MSc. Metropolitan Analysis, Design, and Engineering

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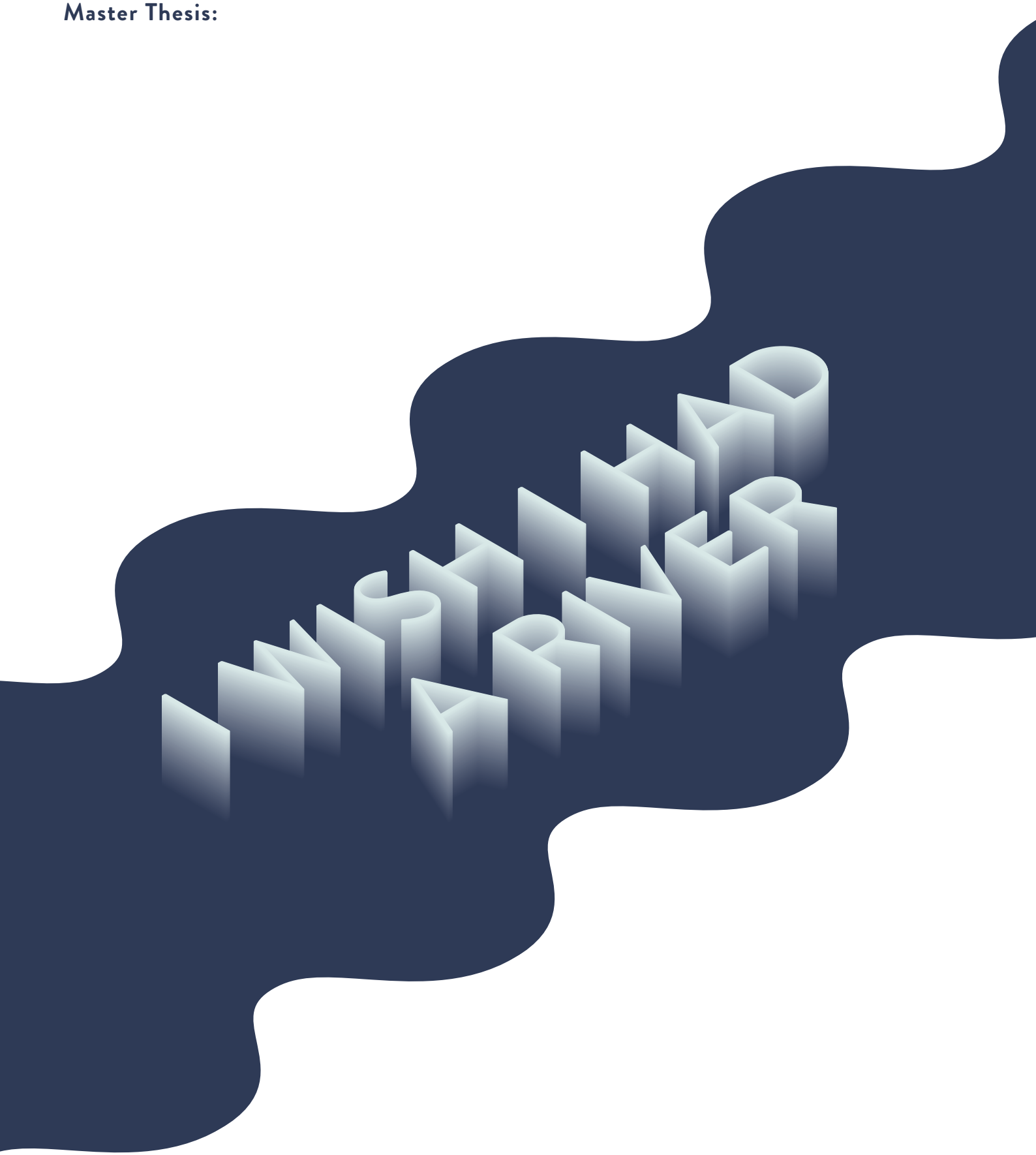

AMS
AMSTERDAM INSTITUTE FOR
ADVANCED METROPOLITAN SOLUTIONS

Water Governance And The Implementation Of Water Sensitive Solutions For The City Of Tepic

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Master Thesis

I Wish I Had a River:

Water Governance and the Implementation of Water Sensitive Solutions for the City of Tepic

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Abstract:

The city of Tepic is facing severe issues regarding water due to increase pressure product of climate change. The disruption of the water cycle, the lack of proper water management, and the way governance is organized had hindered the implementation of sustainable water management solutions. The Mololoa micro-basin holds the potential to be a strategic starting point to encourage a more sustainable water management model for the city of Tepic.

This research try to assess the water governance of the city of Tepic to pinpoint barriers and drivers for the implementation of sustainable water management solutions. Evaluates the social vulnerability of the city through a GIS Analysis to understand the distribution of burdens caused by water problems. And make a case for a Water Sensitive City Vision as a solution to alleviate the water related problems of the city.

TABLE OF CONTENT

1 INTRODUCTION **1**

1.1 Background 1

1.1.1 Water Rights in Mexico 1

1.1.2 The City of Tepic 1

1.1.3 The History of Water Use in Tepic 4

1.2 Problem Definition 5

1.2.1 Man-Made Disruption of the Water Cycle 5

1.2.2 Unequal Spatial Justice and Privatization 7

1.2.3 Water Governance Failures 8

1.3 Research Objective 10

1.4 Research Questions 10

1.5 Research Scope 10

2 Theoretical Background **11**

2.1 Water Justice 11

2.2 Water Governance 12

2.3 Social Vulnerability 12

2.4 Urban Liveability 13

2.5 Water Sensitive Cities 14

2.6 Water Sensitive Solutions 14

3 Methodology **16**

3.1 Water Governance Assessment 16

3.2 Water Vulnerability Mapping 17

3.3 Water Sensitive Solutions 19

4 Results **21**

4.1 Water Governance 21

Assessment of Tepic 21

4.1.1 Barriers for Implementation 21

4.1.2 Drivers for Implementation 25

4.2 Water Vulnerability Map of Tepic 27

4.3 Water Sensitive Solutions for Tepic 34

4.3.1 Application Potentials of Water Sensitive Public Spaces 37

5 Discussion **39**

5.1 A New Governance for Tepic 39

5.2 Redistribution of Water Justice. 41

5.3 Potential of Water Sensitive Solutions 42

5.3.1 Existance: Catchment Systems & Flood Protection 43

5.3.2 Relatedness: Improved Green Recreational Areas 43

5.3.3 Growth: Improved Connection to the River 43

6 Conclusion **45**

8 Reference **47**

9 Annex **50**

LIST OF FIGURES

Figure 1.1. Map showing the location of the basin, the river and the streams in contrast with the urban and rural areas to the municipality of Tepic and Xalisco. 2

Figure 1.2: Urbanization process in the urban area of Tepic. A) Urban area in 2013, Xalisco, Nayarit. B) Urban area in 2020, Xalisco, Nayarit. C) & D) Flashflooding during heavy rainfaill, 2013. 5

Figure 1.3: Failure of water drainage and the process of erosion in the streets of Tepic, near Sugarmil Source: Antonio Echevarría García vía Facebook. 6

Figure 1.4: Examples of selfmade solutions in vulnerable areas. A) School nearby the riverbasin, construction of highwalls. B) Houses near the riverbasin. C) Highsteps to access house and avoid flooding. 7

Figure 2.1. Five layer pyramid demonstrating Maslow's Hierarchy of Human Needs with physiological at the bottom, and self-actualization at the top. 13

Figure 2.2. Alderfer's E.R.G. theory (1969) 13

Figure 2.3. Urban water city states, their socio political drivers and their service delivery functions (Brown et al. 2009) 14

Figure 2.4. Illustration of the relationships between City States and Societal Urban Water Needs 15

Figure 3.1. Jimenez et al. (2020) Water Governance: A Framework for Practitioners 16

Figure 3.2. Image of Floodplains Tepic ,Nayarit, Return period of 2 years (SEDATU, 2016). 19

Figure 3.3. Catalogue of WSS per scale (Deltares, 2018) 20

Figure 4.1. Most populated neighborhoods of Tepic clasified in 6 categories to find patterns. 27

Figure 4.2. Vulnerability Index per Existance Category 29

Figure 4.3. Vulnerability Index per Relatedness Category. A) shows the BGSAs categorized in same sample sizes, B) Shows BGSAs categorized in same size intervals. 30

Figure 4.4. Vulnerability Index per Growth Category. 31

Figure 4.5. E.R.G. Vulnerability Index per Growth Category. 32

Figure 4.6. Overlap between E.R.G. Vulnerability Index and Floodplains with a 2 year return time. 33

Figure 4.7. Illustration of the relationships between City States and Societal Urban Water Needs 34

Figure 4.8. Motto Delay, retain, store and reuse, and only drain when necessary, adapted to the profile of the city of Tepic. 35

Figure 4.9. Distribution of Green Areas and Sport Areas in the city of Tepic 36

Figure 4.10. Proposed areas of intervention for implementation of WSS. A) Ditches and Slopes. B) Lowlands of the Valley 38

Figure 4.11. Strategies Area A. Top Down: infiltration terraces, limit urbanization, cascading dikes, renaturalisation of ditches. 38

Figure 4.12. Strategies Area B. Top Down: infiltration and retention ponds, natural water purification filters, urban retention areas, expansion of wetlands. 38

Figure 5.1. Contrast between dwellings in Los Colomos Neighborhood within a BGAS susceptible to flooding. Source: Google Maps (2015) 41

Figure 5.2. Gated Communities Aves del Paraíso A) Gated acces, B) Top view from the coopted ditches, Tepic, Nayarit. Source: Google Maps (2015). 42

LIST OF TABLES

Table 4.1 Indicators used for the generation of the vulnerability
Index retrieved from the 2020 Census by INEGI: Full table of definitions Annex 2. 28
Table 4.2 Indicators used for the generation of the Existance Vulnerability Index. 28
Table 4.3 Indicators used for the generation of the Relatedness Vulnerability Index. 30
Table 4.4 Indicators used for the generation of the Growth Vulnerability Index. 30

Photo: Main Square, Paco Ávila, 2017.

Photo: Matatipac Valley from San Juan Volcanoe, Christian Frausto Bernal, 2017 ,via Flickr.

1 INTRODUCTION

1.1 Background

Water is essential for sustaining life. It is needed for virtually every human task from household use, agriculture, industry, and leisure while also having an important role in ecosystem functions (Biswas & Uitto, 1999). Global water use has increased six-fold over the past 100 years and its demand continues to steadily grow (UNESCO, 2018). Climate change impacts water resources around the world due to its direct connection to the hydrologic cycle (Wong & Brown, 2009). Further, man-made problems such as flooding, privatization of public water utilities, corruption, displacement by large dam projects, and contamination caused by industry and mining exacerbate the situation (Boelens et al., 2018). These effects further challenge the sustainable management of water resources which are already under severe pressure in many regions of the world (Bates et al., 2008).

Rising demand and declining availability of fresh water often leads to clashes among different water users. The variety of stakeholders lead to a range of perspectives regarding the value of water. This, in turn, effects how water is managed (UNESCO, 2021). Water management is defined as the activities which monitor water resources as well as the measures developed and implemented to keep water within a water quality range useable for human consumption (Bates et al., 2008). Best-practice urban water management is widely acknowledged as complex because it requires urban water planning to protect, maintain, and enhance the multiple benefits and services of the total urban water cycle valued by society. These include supply security, public health protection, flood prevention, waterway health protection, greenhouse neutrality, economic vitality, long-term environmental sustainability, recreation/amenities, and intra- and inter-generational equity (Johnstone, 2014). That is why water managers often focus on optimizing singular parts of the water cycle, as illustrated in many cities across Mexico (CONAGUA, 1992).

1.1.1 Water Rights in Mexico

As established in 2012, the political constitution of the United Mexican States (CPEUM) guarantees the right to access, disposal, and sanitation of water for personal and domestic consumption in a sufficient, healthy, acceptable, and affordable way (CPEUM, 4th ar., Paragraph 6, 2012). However, the statement only focuses on supply security and public health protection without taking into account the several other ways citizens relate to water. This has caused Mexico's water governance to unequally distribute the burdens and benefits amongst the different water use stakeholders. Water governance, in this case, is defined as the social functions that helps regulate development and management of water (Bates et al., 2008).

Most of the causes of the global water crisis are embedded in this unequal distribution of power, poverty, and growing disparity between stakeholders (Rogers et al., 2006). Therefore, the water crisis in Mexico can be seen more as a consequence of the imbalanced and dysfunctional power structures rather than a consequence of generalized scarcity (UNDP, 2006).

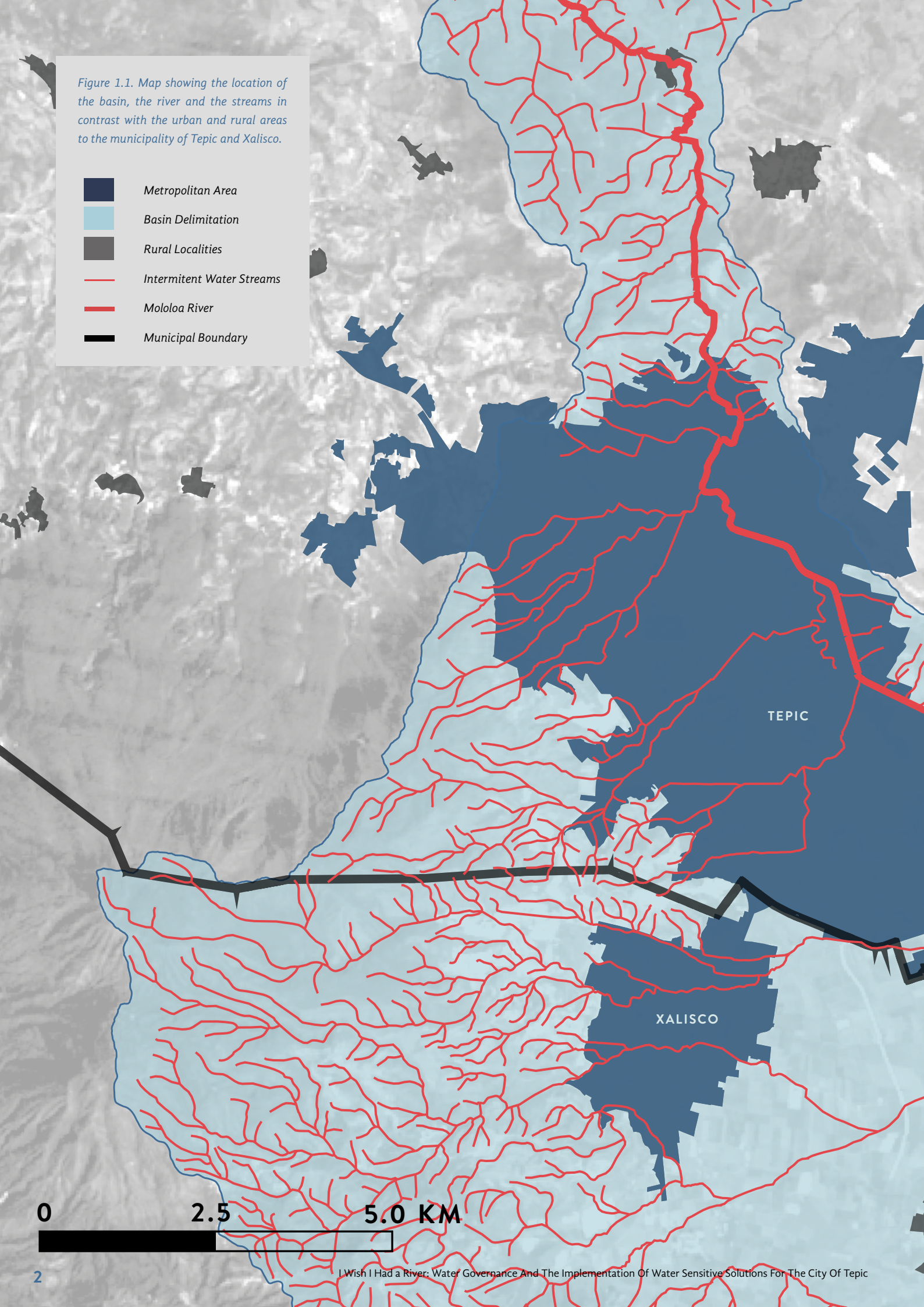

Figure 1.1. Map showing the location of the basin, the river and the streams in contrast with the urban and rural areas to the municipality of Tepic and Xalisco.

The city of Tepic is an example of this mismanagement of water. Tepic is located on the Western side of Mexico and is the capital city of the Mexican state of Nayarit. The city is located within the micro-basin of the Mololoa River in the central part of the state. With a total surface of 56,937 ha, the basin is delimited by five volcanic elevations which altogether form the Matatipac Valley. Approximately 490,000 inhabitants are settled in this valley (Figure 1.1) (INEGI, 2021).

The Matatipac Valley is characterized by its amphitheater shape. This topography turns the valley into a natural receptacle for rainwater while the flat surface of the valley limits the rate of water drainage (Pérez, 1984). Further, the subsoil composition of permeable volcanic material facilitates water infiltration from beneath the ground. These geological, geographic, and topographic characteristics lend to the existence of wetlands, swamps, and springs which become the source of the Mololoa micro-basin (Navarrete, 2020). The natural drainage of the Mololoa micro-basin is formed by natural runoffs and creeks, a situation that unites the different settlements beyond being a metropolitan area, including the city of Tepic (Luna, 2014). The storm drainage infrastructure of the city is integrated by 19 rain water interceptors, 9 natural ditches and a main drain with an intra-urban route of approximately 12 kilometres. (IMPLAN, 2018).

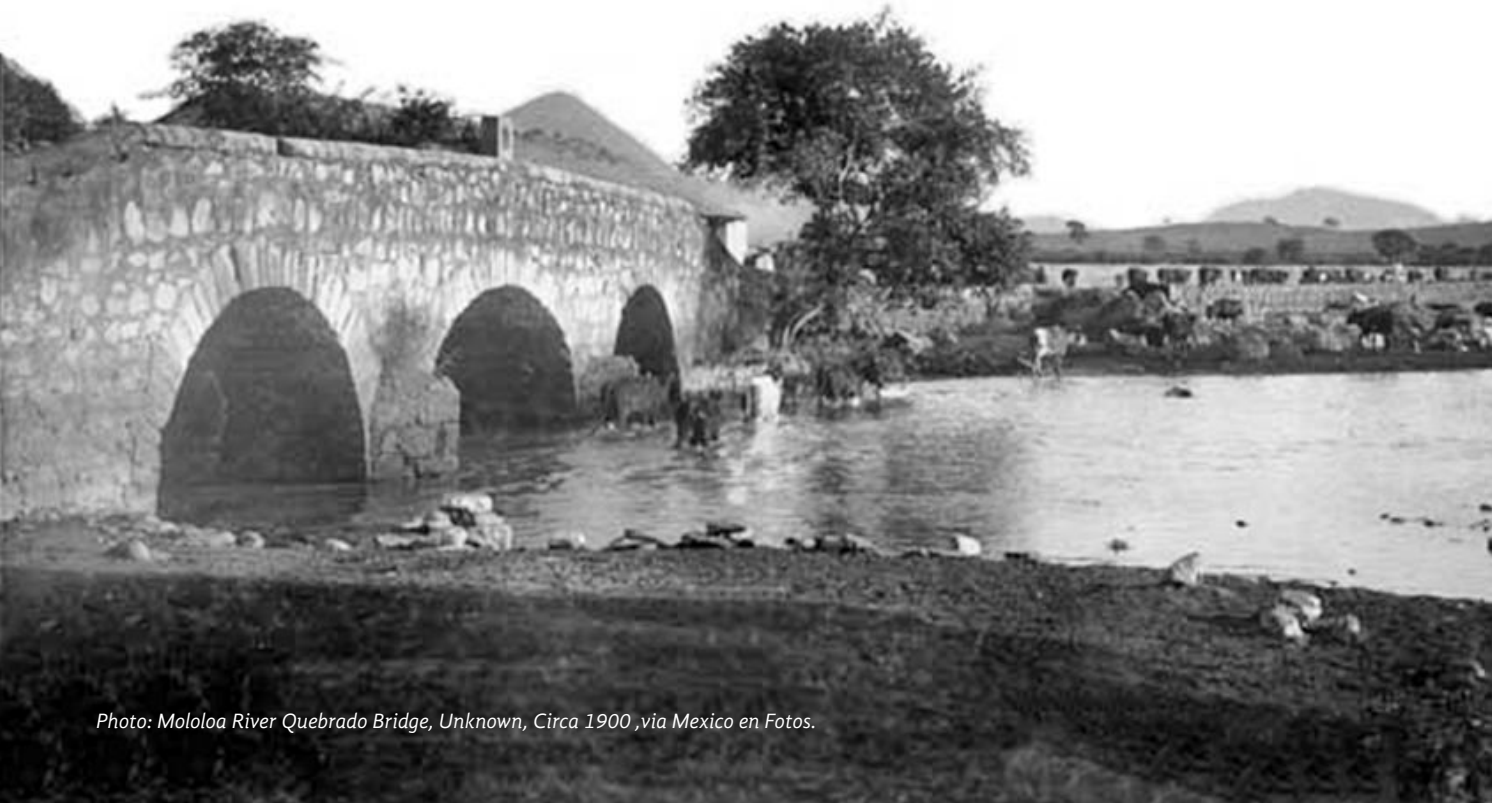

Photo: Mololoa River Quebrado Bridge, Unknown, Circa 1900 ,via Mexico en Fotos.

1.1.3 The History of Water Use in Tepic

How the water is used and who uses it have always depended on the power structures in place. During the first half of the 17th century, the water of the Mololoa River was seen as a valuable asset for the new oligarchy that surged in Tepic after the Mexican independence (Luna & Jarquín, 2016). The prospect of using the river as a source of energy and irrigation led the hacendados (wealthy landowners) to create hydraulic infrastructure to collect, diverge, and dam the resource. During this time, the possession of water became just as important as owning the land itself and high economic power dictated who was able to take control.

This very early setup led to a history of influence to capture land around the river. By the end of the 19th century, the industrial revolution and the radical agrarian distribution of 1910's Mexican Revolution kick-started new socio-political contracts over the control of the water (Luna & Jarquín, 2016). A new water management infrastructure was conceived via private business projects. This resulted in benefiting a small group of wealthy local businessmen who saw a way of appropriating the water resource by making use of their market vision and exercise of power (Lucifer, 1895, in López, 2007). As a consequence, water concessions were given to a wealthy oligarchy while small landowners were restricted in their use of water sourced from the river and surrounded springs. This pattern of catering to the economic power for the sake of the market continues to this day (Olvera, 2020). For the city of Tepic, this poor water management has led to the disruption of the natural water cycles creating different problems for different stakeholders and citizens (IMPLAN, 2018). As a result, the most water vulnerable population in the city is constantly threatened by bureaucratic administrations, market driven policies, and top-down project intervention practices (IMPLAN, 2018).

1.2 Problem Definition

Tepic has found itself founded in a valley with a natural predisposition for the capture of water and whose hydro-social contracts have been shaped by the historic capture of influence around it. The city's water management infrastructure has favored private business projects which benefit the economic oligarchy of the city and was in place well before any policy framework relating to water management was ever in place. The poor water management of Tepic has disrupted the natural water cycle of the valley due to anarchic urbanization, lack of planning, and a western idea of progress which frame water antagonistically as something to be defeated (Navarrete, 2020). These man-made disruptions to the water cycle are further discussed in Section 1.2.1. Additionally, the broken relation with water and the capture of power around it has dictated where people live and how they relate to water. The result has been unequal spatial justice based on economic, demographic, and cultural backgrounds (Section 1.2.2) (Serafín, G., 2019). The combinations of all these problems have led to a biased and failing water governance (Section 1.2.3.)

1.2.1 Man-Made Disruption of the Water Cycle

The Mololoa River is the main source for the recharging of underground water, the main source of supply of the municipality, and is also used for the production of sugar cane crops which is the second largest economic activity in the city (IMPLAN, 2018). The original riverbed meanders along its path, extensive floodplains that changed configurations depending on the amount of rainfall. The fight between the river and the urbanization process has a long past and continues to this day despite several infrastructure interventions (Navarrete, 2020). The history of fighting the river became more severe after 1975 when the original river was confined to a canal. As published in "Diario el Pacífico" (1976), the construction of the canal was done to diverge the Mololoa River prevent the great floods that expanded in the basin every rainy season.

