

# CLIMATE CHANGE IMPACTS ON SOCIO-ENVIRONMENTAL CONFLICTS:

## Vulnerability in Facing Climate Change and Social Conflicts in Mexico

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Social Conflicts in Mexico

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## ACRONYMS

<b>CCC</b>	Centro de Colaboración Cívica
<b>CFE</b>	Federal Electricity Commission
<b>ECLAC</b>	Economic Commission for Latin America and the Caribbean
<b>ENACC</b>	National Strategy on Climate Change
<b>GHG</b>	Greenhouse gas
<b>INE</b>	National Institute of Ecology
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>NGO</b>	Non-governmental organisation
<b>PDCI</b>	Partners for Democratic Change International
<b>PECC</b>	Special Program on Climate Change
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change

## EXECUTIVE SUMMARY

Due to its social, economic, institutional and geographical situation, Mexico is highly sensitive to the effects of climate change and other extreme meteorological phenomena. Although some experts interviewed see the changes in climate as a result of natural climate variability, many others argue that Mexico's environmental situation already presents characteristics which exemplify the effects of global warming and climate change that could be prevented in the future. If the effects of climate change are not countered, some experts believe that Mexico may be susceptible to the eruption of social conflict, as vulnerability among different communities and groups will increase.

The authors propose two models to relate climate change to conflict, based on its physical consequences and on the mitigation and adaptation policies needed to face the challenges it poses.

The physical effects of climate change will directly affect the quality of life and increase people's vulnerability. This can accelerate conflict and result in either a *collaborative* or *adversarial* response from society. The second model concerns the unilateral implementation by the government of policies aimed at fighting climate change. These policies often exclude the affected population from decision-making processes, leading people to perceive these policies as impositions, rather than as solutions.

In both models, a collaborative response of international organisations, non-governmental organisations (NGOs), government, business groups, social groups and individuals, if effective, could avoid or transform potential conflict, and facilitate the reduction of risks and vulnerabilities. However, an adversarial reaction could lead to an exacerbation of existing tensions and to violent conflict, further decreasing the quality of life and increasing the vulnerability of people.

An adversarial response could also be a sign that society has become aware of the hazards and, if this response is listened to, it could lead to proper solutions. Either way, policies should consider dialogue as an effective strategy to generate sound policies that could be stable and effective.

The economic, social and political vulnerability of Mexico to climate change shows that:

- Participation will be key to the effectiveness and sustainability of adaptation and mitigation policies.
- An early-warning system of conflicts related to climate change could provide the necessary information, currently lacking in decision-makers and society, about the effects of climate change.
- An early-warning system, based on democratic principles, could foster society's local capacity to assimilate complex information and encourage social awareness, public discussion and participation.
- If sufficient capacities for democracy are *not* in place, authoritarian practices, monopolisation of scarce resources by some groups, or other abuses that increase people's vulnerability and affect individuals' rights, may lead to an elevation of social tension and a potential escalation of violence.
- There is an urgent need to assess the capacities required, specifically at the local level, and to establish adequate incentives to foster the political will to advance relevant people-oriented public policies.

## INTRODUCTION

Climate change represents the main challenge to overcome in the 21st century. The United Nations Framework Convention on Climate Change (UNFCCC) (1992) defined this phenomenon as ‘a change in the climate which is directly or indirectly attributed to human activity that alters the composition of the planet's atmosphere and which is in addition to natural climate variability observed over comparable time periods’.<sup>1</sup> The effects of climate change are diverse, ranging from increases in temperature, changes in levels of precipitation and intensified weather patterns. Although the exact impacts on human life are hard to predict, in a systemic view, it is increasingly clear that climate change will dramatically affect the ecological, political, economic and social systems, with harder consequences for the poor and the vulnerable. This means that, without strong institutional awareness and response, the risks of social tensions or even violent conflict are high.

Due to its social, economic, institutional and geographical situation, Mexico is highly sensitive to the effects of climate change and other extreme meteorological phenomena. Although some interviewed experts see the changes in climate as a result of natural climate variability, many others argue Mexico's environmental situation already presents characteristics which exemplify the effects of global warming and climate change that could be prevented in the future. If the effects of climate change are not countered, some experts believe that Mexico may be susceptible to the eruption of social conflict, as vulnerability among different communities and groups will increase.

This report presents the risks, challenges and effects of climate change in Mexico and its potential to generate or exacerbate social conflicts. It is based on in-depth interviews and analysis of the main policy initiatives taken by the Mexican government to face these effects and anticipate the future pressures institutions will face in dealing with this phenomenon. The report concludes by providing some policy recommendations to different stakeholders – including the Mexican government, European Commission policymakers and civil society actors – on how to enhance efforts to prevent the eruption of conflict as a result of climate change.

The report is part of the project “Early Warning Systems: Analysis for Action”, which has two objectives:

- 1) To increase our knowledge of conflict dynamics and catalysts; and
- 2) To identify systemic factors that can prevent the escalation or outburst of conflicts, as well as coherent actions to deal with them.

With regard to these objectives, Centro de Colaboración Cívica (CCC), as a member of Partners for Democratic Change International (PDCI), will contribute with research to better understand how climate change and conflict are related, specifically in Mexico.

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1 United Nations (1992). UNFCCC. New York: United Nations, p.3, accessed on 12th May 2010. Available at <http://unfccc.int/resource/docs/convkp/conveng.pdf>

## METHODOLOGY

CCC conducted the research for this report in three phases:

### REVIEW OF EXISTING REPORTS AND OTHER RESEARCH

- National stakeholder analysis for the project *Building Consensus to Formulate National Legislation that Improves Global Climate Security*. The project was led by CCC with the objective of promoting legitimate, stable and effective legislative agreements on climate change through consensus-building techniques, in synergy with the executive's branch strategy. For this document, 35 interviews were conducted with federal legislators, experts, civil society, federal government officials, private-sector representatives and local authorities.<sup>2</sup>
- Documents with the synthesis of results from two dialogue sessions held with over 180 stakeholders during the project mentioned above.
- Local stakeholder analyses for two southern states capitals, Tuxtla Gutiérrez (Chiapas) and Xalapa (Veracruz), around the hydro-meteorological risks posed by climate change. These documents were elaborated through 31 interviews (12 conducted in Xalapa and 19 in Tuxtla Gutiérrez) with local non-governmental organisations (NGOs) and experts, as well as with municipal, state and federal authorities.
- Academic papers and government reports whose main focus is the development of actions to face climate change, particularly in Mexico (A summary of actions taken by the Mexican government can be found on Annex 2).
- Conflict-transformation and negotiation literature review.

### INTERVIEWS

CCC conducted a series of other interviews with organisations who deal with socio-environmental conflicts, authorities at a national and local level, and experts in adaptation policies. The aim was to identify a) their perspectives about the pressures government institutions will face; b) the institutional capacities to cope with the challenges posed by climate change; and c) how the possibilities of changes in environmental conditions could lead to protests, social unrest and even violent conflict.

### ANALYSIS AND RESULTS PRESENTATION

The analysis of the information mentioned above, especially the interviews, served as the basis for a model which shows the relation between climate change and conflict. This model was presented for feedback, in a one-day workshop on 14th July 2010, attended by experts in environment, risk, adaptation and conflict resolution.

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2 See [www.cambioclimaticoysseguridadnacional.org](http://www.cambioclimaticoysseguridadnacional.org)

# CONFLICT AND CLIMATE CHANGE

## WHAT IS CONFLICT?

A variety of definitions of “conflict” exist, depending on the theoretical approach. However, there are aspects common to most definitions. First, it is important to note that conflict is neither a neutral nor an inherently negative term. The nature of conflict is ambivalent: it is capable of generating creative and positive change as well as destructive consequences when the conflict becomes vicious and/or violent.

Derived from the Latin *confligere*, “to fight”, the term “conflict” indicates a confrontation between several actors with incompatible or competitive interests or goals. A conflict can be manifest – visible through evident actions – or latent.<sup>3</sup>

According to traditional definitions, conflict results from two or more parties – which can be individuals or groups, state and non-state actors – striving for the same scarce resources at the same time.<sup>4</sup> However, this terminology might not include environmental and historical issues as causes of conflict.

