sectors.

Climate Change Hazard	Current Weather Data	Climate Scenario Projections	Impacts	Exposed features and sectors
Flooding/ Landslides	**Precipitation:** 1,774mm in the east to 1,834mm in the west. **Temperature:** Between 25.5ºC and 26.8ºC. Extreme maximum temperatures reach 38ºC	IADB projections: • Precipitation increase: 26%. • Temperature increase: 3.7%	Habitat Loss	Cobija, as an Amazonian city, is surrounded by biodiversity; the whole population would be affected if biodiversity diminishes. Natural reserve: Arroyo Bahía Around the river and other bodies of water fauna and flora

Table 16: Identification of climate hazards and exposed features and sectors for Biodiversity dimension
Source: Own elaboration

Sensitivity

The objective is to identify how, in Cobija, the biodiversity dimension currently impacts people, places, institutions, and sectors, as well as the extent of potential future impacts. Three key considerations are: demographics, housing, and production and investment.

Demographic

Regarding the demographic consideration, the data used is the same as that which is presented in the urbanization and climate change dimensions. However, in the biodiversity dimension, this analysis incorporates specific considerations relevant to biodiversity.

In addition to the previous table, the following is a relevant statement:

- Deforestation is a consequence of urbanization and industrial and agricultural activities. It reduces the size of reserve areas and changes environments.

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
Demographics	Proportion of children and elderly	Children are sensitive to biodiversity because they have activities and practices related to the fauna and flora that are on the banks of the river.
	Household literacy[1]	A more literate population can be more sensitive towards biodiversity preservation than those without literacy.
	Proportion of economically active Household members	Human activity impacts biodiversity, as land use for various purposes has led to biodiversity loss due to environmental changes and resource consumption, resulting in pollution.

Table 17: Socio-economic sensitivity variables (Demographic) for Biodiversity dimension
Source: Own elaboration

Housing

Regarding the housing consideration, the data used is the same as that which is presented in the urbanization and climate change dimensions. However, in the biodiversity dimension, this analysis incorporates specific considerations related to biodiversity.

Production and investment

Regarding the production and investment consideration, the data used is the same as that presented in the urbanization and climate change dimensions. However, in the biodiversity dimension, this analysis incorporates specific considerations related to biodiversity.

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
Housing	Materials	Sixty-five percent of households have walls made of bricks, 32% are constructed with wood, and 3% are made of other materials. Additionally, 78% of households have roofs made of calamine. In the biodiversity dimension, the materials used in household construction are important for understanding their origins. For example, the use of wood in construction could negatively impact ecosystems due to the loss of tree species.

Table 18: Socio-economic sensitivity variables (Demographic) for Biodiversity dimension
Source: Own elaboration

Coping capacity

After analyzing the territory with the local government, it has been decided to include Arroyo Bahía (Bahía Stream) as the main protected area, as it is the natural reserve closest to the city of Cobija and presents the following facts:

Consideration	Variables	Sensitive Features (people, places, institutions) and sectors
Production and investment	Land-use areas residential, commercial, industrial, Infrastructure	In the biodiversity dimension, if land uses change to commercial or industrial purposes, it would negatively impact the surrounding environment by reducing the presence of trees and animals.
	Land values	

Table 19: Socio-economic sensitivity variables (Production and investment) for Biodiversity dimension
Source: Own elaboration

1. The Bahía stream basin is a transboundary basin.

2. The Bahía stream hydrographic basin is spatially smaller than the hydrogeological basin and the underlying aquifer.

3. The Bahía stream has a base flow of 1,000 l/s during the dry season, which means it can supply drinking water for twice the current population of Cobija.

4. The Bahía stream, the primary water source for Cobija, does not lack quantity but faces issues related to water quality and management.

5. Fecal and total coliforms are present in the Bahía stream and its tributaries, with concentrations exceeding permissible limits, making the water unsuitable for direct human consumption.

6. There is clear evidence of leachate leakage from the old landfill into the Bahía stream bed.

7. Secondary vegetation in deforested areas helps prevent erosion in the higher parts of the landscape.

8. The lack of vegetation in the tributaries of the Bahía stream, along with sandy-clay soil, facilitates river erosion and increases water turbidity.

9. During the dry season, the Bahía stream receives its water exclusively from the aquifer located beneath its hydrogeological basin.

