

# **Environmental sustainability agenda: Metropolitan Area of Mexicali, Baja California, Mexico**

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## **Abstract**

Human settlements worldwide have experienced environmental problems as a result of population growth, an increase in productive activities and low financial capacity of municipalities to provide adequate infrastructure and public services. At the local level, problems of water, soil and air pollution, as well as, land use changes have arisen due to the expansion of urban agglomerations. Regionally, there have been negative impacts on watersheds, ecosystems and biodiversity. Globally, the world is experiencing climate change, the reduction of the ozone layer and the increase of natural disasters. The situation has posed a challenge in terms of urban and regional planning, especially for metropolitan areas and medium-sized cities. The purpose of this study is to present an alternative to integrate environmental sustainability into metropolitan planning in Mexico, specifically applied to the Metropolitan Area of Mexicali, Baja California. Therefore the Environmental Sustainability Agenda has focused on three objectives: first, identifying the weaknesses of the existing environmental and human settlements legal framework; second, developing an environmental assessment and; third, designing policies, strategies and indicators to implement institutional monitoring of environmental programmes. The results were obtained by conducting surveys, regional community workshops, and reviewing previous research. Lastly, this study concludes with six sectoral programs: water, air, solid wastes, green areas, soils and physical pollution and six transversal



programs that have effects on environmental education, health, climate change, environmental management and the legal framework.

*Keywords:* *environmental planning, environmental agenda, metropolitan planning, sustainable development.*

## 1 Introduction

Environmental impacts occur at the local, regional, and global scale. From recent global environmental summits, it has emerged that these impacts need to be addressed at their corresponding scale. At the local scale, the impacts include the following: population growth has exceeded the capacity of governments to provide local infrastructure and equipment; urban expansion has resulted in the loss of high quality agricultural land, forests and ecosystems have degraded due to water, soil, and air pollution, the increase of private vehicles, material banks have been exploited by the continued demand of construction materials, the concentration of chemical risk areas, as well as the import of food and other supplies to sustain people's domestic consumption. The regional impacts are related to watershed management, ecosystem protection and conservation, and energy source usage. Global impacts consist of climate change, air emissions, ozone depletion, and increases in natural disasters [1, 2]. The problems pointed out above represent a challenge for the field of planning human settlements, primarily in cases of large metropolitan areas and medium cities.

Facing such problems has required a number of efforts over nearly forty years that have improved environmental management. Legal frameworks, both general and specific, have been implemented to regulate environmental quality. This has occurred in both developing and developed countries. New analytical instruments, environmental evaluation methodologies, and prospecting and statistical measures have been developed as product of scientific and technological advancements. Finally, arrangements and agreements have been made between countries for environmental conservation or for commercial purposes, where environmental protection has become important.

Under the above context both Mexico and particularly the state of Baja California, have tried to respond to the protection of the environment in different ways. First, in 1988, a federal legal framework was put in place. In 1992, the state of Baja California implemented an additional legal framework. Both the federal and state frameworks were complementary to existing human settlement legislation. Second, policies and programmes resulting from the various National Development Plans have been developed since the nineties. Third, international agreements between Mexico and the USA have focused on the protection of the environment in the border area. Some of these agreements have been in place since 1982; others are more recent, such as NAFTA. Therefore, the purpose of this study is to integrate environmental and sustainability aspects into the planning of metropolitan areas in Mexico and to specifically focus on issues involving the Mexican-American border. This is referred to as the Environmental Sustainability Agenda for the Metropolitan Area of Mexicali, Baja California.



## 2 Methodology

The methodology focuses on the elaboration of the environmental assessment, on one hand we worked on the review of documentary sources that had two types of contributions: on one side, the assessment of the legal framing, another about institutional policies and other instruments for environmental planning and human settlements; on another side, to provide a quantitative overview of the environmental problems of the metropolitan area of Mexicali municipality that included the following topics: water, energy, air, soil and land use, municipal and hazardous solid waste, green space and ecological conservation and risks. On the other hand, in the realization of the environmental assessment for the municipality regions that formed the metropolitan area of Mexicali through the review of participants of different committees from the community that make up the Committee for Development Planning for the Mexicali Municipality (COPLADEMM, for its acronym in Spanish) including representatives of farms, ranches, health, education, tourism, parents associations, businesses, communal land delegates, environmental groups, potable water committee, committee of neighbors and city officials [3].

