



Participatory Climate Action Planning to Protect Informal & Precarious Human Settlements in Bucaramanga

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Executive Summary

This report is the third volume in a series on Accelerating Climate Action in Colombia through urban laws and policies. It describes the field visits accompanied by Bucaramanga's land legalization team, to several informal settlements in different stages of the land legalization process. It includes the comparative analysis of settlements before and after the legalization process, based not only on field visits, but also interviews with lawyers, architects, planners, social workers, and geologists about the role of urban environmental laws on the land legalization process. The Research Team also conducted three capacity building workshops in Luz de Salvación II, an informal and precarious settlement in Bucaramanga. The workshops were designed to empower residents in the identification and mitigation efforts of climate change hazards that threatened their homes. Bucaramanga's settlement legalization team accompanied the Research Team on to these workshops.

The findings from the three workshops reveal that legalizing settlements, in other words, recognizing the informal neighborhood as an integral part of the city, can provide residents with critical infrastructure, like proper electricity, drainage, and roads. Formal electrical connections are even more crucial with increased urban heat because it prevents wires from melting and causing fires. In sum, upgrading is more important than ever for informal settlements impacted by increased extreme heat and flooding. Land legalization or regularization, accompanied by upgrading, improves the safety of public spaces, homes, and protection from floods and landslides. Coordination between city officials and residents can improve the process by generating buy-in from both sides.

Introduction

This report is the product of a collaboration between UN-HABITAT Andean Countries HUB, the Municipal Government of Bucaramanga, and a University of Michigan team (*Funding for this project was provided by Dow Sustainability Projects Awards.*) It is the third volume in a series on Accelerating Climate Action in Colombia through urban laws and policies. The objective of this report is to assess the land legalization process of informal and precarious settlements in Bucaramanga, Colombia, and identify the successes, challenges, and limitations of climate change mitigation and adaptation strategies in informal settlements. The ultimate goal is to raise awareness and promote a dialogue about the intersection of land legalization programs and climate change in informal and precarious settlements.

Climate change scholarship has only recently investigated the possibility of climate action in these human settlements. (*Satterthwaite, David, et al. "Building resilience to climate change in informal settlements." One Earth 2.2 (2020): 143-156.*) Furthermore, the most common recommendation from policy makers and international organizations has been resettlement as a climate adaptation strategy. (*Tadgell, Anne, Linda Mortsch, and Brent Doberstein. "Assessing the feasibility of resettlement as a climate change adaptation strategy for informal settlements in Metro Manila, Philippines." International Journal of Disaster Risk Reduction 22 (2017): 447-457.*) Although resettlement can be the only viable alternative under certain circumstances, this report focuses on issues of permanence, land legalization or regularization, and climate change adaptation. Newly, scholars have also attempted to rethink slum upgrading in ways that improve environmental sustainability and climate change mitigation and adaptation. (*Collado, José Rafael Núñez, and Han-Hsiang Wang. "Slum upgrading and*

climate change adaptation and mitigation: Lessons from Latin America." Cities 104 (2020): 102791.)



Image 3.

Informality in Bucaramanga ranges from unpermitted construction in existing neighborhoods, irregular subdivisions (those that do not acquire municipal permit), or fully clandestine subdivisions by ‘pirate’ developers, to the creation of entire neighborhoods called “invasions”. (*Fernandes, Edesio. Regularization of informal settlements in Latin America. (2011). Cambridge: Lincoln Institute of Land Policy.*) The settlements studied in this report were of the latter category, although we avoid the term invasion due to its connotation of an unlawful activity. Regardless of the origin of the land occupation, this assessment focuses on informal settlements that are precarious in terms of basic sanitation, infrastructure, and urban services; therefore, more vulnerable to climate change.

Climate change is considered the most urgent and pressing issue facing all levels of government. International organizations to small municipal governments in the most remote locations are encountering tough decisions regarding climate change. In recent years, Latin America has spearheaded several of the most innovative strategies for climate change adaptation and has since served as an international model. Colombia has pushed and passed progressive legislation requiring municipalities to

prioritize climate action planning.