10. The recharge of the aquifer that feeds the Bahía stream comes from the upper parts of this basin and neighboring basins to the east, southeast, and south.

On one hand, in partnership with local and international NGOs (e.g., WWF), GAMC is mapping the presence of animal species and forests. On the other hand, CIPCA is studying the agricultural production of farmers near the urban area of Cobija and its impact on biodiversity. These are practical examples of GAMC's recent work in collaboration with other stakeholders.

Determinant	Description	Relation to biodiversity vulnerability	Situation in Cobija
Economic wealth and financial capital	Municipal financial resources, resident incomes and wealth distribution, economic marginalization, fiscal incentives for climate risk management.	Biodiversity adaptation with internal funding or external support	Currently, the city of Cobija is facing a lack of economic resources, which makes it challenging to implement measures to enhance resilience to climate change hazards. At present, there is no private financing available for biodiversity initiatives. However, it is anticipated that in the coming year, new private entities will engage in this field in Cobija, with an allocated budget.
Access to information and technology	Communication networks, computing tools, freedom of expression, technology transfer and data exchange	Technical data, data modelling capability, sharing and distribution information to Biodiversity	There is a lack of access to information, and few civil servants are familiar with climate change adaptation strategies and biodiversity preservation.
Material resources and infrastructure	Transport, water infrastructure, buildings, sanitation, energy supply and management	Designed, constructed, sited, and managed infrastructure and services to be more adaptable or easier to adapt to biodiversity impacts and risks	Due to a lack of economic resources, GAMC has limited material resources for biodiversity management.
Human resources and capacity	Knowledge (scientific, "local", technical, political), education levels, labor.	Scientific understanding and knowledge, local knowledge, and human resources to undertake biodiversity planning work.	In the dimension of biodiversity preservation awareness, some actions have been undertaken in collaboration with the local university.
Organizational and social capital	State civil-society relations, non-governmental and community-based organizations, relationships between institutions.	Stakeholders (government, non-government, vulnerable groups, etc.) that work together.	One distinctive feature is that several NGOs are beginning to work in Cobija. National and international organizations are focusing on the Amazon with a base in Cobija.
	Modes of governance, leadership, participation, decision and management capacity.	Functioning local government that is capable and willing to enforce municipal laws, plans and regulations.	Biodiversity is increasingly featured in the programs and projects being undertaken (e.g., Herencia, ACEA, FAUTAPO, etc.). In the biodiversity dimension, there is a municipal law that has declared Arroyo Stream a preservation area.

Table 20: Determinants of adaptive capacity and their relation to biodiversity vulnerability for Biodiversity dimension
Source: Own elaboration

06

OVERLAPPING VULNERABILITIES

Urban and Climate Change Vulnerabilities

The conflicting vulnerabilities between urban and climate dimensions have been identified using a map to determine key hotspots in the study areas.

At the city level, the main hotspots are located in the northern and central parts of Cobija, while the western and southern areas experience less pronounced conflicts.

Study area 1 is situated in a zone with a prevalence of urban and climate change vulnerability hotspots, that in its highest category is located at the north part of Mapajo neighborhood, reaching the highest value. Hotspots of medium scale are located in the whole 4 neighborhoods, especially in the areas near to the river bank. In Junín neighborhood there are several hotspots of medium scale throughout its area. In Villamontes neighborhood the majority of hotspots are of the lowest category, with some medium grade at the northern part and near to the river. Pto. Alto neighborhood has some medium scale hotspots at the river shore part of its jurisdiction. Generally, all hotspots identified in Area 1 are located near the border with the Acre River.

Area 2 encompasses the entire Cataratas neighborhood, which has a wide variety of hotspots. However, the highest category hotspot is found in a particular part of the eastern side of the neighborhood, adjacent to the Acre River, where flooding impacts are greater.

