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The Latin American Governments' Role in facing Climate Change and Urban Development

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Abstract Socio-natural disasters are linked to the increase of weather events. This work analyses disaster risk transfer as well as clean technology production and transfer mechanisms in Latin American intermediate cities; our study case is the city Victoria of Durango, capital of the state by the same name in Mexico. In this regard, the theorizations on Climate Change (CC), Disaster Risk Transfer (DRT), Clean Technology Transfer (CTT), Sustainable Development (SD) and Resilience (Re) are reviewed. A mixed approach provided a complete understanding of the research, allowing the use of various tools for field work and the processing of the obtained data. The results reveal that Victoria de Durango, like the majority of Latin American's intermediate cities, shows potentialities for using its invaluable natural resources; but threats and weaknesses were also found: neither citizens nor institutions have a global understanding of risk for achieving sustainability, becoming resilient and being safe, whilst the capital of Durango must face two major risks such as floods and droughts. A Safe City Strategic Plan to face CC, incorporating DRT and CTT production strategies, would enable CC protection policies, as long as political will and active citizens exist.

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1 | INTRODUCTION

The negligence or non-effective incorporation of public policy at the different levels of government of Latin American and Caribbean region countries with regard to strengthening the 2030 Sustainable Development Goals (SDGs), specifically No. 11 “Sustainable Cities and Communities” (UNDP, 2015), severely limit their possibilities for development. In a report on clean energy innovation in this region, Miller & Visicdi (2016) warn of the lag of research and improvement in clean technology indicators, such as patents registration, which restricts progress in CC mitigation.

Between 1990 and 2000, the United Nations (UN) declared the International Decade for Disaster Reduction (IDDR) (Molin, 1997). Guidelines, policies and programmes were intensified throughout the region, increasing the number of experiences with Disaster Risk Reduction (DRR), Climate Change Adaptation (CCA), and, more recently, Resilience (Re). However, on the issue of disaster risk management (DRM) it is notable that the efforts are still insufficient because disasters continue to severely disrupt the entire Latin American geography. For example, the International Disaster Database (EM-DAT, 2020), from the Centre for Research on the Epidemiology of Disasters (CRED), recorded in 2018 that 61.7 million people were affected by 281 extreme weather events.

DRT and CTT and production are very incipient in the region. However, when they exist, the efforts are doubled and economic resources are dispersed, but the opportunity to advance according with the 2030 SDGs is squandered, because policies related to risk - disaster reduction (RDR), CCA and mitigation, environmental-urban management and poverty reduction are separately implemented (Lavell, 2011; Cardona, 2012).

As a precedent of the international community's efforts to understand climate risks and issues as part of disaster risk management, the Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation SREX (IPCC, 2012) talks about the scientific groups interested in CCA and the Comprehensive Risk Disaster Management (CDRM) agendas. For the first time, there is a joint effort to link both scientific communities. However, in the international literature, we could not identify specific references linking both agendas in a programme, or guidelines carried out by some local administration to tackle the causes and consequences of climate risks for intermediate cities.

The main objective of this research is to set up, inside a common agenda, government practices for DRT and the development of CTT to handle hydro-meteorological catastrophes and ensure the safety of intermediate Latin American cities facing CC. This document is the second part of an article published in 2018 by the same authors, whose origin is a Doctoral thesis.

2 | THEORETICAL STRUCTURE

The 11th SDG (Sustainable Cities and Communities) strives to make cities and human settlements inclusive, safe, resilient and sustainable. Nevertheless, this SDG needs the other 16 SDGs for its achievement. In the case of this work, we are mainly considering the 7th, 9th, 12th and 13th SDGs, but without forgetting the rest. The 7th SDG (Affordable and Clean Energy) is about ensuring access to affordable, reliable, sustainable and modern energy. Amongst its tasks, the 9th SDG (Industry, Innovation and Infrastructure) seeks the promotion of sustainable industries, whilst the 12th (Responsible Consumption and Production) talks about the responsible and efficient management of natural resources, and the 13th (Climate Action) demands urgent action to combat CC and its impacts (UNDP, 2015). It is an undisputed fact that the Earth is warming up. One of the causes for this is the impact of human actions. CC effects have increased the occurrence of events such as hydro-meteorological catastrophes throughout the planet. Is humanity preferably preserving the economic system rather than the well-being of society and the conservation of nature?

The effects of CC require a careful consideration of the ethical judgments and analysis of the phenomenon, as well as of the proposals to combat it. To confront CC, an ethical framework related to the economic context must be included. This has been corroborated by specialized scientific data of The Intergovernmental Panel on Climate Change (IPCC, 2012; 2015), The International Centre for El Niño Phenomenon Research (CIIFN, 2017), The Stockholm Resilience Centre (Rockström et al, 2009) and the Stern Report (2006: 27). This report states that CC is global in its causes and consequences, with persistent impacts and long-term development.

The incomprehension or non-acceptance of the CC effects have extended their reach, even with the efforts made. It is necessary to do more to defend a prosperous global environment for human development and well-being, as well as the right to environmental safety. In this regard, Camagni (2005: 200), in his "Theorem of the Locality", proposes that intermediate cities, due to their characteristics in terms of population size, physical dimension and functionality, will be the most suitable spaces for the implementation of successful public policies, because problem solving at the local level is efficient, although it could depend on municipal, state and federal hierarchical planning, including supra-national strategies responding to reduce global problems. As a challenge for the 2030 SDGs, the current and future scenarios presented by scientific communities indicate that CC could continue increasing exponentially. Thus, strategies, policies and measures are required to improve the understanding of disaster risks, including the generation of clean development mechanisms using renewable and clean energies (UNDP, 2015), with the explicit aim of increasing human safety, well-being, quality of life, Re and sustainable development, where intermediate cities are the best application scenario.

Nevertheless, DRT actions involve heavy investments that must be paid for in the present, even though the benefits will be obtained in an uncertain and intangible future, or it could be that the disaster does not occur and the investment will be seen as a useless expenditure. This uncertainty makes these mechanisms a difficult project to execute, making less possible their implementation in places where there is no prevention culture nor the need for insurance as protection. In this regard, Rivas, Aparicio & Páez (2018: 315), in their work about the historical evolution of DRT policies in Latin America and the Caribbean, state that the international institutionalization of the issue of disasters and their devastating consequences entered the agenda along with international cooperation and humanitarian aid during the 1930s, evolving in the 1990s in the understanding of an unresolved development issue, as well as the urban need for sustainability and financial protection, lastly

becoming a resilience-building issue in the 2000s. However, the authors indicate that the efforts have been concentrated in sovereign assurance for the protection of public goods and infrastructure, without transferring to the people and housing protection. SELA (2010: 5) states that financial risk protection "is a practically new area that needs to be prioritized by the authorities and institutions of our region". For example, several Latin American countries have hurricane insurance; but, after floods, governments allocate resources to rebuild the city and not for housing reconstruction. According to Dávila (2008: 77) and Cardona (2007: 37), post-disaster humanitarian aid can become a long-term vicious cycle, since governments wait for aid "to work as insurance without cost", rather than coming up with their own CDRM policies. Both authors remark that "this is the reason why risk management must be comprehensive".

Mexico is one of the leading CDRM countries', especially in the development of financial strategies for DRT through its Natural Disaster Fund (FONDEN), and, since 2006, with the innovative mechanisms called Catastrophe Bonds (Cat Bons). These Cat Bons were applied in the country in 2014, the wake of Hurricane Odile, and in 2017, after the earthquake which affected the states of Oaxaca, Chiapas and Veracruz. Nevertheless, in a digital press report, Torres (2014) mentions that individual insurance or micro-insurance housing protection to cope with the phenomena that hit the country are virtually non-existent. For example, only 5% of small and medium-sized enterprises have damage insurance, whilst only 5% of households throughout Mexico have purchased a protection policy voluntarily.

The catastrophe bond covers losses associated events with low probability of occurrence, but with great magnitude and impact, and, to grant monetary compensation, the event must exceed certain damage thresholds. For example, we can mention some frequent catastrophic hydro-meteorological events which in most cases would not pose a high threat, but, because of the high social fragility, great physical exposure and low urban Re (Cardona, 2001), they are destructive, affecting almost immediately thousands of families without protection. The report "State of the Cities of Mexico" outlines the significant impact of disasters resulting from hydro-meteorological catastrophe threats increased by the CC effects, adding to unplanned urban growths, poverty and environmental deterioration. This previous sum has intensified desertification in the north of the country, and has increased the occurrence of flooding on the Gulf of Mexico and Yucatan Peninsula coasts. Mexico's National Centre for Prevention of Disasters (CENAPRED, 2019) has the historical inventory of catastrophic hydro-meteorological events.

There are different DRT mechanisms according to the types of needs. The financial protection strategies should be in line with the different urban-territorial dynamics and the social and ecological interactions. In Latin America and the Caribbean, few actions have been taken in relation to CTT and production policies, even though these countries have an immense amount of renewable resources that can be used as sustainability drivers.

In this regard, and according to the 2030 SDGs, it will be necessary to consider at the local legislation level a programmatic line of public policies related to the management of clean and/or renewable energies, as well as those leading to sustainable mobility, comprehensive management of solid waste, the increase of green areas in cities and the commitment to a circular and green economy. Similarly, this legislation should be related to public conversion programmes to steer companies in the aforementioned process, leading to the sustainability of the cities through various international financing mechanisms (UNDP, 2015). In addition, the strategies should allocate part of the national budget to significant disbursements for stimulating public-private agreements that would allow the private sector, under certainty conditions and clear regulations, to make important investments towards decreasing carbon dioxide (CO2) emissions.

3 | METHODOLOGY

A mixed research approach was used in this work, according to the principle of theoretical saturation; the information was collected until the same data was obtained (Glaser and Strauss, 1967). The sample of the qualitative phase was composed by 31 interviewees, broken down into 16 individual interviews and four focus groups whose total was 15 people. Likewise, the direct observation technique allowed for the witnessing of special events and key incidents that occurred in the study area, between September 2016 and December 2018.

Figure 1 shows a table with the name of each group as heading. For organized civil society, we conducted eight interviews: six individuals plus two focus groups, with a total of 14 people interviewed. Also, we had three individual interviews with industrial entrepreneurs. We also conducted nine interviews with public officials linked to municipal and federal offices: seven individuals plus two focus groups. In total, we had 20 interviews. The number of participants was divided in 14 for the organized civil society, the above-mentioned three industrial entrepreneurs, and 14 for the public officials.