Bucaramanga, Colombia, has a population of approximately 581,130, making it the metropolitan center of the Santander Department. Bucaramanga is known as the City of Parks due to the prevalence of green spaces in its urban design. As one of the largest cities in Northeastern Colombia, Bucaramanga is a hub for urban environmental management for surrounding municipalities. (*Britannica, The Editors of Encyclopaedia. "Bucaramanga". Encyclopedia Britannica, 12 May. 2010, <https://www.britannica.com/place/Bucaramanga>. Accessed 31 December 2022.*)

In recent years, the work of the Municipality of Bucaramanga has served as an example of innovative and robust strategies for the mitigation and adaptation of climate action and planning. By expanding green spaces within the city there is a need to understand if these amenities and social services by the municipalities are exclusive to residents living in formal neighborhoods. Municipalities are often unsure about the regulatory framework involving neighborhood improvements, given multilevel governance restrictions on regularizing land in ecologically sensitive areas.

Bucaramanga faces a dilemma regarding informal settlements in areas of risk and environmental protection, which do not receive municipal services. At face value, informal and precarious settlements are not permitted in these areas; however, fieldwork and expert interviews reveal that the municipality attempts to mitigate risk and offset the environmental impact in order to promote land legalization and regularization. The municipality aims to avoid relocations and facilitate upgrading. . Notably, informal settlements are vulnerable to climate change's consequences, including mudslides, floods, and heat waves. Bucaramanga faces the challenge of implementing mitigating

and adaptive strategies in settlements that are not considered parts of the city.

Informal Settlements and Climate Action Planning

Informal settlements are an increasingly pressing challenge for national and municipal governments to address. The definition of informal settlements varies among intergovernmental institutions but shares a common understanding. Typically, informal settlements are considered unauthorized housing in areas where occupants have no legal claim or right to occupy. The United Nations Habitat extends this standard definition of informal settlements to include “urban neighborhoods that developed outside the formal system recording land ownership, land tenure and a range of regulations relating to planning and land use, built structures and health and safety.” (*Based on the definition by the Organisation for Economic Co-operation and Development (OECD)*)

Informal settlements are a global social and economic challenge, especially in Latin America. The Inter-American Development Bank approximates that 45 percent of people living in the Latin American Cities “do not have a decent place to live and instead reside in unsuitable housing built with precarious materials or without basic amenities.” (*Inter-American Development Bank, 2022.*) These informal settlements may exist within or beyond the municipal core areas, and their residents face persistent challenges affecting their quality of life. International agencies also use the term slums. An United Nations’s expert group defined slums as including the five categories: “inadequate access to safe water; inadequate access to sanitation and other infrastructure; poor structural quality of housing; overcrowding; and nsecure residential status” (tenure insecurity). (*UN-HABITAT. Twenty First*

Session of the Governing Council (2007), 16-20, April 2007. Nairobi, Kenya.)

There is a link between climate action planning and informal and precarious settlements that minimize the intended impacts of mitigative and adaptive tools. Institutional programs and aid activities often neglect informal settlements, as those communities are often difficult to reach. This poses a significant problem for informal settlements as they are often disproportionately at risk to disasters due to environmental and social vulnerabilities.

Yet, despite all these tools and strategies, informal settlements are often not considered in implementing and monitoring climate change adaptation efforts. Informal settlements face a unique challenge: they need to be incorporated into a municipality and have their voices heard in climate action planning.

Colombia is home to five million people living in informal housing communities (*IDMC (2020), From Aid to Empowerment: Addressing Urban Displacement in Colombia's Informal Settlements, Internal Displacement Monitoring Centre.*) In Bucaramanga, more informal housing settlements have been built as the city's population has grown. OECD estimated that Bucaramanga maintains 8.8 percent of informal settlements in the country (<https://www.oecd-ilibrary.org/sites/0363ea87-en/index.html?itemId=/content/component/0363ea87-en>). New neighborhoods and settlements surround the city's center and are built in precarious areas near rivers and valleys, putting them at risk of flooding and landslides.

Methodology

In August of 2022, the University of Michigan team traveled to Bucaramanga to conduct fieldwork, which included interviews with the interdisciplinary team of experts, ranging from social workers, architects, planners,

geologists, engineers, and lawyers to better understand the process of land legalization in Bucaramanga. The interviews followed presentations by each expert on the land legalization team, which was housed in the planning department with members from other municipal departments. Findings from these interactions are summarized under the section Urbanistic Land Legalization or Regularization.