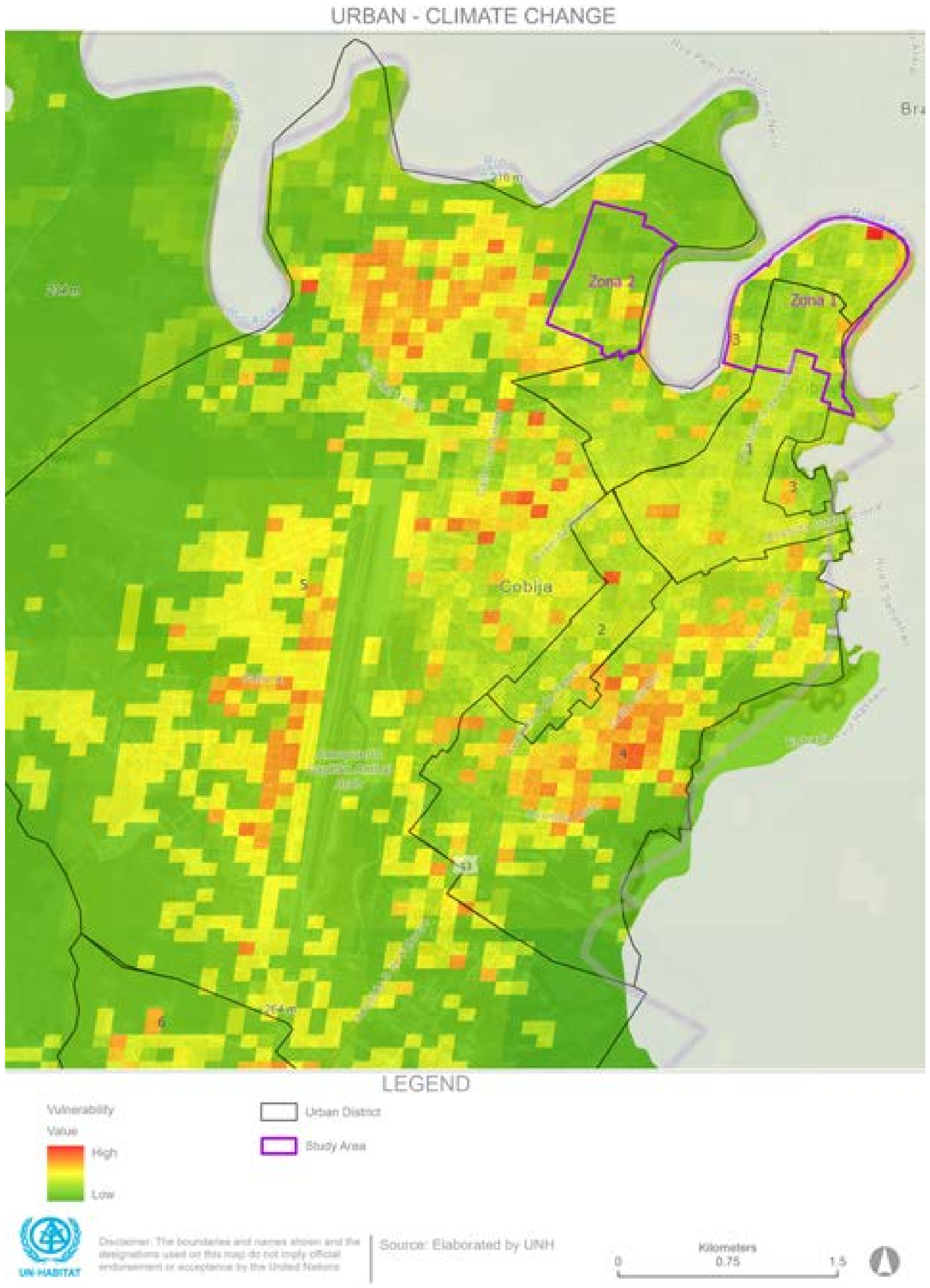
Notably, the main bridge connecting Cobija with the Brazilian city of Brasileia is located near the most pronounced hotspot. Additionally, the hotspot in the Junín neighborhood coincides with areas that have previously experienced flooding or landslides after water levels decreased.

In terms of population density and vulnerable hotspots, most of the population resides in areas of the city that are not exposed to flooding. However, urban growth has led to some dense areas being situated on landslide sites.

It is crucial that the identified hotspots in both the urban and climate change dimensions are used for better planning regarding urban expansion and development. The northern part of the city, exposed to flooding, is particularly sensitive due to inadequate infrastructure to protect homes from flooding and erosion.

Therefore, government and community management must be strengthened to address future scenarios of more intense flooding. Investment in maintenance or new infrastructure resilient to this climate threat should be prioritized. Additionally, the increasing temperatures in densely populated and infrastructure-rich areas of the city necessitate more resilient infrastructure and basic services.