Conflict is often explained through theoretical analysis rather than through objective facts, such as the reality of different parties competing for material interests, structural relationships (power) and (violent) behaviour.<sup>5</sup> For instance, Johan Galtung analysed the causes of violent conflict in three phases: before violence, during violence and after violence. He classifies violence in three categories: direct violence (behavioural), cultural violence (social constructs) and structural violence. Each of these categories represents individual angles of what he terms ‘the violence triangle’. Conflict constitutes a dynamic process in which these components have an influence on each other. According to this model, conflict starts with a contradiction, regarding the parties’ interests and needs or their relationship, followed by the actors developing hostile attitudes and conflictual behaviour.<sup>6</sup>

Conflict is usually described as a cyclical phenomenon which can evolve from (relative) stable and peaceful situations to crisis and war, and thereafter de-escalate into relative peace again. At this stage the peace may be durable or conflict may break out again.<sup>7</sup>

## WHAT IS THE RELATIONSHIP BETWEEN CLIMATE CHANGE AND CONFLICT?

From a systemic perspective, the effects of climate change, such as the rise of sea levels, increased resource scarcity, and the intensification of natural disasters – combined with political and economic instability, migration, social fragmentation and an inappropriate response from the government – might become catalysts for conflict.<sup>8</sup> The authors propose two models to relate climate change and conflict. The first focuses on the physical

3 M. E. King and C. A. Miller (2006). *Teaching model: Nonviolent transformation of conflict*. University of Peace.

4 P. Wallensteen (2002). *Understanding conflict resolution: War, peace and the global system*. London: Sage Publishing.

5 N. Swanström and M. Weissmann (2005). *Conflict, conflict prevention, conflict management and beyond: A conceptual exploration*, Concept Paper. Johns Hopkins University and Uppsala University. Available at [http://www.silkroadstudies.org/new/docs/ConceptPapers/2005/concept\\_paper\\_ConfPrev.pdf](http://www.silkroadstudies.org/new/docs/ConceptPapers/2005/concept_paper_ConfPrev.pdf)

6 O. Ramsbotham, T. Woodhouse and H. Miall (2005). *Contemporary conflict resolution: The prevention, management and transformation of deadly conflicts*. Cambridge: Polity Press.

7 N. Swanström and M. Weissmann (2005). Op. cit.

8 D. Smith and J. Vivekananda (2009). *Climate change, conflict and fragility: Understanding the linkages, shaping effective responses*. London: International Alert. p.7. Available at <http://www.international-alert.org/resources/publications/climate-change-conflict-and-fragility>

consequences of climate change and the second on the policies needed to face the challenges it poses. These models are, of course, simplified ways of addressing a much more complex context, which includes poverty, economic crisis, unemployment, religious disputes, migration, partisan politics, power relations and ethnic conflicts, among other problems.

Our assumption is that, within a context where tensions are high, the physical effects of climate change, along with mitigation and adaptation policies, will aggravate tensions and influence different stakeholders' responses to the situation. According to some experts, the stakeholders' reactions are not always either collaborative or adversarial, but are often a combination of both.

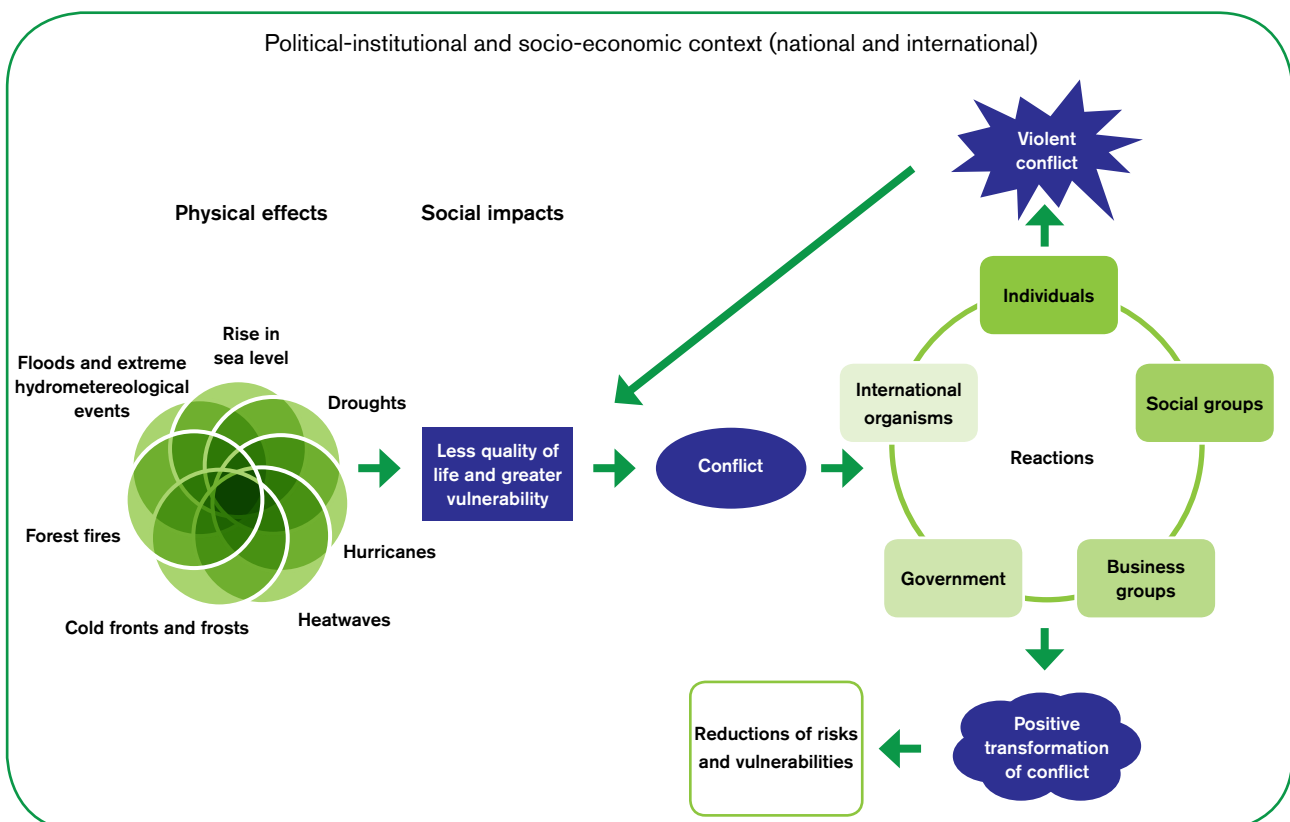
Time is also an important variable to consider, as environmental phenomena are likely to repeat themselves with more or less intensity every year, challenging the institutional and social capacities of different regions of Mexico.

## PHYSICAL EFFECTS OF CLIMATE CHANGE AND CONFLICT

The physical effects (see Figure 1) of climate change, such as hurricanes, droughts, floods, extreme hydro-meteorological phenomena, forest fires and heat waves, directly affect the quality of life and increase people's vulnerability. For example, a flood can represent the loss of houses, livelihoods, crops and/or livestock for many families, who will have to allocate resources in order to return to their normal life.

Such a reduction in the quality of life can accelerate conflict and result in either a *collaborative* or *adversarial* response from society (individuals, governments, international organisations, NGOs, social and business groups). In the case of a collaborative reaction, if effective, potential conflict could be avoided or transformed, and facilitate the reduction of risks and vulnerabilities. However, an adversarial reaction could exacerbate existing tensions and social anxiety if things are not resolved, which could, in turn, lead to violent conflict and thus further decrease the quality of life and increase the vulnerability of people, as shown in Figure 1.