Furthermore, the Research Team conducted field visits in four informal settlements: Luz de Salvación II, José Antonio Galán, Cristal Alto, and Parque Lineal. Cristal Alto and José Antonio Galán had been legalized, and José Antonio Galán had developed a disaster response plan with the help of GOAL, an Ireland-based humanitarian aid NGO. Luz de Salvación II was in the process of legalizing. The University of Michigan Team visited all four settlements, meeting with local leaders. The visit to José Antonio Galán and was organized by representatives from GOAL and Bucaramanga's Office for International Relations. Representatives from the land legalization team also accompanied the University of Michigan team.

With the goal of climate action in mind, this project also included capacity building workshops with community leaders in Luz de Salvación II, the Team conducted three workshops designed to empower residents in an informal settlement to direct climate change mitigation and adaptation efforts by centering climate change on their perspectives and experiences. How can community leaders make sense of the environmental, legal, and infrastructural conditions of their settlements through the lenses of climate change? What are the overlaps between informal settlement legalization, upgrading, and climate action? To learn with community leaders, the University of Michigan team conducted

interviews with community leaders in Luz de Salvacion !! and conducted the following workshops: transect walk, participatory mapping, and community chronology (oral history timeline). The following sections further describe specific methods and the main findings.

Findings

Urbanistic Land Legalization or Regularization

Sustainable urban development must include the legalization of informal settlements. Bucaramanga uses the term land legalization, while other authors also use the term land regularization (Fernandes, Edésio. *Regularization of informal settlements in Latin America*. (2011). Cambridge: Lincoln Institute of Land Policy.) The land legalization process in Colombia is the opposite of individual land titling programs in the style of Hernando De Soto, such as the programs that allocate real property rights on land to individual shack dwellers in Lima, Peru. Land titling programs focus first on providing individual property rights to those inhabiting a home in an informal settlement. Under this approach land title (individual property rights) is the first step (Gilbert, Alan. "De Soto's *The Mystery of Capital*: reflections on the book's public impact." *International development planning review* 34.3 (2012): doi:10.3828/idpr.2012.15) In contrast, in countries like Colombia and Brazil, the concession of individual property rights to those living in informal settlements, if applicable, is the last step. Under land regularization, the priority is to legalize (regularize) the neighborhood, including the informal settlement in the city map. A second and sometimes concurrent step would be to implement, what the literature calls slum upgrading programs, or the provision of basic services and infrastructure (Macedo, Joseli. "Urban land policy and new land tenure paradigms: Legitimacy vs. legality in Brazilian cities." *Land Use Policy* 25.2 (2008): 259-270.)

In Colombia, entire settlements are legalized, allowing them to become part of the city. Cities are then able to provide roads, parks, and authorize utilities. Large projects must rely on additional funding and financing from other subnational, national and international levels.

At the national government level, Colombia encourages the recognition of existing dwellings and other constructions located in informal settlements that have been through the process of land legalization or urban land legalization at the municipal level. Law 1848 of 2017, enabled by Decree 1333 de 2020 sets out general guidelines delegating the responsibility of formalizing settlements and legitimizing land titles to municipalities. Decree 564 of 2006 (articles 122 to 131) establishes the rules for urban land legalization or regularization, Article 131, also clarifies that land legalization does not imply the recognition of individual private property rights. Settlements in areas prone to flooding or earthquakes (unmitigable risk), or environmentally protected areas cannot be legalized. Local governments are barred from providing services in these areas. The national law and decrees does not provide detailed guidance on completing the legalization process but gives leeway to the local governments who establish their own land use regulations in conformance with multi-level environmental laws and public safety regulations.

The Municipality of Bucaramanga institutionalized the legalization process in the Plan de Ordenamiento Territorial (POT-Territorial Arrangement Plan). The city has created an interdisciplinary legalization team of lawyers, social workers, architects, engineers, and geologists. This team analyzes the viability of each settlement and determines their eligibility for legalization. Requirements include approval from half of the settlement's population, a risk

management analysis, and an initial resolution approved by the Director of Planning. Subsequently, the city will commission an in-depth vulnerability assessment (Amenaza Vulnerabilidad Riesgo). This analysis is crucial in determining which settlements can and cannot be legalized. Settlements deemed too vulnerable for mitigation works would be a liability to the city if they were legalized. At-risk settlements are often provided for by international non-governmental organizations, such as GOAL, that help to adapt to and mitigate environmental risks. There is currently no funding available to help relocate residents of these vulnerable communities. Likewise, in considering the circumstances under which risk can be mitigated, municipal officials explain that the cost for risk mitigation can be particularly high for certain public works and even if partial legalization is legally feasible, there is no guarantee that the funding will be available.

