



**Desertification and Migration:
Mexico and the United States**

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THE U.S. COMMISSION ON IMMIGRATION REFORM IS A BIPARTISAN COMMISSION AUTHORIZED BY THE IMMIGRATION ACT OF 1990 AND CHARGED WITH EXAMINING IMMIGRATION POLICY AND ITS IMPACT ON SOCIAL, ECONOMIC, AND COMMUNITY RELATIONS, ON POPULATION SIZE AND CHARACTERISTICS, AND ON THE ENVIRONMENT.

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EXECUTIVE SUMMARY

The greatest threat to habitability may be the degradation of agricultural lands in developing countries where many people depend upon farming for their livelihood. Long periods of over-exploitation due to population growth and poverty inevitably result in land degradation, sometimes irreversibly altering the carrying capacity of the land. This phenomenon, known as desertification, currently affects 3.6 billion hectares, the equivalent of one-quarter of the world's total surface.

The Commission on Immigration Reform [CIR] requested this preliminary study of environmental degradation related to unsustainable land and water use as one of the potential root causes of certain migration from Mexico to the United States. Perhaps as with no other country, migration from Mexico raises critical issues within the Commission's mandate. The 2,000 mile border between Mexico and the United States historically has been porous. In the past thirty years the U.S. has deported more than seventeen million illegal Mexican immigrants. The large wage differential between the two countries and extensive migrant networks act as an enormous "pull" in motivating migration. The

poverty and economic disparity in Mexico are strong factors which "push" migrants toward the U.S. Trade relations and the exchange of goods and services across the border heighten the need for stable relations with Mexico. Thus, migration from Mexico will continue to be an important focus for foreign policy development and, specifically, of concern to the Commission.

The findings contained in this report suggest that serious impairment of Mexico's agricultural lands may give rise to migration. There is evidence to suggest that a portion of the 900,000 persons who migrate annually from the arid and semi-arid regions of Mexico do so because of the desertification processes which yearly impair 1,000 square miles of surface area and cause the abandonment of another 400 square miles of farmlands.

As environmental degradation can often be addressed through targeted intervention, this report presents recommendations for future action by the Commission and/or Congress that go beyond reform of traditional migration policies and institutions. It identifies specific issues for further study and policy development as a first step in addressing Mexican migration related to desertification.

Findings on Mexico: Preliminary Case Study

Mexico is the third largest and second most populous country in North America. Two-thirds of the country's poor people are farmers and farm workers. Three-quarters of those most impoverished live in rural areas, many as subsistence farmers.

Desertification in Mexico

Most of Mexico's lands are undergoing some process of land degradation. As a result, approximately 2,250 square kilometers of potentially productive farmlands are taken out of production or abandoned each year. Experts estimate that Mexico's desertification problems are caused largely by the excessive clearing and cultivation of land unsuitable for agriculture, overgrazing, the exploitation of forests and vegetation for fuel, the application of inefficient irrigation practices, mining activities, and urban expansion. Climate

conditions, particularly periods of prolonged drought, exacerbate these problems.

The environmental and socioeconomic impacts of desertification have become more widespread as people abandon degraded lands and move onto marginal lands that are even less suitable for agriculture. This "push" into marginal lands is attributable to a number of factors, including government policy, monopolization of higher quality land by large-scale farmers, and a high population growth rate.

Historic Migration from Mexico to the United States

Mexican migration to the United States historically has been rooted in economic trends on both sides of the border. Most of this migration has been illegal, despite such government initiatives as the "Bracero Program," that permitted temporary recruitment and employment of Mexicans in the United States. Legislative efforts, including the Immigration Reform and Control Act of 1986 [IRCA], have been unsuccessful in substantially curbing illegal immigration.

Migration Related to Desertification

Mexicans have fled rural poverty for decades to seek better opportunities in Mexican cities and the United States. The reasons for migration are often complex, but relationships between certain environmental conditions and population movements can be identified.

The quality of farmlands, availability and reliability of water supply, and the management of lands play an important role in contributing to migration from rural areas. Specifically, land degradation and desertification frequently lead to migration when people can no longer subsist on the land. The Mexican government has found that approximately 900,000 people now leave arid and semi-arid areas every year. Our investigation, including analysis of geostatistical information and migration data, confirmed that the inability to make a living from the land due to dry conditions and processes of soil erosion contribute to the decision of rural people to migrate. This is supported by studies of other regions in Mexico and Latin America.

No one has attempted to determine how many of these migrants leave the rural areas of Mexico because of serious impairment of farmlands or other desertifi-

cation processes. The time constraints and scope of our investigation did not permit us to undertake any real quantification analysis. Further investigation and data development is warranted to provide a more accurate basis for determining the scope of the problem.

Conclusions & Recommendations for Future Action

The findings contained in this report support the following preliminary conclusions.

First, there is evidence to suggest that a portion of the migrating population from Mexico to the United States consists of people who are moving because they cannot farm the lands due to ongoing processes of soil desertification. Second, preventing this migration will require addressing the environmental causes of the problem, largely associated with unsustainable land and water use in Mexico. It is likely that specific policies will be necessary to assure the viability of farming and to revitalize degraded lands. Third, while the development of data on migration associated with environmental problems is too premature to recommend specific foreign policies, our preliminary

analysis reveals that the Commission and Congress will need to look beyond traditional immigration policy to address the root causes of the problem. The precise programs and policies will depend upon the results of further field and analytical study described below.

Issues for Further Investigation of the Environment and Migration Phenomenon

The following recommendations are presented for the Commission's future action to improve understanding of immigration and foreign policies that could be formulated to address the problem.

Investigate the relationship between the environment and migration. Reversing the trends of land degradation in Mexico will be critical in stemming the migration related to unsustainable use of agricultural lands in certain regions. Investigating the links between environment, migration, and population, as well as the interrelationship of climatological factors, will provide more definitive analysis of these trends that can form the basis for appropriate policy development. In this context it would be useful to investigate the lands currently undergoing desertification

in rural and semi-arid areas of Mexico that foster significant involuntary migration. This information should be analyzed in conjunction with migration and population data and other geostatistical information.

Investigate the development of immigration and other policies that may be responsive to address ecologically-induced migration. Traditional measures, such as tightening border controls and employer sanctions for hiring illegal immigrants, will be insufficient to prevent the migration related to serious environmental deterioration in Mexico. These traditional policy responses may be more effective if coupled with agricultural land remediation, training, and educational programs. If the objective of U.S. immigration policy is to address root causes of migration, then such an objective will need to incorporate broader policies that involve international cooperation, aid, and technical support measures.

Issues for Evaluation in Developing Broader Policy Responses

The United States could play a catalyzing role in the development of such policies, particularly given its expertise in agricultural management. The Commission and/

or Congress should investigate opportunities for policy development in this area.

Distinguish between environmentally-motivated migrants and other economic migrants to address environmental root causes of migration. Adverse environmental conditions can lead to increased poverty when families can no longer subsist on their lands. They may be forced to join the growing numbers of other “economic” migrants. However, it appears useful to distinguish between these “environmental” migrants and other economic migrants for two reasons. First, understanding that some segment of the international migration population is primarily motivated to move because of their inability to farm could foster the development of environmental programs specifically designed to stem *this cause* of migration. Second, because the motivation for leaving their homelands is different from that of other economic migrants, those forced to leave because farming is unsustainable may consider returning home if remediation programs are offered. The Commission should explore this distinction in its further study of migration and environment issues and in developing policy recommendations.

Investigate how policy responses could provide an opportunity for some mi-

grants to return home. The preliminary findings of our investigation suggest that migrants forced to leave because farming is unsustainable may consider returning home if they can successfully farm the land. Further study is needed to determine whether these findings represent the attitudes of a broader base of rural migrants in the United States. If so, the Commission and/or Congress should determine the potential for developing policies to promote the return of rural migrants to participate in agricultural training and development programs in Mexico.

Investigate the opportunity for establishing joint U.S.-Mexico programs to address the migration related to environmental problems. The creation or modification of certain policies in Mexico likely will be needed to redress the growing environmental problems related to harvesting of forests and vegetation. Financial assistance and transfer of technical expertise could play a key role in promoting the implementation of these policies in many parts of Mexico. The Commission and/or Congress should explore the opportunity to develop cooperative programs with Mexico to create, finance, and implement environmental mitigation and prevention programs.

Potential Short- and Long-Term Opportunities for Development of Environmental Solutions

This report identifies specific measures that warrant further consideration in the formulation of environmental programs and policies. These are based upon preliminary investigation of some desertification problems in Mexico and our experience in developing recommended programs to address agricultural management problems in the western United States. We have identified the need to develop such policy goals as: reducing crop cultivation on marginalized lands; instituting controlled grazing practices and promoting alternative sustainable uses of the lands affected; reducing water-intensive crop cultivation in certain areas; substituting drought resistant crops, where appropriate; and implementing efficient agricultural water management practices.

The primary difficulties in translating these objectives into actual practices will be (1) securing the resources and expertise necessary to assist farmers in modifying their behavior and, (2) obtaining the

cooperation of the rural workers who traditionally have followed particular cultivation, grazing, harvesting, and irrigation practices.

One way to achieve the necessary participation may be to carry out model programs or pilot projects to test the recommended changes in land management. Rural participants closely involved in the development and application of solutions will ensure that programs are more practical and influential in fostering change by both the immediate participants and outside observers. If there is sufficient financing to reduce the risks, rural communities or *ejidos* may participate voluntarily in these projects.

INTRODUCTION

The scope of the mandate of the Commission on Immigration Reform [CIR], as created by the Immigration Act of 1990, includes examination of the impact of immigration on the foreign policy and national security interests of the United States. Perhaps as with no other country, immigration from Mexico raises critical issues within this mandate. The 2,000-mile border between Mexico and the United States historically has been porous. In the past thirty years, the U.S. has deported more than seventeen million illegal Mexican immigrants. The large wage differential between the two countries and extensive migrant networks act as an enormous "pull" in motivating migration. The poverty and economic disparity in Mexico are strong factors which "push" migrants toward the U.S. Trade relations and the exchange of goods and services across the border heighten the need for stable relations with Mexico. Thus, immigration from Mexico will continue to be an important focus for foreign policy development.