To perform this community planning exercise sessions were organized through COPLADEMM conducted between September and November 2011. In the first case the assessment of the city of Mexicali was made in COPLADEMM headquarters. The second session was held in the South Valley subregion called Guadalupe Victoria to where members of the various committees of the municipal offices that integrate this area attended. The third was held in the town of Ciudad Morelos, and was attended by community representatives of various administrative sectors in this area.

As result of this second phase two types of information were obtained: on one hand the survey applied to actors from the community regarding issues contained in the environmental agenda. On the other, there were the results of the internal discussion among the participants of the relevant issues to be addressed regionally in the metropolitan area. The environmental information along to the previously mentioned will provide an integrated and complementary assessment vision. Information that will be added to the legal framework. The material generated will serve as input for the design of policies and for the list of indicators.

## 3 Environmental assessment of the metropolitan zone of Mexicali

### 3.1 Socio-economic-evolution of the metropolitan zone

The municipality of Mexicali is located in the State of Baja California, Mexico; it is bordered to the north by the Imperial County of California in the United States of America, and east bounded by the Colorado River, state line between Baja California and Sonora. Mexicali sits on a large delta plain shared by two



large agricultural valleys: Mexicali (Mexico) and Imperial (USA) both were created, since last century, as a huge irrigation area oriented to export products.

The delta is crossed by numerous seismic faults that are part of the San Andres system, which makes this a highly seismic zone and at the same time, becomes in a rich area in geothermal resources, resulting from tectonic activity and the presence of aquifers that support power generation for the region. Mexicali is located in an arid area, a condition that makes water a scarce resource in both surface and underground; the Colorado River is the only permanent source of supply for Mexicali and other cities in the state, which is regulated since 1944 by the international Mexico-US treaty [4].

The climatic conditions of the region, characterized by extreme dry warm climate, have constrained the development of certain types of crops for agricultural and livestock production, hence the latter activity has less participation in the economy, primarily engaged in the production of meat and milk. Another activity is the extraction of sand, gravel and clay, to support the production of building materials for the manufacture of concrete and block walls, materials that supply both the domestic and international markets.

There are also, regional fresh and salt water bodies, where fishing and aquaculture is accomplished. The Mexicali valley has an extensive network of canals and some lakes from where some species are extracted or cultivated such as: bass, striped, channel catfish, blue catfish, tiger catfish, crappie, carp, bluegill and tilapia. While in the coastal area of the Sea of Cortez in San Felipe there are caught species like mullet, shrimp, shark, sardines and algae [5].

Tourist activities are mainly developed on one hand, in major cities of Mexicali and Algodones, oriented to business, industry, trade and health services and; on the other, focused to recreation in the port of San Felipe, associated to beaches, hunting, ecological, fishing and off-road racing. As places of attraction we can find; San Felipe, Laguna Salada, Guadalupe Canyon, Rio Hardy, The Valley of the Giants and Punta Estrella.

The metropolitan area of Mexicali had its beginning with the settlement of the city in 1903 and from that date to the present has 936.826 inhabitants in the metropolitan area [6]. The development process in the early days of the town was marked by national and international events that have influenced the development of the main economic activities and human settlement in the region. The whole development along time have had produced environmental impacts as a result of continuous population immigration to the border, large development projects: waterworks for agriculture , industry and human settlements, roads and communications infrastructure, changes in land use, an increase in urban and rural settlements and services that have demanded the use of natural resources such as water, energy, building materials, food processing, manufacturing, provision of goods and services and finally the disposal of wastes, resulting in air, soil and water pollution.

The economic development of the region from 1903 to 1950 was based on the primary sector, situation that has been reversed in the 1960s with the federal promotion of industrialization in the northern border of Mexico throughout The

“Maquiladora“ programme (assembly industries), industrialization that has been widened until the late eighties.

By the nineties, the economy of Mexicali had been based on three productive sectors: agriculture, maintaining its presence in the local economy; industry, consisting on small and medium size industries export-oriented, but nearly without industrial networks at the regional level and; commerce and services supported in a regional market. In the same period there was a positive growth in the trade and services activities and a cumulative knowledge that have had impacted in a qualitative transformation in the production sector [7].