Once a settlement has been approved through the risk assessment process, there will be social and structural diagnostics. The interdisciplinary nature of the team allows for each aspect of a settlement's reality to be assessed and incorporated into the process. The social workers on Bucaramanga's legalization team will address social vulnerabilities. The structural and technical teams focus on the viability of the constructed buildings and what rebuilding will be necessary. This later step also includes surveying and formally demarcating property lines.

Capacity Building Workshops in Luz de Salvacion II

This participatory methodology was conducted in the Luz de Salvacion II settlement. The municipality of Bucaramanga is actively formalizing this human settlement as a "proper" neighborhood. Along with

interviews of the city government's interdisciplinary team, the University of Michigan team were able to work with the neighborhood level elected officials, members of the Junta de Acción Comunal_ JAC, to learn about their community. The Communal Action Boards (JAC - Junta de Acción Comunal) are autonomous civil society organizations that promote citizen participation in the management of their communities. At the same time, they serve as a means of dialogue between community members and the national, departmental and municipal governments. JAC representatives are elected by community members. In the case of Luz de Salvacion II, residents of this informal and precarious settlement.

Luz de Salvacion II's position within the land legalization process allowed us to see a settlement that was not in an officially designated environmentally hazardous zone that was in the process of going through risk management analysis. The community is committed to the legalization process and is working with the legalization team to complete the process. Their understanding of the legalization process and their hopes for the future of their community aided the



Image 1.

research team in their analysis. In order to learn more about the settlement, the research team conducted three workshops: a transect walk, a participatory mapping activity, and a community timeline workshop.

Transect Walk, the method

For the World Bank, the transect is part of “a tool for describing and showing the location and distribution of resources, features, landscape, [primary] land uses along a given transect.” Transect walks provide a means to assess the well-being of residents in the determined area by providing a picture of their immediate surroundings.

The transect walk was the research team’s introduction to the community. They met members of the la Junta de Accion Comunal, a board of 18 representatives elected by the residents of Luz de Salvación II, that served as the neighborhood liaison to the city and the legalization team in the settlement. Transect walks create a shared base of knowledge for participants in the capacity building workshops.

Transect walks are commonly used at the beginning of a participatory process, allowing participants already familiar with the environment to rediscover it and allowing other participants to become acquainted with the surroundings. The walk permits for the demonstration of specific aspects of a community as well as more general observations. Transect walks are a tool for showing the distribution and location of resources, land uses, and topography in the area.

While walking side-by-side with residents, the University of Michigan team learned in a conversational mode about the history of the settlement and the challenges that residents face. Furthermore, through direct observation, the team learned about the topography, and the conditions of the built and natural environment, which was also the topic of conversations. . The team documented the two mile walk through the settlement with photos and videos, interviewed community members and legalization team members, and looked for specific climate hazards. Research team

members asked community members about their experiences in the settlement.

During the transect walk, the Team applied a direct observation checklist, which was documented with photos and questions on several conditions, such as areas prone to flooding, mudslides, and washouts, and fires, trash collection sites, and public spaces residents socialize, to name a few. Notably, we documented makeshift infrastructures for risk prevention and climate change adaptation, such improved and informal flood retention walls Residents pointed out the variety of homes in the settlement, as well as schools, businesses, utility systems, and areas hit by recent mudslides. to assess the well-being of residents in the determined area by providing a picture of their immediate surroundings.

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Transect Walk, Findings

On the transect walk, the research team looked for common areas where fires were for cooking purposes and unplanned exterior or structure fires. The research team examined areas where residents could not build due to excessive exposure to heat, rain, or unstable terrain that was prone to erosion and landslides. The research team mapped utilities such as drinking water access via municipal supplies and wells, sewage disposal systems, water meters, water delivery systems like tanks and piping, and sanctioned and unsanctioned power lines.

To map environmental dangers, the research team looked for areas prone to flooding, landslides, washouts, floods, and exterior and structure fires. The research team also

looked for certain types of infrastructure like paved and unpaved roads, trash collection sites with and without dumpsters, trash incineration sites, and developed open and green spaces like parks. The research team also mapped civic institutions like businesses, churches, schools, and recreational facilities like football fields and futsal courts. The research team mapped means of livelihoods like farming and animal husbandry.