FIGURE 1: PHYSICAL EFFECTS AND CONFLICT



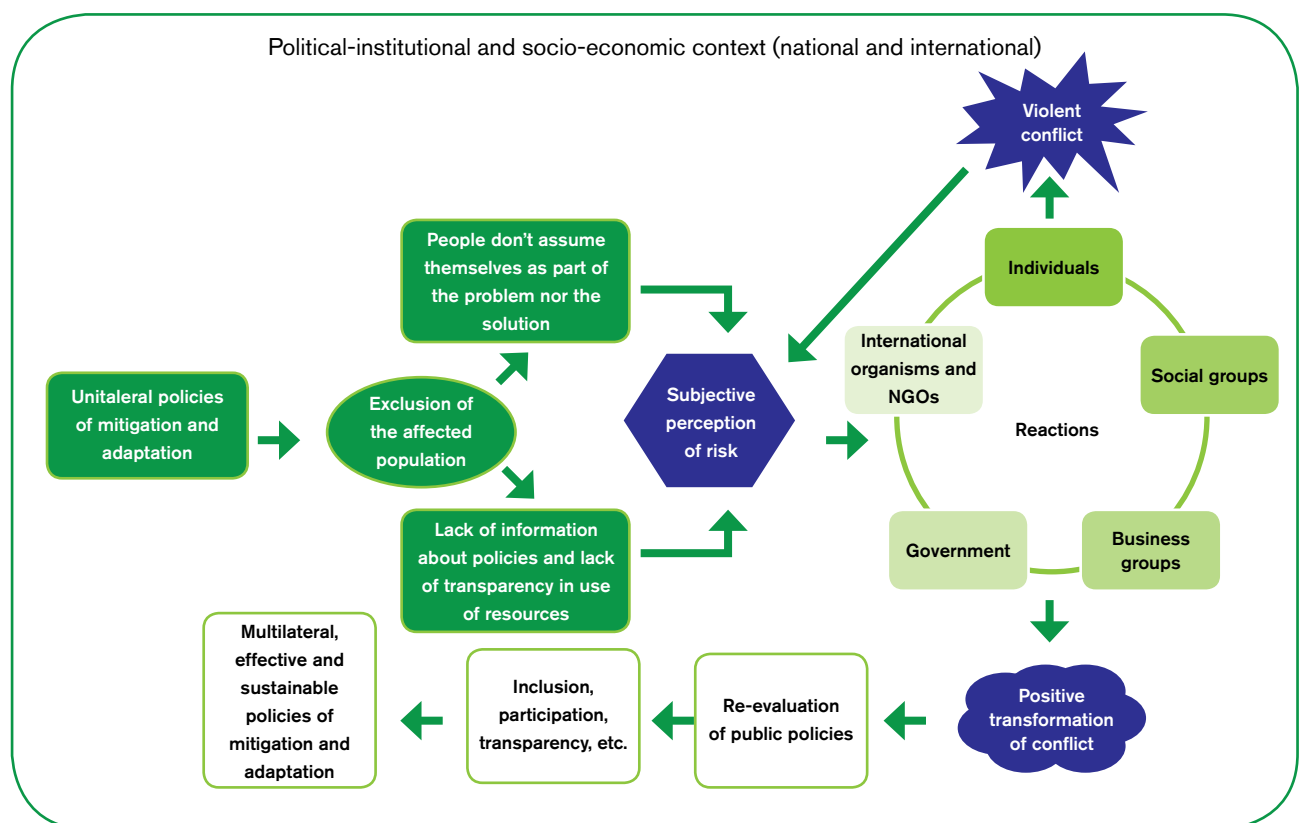
## ADAPTATION AND MITIGATION POLICIES AND CONFLICT

The interviewed experts generally agreed that the Mexican government implements unilateral policies of mitigation and adaptation. Examples of this include the construction of an eolic power plant in La Ventosa, in the state of Oaxaca, or the climate change law in the state of Veracruz, where, according to local interviews, the legislative process excluded the affected population, as well as several experts, which has led to tensions and could possibly compromise the effectiveness of its implementation.

On the one hand, when people are excluded from decision-making processes, the consequences of the new policies – and the new policies themselves – are perceived as an imposition and not something they have participated in voluntarily. People do not consider themselves to be part of the problem nor part of the solution. On the other hand, when an affected population is not informed about the nature of a project – for example, what the project is about, how it affects them, what damages will be caused, what compensation they will receive and whether they will be relocated – they form what some academics call ‘a subjective perception of risk’.<sup>9</sup> This subjective perception of risk is caused by a lack of information about the policies and lack of transparency in the use of the resources. For example, in Zimapán, in the state of Hidalgo, locals did not know the government was building a hazardous waste-disposal centre 10 km from their town until it was already under construction and the mayor made a formal announcement. Lack of consultation with the citizenry, combined with incomplete or belated information, often leads to frustration and a lack of trust in the government.

The subjective perception of risk means international organisations and NGOs, governments, business groups, social groups and individuals may react either with a spirit of collaboration or hostility. For example, a social group may begin street protests in reaction to public policies they disagree with. The government can react in an adversarial way, potentially leading to repression and violent conflict, or it can start a positive transformation of the conflict by re-evaluating public policies and including the affected population in the decision-making process – an approach more likely to result in multilateral, effective and sustainable policies of mitigation and adaptation.

FIGURE 2: PUBLIC POLICIES AND CONFLICT



9 D. Matten (2004). 'The impact of the risk society thesis on environmental politics and management in a globalizing economy – principles, proficiency, perspectives', *Journal of Risk Research*, Vol. 4, No. 7, pp.377–98.

An example of this challenge is illustrated in the case of La Ventosa Eolic Park, in the state of Oaxaca. It was built in 2007 by the Spanish firm Iberranova-Iberdrola. Considering that the Istmo de Tehuantepec region of Oaxaca has winds up to 36 km per hour, it is understandable that the Mexican government decided to construct a wind park there, in Juchitán de Zaragoza, in order to decrease the country's emissions. The wind park has an extension of 2,500 hectares and the potential to reduce Mexico's greenhouse gas (GHG) emissions by 6 million tons over 10 years. Furthermore, the energy generated by this wind park is supposed to meet the energy needs of 500,000 people and provide 25 percent of the energy required for the Mexican cement producer Cemex.

At the same time the construction of the wind park has caused a social conflict. The Istmo area has long been inhabited by indigenous tribes, but, according to Javier Balderas Castillo, Director of Centro de Derechos Humanos Tepeyac (Human Rights Centre Tepeyac), this transnational eolic project was carried out without consulting the people from the Istmo. Landowners were tricked and coerced into signing contracts with the promise that the eolic project would bring great economic and work opportunities for them. Yet the indigenous Zapotec tribe feel that they did not receive enough money for their land and that the region does not profit from the wind park at all. As the Mayor of Juchitán stated, 'we want to be part of a project that does not consider us just as cheap labor but as property owners and partners.'<sup>10</sup> Other reasons for criticism include the fact that all the technology is imported and that the energy is not distributed to the local inhabitants. This has provoked several protests. For example, in August 2009 a group of 87 Zapotec farmers from La Ventosa suspended the operation of 42 wind turbines by entering the wind park and pressuring a technician to stop them.<sup>11</sup> Conflicts around this project have not yet been solved.

Having outlined our understanding of how climate change and conflict are related, in the next section we present the main effects of climate change that government and other experts predict for Mexico and its regions.

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<sup>10</sup> See <http://mendocoastcurrent.wordpress.com/2009/01/23/mexico-launches-550-million-wind-farm/>

<sup>11</sup> See <http://www.eluniversal.com.mx/notas/621217.html>

# CLIMATE CHANGE IN MEXICO

## EXPECTED GLOBAL EFFECTS

Our climate is the result of complex and permanent interactions between atmosphere, oceans, poles, continents, planetary rotation, planetary life and human activities. According to the Intergovernmental Panel on Climate Change (IPCC), the main global effects expected from this phenomenon are:

- An increase in the average temperature of the planet.
- Significant changes in precipitation patterns at a global level.
- Warming of the oceans, associated with a reduction of the biosphere and the melting of glaciers in both poles (which will also contribute to the increase in sea level).
- Changes in frequency, types and intensity patterns of extreme weather events.

These environmental changes have direct repercussions for economic and social variables, which include:<sup>12</sup>

- Significant decrease in agriculture productivity, with adverse consequences for food security and exports.
- Important changes in the quality, quantity and availability of water resources for human consumption, agriculture and power generation.
- Damage in coastal zones due to the increase in sea level.
- Acceleration of coral bleaching and increase in the death rates for reefs and associated ecosystems.
- Increase in economic damage due to the greater intensity and frequency of hurricanes and tropical storms as a result of the increase in air temperature and sea level.
- Significant losses in biodiversity due to the extinction of species in the majority of tropical areas.
- Gradual replacement of the tropical forests in the Amazon and elsewhere with agriculture or livestock.