Group names	Organized civil society	Industrial entrepreneurs	Public officials linked to municipal and federal offices	Total
Number of interviews	8	3	9	20 interviews
	6 individuals + 2 focus groups (8 persons in total)	3 individuals	7 individuals + 2 focus groups (7 persons in total)	
Number of people interviewed	14	3	14	31 people interviewed

Figure 1 Table showing the name of each focus group, the number< of interviews and the number of people interviewed. *Elaborated by the authors*

We explained to the participants that the main theme of this work was the study and importance of related policies and programs to disaster risk prevention and the use of clean technologies to save energy and for recycling and the rational use of motor vehicles. The main goals of the meetings were to find out about the perspective that citizens have on the work done by the decision makers. In addition, we asked about the vision of the politicians, as well as the relations between industrialists and merchants facing sustainability. The interviews were applied to the selected sample between February and April 2018, and between August 2018 and January 2019. The participants' details are shown in Figure 2.

<table>
<tr><th>Organized civil society</th><th>Industrial entrepreneurs</th><th>Public officials linked to municipal and federal offices</th></tr>
<tr><td>Two historians of the city</td><td rowspan="2">President of an important group of the automotive industry</td><td rowspan="3">Five directors active in the environment, planning, civil protection, urban development and housing areas of the municipality of Durango</td></tr>
<tr><td>A guild of architecture professionals</td></tr>
<tr><td>An Environmental NGO</td><td rowspan="3">President of a major business group in the electronics industry</td></tr>
<tr><td>An environmental activist</td><td></td></tr>
<tr><td>An individual affected by the 2016 flood</td><td>A Citizen counsellor of the Institute of Urban planning of the Municipality of Durango</td></tr>
<tr><td>A private school principal, whose facilities were affected by the 2016 flood</td><td rowspan="2">Important female entrepreneur in the educational area</td><td>Two former high-ranking Urban Planning officials of the Municipality of Durango</td></tr>
<tr><td>A director of a Regional Development Research Centre</td><td>High-ranking officials of the National Water Council</td></tr>
</table>

Figure 2 Details of focus groups participants. *Elaborated by the authors*

To interpret the results of the interviews, this work was based on the hermeneutic-dialectical method (Martínez 1998). Using this strategy, we sought to structure and interpret the meanings, dynamics and relationships of DRT with CTT and production of policies, leading us to discover, understand and explain the structure of the system of said relationships, and the theoretical approaches for comprehending the ethical meanings of the public practices within the SD framework.

In the quantitative phase, we made 545 surveys with a 96% confidence level. In 2010, the total population of the Victoria Durango urban area was 524,266 inhabitants, according to the XIII Census of Population and Housing 2010 (INEGI, 2012). The survey was concentrated in 128 sectors, 58 located in the historically flood-risk areas and 70 in a buffer zone (Figure 3). The risky zone is located in majority along the intubated pluvial drainage which crosses the city called the Acequia Grande stream (Bracetti, 1906; Guerrero, 2015; Gobierno Municipal de Durango & SEDESOL, 2012), whilst the buffer zone is considered as the rest of the urban area. The software package used for the 545 household surveys analysis was IBM SPSS Statistics 22. Open questions were part of the qualitative descriptive block included in the first part of the survey. The information was emptied into a database, for it to be categorized and hierarchized according to thematic areas. For a spatial interpretation of our research, we used the Geographic Information Systems (GIS) as a tool.

The thematic axes addressed in this research are: Climate Change, Disaster Risk Transfer, Transfer of Clean Technologies, Sustainability and Resilience. The survey was divided in five sections. The first one was a personal descriptive section including gender, education, occupation and age. We also inquired about housing information: number of bedrooms, bathrooms and people living in the household. The socio-economic data were linked to the family income and its expenses for services. The second section looked for the respondent's qualitative knowledge about the risks in the city, the events that have affected the participants, information regarding the type of actions carried out by public institutions in emergencies, as well as the type of damages, their prevention and possible solutions programmes.

The third part of the survey was a descriptive section through representative scales including three blocks. Firstly, the degree of knowledge about the thematic guiding axes of the study (CC, DRT, CTT, SD and Re); the response options were: nothing, few, much and too much. The second block tried to find out about the people's completion of tasks during hydro-meteorological events in relation with the above-mentioned axes. The response options were: never, sometimes, almost always, and always. The third block sought to evaluate conduct and attitude in the face of different dilemmas, alternatives or arguments linked to CC, DRT, CTT, SD and Re. The answer options were: strongly disagree, disagree, agree and strongly agree.

The fourth part of the survey looked for qualitative knowledge about the identification of risky zones in case of floods, the effects of droughts in the State and the City of Durango, the existing green urban spaces for reducing global warming, the city's air quality and the pollution caused by public transport. Moreover, in this section, we asked if people knew that the city water contained arsenic and fluorine. In addition, we wanted to know if measures to prevent disasters were taught in schools or universities. The scale had the values: none, low, moderate, high.

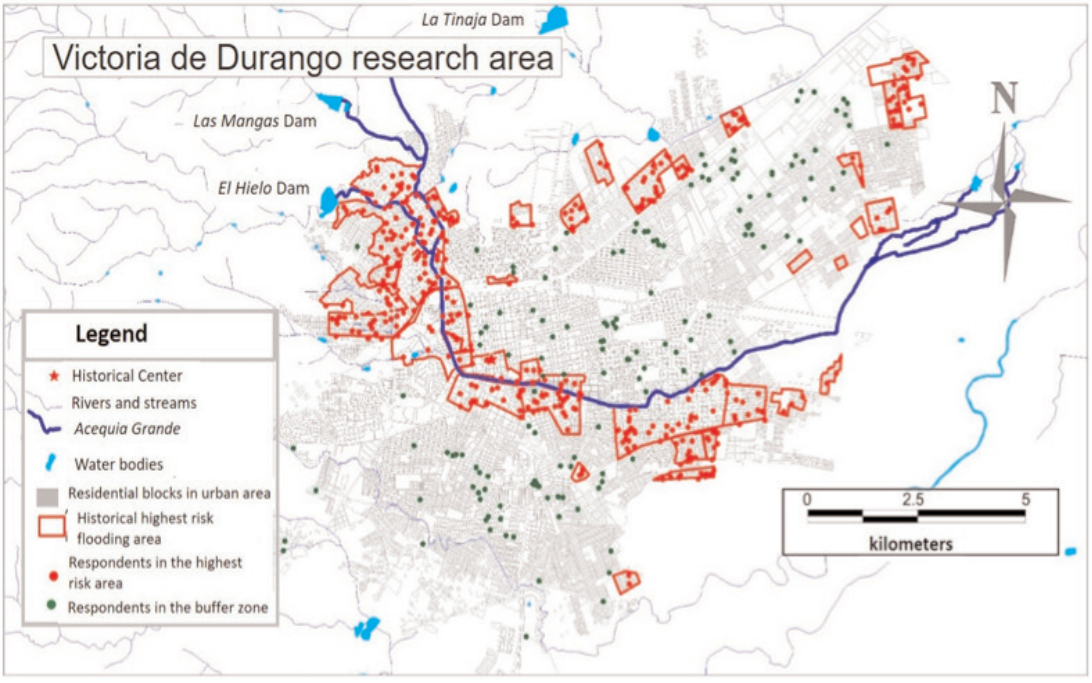

Figure 3 Victoria de Durango research area.
Elaborated by the authors based on Bracetti (1906), Guerrero (2015) and Gobierno Municipal de Durango & SEDESOL (2012)

A descriptive section about the knowledge and use of clean energies came at the end of the survey. We asked about the use of equipment to heat or cool homes, if the institutions provided information on how to act during droughts or floods, the use of public transport or cycling, energy-saving devices and solid waste management. The answer options were: never, almost never, usually, always.
Disasters are not inevitable facts; on the contrary, since the end of the 20th century, they are conceived as an unsolved problem of global development (LaRED, 2015). Vulnerability is not a multiplication factor. In this research, we affirm that risk is the expression of a sum and not of a multiplication, because mathematically the risk will never be zero (0) (Equation 1). Cardona (2012) conceives vulnerability as the sum of physical exposure, social fragility and the capacities developed to deal with threats. Re is built by citizens and institutions who manage the city not affecting budgets that underpin the development plans.

Risk = Threat + Vulnerability

Equation 1. Risk

This research deals with the impact of socio-natural risks (SNRs) increased by the CC effects. Thus, SNRs are the result of the sum of socio-natural threats (SNTs) and Vulnerability (V), which in turn is operationalized as the addition of the uncontrolled level of physical exposure (PhEx), social fragility (SF) and CCA capabilities built to support disaster (Re) (Equation 2).

SNR= SNT + V = X, never zero (0)

Equation 2. Socio-natural risk

The Earth is warming up, affecting climate cycles. From our results, three reasons are extracted to understand why the population of Victoria de Durango values this city as safe. However, one question arises: against what adverse events is this city safe? Firstly, in the west, the city is protected against hurricanes coming from the Pacific Ocean by the *Sierra Madre Occidental*. Secondly, with the improvement of the drainage system, the city will be safer in terms of floods risk. The third element is the absence of geological risks; there are no earthquakes nor volcanoes in this area. Likewise, if the *Agua Futura Project* is completed, there will be a water supply for the future, as part of the city's security in the face of CC. People's risk perception often minimizes the potential impacts of threats, although destruction is real and maximized by vulnerability. Because they are sporadic, events are forgotten and trivialized. No financial protection measures are taken because damages may or may not occur. Insurance is postponed. Durango's government action against CC effects is a partial understanding of CDRM, mitigation and CCA mechanisms, since only reactive actions are taken. In this research we assume Equation 3 to define a resilient city:

Resilient City = Citizen´s Re + Institutional Re + Physical-Structural Re

Equation 3. Resilient City

Since the UN Agenda 21 and the Summits on Habitat, Disaster Risks and CC, international cooperation initiatives have emerged. Amongst them are the City Prosperity Index (CPI), the NUA-Habitat III, the Campaigns for Resilient Cities and Governance and for Safe Cities, as instruments for helping local governments to ensure more sustainable solutions against CC effects seen as global challenges (Graizbord & Monteiro, 2011).

Case Study: The Intermediate City Victoria de Durango, Durango, Mexico.

The word *Durango* comes from the Basque language and it means "beyond the water". The name was taken from the city located in the Spanish province of Biscay. In Mexico, the city Victoria de Durango plays an important role as capital of the state of Durango and capital of the municipality with the same name. The also called City of Durango is located in North-western Mexico, on the western side of a plain known as Guadiana River Valley and in the central part of the aforementioned state. Based on the criteria established by Carrión (2013), Victoria de Durango meets the characteristics to be considered an intermediate urban centre of medium size, with 586,904 inhabitants in 2017. For 2030, the estimated population is 656,180 (CONAPO, 2018).