The metropolitan area of Tepic has been subjected to a steady and constant process of urbanization. The process has had sever repercussion on the ecosystems that surround the metropolis since they became part of a transformation process (Figure 1.2). The deterioration of natural resources is particularly reflected in the Mololoa micro-basin where the natural functions of the basin and the ecosystems that surround it have been urbanized (Jauregui et al., 2014).

Figure 1.2: Urbanization process in the urban area of Tepic. A) Urban area in 2013, Xalisco, Nayarit. B) Urban area in 2020, Xalisco, Nayarit. C) & D) Flashflooding during heavy rainfaill, 2013.

The urbanization process has reached the margins of the natural ditches in the city while replacing the natural runoffs of water with impervious surfaces. The natural ditches are described as federal areas, which require a 10 meter buffer around them for their urbanization which has not been respected (IMPLAN, 2018). These channels for the evacuation of the rainwater soften before reaching the river and flow into the flattest areas of the valley, thus causing flash floods where the sewer infrastructure does not exist.

The lack of proper separation of sewer-water and rainwater drainage infrastructure represents a huge issue for public health. Since the rainwater doesn't have other outlet but a single sewage line, the drainage system experience a very high stress every rainy season. This ends up collapsing the piping, filling the streets with polluted water, especially in the low areas of the valley where the water tends to accumulate (Fig. 1.3) (Interview Partida, A., Nayarit, September 2021).

This also represents a huge risk for the underground water quality. The breakdown of the pipes causes the private discharges to flow underneath the streets like underground rivers, eroding the soil, polluting the water tables, and creating sinkholes (Figure 1.3) (Interview Partida, A., Nayarit, September 2021). This is just one of the several complex problems the water management and service providers face.

Figure 1.3: *Failure of water drainage and the process of erosion in the streets of Tepic, near Sugarmil Source: Antonio Echevarría García vía Facebook.*

According to the 2013 INEGI Water Collection, Treatment, and Supply Census, the country's water and sanitation service providers have losses up to 60% of the volume drinking water injected into the networks. This has adverse effects on the availability of water and on the finances of the sector. On the one hand, greater volumes of water must be extracted to compensate for leaks while, on the other hand, it is not possible to balance the finances of the providers (Jimenez, C., 2019 in Ávila et al., 2020). Therefore, subsidies are required. The disruption in the water cycle has been impacted by different factors, but each related to man-made transformation on the natural environment. This has forced the population to adapt in different ways to withstand the problems it carries.

1.2.2 Unequal Spatial Justice and Privatization

The metropolitan area of Tepic was recognized as such by the Ministry of Social Development (SEDESOL) and the National Population Council in 2014. The effects of water issues, however, do not affect everyone in the metropolitan area the same way. Each neighbourhood and region within the boundaries of this area have responded in a different way to the limitations and possibilities their natural environment gives them. The political, demographic, economic, cultural, and spatial forces have dictated the development of the city without any general guidance or long-term planning (Serafín, G., 2019).

After the deviation of the riverbed, the lowlands were soon invaded by informal settlers. By 1975, at least 29 different settlements were identified in the area. From 1987 to 1994, the urban growth of Tepic reached an extension of 3,754 hectares, including the aforementioned wetlands. Now this area has been divided into at least 20 neighborhoods that are susceptible to flash floods (IMPLAN, 2020) (SEDATU, 2014).

Land belonging to Ejidos (communal land owned by the Mexican state) located near the river basin was being sold and bought for its development to private individuals, repeating the pattern on land grab by the economic power. As a consequence, the remaining water bodies were illegally filled with debris and other materials to facilitate construction which further disrupted the natural water cycle of the basin.

According to the Nayarit Environmental Network, a civic organization, the Ministry of the Environment and Natural Resources (SEMARNAT) will not acknowledge an official delimitation for the polygons of the river basin nor the perimeters around it. This makes the invasion of land even easier as it allows landowners to expand their properties during every government change (Angel, 2020).

Neoliberal policies implemented during the twentieth century solidified this trend. The existence of hegemony of a political party and control of the executive power over the legislative powers allowed the ones in power to overcome resistance from the system itself by containing small oppositions and granting privileges to certain organized groups with the political capacity to defend their interests (Navarrete, 2020).

The distribution of access water rights and water related decision making is, therefore, extremely skewed towards the needs of the people that had benefited from all this capture of influence. This leaves the most vulnerable to manage the burdens of water problems on their own (Figure 1.4)

Figure 1.4: *Examples of selfmade solutions in vulnerable areas. A) School nearby the riverbasin, construction of highwalls. B) Houses near the riverbasin. C) Highsteps to access house and avoid flooding.*

1.2.3 Water Governance Failures

At a policy level, the general framework that regulates and manages the water for the country is outlined in article four and 27 in the Political Constitution of the United Mexican States (CPEUM), which recognizes the human right to water and sanitation while listing which sources of water recognized as national waters. From there, the National Water Law is shaped to establish the agreements between the three levels of government in water matters.

According to the 110th article from the CPEUM each estate has its own constitution. Nayarit's constitution establishes that, on a municipal level, the city councils have the ascription of drinking water, drainage, sewerage, treatment, and disposal of wastewater by providing the guidelines to the decentralized water operation agencies for each city. The operation agencies in the metropolitan area of Tepic are the Intermunicipal System of Drinking Water and Sewerage Services for Tepic (SIAPA) and the Municipal Operator Body of Drinking Water, Sewerage, and Sanitation for Xalisco (OROMAPA).

At an institutional level, the National Water Law established the National Water Commission (CONAGUA) as the directing authority at the Federal level (1992). CONAGUA is a decentralized administrative body whose purpose is the regulation, control, and preservation of the quality and quantity of water. This means that CONAGUA controls the amount of water distributed and then delivers the water to the operating agencies at a municipal level while also managing the federal water infrastructure (i.e. damns, pipes, and canals).

At a regional level CONAGUA establishes the Basin Commissions to try and strengthen the integrated and sustainable management of water. Tepic, and the Mololoa River depend of the Lerma-Santiago-Pacífico Basin. Finally, by May 18th, 2007 the Basin Council agreed to create the Mololoa River Basin Commission, in the State of Nayarit, with the intention of addressing the water and environmental problems of the Mololoa River Basin. In addition, CONAGUA also created the Basin Councils, bodies of mixed integration, whose function is provide support, consulting and advice between the commission and the different entities at federal, state or municipal level, and the representatives of the water users and the organizations of the society. The Mololoa Micro Basin has also a Council in existence.

Photo: Estern Treatment Plant in the banks of the Mololoa River, Tepic, Nayarit. Gerardo Espinoza, 2020

But despite all of the different commissions and laws as well as all the information and analysis on the problematic regarding water, the city and the river remain in the same state of deterioration. Several potential solutions have been proposed over the years but most interventions have been limited to sporadic, superficial, and media-based implementation of maintenance, reforestation, de-silting, and cleaning actions in the most visible parts of the basin (Navarrete, 2020).

There are some environmental groups pushing for improvement of the river. However, they have only been emergent and sporadic reactions that have not managed to move beyond the collectives (Navarrete, 2020). Their role have serve merely as consultancy or as a way to justify already ongoing strategies (Interview, Duran, S., Nayarit 2021) (Interview, Macedo, L., Nayarit, 2021).

As for general citizens, there is a general awareness on the poor application of laws, regulations, sanctions, and fines as a means to avoid contamination and other water related issues. But their attention is directed mostly on pollution and floods as they are the most tangible of the problems (Navarrete, 2020). Despite all of that, many strategies had been proposed over the years to recover the vocation of the old basin, to recover the ecological health of the river, and to end with all the water related problems of the city (IMPLAN, 2018). But political cycles come and go and the river and the city remain the same as there seem to be a clear bottleneck impending the effectuation of sustainable water management solutions.

Photo: SIAPA water supply infraestructure, Tepic, Nayarit. via: Certeza Política, 2018

1.3 Research Objective

The Mololoa micro-basin holds the potential to be a strategic starting point to encourage a more sustainable water management model for the city of Tepic. Therefore, this research aims to understand what influence sustainable urban water management solutions could have to improve water justice for the city. This will be pursued through three primary objectives which are to:

I. review the state of water governance for the city of Tepic including what barriers are preventing good water management and which could be potential drivers for sustainable water management practices;

II. assess how social vulnerability is distributed along the basin in the metropolitan area of Tepic to better understand the spatial distribution of burdens caused by water problems; and

III. investigate which sustainable water management solutions could be implemented according to the city's water vulnerabilities, potential impacts, and implementation feasibility.

1.4 Research Questions

The three research objectives will be investigated by answering the following research questions (RQ) and sub-research questions (SRQ):

RQ: What is the potential of sustainable urban water management solutions for improving water justice in the city of Tepic?

- RQ1. What is the state of water governance in Tepic?
  - a. What are the barriers for implementing sustainable water management solutions in Tepic?
  - b. What are the drivers behind the implementation of sustainable water management solutions in Tepic?
- RQ2. Which areas of the city are the most vulnerable to water related problems?
- RQ3. Which sustainable water management solutions can be implemented in the city of Tepic?
  - a. What are the potential impacts of implementing WSS in Tepic?
  - b. How would they look like?

1.5 Research Scope

The geographic scope of this research will be limited to the Metropolitan area of Tepic, including the municipalities of Tepic and Xalisco. Although there are more rural locations within the bounds of the municipality of Tepic, the urban fabric has not reached them, therefore, the dynamics that exisit within them are not relevant. Emphasis will be on the Mololoa micro-basin as part of the Santiago-Lerma Basin within the bounds of the metropolitan area. While the basin as a whole will be taken into consideration, the problems faced at the beginning and end of the stream are very different from the ones present in the urban area. The urban fabric also touches upon the Huaynamota River micro-basin and the Huicicila River basin, however, they are excluded as they only touch upon rural areas of the municipality and small developments outside the urban fabric of Tepic. The solutions investigated will be architectural in nature and do not include structural or engineering calculations nor recommendations. The solutions will be based on the Deltares Climate adaptation app for the catalogue of water sensitive measures retrieved from the report Water Sensitive Mexico City (2018) by the Urbanisten and Deltares, in collaboration with the Mexican Government.

2 Theoretical Background

Preliminary research was conducted on the topic of sustainable water management as well as water governance and policy in the context of the case study. This was done in order to select the concepts to include in the theoretical background. This first approach involved desk research and preliminary interviews with actors and agents involved in the planning, water management, and research from the city of Tepic. The aforementioned was used to understand in a deeper way the relation Tepic has with water, to validate the problem statement, and to select key concepts to guide the research. The concept of Water Justice is put into context for Latinoamerica (Section 2.1), and the relations it has with water governance (Section 2.2). Also the link between social vulnerability (Section 2.3) and urban liveability (Section 2.4) in the city is introduce. Followed by concepts of Water Sensitive Cities (Section 2.5) and Water Sensitive Urban Design (Section 2.6).

2.1 Water Justice

The main issues around water in Tepic are related to water justice as there is currently an uneven distribution of water access, control, and impacts (see Section 1.2). For this case, water justice can be defined as the societal and academic endeavor to critically explore water allocation, governance, and knowledge production by combining struggles against water-based forms of material dispossession, cultural discrimination, political exclusion, and ecological destruction as rooted in particular contexts (Boelens, R., 2015). In Latin America, neoliberal models of equality have always tended to reflect the dominant water society disregarding interests and views from other identities such as rural farmers, indigenous people, and woman (Boelens, R., 2015). When power relations influence water knowledge and development, it produces particular claims to truth that have an impact in the decision-making processes creating an unequal distribution of burdens and benefits (Boelens et al., 2018).

By defining water justice within the bounds of cultural discrimination and political exclusion, we put in context the history of Mexico. The history of Tepic is the history of Mexico and colonial powers played a role in the way the hydro-social contracts have been shaped (see Section 1.1.3). Water Justice does not happen in a vacuum and colonial power structures still play a role in how Mexican society operates (Navarrete, L., 2020). This is seen in the fights of nature advocates (i.e. indigenous communities) who withstand against political and economic powers for the exploitation of natural resources. Most often, these conflicts end in violence and enforced disappearance (Coronel et al., 2017). Injustice combines issues of distribution with those of recognition where cultural, ethnic, and gender discrimination constitute the foundation to privilege allocation of water rights to some over others (Fraser, 2000; Boelens et al., 2018). The notions of participation, recognition, and distribution are closely related to the control of water. And so, the mechanisms, processes, and institutions that articulate these priorities, legal rights, and obligations form part of the concept of water governance.

2.2 Water Governance

The Global Water Partnership defines water governance as the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services at different levels of society (Franks & Cleaver 2007). Thus, governance becomes central to achieve water justice. Governance provides a way of conceptualizing and understanding how the different sectors in society work together to achieve certain outcomes.

The concept of water governance embraces the relationships between governments and societies, including formal and informal interactions. There lies the importance of involving more voices, responsibilities, transparency, and accountability of formal and informal organizations associated in any process (Tortajada, 2010). In the city of Tepic this is needed specially as reflected on the relation between government authorities and citizens collectives (Section 1.2.3).

In other words, water governance can comprise all social, political, economic and administrative organizations and institutions, as well as their relationships to water resources development and management. It is concerned with how institutions operate and how regulations affect political actions and societal concerns through formal and informal instruments (UNDESA et al., 2003).

2.3 Social Vulnerability

Based on the generation of climate scenarios, various studies in Mexico agree that variations in temperature and precipitation will occur with different intensity and frequency (CONAGUA, 2018). This in turn would increase the social vulnerability of communities with a lower capacity to adapt to extreme weather events (Arreguín et al., 2015). Vulnerability, as opposed to poverty, is constructed and manifested in the context of a real threat. And so, vulnerability consists in the affirmation that threats are contextual, where the social and political systems create the conditions in which threats have a differential impact on different groups within societies (Blaikie et al., 1998). The government plays a role in in influencing the structure of opportunities. This is done through its influence on production, distribution, and asset use which facilitates the access of channels for mobility and social integration (Arreguín et al., 2015)

To understand vulnerability, it must be recognized that there are multiple ways of experiencing vulnerability and differentiated strategies to counteract it towards greater resilience (Daze et al., 2010). Resilience can be understood as the ability of a system to maintain or rapidly return to desired functions in the face of a disturbance by adapting to change and to quickly transform systems that limit current or future adaptive capacity." (Meerow et al., 2016). So for a system to move towards greater resilience it has to be able respond to changes and be self-sustained.

2.4 Urban Liveability

Kashef (2016) states that for people participate in successful and self-sustaining social systems, they should integrate physical and social well-being parameters to have a productive and meaningful human existence. This relates to the concept of livability. Livability refers to various constructed views regarding the quality of life, wellbeing, and/or the satisfaction of the needs of the people in any human living environment (Johnstone, 2014). So to improve the well-being of people, their satisfaction needs to be met. Humans require that their basic needs be satisfied in order to ensure their continued survival (Johnstone et al., 2012). Maslow (1943) established a hierarchy of five sets of goals associated to human needs with the most fundamental at the bottom (physiological) and the highest attainment of being at the top (self-actualization) (Figure 2.1).

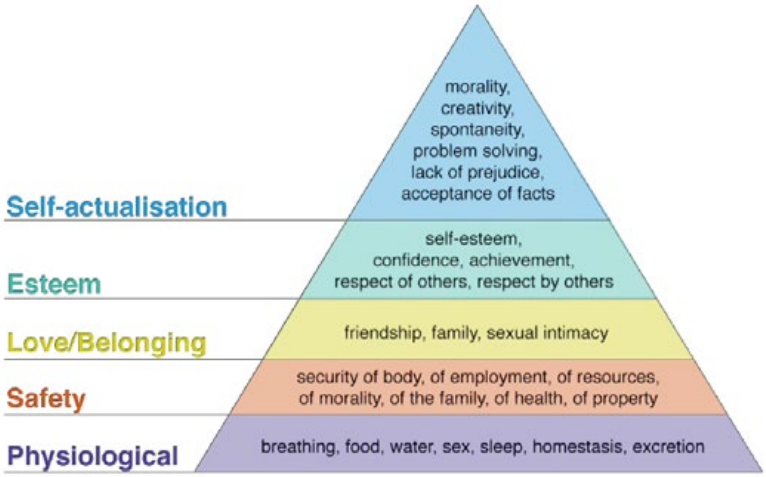

Figure 2.1. Five layer pyramid demonstrating Maslow's Hierarchy of Human Needs with physiological at the bottom, and self-actualization at the top.

Alderfer (1969) presents the E.R.G. theory as a development of Maslow's five tier hierarchy of needs and contracts the tiers into three levels: existence, relatedness, and growth (see Figure 2.2). Maslow's layers are merged as follows:

I. safety and physiological needs are merged into Existence (providing the physical and material needs for survival);

II. love and esteem are merged into Relatedness (the need for interpersonal relationships); and

III. self-actualization and self-esteem are merged into Growth (the intrinsic desire for personal development) (Johnstone et al., 2012).

The relationships between the three levels are then dependent on each other as higher order needs are unlikely to be desired if lower needs are not satisfied.

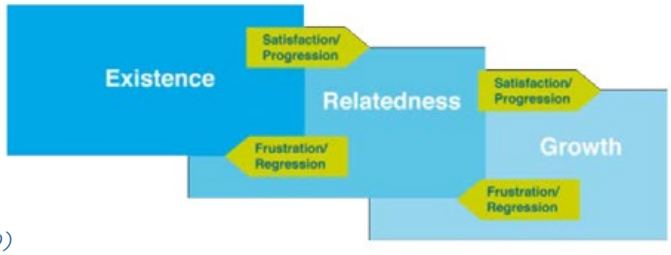

Figure 2.2. Alderfer's E.R.G. theory (1969)

An important consequence of the E.R.G. Theory is that Relatedness extends beyond interpersonal relationships to consider interrelationships between people and their biophysical environment. So the satisfaction of needs relate to both how well people respond to changes as well as how people relate with their surroundings (i.e. the urban environment). However, Herington et al. (2006) describes how the quality of life that a city offers its residents varies amongst social groups depending on factors like gender, ethnicity, class, and age. Further the way people choose to use and interact with a city differs (Pacione, 2001).

2.5 Water Sensitive Cities

Water is undoubtedly an essential ingredient for living in a city as it positively contributes to the quality of life (McGregor et al., 2009). Based on Alderfer's E.R.G. Theory, De Haan et al. (2011) developed a framework considering societal urban water needs as a driver of sociotechnical transitions in urban water by relating water systems with human needs. This became the stepping stone for the concept of water sensitive cities. Brown et al. (2009) describe the development of water systems in cities as an embedded state continuum of water supply, sewered, drained, and waterway cities and suggest a forward trajectory to the water cycle and water sensitive cities (Figure 2.3).

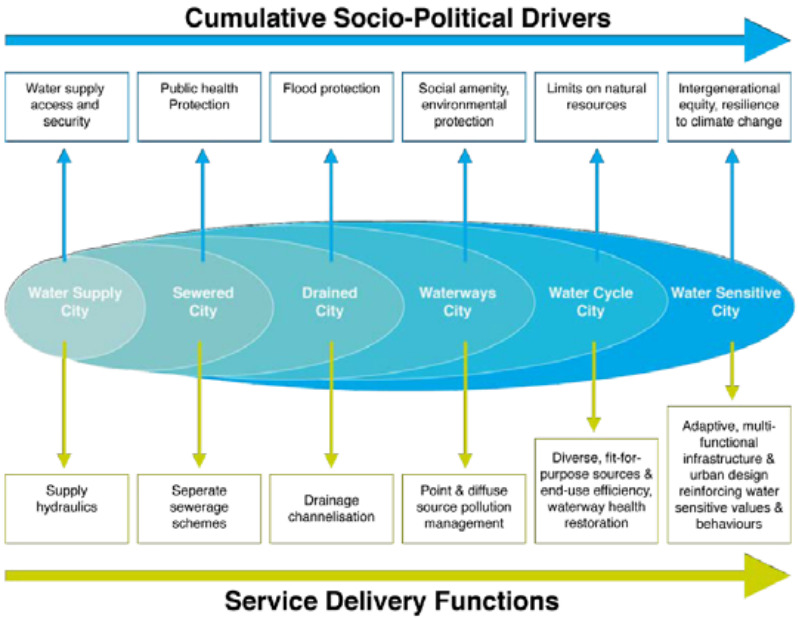

Figure 2.3. Urban water city states, their socio political drivers and their service delivery functions (Brown et al. 2009)

A water sensitive city can be broadly described as an urban area that seemingly integrates the natural water cycle of its context as an integral part of almost every feature of the urban landscape. Water sensitive cities would ensure environmental repair and protection, supply security, public health, and economic sustainability, through water sensitive urban design (WSUD) and Integrated Urban Water Management (IUWM) (Brown et al. 2007). IUWM represents the managed hydrological cycles in a city to change the impact of urban development. This is based on the contextual natural water cycle in order to make a more efficient use of the resource (Barton et al., 2009). A water sensitive city takes the integration of water cycles further to link with other environmental aspects for example urban microclimates, and social dimensions like the benefits of alternative urban design for stormwater systems contributing to the higher order societal needs for water.

2.6 Water Sensitive Solutions

A water sensitive city is accomplished through WSUD which aims to ensure that water is given due importance within the urban design process through the integration of urban design with the various disciplines of engineering and environmental sciences associated with the provision of water services. (Wong & Ashley, 2006). One way in which WSUD does this is through green infrastructure. Green infrastructure aims to mimic natural biophysical and ecological processes and provides a means for re-introducing or maintaining 'nature' in urban environments using vegetation, soils, and natural processes to manage water and create healthier urban environments (Johnstone, 2013). In consequence, each urban water city state contributes to the satisfaction of societal urban water needs by establishing a relationship between the city states and Alderfer's Existence, Relatedness and Growth categories (Figure 2.4).

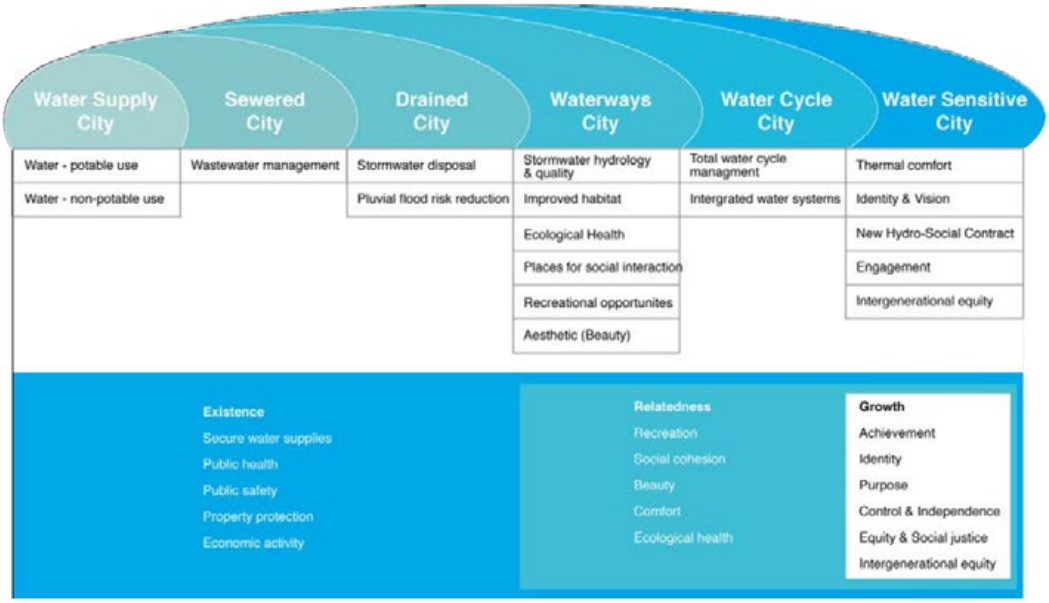

Figure 2.4. Illustration of the relationships between City States and Societal Urban Water Needs

We can then affirm that a Water Sensitive City cateres to the different urban water city states contribute to the societal satisfaction of needs, making citizens less vulnerable to unexpected shocks.

