Recibido 10/05/2021
Aceptado 28/06/2021

MINGA: SUSTAINABLE AND REPLICABLE URBAN RENOVATION MODEL, THE BUENAVENTURA CASE

MINGA: MODELO REPLICABLE DE RENOVACIÓN URBANA SOSTENIBLE, CASO BUENAVENTURA

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RESUMEN

Este artículo presenta los resultados obtenidos en la investigación realizada durante la ejecución de un diseño de renovación urbana sostenible en la ciudad de Buenaventura, Valle del Cauca, Colombia, como parte de la propuesta del equipo MINGA para el SDLAC 2019 (Solar Decathlon Latin America and Caribbean). Este proyecto fue desarrollado por un grupo de estudiantes y profesores, dentro de los espacios académicos de los programas de pregrado de Arquitectura e Ingeniería Civil de las universidades partícipes del equipo MINGA. Se utilizó la metodología de enseñanza-aprendizaje basada en proyectos, con integración curricular en cursos interdisciplinares tipo taller de proyectos. El objetivo principal fue demostrar la viabilidad de un proyecto de urbanismo resiliente, concebido para el clima futuro en una ciudad costera del trópico cálido-húmedo. Los resultados demostraron que se puede crear un urbanismo climático, resiliente al clima, que garantice la permanencia de los habitantes originales de las zonas costeras, mitigando los riesgos por inundación y garantizando el arraigo cultural de sus habitantes, aun en escenarios de aumento en el nivel del mar

Palabras clave
urbanismo sustentable, cambio climático, vivienda social

ABSTRACT

This article presents the results obtained in research made during a sustainable urban renewal design in the city of Buenaventura, Valle del Cauca, Colombia, as part of MINGA team's proposal for SDLAC 2019 (Solar Decathlon Latin America and Caribbean). This project was developed by a group of students and professors, as part of the undergraduate programs of architecture and civil engineering of the partner universities in the MINGA team. A project-based teaching-learning methodology was used, integrating the curricula in interdisciplinary project workshop-type courses. The main goal was to demonstrate the viability of a resilient urban planning project, conceived for the future climate in a coastal city in the hot-humid tropics. The results showed that a climate-resilient urbanism can be created, which guarantees the permanence of the original inhabitants of the coastal areas, mitigating flooding risks, and preserving the cultural roots of the inhabitants, even under sea-rise scenarios.

Keywords
sustainable urbanism, climate change, social housing

INTRODUCTION

The Solar Decathlon is currently the most important international sustainable construction academic event. Held since 2002, it states among its goals, the education of students and the public regarding the environmental benefits that sustainable construction provides (Kos & De Souza, 2014). The Latin American editions of the competition, held in Cali, are pioneers in focusing attention on sustainable housing solutions for low-income neighborhoods, with a regional relevance for the tropics (Herrera-Limones, León-Rodríguez & López-Escamilla, 2019). For the 2019 edition, an alliance was made between the Pontifical Xavierian University – Cali (Colombia), the Federal University of Santa Catarina, and the Federal Institute of Santa Catarina (Brazil), forming an interdisciplinary team comprising students and professors from architecture, engineering, visual communication design, and communications. The Minga team designed, built and set up a housing prototype that is part of an urban multi-family housing project for the city of Buenaventura. Although the urban proposal is located on a specific site, bearing in mind the environmental, social and economic conditions of the city and the region, using a project that meets the population's needs, it is adaptable to other regions with similar coastal conditions in the warm-humid tropics.

The planet's urban coastal areas are the most vulnerable when it comes to the negative effects of climate change, on being highly populated, and having a higher population growth projection (Béné *et al.*, 2018; Neumann, Vafeidis, Zimmermann & Nicholls, 2015). In these regions, and particularly in Latin America, there are high rates of poverty, exclusion, inequality and housing precariousness, which make life on the coasts, a very high risk option (Nicholls *et al.*, 2014; Vergel Tovar, 2010). All this outlines new challenges for coastal cities: making them more viable and suitable for future climatic conditions, prioritizing the protection of their inhabitants, and protecting infrastructure against the negative effects of climate change, using adaptation strategies that foresee events, and reduce vulnerability (Hernández-Guerrero, Vieyra-Medrano & Mendoza, 2012).

Facing the new challenges, methodological approaches become necessary, that are capable of developing climate-proof urban models (Wardekker, De Jong, Knoop & Van Der Sluijs, 2010), which focus on climate urbanism as a new paradigm beyond the concept of sustainable urbanism (Long & Rice, 2019). It is under this scenario of charge that the concept of urban resilience gains strength, understood as the capacity of a system to maintain or quickly revert to its desired operation after a disturbance (Meerow, Newell & Stults, 2016). It is necessary that urban systems increase their adaptation capacity, preparing a suitable response to current and future challenges (Hernantes, Maraña, Giménez, Sarriegi & Labaka, 2019).

The case study also outlines the challenge of acting on the informal city. Traditionally, large urban projects provide an answer to a physical setting that needs to be transformed, but rarely do they consider the true needs of their inhabitants (Hernández Araque, 2016). Thus, design processes must be developed with community participation, offering "locational" responses, suitably fitting the specific contexts (Musango, Currie, Smit & Kovacic, 2020). The proposal presented here, suggests that it is possible to prepare a resilient urban renewal model, that minimizes forced displacement within the city, and that slows down urban expansion, through a project that considers current and future climate conditions, sociocultural conditions, and that reinterprets the occupation systems of ancestral lands, using new construction technologies and innovative design processes.

CONTEXTUALIZATION

Buenaventura is a coastal city in southeastern Colombia (3°52'59'' North, 77°4'1'' West). With its strategic position, its connection to the Pacific Ocean, and its proximity to the Panama Canal, it is home to one of the country's most important ports. The city is divided into two: the continental section, and the island of Cascajal, connected by the city's main road, Avenida Simón Bolivar. This relationship with the sea is a very important aspect for the economy, the environmental wealth, and the culture of the city. Despite this, due to political reasons, the economic revenues are not reflected in the city infrastructure. It is for this reason, that the living conditions of inhabitants are often precarious.