Durango City is linked to the states Sinaloa, Coahuila, Nuevo León and Tamaulipas through National Motorway 40, an important axis that connects North-western and North-eastern Mexicans, linking the Pacific coast with the Gulf of Mexico, starting from the Port of Mazatlán, passing by Durango, and connecting with the industrial axis Torreon-Saltillo-Monterrey until it reaches the border cities of Reynosa and Matamoros. Durango is also part of the connection between Mexico City, the capital of the country, and the Ciudad Juarez – El Paso border, this being an important point on National Motorway 45 or the Pan-American Motorway. This road also passes through the states and cities of Querétaro, Guanajuato, Aguascalientes, Zacatecas and Chihuahua (Figure 4).

Figure 4 Location of the State and the City of Durango. *Elaborated by the authors*

The site was selected because this city has Legislation for Disaster Risk Management and CC (Ayuntamiento de Durango, 2018), in addition to a register of the increased recurrence of historical events, like atypical rain and drought impacts that could be caused by the effects of CC (Bracetti, 1906; Guerrero, 2015), plus a Natural Risk Atlas from Durango City (Gobierno Municipal de Durango & SEDESOL, 2012). This place has the potential to deal with negative consequences that could be

generated by CC at an early stage, because some people have taken the first steps towards a culture of insurability (Maldonado, 2017); we can find activism from society, academia and research centres. Sustainability research and academic works are in progress, on such as renewable energy management, mobility, recycling and transfer of clean technologies (CIMAV-Durango, 2018). Durango also has its own Urban Resilience Guide (SEDATU, Gobierno Municipal de Durango & UMB, 2018), based on "The Ten Essentials methodology" developed by the United Nations Office for Disaster Risk Reduction (UNDRR, 2019). This guide exposes the dimensions for evaluating the Urban Resilience Profile URP (Figure 5). The selection was based also on the logistics facility for the researchers to carry out the study.

The TEN Essentials for Making Cities Resilient	Resilience interval	Resilience grades
1. Organize for disaster resilience. 2. Identify, understand and use current and future risk scenarios. 3. Strengthen financial capacity for resilience. 4. Pursue resilient urban development and design. 5. Safeguard natural buffer to enhance the protective functions offered by natural ecosystems. 6. Strengthen institutional capacity for resilience. 7. Understand and strengthen societal capacity for resilience. 8. Increase infrastructure resilience. 9. Ensure effective disaster response. 10. Expedite recovery and build better.	0.841 - 1.00	VERY HIGH
	0.681 - 0.840	HIGH
	0.521 - 0.680	MEDIUM
	0.361 - 0.520	LOW
	0.00 - 0.360	VERY LOW

Figure 5 The Ten Essentials, intervals and grades for Urban Resilience.
Sources: UNDRR (2019), SEDATU, Gobierno de Durango & UMB (2018) with adaptations by the authors

4 | RESULTS

As we mentioned, 545 people answered our questionnaire: 300 women (55%) and 245 men (45%). The age groups under consideration were: 18-25 years old with 110 participants (20%), 26-44 with 209 (38%), 45-60 with 148 (27%), 61-70 with 41 (8%), and 71-90 with 37 (7%). Regarding the level of education, 304 (56%) of our respondents did not go to university, 231 (42%) completed an undergraduate university programme, and only 10 (2%) carried out graduate studies. Concerning professional occupations, 10 (2%) of our interviewees hold a management position, 71 (13%) are independent professionals, 103 (19%) employees at different levels, 89 (16%) traders, 34 (6%) technicians or machine operators, 6 (1%) artisans, 7 (1%) agricultural workers, 90 (17%) students, 21 retirees (4%) and 114 (21%) housewives. As to the origins of people that answered the questionnaire, 429 (79%) of them were born in the State of Durango.

Based on the distinction between CC and Climate Variation (CV), plus the absence of CCA and CDRM policies, CC no longer corresponds to strictly natural processes. When we asked how much has the drought affected the State of Durango and its capital city, 80% of our respondents recognized that

droughts have affected the State and 69% the city. The inhabitants of the area exposed to floods in Durango City commented that during drought times water is rationed. During the 2010-2011 drought, water was only available from 8 to 11 AM, and the prices of basic items increased, the same problem occurring during floods. We found coincidences within the collective memory, mainly for events occurred between the last decade of the 20th century and the second of the 21st. People reported annual effects in dwellings located in the floodplain and without storm drains. The effects of the September 2016 and October 2018 rains were also highlighted.

Few green space areas exist in the city. The public zones are the *Guadiana* and *Sahuatoba* parks, located on the north-western side, as well as some tree-lined squares and boulevards. A private green space, called *Club Campestre*, is located on the south side. Altogether, they barely reach 3 m^2 per inhabitant (Figure 6), far from the 9 m^2 per inhabitant that cities like Mexico City have established as a minimum (PAOT, 2010). Concerning pollutant emissions (SEMARNAT, SEGOB & Gobierno del Estado de Durango, 2016), three monitoring stations in the city often do not show complete data; the most important belongs to the National Polytechnic Institute (IPN). When data are available, they show that the air quality is unhealthy, especially in the eastern part of the city, where the highest population density is found, and which is practically without green areas. This air quality is perceived in our research to be due to brickyard activity, unpaved streets and the lack of a vehicle inspection programme. A faint haze clouds the sky in summer and produces thermal inversion in winter.

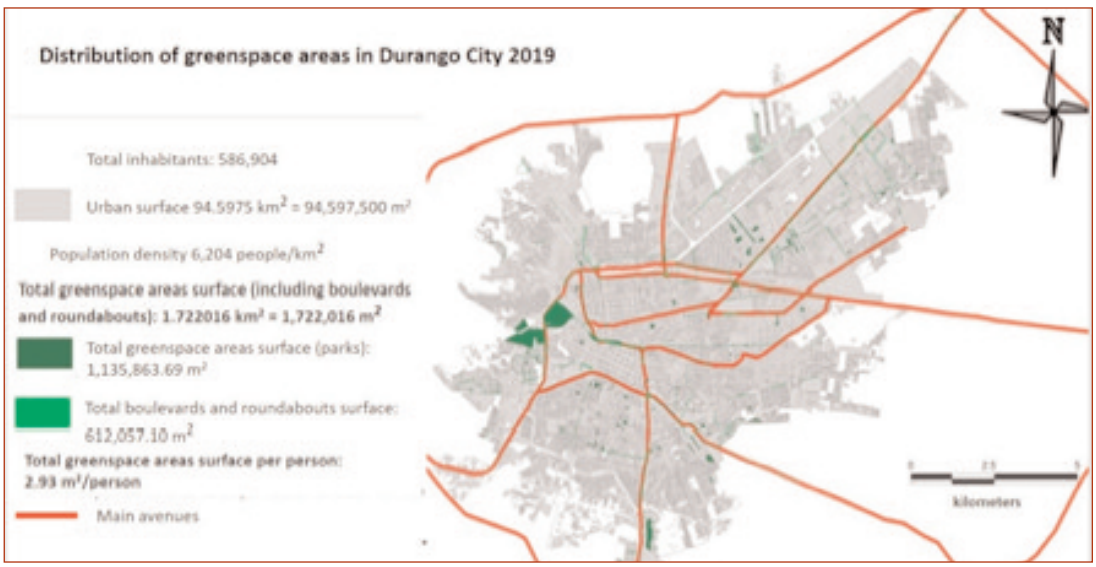

Figure 6 Distribution of green space areas in Durango City (2019).
Source: Elaborated by the authors based on INEGI (2012) and CONAPO (2018)

An interviewed professor, the Director of the Interdisciplinary Research Centre for Comprehensive Regional Development (CIIDIR) Durango Campus, whose fields of expertise are Comprehensive Water Management and Regional Development, pointed out that Re is linked to "the balance between the use of the environment and the ability to recover it". An artificial system built in the city has complicated the Re conditions, generating Greenhouse Gases (GHG), heat and garbage, plus increased energy, water and natural resource consumption. About Victoria de Durango's conditions for becoming a sustainable city, the population is divided almost equally, recognizing opportunities and potentials, but also weaknesses and threats.

On waste control, people value not throwing litter on the streets, because it boosts flooding adds to separating and recycling garbage and demands the cleaning of drains. Not throwing trash and cleaning streets was mentioned by 348 of our 545 respondents (64%), highlighting the lack of citizen culture, even if the municipal collection service has a good rate (Figure 7).

People would be willing to promote sustainable mobility by using public transport, a cycle path network and improved sidewalks for pedestrians. 79% of our participants would use public transport often, 66% would like to use a bicycle as a means of transport and 91% would walk frequently. As regards the use of each modality alone or combined, it allows to propose adjustments according to people's physical conditions, travel distances, age and personal preferences (Figure 8). Bicycle is the main means of transportation for construction workers and students in Durango, but cycling can be seen as a source of chaos. Due to the absence of bicycle paths, cyclists circulate between cars on avenues and streets, or between pedestrians on sidewalks. In addition, some bicycles have been turned into "cargo tricycles" for informal trade, becoming part also of vehicular traffic. We can add that motorists have no culture of respect towards cyclists, and neither do cyclists have a culture of respect towards motorists and pedestrians. Many times, bicycles are used to transport two people, when they are only designed for one person (Figure 9). In sum, bicycles are used for cargo transport, street commerce and barriers. Also, when designing cycle paths, three-wheeled models should be considered. The Comprehensive Sustainable Urban Mobility Plan (PIMUS) shows that in a business day about 26,638 trips are made by bicycle, of which around 15% is done during peak hours (Gobierno del Estado de Durango, 2012).