It is important for the city to grow in areas that are not exposed to climate change hazards, in accordance with Cobija's urban plans. For instance, in the case of the Cataratas neighborhood, growth should be directed westward, thereby avoiding the most vulnerable hotspots identified in this assessment.



Climate Change and Biodiversity Vulnerabilities

The conflicting vulnerabilities between climate and biodiversity dimensions have been identified using a map to determine key hotspots in the study area.

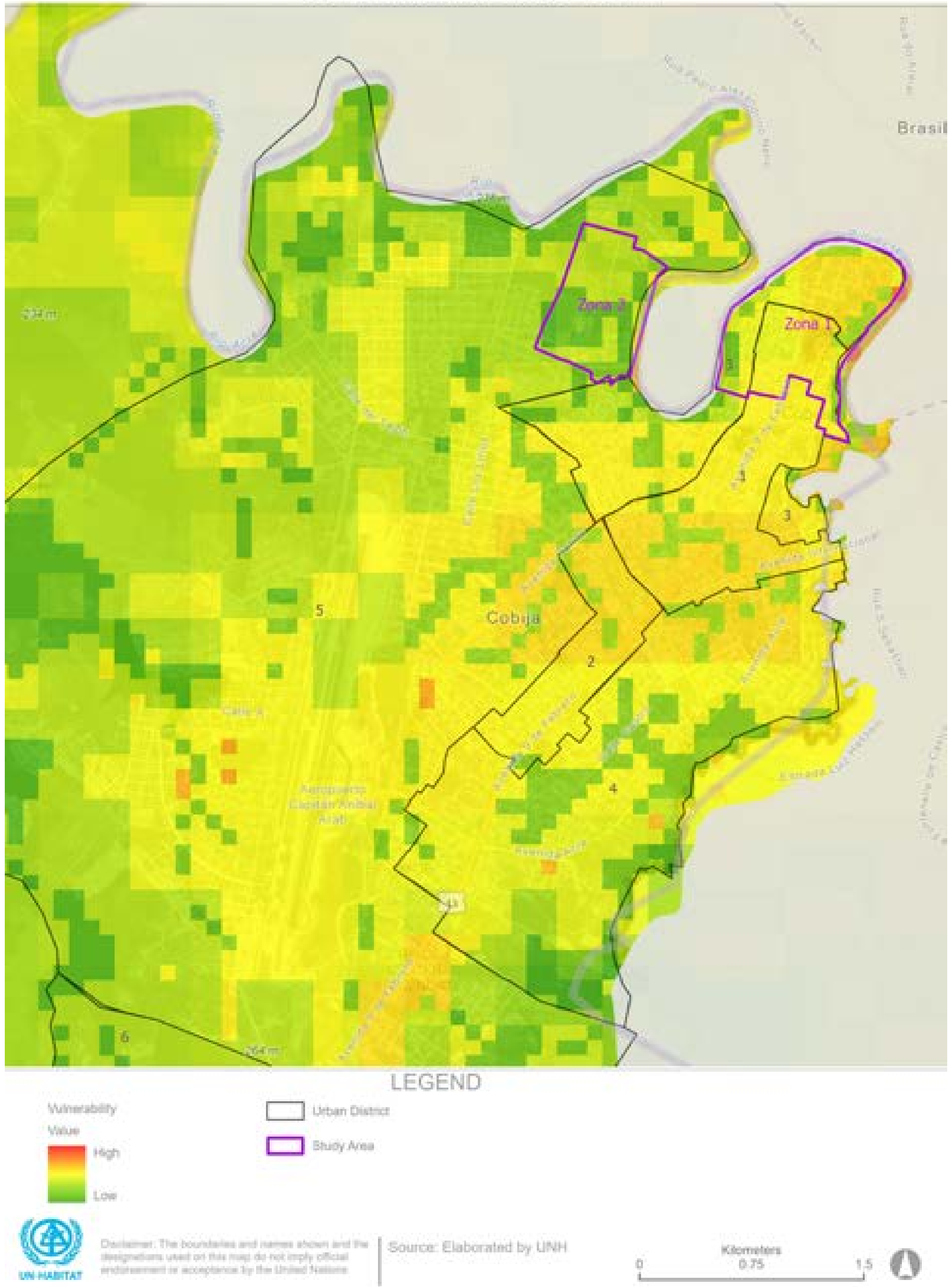
Recognizing that ecosystems represent the broadest scale of biodiversity, the services they provide are closely linked to climate. The climate in an ecosystem regulates the temperature and humidity conditions on which the different species depend for their maintenance and development. In the case of Cobija, the humid forest depends on a unique balance within the Amazon region, characterized by constant and intense rainfall that supports the growth of a large mass of trees and other vegetation essential for carbon capture from the atmosphere. Therefore, when climatic threats and alterations in climate variability occur—such as changes in rainfall and temperature—ecosystem services and species stability are adversely affected.