A Water Senstive City vision is underpinned by three principles of practices (Wong and Brown, 2009):

1. understanding cities as catchments to provide resources at different scales in fit-for-purpose applications;
2. cities providing ecosystem services to integrate urban water management into the urban landscape, providing multiple benefits such as heat mitigation, ecological health and landscape amenity; and
3. water-conscious communities, where citizens value and are connected to their water environments and engage in water-conscious behaviors, and water, planning and design professionals work collaboratively to deliver water sensitive outcomes.

This is precisely why the concept of water sensitivity is so appealing in the application of urban areas, like the city of Tepic, as it alleviates several layers of needs by making a city more livable, improving their water management, and ultimately building on the water governance and improving water justice.

And so, Water Sensitive Solutions (WSS) becomes an umbrella term which includes WSUD and IUWM with the purpose to achieve a Water Sensitive City Vision.

Photo: Wetlands within the urban area. Tepic, Nayarit, 2020. via Gente Nayarit

3 Methodology

The research has a first instance of analysis and a second moment of recommendations, the methodology is divided accordingly. A mix of materials and methods is used at each stage of the research.

3.1 Water Governance Assessment

The organization for Economic Cooperation and Development (2011) provides evidence of governance failures as a stumbling block on water policy design and implementation. This problem is clearly seen in the city of Tepic (Section 1.2.3). For this reason the research seeks to understand the state of water governance in the city of Tepic. The methodology for understanding the state of water governance for the city of Tepic is based on the statement that governance is a combination of functions, performed with certain attributes, to achieve one or more desired outcomes, all shaped by the values and aspirations of individuals and organisations. (Jimenez et al., 2020). Jimenez et al. (2020) proposed a practical definition of water governance, dividing the concept into what (i.e functions), how (i.e. attributes), and what for (i.e. outcomes) (Figure 3.1).

An adapted version of this framework will be used to guide the build-up of semi-structured interviews where the different governance functions will be asses with a variety of stakeholders. To choose the actors and agents for this, the stakeholders' relations of power within the hydro-social contracts will be taken into consideration. This included their ability to act, choose, and capability to make a difference or how they exercise their power. Three spheres will be consulted: academic, institutional, and civic society. The semi-structure interviews will be catered to the role of each stakeholder and their importance within the water governance structure.

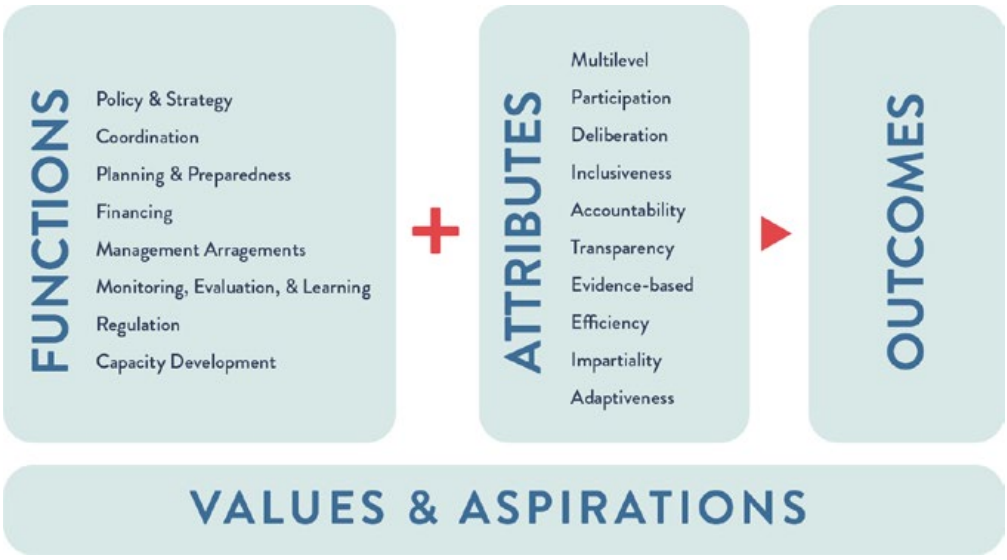

Figure 3.1. Jimenez et al. (2020) Water Governance: A Framework for Practitioners

The functions around governance are usually interlinked as they are part of a system. Governance functions are processes performed by organizations and other stakeholders to manage water resources and services. Meanwhile, water governance attributes describe how the governance functions are performed. Jimenez et al. (2020) makes a detailed description of each of these functions.

For the purpose of mapping the interview the concepts of each of the functions will be projected into the quotes that will be provided by the interviewees. Once tagged, each function will be given the attribute which closer relates to what will be said during the interview. The line of thought used when assessing the quotes will be:

- What function relates to the quote?
- What attribute is given to said function?
- Is it a barrier or a driver for the implementation of sustainable water management solutions?

Each stakeholder response will then be analyzed individually, compared, and/or complemented with data from secondary sources and materials.

Next, a systematic literature research will then be conducted. According to Jimenez et al. (2020), values and aspirations cut across the whole process of governance. Agreed values tend to be formulated as "principles" in policy and strategy documents. Thus, different planning and policy tools at state and municipal level will be assessed.

According to the UNESPAC (2009) good governance needs to "include promoting legitimacy and voice through participation, consensus, and informed decisions; the performance of institutions and processes through responsiveness, effectiveness, and efficiency; promoting accountability and transparency; ensuring fairness by implementing equity, rule of law, and conflict management". This statement will be taken into consideration after the assessment to evaluate if good governance is achieved.

3.2 Water Vulnerability Mapping

The vulnerability scattered around the city of Tepic will be mapped using a geographic information system (GIS) software for the analysis of geospatial data and relaying on the definition of vulnerability by Arreguín et al. (2015). The goal of said mapping is to make a comparison between the basic geo-statistical areas (BGSA) of Tepic to discover spatial relationships between the vulnerability of the people, basin structure, and water problems experience in the city.

In the context of the National Institute of Statistics and Geography from Mexico (INEGI), a BSA is a geographic area occupied by a set of blocks perfectly delimited by streets, avenues, walkways, or any other easily identifiable feature on the land and whose land use is mainly residential, industrial, service, commercial, etc. (INEGI, 2020). It constitutes the basic unit of the National Geostatistical Framework and, depending on its characteristics, can be urban or rural.

The BGSA's of the city of Tepic will be ranked via a vulnerability index. Said index will be based on the methodology from the Mexican Institute of Water Technology (IMTA) and data from the 2020 Census provided by the National Institute of Statistics and Geography (INEGI). The intervals of high and low vulnerability from the original method by IMTA will be dismissed. The index done in this research will score from 0 to 100 to create a hierarchy among BGSA'S. That would allow the categorization of the data in same size samples, to find a patterns.

The conditions of vulnerability refer of the ability of a person, household or community to answer to a situation of danger. The answer is the result of the relation between the internal and external characteristics of people and their environment (Busso, 2001). The distinction will be used to relate the concept of vulnerability and the Alderfer's E.R.G. theory of satisfaction of needs by dividing the indicators into the categories of needs of existence, relatedness, and growth.

The indicators from the census 2020 will be reviewed to determine into which category they will fit into.

Alderfer's Existence relates to a person's physical and material needs such as food, clothing and shelter. The indicators of existence will be given a two factor due to their importance as they are the base for the other satisfaction of needs, and because of the context they have in México. IMTA and CONAPO (2015) describe:

> • Inhabited private dwellings that do not have piped water nor drainage in the area of the home: There is a close correlation between the absence of water and sewerage services with the presence of water-borne diseases. This highlights the importance of these services in shaping the social vulnerability in housing.
>
> • Population without affiliation to health services: When analyzing cases where disasters have occurred as a consequence of extreme hydro meteorological events the lack of institutions that provide medical services locally such as the Mexican Social Security Institute, Institute for Social Security and Services for State Workers and Popular Insurance, among others.
>
> • Population aged 12 and over not economically active: more relevance was given to wage income than to the dependency ratio. Currently, Mexican men and women enter work younger and retire at an older age. On the other hand, having a higher income gives families a greater capacity for resilience to recover from disasters.

Alderfer's Relatedness relates to a person's interpersonal needs within his personal as well as professional settings, also described as social and external esteem needs. De Haan et al. (2011) consider a person's interactions with their environment as part of this suite of interpersonal needs. For this reason the distance to a recreational area (e.g. green space, sports facility, park) will be consider inside this category.

To acquire the distance to a recreational area, spatial analysis will be required. To get the locations of different recreational areas within the city of Tepic we will refer to INEGI's geostatistic framework form the 2020 Census. Using a geospatial analysis software it was calculated the distance from the centroid of the BGSA to the nearest public space.

Alderfer's Growth relates to a person's needs for personal development. Societal growth needs to reflect the engagement of society in the processes that shape cities and urban water systems. This will be related to the concept of water justice and water governance (Section. 2.2), and how identities have a role in the decision making power over the processes that shape de city.

All the data from the indicators will be transformed from absolute numbers to the percentage of coverage depending of the population of each Basic Geo-statistical Area (BGSA). Based on the percentage of coverage of each indicator, the highest and lowest values will be noted to determine the existing range between the two. Subsequently, this range will be used in a simple rule of 3 to get the percentage of vulnerability for each category, from zero to a hundred. That way the vulnerability score among BGSAs could be ranked.

The score of each category will be averaged to get the overall vulnerability score. The data will be linked to the spatial boundaries of each BGSA through a unique code also provided by INEGI. Once the different scores were put in for the geospatial analysis, the vulnerability will be compare against the location of floodplain in the valley (Figure 3.2), using data from the Ministry of Agricultural, Territorial and Urban Development (2016).

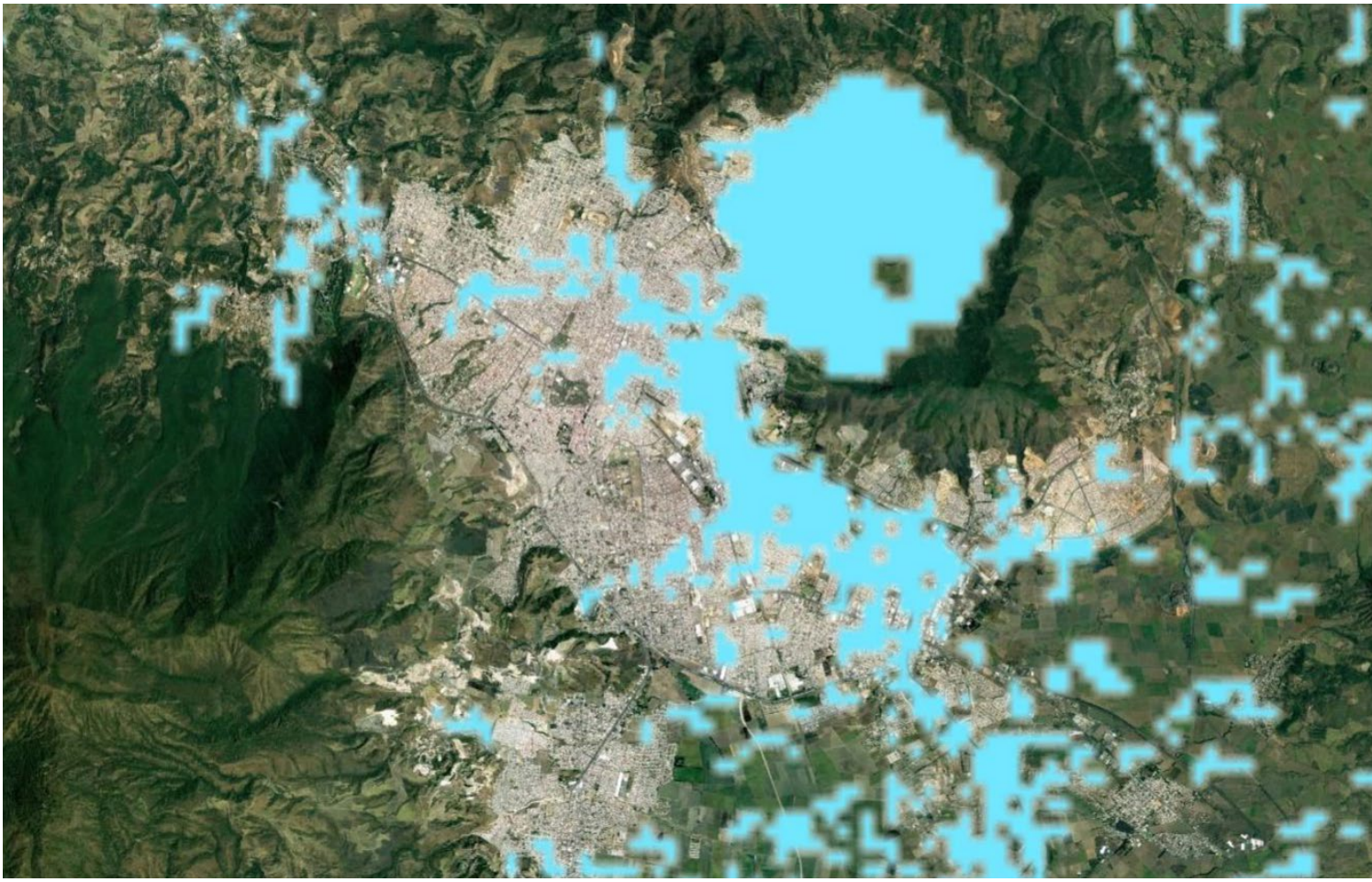

Figure 3.2. Image of Floodplains Tepic ,Nayarit, Return period of 2 years (SEDATU, 2016).

3.3 Water Sensitive Solutions

Brown et al. (2009) framework of urban water city states and Alderfer's E.R.G. theory of satisfaction of needs will be used to understand how the water problems the city of Tepic could be tackled by WSS. The information gathered from the previous answers will be used to build upon the results of the third one. Mainly the insight from the interviews provided by the public workers, experts, and citizens, as well as the assessment on the different planning and policy tools.

This aspect of the research will also build upon a previous report commission by the Public Space Authority from Mexico City's Government on Public space as a rain management strategy (Deltares, 2018). This report contains an adapted and summarize version of Deltares' Climate Adaptation App, a catalogue of feasible measures for projects with a specific climate adaptation goals (Figure 3.3). This summary, adapted to the context of Mexico, sorted by scale and under the motto: "Delay, retain, store, and reuse, only drain when necessary". This statement defines the goals to be achieved in order to close the water cycle and to create a sustainable water balance on the long term (Deltares, 2018).

The solutions should be understood as contributions to try and heal the disturbed water cycle of the city of Tepic. Water sensitive public space strategies include offering measures to local policy makers that solve local problems and at the same time making an effective contribution for the restoration of the water balance in the entire city (Deltares, 2018).

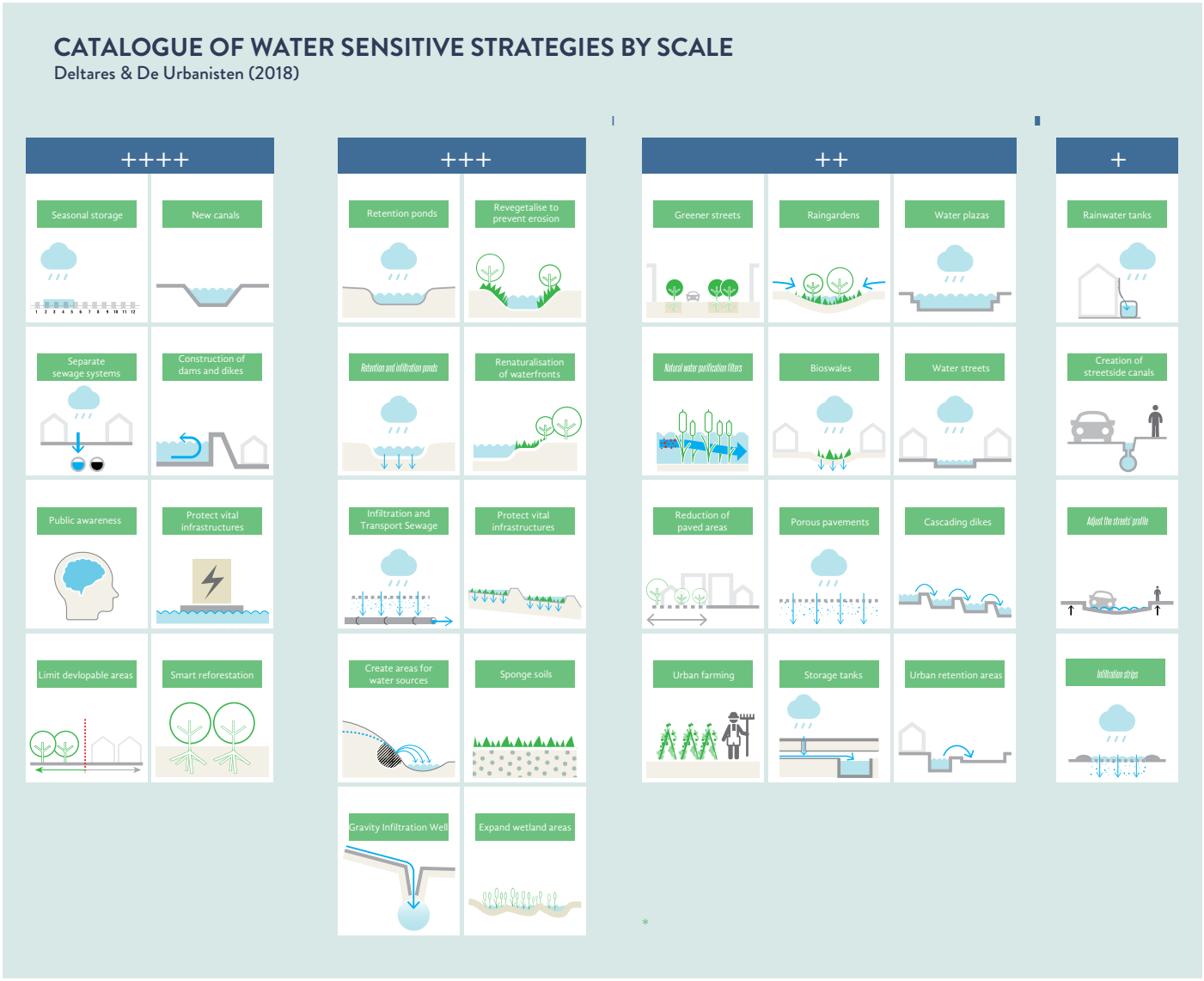

Figure 3.3. Catalogue of WSS per scale (Deltares, 2018)

4 Results

4.1 Water Governance Assessment of Tepic

4.1.1 Barriers for Implementation

Many barriers related to governance were pinpointed for the implementation of sustainable water management solutions. The most important was found to be the mis-alignment across different levels and sectors on values and aspirations for water management (Mendoza, 2020; Interviews Annex. 1). As presented in the problem definition (Section 1.2.3), the National Water Law is the policy framework in effect for water management but was published in 1992. Since then, the law has had eight modifier decrees (Ávila et al., 2020). However, there has not been a full update to the law which has consequences on the integration of a common vision (aspirations and values) on how to manage the resource in different sectors and at every government level.

Of the initiatives presented in congress since 1992, nine are related to how the water is used and eight are related to institutional and administrative aspects. Although important, the initiatives are centered in the first three cumulative sociopolitical drivers of Brown et al.'s Urban Water Management Transition Framework (i.e. water supply and health protection). Six initiatives have been filed in congress for the conservation or rehabilitation of hydrological basins and different types of surface water bodies. Three of these are centered on human rights and water culture, three are on water reuse, and two are focused on rainwater (Ávila et al., 2020). All of these are key elements for the implementation of a sustainable urban water management and pillars for WSS.

Mendoza, E., author of the Inter-sectorial Integration Diagnostic for the Mololoa Basin (2020) carried out an analysis of 12 planning instruments at a state and municipal level, namely Nayarit and Tepic. The analysis touched primarily on plans and administrative tools related to urban development, housing, environment, and water resources. The diagnosis showed that a lot of the topics addressed in the planning tools and legislations are superficial and rarely action based once translated into state and municipal level (Interview Mendoza, E., Jalisco, September 2021). According to her studies, within the tools there is no comprehensive vision in land use planning and land planning policies when carrying out sustainable and comprehensive water management. Further, there is a lack of lack of legislative and regulatory requirements to contemplate implementing sustainable urban water strategies.

This statement is backed up by Director of Territory Planning for Tepic at the Municipal Planning Institute who stated:

> *"The topic of water in every planning instrument and program is quite limited. Water is only touched in a very superficial manner, isolated from other sectors, and in very technical terms. There isn't an integral vision on water and is not seen as a main axis in which public policy should be done"*
> *(Interview Partida, A., Nayarit, September 2021).*

This fragmented vision of knowledge is the result of the narrow focus of single-sector water management (Mendoza, 2020). The lack value alignment polarizes the vision on water as either a problem or an asset. This makes it very difficult to carry out any other function of governance towards the most efficient use of the resource and the mitigation of water nuisances. The polarized perspective also steers the actions of actors involved in the different sectors of water management to deprioritize the implementation of sustainable urban water solutions. Public figures in positions of power are reluctant to incorporate any sustainable solution into their plans and agendas as they see them as not politically profitable. This is primarily due to the lack of understanding on what a sustainable water solution is. Additionally, these solutions are both time consuming and costly but the most crucial barrier is that the results are not reflected within their political cycle (three years), removing any incentive to pursue. This is the challenge of technical and academic advisors have to deal with when proposing solutions (Interviews Villagrana, A., Partida, A., Mendoza, E., Nayarit, September, 2021).

The fragmented vision creates a problem of efficiency within several governance functions. Efficiency is achieved when processes and institutions produce results that meet the needs of society. It does this while making the best use of resources at their disposal including workflows, specific activities, and steps that must be taken with the objective of providing a sustainable output (Jimenez et al., 2020). However, in Tepic the fragmented vision of knowledge creates a duplication of activities, an execution of technique without objectivity, institutional fragmentation, impartiality, and disregard among other things (Mendoza, 2020). In Tepic, water management focuses only on the three first socio-political drivers of the urban water management transition framework which emphasize the use of grey infrastructure. Grey infrastructure, in this case, is defined as urban drainage systems that are predominantly composed of concrete and steel (Tavakol-Davani et al., 2015). This outdated vision, once again, trickles down to every function within governance.

As mentioned in the methodology, functions around governance are usually interlinked (Section 3.1). In the city of Tepic that is reflected in the functions of coordination, managing arrangements, planning, and financing in which the first three have a direct impact on the fourth.

Jimenez et al. (2020) defines coordination as the processes, mechanisms, instruments, and platforms that promote and ensure multilevel, multisectoral, and multi-stakeholder cooperation among all actors. It entails information sharing, dialogue, and collaborative decision-making, linked to policy making and planning. Mendoza (2020) states that there seems to be a high multilevel participation between the three levels of government (vertical coordination). But at the municipal level this appears to not be the case (horizontal coordination), especially when talking about water. This could be explained in part by the limited capacities of the city council due to the lack of technical profiles within their teams (Interview Partida, A., Nayarit, September, 2021). This limitation hampers the communication among dependences, making strategies on certain topics hard to explain, approve, and execute. According to the Director of Territory Planning of Tepic from IMPLAN, the communication with other municipal institutions is limited to request of data or to inform approved work that is already done or decided, not for collaboration (Interview Partida, A., Nayarit, September, 2021).

This lack of coordination on the bottom level makes management arrangements confusing. Management arrangements is characterized as the combination of organizational, managerial, and institutional arrangements at national and sub-national levels that support the functioning of the management entities. In the service provision, it entails the definition of the service delivery model. This includes who owns, who invests, who develops, who operates, who supervises, and who provides technical support as well as the relationship between these actors (Jimenez et al., 2020). The lack of clarity on these arrangements in addition to the lack of coordination isolates each sector to work and frame their own problem of water to suit their own understanding (Interview Villagrana, A., Nayarit, September, 2021).

Photo: Tepic's City Council's Building Via: Meridiano Newspaper

This has a direct impact on the functions of planning within water governance. Planning is the process of data collection and analysis, formulation of actionable plans, and estimation of costs (Jimenez et al., 2020). The impact on planning is tangible in the tools for land-use when talking about water management. There seems to be a very superficial involvement on the topic of water in land use tools, mostly with regards to the service provision, but it doesn't involve other sectors like housing or environmental policy (Mendoza, 2020). Even then, there seems to be a gap between what is written in policy and the actions taken. This lack of coordination among different sectors, the blurry distinction among management arrangements, and the unaligned formulation of the water problem in planning tools makes the procurement of funding a very difficult task.