Additionally, the research team mapped the types and sizes of buildings present in the settlement. Specifically, the research team looked for buildings made from scavenged material like cardboard, wood, tarps, and corrugated metal, buildings that were a combination of those as well as concrete and brick, and finally, buildings that were fully constructed from ferrocement, cinder block bricks, with glass windows, purpose-built doors, and plastered facades. The research team also documented the number of floors buildings had.

The research team identified the grassroots, self-built infrastructure in Luz de Salvación II had been developing infrastructure despite still being in the process of legalization. The single access road into the canyon in which the settlement is located was paved, as well as several roads within the settlement. The access road was narrow, barely permitting two vehicles to pass one another, and very steep. The pavement was heavily damaged in parts, showing potholes and concrete planks unlevelled with each other. Within the settlement, the few roads that were paved showed signs of degradation.

Footpaths crisscrossed the neighborhood, connecting the roads that ran parallel to the canyon slopes, often perpendicular to the roads and the slope, making them very steep. These vary in quality and security. Some were made of concrete blocks, some were made of poured concrete, and others were simply dirt. The dirt paths were treacherous

during the rain, as they could erode and become slick with mud. Some trails were overgrown, in addition to being very steep. Residents did not feel safe on the road entering the settlement, saying the muggings were not uncommon. The only open space in the settlement, “La Cancha,” or football pitch, at which residents felt unsafe.

Potable water was supplied via thin PVC pipes fed by the municipal water system at the canyon's rim via what is locally known as pilas públicas. Residents self-built the network of pipes that connected to pilas públicas. Article 3 of Decree 302 of 2000, amended by Decree 229 of 2002, paragraph 3.27, now compiled in Decree 1077 of 2015 "defines pilas públicas, as the supply of water by the water service provider, provisionally, for collective supply, and in areas that do not have a water supply network, provided that the technical and economic conditions prevent the installation of home networks". According to AMB, Acueducto Metropolitano de Bucaramanga's website, "The public water supply systems are installed to meet the basic needs and contribute to the improvement of the quality of life of the inhabitants of neighborhoods and human settlements that do not have the technical conditions for access to individual water supply services." (*Information available at <https://www.amb.com.co/amb/servicio-al-cliente/pilas-publicas/The Acueducto Metropolitano de Bucaramanga SA ESP is the water utility company serving Bucarmanga metropolitan area>.)* At the time of the transect walk, residents were paying for water collectively, with a single water bill. Members of la Junta would collect each households' share by going door to door collecting money. Residents enhanced water security by storing rain water using water tanks.

Wastewater was discharged into ravines, including a concrete channel installed by an NGO at the bottom of the canyon. Black water discharged from houses on the canyon's rim

above and by residences on the plateau into the canyon, causing landslides by saturating the soil and destabilizing the steep slopes.

Because the settlement was not legalized, it did not have gas service, and only some residences were electrified. Residents were connecting their own electrical service to existing lines, running wires and setting poles dangerously close to buildings and trees, or building homes dangerously close to lines. These had already resulted in fires. The canyon's uneven terrain made keeping the power lines sufficiently far from the ground difficult. Many families were still cooking on small fires outside their homes since they had no gas. Some homes had gas-powered appliances fed by external tanks for purchase at neighborhood stores.

Burning trash incineration was common due to a lack of sufficient municipal waste removal services. Bucaramanga provided a 4-yard dumpster to Luz de Salvacion, which was insufficient.

Rapid and undocumented growth of the settlement posed a challenge for the city and the residents. Previous to legalization, all services the city provided were the result of monthly censuses conducted by the city. This limited the availability of water, the extent of waste removal, and transit services. The city struggled to document the state of development in preparation for installing municipal services.

Residents kept chickens outside of homes or in small coops. Dogs were common, but larger livestock was not present. Residents had small gardens, and potted plants were common.

Small convenience-style stores made up a majority of the commercial enterprise. These stores sold non-perishable goods and household supplies, including gas. They were often located in the ground floors of

multi-story buildings.

Luz de Salvacion II had no schools, but it did have several churches. Like the stores, these were small establishments, often on the ground floor of a multi-unit building.

Public green spaces in Luz de Salvacion were limited. One area referred to as la Cancha, or football pitch was the only undeveloped open space. The steep, uneven terrain of the canyon made it difficult to create any larger open area. Residents highlighted La Cancha as an area where they felt unsafe, especially at night.

The primary natural hazard threatening residents were landslides triggered by heavy rain or wastewater discharged onto the slopes of the canyon. These had flooded homes and eroded roads and pathways. Fires were limited by the predominant building material of concrete and brick, which are less flammable. Homes made of wood or salvaged materials were at greater risk of fires.

