Building Resilience to Extreme Events in Cities: The Case of La Paz City, Mexico

Antonina Ivanova & Patricia Ahumada
Economics Department, APEC Studies Center
Autonomous University of Baja California Sur
aivanova@uabcs.mx

UCCRN Case Study Docking Station (2024)
DOI: 0. y e sb

Keywords	Multi-hazard assessment, natural disaster, vulnerability, resilience
City Population	292,241
City Area	20,270 km^2
GDP City	4.3 billion USD
Climate Zone	Cwb
ARC3.3 Linkage	Equity, Development, and Informality Element

Introduction. The municipality of La Paz (state of Baja California Sur) has around 292,241 people and receives more than 500,000 visitors annually for work, business, education, health and tourism. 93.6% of the population of La Paz is concentrated in the coastal area, while 4.3 and 2.0%, respectively, are located in the valley and the mountains (Ivanova & Gamez, 2012). The city of La Paz is the capital of the State of Baja California Sur, thus concentrating the majority of governmental, educational and health services.

The Koppen Climate Classification subtype for this climate is "Cwb". (Oceanic Subtropical Highland Climate). The average annual temperature in La Paz is 61.5°F (16.4°C). The warmest month, on average, is May, with an average temperature of 66.4°F (19.1°C). The coolest month on average is January, with an average temperature of 54.5°F (12.5°C). The area of the city is expected to significantly expand by 2030 (Map 2).

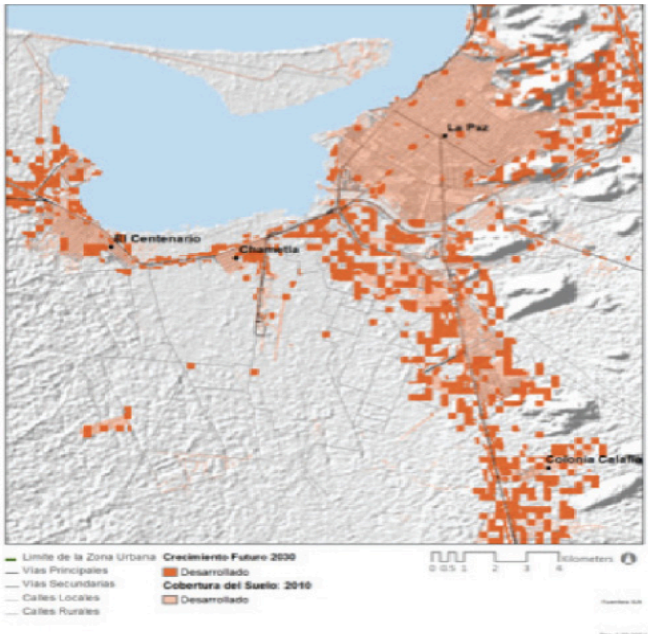
This case study aims to:

1.) Analyze the vulnerability of La Paz City to extreme events by conducting a multi-hazard assessment.

2.) Identify the institutional capacities for improving resilience and response capacity.

3.) Present some future challenges.

Map. 1: *The State of Baja California Sur in Mexico*
Source: INEGI, 2020



Map 2: *Forecast of the urban footprint of La Paz to 2030*
Source: Ivanova, 2016

Brief History: Vulnerability of La Paz City. La Paz City is exposed to various natural hazards, such as extreme heat, hurricanes, droughts, landslides, seismic events, floods — caused by torrential rains and storm surges — and high-speed winds (Atlas of Risks, 2012).

Due to its coastal location and geographical position, the city is exposed to hurricanes. The hurricane season begins in the first fortnight of May and ends in early November (Risk Atlas, 2012). On average, Baja California Sur is hit by a hurricane every 2.85 years; however, climate change scenarios for this region estimate that tropical cyclones will increase in intensity with shorter return periods due to hydrometeorological changes (Ivanova & Bermudez, 2013).

The areas that present the greatest threats of flooding are those located on the coastline at a height above sea level of less than 50 centimeters (Atlas of Risks, 2012). Additionally, the increase in mean sea level rise and the increase in storm surges can cause additional damage in coastal areas, particularly under the A1F1 scenario, which represents an increase of 18 cm for the year 2030 and 30 cm by 2050 (Ivanova et al., 2016).