In study area 1, half of Junín (both northern and southern parts) along with the northern areas of Mapajo, Villamontes, and Pto. Alto neighborhoods experience conflicts related to biodiversity and climate change. This suggests that there is a compounded climate-biodiversity vulnerability. For instance, flooding from the Acre River leads to the loss of natural habitats crucial for maintaining local biodiversity.

In study area 2, the Cataratas neighborhood does not exhibit conflicts with high-value hotspots, but rather with medium-value hotspots in the northern part of the neighborhood, however; at the center and southern part of it there are low range hotspots. This is due to the fact that, although it is highly exposed to flooding, its sensitivity is moderate due to lower population density and urban infrastructure.

The increasing frequency and intensity of climate change hazards (e.g., flooding) could cause severe damage to the ecosystem and result in significant loss of biodiversity in the Amazon.

CLIMATE CHANGE- BIODIVERSITY



Biodiversity and Urban Vulnerabilities

The conflicting vulnerabilities between biodiversity and urban dimensions have been identified using a map to determine key hotspots in the study area.

Like many cities, Cobija has adopted an urban model characterized by low density and segregated land use, typical of the Amazon region. The relationship between land-use change and biodiversity is complex. The strategic natural ecosystems of the city, particularly those linked to bodies of water and humid forests in the periphery, have experienced significant biophysical alterations due to deforestation, changes in water courses, and the encroachment of infrastructure and buildings. Although the city is surrounded by rich natural resources, this ecosystem is fragile in the face of climatic variations, decreased precipitation, and rising temperatures, which can restrict ecosystem services and abiotic conditions necessary for the survival of various species.

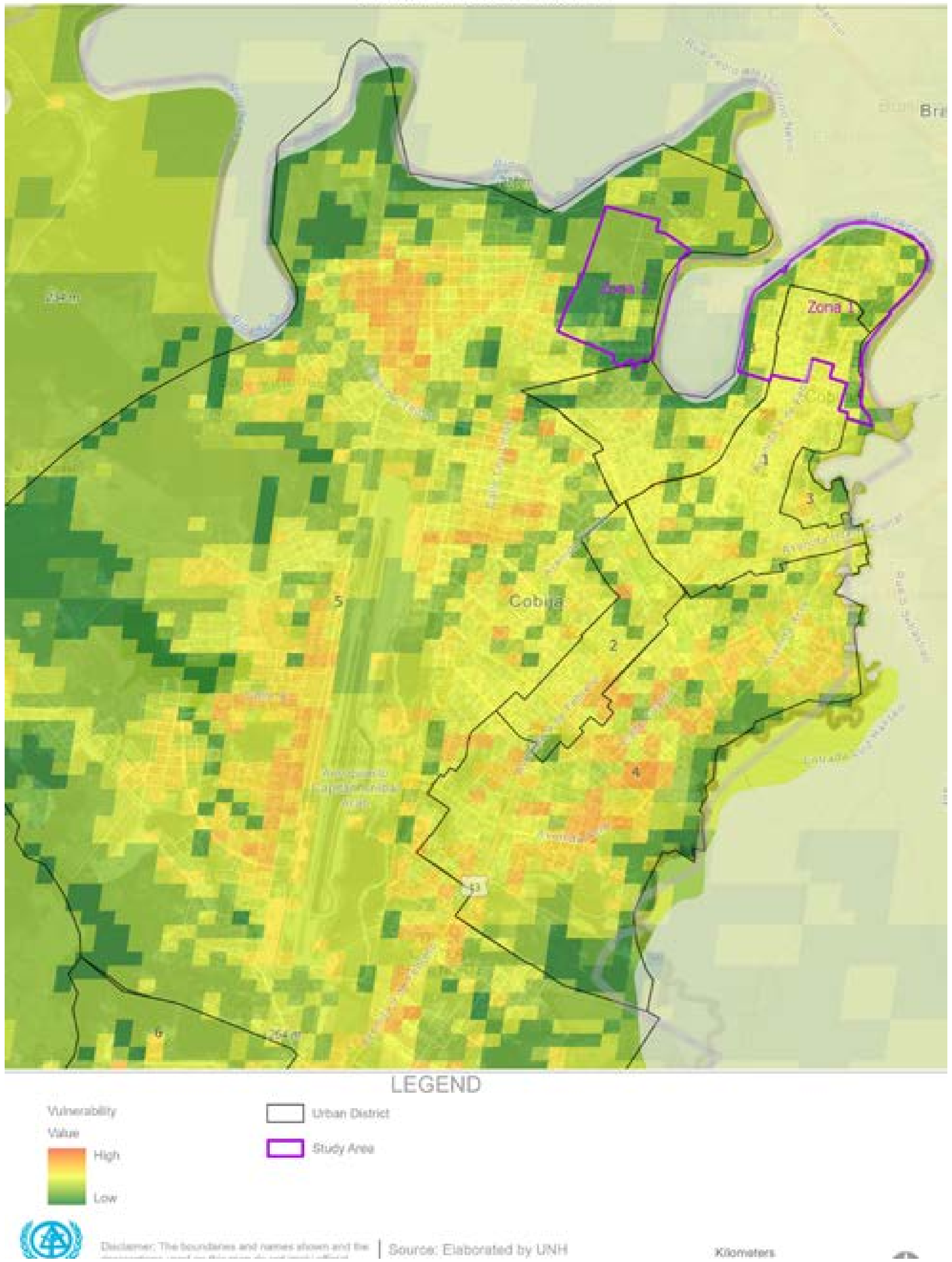
Throughout Cobija, areas with the highest population density and urban expansion are particularly vulnerable to biodiversity loss, as they disrupt ecological connectivity within the urban system and protected areas.