The last period going from 2000 up to 2012, a period characterized by two global financial crises in 2001 and 2007, they have had an impact on the US economy and therefore on the Mexican economy, due to the dependence for trade in the border area of the northern Mexico. Recent financial crises have affected almost all sectors of the economy, because the previous crises have had impacted the production sector [8]. The instability caused by financial crises have also affected the manufacturing sector and particularly the tertiary sector in 2007 in which the growth was diminished in the real state sector, as well as it was slowed the construction of condominiums and residences oriented to US tourists over coastal areas in San Felipe.

To counter act the crisis, federal government have encouraged the construction sector, with the purpose in mind to reduce the nationwide housing deficit by means of a massive program to stimulate the economy in medium and large cities. Such projects have had two types of effects: a positive one consisted of strengthening metropolitan areas and; a negative one, that has derived to urban sprawl problems within the city-regions. Consequently, in 2005, the national system of cities in Mexico was reclassified from 37 metropolitan areas to 54 metropolitan areas in 2005 [9], under this project was created the Mexicali Metropolitan Area. Such policy has demanded the proposal of new environmental planning tools applied to the regulation of human settlements, like the Environmental Sustainability Agenda for Metropolitan Areas. The development of this agenda for Mexicali, was economically supported by the Ministry of Environmental Protection of Baja California and conducted by the Autonomous University of Baja California.

There has been a bi-national environmental effort between US-Mexico since 1982 known as the agreement of La Paz, that has tried to influence on the prevention, mitigation and enhancement of environmental quality in the border area of northern Mexico through agreements and programs. As an example is The Border Program XXI in the nineties, which had been a result of environmental agreements of the North American Free Trade Agreement (NAFTA), which have had as a main goal the sustainability of the border and to establish initiatives that would lead to the protection and enhancement of environment to safeguard public health and the natural areas of the region. This program has dealt with issues like natural resources, environmental information, environmental health, air and water quality, solid and hazardous waste, enforcement of the law, pollution prevention, as well as emergency or



contingency prevention, all these issues are still active in the Border 2012 Program [10].

During the last decade there has been tremendous pressure on the use and quality of natural resources, such as water supply for human settlements in Mexicali and other state cities such as Tecate and Tijuana. The construction sector has demanded the exploitation of large number of sand and gravel and other construction materials, to satisfy the explosive housing growth. The expansion of urban areas had required the conversion of arable land to urban land use and the consequent transfer of water rights to non-agricultural uses; in the same situation is the demand of electric power generation to meet the growing demand of industrial and residential sector as well as for exports. All of these issues have contributed to increase the levels of air, water pollution and solid waste generation.

Current problems of pollution and ecosystem deprivation in the metropolitan area of Mexicali are consequence of the economic, social and environmental dynamics of the border region over more than 100 years. Whose trends are complex, due to their multiple worldwide networks with other cities and regions to sustain its development.

### 3.2 Environmental problems and priorities

There are similarities between the statistical information and the perception of people on main environmental problems and priorities in terms of a metropolitan agenda as a result of the literature review and from community actors. The following section presents the environmental assessment of the metropolitan area, based on key issues derived from people's perception from different regions, raised through community workshops in 2011, and later from the assessment of legal and-regulatory framework [3].

*a. City of Mexicali* – air pollution is located in the first place of environmental problems, caused by emissions of private and public transport, electric power generation, industry, unpaved streets, and those from natural sources. The second largest problem, are urban solid wastes, given its continued growth in per capita generation, combined with illegal dumping on property lots, roads and drains within and outside city limits; moreover transfer centers are insufficient. Third, regarding water quality, it needs to improve safe water programmes in rural areas of Mexicali Valley and San Felipe, as it is required to increase the capacity of wastewater treatment. Fourth, industrial activity and of certain services demand storage and transportation of hazardous waste, representing a latent risk in the city. Fifth, the inappropriate amount of green areas that is required according to the national and international standards. Sixth, regarding environmental plans, the city lacks of these documents to provide adequate handling and management of the environment. Finally, visual pollution, as a result of numerous street advertising signs, street garbage disposal, graffiti and many abandoned buildings.

*b. North Valley* – in this area environmental problems are the result of farming and ranching, extraction and production of handmade bricks that affect



air quality, soil and water pollution. Tourism and recreation activities around the Algodones area, have deteriorated natural landscapes due to all terrain transit of vehicles on dune areas contributing to air pollution. As well as in the rest of Mexicali Valley there is the practice of illegal disposal of waste and rubbish over roads and air pollution due to agricultural fields' fumigation. This zone has an area of wetlands, which were fed by water leaks that have been dried due to concrete-lined of All American Canal and excessive groundwater extraction to which this zone is subject for domestic use and irrigation.