## EXPECTED EFFECTS IN MEXICAN STATES

While some experts interviewed for this report see the changes in climate as a natural variability (not anthropogenic), others argue that Mexico is already experiencing phenomena that demonstrate the potential future effects of global warming and climate change. For example, the number of hurricanes with great intensity has increased in the last 10 years; since 2000 an increase of 1.0°C has been recorded in the average temperature of the country; and the sea level has risen 10 cm in Veracruz since 1955.<sup>13</sup> If this increase continues, thousands of kilometres of coast could be flooded with salt water, affecting agriculture, coastal infrastructure, livestock, tourism, water supply and housing.

Climate variability and its effects are hard to predict. However, scientific evidence and expert opinion suggest that climate change is and will be the cause of the intensification of natural phenomena and disasters in Mexico. As regions within Mexico vary greatly in geography, population and economic development, 'climate change will not be a uniform experience'.<sup>14</sup> With this in mind, the analysis summarises the expected effects of climate change and vulnerable sectors for each of the 31 states and for the Federal District (Mexico City) of Mexico.

12 Economic Commission for Latin America and the Caribbean (ECLAC) and the International Development Bank (2010). *Climate change: A regional perspective*. Santiago de Chile: United Nations. Available at [http://www.eclac.org/publicaciones/xml/3/38763/2010-110-Climate\\_change-a\\_regional\\_perspective.pdf](http://www.eclac.org/publicaciones/xml/3/38763/2010-110-Climate_change-a_regional_perspective.pdf)

13 Inter-ministerial Commission on Climate Change (2007). 'Estrategia Nacional de Cambio Climático' [National Strategy on Climate Change]. Available at [http://www.cinu.org.mx/temas/Calentamiento/vinculos/Estrat\\_nal\\_Sintesis.pdf](http://www.cinu.org.mx/temas/Calentamiento/vinculos/Estrat_nal_Sintesis.pdf)

14 J. R. Lee (2009). *Climate change and armed conflict. Hot and cold wars*. New York: Routledge. p.3.

The analysis of several sources around climate change effects in different regions (see Annex 1<sup>15</sup>) conducted by the authors, shows that twenty-five states will be affected by droughts, fourteen by hurricanes, nine by extreme precipitations, eight by frosts, five by floods, four by heat waves and four by fire. Alarmingly, all the states but one (Campeche) will suffer a decrease in the water supply in the range of 20 to 80 percent by 2025. This situation is critical, not only because it will affect food production and human health, but also because it can generate tensions between communities and states for the control of this resource, as well as competition between different users.

Mexico's population is very vulnerable to these changes. For example, on the one hand, because most of the Mexican territory has semi-arid weather, changes in rain patterns could generate severe droughts and jeopardise food production. On the other, intense precipitation in some regions could be the cause of high-scale floods and mudslides which would threaten the lives and livelihoods of many people. Further, densely populated coasts could mean millions of people displaced due to the rise in sea level.<sup>16</sup> In a more specific way, the changes mentioned above will have direct or indirect effects on the following:<sup>17</sup>

### a) Agriculture

Agriculture will be one of the economic activities most harshly affected by climate change. For example, some calculations predict that the surface with good conditions to grow crops will diminish from the current 40 percent of the national territory to 25.<sup>18</sup> This will directly affect 24 million Mexicans (23.2 percent of Mexico's total population) that work and live in rural areas.<sup>19</sup> The possible effects of climate change in this sector include:

- Increase in food prices and tension between producers and consumers as food security is affected.
- Social unrest and considerable pressures for government support in order to stop the decline in production and rural incomes.
- Migration towards urban centres or other countries.
- More exploitation of natural resources, such as forests, to sustain livelihoods in rural areas.
- An increase of the areas of cultivation, meaning more deforestation.

Moreover, experts interviewed argue that, as temperature rises, especially in the north of Mexico, agriculture and forests will also need more water, which, in turn, will increase pressure on national and local governments to provide new infrastructure to ensure the provision of water for human use.

### b) Ecosystems and biodiversity

Because climate determines ecosystems' vegetation, Mexican ecosystems are highly vulnerable to changes in temperature and precipitation. According to the National Institute of Ecology (INE), 50 percent of the vegetation in the country will be affected and modified by climate change. The most sensitive areas are the temperate-climate forests. 'The adverse effects of climate change in ecosystems and biodiversity are especially important given the fact that Mexico is considered one of the countries with the most biodiversity in the world':<sup>20</sup> 70 percent of the world's species (flora and fauna) live in the country.<sup>21</sup> Furthermore, as forests are a natural source of water production, one of the main effects of a change in forests is a reduction in water supply in some areas.

15 The sources used to build the table are listed in the References section in Annex 1.

16 V. Magaña, J. Méndez, R. Morales and C. Millán (2004). 'Consecuencias presentes y futuras de la variabilidad y el cambio climático en México' [Present and future consequences of variability and climate change in Mexico]. In J. Martínez, A. Fernández and P. Osnaya (Eds.). *Cambio climático: Una visión desde México* [Climate change: A vision from Mexico]. Mexico: INE. p.203.

17 INE, 'Cambio climático en México' [Climate change in Mexico], accessed 21st May 2010. Available at [http://cambio\\_climatico.ine.gob.mx/comprendercc/porquydonesomosvul/donesomosmasvul.html](http://cambio_climatico.ine.gob.mx/comprendercc/porquydonesomosvul/donesomosmasvul.html)

18 Ibid.

19 Secretariat of Agrarian Reform, accessed 15th June 2010. Available at <http://www.sra.gob.mx/sraweb/preguntas-frecuentes/>; Federal Government of Mexico, accessed 15th June 2010. Available at <http://www.presidencia.gob.mx/?DNA=30>

20 L. Villers and I. Trejo (2004). 'Evaluación de la vulnerabilidad en los ecosistemas forestales' [Assessment of vulnerability in forestry ecosystems]. In J. Martínez, et al. (Eds.). Op. cit.

21 Biodiversidad Mexicana, '¿Qué es un país Megadiverso?' [What is a megadiverse country?], accessed 23rd June 2010. Available at <http://www.biodiversidad.gob.mx/pais/quees.html>

**c) Coastal zones**

Mexico has 11,122 km of coasts. According to the INE, the most vulnerable coastal zones are located in the Gulf of Mexico and the Caribbean (2,810 km), specifically in Tamaulipas (Río Bravo Delta), Veracruz (Alvarado's Lagoon and Papaloapan River), Tabasco (Grijalva, Mezcapala and Usumacinta Deltas), Yucatán (Los Petenes isles) and Quintana Roo (Sian Kaán Bay and Chetumal). In these zones, coasts could be covered with salt water up to 50 km inland.<sup>22</sup> Apart from the ecological damage, the flooding of coastal areas will have a direct adverse effect on communities located in them and on their economic activities, such as fishing, raising livestock, growing crops and tourism. Being deprived of their homes and means of living, people will expect the authorities' help; the inability to respond to these demands could generate social unrest and, eventually, an open conflict.

**d) Desertification**

Because climate change will modify precipitation and wind patterns, erosion and deterioration of soils will increase. According to the INE, 70 percent of Mexico's territory is highly vulnerable to droughts. Droughts and desertification will affect 90 percent of the territory of the states of Jalisco, Michoacán, Guerrero, Oaxaca and the north of Sinaloa; 75 percent of Chiapas and Campeche; and most of the territory of Quintana Roo. The social impacts of desertification will be extremely grave because the most vulnerable zones are also the most populated ones and where many economic activities take place.<sup>23</sup>

**e) Hydrology**

The impact of climate change on water resources is quite complex. Potential effects will depend on changes in volume and quality of surface and underground water, as well as on the demand and extraction for human activities. The most vulnerable regions are the centre of the country, Baja California and the Lerma-Chapala-Santiago basin. Once again, the most vulnerable regions are also the most populated.<sup>24</sup>

The effects described above will increase vulnerability in several ways.