Alejandra Villagrana, the lead researcher of the document "Comprehensive hydrological and sanitation management plan in the Mololoa river basin in Tepic", explains how most resources for research and implementation need to be funneled directly from federal funding which is a very bureaucratic process (Interview Villagrana, A., Nayarit, September, 2021). Without the efficient work of the governance functions mentioned before, financing becomes very complicated. Architect Joaquín Jara, managing director of SIAPA Tepic explains:

> *"To make any kind of waterworks in the city an application needs to be submitted to get federal funding. This is done with the proceeding of a file, validation of said file and authorization from the federal level. After authorization the execution of the infrastructure is put in a tender, this one is contested, and the winning company performs the construction" (Interview Jara, J., Nayarit, September, 2021).*

The process is so slow and inefficient that SIAPA has opted for a new scheme to be implemented in which the citizens directly provide the cost of materials for the implementation of street level infrastructure to save both time and management costs (Interview Jara, J., Nayarit, September, 2021). Although the involvement of citizens is commendable and proven to make citizens gain ownership of their public spaces and infrastructure, the process is far from ideal. This is because people with less resources cannot access this scheme and it doesn't apply to infrastructure on a larger scale. In addition to this, most water operating agencies have problems with the collection of service fees and, even then, the fees tend to be too low (Palma, C., 2019 in Ávila et al., 2020). Since 2016 there has been a budget cut of 83% for water operating agencies (abid.). So even when there are plans to implement sustainable water management solutions, the funding is just not there.

Another hard problem within financing is that technical de-centralized institutions like IMPLAN are financially dependent of the municipal budget. However, there is no financial batch dedicated to their support. At the same time, there is no legal framework that oblige people in power to listen to these technical advisors. Therefore, IMPLAN holds a weight by influencing the decision making process but do not have decision-making power. The Cabildo, the highest body of authority in the city council, is responsible for defining the policies of the public administration, referring to laws and regulations applicable to the municipality (Interview Partida, A., Nayarit, September 2021). This also dictates which large infrastructure gets implemented. This is very harmful when making evidence based decisions at a government level. There is a lot of data within the planning and administrative tools that either doesn't match, is outdated, or is purposely misinterpreted depending on the sector involved (Interview Mendoza, E., Nayarit, September 2021). Without the proper funding for these technical institutions, the pattern of decision making without reliable technical, scientific, empirical, and contextual evidence will continue.

The accumulation of all these problems makes involvement of citizens challenging. People ignore the scope of the different sectors involved to solve water problems in the city creating mistrust and discouraging participation (Interview Partida, A., Nayarit, September 2021). People ignore where in the government structure they should be vocal about their needs (Interviews Macedo, L., Nayarit, Semptember 2021). When they manage to do this, they are met with disregard and a beaurocratic processes that left them feeling the government apparatus is structured in a way their voices have no transcendence (Interviews Durán, S., Nayarit, Semptember 2021). Problems mentioning regulation, monitoring, evaluation, and learning were also found within the data gathered. Although it presents an issue for the water governance in the city of Tepic as a whole, it only presents a problem for the implementation of sustainable urban water solutions down the line (e.g. assessment on impact, construction costs, scalability). To summarize, the biggest issues around water governance for the city of Tepic that could potentially delay or hamper the implementation of sustainable urban water solutions are that there is no common vision and no legal framework supporting implementation. The lack of common vision is shown in the disconnection amongst different sectors (land-use, environment, housing, and urban planning) obstructing sustainable, comprehensive water management. Since this vision comes from a national level, it trickles down to other spheres of government dictating different functions of governance. As a result, there is lack of coordination between the different actors involve in the water management of the city. This impacts management arrangements as there is no clear distinction into which institution does what in water topics, producing a lack of efficiency, duplication of tasks, and deflection of accountability. This is consequentially projected in planning instruments and tools with barely any mention of water aside from water supply, sewer and flooding protection. The sum of all the above results in ineffective capture of funding through beaurocratic processes and the mistrust from citizens and civic organizations.

Added to that, there is no legal nor normative framework around the implementation of sustainable urban water strategies. Regulations and policy are based on hard engineering and traditional drainage systems (Mendoza, 2020). Thus, actors in some institutions do not fulfill the technical requirements for clear communication and collaboration for their implementation as they appeared not to be needed. Due to the intersectionality needed for the application of said strategies, there is a reluctance from decision-makers to push for sustainable initiatives because of the risk failure in comparison with conventional drainage and supply water systems. And so, a loop seems to close.

4.1.2 Drivers for Implementation

There is a clear urgency at a national level for coming up with a single unified vision. During the Forum Panorama and Perspectives of Water in Mexico (2019-2024), one of the main topics touched upon was the need for guaranteeing the institutional coordination for water management (Ávila et al., 2020). This is focused on the creation of coordination mechanisms between the federation, the estates, and the municipalities, but also between the different ministries and public agencies within each order of government. It consists in the elaboration of different instruments of territorial planning (e.g. urban, municipal, ecological, among others) in an inter-sectorial manner under a common perspective of integral water management. This would be achieved over the formulation of a new Water Law to replace the 1992 version (Velasco, A., 2019 in Ávila et al., 2020). The new water law would need to articulate the different legal systems so that water management could be transversal and complementary in the national public policy. Mainly in correlation with the General Law of Ecological Balance and Environmental Protection and the General Law of Climate Change (abid.). This is an answer to what is seen as part of the current barriers hindering sustainable urban water solutions in Tepic (Section 4.1.1).

There is also mention on the need for regulation on groundwater and aquatic ecosystems like wetlands (Ávila et al., 2020). This is particularly interesting since they are present in Tepic's hydrography and form an integral part of the water cycle of the valley (IMPLAN, 2018). Topics related to the developed opportunities for local management and innovation were also present. This includes the exploration of community water management and the implementation of new solutions at local level. That would require a legal framework and incentives to promote new solutions to water management. These would include such ideas as eco-techniques or best practices (Mesta, F., 2019 in Ávila et al., 2020). CONAGUA is pushing more and more for the capture of rainwater and promoting it through the National Program for Rainwater Capture and Green infrastructure in rural areas (Jiménez, B., 2019 in Ávila et al., 2020). All of this would set the bases for sustainable urban water management strategies.

Photo: Old Mololoa Basin, Photo: Gerardo Espinoza, 2020

Another driver touched upon was the need to create awareness in the care of water and to allow water users to collaborate by giving them responsibilities (Rosario, A., 2019 in Ávila et al., 2020). This is not new for Tepic's context. At a local level there are several grassroot organizations working towards the solutions of water management craving to have more decision power. During the data collection a representative from the "Citizens Movement for the banks of the Mololoa River", mentions that the association has been invited to give their opinion on projects but they are not part takers in the planning, development, implementation, or execution of solutions for the water problem in the city, even when asked (Interview Durán, S., Nayarit, September 2021). The association has been pushing on the institutionalization of water audits to check and revise water related public infrastructure. However, so far there has been no success.

The Collective to the Rescue of the Old Mololoa Riverbed (CORECAM) has also been pushing for solutions regarding the wetlands present in the lowest parts of the valley as well as the official delimitation of green areas and to safeguard the flora and fauna of the area. (Sol Ángel, 2021; Interview Macedo, L., Nayarit, September 2021). Despite the overall distrust people have towards government, there is also a willingness to participate in governance functions to improve the quality of life of the city. People don't take action because of ignorance on how to proceed legally to achieve an outcome or don't really understand what exactly to demand for the water problems of their city to be solved (Interview Macedo, L., Nayarit, September 2021). Water user involvement represents a step forward towards the implementation of sustainable urban water solutions.

Implementation of sustainable solutions for the solution of urban problems is also being pushed decentralized technical institutions like IMPLAN (IMPLAN, 2018). In the past, planning tools where not align towards a long term vision of sustainability, however there is an effort from the current management to follow the United Nations Human Settlements Programme's (UN-HABITAD) sustainability goals in the tools that they generate (Interview Partida, A., Nayarit, September 2021). This aligns with what is stated by the representative from the Mexican Center for Environmental Law about the importance of paying attention to other laws (e.g. energy law, mining law, and human settlements law) where the substantive content of these laws affect, to varying extents, the management of either water conservation or use (Velasco, A., 2019 in Ávila et al., 2020). So there is still a long way to go to set up the policy framework and management arrangements needed for the implementation of sustainable urban water management, but the transition is definitely in sight from different sectors down to the citizenship.

Photo: Wetlands in Los Colomos Neighbourhood, Photo: Misael Ulloa, 2016

4.2 Water Vulnerability Map of Tepic

The city of Tepic is composed of 283 BGSA according to the latest census (INEGI, 2020). The data showed in the maps part of the results is categorized in same sample sizes to help identify patterns. The population from the metropolitan areas of Tepic are distributed to the north and south-center of the urban area of Tepic. In Xalisco, this is to the North West and the center of the town (Fig. 4.1) (IMPLAN, 2018). This provides an idea on how some vulnerabilities are distributed in relation with the number of people living in certain BGSAs. The BGSA with less than ten inhabitants were excluded as they were considered outliers.

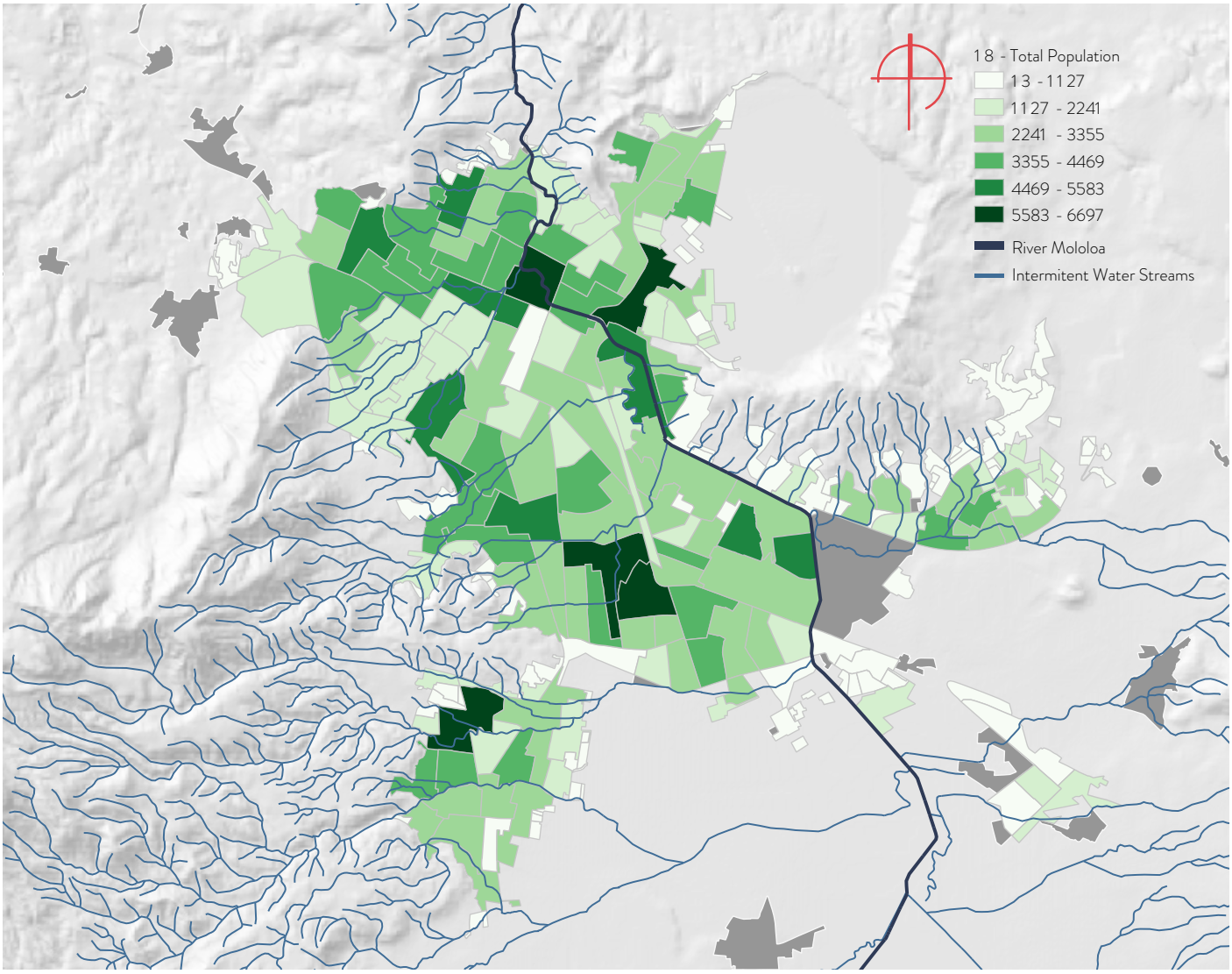

Figure 4.1. Most populated neighborhoods of Tepic clasified in 6 categories to find patterns.

For the vulnerability index, around 17 indicators were chosen from the 2020 census (INEGI, 2020). The indicators were chosen accordingly to the methodology used by the IMTA, taking in consideration five topics that influence the development capacity of a community: education, health, housing population, employment, and income (see Table 4.1).

Table 4.1 Indicators used for the generation of the vulnerability Index retrieved from the 2020 Census by INEGI: Full table of definitions Annex 2.

CODE	Category or Indicator
CVEGEO	Geostatistics Code
POBTOT	Total Population
PROM_OCUP	Occupancy Avarage per household
P3YM_HLI	Population of 3 or more that speaks an Indigenous Language
HOGJEF_F	Households with female head of the house
PCON_DISC	People with disability
PCON_LIMI	People with limitations
P15YM_AN	15-year-old population and more that are illiterate
GRAPROES	Average grade of schooling
P15YM_SE	15-year-old population and more without schooling
PSINDER	Population without affiliation to health services
PE_INAC	Population aged 12 and over not economically active
VIVTOT	Total Dwellings
VPH_PISOTI	Private dwellings inhabited with dirt floors
VPH_1CUART	Private dwellings inhabited with only one room
VPH_AGUAFV	Inhabited private dwellings that do not have piped water in the area of the home
VPH_NODREN	Inhabited private dwellings that do not have drainage

As explained in the methodology (Section 3.2), For the vulnerability index related to Alderfer's Existence category of needs, the indicators are presented in Table 4.2

Table 4.2 Indicators used for the generation of the Existance Vulnerability Index.

CODE	Category or Indicator
PSINDER	Population without affiliation to health services
PE_INAC	Population aged 12 and over not economically active
VPH_AGUAFV	Inhabited private dwellings that do not have piped water in the area of the home
VPH_NODREN	Inhabited private dwellings that do not have drainage

As for the geospatial distribution analysis of the Existence category (Figure 4.2), it seems like the highest vulnerability is located for the municipality of Tepic in the west of the urban area. There seems to be some coincidences with BGSAs with high levels of population but not enough to find a clear correlation. There also seems to be an unequal distribution of this vulnerability around the whole city without a clear pattern related to the proximity to streams, rivers, or areas that flood.

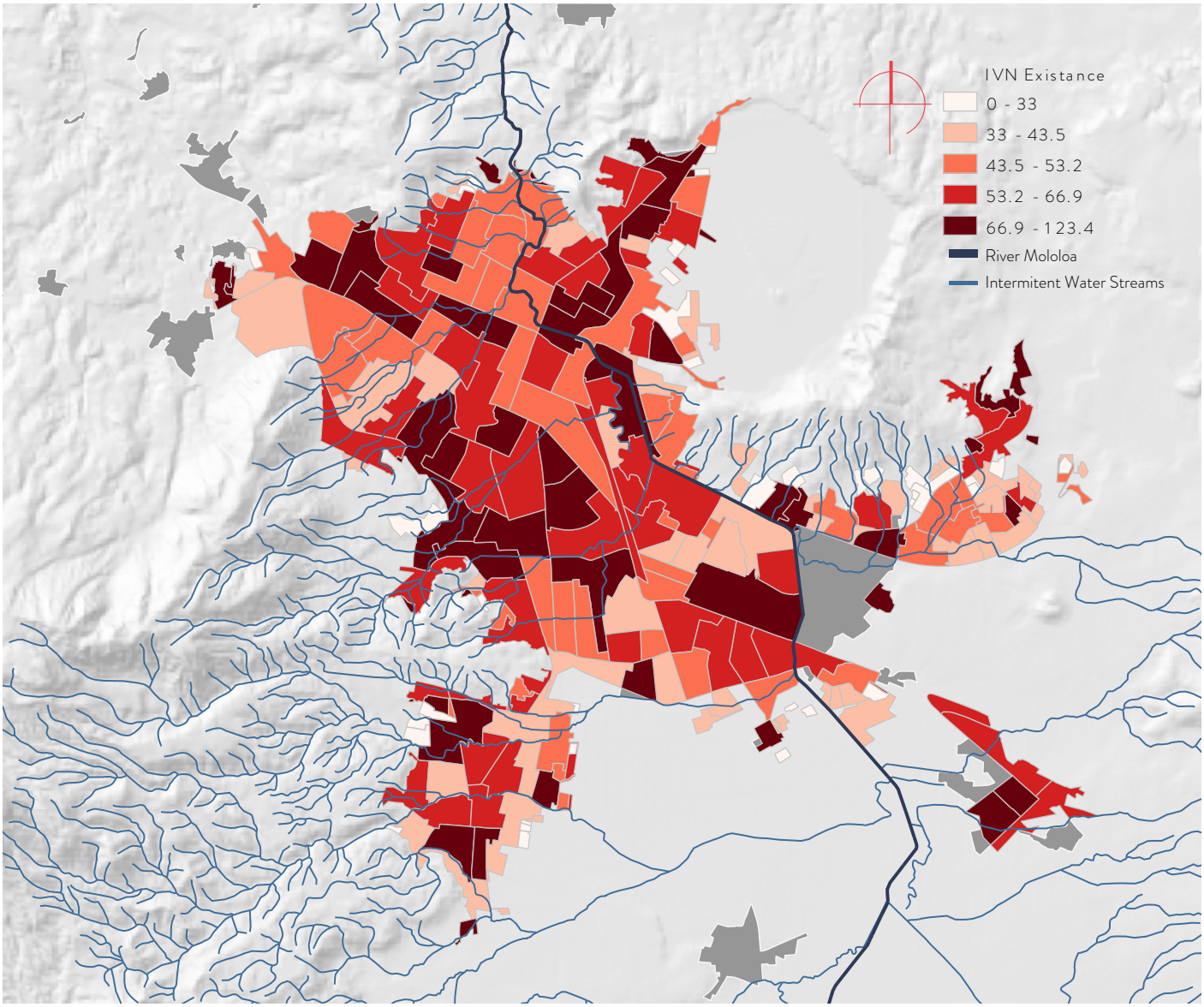

Figure 4.2. Vulnerability Index per Existance Category

The two indicators with the greatest weight in the construction of this index is the percentage of population without any affiliation to health services and the economically inactive population. This is not that surprising since more than 50% of the population of Tepic is economically inactive (IMPLAN, 2018). From the economically active population the 30% works in retail trade and 12% in temporary accommodation and food and beverage preparation services which sometimes by being small businesses don't count with affiliation to health services (IMPLAN, 2018). Income was not included in the index due to lack of specificity per BGSA but according to CONEVAL (2015), 34.3% of the population of Tepic had income below the line of well-being. This means that they earn less than 3,195 Mexican pesos per month (135.63 euros per month). According to CONEVAL (2018), most of the city holds water and drainage services. Regardless of this data, the presence of the infrastructure doesn't take into account the quality of service, nor the existing problems resulting of old supply and sewer infrastructure.

The Relatedness category relates to a person's interpersonal needs which includes a person's interactions with their environment. For this category the indicators chosen are presented in Table 4.3:

Table 4.3 Indicators used for the generation of the Relatedness Vulnerability Index.

CODE	Category or Indicator
PROM_OCUP	Occupancy Avarage per household
VPH_PISOTI	Private dwellings inhabited with dirt floors
VPH_1CUART	Private dwellings inhabited with only one room
DIST_RECRE	Distance to recreation area (sport area, green area, park)

The indicators chosen for this category are not very telling to the overall relationship of the surrounding city. According to CONEVAL (2015), most dwellings in the urban area have floors that are not dirt and the few that exist are in new areas on the outskirts of the metropolitan area. The occupancy per household and dwellings with one room are indicator for the level of crowdedness that a person might experience within their environment. However, the numbers are very low and homogeneous around the city. When categorizing the data with same intervals (Figure 4.3b), it shows that most of the city has fairly low vulnerability scores on this category. Meanwhile, when categorizing with same size samples, the only clear pattern seen is that the most vulnerable BGSAs tend to move outside the city center (Figure 4.3 a).

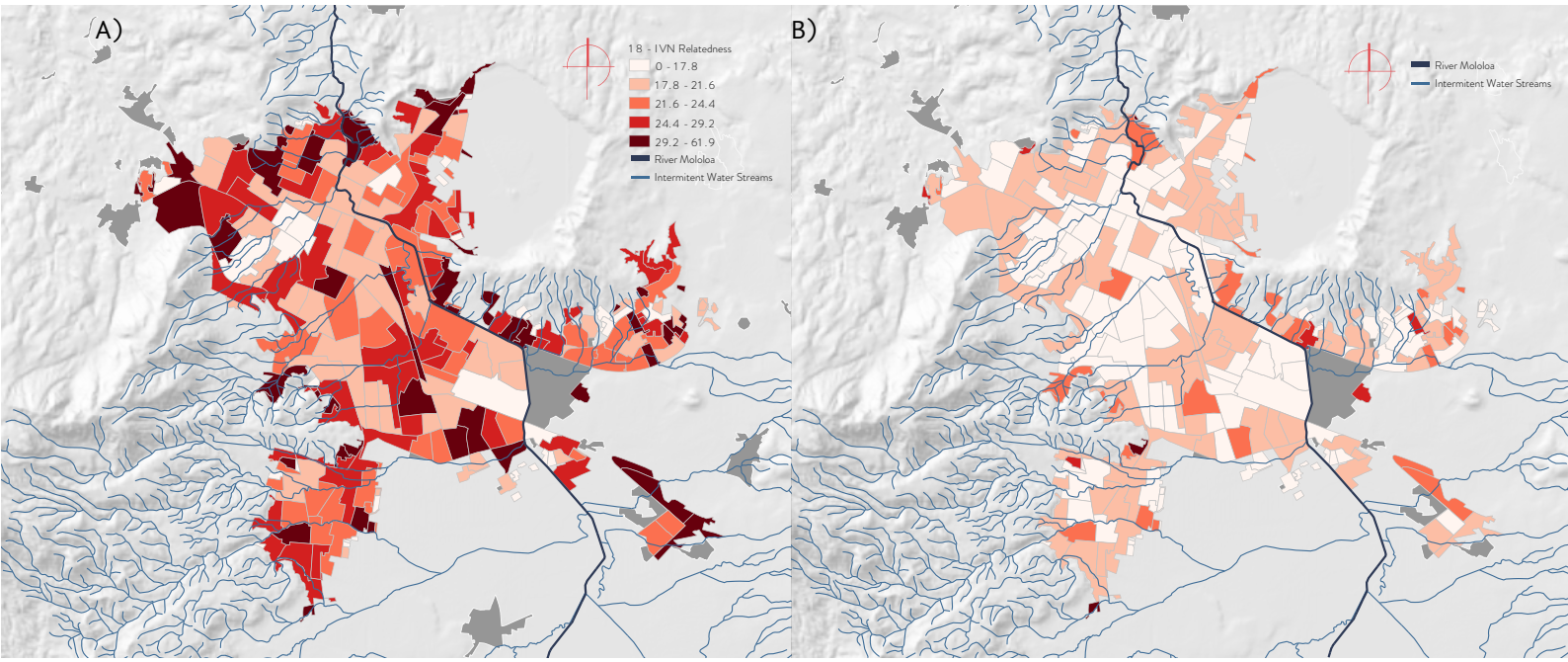

Figure 4.3. Vulnerability Index per Relatedness Category. A) shows the BGSAs categorized in same sample sizes, B) Shows BGSAs categorized in same size intervals.

The growth category relates to a person's needs for personal development. For this research, these are linked to the concept of water justice and water governance where the most vulnerable identities have less engagement in the processes that shape cities and urban water systems (Section. 3.2). The chosen indicators for the generation of this index are in Table 4.4:

Table 4.4 Indicators used for the generation of the Growth Vulnerability Index.