According to the Köppen-Geiger climate classification, the climates of Colombia are type "A" which correspond to tropical humid ones. Specifically, Buenaventura has an "Af" tropical rainforest climate, with high temperatures -around 30°C- and very small variations throughout the year, abundant rainfall (150-1000 cm), fairly cloudy, and with a high humidity (Rafferty, 2009). Thanks to its location, the city has a great diversity and natural wealth. Although it has a relevant number of species of flora and fauna, at an urban level it lacks space with suitable environmental conditions. Urban sprawl has been projected in the Regional Organization Plan (POT, in Spanish) (Buenaventura Mayor's Office, 2001), perpetuates deforestation and considers the use of many important ecosystems for this purpose, like the mangrove swamps (Figure 1).

With an estimated population of 440,995 inhabitants (DANE, 2005), considering both the rural and urban area, the communes (areas) with the highest density are located along the southern edge of the island -especially 3 and 4- (Figure 1), which have informal overcrowded settlements with a high number of people per dwelling, in just a few square meters. Most of the

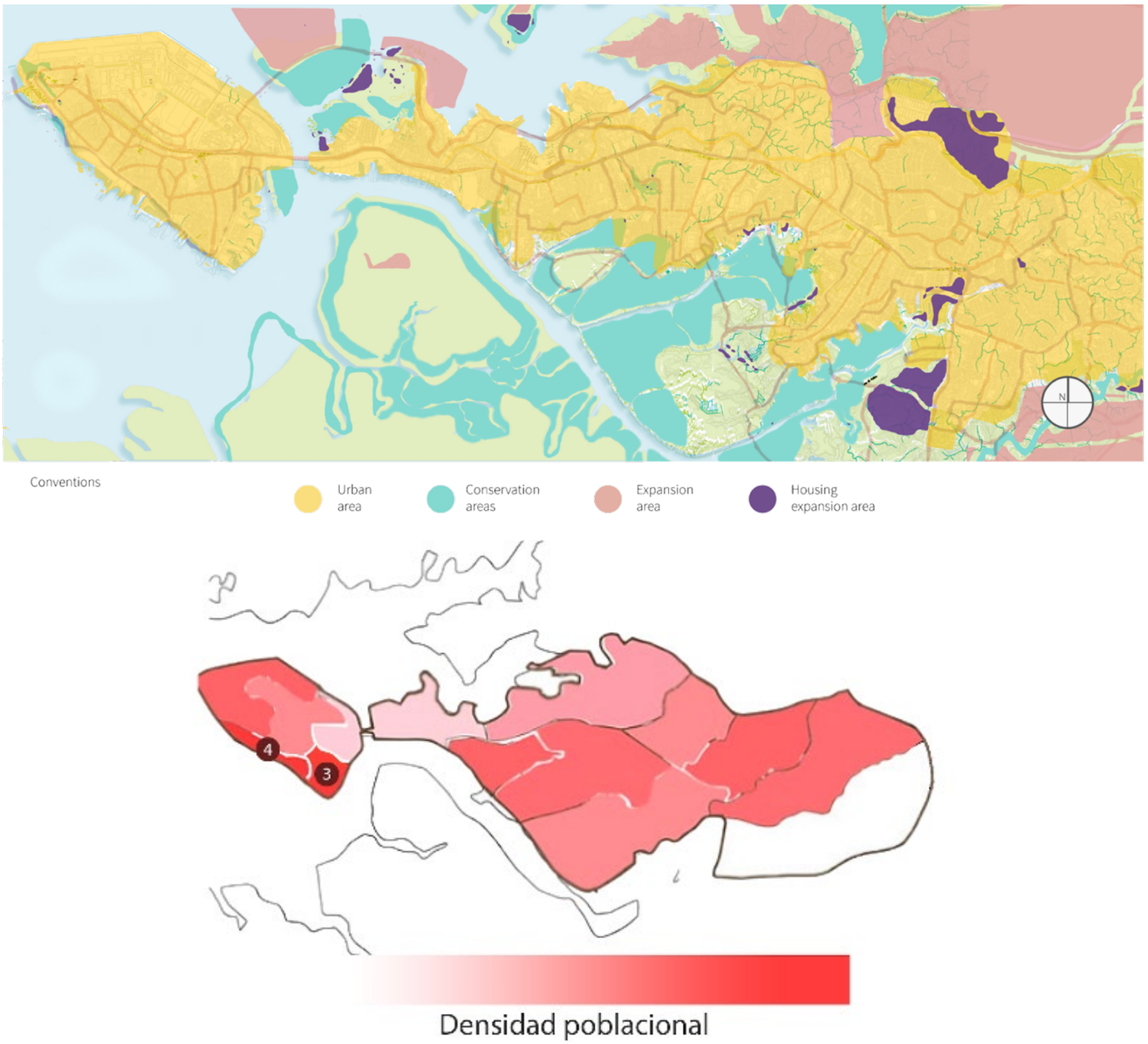

Figure 1. Expansion areas / Populational Density of Buenaventura. Source: Prepared by the Authors.

municipality's homes with Unsatisfied Basic Needs (UBN) and poverty are concentrated in this sector of the island (DANE, 2020). In fact, in Buenaventura, more than 15% of the population do not have basic services (DANE, 2018), and these areas are within those most affected in this sense. In addition, the levels of violence are higher in these communes than in the rest of the city.

Added to this, different social and economic issues affect the community, including: forced displacement, a lack of equality and work opportunities, limited access to education and health, illiteracy, illegality, etc. (Martínez *et al.*, 2013). In 2013 alone, more than 13,000 people were forcibly displaced to the city (Schoening, 2014), which may explain the growing development of informal settlements, especially along the edge of the island, which have grown towards the ocean, with precarious conditions, on lacking resources for their inhabitability.