**ECONOMIC VULNERABILITY**

- Disruption of economic activity in general, mainly in agriculture, fishing, livestock, forestry and tourism.
- Disruption of production chains.
- Food scarcity and water shortage for human consumption as consequences of the changes in the cycles of harvest, production and water.
- Loss of infrastructure, mainly in the oil industry located in the coasts.

**SOCIAL VULNERABILITY**

- Disruption of the millions of Mexicans who inhabit coastal cities and areas with a risk of flooding, which will require a relocation of the population.
- Greater impoverishment of the rural population because their source of income will be affected by climate change.
- Displacement of the rural population to the city, which will increase pressure on the urban system through an increase in urban poverty.
- Public health emergencies such as dengue fever and malaria cases.

**POLITICAL VULNERABILITY AND NATIONAL SECURITY**

- Conflicts over the control of water and other resources.
- Weakness of the state (due to a lack of resources) to help and relocate the victims of natural disasters.
- Increase in subversive groups as a result of the intensification of poverty and competition for natural resources.
- Authoritarian practices to control the situation and implement necessary adaptive and mitigating measures.

22 INE, *Estudios de Vulnerabilidad* [Vulnerability studies], accessed 15th June 2010. Available at [http://www2.ine.gob.mx/cclimatico/conv\\_marco2\\_3e.html](http://www2.ine.gob.mx/cclimatico/conv_marco2_3e.html)

23 O. Oropeza, M. Hernández, R. Zárate, et al. (1995). *Estudio de País: México: Vulnerabilidad a la Desertificación y a la Sequía Meteorológica* [Country study: Mexico: Vulnerability to desertification and meteorological drought]. Mexico: INE.

24 V. Mendoza, E. Villanueva and L. Maderrey (2004). *Vulnerabilidad en el recurso agua de las zonas hidrológicas de México ante el Cambio Climático Global* [Vulnerability of Mexican hydrological zones to climate change]. In J. Martínez, et al. (Eds.). Op. cit.

Experts agree that there is an institutional gap between the generation of information and the capacity of governments, at regional and local level, to assimilate this information and produce sound policies. According to the INE, at present of the thirty-two states of Mexico only two, Mexico City and Veracruz, have Climate Action Plans, while eight more are in the development process, six are in the planning process and sixteen have not yet begun planning.<sup>25</sup>

Moreover, as shown in the following section, capacities and potential for action are not the same in every part of the country and debates at the local level are ongoing. For example, in Tuxtla Gutiérrez, the capital of the southern state of Chiapas, the issue of whether atypical hydro-meteorological events such as strong precipitations are due to climate change or to a natural variability of climate is still being discussed. Nonetheless, the majority of the interviews show that the risks associated with these events are increasing due to the urbanisation process.

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25 INE, *Avances de los Programas Estatales de Acción ante el Cambio Climático* [Advancements in state action programmes regarding climate change], accessed 27th July 2010. Available at <http://www2.ine.gob.mx/sistemas/peacc/>

## CLIMATE CHANGE? PERCEPTION OF CLIMATE IN TWO SOUTHERN STATE CAPITALS

For this project, we focused on the states of Chiapas and Veracruz because of their hydrological importance. The state of Chiapas is part of the hydrological region known as “Frontera Sur” which represents 5.19 percent of the Mexican territory. One of the main problems in this region is the recurrent extreme hydrological events which cause rivers to overflow. Also, because of deforestation and extreme precipitations, there has been substantial erosion, worsening the flooding problem. Veracruz is the third most populated state in Mexico; it has more than 40 rivers and 35 percent of the surface water of Mexico traverses its territory. But the advantage of being a state rich in water resources becomes a problem when intense precipitations occur. In addition, its location makes Veracruz vulnerable to tropical storms and hurricanes that threaten the life of its inhabitants.

This section is based on two local stakeholder analyses carried out by CCC in 2009. The analyses were made after interviewing 31 representatives of local NGOs and experts, as well as municipal, state and federal authorities (12 from Chiapas and 19 from Veracruz).

### TUXTLA GUTIÉRREZ, CHIAPAS

The people interviewed identified diverse risks related to climate change during the previous few years in the state of Chiapas. It is important to mention that none of the people interviewed associated such risks with global warming; in fact, the majority attributed them to human causes. The risks identified can be grouped in the following categories:

#### **a) Rains**

In general, the people interviewed affirmed that the rain pattern had changed. Those who affirmed the previous statement noted that:

- The average precipitation rate has decreased.
- When they happen, rains are more torrential.
- The rainy season comes earlier each year.
- The pattern of the rains has become more unstable.
- It rained “in zones” and not in a uniform manner in the city.

#### **b) Temperature**

There was no consensus among the people interviewed as to whether the temperature had increased or remained the same. For example, some agreed that it had been less cold in the winter and, in general, the heat was more intense. Others, however, stated that temperatures had become extreme: colder in the winter and warmer during summer. Also, some declared that temperature varied by zone in the same city: that it was much warmer in the centre than in the zones with more trees.

#### **c) Seasons**

The people interviewed affirmed that there had been a loss of seasonality.

**d) Floods**

Even though in recent years there has not been an important flood, the level of the river Sabinal has been high. The people interviewed supported the claim that floods are the product of urban growth, especially the increased amount of pavement (that impedes water filtration, takes away natural barriers and lets the water run into the river with greater speed). There was no agreement on whether the streams have more water or are drying out.

**e) Cloudiness**

Two people who were interviewed mentioned this issue. One perceived more cloudiness, even if there was no rain, and associated this phenomenon with the presence of dams. The other, in contrast, believed that it had become less cloudy.

**f) Mudslides**

The people interviewed identified deforestation as the principal cause of mudslides, especially along the highways and in high zones.

**g) Fires**

The majority of the interviewees mentioned that there had not been a variation in the pattern of the fires; however, others maintained that the fires had increased, mostly due to increased burning of trash.

**h) Winds**

One interviewee mentioned that the winds had increased.

**i) Main expected effects**

The main effects of climate change that will affect the state are:

- Less quality and availability of water leading to a greater number of gastrointestinal illnesses.
- Increase in temperature leading to increased susceptibility to pathogen outbreaks.
- Increase in electricity consumption (due to the use of air conditioners).
- Growth in rivers.
- Atypical rains.
- Cold fronts.
- Overflows in tributary streams.

**XALAPA, VERACRUZ**

There was a high level of knowledge among interviewed participants regarding changes that have resulted from the variations in climate conditions.

- Principal changes observed in the conditions of the climate:
  - There is a greater concentration of rains (rains with more intensity in less time).
  - The streets have flooded with greater frequency than before.
  - The climate of the state has become warmer.
  - Due to the deforestation on the eastern slope of the Cofre de Perote, the annual precipitation level has been reduced.
- Outlook for the next few years:
  - Increase in the storms in the mountains.
  - More violent storms.
  - Periods of heat in the cities.
  - Frequent fires (particularly in the northern zone of the state).
  - Melting of glaciers (in the case of the Pico de Orizaba).

- Impact of these changes on the supply of water and sanitation:
  - The increase of rains will affect the level of turbidity of the water and its necessary process of disinfection.
  - Obstruction of the pipes by residue in the water.
  - The torrential rains have become a permanent risk for people that live next to the rivers.
  - Water cannot be supplied at 350 litres/person/day if the temperature surpasses 4°C as the Hadley Centre of Meteorological Services in Britain predicts.
  
- Approaches to the relationship between climate change and water:
  - One of the interviewees perceived that the population and some government officials understand climate change as an 'inevitable issue of the planet and not as consequences of local and regional decisions'.
  - Another interviewee considered it tendentious to attribute all water problems to climate change. Climate change is not an independent variable; it is a dependent variable like others, such as poverty and deforestation.

Finally, an expert on the subject warned that we must be cautious about long-term forecasts of climate change, since new variables are likely to be taken into account to evaluate climate change, and the measuring instruments used are constantly being refined.