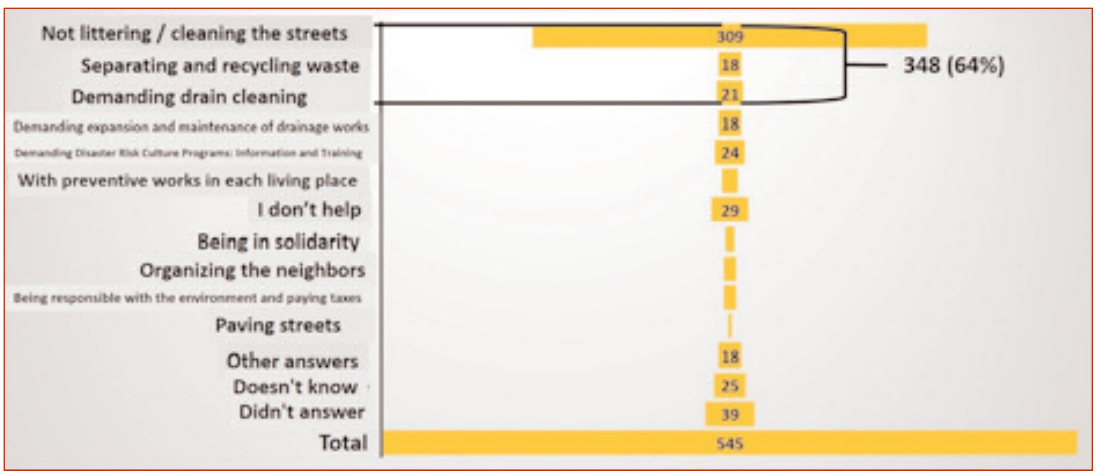

Figure 7 Respondents' views on waste control

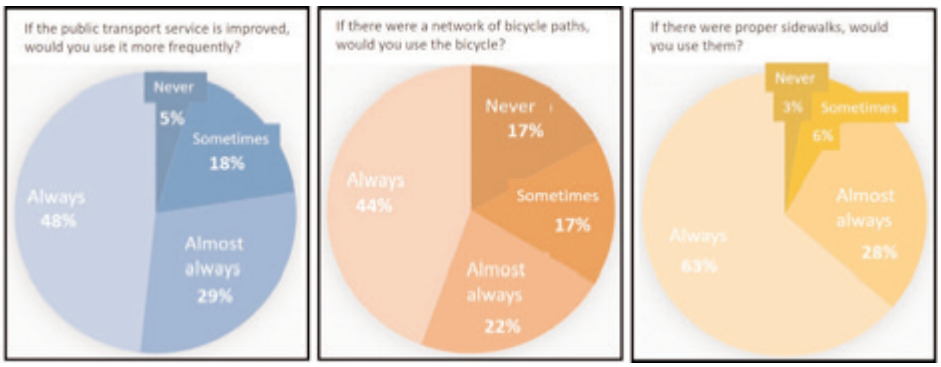

Figure 8 People's opinions about sustainable mobility

Figure 9 Cycling mobility aspects: bicycles used to transport two people, "cargo tricycles" for informal trade circulating between cars on main avenues, and cyclists circulating between pedestrians on sidewalks. *Pictures taken by the authors*

With regard to the institutional architecture of CDRM, a historian commented "in Mexico a culture of prevention was created, but citizenship has no empathy with it". Mexico has 2,457 municipalities (Academia de Ingeniería de México, 2017), but only 375 municipal atlases have been drafted between 2010 and 2016. The Durango Municipality has its own since 2012. Do you know if the city has an emergency action programme? Only 33% of 545 people answered yes to this binary question. As a first response action programme, people mentioned the Civil Protection System, the municipal police, the Red Cross and the Emergency Telephones (Figure 10).

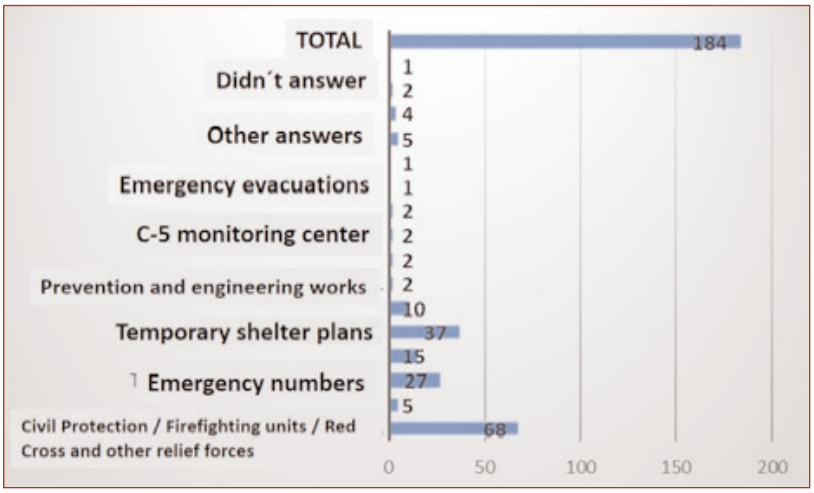

Figure 10 First response action programmes used by our interviewees.

As officials of the National Water Commission (CONAGUA) participating in one of our focus groups commented (the one with public officials linked to municipal and federal offices), the risk variable is not considered in Durango's urban planning processes: "In Durango there is a lack of urban planning, it is very deficient. In fact, in Durango the drainage is composed by municipal wastewater and the existing sewers are connected to those drains, creating a mixed system. The only existing pluvial drainage is the intubation of the *Acequia Grande* (Big Ditch) stream, which crosses the city". The experts mention that this drain has no absorption capacity when precipitations are above 50 mm.

The construction and adaptation of infrastructure for reducing and mitigating risks is a need felt by the population. In our fieldwork, 89% of participant people considered that the city has not enough pluvial infrastructure, confirming the argument made by all the interviewed key actors, who refer to the insufficiency and ineffectiveness of the drainage system as a problem during the rainy season, because flooding is increased due to the city's flat topography.

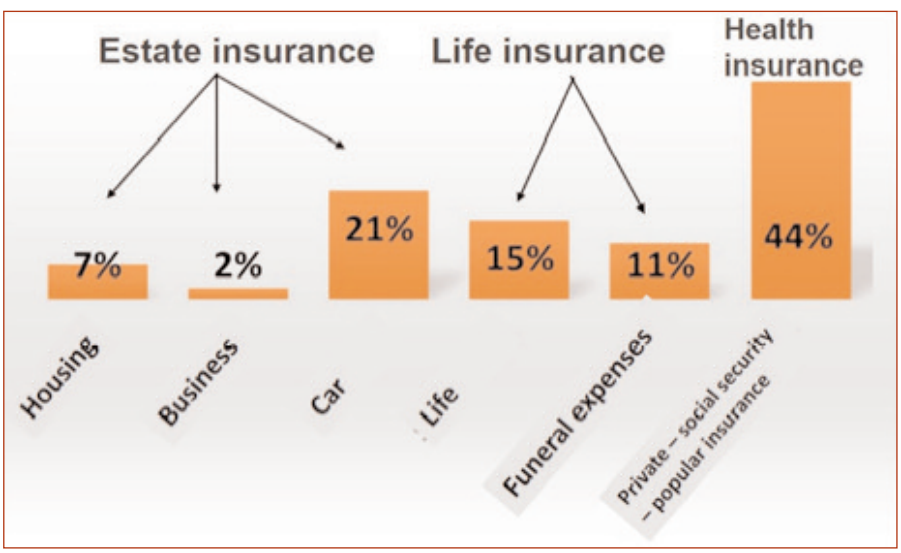

Figure 11 Insurability preferences of our respondents

The insurability culture is present in the health, life and estate fields. In our research, health insurance is moderately entrenched, this option includes private and public hospital services; social security is linked to a formal job and popular insurance is for people without work benefits, both are part of the public amenities (44%). The second option is related to life insurance itself (15%) and funeral expenses (11%), meanwhile the estate insurance refers to housing (7%), business (2%) and automobile (21%) (Figure 11). Patrimonial protection is part of the financial institution requirements for granting access to a bank or mortgage loan. A former bank manager we interviewed stated that the reasons that could affect the insurability culture are the late response or the refusal of insurers when clients request policy activation. In Mexico, in 1994, a financial bubble started, people having insurances to protect their investments did not receive positive answers from the insurers. Facing foreign capital flight, people lost houses, businesses and cars, because they could no longer continue to pay due to inflation and increased interest rates. At the time, the National Commission for the Protection and Defence of Financial Services Users (CONDUSEF) did not exist, and neither did the Mexican Association of Insurance and Bonding Agencies (AMASFAC).

In another order of ideas, CTT and production, also known as Clean Development Mechanism (CDM), is an instrument to contribute to CC mitigation, and so is the use of alternative energies to achieve the reduction of GHG emissions. In other words, the restructuring of industries (fixed sources) and services in the city that demand energy to function, such as the automotive fleet (mobile sources), is required. More than 90% of participants revealed their willingness to incorporate renewable energies into their homes, if they had the economic ability to obtain solar boilers, photovoltaic panels, energy saving appliances and efficient light bulbs.

Our results reveal that the use of these resources is based on economics and not really environmental awareness. Companies can get financing and tax benefits whose return is seen in about the third year, with a use guarantee of about 20 years. It will always be advisable, in the first instance, to use passive measures before active ones. The former includes the use of common sense in the adequacy of site conditions, the design of airtight enclosures with adequate ventilation and the use of materials and construction systems that efficiently aid the transfer or resistance to heat. Active energy includes renewable energy sources.

Durango generates knowledge and technology in renewable energies and the environment through two educational centres. At the Ungraduated level, since 2011, the Technological University of Durango (UTD) has a Renewable Energy Engineering programme, whilst the Advanced Materials Research Centre (CIMAV–Durango), since 2015, with master's and doctoral studies, is focused on solutions to solve problems such as water poverty, as well as promoting renewable energies technology, mainly solar, thermal and photovoltaic.

Nevertheless, there are no specific policies or programmes in public institutions to promote a gradual replacement of traditional energies with clean and/or renewable energies, as established by the Durango State Climate Change Law 2013, Art. 29 (Congreso del Estado de Durango, 2019). However, in our meeting with a focus group from the Municipal Housing Institute (INMUVI), one of the participants commented that they are working for the inclusion of solar boilers in housing, and they are aware that the federal government's housing programmes require the incorporation into new homes of energy-saving boilers, light bulbs, toilets and showers.

The above-mentioned interviewed professor, specialist in Comprehensive Water Management and Regional Development, pointed out that there are efforts made by foreign investors without a strategic plan, but facilitated by different levels of government: "10 to 12 solar park projects with

Spanish and Asian financing are estimated; the smallest have been built, the largest have not started yet. However, national investment is not encouraged; it has to do with those who own the technology, but it should be done within the international guidelines' framework established by the recipient countries. I think that the energy issue, although it has a plan, remains within the boundaries of romanticism; it is not aggressive, although we all have the potential to undertake it".

Regarding the Re issue, societies involved in adverse situations have greater chances of satisfactory responses versus those which are not organized. Out of our 545 participants, only 178 were directly or indirectly affected by flooding; 95 of them (56%) never faced collectively this situation (Figure 12), and those who worked together told that they acted in a reactive way, without future possibilities to be organized. In other words, people were not organized, but there were those who spontaneously helped those who were affected the most; others cleaned streets, uncovered sewers, drew water and put up barriers or looked for government aid. As to the question about whether the community is organized in the event of emergencies due to rains and droughts, 81% of respondents recognized that they are not organized in the event of an emergency, contrasting with information provided by the Civil Protection Office on the existence of 700 neighbourhood committees attached to this unit, whose roles are prevention and organization tasks for eventual emergencies and/or disasters.