CODE	Category or Indicator
P3YM_HLI	Population of 3 or more that speaks an Indigenous Language
HOGJEF_F	Households with female head of the house
PCON_DISC	People with disability
PCON_LIMI	People with limitations
P15YM_AN	15-year-old population and more that are illiterate
GRAPROES	Average grade of schooling
P15YM_SE	15-year-old population and more without schooling

The vulnerability scores relating to growth are the most interesting. The people who are the most vulnerable seem to be concentrated at the end of the river stream, close to where the water naturally flows (Figure. 4.4). Villagrana, A. divides the problems of the river into three sections: upstream (i.e. before entering the city), within the city, and downstream (i.e. at the outlet) (Interview, Nayarit, September 2020). Apparently, the characterizations of the people most vulnerable are woman, indigenous people, people with disabilities, and less educated people who are located in the downstream section of river. In this section, the river has already travelled halfway across the city and the river is already polluted.

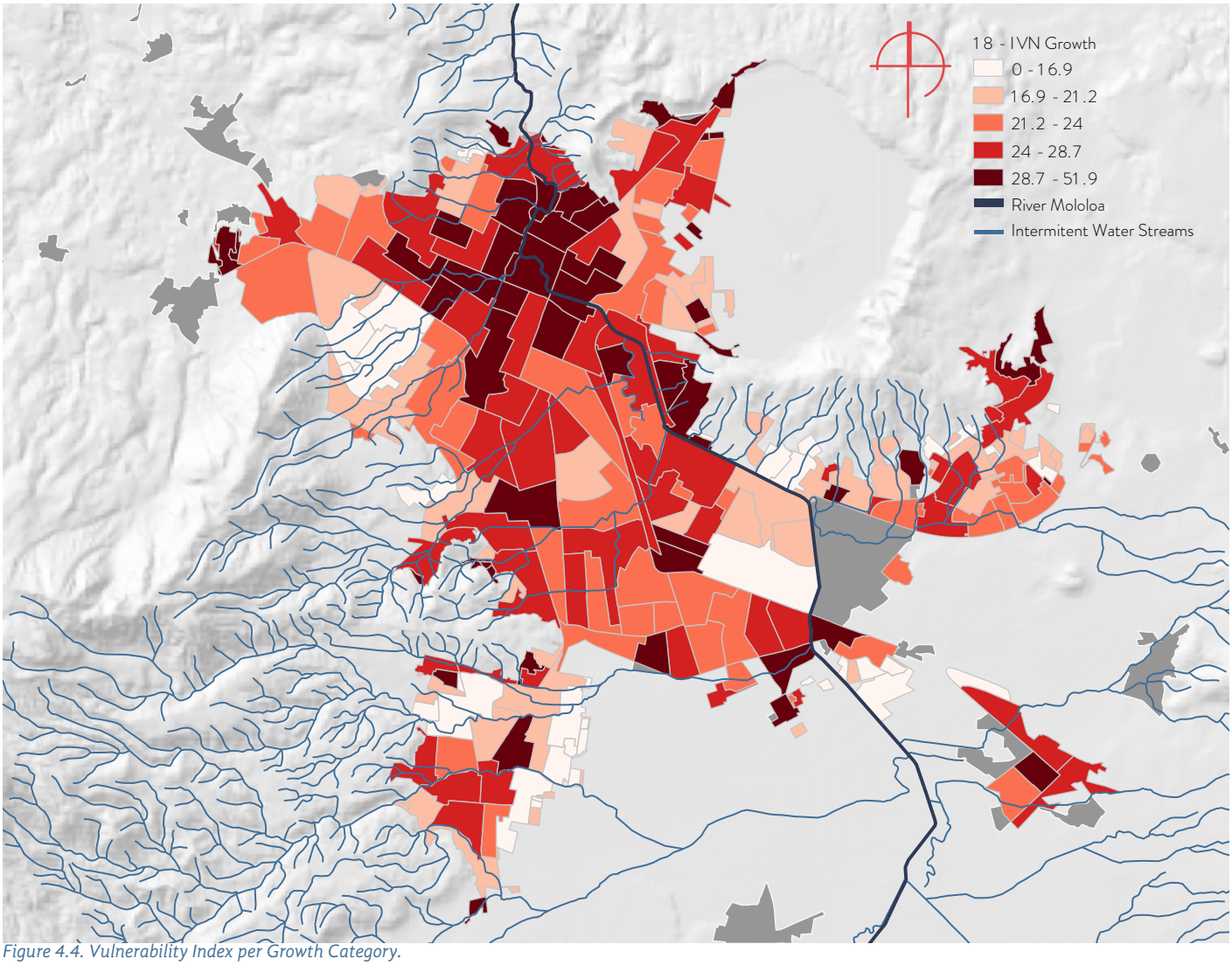

Figure 4.4. Vulnerability Index per Growth Category.

This section is also the portion of the river that runs naturally and was not contained in a canal. Constructions have invaded the river banks and, consequently, the section of the basin has been reduced, becoming a bottleneck during floods.
This means that, unlike the upstream section, the main concern is rooted in the imagination of the inhabitants and the risk of overflows and floods (Navarrete, 2020). In addition, this section of the river is fully secluded between the urbanization, resting all utilitarian value the river and the water that runs in it could have. Most intervention done to the river had been in the previous sections where the interventions are the most visible. These interventions neglect the people that live in the downstream section. These upstream and downstream parts of the river represent a duality between the planned urbanization of the upstream section and the free, natural, and intuitive downstream section (Navarrete, 2020).

The final map reflects the average of the E.R.G. theory vulnerabilities (Figure 4.5). When categorized in the same size intervals, it is seen that most of the city has a very homogeneous level of vulnerability apart from some BSGAs in the north west of the city. But, when categorized in the same size samples, it can be seen that the map is very similar to the one related to the existence category. Meaning that said category holds a weight in the building of the index.

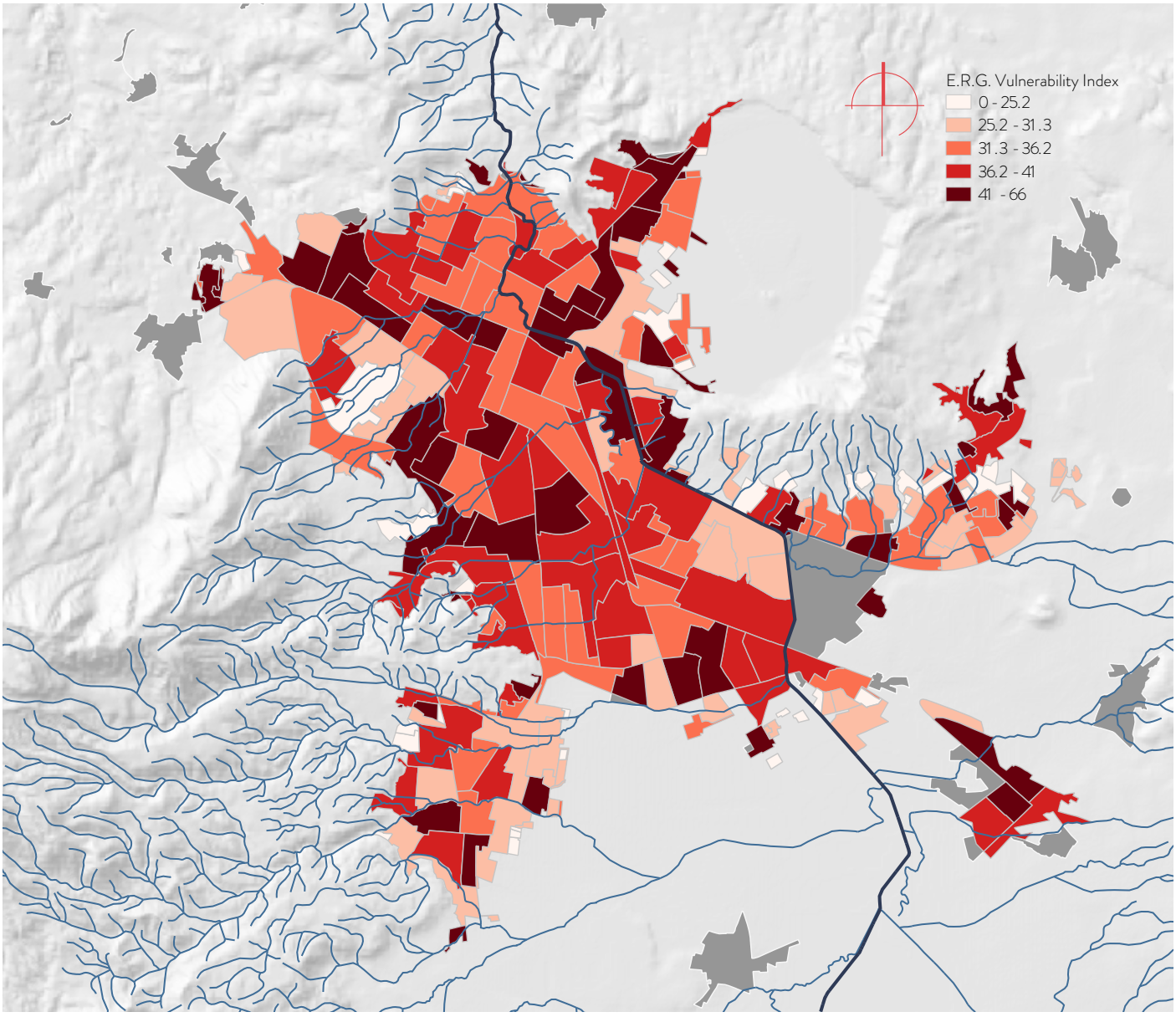

Figure 4.5. E.R.G. Vulnerability IndeX

As shown in Figure 4.6, there is not a clear correlation between the results presented in Figure 4.5 and the flooding plains, river, or streams. However, this presents itself as an opportunity to see which BGASs are the most vulnerable when an extreme weather event such as flooding occur, making a case for the implementation of sustainable urban management solutions. This means that there can be a variety of strategies that could be implemented to mitigate said vulnerability.

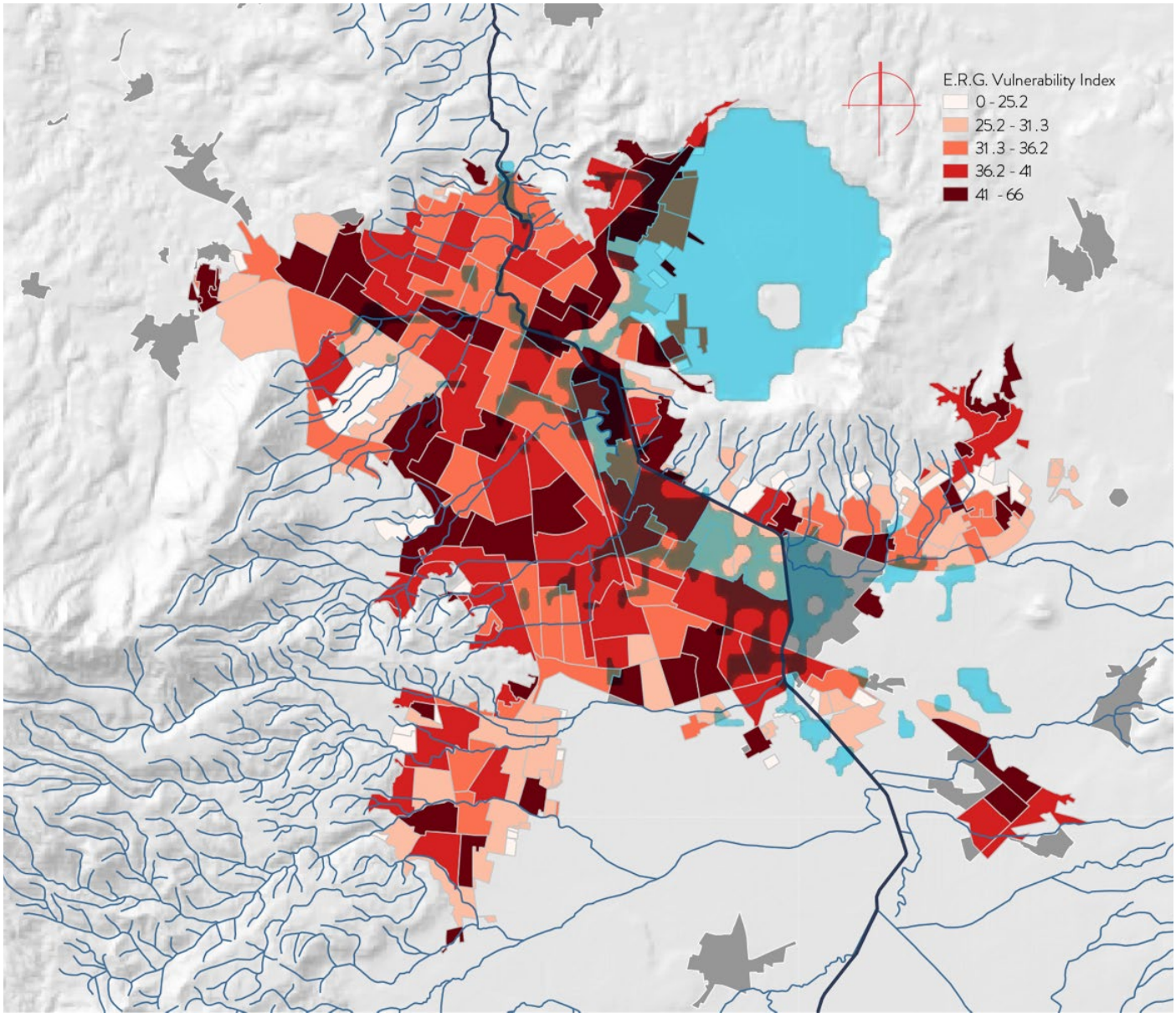

Figure 4.5. Overlap between E.R.G. Vulnerability Index and Floodplains with a 2 year return time.

4.3 Water Sensitive Solutions for Tepic

As presented in Section 4.1, the water governance of Tepic can be placed within the first three stages of Brown et al. (2009) urban water city state (i.e. Water supply, Sewered, and Drained city). The current disruption of the water cycle (Section 1.2.3), lack of common vision for water management (Section 4.1.1), and lack of engagement with the vulnerable population (Section 4.2) makes the city of Tepic a great candidate for the implementation of a Water Sensitive Vision. Water sensitive city vision would not only in tackle the water vulnerability of Tepic but also change the way water users and actors relate and think about water. Water sensitive city entails an adaptive multifunctional infrastructure and an urban design perspective that seeks to reinforce awareness and sustainable water behaviors, offering solutions beyond the technical measures in which people are being engaged (Johnstone et al., 2012).

As mentioned in the theoretical background, there is a link between the satisfaction of needs and livability that can be achieved through the progression of water city states until reaching water sensibility (Figure 4.7) (Section 2.4 and 2.5).

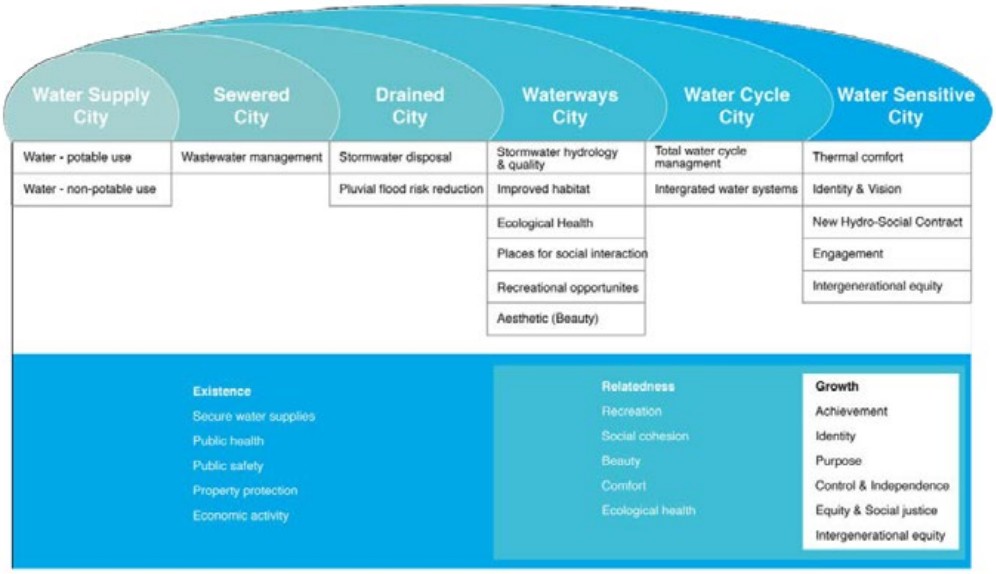

Figure 4.7. Illustration of the relationships between City States and Societal Urban Water Needs

Tepic is in a Drained City state. Therefore, it is focused on only meeting its existence needs. The city of Tepic has a favorable balance regarding the availability of water (IMPLAN, 2018). However its failure is due to deficiencies in the distribution infrastructure (Interview Partida, A., Jara, J., Nayarit, September 2021). The supply of drinking water for the city of Tepic is entirely dependent on underground sources. The extraction is carried out through 61 deep wells and services approximately 120,000 users, benefiting around 480,000 inhabitants and SIAPA Tepic is responsible for its operation, maintenance, and administration. However, they work within a valve system which is poorly managed (IMPLAN, 2018; Interview Jara, J., Nayarit, September 2021). A similar situation happens with the sewer system. Most of the urban area of Tepic is located on flat and semi-flat land with slopes of less than 2.5% which presents a challenge for evacuation of sewage water, for what they need pumping stations (IMPLAN, 2018). Both systems rely heavily on technical solutions for their correct operation. In addition to that, the lack of proper rainwater drainage worsen the state of the sewage system (Section 1.2.1).

WSS could potentially alleviate some of these issues by revisiting the motto: Delay, retain, store and reuse, and only drain when necessary (Deltares, 2018). This statement defines the goals to be achieved in order to close the water cycle and to create a sustainable water balance on the long term for the city of Tepic. Tepic's water cycle is divided similar to a lot of different cities in Mexico, with the ultimate example being Mexico City: a valley surrounded by mountains with a natural vocation for water catchment (Section 1.1.2; Deltares, 2018). Figure 4.8 identifies key points within the hydrological balance where physical interventions through the implementation of public space projects would contribute to the mitigation of some of Tepic's water related vulnerabilities.

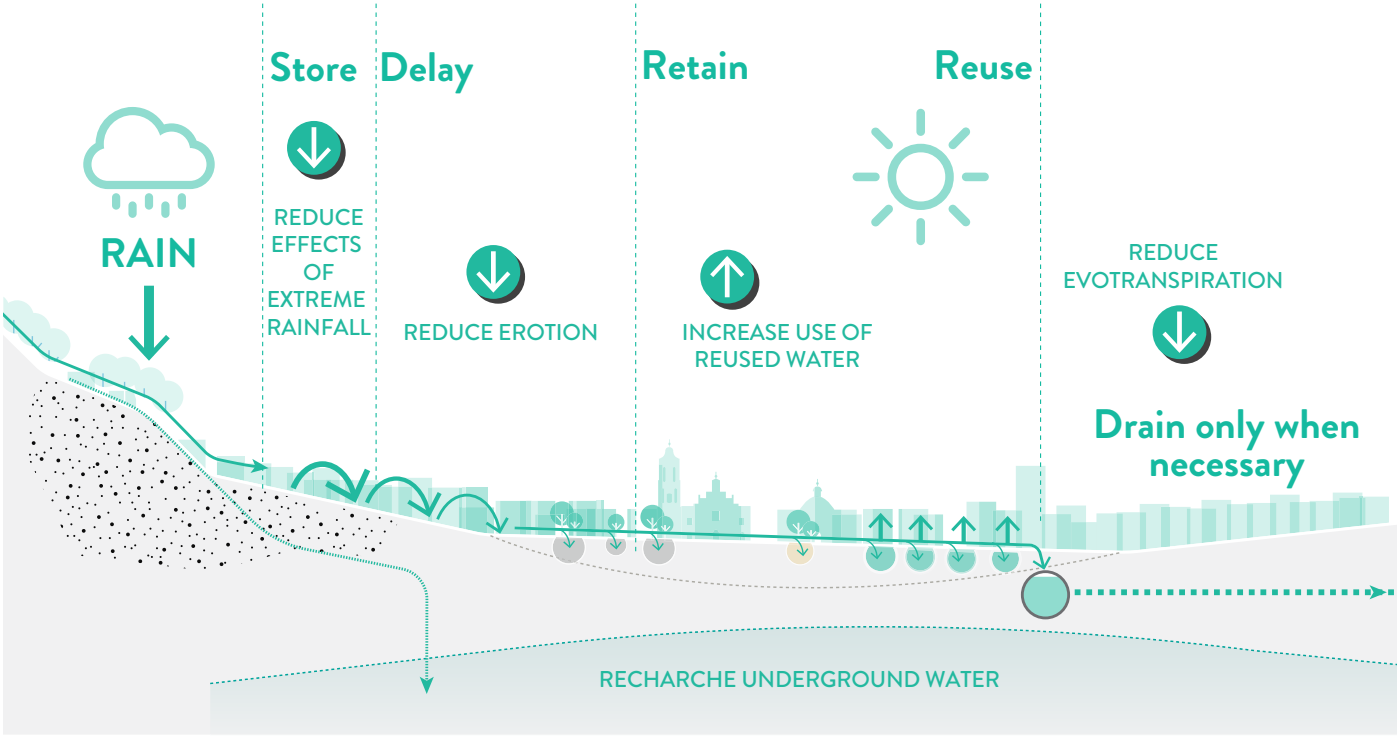

Figure 4.8. Motto Delay, retain, store and reuse, and only drain when necessary, adapted to the profile of the city of Tepic.

The motto could be reformatted as the following framework for approaching the problem:

- Storing water on the hillsides could potentially reduce the effects of extreme rainwater events by reducing high volumes of runoff water thought the hillsides.
- Delaying and retaining could avoid the erosion of the ground and flash floods lower areas in the valley.
- Retaining water instead of flushing it away would allow for the recharge of the ground water while curbing the evapotranspiration.
- Reusing rainwater for a multitude of activities, including the preservation of green infrastructure, could help with water scarcity issues.

This approach could potentially relieve pressure on the sewage system that gets broken every time there is an extreme rain event (Section 1.2.1).

Moving forward in the progression towards a Water Sensitive City we encounter the Relatedness category of satisfaction of needs. Water way and Water cycle City cater to this category. Relatedness satisfaction of needs supports social interactions and contribute to the societal-environmental relationships (Johnstone, 2014). For this kind of interactions to happen, public space plays a fundamental role (Forgaci, 2018). At the moment Tepic holds a very low density of recreational and green areas (Figure 4.9). According to IMPLAN (2018), there are 99 sports areas operating in the municipality. However, geographically, there is a lack of distribution around the urban area. Further, it does not mention anything about the quality or accessibility of said spaces. With regards to green areas, Tepic has 1.2 sqm on average per capita (Mejía & Gómez, 2015). The World Health Organization (WHO), however, recommends a standard of at least 9 sqm of green areas per capita (Reyes & Figueroa, 2010).