## CONCLUSIONS AND RECOMMENDATIONS

This document reflects the work undertaken by CCC during the first year of the “Early Warning Systems: Analysis for Action” project. Although the project is still in progress, the findings obtained to date – through the research and analysis conducted by the authors and the feedback received from peers and colleagues from different backgrounds – allow us to make the following preliminary comments:

- The relation between climate change and conflict is not linear. On the contrary, it is embedded in a complex context where climate change effects can exacerbate existing tension between individuals, communities, social groups and governments at all levels. As seen above, in order to respond to the physical consequences of climate change, the Mexican government has developed adaptation or mitigation policies which, depending on how these are implemented, have given rise to either positive or negative responses from different stakeholders – individuals, social groups, international organisations, NGOs, businesses and the social sector.
- These responses can be collaborative or adversarial. Collaborative responses could more easily lead to the reduction of risks and vulnerability. However, adversarial responses could either directly lead to violent conflict, or be a sign that the society has become aware that the situation needs attention. In this last case, adversarial responses could lead to a positive transformation of conflict into actions that could reduce people’s vulnerability.
- Stakeholder responses, whether positive or negative, could be handled by opening the space for dialogue. Indeed, through the establishment of multilateral and comprehensive policies, which would take into account stakeholders’ interests, concerns and needs, constructive solutions and effective instruments for fighting against climate change can be put into place. As a participant in one CCC workshop confirmed: ‘not every conflict leads to disaster, but all disasters could lead to conflict’.
- The effectiveness and sustainability of adaptation and mitigation policies will depend on how much they take into account the interests, worries and needs of different stakeholders. It is imperative for governments, donors, international organisations and NGOs to acknowledge that social participation is essential for successfully coping with climate change effects.
- CCC’s research has revealed that, despite a lack of polls to gauge the population’s views on the risks posed by climate change, it is clear that, given the lack of information provided by key decision-makers, the population is not well aware of the effects of climate change.
- Therefore, climate change is an issue that has to be addressed through an early-warning system, which would include all stakeholders from the beginning of the whole prevention process, without allowing change to depend only on a single institution or ministry in a government.
- The early-warning process should be inclusive and embedded in society. In this way, transparency, accessible information, and freedom of the press would be respected. Further, the capacity of local universities, NGOs and the business sector to assimilate complex information would be built, while social awareness, public discussion and participation would be encouraged. An inclusive approach would be very effective in facilitating the ability to “sound the alarm” on climate change consequences.
- If sufficient capacities for democracy are *not* in place, in some regions we could see a return to authoritarian practices, the monopolisation of scarce resources by some groups, or other abuses that would increase people’s vulnerability and will affect individuals’ rights, potentially leading to an elevation of social tension and a probable escalation of violence.
- In Mexico, state authorities do not pay enough attention to strengthening local capacities. This report stresses that there is an urgent need to assess where these capacities are lacking and to come up with adequate incentives to foster the necessary political will to advance relevant people-oriented public policies.

- A National Strategy on Climate Change (ENACC) has been proposed at the national level and recently a Special Program on Climate Change (PECC) has been put in place. Nonetheless, this PECC is limited in the sense that it does not ask for the necessary legislative changes; it only provides for actions to be taken up until the end of the current presidency (2012). The PECC gives priority to mitigation over adaptation. It is still too general and only includes a few clear actions, without envisaging systemic changes, such as energy-efficiency policies or long-term vulnerability reduction.

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## ANNEX 1: CLIMATE CHANGE EXPECTED EFFECTS AND VULNERABILITY IN MEXICAN STATES



Map source: <http://www.map-of-mexico.co.uk/espanola/mapa-politico-de-mexico-grande.htm>

STATE	CLIMATE CHANGE EXPECTED EFFECTS	VULNERABILITY
<b>Aguascalientes</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Heat waves</li> <li>▪ Floods</li> </ul>	<ul style="list-style-type: none"> <li>▪ Stress over the water scarcity because of high demand/ inefficient use of water for agriculture and urban consumption and deteriorated soils and ecosystems.</li> <li>▪ Increase in urbanisation and in poverty levels.</li> <li>▪ Infertile soils and irregular rain patterns that affect corn, bean and forage crops.</li> <li>▪ Desertification of 185,290 hectares and indiscriminate extraction of underground water.</li> </ul>
<b>Baja California</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Floods</li> </ul>	<ul style="list-style-type: none"> <li>▪ Critical stress over the supply of water, which will diminish by 80% by 2025. Intrusion of salt water to underground water reservoirs because of indiscriminate extraction.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ 25% of the arable land depends on seasonal rains.</li> <li>▪ Human life and economic losses because of hurricanes.</li> </ul>
<b>Baja California Sur</b>	<ul style="list-style-type: none"> <li>▪ Hurricanes</li> <li>▪ Extreme precipitation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Critical stress over the supply of water, which will diminish by 80% by 2025. Intrusion of salt water to underground water reservoirs because of indiscriminate extraction.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ 25% of the arable land depends on seasonal rains.</li> <li>▪ Human life and economic losses because of hurricanes.</li> </ul>
<b>Campeche</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Hurricanes</li> </ul>	<ul style="list-style-type: none"> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Even though the state has high precipitation levels, periods of low or no rain have become frequent. These periods of drought affect agriculture, livestock and fishing, and increase the proneness to forest fires.</li> <li>▪ Oil and natural gas extraction facilities are very vulnerable to climate change. 96.4% of oil extraction and 95.8% of gas extraction activities are located in the state.</li> </ul>
<b>Chiapas</b>	<ul style="list-style-type: none"> <li>▪ Hurricanes</li> <li>▪ Extreme precipitation</li> <li>▪ Forest fires</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over the supply of water, which will diminish by 20% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Dramatic decrease of areas covered by tropical and temperate forests.</li> <li>▪ Health emergencies: increase of malaria, morbid diarrhoea and dengue fever cases caused by warmer temperatures.</li> </ul>
<b>Chihuahua</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Frosts</li> <li>▪ Heat waves</li> </ul>	<ul style="list-style-type: none"> <li>▪ Critical stress over water supply, which will diminish by 60–80% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Total and partial losses of agriculture production because of long drought periods, even during the rainy season (July–September). This has caused, and will continue to cause, unemployment, migration and conflicts between water users.</li> <li>▪ Less precipitation because of deforestation (caused by fires, droughts and land-use changes).</li> </ul>

<b>Coahuila</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Frosts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Critical stress over water supply, which will diminish by 60–80% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Total or partial loss of agriculture and livestock production. This will continue to cause unemployment, migration and conflicts between water users.</li> <li>▪ Less precipitation because of deforestation (caused by fires, droughts and land-use changes).</li> </ul>
<b>Colima</b>	<ul style="list-style-type: none"> <li>▪ Hurricanes</li> <li>▪ Droughts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Severe stress over the supply of water, which will diminish by 40–60% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Health emergencies: increase of dengue fever and malaria cases caused by warmer temperatures.</li> </ul>
<b>Distrito Federal (Mexico City)</b>	<ul style="list-style-type: none"> <li>▪ Floods</li> <li>▪ Heat waves</li> </ul>	<ul style="list-style-type: none"> <li>▪ Critical stress over water supply, which will diminish by 80% by 2025.</li> <li>▪ Densely populated areas and increase in urbanisation and in poverty levels.</li> <li>▪ Loss or deterioration of forests within the limits of Mexico City.</li> </ul>
<b>Durango</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Frosts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ 31% of mountain forests, 22% of temperate forests and 10% of tropical forests of the state will be damaged.</li> </ul>
<b>Guanajuato</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Frosts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over water supply, which will diminish by 20–40% by 2025. The Irapuato-Salamanca-León industrial belt will be particularly affected.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ 50% of the state's territory will be affected by desertification.</li> </ul>
<b>Guerrero</b>	<ul style="list-style-type: none"> <li>▪ Hurricanes</li> <li>▪ Extreme precipitation</li> <li>▪ Forest fires</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over water supply, which will diminish by 20–40% by 2025. The touristic zone in the Pacific coast will be particularly affected by water shortages.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Health emergencies: increase in dengue fever and malaria cases caused by warmer temperatures.</li> </ul>
<b>Hidalgo</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Frosts</li> </ul>	<ul style="list-style-type: none"> <li>▪ The Tula-Vita-Asasco industrial belt will be affected by a decrease in water supply.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ 50% of the state's territory will be affected by desertification.</li> </ul>
<b>Jalisco</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Hurricanes</li> <li>▪ Forest fires</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over the supply of water, which will diminish by 20–40% by 2025. High demand for water for agriculture and urban consumption.</li> <li>▪ Densely populated areas, increase in urbanisation and poverty levels.</li> <li>▪ Low intensity but long drought periods, which will continue to affect the Chapala Lake and crops that depend on the rainy season.</li> <li>▪ Decrease of the land suitable for corn crops.</li> <li>▪ 31% of the state's mountain forests will be affected.</li> </ul>