Hydrometeorological patterns will modify with climate change, affecting the distribution of heavy rains and the frequency of droughts. These patterns are susceptible to El Niño events by causing more extreme climatic variability in the Gulf of California and the Pacific Ocean (Geoadaptive, 2015).

For example, rainfall of 425 mm was recorded in a 24-hour period due to Hurricane Liza on September 30, 1976 (Wurl & Martinez, 2006), which caused floods and stream overflows with a balance of more than 600 deaths in the city of La Paz. An illustrative case of how a meteorological event can accentuate all vulnerabilities of climatic impacts in the region was Hurricane Odile on September 14, 2014. It triggered multiple damages in the city of La Paz and exposed the low response capacity of the authorities and the lack of climate resilience. In general, some deficiencies were seen in the cooperation of the three levels of government, as well as a lack of collaboration with civil society. On the other hand, there were also positive responses, such as the cohesive response of local communities (Geoadaptive, 2015).

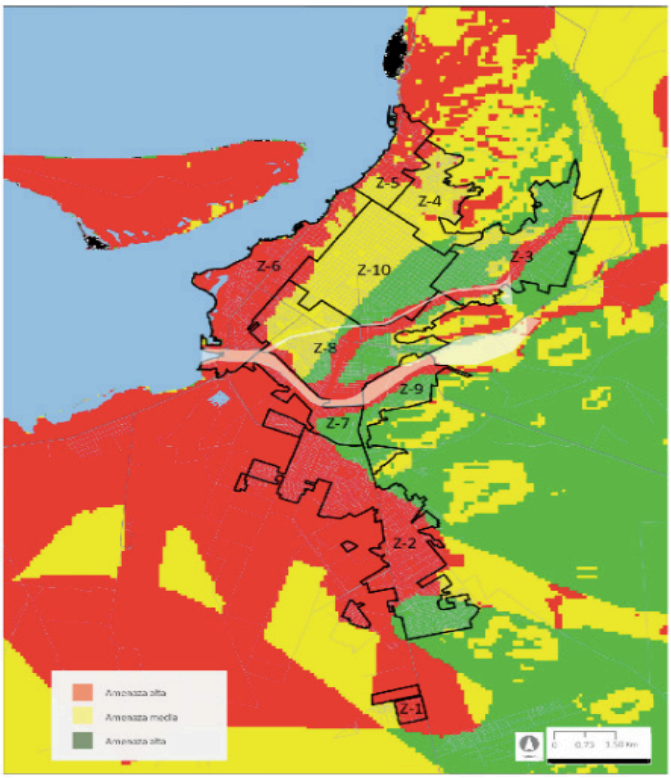
Analysis, Evaluation, and Implementation.

Multi-hazard assessment

Future climate scenarios forecast increases of 2°C for the period 2015-2039 and an extension of the season corresponding to summer (PACCLAP, 2013).

It is important to consider the impacts that multiple hazards may have on a specific site. Map 3 shows the superimposition of the natural hazards that exist in La Paz: drought, high temperatures, flooding, tides, landslides, tsunamis, erosion, steep slopes, faults, winds, and sea level rise. The assessment is based on a traffic light system: Low (green), Medium (yellow), and High (red), with High being the one that should be given the most attention. There is the possibility of several threats occurring simultaneously; for example, flooding could trigger landslides on steep slopes. The level of threat is calculated quantitatively from the frequency with which they occur, according to historical data and scientific analysis (UNISDR, 2009). The areas most exposed to multiple threats are concentrated in the north and west of the city (zones 1, 2, 5, 6, 7) and constitute the coastal zones or in proximity to the flood plains. The eastern areas of the city are less susceptible to hazards, as they are not in contact with the coastline or in the flood plains. The city center (zone 10) also experiences a low hazard as it is located at a higher elevation and outside of the high-hazard zones (Ivanova, 2016).

The processes of adaptation to climate change and management of natural hazards require a comprehensive vision that considers the resources available to the stakeholders in the implementation of intersectoral actions (UNEP, 2009, 2011; UNISDR, 2014).