CIR requested this preliminary study of one of the potential root causes or push factors of migration from Mexico: environmental degradation related to unsustainable land and water use in rural areas. Though this relationship has been little

studied, our investigation revealed that there may be a strong link between serious impairment of agricultural lands or "desertification" and increased migration to the U.S. There is evidence to suggest that a portion of the 900,000 persons who migrate annually from the arid and semi-arid regions of Mexico may do so because of the desertification processes that yearly impair 1,000 square miles of surface area and cause the abandonment of another 400 square miles of farmlands.

Perhaps unlike other economic root causes of migration, environmental degradation often can be prevented or remediated with targeted intervention. We have a solid understanding of the management techniques required to address many agricultural land and irrigation problems, but often there is a lack of education, training, and financial resources to undertake the necessary reforms. Such reforms could yield both short- and long-term benefits to Mexico and the United States in addressing the problem.

Our findings suggest that the Commission's further investigation of the environment and migration phenomenon is warranted to increase understanding of the official policies that could be formulated in response. Congress will need to look beyond traditional immigration policies to address the environmental root

causes of migration. In this paper, we present the findings of our preliminary study and recommendations for further action by the Commission and Congress.

BACKGROUND

There are many areas in the world where unsustainable land use practices inevitably result in soil deterioration, sometimes irreversibly altering the carrying capacity of the land. This process of desertification can have profound social and economic impacts, including migration.

The United Nations Conference on Environment and Development [UNCED] concluded that desertification affects 3.6 billion hectares of rain-fed croplands, rangelands, and irrigated lands, the equivalent of one-quarter of the world's total land surface, and 70 percent of all drylands (UNCED 1992a:47). Even more critically, this phenomenon affects one-sixth of the World's population (UNCED 1992a:47). The United Nations Population Fund recently concluded that more than 135 million people may be at risk of being displaced by severe desertification (UNPF 1991:32).¹

While the causes of environmentally-induced population movements are numerous, the greatest threat to habitability may be the degradation of agricultural lands in countries where most people depend upon farming for their livelihood. Population growth and poverty place additional pressure on scarce land resources, exacerbating desertification (UNPF 1991:32).¹ If growth rates are not reversed, the current, alarming pace of environmental degradation will accelerate: each year, eleven million hectares of tropical rainforests are cut, twenty-six billion tons of topsoil are eroded, and six million hectares of arable land are desertified (UNCED 1992c:para 47, 48, 69, 70, 79, 82, 83, 101). These factors ultimately force people to abandon an agricultural subsistence and relocate to nearby already overpopulated urban centers or to migrate to neighboring states.

We have investigated this issue in various countries and regions of the world. (Maloney 1990/91a, 1990/91b; Sanders 1990/91a, 1990/91b; Tamondong-Helin & Helin 1990/91; Catanese 1990/91). Development in parts of North America and the Caribbean Basin countries has led to substantial rural outmigration over the last

¹The current trends in population growth exacerbate this threat. The expected increase in the world's population by nearly one billion people will occur in poverty-stricken areas, increasing pressure on lands that already have been marginalized (UNCED 1991; El Hinnawi 1985).

three decades, some to the United States and most to urban centers within the affected countries (Commission for the Study of International Migration and Cooperative Economic Development 1990:101). Little has been documented, however, on the relationship between environmental degradation and migration in this region.²

Mexico is one of many countries affected by these problems. Mexico's climate is predominantly arid or semi-arid. Much of its surface area is affected by desertification, caused by a combination of climatological factors and unsustainable land-use practices. Mexico has also been the source of large-scale, cross-border migration for several decades. The findings contained in this report indicate that the increasing impairment of Mexico's agricultural lands is a potentially significant cause of migration to the United States that warrants further study. Preliminary evidence of this relationship suggests further avenues of research, education, and targeted intervention will be necessary to remediate existing or prevent future problems.

Our findings and recommendations presented below are based upon work that we completed for the United Nations Secretariat for the Intergovernmental Negotiating Committee for a Convention to Combat Desertification and Drought [INC-D]. Our analysis was expanded to focus on issues critical to U.S. immigration policy development.

FINDINGS ON MEXICO: PRELIMINARY CASE STUDY

Introduction and Methodology

In investigating the desertification and migration problems in Mexico, we undertook an extensive literature review, conducted sample interviews with migrants living in Northern California³ and with people in several rural towns and villages in Central Mexico, and discussed the is-

²There is an abundance of literature on deforestation and land degradation, with only incidental reference to the resultant migration. While migration experts and academics have undertaken much research on migration patterns in this region, they have not looked deeply into how environmental problems may contribute to these population movements.

³California is the primary destination of most undocumented migrants from Mexico. "Approximately two-thirds of undocumented Mexico State migrants in the United States are to be found in California . . ." (Bustamante 1992:10).

sues with migration and environment experts. As we had such a short time to conduct our investigation, the findings presented below can be viewed only as preliminary.

The maps presented in this report were developed for the Natural Heritage Institute in connection with this project and as part of a cooperative program between COLEF [El Colegio de la Frontera Norte in Tijuana directed by Dr. Jorge Bustamante] and ORSTOM [The French Institute of Scientific Research for Cooperative Development], a study financed in part by CONACYT. This is part of a Geographic and Statistical Information System [SIGEF] concerning the North Frontier/Border created by D. Delaunay and J. Santibanez. The maps use the Savane and Rapido parameters developed at the Institute by Marc Souris and Michel Lepage. The census information is taken from CODICE90, CD-ROM edited by INEGI. The information provided on migration was obtained from surveys conducted by Dr. Bustamante, R. Corona, and J. Santibanez of COLEF. The climatic characterization is derived from the National Atlas of Mexico of UNAM, from the National Atlas of the Physical Environment of Mexico and relevant letters published by ENEGI. The authors of the geostatistical information presented are Daniel Delaunay (Demographer), Alain

Winckell (Geographer) and Michel Lepage (Data Analyst) of ORSTOM.

Demographic and Geographic Profile

Mexico is the third largest and second most populous country in North America. Its current population of 88 million people has quadrupled since 1940, (Commission for the Study of International Migration and Cooperative Economic Deveopment 1990:11), and is growing by 1.5 million people annually (Commission for the Study of Migration and Cooperative Economic Deveopment 1990:12). Mexico City, the capital of Mexico, is the most populated city in the world, with an expected 25 million people by the year 2000 (UNPF 1991:60).

Mexico's territory extends over 1,958,201 square kilometres, bordering the United States to the north, the Gulf of Mexico and the Caribbean Sea to the east, Belize and Guatemala to the southeast, and the Gulf of California and the Pacific Ocean to the west. Most of the country is highland or mountainous. Approximately 20 percent is forested. Most of the Yucatán Peninsula and the Isthmus of Tehuantepec in the southeast is lowland. There are lowlying strips of land along the Gulf

of Mexico, the Pacific Ocean, and the Gulf of California. The heart of Mexico is the great Mexican Plateau, which is interrupted by mountain ranges and segmented by deep rifts.

The country is divided into thirty-one states and a federal district that includes the capital, Mexico City [Map 1 p.19]. The government is organized as a federal republic, with the powers of chief executive and head of state vested in a popularly-elected president.

Approximately 55 percent of Mexico's population are Mestizo, 29 percent Amerindian, and 10 percent European, with Spanish the primary language and Roman Catholicism the most-practiced religion. Two-thirds of the country's poor people are farmers and farm workers. Three quarters of those most impoverished live in rural areas (Martin 1993:99). Many in agriculture are *subsistence* farmers who commonly grow corn and beans for their families and depend on low and variable rainfall for the success of their crops (Martin 1993:100).

A unique feature of Mexican agricultural management is its communal land or "*ejido*" system. *Ejidors* are communal farms that were created after the Mexican revolution when the government redistributed land from large landowners to the land-

less peasants for whom the revolution was fought. *Ejido* members obtain land as a group from the government, but usually farm the land individually. *Ejidors* control about 70 percent of Mexico's croplands and half of its irrigated lands (Martin 1993:101). National policy now allows individual *ejido* members to sell or rent their land.

Desertification in Mexico

There has been much debate about the meaning of the term "desertification." The best explanation of it as *both* a physical state of land degradation and as a process of deterioration may be the following:

Desertification, revealed by drought, is caused by human activities in which the carrying capacity of the land is exceeded; it proceeds by exacerbated natural or man-induced mechanisms, and is made manifest by intricate steps of vegetation and soil deterioration which result, in human terms, in an irreversible decrease or destruction of the biological potential of the land and its ability to support populations. (Mainguet 1991:4)

The term is technically defined by the recently adopted United Nations Convention to Combat Desertification as, "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities." (UNGA 1993b)

Most of Mexico's lands are undergoing some process of land degradation. The government of Mexico has concluded that 97 percent of its territory is affected to some degree, and that 60 percent of its territory is extremely or severely degraded.⁴ This data is not surprising in light of findings by experts in 1978 that approximately 150 million hectares of land had problems of desertification, representing 80 percent of Mexico's territory (Medellin-Leal 1978:107). These experts estimated that desertification would continue to advance rapidly in Mexico, degrading between 100,000 and 200,000 hectares of land per year. The Mexican government's current findings suggest that this prediction was correct.

As a result of this land degradation, it is now estimated that 1,000 square miles or

2,250 square kilometers of potentially productive farmlands are taken out of production or abandoned each year (Myers 1993:140; UNPF 1991:99). These figures demonstrate the gravity of the desertification problem in Mexico and underlie the need for immediate preventative and remedial measures.

Aridity in Mexico

Much of Mexico is comprised of arid and semi-arid zones, making the lands vulnerable to the processes of desertification, as discussed below. These lands constitute more than 50 percent, and perhaps as much as 80 percent, of Mexico's territory (Myers 1993:139; Ballin-Cortes 1990a:3). [See **Map 2**]. The government of Mexico estimates that they comprise 52.5 percent of Mexico's total land area (Comision Nacional de las Zonas Aridas 1993:sum 1.1).