In study area 1, Mapajo and Junín neighborhoods are clearly situated in zones with conflict between urbanization and biodiversity, with vulnerability ranging in the medium level. This situation is largely due to their proximity to the Acre River, which directly impacts local biodiversity. In the same aspect, Pto. Alto and Villamontes neighborhoods are in areas with medium conflict levels between urbanization and biodiversity.

In Area 2, the northern part of the Cataratas neighborhood present areas that agglutin hotspots of medium level of vulnerability. However, its central and southern areas experience less conflict areas between urbanization and biodiversity. This suggests that Area 2 faces less conflict overall, mainly due to greater coverage of natural spaces and conditions that hinder urban development.

Regarding the overall conflict between biodiversity and urban growth, while Cobija is not experiencing exponential urban sprawl, new neighborhoods and migration from other parts of Bolivia could impact the natural reserves surrounding the city, such as Arroyo Bahía.

URBAN- BIODIVERSITY

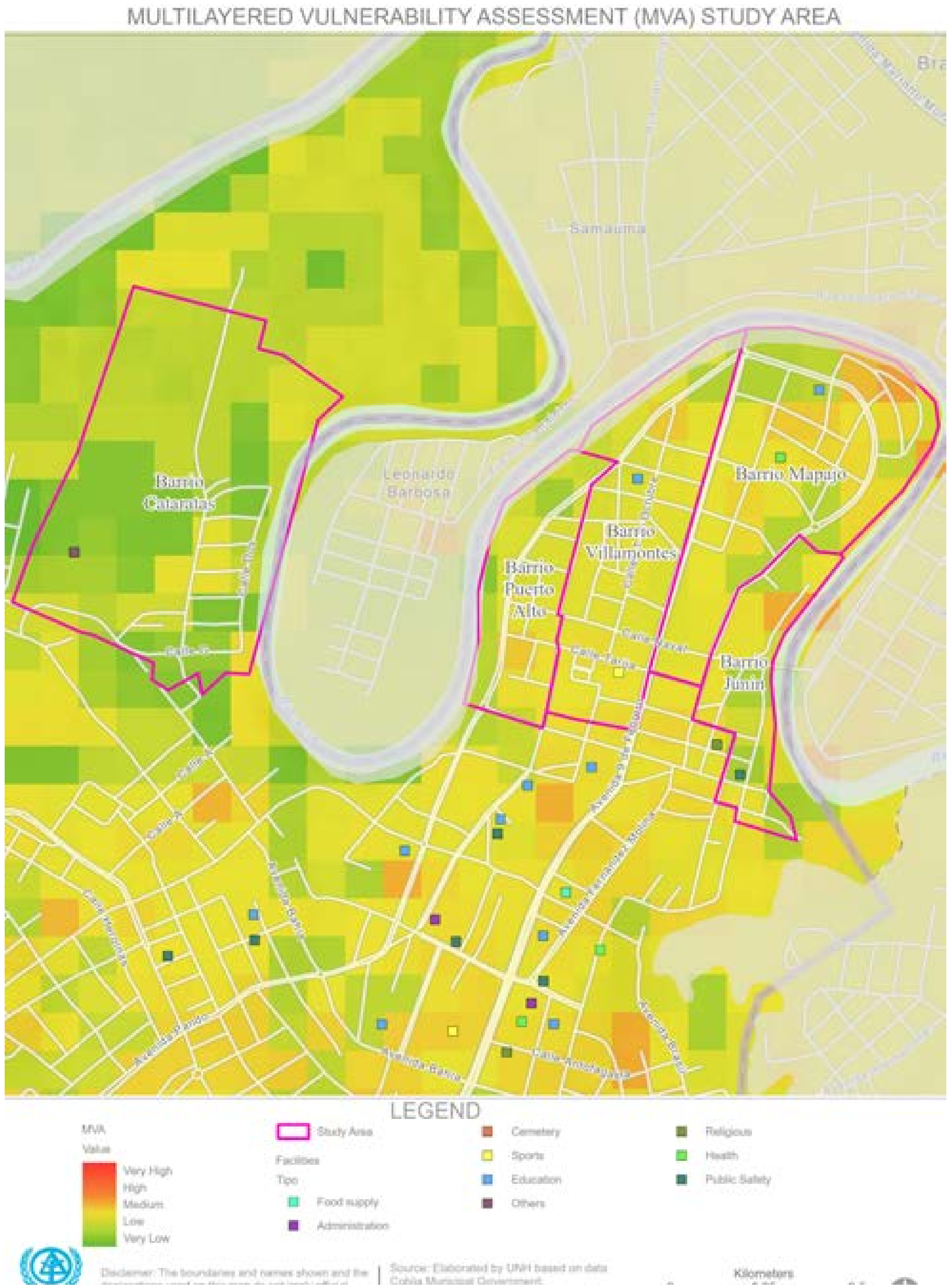


Multilayered Vulnerability Hotspots

The three dimensions studied in this assessment (urban, climate change, and biodiversity) indicate that Cobija, particularly the five neighborhoods examined, is situated in a territory vulnerable to climate change hazards. The overlapping nature of these dimensions has created hotspots of conflict that should be prioritized to enhance community safety and resilience to climate change. The most vulnerable hotspots are located in study area 1, which includes the oldest neighborhoods of the city, closest to the riverfront.

The ecosystem is central to the interconnection of biodiversity, climate impacts, and urbanization. Cobija's natural wealth is a strategic asset for urban and climate risk management, making its preservation urgent. In terms of the three contributions to vulnerability—exposure, sensitivity, and adaptive capacity—we can make the following observations:

- Study areas 1 and 2 show greater exposure to climatic threats (flooding and landslides) due to various factors related to urbanization and planning. Study area 1 comprises four traditional neighborhoods located along the banks of the River Acre, making them particularly susceptible to flooding and subsequent landslides. Similarly, study area 2 (Cataratas neighborhood) is a newer neighborhood with a lower population but a larger area, where the eastern part is more vulnerable to flooding. Currently, institutional weaknesses hinder the city's ability to address these challenges. Moreover, a lack of financial resources and effective urban planning prevents Cobija from being resilient to climate change and ready to implement a comprehensive disaster risk prevention strategy.
- In terms of sensitivity, many households are precarious structures, particularly in Cataratas, while study area 1 has better building materials. Both areas have access to essential services, but the storm drainage systems need updating. Educational and health services in these areas often experience disruptions due to flooding. Although there are paved roads, flooding directly affects this infrastructure. Key variables contributing to vulnerability include demographics (gender and the proportion of children and the elderly), welfare (poverty rates), and production (land use).
- Regarding adaptive capacity, residents of Cobija, having experienced disasters, are increasingly prepared for such events. Some neighborhoods have knowledge of early warning strategies, and some residents own properties elsewhere in the city for potential relocation. Schools in other parts of Cobija receive students from flood-affected schools. In terms of household design, many homes in Pto. Alto and Cataratas are built on stilts to withstand rising river levels. After disasters, volunteer groups, including university students, Red Cross staff, and civil servants from GAMC and the Regional Government, assist affected individuals. Sports facilities are often used to shelter those who have lost their homes. Unfortunately, these responses typically occur after disasters, with few preventive actions taken in advance.