Map 3: *Superposition of natural threats that exist in La Paz*
Source: Fuente - Ivanova (2016)

It is important to consider the impacts that multiple hazards may have on a specific site. Map 3 shows the superimposition of the natural hazards that exist in La Paz: drought, high temperatures, flooding, tides, landslides, tsunamis, erosion, steep slopes, faults, winds, and sea level rise. The assessment is based on a traffic light system: Low (green), Medium (yellow), and High (red), with High being the one that should be given the most attention. There is the possibility of several threats occurring simultaneously; for example, flooding could trigger landslides on steep slopes. The level of threat is calculated quantitatively from the frequency with which they occur, according to historical data and scientific analysis (UNISDR, 2009). The areas most exposed to multiple threats are concentrated in the north and west of the city (zones 1, 2, 5, 6, 7) and constitute the coastal zones or in proximity to the flood plains. The eastern areas of the city are less susceptible to hazards, as they are not in contact with

the coastline or in the flood plains. The city center (zone 10) also experiences a low hazard as it is located at a higher elevation and outside of the high-hazard zones (Ivanova, 2016).

The processes of adaptation to climate change and management of natural hazards require a comprehensive vision that considers the resources available to the stakeholders in the implementation of intersectoral actions (UNEP, 2009, 2011; UNISDR, 2014).

Stakeholder Analysis

Although there are numerous efforts in the areas of land use planning, environmental protection and risk management, their effectiveness depends on coordination between the actors, so that they can be applied properly and efficiently.

We define the stakeholders with influence on urban management based on the previous studies, and the multiple consultations and workshops carried out. We present the internal instances within the municipal administration, which are in charge of risk management and civil protection issues. Within the municipality, both the Environment Directorate, belonging to the General Directorate of Comprehensive Management of the City, and the Civil Protection Directorate, represent the two most influential instances in urban and risk management issues. Both have the power to exercise guidelines and regulations that shape the territory and structure, and coordinate the preparation and response to natural disasters.

Other actors that, although related, are not a direct part of the municipal administration, such as the Municipal Planning Institute (IMPLAN). These actors fulfill a key function, being a decentralized public body of the municipal public administration and having binding powers over all the sectors of the municipality. It is therefore a critical link between the municipal public administration, the real estate sector, and civil society.

The academic sector represents the actor with the capacity to contribute knowledge and data to improve decision-making. The main representatives are the Autonomous University of Baja California Sur (UABCS), and the Center for Biological Research of the Northwest (CIBNOR). Other important stakeholders are some non-governmental organizations (NGO) and international cooperation agencies. Como Vamos La Paz – Citizen Observatory, represents a key stakeholder in the development process, the strengthening and enrichment of citizen participation and the transparency of administrative management. The Inter-American Development Bank (IDB), and the agencies WaterClima (part of the Spanish consultant WE&B) and the German Cooperation for Sustainable Development (GIZ), with established and financed programs and agendas, contributed to the issues of urban and risk management. Both organizations have collaborated in these aspects with the City Council of La Paz. The Inter-American Development Bank (IDB), through its ICES program, is supporting improvements towards sustainability and resilience in the energy sector.

In 2013, the Climate Action Plan for the City of La Paz and adjoining areas, sponsored by IDB, was developed. The Study of Current and Future Vulnerability to Climate Change was developed in 2016 and later the Adaptation Strategy against Climate Change was developed for the Municipality of La Paz in 2017 by GIZ. These two studies are the basis for the Climate Action Plan of the municipality of La Paz (PACMUN) that will launch the present administration (Municipality of La Paz, 2021).

Future Implementation and Concluding Thoughts. The main body for monitoring, follow-up, and evaluation is the Secretariat of Urban Planning, Infrastructure, Mobility, Environment and Natural Resources. Como Vamos La Paz – Citizen Observatory is continuously holding forums and consultations with civil society to outline and evaluate policies oriented towards sustainability and resilience, as well as their results and impacts at the neighborhood and city levels.

Despite the existence of these institutions, they are not duly equipped to implement and execute actions that ensure adequate urban growth combined by the risk of extreme management.

The La Paz Population Center Urban Development Program, 2018 (PDUC) integrates information from the 2012 Risk Atlas, PIMUS (Sustainable Urban Mobility Plan for La Paz) and PACCLAP. However, it only covers the population center and should be extended to the complete urban area.