In this way, the shoreline of Cascajal Island mainly comprises refill used by the inhabitants to gain land from the ocean, expanding its urban boundaries. A traditional construction system is used for this: stilts (Figure 2). In this, the stilts (hardwood palm trunks) are driven into the seabed, to set a base made from the same wood, to build on this, then refilling underneath using waste material. This causes great contamination to the sea, and puts those settling there in danger, due

Figure 2. Existing structures in the study area. Source: Prepared by the Authors

to the high flood risk there is on the southern part of the island and the western part of the continental area (Figure 3). Likewise, the lack of planning has generated deficiency or absence of water and sewerage systems, among other deficient or non-existent systems.

Similar cases have been studied at a regional level, like that in Morelia (Mexico), as flooding events can be associated to the way the city is conceived. Its lack of planning and a clear response from the authorities, demonstrates that the socioeconomic differences compared to those living in the periphery (as also happens in the case of the Bonaverense community) reflects a notorious "risk inequality". Because of this, the notion of adaptability that the MINGA project and the case study in Morelia seek to show, becomes a kind of euphemism of "social justice" (Hernández-Guerrero *et al.*, 2012).

The World Health Organization states that "green" and "blue" public spaces can greatly improve mental and physical health, and people's quality of life, reducing stress levels, comorbidities, and providing spaces for rest, leisure and physical activity (World Health Organization, 2016). Currently, Buenaventura has a public space index of 0.51m^2 per inhabitant, represented by a lack of public parks, well below the cities that were subject of the aforementioned study. On the other hand, regarding the road system, Avenida Simón Bolivar is a main road that communicates the city with the rest of the country. A road is projected on the north side of the island that will be built with a more commercial and heavy transportation purpose, which will revitalize this area of the city and will consolidate the south as a residential and light transportation area. Thus, the MINGA team understands the variables of the context, and has taken the decision to mainly work on the shoreline of Cascajal Island, and in a sector along the coast of the continental area.

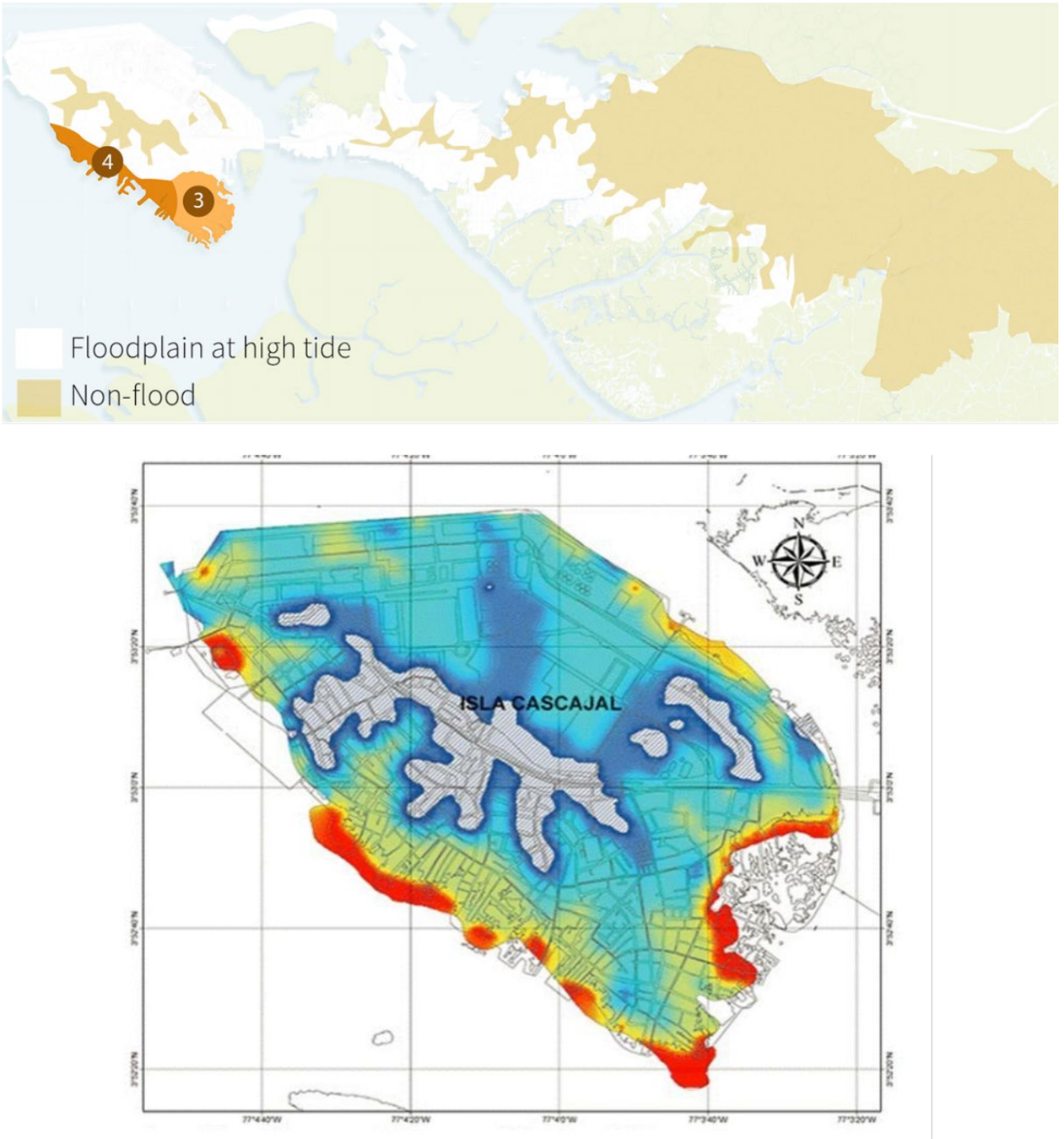

Figure 3. Flood map of Buenaventura and Cascajal Island.Source: Left: Preparation by the Authors. Right: Cocuñame & Salcedo (2017, p. 200).