<b>Estado de México</b>	<ul style="list-style-type: none"> <li>▪ Extreme precipitation</li> <li>▪ Cold fronts</li> <li>▪ Droughts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Critical stress over the supply of water, which will diminish by 80% by 2025. High demand for water for agriculture and urban consumption.</li> <li>▪ Densely populated areas and increase in urbanisation and poverty levels.</li> <li>▪ Desertification and wind erosion.</li> </ul>
<b>Michoacán</b>	<ul style="list-style-type: none"> <li>▪ Hurricanes</li> <li>▪ Droughts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over water resources, which will diminish by 20–40% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Increase in droughts.</li> </ul>
<b>Morelos</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over the supply of water, which will diminish by 20–40% by 2025. Water supply varies greatly in different regions of the state, the north having a severe problem of water shortages because of the loss of the Popocatepetl glacier and deforestation. Topographic and geological characteristics cause a very limited availability of surface and underground water.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Open-air agriculture, which represents most of the state's crops, is highly vulnerable to climate change.</li> </ul>
<b>Nayarit</b>	<ul style="list-style-type: none"> <li>▪ Hurricanes</li> </ul>	<ul style="list-style-type: none"> <li>▪ Severe stress over the water supply, which will diminish by 40–60% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ 50% of the state's territory will be affected by desertification.</li> </ul>
<b>Nuevo León</b>	<ul style="list-style-type: none"> <li>▪ Extreme precipitation</li> <li>▪ Droughts</li> <li>▪ Cold waves</li> </ul>	<ul style="list-style-type: none"> <li>▪ Severe stress over the water supply, which will diminish by 60–80% by 2025.</li> <li>▪ Densely populated areas and increase in urbanisation and poverty levels.</li> <li>▪ Health emergencies: increase in dengue fever and malaria cases caused by warmer temperatures and by an increase in humidity.</li> </ul>
<b>Oaxaca</b>	<ul style="list-style-type: none"> <li>▪ Hurricanes</li> <li>▪ Forest fires</li> <li>▪ Droughts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over the water supply, which will diminish by 20–40% by 2025. Surface water will be particularly affected by climate change.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ The enormous dependence of local agriculture on the rainy season could translate into total or partial losses of food production. Water extraction for agriculture and urban consumption has increased, which has diminished the availability of underground water. If water extraction is not regulated, competition for it may be the cause of social conflicts.</li> <li>▪ The state's temperate forests are very likely to disappear because of climate change.</li> <li>▪ Health emergencies: increase in dengue fever and malaria cases caused by warmer temperatures.</li> </ul>

<b>Puebla</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Frosts</li> <li>▪ Extreme precipitation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate pressure over the water supply, which will diminish by 20–40% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ The state will be severely affected by droughts.</li> <li>▪ The land suitable for corn crops will diminish.</li> <li>▪ Health emergencies: increase in morbid diarrhoea cases.</li> </ul>
<b>Querétaro</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate pressure over the water supply, which will diminish by 20–40% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ 50% of the state's territory will be affected by droughts.</li> </ul>
<b>Quintana Roo</b>	<ul style="list-style-type: none"> <li>▪ Hurricanes</li> <li>▪ Extreme precipitation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over the supply of water, which will diminish by 20–40% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Even though the state has high precipitation levels, periods of low or no rain have become frequent. These periods of drought affect agriculture and livestock, and increase proneness to forest fires.</li> <li>▪ Material damages to tourist infrastructure and decrease in tourism.</li> </ul>
<b>San Luis Potosí</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Extreme precipitation</li> <li>▪ Frosts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Severe stress over the supply of water, which will diminish by 60–80% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ In some regions, agriculture will be severely affected by floods cause by extreme rains.</li> <li>▪ Water shortages.</li> </ul>
<b>Sinaloa</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Floods</li> </ul>	<ul style="list-style-type: none"> <li>▪ Severe stress over the supply of water, which will diminish by 40–60% by 2025. Present water shortages are caused by indiscriminate extraction of water for agriculture, industrial and urban consumption.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Health emergencies: increase in dengue fever and malaria cases caused by warmer temperatures and more humidity.</li> </ul>
<b>Sonora</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Heat waves</li> <li>▪ Cold fronts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Critical stress over the supply of water, which has diminished and will continue to do so because of technological, productive and social processes that have caused deterioration in the environment.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ The arid zones of the state will increase by 30%.</li> <li>▪ The state's high-technology production of fruits and vegetables and the expanding urban centres will compete for the water supply.</li> <li>▪ Inefficient water distribution systems in the countryside.</li> <li>▪ Increase in pollution and salinity of soils.</li> <li>▪ Deforestation and erosion caused by immoderate cutting of trees and forest fires.</li> <li>▪ Increase in mortality rates because of heat waves.</li> </ul>

<b>Tabasco</b>	<ul style="list-style-type: none"> <li>▪ Floods</li> <li>▪ Hurricanes</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over the supply of water, which will diminish by 20% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Even though the state has high precipitation levels, periods of low or no rain have become frequent. These periods of drought affect agriculture, livestock and fishing, and increase proneness to forest fires.</li> <li>▪ The state has one of the most vulnerable zones to a rise in the sea level: the Grijalva-Mazcapala-Usumacinta delta.</li> </ul>
<b>Tamaulipas</b>	<ul style="list-style-type: none"> <li>▪ Hurricanes</li> <li>▪ Droughts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over the supply of water, which will diminish by 20–40% by 2025.</li> <li>▪ Increased urbanisation and poverty levels.</li> <li>▪ Total or partial losses of agricultural production because of droughts or floods (depending on the region).</li> <li>▪ Long drought periods, even during the rainy season (July–September), will continue to cause unemployment, migration and conflicts between water users.</li> <li>▪ Deforestation caused by fires, droughts and land-use changes will diminish precipitation.</li> <li>▪ Health emergencies: increase in dengue fever and malaria caused by warmer temperatures.</li> </ul>
<b>Tlaxcala</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Frosts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over the supply of water, which will diminish by 20–40% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Droughts will increase throughout the state.</li> </ul>
<b>Veracruz</b>	<ul style="list-style-type: none"> <li>▪ Extreme precipitation</li> <li>▪ Hurricanes</li> <li>▪ Droughts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over the supply of water, which will diminish by 20–40% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Decrease in land suitable for corn crops. Total or partial loss of agricultural production due to hurricanes and floods or droughts (depending on the region).</li> <li>▪ The state's temperate forests located in the Sierra de Zongolica will be severely damaged.</li> <li>▪ Health emergencies: increase in dengue fever and malaria cases caused by warmer temperatures.</li> </ul>
<b>Yucatán</b>	<ul style="list-style-type: none"> <li>▪ Hurricanes</li> <li>▪ Droughts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Moderate stress over the supply of water, which will diminish by 20–40% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Even though the state has high precipitation levels, periods of low or no rain have become frequent. These periods of drought affect agriculture, livestock and fishing, and increase proneness to forest fires.</li> <li>▪ The isles known as Los Petenes will be severely damaged by the rise in sea level.</li> </ul>
<b>Zacatecas</b>	<ul style="list-style-type: none"> <li>▪ Droughts</li> <li>▪ Cold waves</li> </ul>	<ul style="list-style-type: none"> <li>▪ Severe stress over the supply of water, which will diminish by 60–80% by 2025.</li> <li>▪ Increase in urbanisation and poverty levels.</li> <li>▪ Severe droughts.</li> </ul>

## ANNEX 1 REFERENCES

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## ANNEX 2: ACTIONS TAKEN AT A NATIONAL LEVEL

The Mexican government has been carrying out different actions to address climate change since 1992, when the country signed and ratified (1993) the UNFCCC.<sup>26</sup> The most important actions taken thus far have been the establishment of the Inter-ministerial Commission on Climate Change (2005), the ENACC (2007) and the PECC (2008).