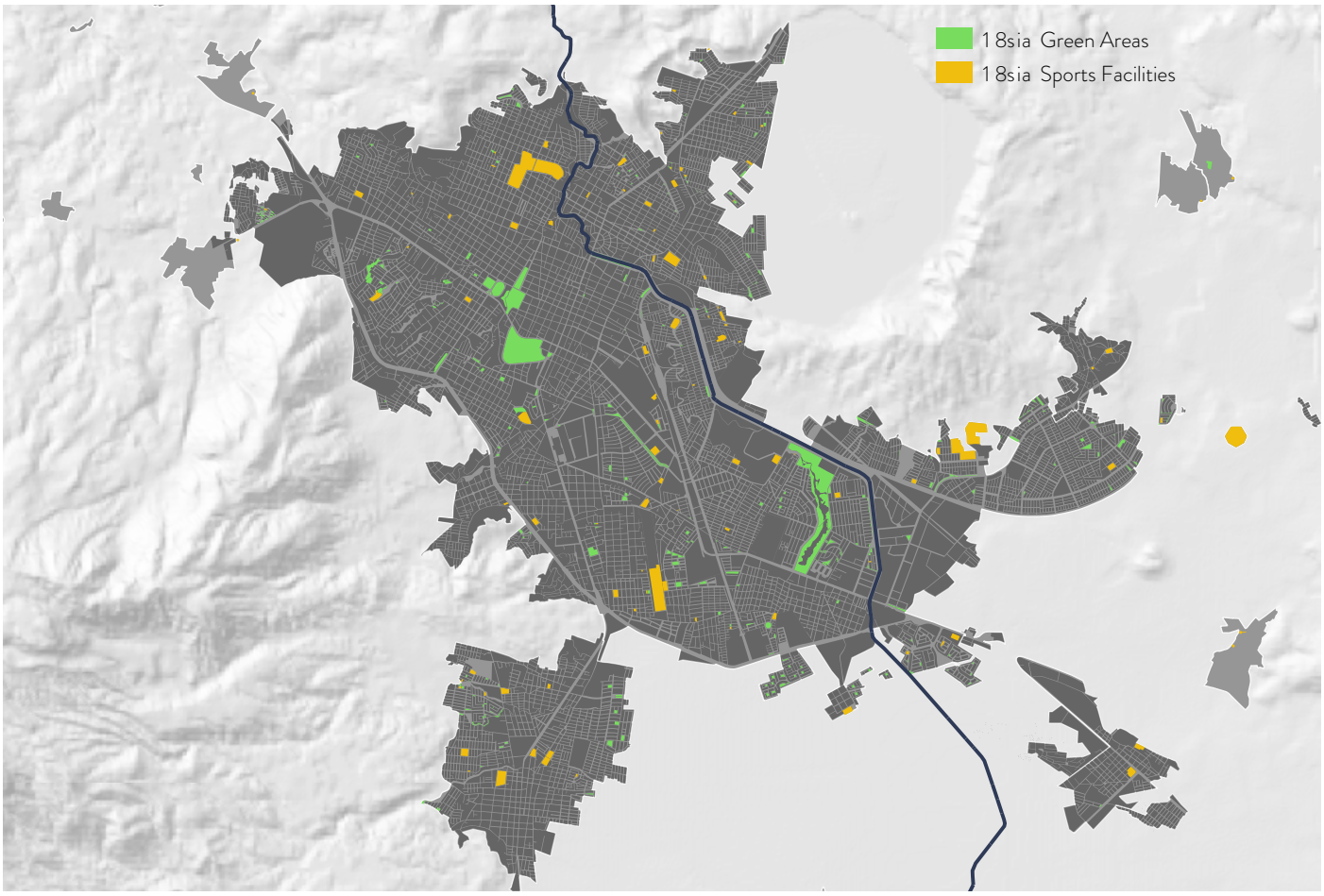

Figure 4.9. Distribution of Green Areas and Sport Areas in the city of Tepic

The lack of green recreational spaces has a direct impact on the satisfaction of Relatedness societal needs which includes beauty, comfort, social cohesion, and ecological health. For citizens to actively pursue activities, the built environment needs to be accessible and comfortable. Trees, landscaping, and flowers play a key role among the elements in city space by providing shade, cooling, and clean air. In addition to their immediate aesthetic qualities, the green elements in the city have a symbolic value passing a message about recreation, introspection, beauty, sustainability, and the diversity of nature (Gehls, 2010). This experience of comfort influences the decision on whether or how to use a space (Ali & Patnaik, 2018). Thus, the presence of green public spaces are important as they promote activities and healthy behaviors that may cultivate social cohesion (Jennings & Bamkole, 2019). As mentioned in the theoretical background (Section 2.6), green infrastructure in urban design is consistent and synergistic with the philosophical basis for WSUD (Wong & Brown, 2009). Thus, WSS that incorporate green infrastructure could achieve an improvement on the quality of the public space by creating new areas for recreation while revitalizing the ecological health of Tepic.

As it is now, people in Tepic have a dual understanding of water. On the one hand, they have positive experiences of the river and its banks are perceived as places for relaxation, fun, and social interaction. On the other hand, it is also perceived as a place where crime, drug use, and other transgressive practices happen due to the state of contamination of the river and the repercussion on the public spaces around it (Navarrete, 2020). Environmental and social problems lead to negative meanings and, at the same time, prevents the generation of a sense of belonging and appropriation of the river that could contribute to solving the problems. Adding to that, by ceasing the utilitarian dependence on the water of the river and its different effluents the physical, direct, and corporeal relationship with the river was lost. Consequently, the existing link and sense of appropriation was broken and the sense of identity around the river was lost (abid). WSUD has the potential to create urban places that have their own particular identity. This are places where the management and use of water creates a local environment that communities identify with and have a particular sense of belonging (Johnstone, 2012).

By reaching a Water Sensitive City stage, the Growth category of satisfaction of needs is addressed by the engagement of society in the processes that shape cities and urban water systems (Johnstone, 2012). As discussed in Section 4.2, Tepic has an uneven distribution of social vulnerabilities and vulnerabilities of the growth category present a pattern of closeness to the unrectified river basin. Development of water sensitive city systems have the capability to contribute to societal growth. They do this by improving equity and ensuring that entire communities are beneficiaries of the advantages of better quality of life (through better water management, access to water, to recreational public spaces, etc.). In order to assure equity and social justice, there needs to be an even geographical distribution of benefits and access to them across society. This should be done in order to avoid the marginalization and exclusion of benefits of societal systems. (Johnstone, 2012). Most importantly, WSUD and the ideas of water sensitive cities create a vision for future cities. This is something that Tepic desperately needs as discussed in Section 4.1.1. Actions that help strengthen the values and agreements around water management towards resilient urban water systems. Clarifying expectations of the citizens and helping decision makers towards a transformational pathway (Johnstone, 2012).

4.3.1 Application Potentials of Water Sensitive Public Spaces

For illustrative purposes, two areas are showcased on how WSS could look like in three vulnerable areas of the city of Tepic for different moments of the water cycle using as a base the toolbox generated by Deltares (2018).

The first area explored in the natural ditches located in the west of the Tepic (Figure 4.10a). This slopes for part of the natural drainage of the city (Section 1.1.2) the goal in the ditches would be to minimize the runoff's speed and volume in order to prevent flash floods downhill. The ditches are in the transition area between the mountains and the low urbanized Basin (Deltares, 2018). Among the main strategies aimed at decreasing the water's speed are building small dams or natural obstacles and to temporarily retain the water in public spaces. The goal is to give it time to infiltrate in a natural way, for example, supported by natural purification and infiltration areas. These areas have the potential to become attractive spaces that help to clean the water polluted by flowing over urbanized surfaces. Once clean, it can sink into the porous rock bed and replete the aquifer. The strategies are illustrated in Figure 4.11.

The second area explored are the low lands of the basin, where the water tends to accumulate (Figure 4.10b). The area is part of the old river basin, so the area naturally accumulates water (Section 1.2.1). Unfortunately, the water that comes all the way from the slopes comes already contaminated and polluted. So among the strategies aimed to help with the water pollution and ease the negative impact of flooding could be retention and infiltration ponds. This could be located in non-urbanized areas of the low lands. The expansion of the existing wetlands would also help with recovering the ecological health of the area as well as serve as natural water purification filters. These areas have the potential to become attractive spaces for social interaction and other activities. The strategies are illustrated in Figure 4.12.

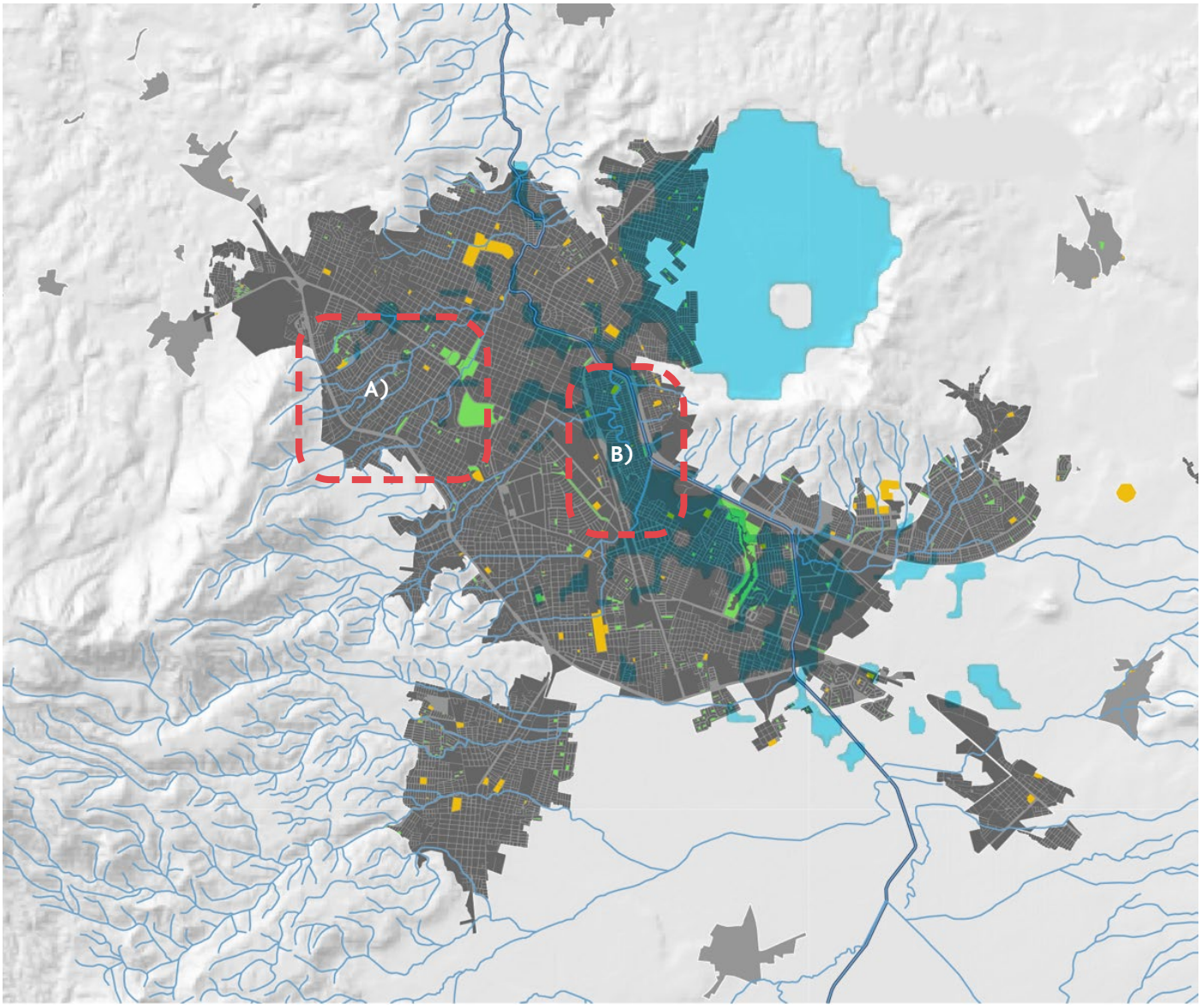

Figure 4.10. Proposed areas of intervention for implementation of WSS. A) Ditches and Slopes. B) Lowlands of the Valley

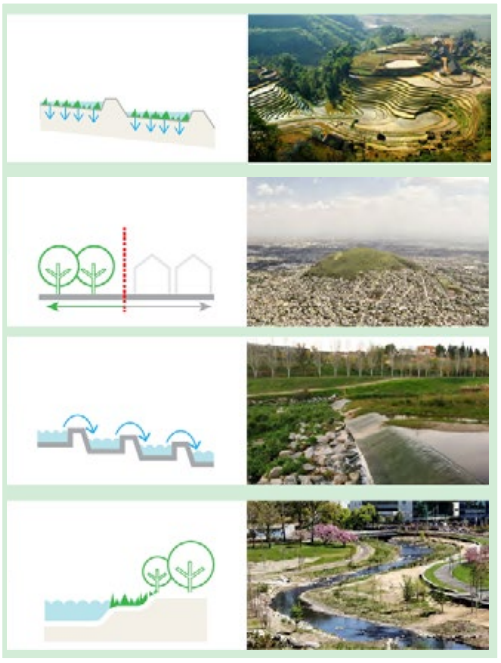

Figure 4.11. Strategies Area A. Top Down: infiltration terraces, limit urbanization, cascading dikes, renaturalisation of ditches.

Figure 4.12. Strategies Area B. Top Down: infiltration and retention ponds, natural water purification filters, urban retention areas, expansion of wetlands.

5 Discussion

5.1 A New Governance for Tepic

The results of this research show that water governance for Tepic has been a large barrier for improving the overall water management of the city. This includes a lack of common vision and misaligned values that trickle down from the national level. This is mostly due the obsolescence of the national water law that was created over 30 years ago (CONAGUA, 1992; Ávila et al., 2020). The lack of common vision for how water should be managed affects all different functions of governance around water. The governance functions that seem the most affected by the lack of common vision are coordination, management arrangements, and planning which consequently affect the procurement of funding for the implementation of any water management infrastructure, big or small.

According to the Manager Director of SIAPA, funding is one the biggest obstacles to overcome (Interview Jara, J., Nayarit, September 2021). However, this statement alludes to the non-payment culture that is so pervasive in the city. Citizens do not pay their fees for water services, so SIAPA remains underfunded to be able to performed water infrastructure which makes citizens not paying for the poor quality of the service, thus creating a negative feedback loop. The way citizens relate to water and water infrastructure has a direct impact on the provision of the service. However, by blaming the people, the mainstream water policy community fails to search out the root causes of their water problems. This perspective aligns with the belief from expert knowledge systems, formal legal structures, and market forces that blames the victims (Boelens et al., 2018). These models and procedures fail to examine the social, cultural, symbolic, and institutional conditions underlying poor distributions in the first place, therefore, it continues to hamper water justice.

Within this topic, Villagrana highlights the importance of the citizen's collaborative participation. The problem construction and solutions should not be left only to the experts. However, this expertocracia, or power exercise only by experts, is prevalent among the political spheres (Interview, Villagrana, A., Nayarit, September 2021).

The issue with how people relate to the water and water services can be traced to the loss of water culture around the river and the basin (Section 5.3) which is also linked to the lack of an overall common water vision. This fragmented vision lead to confusion and lack of understanding among stakeholders involved in water management, namely public government officials and citizens, resulting in them not seeing sustainable urban water solutions as a way to solve the water problems. Top government officials consider alternative water solutions as not politically profitable, mainly due the short timeframe of the political cycle and their lack of understanding of alternative water management solutions (Section 4.1.1). On top of that the intersectionality needed to apply water sensitive solutions is not compatible with the conventional water management in existence. This means that there is not a policy framework into which sustainable water management can operate. Due to the recurrent problems with the water supply distribution and the problems in the drainage system (Section 1.2.1) the focus of the citizens is concentrated on technical solutions to improve said systems in addition to avoiding flooding and treating wastewater (Navarrete, 2020).

The flaws found in coordination and management arrangements have a direct impact in accountability, transparency, and participation within the governance of the city. Since there are not clear distinction task divisions, government officials tend to delegate and blame each other for the neglect of certain functions (Interview Macedo, L., Nayarit, September 2021). A similar situation happens when information is shared (Interview Partida, A., Nayarit, September 2021). In consequence, institutions hold no accountability. The same applies to individuals and companies that hurt others when they effectuate poor water practices such as pollution, illegal connection to sewage services or over-exploitation of aquifers. This combination of lack of accountability and transparency makes the perfect petri dish in which corruption can flourish. Corruption discourages the participation of citizens in governance processes as they are aware of the

failed system in which they operate (Interviews Durán, S., Macedo, L., Nayarit, September 2021). Many citizens, especially the ones with high stakes in water management, feel unseen, unheard, and frustrated when it comes to denouncing acts of injustice. One particular statement reads:

> *"The government and justice systems are structured in a way that our complaints have no effect" (Interview Durán, S., Nayarit, September 2021).*

Consequentially, technical decentralize institutions have a hard time incentivizing the participation of citizens when it comes to formulate urban strategies for the improvement of the city (Interview Partida, A., Nayarit, September 2021). So although accountability, transparency, and participation may not have a direct impact when initially trying to propose water sensitive solutions, it could eventually present itself as a problem due to popular opposition, clash of interest with actors with preferential treatment, or simply acts of corruption that could hinder the implementation process.

The traffic of influence around water discussed in Sections 1.1.3 and 1.2.2 were briefly addressed during the data collection (Interviews Annex 2). For citizens it is very clear and normal that influence is an unescapable force that permeates the governance apparatus. Both Macedo and Durán mentioned how it is hard to keep political influence and agendas outside the citizens collectives. For researchers like Villagrana, when coming across water polluters in their research, stakeholders in positions of power tend to avoid talking about the economic power figures creating them (Interview Villagrana, A., Nayarit, September 2021).

Economic power is so ingrained in the political systems that there is a lack of credibility, regulation, and accountability when refereeing to them (Interview Durán, S., Nayarit, September 2021). A clear example is the extractive water industries like the Coca Cola Company. Don Antonio Echevarría Domínguez , the owner of the concession of the Coca Cola Company, also has a long history within public office since the early 80's: twice he was the Secretary of Finance and Administration of the Government for the State of Nayarit on two occasions, Alternate Municipal President of Tepic, Secretary of the Fund for the Promotion of Economic and Productive Activities, Secretary of the Board of Directors of the Public Treasury on three occasions, and even Governor of Nayarit in 2001 (Bien Informado, 2016). Further, his son Antonio Echeverría García was the governor of the State from 2018 to 2021. So not only the Echevarría family had taken part on building the narrative around water due to its privileged position, but their traffic of influence creates no incentives to improve transparency, accountability, or regulation around water governance since they are direct beneficiaries of its failure.

This traffic of influence is also a liability when deciding which infrastructure gets to be built. As shown in Section 4.1.1, IMPLAN holds influence and provides tools to make informed decisions on where to allocate funding and where to deploy certain strategies, but ultimately it is the Cabildo who has a final say. This means that even when a project has been deem unfit for the city by the planning tools, the Cabildo could still potentially approve any project even when it is not in the best interest of the city. It is also susceptible to the capture of influence and corruption.

As presented in Section 4.1.2, there is a clear urgency at a national level for coming up with a single unified vision on water management mentioned repeatedly during the Forum "Panorama and Perspectives of water in Mexico 2019-2024" (Ávila et al., 2020). Said vision would require a new National Water Law that articulates the legal systems from the different sectors (e.g. housing, environment, water, energy) in a transversal and complementary way. This would be the first stepping stone toward a water sensitive city vision for the Tepic and the country.
Despite the many issues within governance in Tepic, there has been a push from IMPLAN to align all planning documents to the sustainability goals agendas from UN-HABITAD, with a long-term vision (Section 4.1.2). So there is willingness from the technical and academic stakeholders as well as citizens to come up with the best solution for the problems of the city of Tepic.

5.2 Redistribution of Water Justice.

The overall distribution of social vulnerabilities around the city seem to be scattered. These are mostly responding to the density of neighborhoods, appearance of new developments, anarchic growth, and market speculation (Section 4.2). There seems to be a process of abandonment happening in central areas of the city. Meanwhile, new developments, usually in the outskirts of the city, tend to grow and become denser (IMPLAN, 2018). The uneven distribution of the population makes it that the infrastructure in central areas get underutilized and neglected, while there is still a need to create new infrastructure for new developments elsewhere.

CONEVAL classifies Tepic as a city with low social vulnerabilities (CONEVAL, 2018), however, there is a big segment of the population who is economically inactive, living without access to health services, and away from recreational and green areas. As part of the vulnerability assessment on the existence satisfaction of needs, most dwellings count on running water, a functioning sewage system, and public infrastructure. However, the data does not take into account the quality of said services or the intermittence in which they operate. The data is framed in a way that it would appear there are no big vulnerabilities happening in the city which is misleading.

As for the relatedness index, there is a clear pattern in which the most central areas of city are the least vulnerable. However, this low index of vulnerability could also be linked with the level of occupancy these dwellings have. Since there is a pattern in which dwellings in more central areas are being abandoned, they also appear to be the least dense. This means that there is a smaller population left vulnerable if a disturbance would concur. Since some of these areas are also not being developed, there are more dwellings without dirt floors and/or with more than one room. However, these variables are nonexistent in the outskirts of the city. Within the relatedness index, it is also good to mention that although some green areas may seem close to the centroid of a BGSA, accessibility or reachability is not to be taken into account. Some streets are private streets, some areas are within gated communities, and some are just poorly connected through streets or sidewalks. That is why it is worth mentioning that the results could have worked better if the analysis would have been done at a block level, instead of BGSA. This is because within a single BGSA there could still be hard contrasts between dwellings and populations. The indexes are skewed due to the presence of gated communities within certain BGSA.

The gated communities incorporate heterogeneous privileged groups that represent the “winners” of globalization: members of the bourgeoisie, nouveau riche, traditional oligarchs, political elites, emerging national and transnational classes (Camus, 2019). Such is the example of some of the BGSA susceptible to flooding down in the valley. While some plots were invaded after the deviation of the river (Sol Angel, 2021) some other areas where coopted by the economic elite due to the lack of transparency and accountability within the governance apparatus. After the purchase, these areas where developed as gated communities with higher market values for the purpose of profit (Figure 5.1).

Figure 5.1. Contrast between dwellings in Los Colomos Neighborhood within a BGAS susceptible to flooding. Source: Google Maps (2015)

The same happens in areas close to the natural ditches where rainwater flows. Due to the presence of greenery and a pleasant microclimate, some of this areas where invaded to create gated communities that exclude the rest of the population from the enjoyment of said natural services (Figure 5.2). The residents living in this gated communities live as if they were not part of the city (Duhau & Giglia, 2008) which impacts the overall social cohesion and ability to reach sustainability goals.

Figure 5.2. Gated Communities Aves del Paraíso A) Gated acces, B) Top view from the coopted ditches, Tepic, Nayarit. Source: Google Maps (2015).

However, a very interesting pattern comes from the growth index of satisfaction of needs. It appears that dwellings with populations whose identities are more socially vulnerable (i.e. dwellings occupied by families with a female head of house, indigenous people, disabled people, or uneducated people) are located in the downstream section of the river. This relates back to the definition of Water Justice given in the theoretical background (Section 2.1). Historically, the downstream of the river has been neglected and due to the invisibility of this section of the river, has suffered from the least interventions from government authorities (Navarrete, 2020). Despite having the same problems with flooding, erosion, and pollution as those living upstream, this area is of little interested to people in power because the problem is not directly visible and does not compare with strategies in the upstream that have greater visibility due to the potential political gain. However, this area presents a bottleneck where the sum of all the other issues in the basin merge with a bigger impact on people's life due to their vulnerable situation.

Although not all the BGSAs in the area are in direct contact with the river basin of flooding areas, Water Sensitive Solutions could have a bigger impact due to the inherent vulnerability of the population there. But these also need to take into account the implementation of said solution that whatever happens upstream ends up having an impact downstream.

5.3 Potential of Water Sensitive Solutions

WSS could have a positive impact on the livability satisfaction in Tepic. WSS respond to the natural water cycle of the urban areas by using public space design solutions which ultimately have an impact on how people relate with water, the city, and themselves. At the basic level of existence, WSS could potentially reduce the effects of extreme weather events, such as flooding and slowing down the erosion process of the soil, both very prominent issues in Tepic (Section 4.3).

5.3.1 Existance: Catchment Systems & Flood Protection

Currently, the city does not consider the separation of rain and wastewater which makes the overall sewage infrastructure reach critical capacities every rainy season. By using WSUD to capture rainwater before it reaches the sewage system could potentially reduce the pressure on the sewage system. However, there is still a need for grey infrastructure that involves the proper separation of the different qualities of water. Green infrastructures, part of WSUD, could be used as buffer during the transition to a more sustainable water separation system. This is especially important for the people that live in the lowest flattest regions of the valley, as these people suffer the consequences of flashfloods coming from the impervious areas of the hills. WSS could also expand the reuse of rainwater for different activities in the city and balance the levels of underground water by allowing the time to infiltrate instead of fully drain out of the city. Tapping into new sources of water could potentially aid the existent supply infrastructure and even out the burden that this particular service suffers around the city. This is especially important since the problem with water in Tepic is not lack of the resource, but the poor distribution (Interviews Partida, A; Jara, J; Nayarit, September 2021). Also, by improving the overall water cycle, the river Mololoa could be positively benefited by improving its ecological health and going back to its original vocation as Tepic's most important source of water.