Homes varied in material and size. Informal settlers began constructing their homes using wood, cardboard, corrugated iron, and



Image 2.

tarps. As their tenure endured, they fortified their homes with concrete and bricks. More established buildings were multi-story, with ferrocement floors and pillars and brick walls. Some used prefabricated components for the floors. Homes were often increasing, with residents adding floors to house tenants or family members. Some residents had plastered and painted the exteriors of their

homes, while some still showed the concrete and brick components. Not all homes had glazed windows.

Participatory Community Mapping

The Research Team mapped the settlement using an aerial photo of the settlement with the route of the transect walk drawn in. The Research Team asked community members to place color coded stickers on the map to geo locate what they had pointed out on the walk the day before (Appendix III).

The map allowed residents to discuss and explain areas that the Research Team were not able to see on the transect walk. Since the mapping activity happened a day later, community members were able to process the transect walk and think about the types of questions they knew would be asked of



Image 3.

them. The questions attempted to strike a balance between resources already available in the community, hopes they had from the legalization process, and issues of climate change that needed to be addressed.

Community Chronology (Oral History Timeline), the method

The last workshop the Research Team conducted in the settlement was to record an oral history of Luz de Salvación II. The Research Team created a large timeline with years split into three year increments between pre-2001 and 2022. Each participant was allocated a row in the timeline, where they

placed post-it notes on which they or Research Team members had written the events that had occurred that particular year. Answers included information about the participants' lives in the community, utility availability, and local leadership. Many of these informal settlements are created incrementally and do not have a comprehensive history. It is important to create a space where members of the community can share their experiences and create a shared history.

Community Chronology (Oral History Timeline), History, Findings

The research team asked residents to recount their experiences with the neighborhood. Before 2001, there were only two or three houses in the neighborhood and many of the members of the Junta lived with family members or rented houses or apartments. A store opened in the upper part of the settlement between 2004 and 2006, and the Calle de Mandarinas, the main street, was paved and privatized. During this period, the Junta was established with Doña Matilde as Interim President. There was a landslide in the neighborhood.

The road opened the neighborhood to settlement. Between 2007 and 2009, a resident built the first building with 4 floors. Don Alidio began his 14-year tenure as Junta President, winning election to three four-year terms, followed by a two year emergency term during the COVID-19 pandemic. In 2008, utilities began appearing in the neighborhood. Residents paid for water with a collective bill based on the number of residents that were connected to the water supply.

Blanca had moved to Luz de Salvacion II by 2010 and owned her home outright, where she raised her children, marking the happiest years of her life. Flor Elide bought a lot in Luz de Salvación II at this time. José Vincente installed an electrical meter on his home as the neighborhood gained access to

electricity. The neighborhood still lacked important infrastructure like bridges across the stream that ran down the middle of the canyon. The community center was built during this time, which several residents highlighted as an important step. There was another landslide during this time period, flooding several homes.

Image 4: Photo of an area that had recently experienced a mudslide and the current water infrastructure.



Marta built her house in 2013 and moved to Luz de Salvación II. Meanwhile, the Calle de Mandarinas was paved, and the city installed stormwater drainage systems.

From 2015 to 2016, all the members of the Junta the research team spoke with had moved to the neighborhood. Crowding started becoming an issue in the existing buildings and the neighborhood. For example, 45 people lived in a 3-floor apartment.

The city began collecting trash and recycling. Previously, residents had been burning their trash or bringing it to a collection point outside of the neighborhood.

Leila built her house between 2017 and 2018. She had previously rented an apartment with her husband and daughter. Marta undertook several home improvement projects, installing tile flooring, creating a garden, and building a fence around her yard.

At this point, the Junta consisted of 15 women and three men. There was another landslide in 2018, flooding homes. Meanwhile, the electrical grid in the neighborhood was expanding, and the city removed the recycling bins after they were damaged. By 2019, Flor Elide's house was ready for her to move in with her family, seven years after purchasing the lot. Internet service was improved beyond the modem it was originally on.

Estefany took over as President of La Junta in 2022 and immediately advocated for improved water connections. Previously water had been delivered by the fire department via a system of tanks. The amount of water delivered was based on a monthly census of residents due to the neighborhood's rapid growth. The neighborhood is now connected to the municipal water system. The neighborhood also upgraded the water supply lines from a three-quarter-inch to an inch and a half, improving the rate of flow. At this point, there were about 400 residences in Luz de Salvación II.