Approximately eight million hectares of land, constituting approximately 45 percent of all agricultural land, is farmed or used for grazing in the arid and semi-

⁴We were unable to obtain a complete copy of the *Plan de Accion Para Combatir la Desertification en Mexico* before this paper was submitted to the Commission. Where possible, we refer to the portions of the final plan that we obtained (Comision Nacional de las Zonas Aridas 1994). Where we were missing portion of the final plan, we have in a few instances, relied on information contained in a prior version of the plan prepared in October 1993 (Comision Nacional de las Zonas Aridas 1993).

arid regions of Mexico. Of this land, only about 25 percent is irrigated. Seasonal agriculture, or rainfed farmland, in these regions has the highest rate of crop loss in the country. Frost and drought are the principal causes (Comision Nacional de las Zonas Aridas 1993:sum 1.3).

The desert, arid, semi-arid, dry subhumid, and humid regions of Mexico are shown on **Map 2** [p.20], "Index of Aridity." Of Mexico's territory, 23.6 percent is desert, 11.2 percent is arid, 9.9 percent is semi-arid and 25.7 percent is dry sub-humid [**Map 2**]. This indicates that approximately 70 percent of Mexico's lands may be vulnerable to desertification. Levels of precipitation and evaporation in Mexico tend to support this estimate: **Maps 3, 4, and 5** [pp.21-23] identify precipitation and evaporation levels in various regions in Mexico and the number of dry months per year experienced in these regions. We determined "aridity" for the purpose of these charts as the ratio of average annual rainfall and average annual evaporation. In developing this working definition of aridity, we incorporated the definition now contained in the U.N. Con-

vention to Combat Desertification (UNCCD 1994).⁵

Processes of Desertification and Regions Most Affected

There are a number of natural mechanisms or phenomena that contribute to the processes of desertification of vulnerable lands (those lands being utilized beyond their carrying capacity). The most significant of these in Mexico are wind and water erosion of soils, affecting between 60 percent and 85 percent of Mexico's territory (Comision Nacional de las Zonas Aridas 1993:Ch 2, sect 2.3.2, 2.3.3). Experts estimate that at least 70 percent of Mexico's agricultural lands are affected by soil erosion of some type (Myers 1993:140; UNPF 1991:98).

Other significant types of land degradation that form part of the desertification process include salinization, sodification, physical degradation, biological degradation, and chemical degradation. The Mexi-

⁵Article 1 of the text defines arid, semi-arid, and dry sub-humid areas as areas "in which the ratio of average annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65" (UNCCD 1994). While this definition does not provide clear guidance, it does suggest the importance of examining temperatures, precipitation and evaporation or potential evapotranspiration in determining the level of aridity in a particular region.

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can government estimates that these processes affect 20 percent, 15 percent, 20 percent, 80 percent and 15 percent of Mexico's territory respectively (Comision Nacional de las Zonas Aridas 1993:Ch 2, sect 2.3.2-2.3.7).

Salinization and sodification of soils are of particular interest to some because they are caused primarily by irrigation that is otherwise considered to be a beneficial practice. The problems generally stem from poor draining of irrigated lands and the application of poor quality water. An estimated one-fifth of Mexico's cropland is irrigated (Liverman & O'Brien 1991:351), and 10 percent of these lands are now highly salinized (Myers 1993:140; Comision Nacional de las Zonas Aridas 1993:Ch 2, sect 2.3.4). Our investigations suggest that this problem is particularly notable in such arid states as Sonora where irrigation is relied upon for the production of crops in the absence of significant rainfall (Arguelles 1993).⁶

The government of Mexico has investigated the extent of these processes of land degradation in the states of Mexico (Comision Nacional de las Zonas Aridas 1993:Ch 2). According to this investiga-

tion, the Mexican states with the greatest rates of land degradation are:

Water erosion. Aguascalientes, Guanajuato, Coahuila, Michoacan, Zacatecas, Jalisco, Nuevo Leon, and San Luis Potosi, with more than 45 percent of the surface severely affected;

Wind Erosion. San Luis Potosi, Morelos, Hidalgo, Nuevo Leon, Baja California, Queretaro, and Zacatecas, with more than 80 percent of their surface affected;

Salinization. Tamaulipas, Sonora, Baja California, Chihuahua, Coahuila, and Colima, with more than 2 percent of their surface affected;

Sodification. Campeche, Sonora, Quintana Roo, Morelos, Yucatan, Tabasco, and Mexico, with 13-40 percent of their surface affected;

Physical Degradation. Hidalgo and Veracruz, with 40-90 percent of their surface affected;

Biological Degradation. Colima, Morelos, Tabasco, Chiapas, Veracruz,

⁶Mr. Arguelles is an agrarian lawyer with substantial experience and knowledge of conditions in the Sonora area.

Jalisco, Michoacan, Nayarit, Yucatan, and Sinaloa, with more than 90 percent of their surface affected;

Chemical Degradation. Tabasco, Campeche, Veracruz, Nayarit, and Oaxaca, with 20-67 percent of their surface affected;

States that are experiencing nearly all of these forms of degradation are: Chihuahua, Coahuila, Colima, Jalisco, Mexico, Sinaloa, and Sonora (Comision Nacional de las Zonas Aridas 1993:Ch 2, sect 2.3.2-2.3.7). Our investigation indicates that there may also be considerable land degradation in Puebla and Guerrero.

Given the extent of arid and semi-arid areas in Mexico, it is likely that a significant portion of the lands in Mexico are vulnerable to, or are presently undergoing, desertification at some level. We were unable to obtain precise information on the areas in which the soil or vegetative deterioration has resulted in an irreversible decrease or destruction of the biological potential of the land and its ability to support people. Further investigation will be needed.

Experts have found that serious desertification usually exists along the borders of deserts, such as Northern Mexico and in

the areas of transition between semi-arid and subhumid or tropical zones (Ballin-Cortes 1990b:158) [See **Maps 2 and 6** pp.21,24]. Our observations of the borders of the Chihuahuense Desert in the San Luis Potosi area were consistent with this finding.

Unsustainable Land-Use Practices Causing Desertification

Human activities are generally considered to be the determining factor in all stages of desertification (Mainguet 1991:5). It is estimated that 87 percent of desertification problems are caused by unsustainable land use, with the remaining 13 percent attributable to climate conditions (Ballin-Cortes 1990a:3). The overexploitation of lands can make them vulnerable to the processes of desertification. Lands in arid or semi-arid areas that have been stripped of their vegetative cover are perilously susceptible to erosion from harsh winds or rains. This degradation may irreversibly alter the ability of the soils to sustain crops that may be replanted or vegetation for grazing.

The types of land use practices that can lead to desertification include:

1. Clearing and cultivating lands unsuitable for agriculture or cultivating crops in a manner that overburdens the land without taking adequate precautions against erosion;
2. Overgrazing lands, including placing too many animals on small parcels of land and failing to rotate the lands grazed;
3. Exploiting forests and other vegetation for fuel, consumption, and sale;
4. Adopting poor water management and irrigation practices;
5. Urban expansion, mining, and public works. (Medellin-Leal 1978:63-71; Comision Nacional de las Zonas Aridas 1993:Ch 2, Sect 2.2.1-2.2.4; Ballin-Cortes & Vasquez Rocillo 1993).

Of these activities, the first two may cause the most widespread degradation in Mexico (Ballin-Cortes & Vasquez Rocillo 1993).

Our field investigation confirmed that poor cultivation practices and overgrazing are serious problems. We toured parts of San Luis Potosi in the Desert of Chi-

huahua reputed to be typical of arid and semi-arid areas with desertification problems. There we observed, and confirmed through interviews, that the majority of the rural population tries to subsist by growing corn and beans, despite the fact that the natural soil base is only marginally productive, even when rainfall is adequate, and is generally exhausted by these crops in a short time (Ballin-Cortes & Vasquez Rocillo 1993; Natural Heritage Institute 1993). When rainfall is inadequate, as is frequently the case, these people find themselves in a desperate situation. We also observed that a substantial portion of the rural population practices grazing as a supplement or alternative to cultivation.

The results of these practices were visible in the land conditions we encountered. Vegetation was extremely sparse in the areas surrounding each village and many dusty fields of little apparent productive value were left exposed to wind and water erosion. The poverty of the people living in these conditions was notable. At the time of our visit, hundreds of women and children from the villages lined the central highway begging for candy, money, or gifts for the upcoming Christmas season.

The environmental and socioeconomic impacts of desertification have grown as

people abandoned the degraded lands and moved onto more marginal lands, less suitable for agriculture (Ballin-Cortes & Vasquez Rocillo 1993). The push into marginal lands is attributable to a number of factors, including official policies. First, as land is exhausted due to unsustainable cultivation and grazing, rural inhabitants seek official authorization to clear more land, which they use and manage in the same way, thereby continuing the pattern of degradation and abandonment of lands. Second, the government has commonly granted permits for this type of clearing in an attempt to placate poor rural farmers and obtain political support (Ballin-Cortes & Vasquez Rocillo 1993). The government generally has promoted the expansion of agriculture and grazing into marginal lands in the wake of the Mexican revolution as part of the effort to provide peasants with promised land. The government has sometimes attempted to satisfy peasant demands by providing them marginal land not previously cultivated, rather than taking land from large landholders.

Third, large-scale farmers have consistently purchased the more marginalized lands of the smaller-scale farmers, causing them to seek new land in even more marginal areas (Myers 1993:141). Many believe that this trend will intensify in the wake of new land reform policies which allow *ejido* members to sell or rent their

land (Villarejo 1993; Ballin-Cortes & Vasquez Rocillo 1993). Fourth, high population growth rates increase the demand for land in Mexico causing both a *push* into marginal lands and an increase in the level of many activities contributing to desertification (Liverman 1992:64; Myers 1993:141-42; Comision Nacional de las Zonas Aridas 1993:Ch 2, sect 2.1). The government of Mexico has noted that the advance of desertification is particularly rapid in central Mexico where the population density is greatest and the pressures on the land are most severe (Comision Nacional de las Zonas Aridas 1993:Intro). **Map 6** [p.24] illustrates those areas where rural density is the greatest in Mexico and correlates this with data on aridity. As the map indicates, the central plateau is a semi-arid zone with high population density. As discussed below, **Maps 7 and 8** [pp.25,26] also identify significant migration from this region.