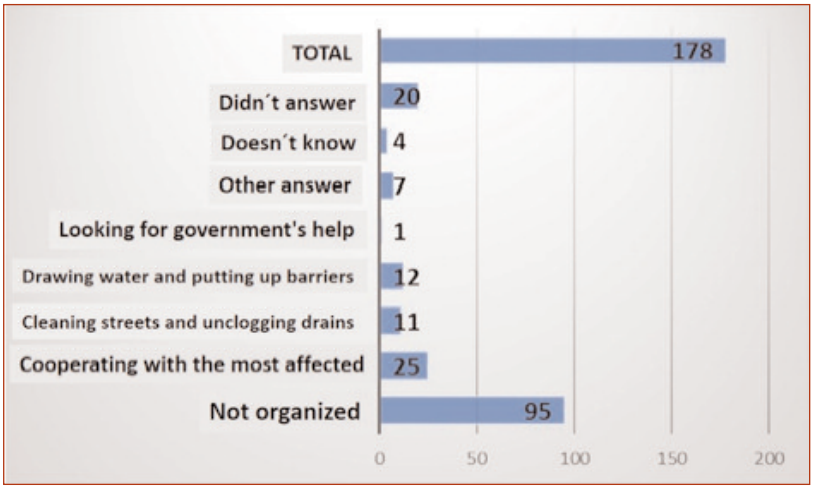

Figure 12 Participants in our survey who have been directly or indirectly affected by floods

With regard to Re, the social fragmentation dilutes any particular effort of small groups who end up being intimidated by political power. We contrasted the results of the Urban Resilience Profile (UPR) (SEDATU, Gobierno Municipal de Durango & UMB, 2016) with those of our research. Even though the Risk Atlas provides information about the history of disasters and damages (Gobierno Municipal de Durango & SEDESOL, 2012), the UPR does not. Our work collected data on historical floods, reflecting centuries-old events in flood-prone areas. We can state that the water path during the 2016 river flood along the *Acequia Grande* is comparable to the 1906 flood. This stream today is piped under the *Dolores del Rio Boulevard*.

We compared the URP results with our research. The maximum level of Re is 1,000. The URP was carried out by the *Universidad Mexiquense Bicentenario* (UMB), the Agrarian, Territorial and Urban Development Ministry (SEDATU) and the Durango City Council. Our research covers a household survey, interviews with key people, documentary research and field work over a two-year span. In Figure 13, the blue line corresponds to URP data and the orange line to our records. For the URP,

Durango City reaches Very High, High and Medium resilience horizons, whilst our evaluation shows Very Low and Low to Medium levels.

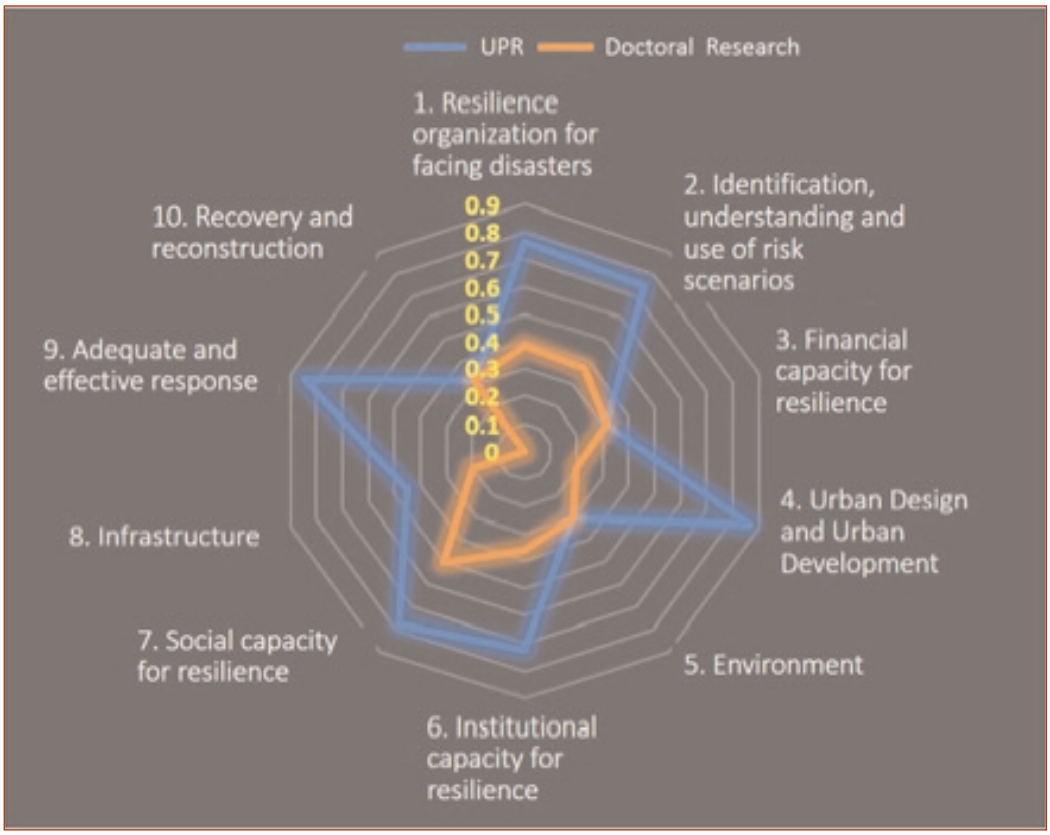

Figure 13 Analysis of the Urban Resilience Profile URP from Durango City comparing the official data (SEDATU, Government of Durango & UMB, 2018) versus data from our current investigation

The coincidences between URP and our research are in the Very Low Re level on Axis 3 (financial capacity for Re), 5 (Environmental) and 10 (Recovery and reconstruction). For Axis 3, in Durango City post-disaster responses are based on activating the FONDEN mechanisms through emergency declarations, reducing the financial city capacity for risk management and Re actions. On Axis 5, the URP remarks that the city does not have CCA nor CDRM plans. Although there is a good system of solid waste collection and final disposal, ecosystems such as the *Málaga* wetland are poorly protected. Since 2017, air pollution has increased and there are no corrective measures in place. During 2020, more than 480 trees will be felled for the construction of a vehicular bridge over the Francisco Villa Boulevard (Blanco, 2020), which will decrease the small number of green areas to the east of the city, a zone defined by the URP as very vulnerable. For Axis 10, there was limited institutional response and CDRM for the floods that occurred in September 2016 and October 2018.

The biggest contrasts are on Axis 1 (Re organization in the face of disaster), 2 (Identification, understanding and use of risk scenarios), Axis 4 (Urban design and development), Axis 6 (Institutional capacity for resilience) and Axis 9 (Adequate and effective response), for which the URP shows a High or Very High Re level whilst our results Very Low. For Axis 1 and 2, both the media and this research show that the five deaths that occurred during the river flood on September 29 and 30,

2016 could have been avoided if the Municipal Civil Protection System had alerted and evacuated the population in a timely manner. The same thing happened in the centre of the town *El Pueblito*, in October 2018, where although there were no deaths, the late warning did not allow the population to organize its evacuation. On Axis 4, the development plans show duplicity, contradictions, inoperability and disappearance for no apparent reason. In addition, our interviewees expressed high concern due to the city's chaotic growth and the consequent problem of supplying services and equipment.

The UPR rated Axis 6 with a High resilience degree. Although during the time of our investigation Durango has worked on the identification and prohibition of new constructions in risk zones, based on public regulations, Civil Protection officials stated that their hands were tied when facing problems such as the housing densification around the *El Hielo* Dam. Also, the Risk Atlas (Gobierno Municipal de Durango & SEDESOL, 2012) warns about vulnerable populated areas that remain without storm drains and with unpaved streets, thus becoming sources of possible floods and diseases. Considering the previously mentioned hydro-meteorological events and the findings of our research, we evaluated Axis 9 as Very Low, because since the three years after the disaster declaration due to river flooding, the Municipality of Durango has not made public a report on the damage assessment. This report exists, but we were never given the facilities to access it.

On axes 7 (Social capacity for resilience) and 8 (Infrastructure), there are no big differences between the URP and our work. For UPR, Axis 7 has a High rate, and for us Medium. As long as there are more and better-quality channels of dissemination and communication, society will be prepared to face the impact of some potentially destructive phenomena. This indicator coincides with our interviews and surveys regarding the information available through the media as well as Civil Protection drill training people in schools. However, this is not the case in terms of social fabric cohesion and the support for the most vulnerable sectors. The UPR considers in Axis 8 the incorporation of adaptation and mitigation measures, to prevent a potentially destructive natural phenomenon from causing damage, and, if such an event does occur, to ensure that its effects will be minimal; here, the UPR considers Re to have a Low degree, whilst, in our analysis, infrastructure has a Very Low level. Although the PRU states that there is 94% sewerage coverage, with deficits only in irregular settlements, neighbourhoods undergoing a regularization process and villages away from urban areas, the reality is that this coverage assessment does not mean that it is efficient. It is notorious that during the rainy seasons, puddles form on boulevards, in the city centre and in vulnerable areas at the periphery.

The URP also exposes the lack of action as far as CCA, especially when it comes to droughts. This phenomenon is a risk that requires greater attention. Durango does not have too much data on how CC could affect the city in the future. The URP adds that the Risk Atlas does not include the analysis of how the increase in icy waves or the intensification of drought can affect Durango.

We elaborated a Durango City Map showing the location of the City Centre, the main streams and rivers, the *Acequia Grande* route, the main avenues and roads, water bodies and the higher risk flooding areas. We also added Durango's urban expansion in 1970, 1990, 2000 and 2015, completed by the marginalization degree by census tracks along the *Acequia Grande* route in the city (Figure 14). We noted that the sectors without data (CONAPO, 2015) also correspond to areas without storm drains. Once homes in risky areas are identified, the municipality must apply for federal funding from the Territorial Management and Population in Risk Zones Relocation Schemes Programme (POTER) (SEDATU, 2015).