While residents in informal settlements are exposed to crime and environmental risk, the informal settlement provides a path to tenure security that residents otherwise would not have. Most of the residents the research team spoke with were living with family members, mostly parents and in some cases, grandparents, before moving to the Luz de Salvación II.

Comparative Analysis: Settlements José Antonio Galán and Cristal Alto

Legalized settlements are still in ecologically and industrially precarious locations. Despite municipal infrastructure, the settlement's location between the Rio de Oro and heavy industry like tank farms exposes the residents to natural and industrial disasters and accidents, or a combination of the two. This reality highlights municipalities' and residents' challenges as they look to support themselves or their most vulnerable residents. Additionally, residents rely on the river for their livelihood, often mining the riverbed for sand or gravel, deepening the channel and risking erosion of the banks on which their houses are located.

The research team toured Cristal Alto, a legalized settlement. It had comprehensive water, gas, electricity, and sewage utility services. The road servicing the settlement, located in a canyon off the main plateau, had two lanes and was fully paved. Parks had play structures for children and exercise equipment for adults. A small levee protected the creek running near the settlement.

Legalization does not place all settlements on equal footing. Once a settlement is legalized, it can take years before all the infrastructure is installed. José Antonio Galán, a legalized settlement, is located between heavy industry and the Rio de Oro. Accidents at the industrial site had threatened the safety of the settlement before, as had flooding. NGOs and the municipality had worked together to prepare residents of José Antonio Galán for flooding by mapping evacuation routes.

Additionally, the settlement still lacked important types of infrastructure, such as a sheltered location for the residents to seek refuge during flood events or outdoor playgrounds for children sheltered from the sun and rain. Currently, the school in

the neighborhood has one concrete exterior area, which was walled in on all sides but had no overhead protection for the children.

Conclusion

Bucaramanga's land legalization team has two main strengths that allow it to operate effectively. Firstly, they have an interdisciplinary skillset, which gives them expertise in all the relevant areas. Rather than approaching legalization for an engineering or legal standpoint, they make sure that the human and technical aspects are part of the process. Secondly, visiting the settlements allows the land legalization team to build trust with the residents. Their physical presence demonstrates commitment to tailor the topographic assessment and urbanistic regularization plan to the particular needs of each informal settlement.

Settlements are motivated to apply for legalization because of the likelihood that at least some infrastructural improvements will follow land legalization. Lack of reliable potable tap water, faulty and informal electricity, and insecure outdoor public space all pose problems for the residents. As the residents of the four informal settlements visited highlighted, improved infrastructure would mitigate the effects of flooding, could prevent fires, and improve household waste collection. Additionally, public transit connections to the settlements would help the residents gain improved access to the rest of the economy and society.

The three capacity building workshops conducted in Luz de Salvacion II by the Research Team provided Bucaramanga's legalization team with insights on the effectiveness of their programs, in addition to granting the residents a rare opportunity to make their voices heard internationally and to reframe their struggles for slum upgrading under the umbrella of action towards climate change mitigation and adaptation.

The findings from the three workshops reveal that legalizing settlements, in other words, recognizing the informal neighborhood as an integral part of the city, can provide residents with critical infrastructure, like proper electricity, drainage, and roads. Formal electrical connections are even more crucial with increased urban heat because it prevents wires from melting and causing fires, a problem identified during the participatory mapping and the chronology workshops at Luz de Salvacion II. Informal construction methodologies are already responding to these problems, with local construction warehouses selling more affordable titling pre-painted in white to reflect sun and cool the interior of spaces. Flooding and mudslides remain an issue, despite self-built infrastructure, such as sand bag walls to divert rainwater, as the University of Michigan documented during the transect walk.

At least part of this problem can be solved with sewage and drainage systems. In sum, upgrading is more important than ever for informal settlements impacted by increased extreme heat and flooding. Land legalization or regularization, accompanied by targeted upgrading, improves the safety of public spaces, homes, and protection from floods and landslides. Coordination between city officials and residents can improve the process by generating buy-in from both sides. Finally, funding for incremental housing improvements are available in Colombia; however, clear, integrated and additional mechanisms to fund basic sanitation may be the most important investment in climate action.

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Appendix I: Photos

Cover page.



Image 1.



Image 2.



Image 3.



Image 4: Photo of an area that had recently experienced a mudslide and the current water infrastructure.