METHODOLOGY

Considering the guidelines of the competition, the urban proposal of MINGA was made by integrating the topics of the Solar Decathlon into the courses of the final years of the undergraduate Architecture and Civil Engineering courses of Xaverian – Cali and UFSC, courses where a project based teaching-learning methodology was implemented, which allows students to put into practice, the theoretical knowledge acquired in traditional courses (Herrera-Limones, Rey-Pérez, Hernández-Valencia & Roa-Fernández, 2020; Jin *et al.*, 2018; Osuna-Motta, 2018). With this approach, the research, made by more than 80 students and 12 teachers from Colombia and Brazil, focused on the issue of mid density urban design applied to the context of the Latin American tropics, to achieve an innovative proposal inspired by

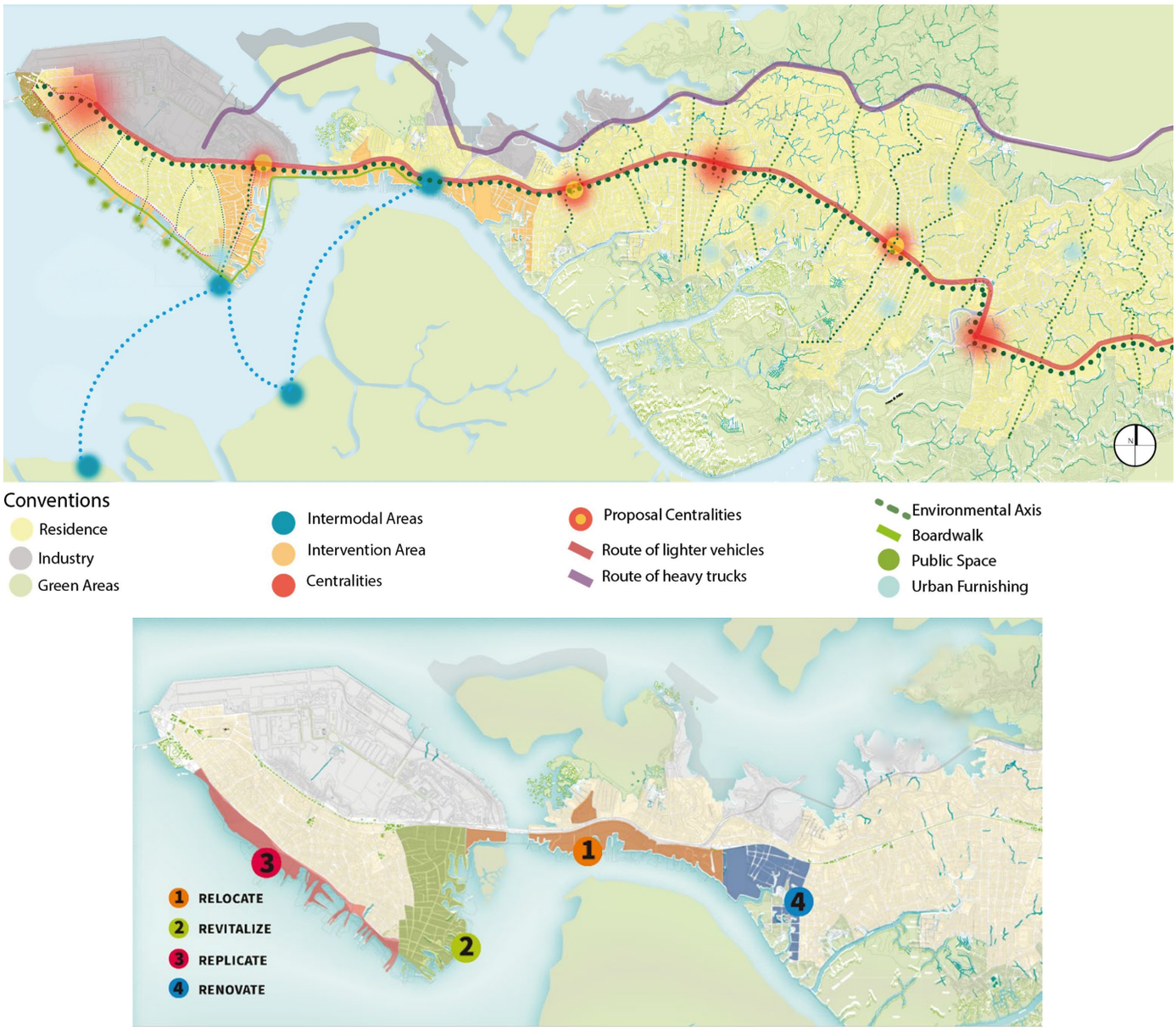

Figure 4. Urban Master Plan. Proposal of MINGA – 7 Phases of the Project. Source: Prepared by the Authors

low cost social housing, that is sustainable to climate conditions over the next 50 years. The process was the following:

1. Analysis and research about the territory was made, addressing the environmental, historic, social and economic, highway, morphological, public services, regulatory, uses and facilities, and risk conditions.
2. It began with a basic outline, moving from a macro to a micro scale, identifying which were the places in the city with the most risks and critical conditions, to work on these within a master plan.
3. Then, an Urban Master Plan was outlined, which comprised both the continental area and Cascajal Island. It considered 3 phases where relocation strategies for the inhabitants of the areas being affected were included, along with the design of roads and areas to intervene (both for housing development and for public space and equipment). The scale of the site was also developed in greater detail, covering several blocks in the southern sector of the island, replicating the housing prototype in high-rise buildings.
4. Finally, a housing prototype was made which was built to real scale to demonstrate its operation, along with a 1:250 scale model that shows the housing units that form high-rise buildings designed for the urban plan, as well as some of the public spaces and the proposal vis-à-vis the road design.

Figure 5. Localization and scale proposal. Source: Prepared by the Authors.

RESULTS AND DISCUSSION

A feasible urban renewal proposal was prepared, in a sector where the municipal authorities had planned an eviction process due to the high flood risk in the area. The measure, which does not consider mitigation alternatives to keep the inhabitants where they are, would uproot a population that economically and culturally depends on their relationship with the sea. The model is explained below, using the scales it was based upon: from macro to micro.