*c. South Valley* – this area is crucial in the provision of goods and services to a wide productive area and small towns. Environmental problems are attached to air and water pollution by agro-chemicals, agricultural fumigation, agricultural fields and domestic waste burnings, besides the transit of vehicles through unpaved roads and streets. Moreover there is illegal disposal of waste and rubbish in drains and roads, as well as household waste disposal on open areas. The lack of sewage systems in small towns, treatment plants and the leaking of agricultural drains have negative direct environmental impacts over surface and groundwater bodies in the valley and the Colorado delta. South valley has been severely affected by the expansion of Cerro Prieto geothermal field, which has increased soils salinity and air and water pollution. The location of the water treatment plant Arenitas have contributed to odor generation and the industrial corridor Ejido Puebla with air and noise pollution.

In the case of San Felipe coastal subregion, the most severe problem is the availability of water, a scarce resource that has been usually over exploited for domestic use and tourism. Recently another aquifer, through Las Tinajas area, has been exploited by mining activities. Added to this is the problem of the disposal of municipal solid waste in San Felipe area, having its critical periods during vacation and holidays seasons due to massive influx of tourists. The presence of tourists affects ecological zones as the estuary, beaches, dunes and hills due to motorized off-road vehicles generating dust clouds, affecting native vegetation and causing soil erosion. Moreover there are illegal settlements located in areas subject to flooding. The northern part of this subregion belongs to buffer zone of the Biosphere Reserve of the Upper Gulf of California, which has land use restrictions.

Priorities were set as a result of literature review and community workshops, Air quality was at the top, followed by solid wastes and water quality and its infrastructure facilities. The three of them were associated with population health problems, such as respiratory and gastrointestinal diseases, allergies and, skin and eyes affections. At another level of priority was placed the topic of urban green areas, as a need of urban public spaces that fulfill social and ecological functions that contribute to environmental improvement. Another topic was environmental education, as a driving force to modify consumption patterns and obedience of laws. Finally, although physical contamination (odors, noise, light and visual pollution) was set in the last place, it contributes to achieve quality of life and livable towns.



### 3.3 Legal and normative assessment

The legal framework is mainly updated until 2010 and 2011 and it is integrated by 77 agreements that have been decreed from 2002 up to 2010 dealing with environmental matters: water, biodiversity, pollution, energy, solid and hazardous wastes. However, from the total of 19 environmental policy instruments that should have been implemented from the legal framework, they have only been created 12 and from them, just 4 have been updated, however there are still missing 7 planning instruments to be developed.

The missing instruments are: Touristic Land Use Management Plan of the State of Baja California; Municipal Environmental Protection Programme; State Air Quality Management Programme; Local Prevention and Integrated Solid Waste and Special Wastes Management programmes; State Emissions Inventory and Transfer of Pollution Emissions to the Atmosphere; Municipal Residual Water Discharges and Disposal of Debris and State Management of Special Wastes; the State Environmental Journal and; the State Prevention and Control of Lighting Pollution. Meanwhile the four outdated programmes are: Roads and Transport Master Plan 2005; State Programme of Fisheries and Aquaculture 2003–2007; State Ecological Land Use Programme 2005 and Municipal Ecological Land Use Programme 2000.

The Urban Development legal framework consists of 17 urban development plans, programmes and directives in the municipality of Mexicali and 6 of them have not been updated: Urban Development Plan of San Felipe, Regional Urban, Touristic, and Ecological Development Plan of the Coastal Corridor of San Felipe-Puertecitos and the Master Plan of Transit and Transport of Mexicali, the Municipal Ecological Land Use Programme, Urban Development Plan of Los Algodones, Urban Development Directives of Coahuila Station, and also are still missing 4 programmes to be submitted to approval by municipal authorities.

## 4 Environmental policies and programmes for the Metropolitan Zone

### 4.1 Environmental topics

In this section it is presented two types of policies; some focused to the solution of key topics of the agenda and others to deal with transversal subjects that must be integrated into each environmental topic.

Policies for key topics, will be oriented, to the prevention, reduction and remediation of pollution by different types of sources, such as air, water and soil pollution; meanwhile the others will aim to strengthen the relationship between urban green areas and natural resources for its sustainable use in the metropolitan area.