The General Law of Civil Protection defines the responsibility of each state and municipality to have the normative instruments and regulations that facilitate its implementation, including the integration of the Risk Atlas in the urban planning instruments, clearly indicating whether different areas of the city are suitable for the development of both private and municipal infrastructure and public goods. In particular, the designations of land for different developments must go through an approval process including the information of the Risk Atlas (Ivanova et al., 2017). The rule also includes the periodic updating of the Risk Atlas, according to the present and expected climate change effects. However, In the Subregional Plans for Urban Development, the information from PACCLAP and the Atlas of Risks has not been effectively reflected.

Beyond the designation of land uses and urban estates, the General Directorate of Comprehensive Management of the City must establish procedures for the inspection of construction systems and the selection of materials resistant to the threats that affect La Paz. Clear rules must exist to deny permits to construction that do not comply with risk management guidelines. With respect to the population that presents a high degree of marginalization or that lives in irregular areas, the Civil Protection Directorate must coordinate with the Territorial Planning Directorate on the generation of information that helps marginalized residents with the necessary information regarding threats and adequate, resistant construction systems.

References

Atlas of Risks. (2012). Municipality of La Paz.

Geoadaptive (2015). Strategic Interventions towards a Resilient Future of the City of La Paz, BCS, México. *Municipality of La Paz, ICF, BID & Geoadaptive.*

INEGI (2020). *Statistic Yearbook by Federal Entity*. www.inegi.gob.mx/prod_serv/contenidos/.../bvinegi/2010/Aepef2020.pdf

Ivanova, A. & Gámez, A. (2012). *State Plan of Climate Change Action,* (PEACC). http://spyde.bcs.gob.mx/cgds/files/proyectos/PEACC/foros/Presentacion_Informativa_Foros_

Ivanova, A. & Bermúdez, A. (2013). *Climate Action Plan for the City of La Paz and Adjoining Areas*. (PACC-LAP). http://www.lapaz.gob.mx/images/stories/cambioclima.zip

Ivanova, A. (2016). *Building Resilience in the Cities. Policies, Instruments and Lessons in the Face of Extreme Events*. La Paz, Baja California Sur, Mexico in The Integral Implementation of the New Urban Agenda. Experiences and Contributions from Lation America, GIZ & Cite, Flacso, Quito, Ecuador, pp. 145-171.

Ivanova, A., Reyes, H., Salvadeo, Ch., Serrano, R. & Ramirez, E. (2016). *Present and Future Vulnerability Assessment of the Municipality of La Paz*. GIZ.

Ivanova, A., Reyes, H., Salvadeo Ch., Serrano R. & Ramirez, E. (2017). *Strategies and actions for Climate Change Adaptation. Municipality of La Paz*. GIZ.

Municipality of La Paz (2021). *Municipal Development*. Well-being with a gender and inclusion perspective 2021-2024. https://lapaz.gob.mx/images/marco-normativo/PMD%202021-2024.pdf

UNEP (2009). *Training Manual on Vulnerability and Adaptation to Climate Change for Geo Cit ies*. https://wedocs.unep.org/bitstream/handle/20.500.11822/11210/IEA-Climate-Change-VIA-City.pdf?sequence=1&isAllowed=y

UNEP. (2011). *IEA Training Manual, Climate Change Vulnerability and Impact Assessment in Cities*. http://www.unep.org/ieacp/files/pdf/Climate/IEA-Climate-Change-VIA-City.pdf>

UNISDR. (2014). *Disaster Resilience Scorecard for Cities*. Working Document, Version 1.5.

Wurl, J. & Martínez Gutiérrez, G (2006). *The effect of tropical cyclones on the climate in the Santiago Basin, Baja California Sur, Mexico*. III International Symposium on Engineering and Sciences for Environmental Sustainability, Mexico City.

Acknowledgments

We would like to thank Silvia Fontan for her valuable feedback in reviewing this case study.

Additional Data

- **Gross National Income (GNI):** 12,100 USD (Higher-Middle Income)
- **Population Density:** 7,300 people/km^2
- **Gini Coefficient:** 45.4
- **Human Development Index (HDI):** 0.781 (High)
- **Type of Climate Intervention:** Adaptation