Finally, for many years, the National Bank in Mexico has financed the cultivation of such crops as corn and beans, regardless of whether those crops were sustainable by the land under cultivation. This fiscal policy apparently has encouraged rural workers to continue unsustainable agricultural practices and created financial difficulties for the National Bank because the lack of productivity resulted in reduced profits and loans were frequently unpaid (Ballin-Cortes & Vasquez Rocillo 1993).

Climate, Drought and Desertification

Periodic droughts and generally dry conditions in the arid, semi-arid, and dry subhumid areas of Mexico have undoubtedly contributed to the advance of desertification. Only about 12 percent of the nation's water is on the central plateau where 60 percent of the population and 51 percent of the cropland are located (Liverman 1992:45). However, some believe that climatic events have played only a small role in this process, noting that to date temperatures have not changed notably and that the low rainfall experienced in dry years in the arid and semi-arid regions has usually been within the expected range of precipitation (Ballin-Cortes & Vasquez Rocillo 1993).

Where climate change has occurred, some experts suggest that it has been caused or exacerbated by human activity. One study examining the differences between Arizona and Sonora along the United States/Mexico border found that variations in temperature could be explained by differences in vegetation and soil moisture on the two sides of the border (Balling

1988:106-07; Bryant, et al. 1990:260-61). On the Mexican side of the border, vegetation and soil moisture were depleted due to heavy overgrazing, resulting in temperatures that were two to four degrees centigrade warmer than on the Arizona side where grazing was practiced in a controlled, sustainable manner (Balling 1988:106-07; Bryant, et al. 1990:260-61). The authors of the study also believe that the conditions on the Mexican side of the border may actually decrease the amount of rainfall, though this postulation has yet to be verified (Balling 1993). Certainly, the degraded condition of land on the Mexican side of the border exacerbates the erosion caused by rainfall.

In addition, the impacts of climate change on the environment often depend more on the characteristics of the region and people affected than on the nature of the climate change itself (Liverman 1992:44, 57). Thus, for example, one study found that the lands vulnerable to drought in two different regions of Mexico corresponded much more closely with mismanagement of *ejido* lands, lack of irrigation, lack of high yielding seed varieties, and lack of fertilizer than with physical climate conditions (Liverman 1992:60).⁷

⁷The correlation with *ejido* land management appeared to be based on the facts that more marginal land was given to *ejidos* in land reform efforts and that *ejidos* are socially more vulnerable because they have less access to irrigation, credit, improved seeds, and other resources (Liverman 1992:61).

Nevertheless, climate clearly plays a role in the processes of desertification and there is widespread concern that the decline in sustainability of Mexico's lands for agriculture will become even more alarming if predicted global warming occurs. The effects of global warming in Mexico, under any model, will create warmer and drier conditions (Liverman & O'Brien 1991:363). Such conditions could increase significantly the severity and effects of drought, exacerbate the processes of desertification, and devastate the majority of Mexican croplands and farmers relying on low and variable rainfall (Liverman & O'Brien 1991:364; Liverman 1992:45, 65; Myers 1993:140).

Migration Related to Desertification

Mexicans have been fleeing rural poverty for decades to seek better opportunities in Mexican cities and the United States

(Martin 1993:99). Work shortages are worst in the rural areas of Mexico, where unemployment and underemployment affect two out of three of all potential workers (Myers 1993:142). Such unemployment and underemployment generally create strong currents of migration (Martin 1993:52-53).

It is difficult to determine why migration occurs in any time period or from any particular region. The reasons for migration are often complex. Population movements from rural Mexico depend upon a number of factors, including the extent of familial or other networks already established in the U.S. and potential earnings (Massey, Goldring & Durand 1993; Durand & Massey 1992).⁸ Determining, with any precision, the central reason for migration in any particular case or community requires in-depth study and extensive survey or interview of migrants and community members.

⁸“The changing selectivity of migration results from the growth and elaboration of migrant networks, which are composed of ties of kinship, friendship, and paisanaje (shared community origin) between migrants and nonmigrants located in the United States and Mexico. . . . Once the number of network connections in an origin area reaches a critical threshold, migration becomes self-perpetuating in creating the social structure needed to sustain it. Every new migrant reduces the costs of subsequent migration for a set of friends and relatives” (Durand & Massey 1992:17).

Age, availability of jobs and wages also play a central role (e.g., Ritchey 1976; see also Azipe 1981).

Notwithstanding the complexity in attempting to determine the *primary* factor motivating migration in a particular circumstance (which may require disaggregating a multiplicity of reasons), we can identify relationships between certain environmental phenomenon and population movements.⁹ These are discussed below, after a brief summary of historic migration from Mexico to the United States, and should provide context for the discussion that follows.

Historic Migration from Mexico to the United States

The United States, particularly California, is the primary destination of migrants leaving Mexico (Bustamante 1992:10). The border between Mexico and the United States extends 2,000 miles. Unauthorized migrants cross it daily. Since 1964, seventeen million illegal Mexican migrants have been apprehended and deported (Durand & Massey 1992:6).¹⁰

Mexican migration to the United States historically has been rooted in economic trends on both sides of the border. Between 1849 and 1900, more than 100,000 Mexican immigrants migrated to the United States (Corwin 1978:31 citing 12th U.S. census), finding employment throughout the American Southwest as ranch hands, agricultural workers, and track workers for the railroads (Corwin 1978:29). Between 1910 and 1935, as a result of the economic turmoil following the Mexican revolution and the fact that the average wage for an agricultural worker in the United States was two to ten times that of the Mexican agricultural worker (Corwin 1978:53), approximately 1.5 million Mexican migrants came to the United States (Commission on Agricultural Workers 1992:42). During this period, large-scale farms, railroads, and mines in the United States soon became dependent on the Mexican workers, who were willing to accept temporary employment for low wages (Martin 1993:57). Out of their desire for a cheap seasonal labor supply, these commercial interests lobbied fiercely to obtain exemptions for Mexican

⁹This has been determined through several other country-specific investigations, some of which are summarized in this report.

¹⁰For decades there has been significant illegal migration from Mexico to the United States. From 1942-1964, some five million Mexicans were apprehended and deported (Durand & Massey 1992). It is widely believed that the U.S. Bracero programs, granting legal status to thousands of Mexicans and Latin Americans to work the burgeoning U.S. agricultural fields (particularly during World War II), encouraged illegal migration to the U.S.

migrant workers from the then restrictive immigration laws, and were to a great extent successful up until the onset of the Great Depression (Zabin, et al. 1993:19).

After the Crash of 1929, however, as a result of the huge influx of migrant American workers into the farm labor market in California, the Department of State began instituting restrictionist policies that ordered more stringent enforcement of existing immigration laws from which Mexican laborers had previously been exempt (Cardenas 1975:74). From 1929 to 1933, between 300,000 and 450,000 Mexicans were deported or voluntarily departed from the United States (Durand & Massey 1992:5). As the Depression subsided and the United States began preparing for World War II, agricultural employers successfully lobbied for renewed importation of Mexican labor (Martin 1993:60). As a result, the Bracero Program was established in 1942 pursuant to a bilateral agreement between the United States and Mexico (Cardenas 1975:75).

The Bracero Program permitted large-scale recruitment and temporary employment of Mexicans, though it did not provide a mechanism for legal immigration (Cardenas 1975:75). The Bracero Program, as initially passed, lapsed at the end of 1947. During its first five years the

program was small, admitting only 62,000 workers at its peak in 1944 (Martin 1993:61). The Program continued, however, under the Ninth Proviso of the Immigration act of 1917, which exempted temporary laborers from alien exclusion laws (Commission on Agricultural Workers 1992:28). During this phase of the Bracero Program, employers directly recruited and contracted with Mexican laborers without government supervision (Cardenas 1975:77). The most common method of recruiting Mexican laborers at this time consisted of finding Mexicans who were illegally in the United States, temporarily deporting them to the border, and then recruiting them as braceros (Cardenas 1975:78). After the onset of the Korean war, Congress enacted the Third phase of the Bracero Program as Public Law 78 (Mexican Farm Labor Program) in 1951. To protect domestic labor, however, Public Law 78 required that, before Mexican laborers could be recruited, the Secretary of Labor had to determine that: no domestic laborers were available to do the work; the employment of Mexican laborers would not adversely affect the wages of similarly situated domestic workers; and reasonable efforts had been made to attract domestic workers to the employment in question (Cardenas 1975:78). Public Law 78 was extended six times by Congressional amendments until the end of 1964 (Cardenas 1975:79).

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During the entire span of the program from 1942 to 1964, approximately 4.6 million braceros were admitted into the United States (Durand & Massey 1992:6). At its peak between 1956-1959, more than 400,000 braceros were admitted each year (Martin 1993:63).

Despite the Bracero Program, however, illegal immigration continued to be important source of Mexican labor in the United States (Cardenas 1975:79). The number of apprehensions made by the INS (i.e., 4.87 million) was greater than the total number of workers admitted pursuant to the Program (Martin 199:63). Some authors have argued that the Bracero Program actually stimulated illegal immigration by creating the expectation “that the fastest way to upward mobility was to go north,” (Commission on Agricultural Workers 1992:19) and by establishing permanent migratory networks. In contrast to the 4.6 million Mexicans admitted under the Bracero Program and the 1.5 to 5 million workers who immigrated illegally, only 545,000 Mexicans legally immigrated to the United States between 1942 and 1964 (Martin 1993:63).