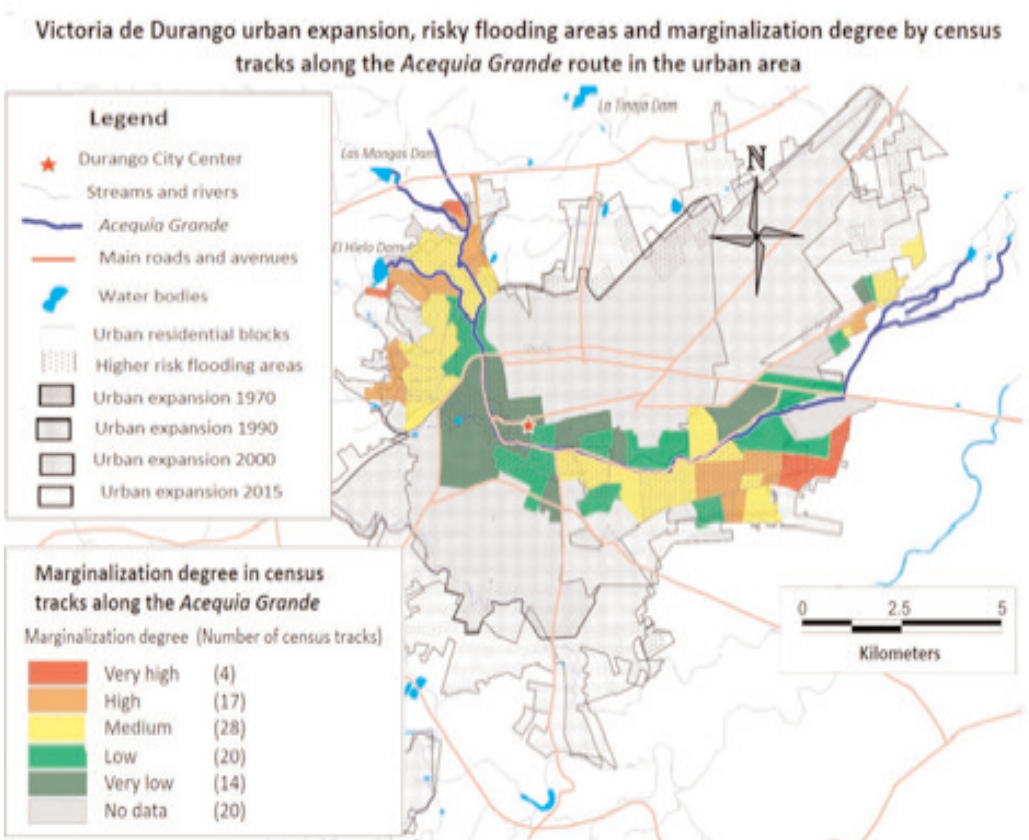

Figure 14 Victoria de Durango Urban Expansion, marginalization degree versus defined higher risky flooding areas nearby the Acequia Grande and flat topography areas without storm drain collection system.
Source: Elaboration by the authors based on The Historical Archive City Maps, CONAPO (2015), Gobierno Municipal de Durango & SEDESOL (2012), CENAPRED (2018)

5 | DISCUSSION

In Victoria de Durango, the rains of September 29th and 30th, 2016, can be considered the most destructive in the last 100 years. Working with the CIMAV-Durango researchers on atypical floods, we integrated historical data and field inspection, with a precipitation statistical analysis, linking the extreme precipitation events magnitude with their occurrence frequency and their probability distributions (Chow, Maidment & Mays, 1994). Using the Python 2.7 software (Python Software Foundation, 2016), a model showed that the 80 mm daily accumulated precipitation has a 20-year return period, 90 mm for 50 years, and 114 mm each 100 years. The 2016 flood was the product of the encounter of three hurricanes (Newton, Orlene and Paine) and a Tropical Storm (Roslyn) causing a 101.2 mm rainfall in just nine hours (CONAGUA, 2016: 26). The flooding affected the city, leaving behind millionaire losses in homes, businesses and essential facilities along with five deaths.

With regard to CCA, the deficit in urban forests and grasslands affects flood mitigation, because water has difficulties infiltrating impermeable soils, in a place with topography of less than 5%, an inefficient sewerage system and uncontrolled urban growth. The public agenda does not provide efficient responses to soft rainfalls between 30 and 50 mm. Nevertheless, for the State of Durango, a group of researchers developed a reference guide related to hydro-meteorological events which applies General Models of Global Circulation of the Atmosphere (GMGCA) (López et al., 2015), using statistical

techniques associated with GIS and based on maximum and minimum temperatures as well as extreme values of precipitation. However, these academics have no details for the Durango municipality scale.

The Guadiana Valley aquifer is under protection (DOF, 2010), while drought may affect the future water supply. However, CONAGUA has not publicized that fluoride and arsenic contaminants have been found in the water extracted from wells that supply the city. Academic research has laid the basis for the *Agua Futura Project*, whose implementation requires several decades. The plan includes the elevation of dams and the construction of macro-tanks as well as a new aqueduct (FCEA, 2011).

Air pollution is another problem in Durango City. In 2002, an industrial park project was created for the conversion of brickyards, which was practically without effect. Although there is a monitoring system with three fixed stations, the one from IPN, located in the most polluted area, does not yield data regularly; the reasons for its malfunction are unknown. At the time of writing this document, April 2020, there are no strategies to mitigate the problem.

Durango inhabitants cannot ride a bicycle without taking the risk of being run over by a vehicle, since the city has no bike paths. People cannot use public transport as their main means of movement, because this service is inefficient; nor can the combine means of transportation with walking because the city's solar radiation is amongst the highest in Mexico. Durango has a PIMUS since 2012 (Gobierno del Estado de Durango, 2012), but the reasons why it has not been implemented are unknown. By now, the city could have had at least exclusive tracks for bicycles and an efficient public transport system.

The energy market has grown with the commercialization of photovoltaic panels, the replacement of fossil fuels and the use of renewable sources in residences certified by the Federal Electricity Commission (CFE, 2015). However, an aggressive government subsidy or soft financing plan would be expected, because the initial investment is expensive. As for the consumption demand of energy saving boilers for, they have visible positioning, a simple technology and a short recovery period. One of the entrepreneurs interviewed stated that a green economy is necessary. The virtuous green cycle generates energy from renewable sources and reuses raw materials and products by recycling them. This process is not found in the vision of the businessmen and managers of the few industries existing in this city.

In Durango there are no management coordinated strategies for solar energy. Also, projects like biogas production from solid waste, solar orchards and air monitoring have not been properly introduced. As a discouraging note, the city's first solar park project is carried out on wetlands (*Humedal Málaga*), evidencing lack of territorial and energy planning.

Victoria de Durango is an intermediate city with great potential to achieve urban sustainability. By mid-2019, progress had been made in the following aspects:

1) 100% of wastewater is treated.
2) Since 2018, public lighting is based on LED luminaires
3) The *Agua Futura Project* is expected to finish in 2025; it will not be necessary to subtract groundwater. Durango can be the only Mexican city with water reserves.
4) The use of solar boilers is becoming more widespread and, although to a lesser extent, solar panels are gradually being installed in the city.
5) The waste collection system covers almost all of the city. Trash ends up in a transfer plant. There is a leachate treatment plant, plus a biogas electric power generator plant.

In view of sustainable mobility and GHG control, the following factors should be considered:

1) The urban topography favours public transport massification, bicycles and walking. However, the new projects prioritize vehicular flow and tree felling, with the unbelievable promise of replanting them (Blanco, 2020).

2) Strategies for controlling air pollution are intermittent. The project to mitigate fixed sources, such as brickyards, has not continued. There is lethargy with the legislation to control the mobile sources of emission gases, cars have priority.

3) Regarding DRT, CTT and production, CDRM and CCA, there is dispersion of efforts, responses are reactive rather than preventive and, by not integrating the variable risk into urban planning, the city's vulnerability has increased, multiplying flood risks. But the *Agua Futura Project* is a progress in CCA related to drought.

The discussion of results allows us to verify that there are capacities under construction in three urban dimensions: citizenship, institutionality and physical-structural. However, we can also highlight capacities that have not been developed, because they have not been reversed in favour of strengthening actions for a resilient city. While contemplating the particulars of SD goal 11, inclusivity, safety, sustainability and Re, and the problems seen in Victoria de Durango, the concept of healthy cities emerge. According to the WHO (1998), a healthy city "is one that is continually creating and improving those physical and social environments and expanding those community resources which enable people to mutually support each other in performing all the functions of life and developing to their maximum potential".

6 | CONCLUSIONS

The interest of this research is focused on the advances towards the construction of a common working agenda for Comprehensive Risk Disaster Management (CDRM) jointly with the mitigation of and Adaptation to Climate Change (CCA). With this in mind, we made a theoretical analysis about Climate Change (CC), Disaster Risk Transfer (DRT), Clean Technology Transfer (CTT), Sustainable Development (SD) and Resilience (Re), inspired by the 11th SDG, which aims for the construction of Sustainable Cities and Communities.

The methodology adopted in this work was a mixed research approach. We had a qualitative phase surveying 31 people, divided in 16 single interviews and four focus groups whose total was 15. Our interviewees included people from the organized civil society, industrial entrepreneurs and public officials linked to municipal and federal offices. In a quantitative phase, we made 545 surveys with a 96% confidence level, concentrated in 128 sectors, 58 located in the historically flood-risk areas and 70 in a buffer zone (Figure 3). As we mentioned, the Durango City risky zone is located along the *Acequia* Grande stream and the buffer zone is the rest of the urban area. We created a database according to our thematic theoretical areas. The GIS helped us come up with a spatial interpretation of our research. Also, the direct observation technique allowed us to experience the floods that occurred in Durango in September 2016 and October 2018.

The rains of September 2016 left five dead and caused millionaire losses, showing vulnerabilities as far as institutions, infrastructure and society. Evidently, a greater vulnerability implies a greater risk. We conclude that floods can be controlled, but droughts could be the biggest obstacle for the city and the state of Durango. Also, the city has difficulties when it comes to its population's water supply, besides its quality, because it contains some degrees of fluoride and arsenic.

In Mexico, the Municipal Natural Risk Atlases are a breakthrough in CDRM and CCA. Its update is federally mandated every six years; however, since 2018 the adjustment of the Durango Municipality Atlas is pending. The Atlas is an opportunity to show concrete works and include historical evidences; as expressed by Bracetti (1906): "with these repeated floods in such a short time, a doubt arises in the spirit that the authority must resolve with a highly urgent preventive measure".

Risk reduction and mitigation works are reactive disaster measures. However, in the subsequent years they become ordinary management works by the state authorities, with federal resources required to manage expensive investments. Because it takes a long time for state offices to receive the cash, palliative works are carried, and the need re-emerges when the disaster is repeated. The attention to climate disasters goes through the implementation of multisectoral public policies for poverty reduction, environmental protection, DRR and CCA. The 2030 SDGs Agenda expresses action strategies for guiding countries to formulate common policies for tackling negative externalities, mainly caused by man's negligence or wrongful actions.

Under these premises, the general objective of this research was to configure, reformulate or merge into a common agenda governmental practices on hydro-meteorological disaster risk transfer (DRT) origin as well as clean technologies transfer (CTT) and development for safer intermediate Latin American cities facing climate change (CC).