URBAN MASTER PLAN

Beginning from the large scale, the urban proposal of MINGA seeks, starting by understanding the context, to generate strategies to solve the different problems of the Bonaverense community. One of the first ones consists of generating two important road links between the island and the continental area: the first would be the one proposed by POT, to the north of the city, that would carry the heavy traffic, and would serve as a commercial link for the city. The other would be the wharf, which will be detailed later on, designed to provide the public space that the city lacks and with several clean transportation options.

In the same way, different already existing routes would be recovered to use them as environmental hubs: first, creating a large green separation along Avenida Simón Bolivar (Av. SB), which crosses the entire city. Second, several important links would be placed along this avenue, with the idea that these become secondary environmental hubs, and end up mainly being recreational public spaces. Third, alongside the wharf, 1st street (Calle 1ra) that runs to the west of Avenida Simón Bolivar to the east of the island, would be fitted out, running alongside the shoreline and linking up with Highway 20 (Carrera 20), which runs to the east side of the main avenue (Simón Bolivar). This road would be available for light transportation, other means of transportation that are already used, like private vehicles, taxis, buses that already circulate in the city, etc. (Figure 4).

At a local scale, the project would be done in 4 phases (Figure 5):

1. Relocation: in this stage, the intention is to connect the island with the continental area of the city, generating public and commercial space alongside Piñal bridge, the only road infrastructure that connects the island with the continent currently. At the same time, the population of the area intervened would be relocated initially, temporarily relocating them in the continental part of the city, leading to the second phase.
2. Revitalization: this would seek to revitalize the first area being intervened, on two fronts: the public, with the section corresponding to the wharf, along with the projected public spaces and equipment; and the private, with the construction of residential areas.
3. Replication: the wharf would be connected to the existing one and all the urbanization model would be replicated along the southern and western shorelines of Cascajal Island, linking this to the continent. This is a triggering action that can foster and promote proper urbanization towards the south, and the consolidation of this residential area with the public space that it requires.
4. Renewal: this last phase would consolidate the urban renewal project, connecting the entire edge of the island with the continental area.

Figure 6. Urban cross-section of the proposal and the factors to promote. Source: Prepared by the Authors

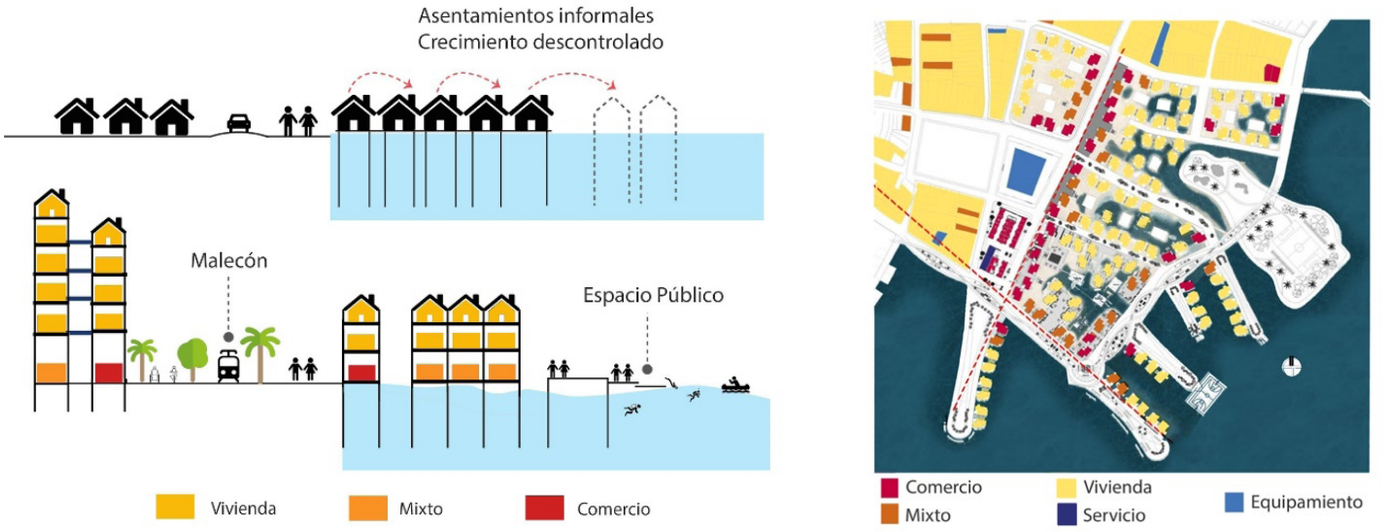

Figure 7. Proposed height and uses. Source: Prepared by the Authors.

LOCAL SCALE

Sustainable use of resources

First and foremost, the intention is to reuse existing land and urban structure, to not generate interventions that damage the region, especially the uncontrolled growth towards the ocean and the deforestation of the mangroves, favoring a more compact, less extensive urban structure (Urriza & Garriz, 2014). Then, due to the important relationship that Buenaventura's inhabitants have with the sea, different economic activities are considered within the urban design, which emerge from this water body, such as: fishing, a different route to land to move between adjoining areas and the continent, as well as its connection with the traditions of the inhabitants and their cultural connotation. Third, the implementation of new mechanisms to supply energy is done on two scales. At a macro scale, using renewable energy sources for public spaces, as well as the implementation of an electric tram for public transportation. At a micro scale, this seeks to replicate the photovoltaic system used in the housing prototype, along with the rainwater collection system and smart sensors to control the consumption of each housing unit.

It is worth adding that, on both scales, the possibility of generating other renewable energy options exists, like wind, tidal and wave power.

Sustainable use of the built space and urban activities

Following MINGA's slogan, "Sustainable Communities", three factors to strengthen the urban project process in Buenaventura were defined: nature, tourism and trade (Figure 6). Using these three dimensions, a mixture of uses is promoted in the project, without losing the main goal of developing an urban sustainable housing model. In the same vein, these are considered to encourage the respective sectors of the economy and to regenerate the public spaces of the city, promoting it as a tourist and economic destination in Colombia, and balancing, as a result, the quality of the residential sector. At the same time, sustainable communities are expected to be generated, preserving the cultural values of the population.