Illegal immigration grew rapidly after the Bracero Program expired. The number of illegal aliens apprehended climbed steadily from 86 thousand in 1964 to more than 1 million by 1977 (Congressional Research Service 1980:37). Estimates of the total number of illegal aliens in the United States from the mid-sixties to the present vary widely, but there appears to be consensus that there was a steady increase until the enactment of the Immigration Reform and Control Act of 1986 [IRCA] (Commission on Agricultural Workers 1992:4; Durand & Massey 1992:7).¹¹ IRCA struck a compromise between agricultural interests, who wanted a temporary worker program that would provide an adequate supply of seasonal laborers, and labor interests, who argued that importing more labor was unnecessary and would depress wages and displace domestic labor (Commission on Agricultural Workers 1992:6). IRCA mandated employer sanctions as the “principal tool for reducing illegal immigration to the United States,” and provided for legalization of more than 1 million illegal agricultural workers under the Special Agricultural Worker Program (Commission

¹¹Durand and Massey suggest that perhaps the most accurate estimate of the number of illegal immigrants in the United States at the time of IRCA is derived from the number of people who applied for general amnesty and legalization through the SAW provisions (2.3 million) plus 25 percent.

on Agricultural Workers 1992:5). Although IRCA was successful in legalizing 2.3 million illegal immigrants, it did not substantially curb illegal immigration (Durand & Massey 1992:10), and, therefore, failed to stabilize the agricultural labor market (Commission on Agricultural Workers 1992:132). The Commission on Agricultural Workers, which was mandated under IRCA to assess it, concluded that, as long as employers continued to hire unauthorized workers and Mexicans lacked economic opportunities at home, illegal migration would continue (Commission on Agricultural Workers 1992:132-33).

Migration from Mexico to the United States Related to Environmental Degradation

The results of our preliminary study of Mexico suggest that the quality of farmlands, availability and reliability of water supply, and the management (or mismanagement) of lands play an important role in contributing to migration from rural areas. The inability to farm because of land degradation or desertification can

result in rural unemployment and general poverty and can lead to migration. In 1978, experts examining the desertification problem in Mexico concluded that approximately 600,000 people abandoned the countryside every year as a direct result of their inability to subsist on the land (Medellin-Leal 1978:59, 71). These experts attributed the inability to survive in the countryside in large part to the process of desertification that continually reduced the workable surface areas of the land and impoverished many Mexicans (Medellin-Leal 1978:59, 65, 71). They also noted that arid and semi-arid areas were the principal sources of these rural migrants (Medellin-Leal 1978:73).

In discussing the historical role that land quality and distribution has played in decisions to migrate from rural Mexico, two experts concluded:

Although the common wisdom is that adopting cash crops and capital intensive production methods led to greater out-migration via displacement of rural workers, comparative studies suggest that the process was more complex. Displacement did occur in communities with poor quality land and in places where land was unequally distributed, but in communities

where land was of high quality and more evenly distributed among families, the advent of commercialized farming increased rural incomes, lowered risks to farm households, and thereby reduced pressures for migration to the United States. (Durand & Massey 1992:35)

Based on more recent investigations, the Mexican government observed that there is still a strong tendency for people to migrate from arid and semi-arid areas, which contain 20 million inhabitants with scarce possibilities for work (Comision Nacional de las Zonas Aridas 1993:Ch 2,sect 2.1). *The government found that approximately 900,000 people now leave these areas every year* (Comision Nacional de las Zonas Aridas 1993:Ch 2, sect 2.1, 2.5).¹² As suggested in earlier studies, a significant portion of the migration from arid and semi-arid rural areas likely is attributable, at least in part, to the desertification that eliminates approximately 1,000 square miles of land and causes the abandonment of at least 400 square miles of farmland every year (Medellin-Leal 1978:59; see also Myers 1993:140; UNPF 1991:98-99). This explains why some ex-

perts have concluded that recent upsurges in migration from Mexico's rural areas are caused by land degradation that, together with rising population levels and the push of small farmers onto marginal lands, has caused an "agricultural squeeze" (Myers 1993P:141; UNPF 1991:99; Bilsborrow & DeLargy 1991:128-29).¹³

Our investigation of the San Luis Potosi area confirmed a strong relationship between the inability to make a living from the land due to dry conditions or land degradation and the decision to migrate, at least temporarily (Natural Heritage Insitute 1993; Ballin-Cortes & Vasquez Rocillo 1993). The people we spoke with stated that when their corn and bean crops were inadequate and grazing was poor, as frequently occurred, one or two family members would be forced to migrate in search of work to supplement the family income. These people generally attributed the failure of crops and grazing to lack of rainfall and the absence of irrigation systems.

Some experts assert that these deficiencies more properly are attributed to the inability of the land to sustain corn and bean crops, the poor management of graz-

¹²In the final version of the National Plan, now being issued, the government notes that the largest part of emigration is from municipalities that are predominantly rural in character.

¹³ Population growth is greater in rural than urban areas (Mendez y Mercado 1985:14).

ing, and general land degradation resulting from these practices (Ballin-Cortes & Vasquez Rocillo 1993). Agricultural economist David Runsten finds many problems with existing agricultural practices in Mexico. Soilborne diseases are common and irrigation practices are poorly applied (Runsten 1994). While the government has begun to take steps to address the problem, in some cases providing compensation to landowners to plant trees on their lands, there apparently has been little research, education, or training in Mexico on alternate or supplemental agricultural techniques to remedy this problem (Runsten 1994). Runsten believes that many of the people living on marginal lands in Mexico will continue to migrate as the lands become unsuitable for farming or grazing.

These observations have been confirmed by other studies of Mexico and Latin America (Bilsborrow & DeLargy 1991:128-9). For example, Edward Taylor has indicated that, in his investigation of Michoacan, Mexico, he found a strong link between environmental degradation and migration. He indicated that:

There is a direct negative relationship between the productivity of family resources in village economic activities and migration. Because crop

production is an important activity, declining productivity on the land increases migration pressures. It also encourages a shift towards less land-quality dependent activities, including livestock production, which unless carefully managed may have a further detrimental effect on land quality, especially in fragile environments. (Taylor 1994)

Taylor notes that the relationship between migration and soil degradation is complex and may exacerbate the destruction of fragile ecosystems in Mexico. There also may be an inverse relationship, where the opportunity to migrate is less costly to a family than the environmental investment needed to increase productivity of the farmland.

The presence of migration opportunities increases the opportunity cost of investing in environmental conservation. In effect, the environment competes with migration for scarce family resources, including time. The basic problem is that migration is an economic activity the returns to which do not depend on land quality. The availability of such activities tends to discourage land conservation. (Taylor 1994)

Notwithstanding this, Taylor further suggests that remittances sent home from those who migrate could provide a source of funds for conservation investment. This is particularly important given that most farmers in Mexico do not have access to credit. Remittances have largely taken the place of the “missing bank” to finance small farm investments (Taylor 1994).

Integration of Geostatistical Data

In completing our investigation, we analyzed geostatistical information concern-

ing various regions of Mexico affected by aridity and likely to be most affected by desertification. We developed a map identifying migration from rural areas, with a cross-comparison to geostatistical data on aridity in Mexico [see **Maps 7, 8** pp.25,26]. The information on migration used in preparing these maps was gathered in a survey of Mexican migrants living and working in the United States who were returning to Mexico in 1993 for an unspecified period of time.¹⁴ The information collected in this survey included the last place of residence in Mexico by rural locality of the migrants. This data is significant because it tends to indicate the relative number of people who migrate to

¹⁴The survey did not attempt to determine whether the migrants intended to return permanently or temporarily for such reasons as vacation or family visit. The survey gathering the data was conducted by Dr. Jorge Bustamante and his colleagues at El Colegio de la Frontera Norte as part of an ongoing, large-scale project funded by the World Bank to produce a direct estimate of the variation of undocumented immigrants from Mexico to be found in the U.S. during the time monitored. This estimate is obtained by focusing on patterns of circulatory migration flows as determined through interviews of randomly selected individuals at a number of Mexican border cities. The project, begun in 1993, will be completed in spring 1994. Because not all data from the survey has been collected and analyzed, we developed our estimates by extrapolating six months of the data, providing an estimate of undocumented immigrants from Mexico in the U.S. in 1993.

The foundational work for the survey methodology consisted of a pilot study in which Dr. Bustamante and his colleagues conducted surveys of migrants at various border crossing points over an approximately six-year period. The new survey methodology used in these interviews was developed based on procedures used to sample mobile populations for biological statistics. The successfully completed pilot study produced the only time series database available on the flows of undocumented migration from Mexico other than the statistics on apprehensions produced by the U.S. Immigration and Naturalization Service and provided the information necessary to determine the proper parameters of the survey and sampling design.

the United States from the rural localities of Mexico.

The use of migration and aridity data in determining precise correlations between migration and desertification is limited for two reasons. First, much of Mexico's territory is arid or semi-arid and we cannot assume that all arid or semi-arid areas are desertified (though, as the government of Mexico concludes, 60 percent of all lands are severely degraded). Second, though there is migration from the rural arid and semi-arid areas, we cannot assume, without further investigation, that all migration identified from these areas is a result of desertification. As discussed above, we do know that the central region of Mexico, which is arid or semi-arid and has a high rural density, has widespread desertification problems and significant out-migration. *Our discussion with experts, research, and analysis of the relevant statistical data (some of which is presented in **Maps 7 and 8**) suggests that further investigation will likely confirm that*

*desertification, as well as other environmental factors, contribute to migration from this region.*¹⁵

Quantifying Migration Flows

There has been considerable debate on the annual flow of migrants from Mexico to the United States (Durand & Massey 1992:4-5).¹⁶ Estimates range from 150,000 persons per year to between 500,000 and 600,000 persons per year (Myers 1993:144; Durand & Massey 1992:6-9; see also Martin 1993:4-6). Approximately 100,000 to 150,000 of these are expected to settle in the United States (Martin 1993:4). An additional 1.5 to 2 million Mexicans who enter the U.S. illegally each year are considered temporary workers or seasonal migrants expected to return to Mexico.¹⁷ The World Bank projects that between 1995 and the year 2000, an additional 750,000 to 900,000 Mexicans will migrate to the U.S (Martin 1993:5).

¹⁵Martin (1993) also suggests that the allocation of water and development of irrigation supplies can be a powerful force in motivating internal migration; water projects in northern Mexico have led to substantial internal south to north migration to Sinaloa, Baja, and other areas. Martin believes that, if Mexico undertakes more such water projects in the north (such as would be likely to reduce transportation costs of fruit grown in Mexico and exported to the U.S. market), there may be more "stepping-stone" migration to the United States.