Physical exposure is a vulnerability factor whose weight in the risk equation can be reduced with urban planning and control. The variable "risk" should appear in urban plans. The Urban Development Directorate of the Municipality of Durango is responsible for organizing human settlements, the urban image and municipal development (Ayuntamiento de Durango, 2018).

In the case of Victoria de Durango, the self-built settlements or those with great architectural and urban environment deficiencies in its are not necessarily the most vulnerable. The issues linked to flooding in this city have to do with the inefficiency and absence of storm drains, combined with its flat topography and a high percentage of streets. The *Acequia Grande* extends along the *Dolores del Río Boulevard*, one of the main avenues of the city. The *Acequia Grande* is an infrastructure work requiring adaptations for flood prevention because the current intubation does not support rains greater than 100 mm/day. In addition, it is necessary to separate the storm drains from the sanitary drainage.

The DRT mechanisms, as well as those for CTT and production, lead to costly investments paid in the present whose profits will be achieved in an uncertain future for the generation that invests. Benefits from the use of renewable energies and non-polluting means of transport, amongst other sustainable practices, like recycling waste, are not seen as first need actions, representing a "diffuse interest" for the common citizen. The implementation of these SD mechanisms will depend on the culture of prevention and the need to mitigate CC. Thus, we can mention property insurance or less polluting technologies. This discourse is understood by professors, environmentalists and public policy makers. We urge these parties to not only translate this speech into scientific articles or legal regulations.

We propose the creation of a Strategic Plan for a Safe City facing Climate Change (PECC), which would take advantage of existing works and accelerates unfinished ones, with scenarios in the short, medium and long term. Figure 15 shows details about new programmes and necessary plans requiring updates, as well as their integration to consolidate this PECC and for its execution.

New Plans & Programmes	Existence	For climate risk control: DRT (identify, prevent and reduce): CCA & risk reduction	For CC mitigation: production and CTT: Energy use, pollution control, GHG emissions reduction	Update	Integration	Strategic Plan for a Safe City facing Climate Change (PECC) Execution	Term	Period
Ecological Planning State Law	Yes	Yes	Yes	2022	2022	2022-2030	Short	2022-2024
							Medium	2025-2027
							Long	2028-2030
Urban Development State Law	Yes	Yes	Yes	2022	2022	2022-2030	Short	2022-2024
							Medium	2025-2027
							Long	2028-2030
Civil Protection State Law	Yes	Yes		2022	2022	2022-2030	Short	2022-2024
							Medium	2025-2027
							Long	2028-2030
Durango Urban Development Program 2025	Yes	Yes	Yes	2022		2022-2024	Short	2022-2024
Drainage Master Plan	Yes	Yes				2022-2027	Short	2022-2024
							Medium	2025-2027
Agua Segura Project	Yes	Yes				2022-2027	Short	2022-2024
							Medium	2025-2027
Risk Management Plan	No	Yes			2022	2022-2030	Short	2022-2024
							Medium	2025-2027
							Long	2028-2030
Territorial Management and Population in Risk Zones Relocation Schemes Program (POTER)	No	Yes			2022	2022-2024	Short	2022-2024
Climate Change State Law	Yes		Yes			2022-2030	Short	2022-2024
							Medium	2025-2027
							Long	2028-2030
Promotion of Durango State and its Municipalities, Use and Exploitation of Renewable Energy Sources Law	Yes		Yes		2022	2022-2024	Short	2022-2024
Comprehensive Sustainable Mobility Plan (PIMUS)	Yes, but it was dismissed		Yes	2022		2022-2024	Short	2022-2024
Strategic Plan for a Safe City facing Climate Change (PECC)	No	Yes	Yes	2022	2022	2022-2030	Short	2022-2024
							Medium	2025-2027
							Long	2028-2030
Energy Efficiency Plan	No		Yes		2022	2022-2030	Short	2022-2024
							Medium	2025-2027
							Long	2028-2030
Municipal Climate Action Program (PACMUN)	No		Yes			2022-2030	Short	2022-2024
							Medium	2025-2027
							Long	2028-2030

Figure 15 Stages for execution and start-up of the Strategic Plan Safe City facing CC (PECC). *Source: elaboration by the authors*

Linking CDRM with mitigation and CCA in a common agenda, specifically as this research has been worked on since the DRT and CTT, aims to reduce the duplication of institutional and budgetary efforts, as well as set guidelines for decreasing environmental problems and disaster risk, making the city more resilient through the multi-sectoral planning instrument PECC, with a 10-year horizon. The scenarios proposed for consolidating the PECC started during the current situation (2020-2021) with an advance of 25%. At the moment, it is important to work on SD with risk approach, plus the citizens' governance. The second scenario (2022-2024) includes short- term progress as 50%. The third considers medium-term actions (2025-2027) as 75%. To consolidate the PECC, long-term actions include 100% advances (2030), reaching Sustainability and Re conditions (Figure 16).

Figure 16 Strategic Plan for a Safe City facing Climate Change (PECC), with a 10-year horizon
Source: elaboration by the authors

Our work shows that the intermediate city Victoria de Durango possesses potentials and invaluable natural resources, but there are also threats and weaknesses. Without a strategic vision, the city will hardly achieve sustainability, become resilient and be safe in front of its greatest risks: floods and droughts. Durango will not be able to have financial access by hiding information, dismissing citizen opinion and postponing structural works on SD and risk reduction. Also, this city needs a citizenry more involved in issues that concern everyone equally.

As we have mentioned, this document has its roots in a doctoral thesis inspired by the challenges of intermediate cities facing climate change, but the authors' background is also linked to urban neighbourhood improvement planning programmes. In the short term, this research could lead to studies about Latin-American self-produced settlements and their capacity for building against CC, as well as the exploration of urban planning and governance for developing public policies against climate risks. We conclude this paper by stating that our survey has a lot of information that goes beyond the scope of the aforementioned thesis. However, tools such as SPSS and GIS will allow us to continue working with this research data.

References

Academia de Ingeniería de México. *Estudio Estratégico. Inventario de Atlas de Riesgo en México. Informe Estado Actual*. Consejo Nacional de Ciencia y Tecnología CONACYT: Mexico City, Mexico, 2017;81 p.

Ayuntamiento de Durango. *2º Informe de Gestión. Un Gobierno Ciudadano de Resultados (Período septiembre 2016-2018)*. Municipio de Durango: Durango, Mexico, 2018.

Blanco, V. Es ilegal la licencia para construcción de puente F. Villa. *El Sol de Durango.* Organización Editorial Mexicana: Durango, México, 2020. Available online: https://www.elsoldedurango.com.mx/local/es-ilegal-la-licencia-para-construccion-de-puente-f.-villa-5029211.html (accessed on 22 April 2020).

Bracetti, F. Sobre la inundación del 28 de julio de 1906. *Periódico La Evolución*, 1906, No. 90. Archivo Histórico de Durango: Durango, Mexico, 1906.

Cardona, O. *Estimación holística del riesgo sísmico utilizando sistemas dinámicos complejos*. Doctoral thesis. Universitat Politècnica de Catalunya: Barcelona, Spain, 2001; 335 p.

Cardona, O. *Diagnóstico de la gestión financiera del riesgo y propuesta de instrumentos financieros factibles de retención y transferencia*. PREDECAN: Bogotá, Colombia, 2007.

Cardona, O. Un marco conceptual común para la gestión del riesgo y la adaptación al cambio climático: encuentros y desencuentros de una iniciativa insoslayable. In *Perspectivas de Investigación u acción frente al cambio climático en America Latina*; Briones, F., Eds.; Número especial de Desastres y Sociedad. La Red: Mérida, Venezuela, 2012; 283 p., ISBN 978-980-7519-00-7.

Camagni, R. *Economía Urbana*. Antony Bosch Editor: Barcelona, Spain, 2005; 331 p., ISBN: 978-84-95348-73-9

Carrión, F. Ciudades intermedias: entre una pirámide trunca y una red urbana en construcción. In *Ciudades Intermedias y Desarrollo Territorial*; Canziani, J., Schejtman, A., Eds.; Fondo Editorial Universidad Católica: Lima, Peru, 2013; pp. 21-31, ISBN: 978-612-4146-29-9.

CENAPRED. Atlas digital de Riesgos del Estado de Durango. *Atlas Nacional de Riesgos*. Centro Nacional de Prevención de Desastres: Mexico City, México, 2018. Available online: http://www.atlasnacionalderiesgos.gob.mx/AtlasEstatales/?&NOM_ENT=Durango&CVE_ENT=10(accessed on 08 May 2020).

CENAPRED. *Desastres en México: impacto social y económico*. Centro Nacional de Prevención de Desastres: Mexico City, México, 2019. Available online: http://www.cenapred.unam.mx/es/Publicaciones/archivos/318-INFOGRAFADESASTRESENMXICO-IMPACTOSOCIALYECONMICO.PDF (accessed on 20 June 2019).

CFE. *Compromisos CFE*. Comisión Federal de Electricidad: Mexico City, México, 2015. Available online:https://www.cfe.mx/CFEAmbiental/Paginas/CompromisosCFE.aspx(accessed on 21 April 2018).

Chow, V. T.; Maidment, D. R. & Mays, L. W. *Hidrología Aplicada*. McGraw-Hill: Bogotá. Colombia, 1994; 597 p., ISBN 958-600-171-7.

CIIFEN. *¿Qué es el Cambio Climático?* Centro Internacional para la Investigación del Fenómeno del Niño, 2017. Available online: http://www.ciifen.org/index.php?option=com_content&view=category&layout=blog&id=100&Itemid=340&lang=es (accessed on 06 February 2017).

CIMAV-Durango. *Investigación: Lineas de Investigación y Docencia*.Centro de Investigación en Materiales Avanzados, S. C. Unidad Durango: Durango, México, 2018. Available online: http://dgo.cimav.edu.mx/lineas-de-investigacion/ (accessed on 08 April 2018).

CONAGUA. *Reporte del Clima en México. Septiembre 2016. Año 6. Número 9.* Comisión Nacional del Agua. Servicio de Meteorología Nacional: Mexico City, Mexico, 2016; 30 p.

CONAPO. *Datos abiertos del índice de marginación.* Consejo Nacional de Población: Mexico City, Mexico, 2016. Available online: http://www.conapo.gob.mx/es/CONAPO/Datos_Abiertos_del_Indice_de_Marginacion (accessed on 08 June 2019).

CONAPO. *Durango: Proyecciones de población de localidades seleccionadas, 2010-2030*.Consejo Nacional de Población: Mexico City, Mexico, 2018. Available online: http://www.conapo.gob.mx/work/models/CONAPO/Proyecciones/Datos/Proyecciones_municipios_y_localidades/Localidades/Durango_loc.xlsx (accessed on 25 March 2018).