In this way, the generation of the different uses allows for greater citizen accessibility considering their needs, reducing transportation distances and times. It is for this reason, in the project's public layout, it proposes placing

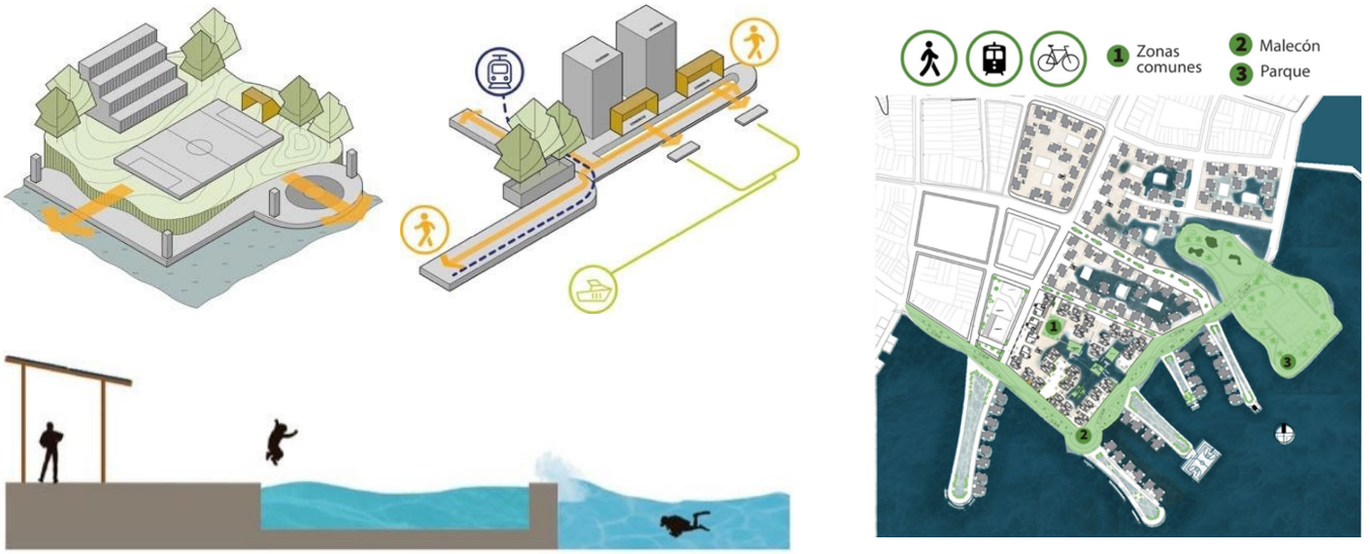

Figure 8. Design of public spaces / adaptability and floodability. Source: Prepared by the Authors

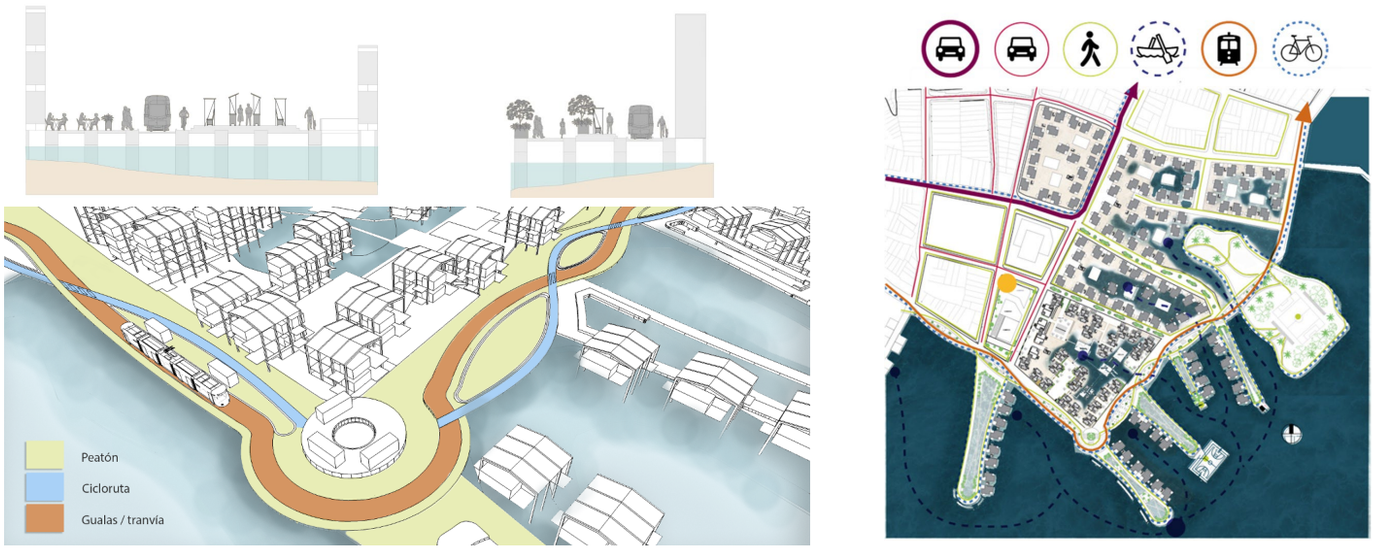

Figure 9. Sustainable mobility proposal / Wharf.Source: Prepared by the Authors.

commercial units alongside the main vehicle and pedestrian routes (which includes the wharf), conserving the privacy of the housing and its common areas within the blocks. Along this same line, as the high-rise densification allows for a greater capacity of inhabitants on a smaller portion of land, it was decided to build high-rise blocks that do not exceed 6 floors or that are under 3 floors. In this way, the buildings are laid out so that their height drops as they approach the sea (Figure 7).

effective public space and development of facilities

The shortage and lack of public space in Buenaventura shows the need to design effective public spaces that give inhabitants more quality spaces, that are more extensive, accessible and better designed. Thus, the use of the unbuilt land is proposed, to generate public areas there, equipped with playgrounds, spaces for physical activity and, where possible, green focal points for the city. These areas are designed to be flood resilient, i.e. so that they adapt to sea rises and where possible, mitigate the impact of possible natural disasters, something that the wharf also looks to do (Figure 8).

sustainable transport and accessibility

To improve and facilitate connection between Cascajal Island and the continental part of the city, a wharf was designed, where the plan is that different forms of clean transportation converge (Figure 9). The design is laid out using a single surface, marking each area out for its respective user, with the goal of democratizing the space, and fostering a culture where the pedestrian is privileged, while giving room for the rest of the means of transportation.