¹⁶Myers (1993:144) suggests that 150,000 to 300,000 illegally migrate to the United States each year to settle.

¹⁷"Most Mexicans are expected to continue to arrive illegally; there are estimated to be 1.5 to 2.5 million illegal entries each year, and over 90 percent of those apprehended are Mexicans . . ." (Martin 1993:4)

No one has attempted to determine how many of these migrants leave the rural areas of Mexico because of serious impairment of farmlands or other desertification processes. The time constraints and scope of our investigation did not permit us to undertake any real quantification analysis. Further investigation and data development is warranted to provide a more accurate basis for determining the scope of the problem. However, the lack of precise data on the number of migrants should not paralyze the policy development process, particularly as quantification historically has been an area for fervent debate in the migration field and there may be enough qualified data to warrant policy considerations. Recommended issues for further investigation are discussed in *Conclusions and Recommendations*, below.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTION

The relationship between ecological destruction and migration is a phenomenon that has been little studied on a global level. Studies of various regions of the world confirm that migration is increasingly a result of serious environmental

degradation, particularly desertification processes that impair the viability of soils and agricultural sustainability.

Mexico has significant desertification problems because much of its lands are affected by arid or semi-arid climate. Historically, it has been the source of large-scale migration to the United States. We undertook a preliminary study to understand better the relationship between severe land degradation in Mexico and migration to the U.S. Our preliminary investigation leads to the following conclusions.

First, there is evidence to suggest that a portion of the migrating population from Mexico to the United States are people who are moving, directly or via Mexico's urban centers, because they cannot farm the lands. The deterioration of the soil base is due to ongoing processes of desertification affected by both climate and unsustainable land and water use practices. Those most acutely affected are subsistence farmers who grow corn and beans for their families to survive.

Second, preventing this migration will require addressing the root environmental causes of the problem, largely associated with inefficient agricultural management. National, regional, and local policies, institutions, and practices in

Mexico likely will need to be reformed. A significant barrier to implementing reforms in Mexico is the lack of education, training, and financial programs for affected farming communities. Too, U.S. domestic policies, particularly in the agricultural sector, may be contributing to these problems and warrant further investigation.

The U.S. Commission on International Migration and Cooperative Economic Development concluded that long-term economic development is the most effective means of preventing international migration in this region (Gregory 1989:31). However, this may not prevent the migration associated with severe ecological damage. Economic development will be more effective if coupled with specific environmental policies, including regulations and financial incentives designed to prevent and redress land degradation and drought (e.g., the lack of reliable water supply). Redressing the problem will require programs to assure the viability of farming and to revitalize salinized soils

or otherwise degraded natural resources in affected rural communities.¹⁸

Third, while the development of data on migration associated with environmental problems is too premature to recommend specific foreign policies, our preliminary analysis reveals that the Commission and Congress will need to look beyond traditional immigration policy to address the root causes of the problem. Precise programs and policies will depend upon the results of further field and analytical study, as described below.

Issues for Further Investigation of the Environment and Migration Phenomenon

The environmental phenomena in Mexico that can give rise to migration and the communities most affected should be investigated more comprehensively to un-

¹⁸The San Joaquin Valley, an historically prosperous region that produces much of California's agricultural revenues of more than \$17 billion, may serve as an example. In spite of its prosperity, the region only recently has begun to address the salinization and other desertification problems that have been building for decades because of poor land and water management practices. These now threaten the viability of 750,000 acres of prime farmland. Thousands of acres have been fallowed because of lack of understanding or attention to the problem by both farmers and regulatory agencies. These groups are now beginning programs to arrest the problem.

derstand better the immigration and foreign policies that could be formulated by United States policymakers to address the problem. The Commission may wish to undertake such investigation or to recommend to Congress that it appropriate resources to conduct the necessary research and field study.

The following specific recommendations are proposed to guide the further action of the Commission and/or Congress:

Further Investigate the Relationship Between Environmental Problems and Migration

Reversing the trends of land degradation in Mexico will be critical in stemming the migration related to unsustainable use of agricultural lands in certain regions. Investigating the links between environment, migration, and population will provide more definitive analysis of these trends and suggest appropriate policy development.

Given the dearth of available field-based documentation on which to formulate policies, further study should seek to

determine how influential a role environmental problems play in decisions to migrate. Field research should include interviews of migrants in affected rural communities as part of broader field studies.

It will be important to investigate the regions that suffer the most acute environmental problems and that foster significant involuntary migration because this information can provide a basis for the development of prevention and remediation programs that could yield short- and long-term environmental and migration benefits to both Mexico and the United States.

Specifically, we recommend more precise identification and investigation of the lands currently undergoing desertification in rural, arid, and semi-arid areas of Mexico. For example, a detailed inventory of the lands in the Central Plateau region could enable more accurate correlation of migration from this area and land degradation patterns, as well as provide information on the number of people who may be affected. This will be critical to identifying priority areas for policy responses.

The key will be to build upon and bridge the existing efforts of researchers, officials, and nongovernmental organizations to analyze environmental problems and

population movements in an integrated fashion. For example, new migration data (that will be available soon) is currently being produced by the Colegio de la Frontera Norte and ORSTOM. This data can be used to determine more accurately the migration patterns in Mexico. Data on outmigration from an area can be combined with geographical information service statistics [GIS] identifying areas of land impairment. In turn, this data can be compared with other regional migration patterns. The data can provide a beginning point for locating the most critical environment-migration areas and determining the number of migrants affected.

The relationship between population growth, environmental problems, and migration also should be studied. Population growth increases pressure on scarce natural resources in rural areas. In agricultural regions, when the carrying capacity of the lands are exceeded, people are forced to move. Little is understood about the dynamic between population growth in certain agricultural regions in Mexico and the marginalization of agricultural lands that promotes migration. Any future investigation into the links between migration and environment should, therefore, include analysis of how population growth may affect environment and migration problems.

Finally, understanding climate change in this region also will be important. Certain data already has been developed on climate change and global warming and can be evaluated further and integrated with research on migration and environment issues. Some experts are concerned that declining conditions in rural Mexico, unemployment, and migration will become worse in the event of global warming. If dry regions of Mexico become warmer and drier as global warming models suggest, Mexican croplands and the farmers who rely on low and variable rainfall could be severely affected. Many more rural inhabitants could be forced to migrate (Liverman 1992).

Investigate the Development of Immigration and Other Policies that May Be Responsive to Address Ecologically-Induced Migration

In carrying out its mandate to consider ways to increase the effectiveness of U.S. immigration policy, the Commission may consider proposals to tighten border controls and employer sanctions for the hiring of illegal immigrants. Preliminarily, we analyzed some of these policies to de-

termine their potential in addressing migration related to environmental degradation.

As the Commission is aware, policies to increase border controls and punitive sanctions against employers and certain other measures were adopted under IRCA. These were designed to control the flow of immigration from Mexico to the U.S. Some contend that IRCA has had relatively little impact on stemming undocumented immigration from Mexico (e.g., Massey, Durand & Donato 1992:139-40, 155-56). The policies have become somewhat controversial because it is asserted that they can lead to violence against Mexicans and can drive undocumented workers further underground, leaving no recourse to challenge employer abuses (Huerta 1992:150-51). In addition, certain federal studies have found that these policies tend to encourage discrimination against foreign workers, whether here legally or illegally (Huerta 1992:87-88, 150-51; Mahoney 1992:150-53).¹⁹

These traditional policy responses probably will not be sufficient to diminish the pressures on migration related to serious

environmental deterioration in Mexico because they do not address the root of the problem. However, these policies can be more effective in addressing this type of migration if coupled with agricultural land remediation, training, and educational programs. If the objective of U.S. immigration policy is to address root causes of immigration, then such an objective will need to incorporate broader policies that involve international cooperation, aid, and technical support measures.

Issues to Evaluate in Developing Broader Policy Responses

The United States could play a catalyzing role in encouraging the development of such environmental policies in Mexico, particularly as many federal agencies possess unique expertise in developing water and land management programs, largely as a result of the lessons learned from the salinization and water problems that have plagued the western United

¹⁹The U.S. General Accounting Office concluded in 1990 that federal employer sanctions resulted in widespread employment discrimination against U.S. citizens and other legal residents, indicating that 20 percent of employers had engaged in discrimination in California as a result of this policy (Coalition for Immigrant & Refugee Rights 1990:6).

States farming regions.²⁰ However, the application of these programs in Mexico is best determined in conjunction with Mexicans most knowledgeable about conditions in their own country. Thus, the Commission and/or Congress should investigate the opportunity for establishing cooperative programs, as discussed below.

Distinguish Between Environmentally-Motivated Migrants and Other Economic Migrants to Address Environmental Root Causes of Migration

A key concern of the Commission is whether these migrants are different from the broader category of “economic” migrants in ways that may warrant consideration of new policies. Our preliminary findings suggest that *migrants unable to farm because of desertification or drought can be distinguished, for purposes of policy development, from other urban or economic migrants who may be primarily motivated to relocate in the United States because of the wage differential.*

Adverse environmental conditions can lead to increased poverty when families can no longer subsist on their lands. They may be forced to join the growing numbers of other “economic” migrants. However, it appears useful to distinguish between these “environmental” migrants and other economic migrants for two reasons. First, understanding that some segment of the international migration population is primarily motivated to move because of their inability to farm could foster the development of programs specifically designed to stem *this cause* of migration. As discussed below, these could include environmental prevention or remedial measures that preserve agricultural land and promote higher agricultural productivity. Second, because the motivation for leaving their homelands is different from that of other economic migrants, migrants forced to leave because farming is unsustainable may consider returning home if remediation programs are offered. [The findings which support this are discussed in more detail below].

It may, therefore, be useful to target this potential group of migrants for policy responses as a means of addressing or preventing one root cause of migration to

²⁰The San Joaquin Valley of California is a prime example. We undertook investigation of these problems for federal and state agencies, producing a 1990 report identifying solutions to the legal and institutional barriers that have contributed to agricultural water and drainage management problems in this region.

the United States. However, the environment-migration phenomena still is too little understood to support recommendations on specific immigration policy reforms, such as the expansion of existing categories of refugees to include persons acutely affected by ecological damage. The Commission should study these issues in further detail.