5.3.2 Relatedness: Improved Green Recreational Areas

At a relatedness needs level, WSS could have a direct impact on public spaces and the relation citizens have with them. Tepic has a clear deficit of green recreational areas. According to the planning tools, there are 99 sites listed as recreational and sport facilities, stating that only 2% of the population is not within the coverage radius (IMPLAN, 2018). This is an example of what is said previously in the Section 4.1.1 in which the information is framed in a way that there seems to be no major issues as 2% seems a reasonable amount of people to not be covered. However, other factors like quality of said spaces or how accessible they are to people are omitted.

Since WSS uses nature based solutions, these urban design strategies could bring green back in to the city improving both the aesthetic value and ecological health. On top of that, greens areas have a direct impact on the microclimate of the city, making it more comfortable. All of it would make public spaces more inviting and accessible for citizens to use, ultimately leading to greater social interactions among people. Social interaction is key to improve the community resilience and the ability of a community to withstand rapid change (e.g. climate change) (Berkes & Ross, 2013).

5.3.3 Growth: Improved Connection to the River

As for the growth satisfaction of needs, most of the stakeholders in the city have a disconnection with the culture around water. In the past Tepic had a deep utilitarian connection with the water cycle of the valley being the crown jewel the Mololoa River. The river has historically been used for utilitarian and commercial purposes, especially during the 19th and early 20th centuries (Navarrete, 2020). This development led to the exploitation of natural resources of the river and the basin and led to problems of contamination, deterioration, and risks of overflows and floods, among others. This western idea of progress promoted by the industrial revolution and colonial thinking brought a new way in which people relate with their environment which gave a different and antagonist significance to the Mololoa River (Navarrete, 2020). The sense of belonging of the river lost significance due the current degraded state.

WSS presents themselves with the opportunity to return a healthy water cycle to the city which would have a positive impact in the condition of the river. This improved condition would allow for people to reconnect to the lost vocation it used to have, creating a new water culture around it, and improving the relation the citizens have with the overall basin. As stated before, the reused of rainwater would allow a better distribution of benefits adding into the equity and social justice satisfaction of needs. The balance of the underground water would also let future generations to still have access to the precious resource securing intergenerational equity.

Although it may seem utopic, historically the river and other natural sources of water were constantly used as an alternative source of fresh water before the degradation of the quality of water and the encapsulation of natural water sources (Navarrete, 2020). The use of the water of the river allowed a smooth transition into what is now known to be the supply management infrastructure. People still remember with nostalgia what the river used to be, which gives hope for the push needed for the implementation of WSS.

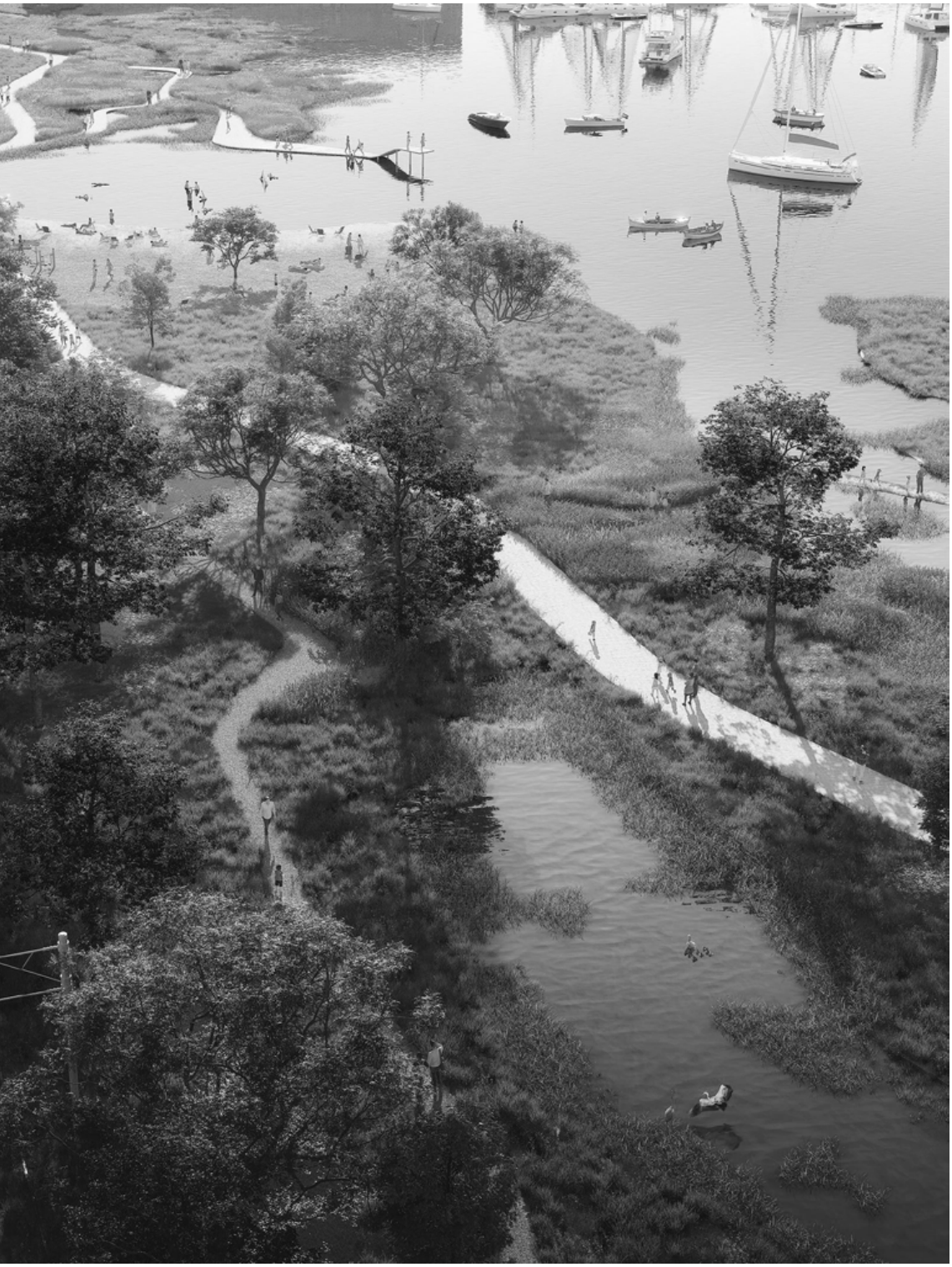

Photo: Water Sensitive Vision, Het Oog, Delva Architect, 2020.

6 Conclusion

The city of Tepic is currently facing several water related problems as a consequence of its natural predisposition for the capture of water, the frequency of extreme weather events, and the obsolete water management infrastructure leading to the disruption of the natural water cycle. WSS explore the potential of urban areas as water catchments to provide resources at different scales for fit-for-purpose applications. It entails the integration of the natural water cycle in its context as an integral part of almost every feature of the urban landscape in order to close the water cycle and create a sustainable water balance on the long term for the city.

However, the current state of water governance in Tepic is an obstacle that must be overcome. For this to be done it would be necessary to create a common vision on the sustainable management of water. This vision would need to start at a policy level by the formulation of a new Water Law to update the 1992 version. This would influence the way the governance apparatus works by coordinating the federation, estates, and municipalities as well as the different ministries and public agencies within each order of government. This would require the updating of different instruments and tools in an intersectoral manner matching legal systems from the different sectors (e.g. housing, environment, water, and energy) in a transversal and complementary way.

This vision for water would need to go beyond policy and push to change the paradigm in the way people think and relate with water. Here lies the real potential WSS as it entails an adaptive multifunctional infrastructure and an urban design perspective that seeks to reinforce water conscious behaviors, beyond the technical measures. This would create water-conscious communities, where citizens are connected to their water environments and water, planning, and design professionals would work collaboratively to deliver water sensitive outcomes.

Steps have already been taken towards a more sustainable water management by different actors in different levels of government. There is a clear urgency from a federal level to come up with a unified vision across disciplines to solve the water problem, however, there is still a long path ahead from acknowledging the problems to effectuate on them. At a city level the IMPLAN has done a tremendous work by aligning the existing planning tools towards clear long-term sustainable goals, but work needs to be done to incorporate water beyond water provision, water treatment, sewage, and flood protection. As for citizens, there is a clear interest to participate in the development and implementation of solutions from people experiencing the direct impacts of the poor water management in the city. Nevertheless, there needs to be a greater interest from the rest of the citizenship to improve the health of the whole basin and not only the tangible summary of the poor water management of the city which is the river Mololoa.

To achieve a Water Sensitive Vision is not an easy process as the current state of governance not only affects the water management of the city but also the flaws in coordination and management arrangements have a direct impact in accountability, transparency, and participation creating the circumstances for corruption to erupt. This is why the different governance functions around water need to be strengthen to avoid capture of influence.

Another consideration to have is the distribution of water vulnerabilities around the city. Despite not having high levels of vulnerability according to the CONEVAL, the city does presents a pattern in which the most vulnerable identities within the population: indigenous people, woman (leading households), disable, and uneducated people cluster in the northwest part of the city, downstream. This section of the river has been historically neglected and has suffered the least interventions for improvement due to the invisibility the river has in this area despite having the same problems with flooding, erosion, and pollution, as other areas upstream. Although the consequences of

a good water management upstream have direct impacts of what happens downstream, WSS would have a greater social impact.

Finally, the summarized catalogue of WSS provided by Deltares is a great first approach for implementation in Tepic. The Matatipac valley shares similar conditions and characteristics as the valley where Mexico City is located. However, more research needs to be conducted on the spatial hydrological cycle of the Mololoa basin including models on flooding, heat waves, underground water recharge, climate, and precipitation to be able to assess the most efficient water sensitive strategies. This includes the centralization of information, improved access, and transparency.

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9 Annex

PhD. Alejandra Villagrana.

Lead Researcher: "Comprehensive hydrological and sanitation management plan in the Mololoa river basin in Tepic, Nayarit: water-sensitive urban-environmental scenarios"

Background: Urbanism.

Date: September 3rd 2021

What her research is trying to do is to unify a big part of the analysis already done in the Matatipac Basin, and specifically in the Mololoa River.

The project is a joint research proposed by the National Council of Science and Technology of Mexico and the State Government. The interdisciplinary research involved people from 5 different academic institutions (National Polytechnic Institute Zacatecas' Campus, University of Guadalajara, Innovative Development Research Center Durango's Campus, Baja California University, and Nayarit Autonomous University) in charge of sanitation, urban strategy, and socio economic feasibility.

The topic of the River is over studied according to the local authorities, but most of the plans are never effectuated upon. The problem is that each public administration brings with them new studies and new teams. This changes prevent previous strategies to have continuity, resulting in the river [and the basin] remaining in its same state.

According to experts on the field, the river technically still have a long term solution.

Inside the municipality there is a break because of the lack of clarity on which functions fell into which authority. There is no collaboration at an institutional level.

The operator system often have to improvise solutions that result in new problems.

The problem of the river [and the basin] is divided in three moments. Upstream, linked to the agro industrial activities. Within the city where it gets polluted by sewage and trash. And downstream where unregulated settlements at the margins of the river basin live in constant risk.

However, one of the most latent problem [In the old river basin] are flooding, sanitation and improving of the drainage systems.

There's a need to create spaces of collaboration and information, not only technical, but too involve citizens, academics, and other civil institutions. The problem and solution should not be left out to the experts alone.

Even though planning and program tools already require citizens' participation, the decisions are still taking only by the authority in charge. The disconnection between institutions result in a lack of transparency in the actions been taken.

In the practical sense, decision making and the effectuation of solutions are still much bureaucratized. The access to information takes a long time and most of the times is not digitalized. Is hard to break with the old scheme of doing things. Although some institutions and collectives are starting to change their paradigm, the municipality still lacks maturity.

Informal powers: indirectly we discover that most polluting companies are not reprehended when breaking the law. Companies get fined but there is no follow up on how to solve the problem. Polluting companies then rather pay the fines than improve their processes. Some of the companies

we could detect where the Sugar mills, Mexifrutas, and a Pig Farm. However, even within the authorities, there is a reluctance of pointing any kind of finger towards this companies.

The capacity development within several municipal institutions is there. There are assets and capacity, but everyone is working in isolation. There is not collaboration form different sectors.

Financing also hits hard when trying to implement any kind of strategy. Most finance need to be funnel directly from federal funds. But since everything is disjointed, every institution tackle the problem from the isolated perspective. This makes it difficult when trying to communicate with institutions such as the Economy Ministry, which does not know the language use in research. Since they are the ones having to funnel the financial resources, they don't know how to portrait the research or the goals of the research, making it difficult to access the money.

Each ministry had different goals and sees water with different lenses.

The utopic scenario would be to create evolve beyond the basin committee, and create a Consortium. The consortium can have more punctual strategies and points of action, with project of different topics related to water sensitive solutions. The economic and productive part can have a bigger impact as a consortium, as it can be more monetized.

The basin committee does work just still really burocratized.

Update systems of transparency and access to information.

Physically I would love to see a more integrated urban image sensible to water. A park developed in the old river basin which can become a protected natural area. A network of green blue spaces, touristic and commercial.

Access to information takes a long time and most of the time is not digitalized.	0 - BARRIER 1FC - Monitoring and Evaluation 2AT – Transparency
Even though planning and program tools already require citizens' participation, the decisions are still taken only by the authority in charge.	0 – BARRIER 1FC - Policy & Strategy 2AT – Participation
Financing also hits hard when trying to implement any kind of strategy. Most resources need to be funnelled directly from federal funds. But since everything is disjointed, every institution tackles the problem from an isolated perspective. This makes it difficult when trying to communicate with institutions such as the Economy Ministry, which does not know the language used in research. Since they are the ones having to funnel the financial resources, they don't know how to portrait the research or the goals of the research, making it difficult to access the money.	0 - BARRIER, 1FC - Financing, 2AT - Efficiency
However, even within the authorities, there is a reluctance of pointing any kind of finger towards these companies.	0 - BARRIER 1FC - Monitoring and Evaluation 2AT - Impartiality
In the practical sense, decision making and the effectuation of solutions are still much bureaucratized.	0 - BARRIER, 1FC - Management Arrangements 2AT - Efficiency
Inside the municipality, there is a break because of the lack of clarity on which functions fell into which authority. There is no collaboration at an institutional level.	0 - BARRIER 1FC - Management Arrangements 2AT - Efficiency
Is hard to break with the old scheme of doing things. Although some institutions and collectives are starting to change their paradigm, the municipality still lacks maturity.	0 – BARRIER VISION - Values & Aspirations
Informal powers: indirectly we discover that most polluting companies are not reprehended when breaking the law. Companies get fined but there is no follow up on how to solve the problem.	0 – BARRIER 1FC – Regulation 2AT - Accountability
The disconnection between institutions results in a lack of transparency in the actions being taken.	0 – BARRIER 1FC – Coordination 2AT - Transparency

The operator system often has to improvise solutions that result in new problems.	0 – BARRIER 1FC - Planning and Preparedness 2AT - Efficiency
The problem and solution should not be left out to the experts alone.	0 – BARRIER 1FC - Planning and Preparedness 2AT - Multilevel
The problem is that each public administration brings with them new studies and new teams. These changes prevent previous strategies to have continuity, resulting in the river [and the basin] remaining in its same state.	0 – BARRIER 1FC - Monitoring and Evaluation 2AT – Accountability
The topic of the River is over studied according to the local authorities, but most of the plans are never effectuated upon.	0 – BARRIER 1FC - Planning and Preparedness 2AT - Efficiency
There are assets and capacity, but everyone is working in isolation. There is no collaboration from different sectors.	0 – BARRIER 1FC – Coordination 2AT - Participation
However, some of the most latent problems [In the old river basin] are flooding, sanitation and improvement of the drainage systems.	0 – DRIVER WATER PROBLEMS
Physically I would love to see a more integrated urban image sensible to water. A park developed in the old river basin which could become a protected natural area. A network of green-blue spaces, touristic and commercial.	0 - DRIVER VISION - Values & Aspirations
The capacity development within several municipal institutions is there	0 – DRIVER 1FC - Capacity Development
The problem of the river [and the basin] is divided into three moments. Upstream, linked to the agro-industrial activities. Within the city where it gets polluted by sewage and trash. And downstream where unregulated settlements at the margins of the river basin live at constant risk.	0 - DRIVER WATER PROBLEMS
The utopic scenario would be to create evolve beyond the basin committee, and create a Consortium. The consortium can have more punctual strategies and points of action, with projects of different topics related to water sensitive solutions. The economic and productive part can have a bigger impact as a consortium, as it can be more monetized.	0 – DRIVER VISION - Values & Aspirations
There's a need to create spaces of collaboration and information, not only technical, but to involve citizens, academics, and other civil institutions.	0 – DRIVER 1FC – Coordination 2AT – Participation 2AT - Deliberation
Update systems of transparency and access to information.	0 – DRIVER VISION - Values & Aspirations

MSc. Esmeralda Mendoza.

- Lead Researcher: "Diagnosis Of Intersectorial Integration: As Part Of The Guidelines For A Participatory Multisectoral Agenda Towards A Water-Sensitive Mololoa River"
- Background: Environmental Urbanism.
- Date: September 5th 2021

One of the main problems detected during the research was the lack of integration starting from the formulation of the problem. Some see the water as a nuance and others as an asset. When effectuating plans and programs, there is a lot of irregularities, mostly linked to ignorance or corruption.

The research is based on the analysis in a diversity of planning and program tools at a federal, state, and municipal level that are part of the Matatipac Basin. The three sectors studied are the urban sector, the hydrological, and the environmental.

A lot of the topics touch upon the tools are quite generalized, and never really action based. Most of the analysis was made in the two first stages of public policy: identification of the problem and strategy approach. There is a lack of integration between the different instruments, the only part

that is apparently integrated is supply, swear and sanitation. But even then, a lot of data doesn't match, is outdated, or is misinterpreted depending on the ministry involved. There is barely any touch upon water sensitive solutions. Most strategies are only focus in the old approach of supply and drainage.

There should be a high integration when public policy, effectuation of actions, and organizational form are align. One of the conclusion reached within the study is the need of a consortium.

There should be a more horizontal relationship between institutions, and not necessarily vertical from national to local. Water should be seen as a binder within different systems, and studied deeply within every institutional sector.

Most political figures lack willingness to transition into more sustainable solutions due to lack of time and money. Political periods are limited to 3 years at municipal level, and financial resources limited. Politics see sustainable [water sensitive] solutions out of their scope.

In planning and program tools citizens are seen in a more organizational way, not really decision makers.

Boundaries of action are disjoined. For the water resource, more municipalities should be integrated as part of the Matatipac basin. However, there are left behind as they are not part of the urbanization of the metropolitan area of Tepic.

There is a lack of common vision.

Ideally, one of the first strategies to follow would be to create more permeable areas and use more greenery in the city (nature based solutions).

A lot of the topics touched upon the tools are quite generalized, and they rarely are action-based.	0 – BARRIER 1FC - Planning and Preparedness 2AT - Efficiency
Boundaries of action are disjoined. For the water resource, more municipalities should be integrated as part of the Matatipac basin. However, there are left behind as they are not part of the urbanization of the metropolitan area of Tepic.	0 – BARRIER 1FC - Management Arrangements 2AT - Multilevel
But even then, a lot of data doesn't match, is outdated, or is misinterpreted depending on the ministry involved.	0 – BARRIER 1FC - Planning and Preparedness 2AT - Transparency,
In planning and program tools citizens are seen more as consultants, not really decision-makers.	0 – BARRIER 2AT – Inclusiveness 1FC - Coordination
Most political figures lack the willingness to transition into more sustainable solutions due to a lack of time and money.	0 – BARRIER 1FC – Financing 2AT - Efficiency
One of the main problems detected during the research was the lack of integration starting from the formulation of the problem. Some see the water as a nuisance and others as an asset.	0 - BARRIER VISION - Values & Aspirations
There is a lack of common vision.	0 – BARRIER VISION - Values & Aspirations
There is a lack of integration between the different instruments, the only part that is apparently integrated is water supply, sewer and sanitation	0 - BARRIER 1FC – Coordination 2AT - Efficiency

There is barely any touch upon water-sensitive solutions. Most strategies are only focused on the old approach of supply and drainage.	0 – BARRIER VISION - Values & Aspirations
When effectuating plans and programs, there is a lot of irregularities, mostly linked to ignorance or corruption.	0 - BARRIER, 1FC - Planning and Preparedness 2AT - Transparency
Ideally, one of the first strategies to follow would be to create more permeable areas and use more greenery in the city (nature-based solutions).	0 – DRIVER VISION - Values & Aspirations
One of the conclusions reached within the study is the need for a consortium.	0 – DRIVER VISION - Values & Aspirations
There should be a more horizontal relationship between institutions, and not necessarily vertical from national to local.	0 – DRIVER 1FC - Management Arrangements 2AT - Multilevel
Water should be seen as a binder within different systems and studied deeply within every institutional sector.	0 – DRIVER VISION - Values & Aspirations

Liliana Macedo.

- Chair: Collective to the Rescue of the Old Mololoa Riverbed CORECAM
- Background: Law.
- Date: September 2nd 2021.

CORECAM is born from the need to delimitate the green areas from the Juventud Neighborhood in the vicinities of the old Mololoa basin. The goals also include avoid the flooding, avoid the discharge of black and grey water to the river, and safeguard the flora and fauna of the area.

Citizens living in the area are aware of the nuisance the water causes, and area aware that is mainly due to the topography of the city, where all the water ends up in the old river basin. Most of this water comes already polluted since is washes off from the upper parts of the city.

Most of the time people don't take action because of ignorance, there is a deep ignorance on how to proceed legally to file complaints. People don't really understand how the water cycle of the city works and they ignore what are the actions they should demand from the authorities.

The people of CORECAM usually feel neglected and unheard when it come to their demands. They know that private stakeholders hold much power, as seen by the properties sold to the Forum Mall in what used to be part of the old river basin.

A lot of the plots given by the municipality did not take into account the natural surroundings, usually given as patronage in exchange for political leverage. The affiliation to political parties has made difficult to keep with being impartial to the goals of the CORECAM, since political parties focus on immediate action instead of the long run solutions.

The lack of continuity in the projects and the short term of the political cycle (three years for municipal authorities) makes it difficult to keep track of the demands, because each administration brings a new team and usually dismisses what the previous administration did.

The water in the area has become a public health issue since a lot of sewage is illegally dumping polluted water into the old basin. The people look more transparency, a more open government and the advance of public policy around the river and other issues.

In the CORECAM there are at least 20 people active, and at least a 100 interested in formalizing the association. People in the area would love to see the old river basin as a protected area and a big lineal park where different activities could take part.
Most hard: Continuity in the strategies, the political cycle at a municipal level only last 3 years, so "decision makers don't have incentives to make long term solutions"

A lot of the plots given by the municipality did not take into account the natural surroundings, usually given as patronage in exchange for political leverage.	0 – BARRIER 2AT – Transparency 1FC - Monitoring and Evaluation
Most of the time people don't take action because of ignorance, there is a deep ignorance on how to proceed legally to file complaints.	0 – BARRIER 1FC – Regulation 2AT - Transparency
People don't really understand how the water cycle of the city works and they ignore what are the actions they should demand from the authorities.	0 – BARRIER 1FC – Regulation 2AT - Evidence-Based
The affiliation to political parties has made it difficult to keep with being impartial to the goals of the CORECAM since political parties focus on immediate action instead of the long-run solutions.	0 – BARRIER 2AT – Impartiality 1FC - Policy & Strategy
The lack of continuity in the projects and the short term of the political cycle (three years for municipal authorities) makes it difficult to keep track of the demands because each administration brings a new team and usually dismisses what the previous administration did.	0 – BARRIER 1FC - Monitoring and Evaluation 1FC – Regulation 2AT – Efficiency 2AT - Transparency
The people look for more transparency, a more open government and the advance of public policy around the river and other issues.	0 – BARRIER 1FC - Policy & Strategy 2AT - Transparency
The people of CORECAM usually feel neglected and unheard when it comes to their demands.	0 – BARRIER 1FC – Regulation 2AT - Inclusiveness
Most of this water comes already polluted since it washes off from the upper parts of the city.	0 – DRIVER WATER PROBLEMS
People in the area would love to see the old river basin as a protected area and a big lineal park where different activities could take part.	0 – DRIVER VISION - Values & Aspirations
The goals also include avoiding flooding, avoiding the discharge of black and grey water to the river, and safeguarding the flora and fauna of the area.	0 – DRIVER WATER PROBLEMS
The water in the area has become a public health issue since a lot of sewage is illegally dumping polluted water into the old basin.	0 – DRIVER WATER PROBLEMS

José Alberto Partida Gómez

- Director of Territory Planning of Tepic at the Municipal Planning Institute.
- Background: Environmental Urban Studies
- Date: September 8th 2021.