The **Inter-ministerial Commission on Climate Change** was created to coordinate the different ministries and other federal government institutions in the design and implementation of national public policies to prevent and mitigate the emissions of GHGs, to adapt to the adverse effects of climate change, and, in general, to promote the development of programmes and strategies to fulfil the obligations acquired by Mexico with the signing and ratification of the UNFCCC and the Kyoto Protocol (signed in 1997 and ratified in 2000). The Commission is composed of the heads of the following Ministries: Agriculture, Livestock, Rural Development, Fishing and Alimentation (SAGARPA); Health (SSA); the Interior (SEGOB); Environment and Natural Resources (SEMARNAT); Communications and Transports (SCT); Energy (SENER); Economy (SE); Finances (SHCP); Social Development (SEDESOL); and Foreign Affairs (SRE).<sup>27</sup>

The **ENACC** and the **PECC** are the present administration's first steps to try to summarise the country's situation regarding climate change and natural extreme events, and to identify specific measures for mitigation and adaptation. In both the ENACC and the PECC, the Mexican government acknowledges climate change as one of the major challenges that humankind must overcome, or, more precisely, manage.

### A LONG-TERM VISION FOR MITIGATION AND ADAPTATION

The Mexican government suggests two opportunities through which climate change can be mitigated on a long-term basis:

- 1) reducing energy intensity; and
- 2) the de-carbonisation of the Mexican economy.

These require maximising the efficient use of energy, minimising fugitive emissions, intensifying the widespread use of low-power-generating or carbon-neutral technologies (such as renewable energy, nuclear energy, and developing capture and geological storage of CO<sub>2</sub>), minimising CO<sub>2</sub> emissions, as well as significantly reducing other GHG emissions of industrial and agricultural activities and managing waste.

The push to address climate change can also be justified from an economic point of view, because the costs of mitigation are lower than the costs of "inaction". According to the UNAM study "The Economics of Climate Change"<sup>28</sup> the damage resulting from climate change in Mexico will be between 3.5 and 4.2 percent of the GDP, resulting from losses in agricultural production, lower availability of water, clearing of forests, effects on health and the loss of biodiversity. The cost of implementing the objectives to address climate change, on the other hand, would only equal 0.56 percent of Mexico's GDP.

Firstly, the ENACC and the PECC identify opportunities for the mitigation of GHG emissions. The main objective in this area is the progressive decoupling of increased emissions from economic growth. The government defined its overall objective as '*50% para el 2050, respecto al 2000*', which describes the government's aspiration to reduce Mexico's emissions by 50 percent by 2050, using as its base the level of emissions in the year 2000. The ENACC and the PECC outline two sectoral entry points and specific mitigation targets within the timeframe

26 Secretariado Técnico de la Comisión Intersecretarial de Cambio Climático (2008). Op. cit.

27 SEMARNAT. 'Comisión Intersecretarial de Cambio Climático' [Inter-ministerial Commission on Climate Change], accessed 13th May 2010. Available at <http://www.semarnat.gob.mx/temas/cambioclimatico/Paginas/cicc.aspx>

28 L. M. Galindo (2009). Op. cit.

of the present government, that is, until 2012. Considering that managing climate change is a long-term project, this timeframe can be criticised as being too short, particularly in respect of the focus on CO<sub>2</sub> reductions, which has failed to lead to the desired outcome in the past.

### **a) Energy generation and use**

The development of the energy market in Mexico has the potential not only to reduce GHG emissions but also to allow for the provision of a cleaner, more sustainable, efficient and competitive energy supply. The government identifies various opportunities in the energy sector for GHG mitigation, indicating their potential savings of emissions. These opportunities range from the area of energy efficiency, actions to be taken by the Mexican oil company (PEMEX) and the industrial sector, power generation and distribution, and renewable energy in the transport sector. In order to develop these mitigation opportunities, public policies have to be guided by certain corresponding priorities.

In the area of the use of energy, the transportation sector accounted for 20 percent of Mexico's emissions in 2006, providing another opportunity for significant reductions in emissions. Even though the government's approach again enforces energy-efficient technologies for the transport sector, it is very significant that the strategy lacks any provision to extend this to the public transport system. A more well-developed public transport system could contribute to keeping private vehicles out of the cities, as people could choose to travel by public transport if the benefit of public transport exceeds the benefit of driving by car. Another possibility would be to levy a toll for private vehicles in the city centres, following the example of the city of London for instance, thereby forcing people to opt for public transport and decreasing emissions.

Furthermore, the government plans to initiate efforts to promote renewable energy. This includes the strengthening of the production and use of sustainable energy as an alternative low-carbon technology, as well as strengthening the use of solar energy to heat water. One example of this is the construction of the wind-energy electric generator corridor known as La Ventosa in the state of Oaxaca. La Ventosa is situated in the region called the Istmo de Tehuantepec (southern Mexico). This area covers a surface of 1000 km<sup>2</sup> that is exposed to very strong winds due to a monsoon phenomenon occurring between the Gulf of Mexico and the Gulf of Tehuantepec. Given these natural conditions, this region appeared to be the perfect place to set up a wind park, operating for the Federal Electricity Commission (CFE) at a capacity of almost 4 MW.

However, the construction of La Ventosa has had a great impact on the environmental and social fields. The Istmo is the most important migratory bird route in the world, so birds and bats have had to change their course due to the windmills. Moreover, there have been oil spills and electromagnetic noise that have directly affected the Istmo's fauna.

Economically, there has not been sufficient steady employment and the remuneration offered by transnational industries for the lands has been very low, between 20 and 30 times lower than in the US or Europe. The presence of the mills has also led to a devaluation of the properties nearby.

Socially, there has been a disintegration of the social fabric within and between communities in the region. This has led to conflict, as communities feel the project was an imposition from the government. There has been more migration of families because they do not feel that they receive any profit from the wind-energy electric generator corridor.

### **b) Vegetation and land use**

In order to conserve carbon in forest ecosystems and reduce GHG emissions from land use, land-use change, forestry and agriculture, three different categories of actions are considered: conservation of carbon stocks, carbon capture and carbon substitution. Opportunities for carbon conservation in forests can be carried out through sustainable forest development, payment for environmental services, wildlife management, conservation of forest ecosystems in protected areas and forest health. Carbon capture would be achieved through reforestation and recovery of land suitable for forestry, soil restoration with reforestation, commercial forestry plantations and a forest Clean Development Mechanism. Furthermore, the government suggests the promotion of forest-derived bio-energy and alternatives in crop and livestock production. These mitigation opportunities again rely on public policies with corresponding priorities.

However, mitigation of climate change through actions for reducing GHG emissions will not be sustainable without clear economic incentives to promote them. Mexico should aspire to the establishment of an integrated national scheme for emissions trading. This scheme would operate with controlled, initially low-set, carbon prices which would be subject to periodic review until reaching equilibrium with international market prices.

Capacity Building for Adaptation to climate change is identified as another objective of both the ENACC and the PECC. This requires developing the abilities of different stakeholders to adjust to and cope with climate change in order to cope with potential damage. Thereby the vulnerability of the country can be reduced and the sustainability of the economic development can be better ensured. The areas of capacity-building in Mexico include hydro-meteorological risk and water resource management, biodiversity and environmental services, farming, coasts, human settlements, and energy generation and use.

In order to improve decision-making and policy response to climate change, investments in research and knowledge creation in the fields of mitigation and adaptation must be made, following the priorities predefined by the objectives and expected outcomes outlined in the ENACC and the PECC.

Regarding the financing of the ENACC and the PECC, it is important to mention that Mexico, as a developing country, has been able to negotiate a loan of \$500 million with the World Bank, which it will use to provide technical assistance to develop institutional capacity, strengthen transversal policies and improve scientific and technological knowledge of emission sources as well as opportunities for mitigation and adaptation. The loan also helps finance the highly ambitious national strategy to address climate change. It is important to highlight that almost all the actions of the ENACC and the PECC are conditioned on foreign financing, which is still being negotiated. In the meantime, the Mexican government has not searched for national financing to implement the objectives established in both the PECC and the ENACC. For example, the government could cut the subsidies to gasoline and electricity and use this money to support the development of cleaner technologies.



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