Congreso del Estado de Durango. *Ley de Cambio Climático del Estado de Durango.*

Periodico Oficial no. 54: Durango, México, 2019. Available online: http://congresodurango.gob.mx/Archivos/legislacion/LEY%20DE%20CAMBIO%20CLIMATICO.pdf (accessed on 10 April 2020).

Dávila, J. D. *Desarrollo de la gestión del riesgo por fenómenos de origen natural y antrópico en el Municipio De Medellín. Periodo 1987-2007*. Universidad de Antioquia: Medellín, Colombia, 2008.

DOF. (1999). ACUERDO por el que se dan a conocer los estudios técnicos del acuífero 1003 Valle del Guadiana, en el Estado de Durango. *Diario Oficial de la Federación*. Secretaria de Gobernación: Mexico City, Mexico, 1999. Available online:

http://dof.gob.mx/nota_detalle.php?codigo=5150942&fecha=07/07/2010 (accessed on 19 April 2020).

EM-DAT. *The International Disaster Database*. Centre for Research on the Epidemiology of Disasters (CRED): Brussels, Belgium, 2020. Available online:https://www.emdat.be/(accessed on 28 March 2020)

FCEA. *Proyecto Agua Futura: plan para abatir la sequía en Durango*. Fondo para la Comunicación y la Educación Ambiental, A.C.: Mexico City, Mexico, 2011. Available online: https://agua.org.mx/proyecto-agua-futura-plan-para-abatir-la-sequia-en-durango/ (accessed on 19 April 2020).

Glaser, B. G. & Strauss, A. L. *The Discovery of Grounded Theory.*Aldine Transaction: New Brunswick, U.S.A., 1967, 284 p., ISBN: 0-202-30260-1

Gobierno del Estado de Durango. *Plan Integral de Movilidad Sustentable (PIMUS). Informe Final*. Transconsult: Durango, Mexico, 2012.

Gobierno Municipal de Durango & SEDESOL. *Atlas de riesgos naturales del Municipio Durango*; Secretaria de Desarrollo Social: Durango, Mexico, 2012; 289 p. Available online: http://www.anr.gob.mx/PDFMunicipales/2012/10005_Durango.pdf (accessed on 08 April 2018).

Graizbord, B. Sostenibilidad urbana: ¿frase vacía o estrategia de desarrollo urbano? In *Megaciudades y cambio climático. Ciudades sostenibles en un mundo cambiante*; Graizbord, B. &Monteiro, F., Eds.; El Colegio de México: Mexico City, Mexico, 2011, pp. 27–46, ISBN 978-607-462-257-7.

Guerrero, J. La Inundación de Durango en 1906. *Liber Chronicvm, 2. Publicación de divulgación mensual de la Crónica de la Ciudad y del Centro de Estudios de la identidad duranguense*, 2015, Volume 1 (1), pp. 1-15.

INEGI. *XIII Censo de Población y Vivienda 2010. SCINCE 05/2012*. Instituto Nacional de Estadística, Geografía e Informática: Aguascalientes, Mexico, 2012.

IPCC. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*: *Special Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: New York, United States of America, 2012; 594 p. ISBN 978-1-107-02506-6. Available online: https://www.ipcc.ch/site/assets/uploads/2018/03/SREX_Full_Report-1.pdf (accessed on 28 March 2020).

IPCC. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.). Intergovernmental Panel on Climate Change: Geneva, Switzerland, 2015; 168 p. ISBN 978-92-9169-143-2. Available online: https://epic.awi.de/id/eprint/37530/1/IPCC_AR5_SYR_Final.pdf (accessed on 02 April, 2020).

LaRED. *La Red de Estudios Sociales en Prevención de Desastres en América Latina*; LA RED: Panama, Panama, 2015. Available online: http://www.desenredando.org/lared/antecedentes.html (accessed on 19 April 2016).

Lavell, A. *Desempacando la adaptación al cambio climático y la gestión del riesgo: Buscando las relaciones y diferencias: Una crítica y construcción onceptual y epistemológica.* UICN-FLACSO: Quito, Ecuador, 2011, 45 p.

López, A.; Pinto, J.; Esquivel, G.; Randeles, V. H. & Bueno P. *Escenarios climáticos locales basados en los MGCG del IPCC. Con enfoque al análisis de vulnerabilidad de los sistemas económicos y naturales del Estado de Durango, México*, 1st ed.; Universidad Autónoma Chapingo: Chapingo, Mexico, 2015; 36 p. Available online: https://www.researchgate.net/publication/293820864_ESCENARIOS_CLIMATICOS_LOCALES_BASADOS_EN_LOS_MGCG_DEL_IPCC_Con_enfoque_al_analisis_de_vulnerabilidad_de_los_sistemas_economicos_y_naturales_del_Estado_de_Durango_Mexico (accessed on 18 April 2018).

Martínez, M. *La investigación cualitativa etnográfica en educación.* 3rd ed.; Trillas: Mexico City, Mexico, 1998; 175 p. ISBN: 9789682456756.

Miller, J., & Visicdi, L. *Innovación en energía limpia en América Latina,* CAF - Banco de Desarrollo de América Latina: Caracas, Venezuela, 2016; 20 p.

Maldonado, S. Otorgarán seguro para vivienda con pago del predial. *El Siglo de Durango*, 2017; El Siglo de Durango: Durango, México. Available online: https://www.elsiglodedurango.com.mx/noticia/929784.otorgaran-seguro-para-vivienda-con-pago-del-predial.html (accessed on 08 April 2018).

Molin, H. Decenio Internacional para la Reducción de los Desastres Naturales (DIRDN). In *Viviendo en Riesgo: Comunidades vulnerables y prevención de desastres en América Latina*; Lavell A. (Ed.); Red de Estudios Sociales en Prevención de Desastres en América Latina (LA RED): Panama, Panama, 1997; pp. 5-10.Available online: https://www.desenredando.org/public/libros/1994/ver/ver_final_nov-20-2002.pdf (accessed on 28 March 2020).

PAOT. *Presente y Futuro de las Áreas Verdes y del Arbolado de la Ciudad de México*; Procuraduría Ambiental y del Ordenamiento Territorial del Distrito Federal: Mexico City, Mexico, 2010; 260 p., ISBN: 978-607-95053-4-9. Available online: http://centro.paot.org.mx/documentos/paot/libro_areas_verdes.pdf (accessed on 07 April, 2020).

Python Software Foundation (2016). *Python language reference, version 2.7*, 2016. Available online: http://www.python.org (accessed on 02 May, 2019).

Rivas, E. M.; Aparicio, C. & Páez, L. D. Políticas de transferencia de riesgo de desastres socio naturales en América Latina y el

Caribe. In *Desarrollo sostenible: Educación ambiental, experiencias prácticas y evaluación de las políticas públicas*; Vázquez, O. &Carrillo, M., Eds.; Montiel & Soriano Editores S. A. de C. V.: Puebla, México, 2018; pp. 307–316. ISBN: 978-607-98467-0-1.

Rockström, J.; Steffen, W.; Noone K.; Persson, A.; Chapin, F. S. III; Lambin, E.; Lenton, T. M.; Scheffer, M.; Folke, C.; Schellnhuber, H.; Nykvist, B.; De Wit, C. A.; Hughes, T.; van der Leeuw, S.; Rodhe, H.; Sorlin, S.; Snyder, P. K.; Costanza, R.; Svedin, U.; Falkenmark, M.; Karlberg, L.; Corell, R. W.; Fabry, V. J.; Hansen, J.; Walker, B.; Liverman, D.; Richardson, K.; Crutzen, P. & Foley, J. Planetary boundaries: exploring the safe operating space for humanity. In *Ecology and Society*, 2009,*14 (2): 32*, pp. Portland State University: Portland, United States of America. Available online: https://www.ecologyandsociety.org/vol14/iss2/art32/ (accessed on 02 April 2020).

SEDATU. *Programa de Ordenamiento Territorial y Esquemas de Reubicación de la Población en Zonas de Riesgo*; Secretaría de Desarrollo Agrario, Territorial y Urbano: Mexico City, Mexico, 2015; 5 p. Available online: https://www.gob.mx/cms/uploads/attachment/file/42988/1_Esquema_2015_POTER.pdf (accessed on 08May 2020).

SEDATU; Gobierno Municipal de Durango & UMB. *Perfil de Resiliencia Urbana. Victoria de Durango, Durango*; Secretaría de Desarrollo Urbano, Gobierno Municipal de Durango, Universidad Mexiquense del Bicentenario: Durango, Mexico, 2018.

SELA. *Mecanismos financieros, seguro y reaseguro contra desastres naturales en América Latina y el Caribe. Experiencias recientes.* Sistema Económico y del Caribe: Caracas, Venezuela, (2010).

SEMARNAT; SEGOB & Gobierno del Estado de Durango. *Programa de gestión para mejorar la calidad del aire en el Estado de Durango (2016-2026)*. Secretaría del Medio Ambiente y Recursos Naturales: Durango, Mexico, 2016, 160 p.

Stern, N. *Stern Review on the Economics of Climate Change*; The National Archives. HM Treasury. Electronic Version: Richmond, England, 2006. Available online: http://webarchive.nationalarchives.gov.uk/20100407172811/http://www.hm-treasury.gov.uk/stern_review_report.htm (accessed on 28 March 2019.

Torres, Y. México tiene baja protección contra riesgos catastróficos. Únicamente 5% del parque habitacional tiene un seguro de daños y 5% de las Pymes del país tienen contratado un producto de este tipo. *El Financiero. Economía* **2014.** Mexico City, Mexico. Available online: http://www.elfinanciero.com.mx/economia/mexico-tiene-baja-proteccion-contra-riesgos-catastroficos.html (accessed on 16 May 2020).

UNDP. *Sustainable Development Goals*; United Nations Development Programme: New York, United States of America, 2015; 21 p. Available online: http://www.undp.org/content/dam/undp/library/corporate/brochure/SDGs_Booklet_Web_En.pdf (accessed on 28 March 2020).

UNDRR. *The TEN Essentials for Making Cities Resilient*; United Nations Office for Disaster Risk Reduction: Geneva, Switzerland, 2019; Available online: https://www.unisdr.org/campaign/resilientcities/toolkit/article/the-ten-essentials-for-making-cities-resilient (accessed on 10 April 2020).

WHO. *Health Promotion Glossary*; World Health Organization: Geneva, Switzerland, 1998; 36 p. Available online: http://www.who.int/healthpromotion/about/HPR%20Glossary%201998.pdf?ua=1 (accessed on 16 May 2020).