Investigate How Policy Responses Might Provide an Opportunity for Some Migrants to Return Home to their Communities

The Commission should undertake further exploration of whether it would be useful to develop policies or programs that could encourage immigrants in the U.S., to return to their home communities voluntarily to engage in sustainable farming activities. The Commission could explore the potential for a joint program with the Mexican government to undertake land revitalization programs in certain communities, with the view toward allowing migrants who wish to do so to return

home to participate in such programs.

Our preliminary findings suggest that migrants forced to leave because the soils are agriculturally unproductive may consider returning home if they can successfully farm the lands. Michael Kearny, Professor at the University of California, Riverside, who has studied land problems and migration in Southern Mexico where many of the people are indigenous, Mixteca, has found support for this view among those in the migrant associations based in California with which he works (Center for U.S. Mexican Studies 1986). These groups desire to improve the situation in their home communities. Many are circular or seasonal migrants who would prefer to remain at home if they could make an adequate living and, similarly, would like to return home if circumstances could be improved in their communities (Center for U.S. Mexican Studies 1986; Kearny 1994). In our interviews conducted with Mexican migrants living in California who migrated from Mexico's agricultural regions, many who identified land degradation or drought as a factor in the decision to migrate expressed a desire to return to Mexico if they could make a living by farming the lands.²¹

²¹We conducted interviews of two groups of Mexican migrants in San Francisco and Oakland, California in December of 1993. During the same month, we also conducted interviews of workers living in villages with problems of desertification in the San Luis Potosi region of Mexico.

Further, certain studies of migration have found that seasonal migrants may own plots of land in their community of origin and may either return to farm or employ others to farm these lands. This is consistent with our findings in interviews of rural workers in Mexico who informed us that families generally wish to remain on their land and only send one or two family members to seek employment in a Mexican city or the United States when necessary to supplement the family income.

Confirming whether these findings represent the attitudes of a broader base of rural migrants in the United States will be important in thinking through policy responses. U.S. immigration policies have focused on apprehension and deportation as a means of returning illegal migrants to Mexico.²² Some studies have found that these efforts have not deterred immigration because many of those apprehended on the border and returned to Mexico simply repeat their attempts to enter the United States until they are successful.²³ These policies may be more effective in addressing certain rural migration if

supplemented by policies that promote *incentives or programs* for migrants to return home to participate in community farming activities.

In some cases, policies adopted in Mexico to revitalize lands or develop reliable supplies of water and to foster equitable distribution among farmers in a community may serve to encourage potential migrants (those who would be forced to migrate in search of employment if they could not farm the lands) to remain in their communities or to encourage migrants in the U.S. to return home. Incentive programs, organized jointly with Mexican officials, could include providing training and education on sustainable farming methods. Community farmers in Mexico and migrants living in the U.S. could be eligible to participate. (These and other possible programs are discussed below).

Further investigation is warranted to determine the potential for developing immigration policies that could promote the return of rural migrants to participate in agricultural training and development

²²Since 1964, approximately 17 million Mexicans have been apprehended and deported (see e.g., Durand & Massey 1992).

²³Data collected by Donato, Durand and Massey provided “no support for the view that apprehension deters migration.” Every migrant who attempted to enter the United States eventually got in (Massey, Durand & Donato 1992:150).

programs in Mexico. The potential for such programs to yield results in reducing migration pressures will depend upon more comprehensive data than the findings presented here regarding the desire of migrants to return to Mexico. Specifically, it would be useful to determine, through migrant interviews and other means, whether these findings are more broadly applicable to rural migrants in the U.S. and how immigration policies can be formulated to meet this challenge.

Investigate the Opportunity for Establishing Joint U.S.-Mexico Programs to Address the Migration Related to Environmental Problems

As the Commission appreciates, the creation or modification of certain national, regional, and local policies in Mexico likely will be needed to redress the grow-

ing environmental problems, particularly to encourage regulations and permitting practices designed to ensure sustainable harvesting of forests and vegetation. Moreover, programs that seek to improve employment opportunities in Mexico could focus on the improvement of agricultural lands, such as those involving expansion of credit to *ejido* farmers to improve irrigation efficiency.²⁴ The specific programs that should be considered are discussed more fully in the next section of this report.

Recognizing that environmental deterioration in Mexico can contribute to migration to the United States, Mexico and the United States should cooperate in developing solutions. The Commission and Congress should consider how cooperative programs with Mexico could be developed to promote, finance, and implement environmental mitigation and prevention programs, including the development of model techniques and evaluation of successful agricultural methods developed by indigenous groups in Mexico that can be replicated in other

²⁴David Runsten, an agricultural economist affiliated with the California Institute for Rural Studies, believes that there is considerable potential in this type of effort. He has worked effectively to promote the production of fruits and vegetables on *ejido* lands in Mexico. Small *ejido* farmers often do not develop their lands or utilize irrigation because of credit difficulties or exclusion from economic opportunities, problems that may be addressed through financial and other policy reforms in Mexico.

regions of the country. Moreover, the U.S. should consider how best to transfer its considerable expertise and technology to prevent or remediate many agricultural problems.

The benefits of such programs to advance U.S. and Mexican interests go beyond the potential for reducing migration to the United States. The U.S. could benefit economically to the extent that private firms may gain opportunities to participate in technology transfer and consultation. Moreover, increasing productivity of agricultural lands in Mexico will be critical to the long-term sustainability and market competitiveness of Mexican agriculture. The North American Free Trade Agreement [NAFTA] may increase rural migration as agricultural exports from the United States to Mexico displace the agricultural produce of small, inefficient farmers (Martin 1993:137).²⁵ If farmers are not competitive, they may be required to diversify their incomes or be forced to migrate to urban areas, including in the United States, in search of jobs.

One potential framework for cooperation could be the North American Free Trade

Agreement, which establishes certain cooperative mechanisms for consideration and transfer of environmental information. In addition, there are several joint border programs that involve the management of lands associated with the shared natural resources of Mexico and the U.S. These and other mechanisms that could facilitate cooperative program development warrant further investigation.

The Commission also should consider the following issues for further research in developing a framework for environmental cooperation with Mexico and in assisting local communities in Mexico.

Potential Short- and Long-Term Opportunities for the Development of Environmental Solutions

Based upon our preliminary investigation of certain desertification problems in Mexico and our experience in addressing these problems in the western United

²⁵Interestingly, NAFTA may increase migration in the short term. Martin (1993:47) estimates that approximately 1.4 million workers will be displaced. This push from rural areas also will be fostered by Mexico's new agricultural policy to reduce subsidies for corn and beans. It may be that environmental remediation efforts could help to balance this "hump" in increased migration by increasing the availability of productive agricultural lands.

States, we have identified certain environmental measures that warrant further consideration as part of any further investigation of the migration-environment phenomenon. These may provide both short- and long-term benefits in addressing the problems. The importance of the measures proposed below will depend upon the precise nature of the problem, the lands affected, the climate, and the community practices within each affected region.

Academic institutions in Mexico, such as the Instituto de Investigaciones de Zonas Deserticas (Universidad Autonoma de San Luis Potosi) already have begun to formulate ideas on model programs that could be undertaken in the local communities most seriously threatened by land and water quality deterioration. It may be useful to consider incorporating such programs into a larger Mexico-U.S. cooperative development assistance program, such as discussed in the previous section.

- Poor cultivation practices and overgrazing have been identified as two of the largest contributors to desertification. The economic and environmental feasibility of the following measures should be evaluated as they can produce immediate environmental benefits:

1. Modification of permitting practices concerning wells to ensure that poor quality water is not used for irrigation;
2. Modification of permitting practices concerning clearing of land for crop cultivation to reduce farming on lands unsuitable for such cultivation;
3. Institution of controlled, sustainable grazing in all areas where grazing is practiced (Ballin-Cortes & Vasquez Rosillo 1993).

Education, training and economic incentives should be provided to growers in affected areas to promote the following policy goals:

4. Reduction of crop cultivation in areas where soil and/or climate are unsuitable for cultivation and institution of controlled grazing practices or other alternative land uses more suitable to these areas (Ballin-Cortes & Vasquez Rosillo 1993);
5. Reduction of water-intensive dry land crop cultivation and substitution of drought-resistant crops in areas where the land and cli-

mate can support some form of cultivation (Mainguet 1991:32, 213);

6. Education and financing to support implementation of rational, water conserving irrigation systems (to replace systems that mobilize salts and waste resources through overapplication of water).
- Other practices contributing to desertification include unsustainable harvesting of forests and vegetation, poorly planned urban expansion, and public works projects. Any investigation should consider the economic and environmental feasibility of the following measures as they can produce immediate benefits:
 1. Modification of regulations and permitting practices to ensure sustainable harvesting of forests and vegetation.