#### *a. Prevention and reduction of pollution*

This policy is focussed to the prevention, reduction and remediation of pollution, including the introduction, expansion and/or improvement of water and sanitation systems in human settlements, such as strengthening the





infrastructure for solid waste management and special handling at the metropolitan level. In the case of physical pollution, it will be mandatory to strengthen environmental regulation, monitoring and supervision of emission sources for odors and noise. Finally, there are also integrated policies to promote and encourage the establishment of companies promoting clean and environmental certifications of existing productive activities, construction and tourism. This policy has raised four programs: air quality, environmental infrastructure, pollution control and physical environmental information systems.

*b. Rehabilitation and restoration of sites*

This policy will promote the restoration of polluted, abandoned or spoiled areas by productive activities by any previous use, located within or outside urban areas, through remediation and improvement techniques to support new land uses. It also integrates economic recuperation of production activities oriented to new environmental and market conditions.

This policy will consider productive agricultural areas that have been affected by water and soil pollution, natural disasters, inappropriate disposal of hazardous or special handling waste, abandoned sand and gravel pits that have not implemented remedial measurements and sites that have been used for the disposal of urban solid wastes.

*c. Conservation of natural resources and biodiversity*

This policy will reinforce the relationship that should exist between urban green areas and available natural resources for the metropolitan area, in order to achieve a sustainable use of them to preserve ecological and environmental functions, through the development of research and technological development. Conservation of natural resources will include; water management, minerals, landforms, soils, alternative energy sources and biodiversity in the natural, productive and urban area. Similarly it will boost conservation in three areas: one, the interrelationship that should exist between the management of natural areas, agricultural and urban green areas (green corridors); two, it will promote the cinegetic exploitation of biodiversity under sustainable resource management practices and, three, it will strengthen the cultural relationship with landscape through conservation and regulation of archaeological, historical and cultural sites in the urban, natural and regional productive areas.

## 4.2 Transverse topics

These policies will be oriented to incorporate actions that are crossways to the problems referred previously on key topics, such as environmental culture and education, environmental health, climate change, environmental assessment and legal and normative framework.

*a. Development of an environmental culture*

This policy will have the aim to carry on environmental education in order to achieve cultural changes in consumption patterns, healthy practices, sustainable use and management of natural resources and the promotion of sustainable built environment. It will also incorporate official and informal environmental education and instruction programmes open to the public, service providers and authorities, where the education sector plays an important role for the change.



*b. Health enhancement*

This policy will be focused on the improvement of human health within metropolitan area, throughout actions oriented to reinforce preventive health programs; the development and improvement of water and sanitation systems and the creation of a database to monitoring progress.

*c. Mitigation and adaptation to climate change*

Policies to mitigate and adapt to climate change are linked to natural and human processes, like urbanization and industrialization taken place at metropolitan areas. Hence policies will be dealing with the above key topics of the environmental agenda and the making of a strategic climate change programme.

These policies would be guided to build urban resilience systems as is established by World Bank, which over the time can be adapted in several directions: long term social and economic evaluation of provision of environmental services and risk; urban infrastructure strengthening; poverty reduction; urban risk reduction; civil protection systems strengthening; strengthening of intergovernmental coordinated work with civil society; implementation of building and urban infrastructure adaptation programmes; protection and management of key ecosystems; creation of educational programs to inform population of climate change, as well as measures of mitigation and adaptation to be taken; and creation of monitoring information systems.

*d. Legal and normative framework of environmental management and human settlements*

This policy will be oriented to back up the environmental management framework, which will have an impact on different laws and regulations on environment and human settlements. It will be necessary to make institutional arrangements for the management of the metropolitan area. The work to be done demands a jointly effort among government, private sector and organizations from civil societies and their participation during planning and management processes.

As a complementary issue is the implementation of monitoring and the assessment of the metropolitan environmental agenda, which requires the creation of an environmental information system and indicators , to provide the inputs to support authorities in decision-making processes and to inform the public the achievements on environmental performance.

## 5 Conclusions

The main challenge of this work will be the development and implementation of the proposed programmes. As a recent metropolitan area, will be deemed necessary to make institutional adjustments to carry out the environmental management of the area, since it implies the convergence and concurrence of the three levels of government, different institutions and the association with the private sector and social organizations. The project of the Agenda will demand also changes in the legal and normative framework to ensure their proper implementation. Another key issue is the enhancement of community



participation; this will involve the economic support of government to communities to help them to building up local capacities to create their own organizations, to look for funding, for management and monitoring of projects.

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