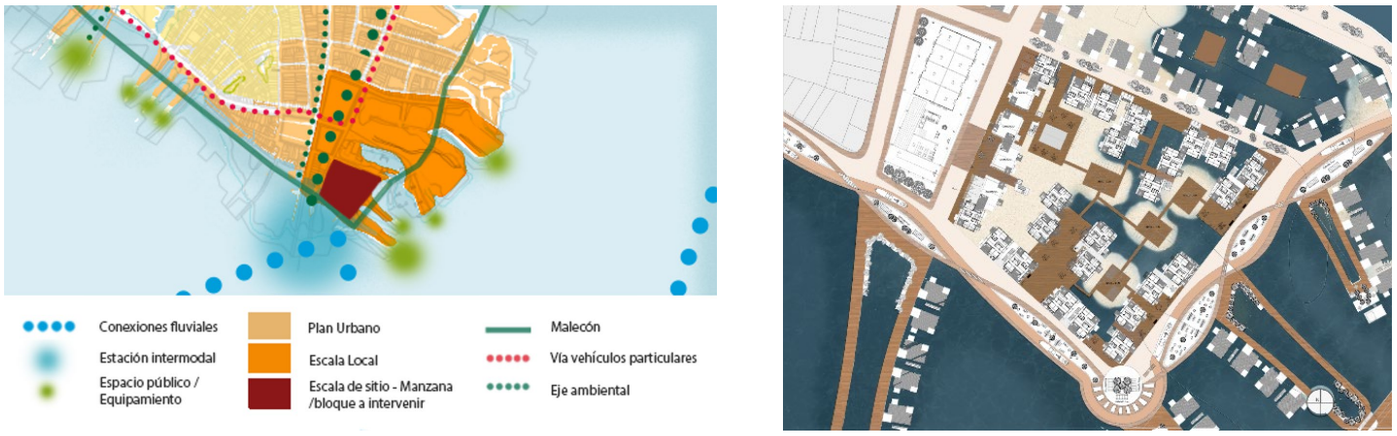

Figure 10. Localization and block plan designed at a site scale. Source: Prepared by the Authors.

Initially, a road will be destined for the traditional ATVs, the most commonly used informal public transportation on the island, formalizing them, and seeking their future transition to a tram as a clean transportation system. A path will also be assigned alongside this, as a cycle path, and another large part for pedestrians, the latter alongside the sea. As an additional solution, understanding the different means of transportation of Buenaventura, a road is included alongside the wharf, which would also cross the entire island, connecting it to the continent, where the flow of vehicles and motorcycles would be.

SITE SCALE

For the urban project, the SDLAC 2019 contest, proposed the in depth development of a block in greater detail. Thus, the MINGA team chose a block to the south of Cascajal Island (Figure 10), in commune 3, an area where different activities converge, which will allow connecting the island to the continental section. The importance of understanding, how the city is conceived for its inhabitants, the characteristics of the urban development and their ways of life, was highlighted. The following goals were set out using this:

- Solving the high demand of effective housing caused by the growing population density on the island. Beginning with communes 3 and 4, where there is a higher number of informally built dwellings, so that it is densified in high-rise, freeing up more common and public space on the ground level, where a density of at least 120 dwellings per hectare is proposed.
- Reaching a balance between the density of inhabitants and the effective public space, improving and maintaining the life in community.
- Fostering the relationships there already are with the sea, so that these are not lost despite the change regarding the means of building the dwelling.
- Designing a sustainable housing model, which considers the possibility of housing up to 8 people in two independent housing modules, considering the way of life of Bonaverense families, where it is common to find more than one nuclear family per dwelling. In addition, it must be economically feasible, without exceeding the maximums of the subsidy policies for social housing in Colombia, making the project accessible to the target population.
- Including common areas to bring the community together, which can remain while the tide is low, be floodable when it rises, and that it is a means of connection and transportation with the sea.
- The common areas for circulation in buildings will be points to foster meeting as an "extension" of the private areas, favoring life in community.
- Making use of renewable energies.
- Having a structural design in line with a resilient building typology, which allows counteracting the possible effects of climate change and the resulting rise in sea levels (Figure 11).
- Setting aside some street level housing units for adaptation to small stores, a practice commonly seen in this sector of the city.

CONSTRUCTION SYSTEM: REINTERPRETATION OF THE TRADITIONAL STILT CONSTRUCTION

A reinterpretation of the stilt housing typology was made, with a novel structural system in Colombia, made from glued laminated wooden colonnades, replacing the traditionally used mangrove wood, which allows building multi-family buildings of up to six floors. With this, the impact of deforestation of these ecosystems is reduced. On the other hand, it seeks to minimize the risk of flooding from tides in the current and future climate, and stop the informal growth of the island through high-rise densification of an urban area, alongside the design of public space and equipment along the island's shoreline.