In summary, the city has acquired experiential knowledge of its climatic threats and has basic response strategies. However, its adaptive capacity is insufficient to reduce the vulnerability of its populations. The implementation of climate-resilient and biodiversity-focused urban management is hindered by various factors, including economic, political, and governance issues.

The vulnerabilities described across different areas (social, economic, physical, environmental) exacerbate one another, creating a vicious cycle of poor practices that increase the vulnerability of communities in the studied neighborhoods.

Cobija faces many challenges in managing its territory effectively. Although it is not a large city, improved planning can still enhance land use if a clear vision is defined. This will help establish priorities and necessary infrastructure for sustainable development. However, implementation has historically been an issue in Bolivian cities, particularly in the Amazon. Therefore, Cobija's efforts should focus on feasible strategies that can be practically implemented in the short and medium term.

Development policies must address employment generation, social cohesion, respect for the Amazonian environment, access to housing, and efficient service provision. This planning should also incorporate resilience to climate change threats. Consequently, GAMC is advocating in both national and international contexts to raise awareness of Amazonian cities.

The challenges outlined above should also be viewed as opportunities, leading to the identification of priority areas for action. Thus, the Cataratas neighborhood, along with Mapajo and Junín, should be prioritized for comprehensive pilot projects that can later be replicated in other neighborhoods of Cobija.

These comprehensive solutions must aim to reduce climate vulnerability to flooding, landslides, and rising temperatures while also strengthening the sustainable management of biodiversity by strategically utilizing the Amazon's natural wealth.

07

REFERENCES

Andersen, L.E. 2014. La economía del cambio climático en Bolivia: Impactos sobre la Biodiversidad. C.E. Ludeña y L. Sánchez-Aragón (eds), Banco Interamericano de Desarrollo, Monografía No. 192, Washington, DC.

Figueroa-Silva, Esau, & León-Aravena, Javier. (2023). Vocación productiva y realidad productiva territorial: el caso de la Provincia de Arauco, Chile, 2021. Población y Desarrollo , 29(56), 31-44. Epub June 00, 2023.https://doi.org/10.18004/pdfce/2076-054x/2023.029.56.031

Gobierno Autónomo Municipal de Cobija. (2022). Agenda Urbana Local de Cobija. (1ra. ed.). La Paz.

Gobierno Autónomo Municipal de Cobija. (2022). Plan de gestión de riesgos y cambio climático del municipio de Cobija (2022-2030). (1ra. ed.). La Paz.

Gobierno Autónomo Municipal de Cobija. (2019). Plan Territorial de Desarrollo Integral. Cobija.

Ministerio de Desarrollo Productivo y Economía Plural. Dirección General de Análisis Productivo. (2020). Informe Estadístico Productivo del Departamento de Pando. La Paz.

Ministerio de Medio Ambiente y Agua. Viceministerio de Medio Ambiente, Biodiversidad, Cambios Climáticos y de gestión y de desarrollo forestal. (2018). Política y Estrategia Plurinacional para la Gestión Integral y Sustentable de la Biodiversidad PLAN DE ACCIÓN 2019 – 2030. (1ra. ed.). La Paz.

Servicio Nacional de Geología y Técnico de Minas. (2010). Hidrogeología del Arroyo Bahía Cobija – Pando. (1ra. ed.). La Paz: Conservación Internacional Bolivia.

Vicepresidencia del Estado Plurinacional de Bolivia. (2024). Trazando el camino del vivir bien: El mecanismo de cooperación por resultados en Bolivia, para la conservación de bosques, la biodiversidad y la continuidad intergeneracional de las culturas del bosque. (1ra. ed.). La Paz.

UN-HABITAT

EMBASSY OF SPAIN IN BOLIVIA

aecid

Spanish Cooperation
BOLIVIA