Appendix II: Planning Workshop Sticker Key

Color coded key to stickers used in the participatory mapping workshop

English	Spanish	Color
Areas of danger: What areas do you avoid? What type of danger is there? When is it dangerous? For whom is it dangerous (women, children)? Also, are there dangers of accidents or falling?	Lugares peligrosos: ¿Qué zonas evita? ¿Qué tipo de peligro? ¿Cuándo es peligroso? ¿Para quién es peligroso (mujeres, niños)? También, peligro de accidentarse o callarse?	Red
Neighborhood Social Points: Is there somewhere you enjoy spending time? Where are there public spaces?	Puntos de encuentro de los vecinos: ¿Dónde te gusta pasar el rato? ¿Donde hay espacios públicos?	Orange
Stores, churches, restaurants, markets, bars	Tiendas, iglesias, restaurantes, mercados, bares	Light Pink
Accumulation of trash: Where do you see a lot of trash? Where is trash picked up?	Acumulacion de basura: ¿Dónde ves demasiada basura? ¿Dónde se recoge la basura?	Purple
Green areas with more vegetation: Are there community gardens?	Áreas verdes con más árboles: ¿Hay huertas comunitarias?	Dark Green
Areas of Erosion	Áreas de Erosión	Light Green
Areas of Mudslides	Áreas de Avalancha	Fuschia
Areas of Recurring Flooding	Zonas de inundación recurrente	Blue
Areas, sites, or groups with intermittent access to water: Where is water missing?	Áreas, sitios o grupos cases con acceso intermitente de agua ¿Falta agua?	Turquoise
Fire or extreme heat	Incendio o Ola de Calor	Yellow

Appendix III: Participatory Mapping of Luz de Salvación II

Satellite image map of Luz de Salvación II showing the stickers applied during the participatory mapping workshop.



Appendix IV: Community Chronology

	Before 2001	2001 - 2003	2004 - 2006	2007 - 2009	2010 - 2012	2013 - 2014	2015 - 2016	2017 - 2018	2019 - 2020	2021 - 2022
					Cronología Comunitaria Luz de Salvación II					
Blanca	Lived in the Barro Garcia with her mother, family, and grandparents				Installed a door.					
Estefany	Lived at her mother's house with her children in Atoles de Fontana									May 21, 2021, Advocated to have better water supply management
Fior Elide	2007: Her parents moved in with her in 2001, lived in a rented home Barzocabermia with her children and husband						2016: Everyone but Fior Elide has moved to LDS		2018: Arrived in LDS from Santa Mariana and built a house on a lot they purchased in 2012	Elide's sister's house has 3 floors
Lelty										
Lella	Lived in Giron with her son in a rented house				Rented an apartment with her daughter and husband			Built house 2018		
Ligia	Moved into Luz de Salvacion with her 3 children in 2001	2001: recently arrived in the neighborhood, I celebrated my son's 15th birthday. Built house many years later.								
Maria Consuelo										
Maria Gilma	Lived in Prados del Sur in Floridablanca with her 2 children in a rented house				Lived in Prados del Sur in 2010 with children in a rented house	Built house in 2013				
Marta	Lived in Barro Manuella Beltran with her mother and nieces		Built road, began building the "big" house, some people kept cows		Beltran with her family in a rented house			2017 Improved house with fence, tiles, and yard		
Jose Vincente	Lived in an apartment in Fontana				Installed electrical meter		Enclosed his house for the first time			
					Neighborhood did not have joddes or widespread electrical supply					
Junta Leadership			Dofra Maribé is interim Junta President	2008: Donn Aldio becomes Junta President		Elections				June 2022: Estefany becomes Junta President
		Only 3 or 4 houses	Landslide	First building with 4 floors	Neighborhood begins electrification	Road gets paved	2016: City establishes garbage collection cities, previously, only collected from the caracol or residents incorporated in	Junia of 18 representatives, 15 women and 3 men	Better internet available in LDS	Previous to 2021 relied on the department to supply water, residents were unable to do laundry at home
General Events			A store moved into the upper part, private road installed at the entrance, there was a farm with cows and smaller houses	2008: first "Jua pulperia" (theoretical or water supply?)	Community Center built	City installs drainage for rainwater	The neighborhood became more dangerous with more people	Expansion of electrical system Recycling bins removed a year after they were destroyed		400 houses in LDS 70% - 80% of residents own their homes
					Landslide					