When he started in the City Council of Tepic, he realized soon enough the difficulties and limited capacities that the administration had and why the city of Tepic was in the state it was.
One of the most complicated challenges he had to face, and still is, was to pitch sustainable solutions as important, necessary and exciting to the people with the decision making power. Authorities are reluctant to incorporate sustainable solutions to their agendas as they see them as not politically profitable due to the short duration of the political cycle.

The city of Tepic already had been diagnosed in the past, and several plans and programs had been in place. Unfortunately most of these plans end up not being applied. The IMPLAN (Municipal Planning Institute of Tepic) over the past 6 years has been trying to change this narrative. Their goal is to used the information from previous plans and update them to align with the new urban agenda of the ONU Habitat.

In his opinion, José believes Tepic has a great potential to succeed in creating a sustainable city that works for everyone. That's why the Institute is set to update all the territorial planning system.

At the City Council there is not a batch allocated to create planning instruments. That's why the Institute decided to train their own personal so they would be able to create their own plans and programs instead of hiring private companies.

In the past planes and programs didn't have the same vision on the long term, but now with the IMPLAN that is changing. It has been possible to allocate all the effort to point into the same direction, to create a sustainable city.

Another big challenge that the institute faces is the fulfilment of said plans and programs. There is not a formal instrument for it to happen, so there is always the risk that the money that comes for the investment of the city goes to whatever whim the people in power have. The task of the institute has been to allocate this effort and investment into where is needed according to the tools.

Another challenge has been to communicate the doing of the planning institute to the population. The ignorance makes it difficult for people to participate.

One of the reasons why the IMPLAN has been a success is due to the fact that is a decentralized body of the city council, away from the influence of political influence. However it's financing comes directly from city council.

Unfortunately the topic of water in every planning instrument and program is quite limited. The topic is only touched in a very superficial manner, isolated and technical. There is no an integral vision on water and is not seen as an axis to which public policy could be done.

There are limited capacities to the city council. The professionalization of the working force is a big issue. Although there is very capable people, there is a lack of technical profiles in the city council. This makes communication of strategies on certain topics hard to explain. This bodies should not be subjected to the political games played every political cycle.

It exist contact with several other municipal institutions, however is mostly limited to information request and communication, not collaborative work.

The most critical problem of water in the city is the poor distribution of the asset. Tepic doesn't present water stress, but the technology and infrastructure conditions are much damaged. The operations of the water system is stuck in a loop. Since the water system is very precarious, the people don't pay their fees for the service, so operations cannot give maintenance nor improve de infrastructure, and the loop repeats itself.

Due to ignorance and corruption, the water drainage system is combined with sewerage and rain water. This results in a very high stress on the drainage system which ends up collapsing. Around 80% (sic.) of all drainage in the city is collapse. This makes the sewage water run freely eroding the ground, creating subsidence and polluting the underground water. This is also related to the pollution of the Mololoa River, as it reflects all the vices the city endures.

Although the opinion of the IMPLAN does hold some weight, the Cabildo is still the one that has to accept the projects that go through, which means even when the IMPLAN and other technical institutes call a project as non-viable, the Cabildo could potentially still accept it.

The sharing of specialized information with other governmental bodies is complicated, especially

with other levels of government (state and federation). But within municipal level is usually easy, apart from the occasional fight of egos when people tend to purposely slow down information.
Citizens participation is not exploit as it should. Citizens don't trust authorities so they are not incentivize to participate. There is a lack of knowledge of the scope in which the institute operates. People come with complaints on current issues while the institute is trying to understand deeper issues and dynamics. There are two ways to follow: there must be a more open government, there cannot be half-inks in this matter. And we need to also educate the citizens and their own responsibility in the issues that afflict the city.
I would like to see a sustainable integrated city, in which all programs and plans operate as one. That Tepic becomes a livable, lively city for everyone.

Although the opinion of the IMPLAN does hold some weight, the Cabildo is still the one that has to accept the projects that go through, which means even when the IMPLAN and other technical institutes call a project as non-viable, the Cabildo could potentially still accept it.	0 – BARRIER 2AT - Evidence-Based 1FC - Regulation
Another big challenge that the institute faces is the fulfilment of said plans and programs.	0 - BARRIER, 2AT – Accountability 1FC - Monitoring and Evaluation
Another challenge has been to communicate the doing of the planning institute to the population. Ignorance makes it difficult for people to participate.	0 – BARRIER 2AT - Participation, 1FC - Capacity Development
At the City Council, there is not a financial batch allocated to create planning instruments.	0 – BARRIER 1FC – Financing 2AT - Efficiency
Authorities are reluctant to incorporate sustainable solutions into their agendas as they see them as not politically profitable due to the short duration of the political cycle.	0 – BARRIER VISION - Values & Aspirations
Citizens' participation is not exploited as it should. Citizens don't trust authorities so they are not incentivized to participate.	0 - BARRIER, 2AT – Participation 1FC - Policy & Strategy
Contact exists with several other municipal institutions, however, is mostly limited to information requests and communication of work already done, not collaborative work.	1FC – Coordination 0 – BARRIER 2AT - Deliberation
However, its financing comes directly from the city council.	0 – BARRIER 1FC – Financing 2AT - Efficiency
One of the most complicated challenges he had to face, and still is, was to pitch sustainable solutions as important, necessary and exciting to the people with the decision making power.	0 – BARRIER VISION - Values & Aspirations
The city of Tepic already had been diagnosed in the past, and several plans and programs had been in place. Unfortunately, most of these plans end up not being applied.	0 – BARRIER 1FC - Planning & Preparedness 2AT - Efficiency
The operations of the water system are stuck in a loop. Since the water system is very precarious, the people don't pay their fees for the service, so operations cannot give maintenance nor improve de infrastructure, and the loop repeats itself.	0 - BARRIER, 2AT - Efficiency, 1FC - Management Arrangements 1FC - Financing

The sharing of specialized information with other governmental bodies is complicated, especially with other levels of government (state and federation).	0 – BARRIER 1FC - Planning and Preparedness 2AT - Multilevel
There are limited capacities to the city council. The professionalization of the working force is a big issue. Although there are very capable people, there is a lack of technical profiles in the city council.	0 – BARRIER 1FC - Capacity Development 2AT - Efficiency
There is not a formal instrument for it to happen, so there is always the risk that the money that comes for the investment of the city goes to whatever whim the people in power have.	0 – BARRIER 2AT – Accountability 1FC - Financing
These bodies should not be subjected to the political games played every political cycle.	0 – BARRIER 1FC – Regulation 2AT - Impartiality
This makes communication of strategies on certain topics hard to explain.	0 – BARRIER 2AT – Deliberation 1FC - Policy & Strategy
Unfortunately, the topic of water in every planning instrument and program is quite limited. The topic is only touched in a very superficial manner, isolated and technical. There is no integral vision on water and is not seen as an axis to which public policy could be done.	0 – BARRIER VISION - Values & Aspirations

Sergio Durán.

- Member: Civil Association Citizens Movement for the banks of the Mololoa River. Citizen Advisory Council IMPLAN.
- Background: MSc. Environmental Science
- Date: September 13nd 2021.

As part of the Civil Association Citizens Movement for the banks of the Mololoa River (CA-CMBMR) they had been asked to help in the decision making process of projects related to the River Mololoa, but mostly in a deliberative role, as the authority in charge is still the one with the decision making power. The association is usually just called to give a point of view in the solution at hand. The last job they were involved was the dredging of a section of the river, in which the association gave a negative vote.

According to the point of view of experts involved in the CA-CMBMR, the problem with flooding in the city is not exclusive of the river overflowing, but more on the poor drainage system and the high level of impervious surfaces around the city. As citizens they pinpoint several areas that suffer from this water problem that are not even close to the river basin.

Unfortunately, the civic association is not part taker in the planning, development, implementation or execution of solutions for the water problem in the city. They are invited to justify projects and proposals, not to cooperate.

The authorities tent to blame the citizens for the water problems the city is facing, especially pollution and waste of the water resource, but the association is aware that single action of a person cannot be compared to the big industrial polluters of the city.

As part of the demands the association has been pushing is the institutionalization of water audits, to check and revise water related public infrastructure. The citizens are able to participate as experts in context, while other kind of experts within the network can give an audit on more specialized topics.

There is a lack of transparency on the information that is being shared. Citizens don't know what

government officials are doing.

The association has also participated in public forums with the aim of educate the people on the problems the river is facing.

The biggest problem the city of Tepic faces is linked to supply and sewage water. There is a deficit in the water supply system. The infrastructure is heavily damaged. The 40% (Sic.) of the water taken from a water well is lost due to leaks in the system. According to the criteria used by CONAGUA a well can be marked as overexploited not only by overconsumption, but also for the lack of efficiency and water loses. The water management system office was (is) abandoned as and has been ransacked for years, as water infrastructure is seen as a way to do business.

In sewage and sanitation, the treatment plants of the city are built by the state government, but are managed at a municipal level, so their maintenance results very expensive for this level of government. The systems used are quite expensive, and there is no clarity on why this system was used.

From this two problems of supply and sewage derives a lot of other problems.

The government and justice systems is structured in a way that our complaints have no transcendence. The authorities asked from the citizens movements to wait for a certain infrastructure to be done to asses if it works or not. And when the citizens dictates that an infraction is been committed, the lawsuit never gains traction, as the authorities keep avoiding responsibilities on the problem at hand.

The government and justice systems is structured in a way that our complaints have no transcendence. The authorities asked from the citizens movements to wait for a certain infrastructure to be done to asses if it works or not. And when the citizens dictates that an infraction is been committed, the lawsuit never gains traction, as the authorities keep avoiding responsibilities on the problem at hand.

The experience in the Basin council was enriching as different points of view converge with the objective of improve the water in the basin. As a council we are heard but governments are bounded by time, budget and sometimes goals are not aligned.

We emphasize that there is a need for authorities to stick to the norms and regulations regarding water, and enforced those regulations to everyone.

The authorities tend to present unfinished working plans, not stick to them, and lack to present reports on their achievements. Even when reports are presented there are no indicators on performance. This lack of information hinders continuity of strategies. There is not clarity on the barriers previous administrations have so there's no way to overcome them.

Ideally there would clear information on the state of the water of the river.

The dream would be that the water in the basin could full fill all the national norms on water quality safety, and that within the urban area of Tepic, the water could still have a recreational use compatible with the river ecosystem. That the river could be also a source of economic growth, business innovation and food security.

The city also need to be compatible with people's costumes and the natural ecosystem. We need a better public transport, and a safer urban space.

There are several examples of the citizens taking initiatives for the creation of better urban spaces, where they put partially money for materials and the municipality manage the construction.

Even when reports are presented there are no indicators of performance. This lack of information hinders the continuity of strategies.	0 - BARRIER, 1FC - Monitoring & Evaluation 2AT - Efficiency
In sewage and sanitation, the treatment plants of the city are built by the state government but are managed at a municipal level, so their maintenance results are very expensive for this level of government.	0 – BARRIER 1FC – Management Arrangements 1FC – Financing 2AT - Efficiency
The authorities asked the citizens movements to wait for a certain infrastructure to be done to assess if it works or not. And when the citizens dictate that an infraction is been committed, the lawsuit never gains traction, as the authorities keep avoiding responsibilities on the problem at hand.	0 – BARRIER 1FC – Regulation 2AT - Accountability
The authorities tend to blame the citizens for the water problems the city is facing, especially pollution and waste of the water resource, but the association is aware that single action of a person cannot be compared to the big industrial polluters of the city.	0 – BARRIER VISION - Values & Aspirations
The authorities tend to present unfinished working plans, not stick to them, and lack to present reports on their achievements.	0 – BARRIER 2AT – Accountability 1FC - Monitoring and Evaluation
The government and justice systems are structured in a way that our complaints have no transcendence.	0 – BARRIER 2AT – Accountability 1FC - Regulation
The systems used are quite expensive, and there is no clarity on why this system was used.	0 – BARRIER 1FC - Monitoring and Evaluation 2AT - Transparency
The water management system office was (is) abandoned and has been ransacked for years, as water infrastructure is seen as a way to do business.	0 – BARRIER 1FC – Regulation 2AT - Transparency
There is a lack of transparency on the information that is being shared. Citizens don't know what government officials are doing.	0 - BARRIER, 2AT – Accountability 1FC - Monitoring and Evaluation
There is no clarity on the barriers previous administrations have so there's no way to overcome them.	0 – BARRIER 2AT - Evidence-Based 1FC - Monitoring and Evaluation
Unfortunately, the civic association is not a part taker in the planning, development, implementation or execution of solutions for the water problem in the city. They are invited to justify projects and proposals, not to cooperate.	0 – BARRIER 1FC - Planning and Preparedness, 1FC - Monitoring and Evaluation 1FC - Management Arrangements 2AT – Participation 2AT - Deliberation
That the river could be also a source of economic growth, business innovation and food security.	0 - DRIVER, VISION - Values & Aspirations
The city also needs to be compatible with people's costumes and the natural ecosystem. We need better public transport and a safer urban space.	0 – DRIVER VISION - Values & Aspirations

The city also needs to be compatible with people's costumes and the natural ecosystem. We need better public transport and a safer urban space.	0 – DRIVER VISION - Values & Aspirations
The dream would be that the water in the basin could full fill all the national norms on water quality safety and that within the urban area of Tepic, the water could still have a recreational use compatible with the river ecosystem.	0 - DRIVER VISION - Values & Aspirations
We emphasize that there is a need for authorities to stick to the norms and regulations regarding water, and enforce those regulations to everyone.	0 - DRIVER 1FC – Regulation 2AT - Accountability

Arch. Joaquín Jara Bravo.

- Member: former director Project Director and current General Director of SIAPA.
- Background: Engineering and Architecture
- Date: September 20th 2021.

As an architect he is specialized in hydraulic development, mostly tenders and calculations, in the city. In his mind water treatment is a very important topic, as most cities in Mexico do not have a proper functional water treatment system, especially Tepic. Basically the river is the treatment plant.

The current city governor has now put him as the general manager of the Water Management Institution of the city, however, he is more of a technical guy and doesn't wants to get involved in politics. The SIAPA works as the operator system for drinking water, managing hydraulic, sewer, and treatment infrastructure. Right now, due to the change of government administration, the operating systems is still in a turmoil.

Jara doesn't consider himself a politician, and the only thing he wants to do is start doing his job.

The biggest problem the city of Tepic is facing regarding water is the culture of no-payment. This is a very complicated topic for the city, since people believe water should be free. "I mean, we do have a universal right for water, but to canalize it, transport it, and put it in place infrastructure is needed, and that comes with a price." If the city manages to solve the problem with the collection of payments, a lot of the problems would be solve. However the people of Tepic do not want to pay for the water, sewer or treatment. This problem I've been seeing for the past 4 years since I'm part of SIAPA. But when there is no water, people take the street, close avenues and go to the newspaper, even when they normally don't pay. People demand something that do not pay for.

The biggest problem for us is the lack of financing, is not the lack of attention we put to the system, but the lack of resources, and that people doesn't pay. This problem could also be addressed if there was another source of financing.

SIAPA's work during the last government cycle was to work in the sewer collectors: Zapopan, Colosio, and "El Punto" station. This three represent the main sewer drainage arteries of the city. There was also work done to modernize the water extraction and distribution system. The water wells that in the periphery of the city produce enough water, but the main problem is the maintenance. The piping is made with asbestos so it fails pretty often. The wells need rehabilitation and is very complex and costly job. The wells represent a very expensive and big project that is awaiting for financing.

Usually the work required by the people is punctual problems in the neighborhoods, drainage and so on.

Usually the communication that we have in regarding of project execution we have with IMPLAN, as we need to know the general planning of the city. With Municipal Public Construction, the city used

to be divided with them to attend the construction, but now everything came back to the operation system. This was made due to cross information and communication issues inside other dependencies. There are 64 wells of water, we just have very poorly distribution. All the distribution systems work with valves that need to be open or closed, this valves are operated by people, and we do not count with enough people.

The new plan as general director of SIAPA is to coordinate with the 7 sector managers to avoid this problem. The infrastructure of the city is very old, but if we could put more attention to it, we could stop saturating the neighborhoods with water trucks. The root problem is the issue with distribution and coordination that lacks attention. SIAPA's core functions are operations and maintenance. It has been proposed that this dependencies have different management as they give different results.

There are two ways to make water works in Tepic. The first one is the regular way in which an application is submitted to get federal funding. This is done with proceeding a file, validation, authorization, then the construction is put in a tender, this one is contested, and the winning company executes the construction. A new way we are trying to implement is, the application is made, SIAPA makes the projects, a list of the materials needed is made, and the citizens put the money directly for it. SIAPA then puts the machinery needed, management and topographic analysis. This shortens the period of implementation to a week or so (Idem)

Since the last administration this program has been put in motion, and now we are working to make it a permanent program. The citizens cooperate, gain ownership of the street, and value it more.

Inside SIAPA there is a part of innovation and technology, but this is completely relegated. There is another dependency within the city hall, but SIAPA doesn't work with them directly, and thus haven't implement anything. The only topic in which some innovation has been made has been water treatment. Punctually in the use of anaerobic water treatment. As well as ultrasonic water metres.

SIAPA has a direct contact with other water management companies in the country, especially with success cases like Aguascalientes, León and Culiacan. This management companies tend to outsource the maintenance and construction, thus tipping to the privatization of the sector. This has proven useful since another problem that SIAPA faces is the relationship with worker unions, they are a cancer.

Most information on reporting and construction advance is the transparency portal, there should be a detail report, and is of free access, even if it's not updated till today. The goal would be that Tepic could have permanent water service for everyone, and as a personal goal, that water treatment facilities work a 100%.

Inside SIAPA there is a part of innovation and technology, but this is completely relegated. There is another dependency within the city hall, but SIAPA doesn't work with them directly and thus haven't implemented anything.	0 – BARRIER 1FC - Capacity Development 2AT - Efficiency
Jara doesn't consider himself a politician, and the only thing he wants to do is start doing his job.	0 – BARRIER 1FC - Capacity Development 2AT – Adaptiveness
Most information on reporting and construction advance is the transparency portal, there should be a detailed report, and is free access, even if it's not updated till today.	0 – BARRIER 1FC - Monitoring and Evaluation, 2AT - Transparency
The biggest problem for us is the lack of financing, is not the lack of attention we put to the system, but the lack of resources, and that people don't pay.	0 – BARRIER 2AT – Efficiency 1FC - Financing

The biggest problem the city of Tepic is facing regarding water is the culture of no-payment.	0 - BARRIER, 1FC Financing 2AT - Efficiency
The current city government has now put him as the general manager of the Water Management Institution of the city, however, he is more of a technical guy and doesn't want to get involved in politics.	0 – BARRIER 2AT – Adaptiveness 1FC - Capacity Development
This is a very complicated topic for the city since people believe water should be free. "I mean, we do have a universal right for water, but to canalize it, transport it, and put it in place infrastructure is needed, and that comes with a price."	0 - BARRIER, 1FC - Financing 2AT – Accountability
Usually, the communication that we have regarding project execution has been with IMPLAN, as we need to know the general planning of the city.	0 - BARRIER 1FC – Coordination 2AT – Deliberation 2AT - Multilevel,
With Municipal Public Construction, the city used to be divided with them to attend the construction, but now everything came back to the operating system. This was made due to cross information and communication issues inside other dependencies.	0 – BARRIER 1FC – Coordination 2AT – Efficiency
The goal would be that Tepic could have permanent water service for everyone, and as a personal goal, that water treatment facilities work 100%.	0 – DRIVER VISION - Values & Aspirations
The infrastructure of the city is very old, but if we could put more attention to it, we could stop saturating the neighbourhoods with water trucks. The root problem is the issue with distribution and coordination that lacks attention	0 - DRIVER WATER PROBLEMS

10 Annex 2

Num.	Category or Indicator	Description	CODE
1	Geostatistics Code	Code that identifies the federative entity. Code 00 identifies records with national totals.	CVEGEO
2	Total Population	Total number of people who habitually reside in the country, the federative entity, the municipality or the territorial demarcation and the locality. Includes the estimate of the number of people in private homes without information on occupants. Includes the population that did not specify their age.	POBTOT
3	Occupancy Avarage per household	Result of dividing the number of people residing in inhabited private dwellings by the number of those dwellings	PROM_OCUP
4	Population of 3 or more that speaks an Indigenous Language	People from 3 to 130 years of age who speak an indigenous language.	P3YM_HLI
5	Households with female head of the house	Households in inhabited private dwellings where the person of reference is a woman. A home is considered in each private dwelling. Includes unique house on the land; house that shares land with other (s); duplex house; apartment in building; housing in a neighborhood or barracks; roof room housing; premises not built for habitation; mobile home; shelter and unspecified private home.	HOGJEF_F
6	People with disability	People who perform with great difficulty or cannot do at least one of the following activities: see, even wearing glasses; hear, even wearing a hearing aid; walk, go up or down; remember or concentrate; bathing, dressing or eating; talk or communicate.	PCON_DISC
7	People with limitations	People who perform at least one of the following activities with little difficulty: seeing, even wearing glasses; hear, even wearing a hearing aid; walk, go up or down; remember or concentrate; bathing, dressing or eating; talk or communicate.	PCON_LIMI
8	15-year-old population and more that are illiterate	People between 15 and 130 years of age who cannot read and write a message.	P15YM_AN
9	Average grade of schooling	Result of dividing the amount of school grades approved by people between 15 and 130 years of age by people of the same age group. Exclude people who did not specify approved grades	GRAPROES
10	15-year-old population and more without schooling	People 15 to 130 years of age who did not pass a school grade or who only have a preschool level.	P15YM_SE
11	Population without affiliation to health services	Total number of people who are not affiliated with medical services in any public or private institution.	PSINDER
12	Population aged 12 and over not economically active	Retired or retired persons between 12 and 130 years of age; students; dedicated to household chores; are permanently unable to work; or they don't work	PE_INAC
13	Total Dwellings	Inhabited, uninhabited, temporary and collective private homes. Includes dwellings without occupant information.	VIVTOT

14	Private dwellings inhabited with dirt floors	Private dwellings inhabited with dirt floors. It comprises the private dwellings for which the characteristics of the dwelling were captured, classified as: single house on the land; house that shares land with other (s); duplex house; apartment in building; housing in a neighborhood or barracks; dwelling on the roof of a building and unspecified private dwelling. Includes private homes without occupant information	VPH_PISOTI
15	Private dwellings inhabited with only one room	Inhabited private homes that have only one room. It comprises the private dwellings for which the characteristics of the dwelling were captured, classified as: single house on the land; house that shares land with other (s); duplex house; apartment in building; housing in a neighborhood or barracks; dwelling on the roof of a building and unspecified private dwelling. Includes private homes without occupant information	VPH_1CUART
16	Inhabited private dwellings that do not have piped water in the area of the home	Inhabited private homes that do not have piped water availability. It comprises the private dwellings for which the characteristics of the dwelling were captured, classified as: single house on the land; house that shares land with other (s); duplex house; apartment in building; housing in a neighborhood or barracks; dwelling on the roof of a building and unspecified private dwelling. Includes private homes without occupant information.	VPH_AGUAFV
17	Inhabited private dwellings that do not have drainage	Inhabited private homes that do not have drainage. It comprises the private dwellings for which the characteristics of the dwelling were captured, classified as: single house on the land; house that shares land with other (s); duplex house; apartment in building; housing in a neighborhood or barracks; dwelling on the roof of a building and unspecified private dwelling. Includes private homes without occupant information.	VPH_NODREN
18	Distance to recreational area	Distance in meters to closest green area, public square or sport facility from the centroid of the neighborhood.	DIST_PARQUE
19	EXISTANCE	Average vulnerability score from	EXISTANCE
20	GROWTH	Average vulnerability score from	GROWTH
21	RELATEDNESS	Average vulnerability score from	RELATENESS
22	VULNERAVILITY	Average vulnerability score from existence, growth and relatedness scores.	VULNERAVILITY

INEGI. Main results by locality (ITER). Population and Housing Census 2020. 2021