VIABILITY: SUBSIDY AND FINANCING POLICY

The VIS or Social Housing policy in Colombia has a subsidy system for the demand. This policy seeks to increase the effective demand of social housing through subsidies

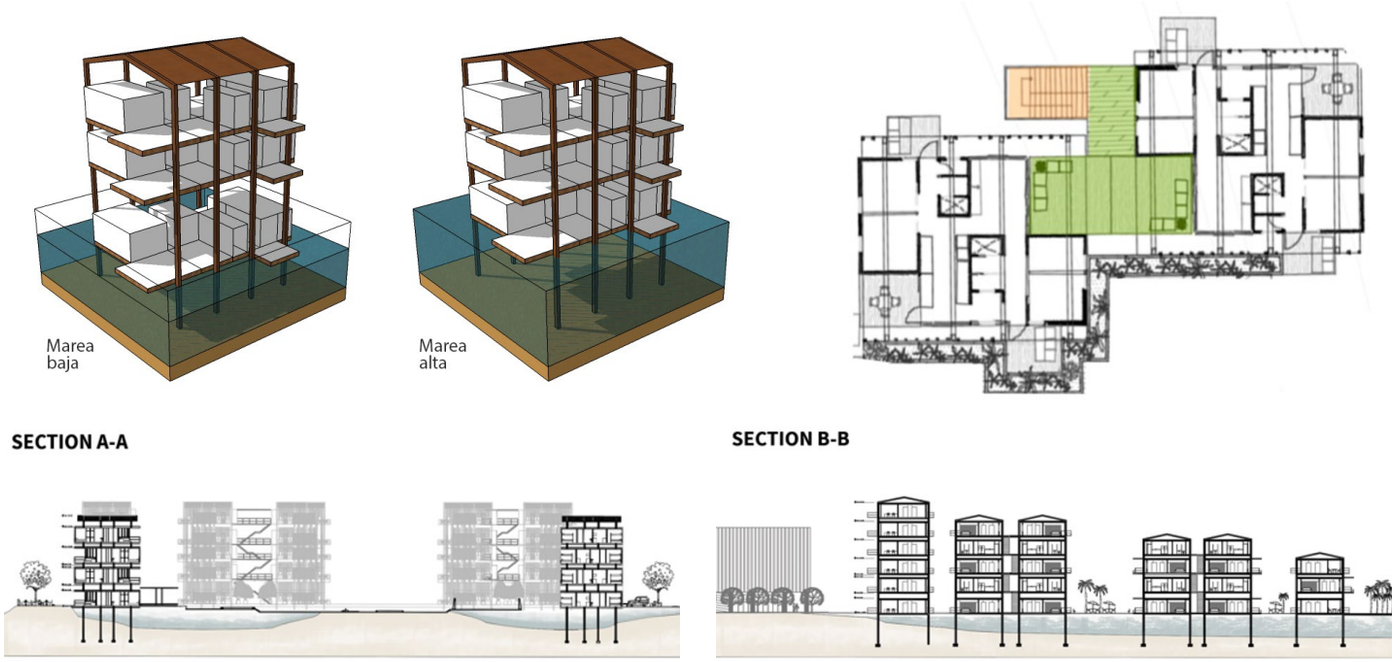

Figure 11. Floatability layout, standard floor plan, and cross section of the dwellings. Source: Prepared by the Authors

to beneficiaries, which are complemented with soft and savings loans, so that families with fewer resources can access their own home. The value granted to the beneficiary families, depends on the range of family incomes and the total cost of the dwelling. To promote the development of urban renewal projects, the national government increased the maximum subsidy for social housing up to 175 SMMLV (Current Legal Monthly Minimum Salaries) which for 2020, is the equivalent of 153,615,525 COP (Colombian Pesos), approximately US$41,794 to July 27th, 2020.

The MINGA multi-family project for Cascajal Island involves housing complexes of up to 6 floors, reaching a density of 127 dwellings per hectare, each one with an option to house up to 2 nuclear families (maximum of 8 people), with high standards of access and quality public and collective spaces. This is done, using industrialized prefabrication and building systems, and local materials. The initiative, to fall within this price range, outlines strategies that foster improving the quality in the urban conditions of the intervention area, with the following conditions:

- It promotes densification of the area with an integrated project that guarantees the construction of public equipment, complementary services and spaces.
- It guarantees the suitable and efficient provision of household public services.
- It foresees an appropriate use and management of the environment and natural resources.
- It promotes the protection and integration of environmental protection and conservation areas, following what is defined in the POT.
- It articulates social housing with infrastructure for the road transportation system.
- It promotes and generates accessible networks for people with disabilities and difficulties with locomotion by eliminating physical barriers.
- It improves the qualitative standards of public space, seeking to increase the quality, provision and a better use of the existing public spaces.
- It guarantees collective equipment systems that cover the needs of the new population that are incorporated to the area.
- It incorporates determining factors of risk prevention and management in a sector that the regional regulatory plan has identified as a high or medium mitigable risk.

CONCLUSIONS

With the results of the MINGA project, the viability of the strategies proposed for the renovation of shorelines in coastal cities of the topics is shown, though low-cost high-rise housing, with a habitational density that suitably uses the existing urban infrastructure, managing to stop the urban sprawl of the cities, dealing with a very sensitive issue in the coastal cities of Latin America and the Caribbean (Barragán & De Andrés, 2016). The project achieves high standards of sustainability, given that its construction cost allows that it is subsidized within the VIS policy in Colombia. This type of sustainable housing generates a lower cost for the users through its service life, as it reduces the value of public services, thanks to the use of photovoltaic solar energy, rainwater and the economic usufruct of the property, providing a module as a store, or from its rental, as a second housing unit of the home.

To conclude, although the urban proposal is located in the city of Buenaventura, Colombia, and bearing in mind

its environmental, social, and economic conditions, the projected strategies used are adaptable to other regions with similar conditions. Thus, the urban renewal model is replicable in any coastal city with a warm-humid tropical climate, as long as the differences regarding conditions are considered, adapting to the context where this is implemented: considering the risk levels, the relationships with the urban structure there is, the characteristics of the population, and the housing policies of the local governments.

All in all, the feasibility of developing sustainable urban renewal is shown, and the importance of generating urban projects that respond to communities' needs is revealed, understanding the relationships that these have with their surroundings, as well as seeking solutions that understand the specific aspects of the territory in question.

ACKNOWLEDGMENTS

We would like to thank the members of the MINGA team, the students, professors, collaborators and volunteers of the Pontifical Xaverian University, Cali, the Federal University of Santa Catarina, and the Federal Institute of Santa Catarina. We would also like to thank the organizers of the 2019 Solar Decathlon Latin America and Caribbean.

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