Measures that can address the problems on a long-term basis include:
 2. Education that promotes sustainable harvesting practices;
3. Institution of planning mechanisms for urban expansion, public works, and mining projects that will ensure that environmental considerations are properly evaluated and considered and that will promote effective public participation in their development and implementation.
 - Drought and other processes leading to desertification often have more severe impacts where lands are more marginal and where farmers lack irrigation, good fertilizer, high yield seeds, and adequate variety in crops. Further investigation should consider ways to reduce these impacts, including by:
 1. Providing financing, technology, and education to expand efficient irrigation systems;
 2. Providing financing, supplies, and education to promote use of good fertilizers, high yield seeds, and substantial variety in crops (Liverman 1992b:332).
 3. Developing policies to address the factors causing the farming of

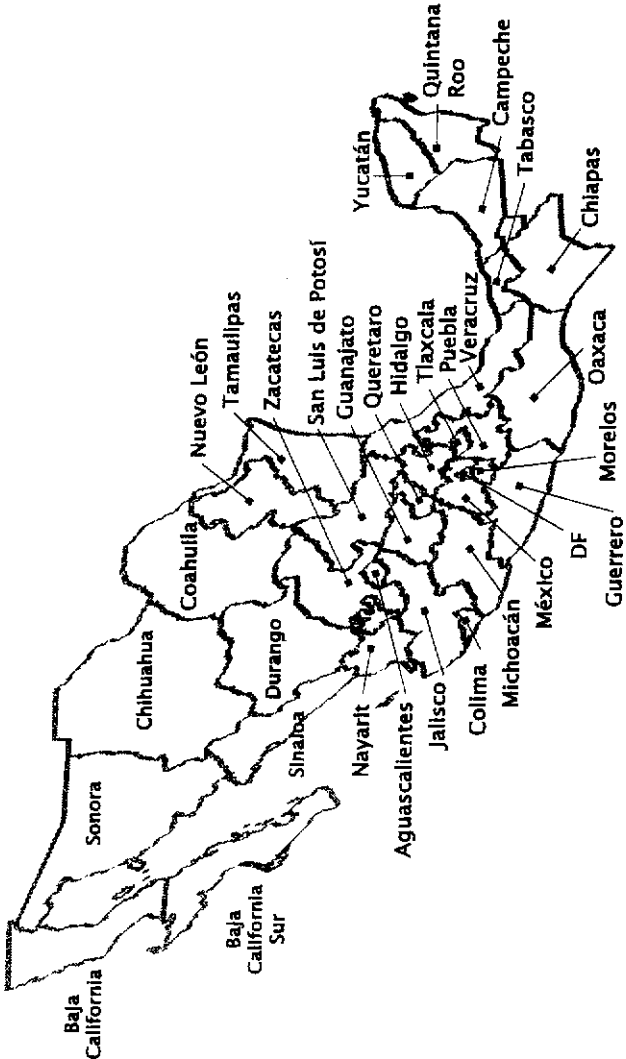
marginal lands, including government regulation, high population growth, and agricultural financing.

- Pilot programs with local participation can achieve significant results:
1. The primary difficulties in implementing many of these recommended solutions will be obtaining adequate financing and the cooperation of the rural workers who traditionally have followed particular cultivation, grazing, harvesting, and irrigation practices. One way to achieve the necessary participation may be to carry out model programs or pilot projects to test the recommended changes in land management (Ballin-Cortes & Vasquez Rosillo 1993; Ballin-Cortes 1988b:4). With sufficient financing to reduce the risks, rural communities or *ejidos* may voluntarily participate in these projects.
 2. Moreover, if rural participants are closely involved in the development and application of the recommended solutions, the actual solutions designed not only may be more practical, but more influ-

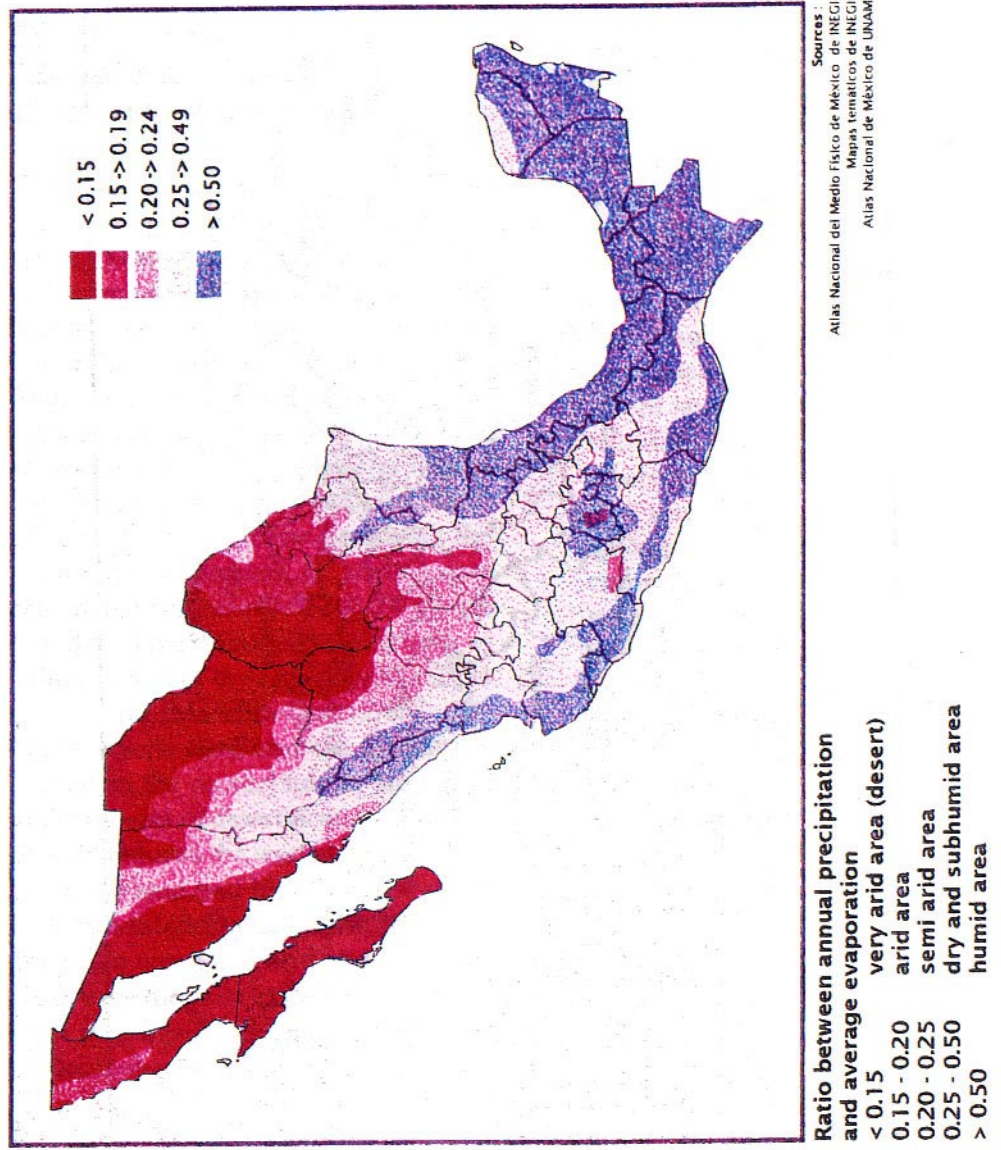
ential in fostering change by both the immediate participants and outside observers. If successful, such projects should serve both to demonstrate the desirability of the recommended solutions and to educate the community's farmers.

3. Once recommended solutions have been tested and proven successful, further implementation can be encouraged in a number of ways. First, education can serve to spread knowledge and understanding of the techniques followed in the pilot projects. Second, government incentives can reduce the risks and provide the motivation needed to undertake changes. Third, government regulation and permit policies can attempt to halt or diminish practices that are clearly harmful and ensure consideration of environmental effects.

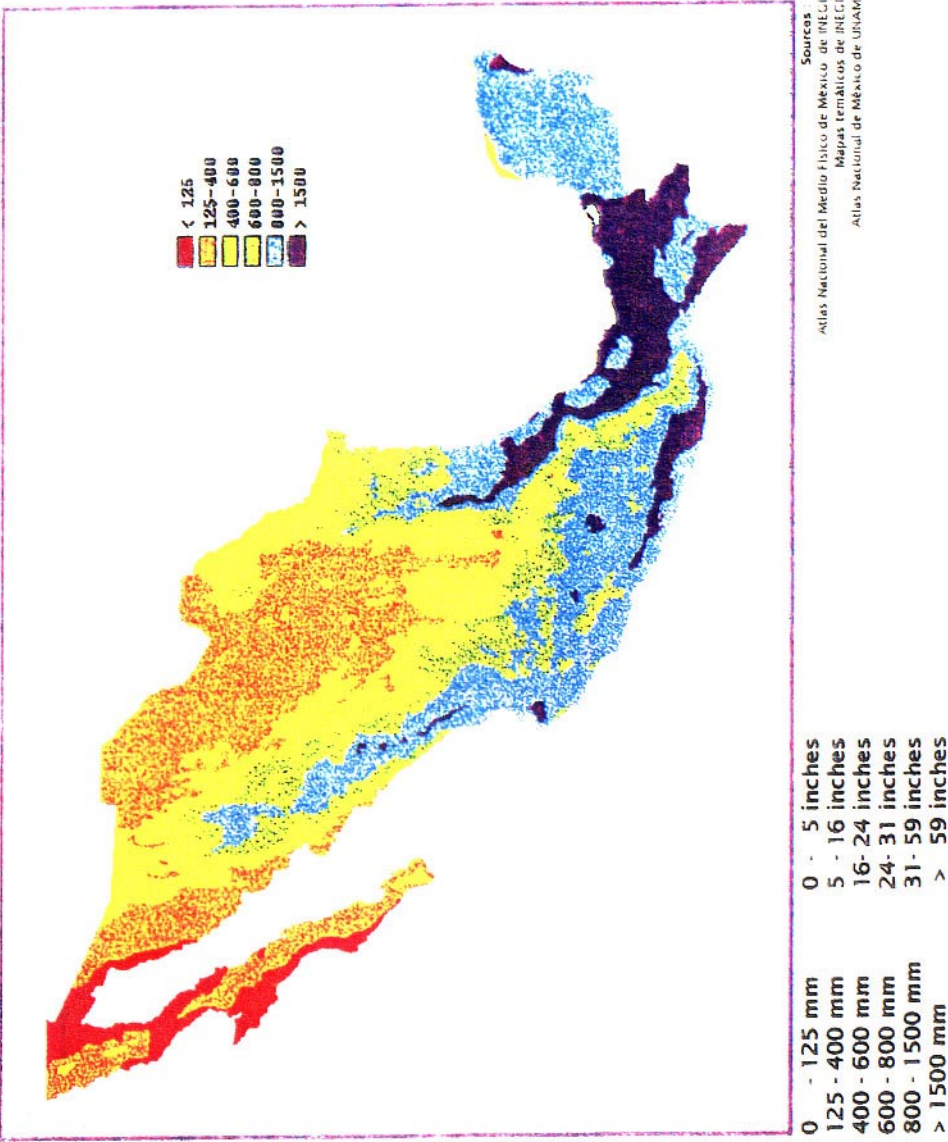
1. The Mexican States



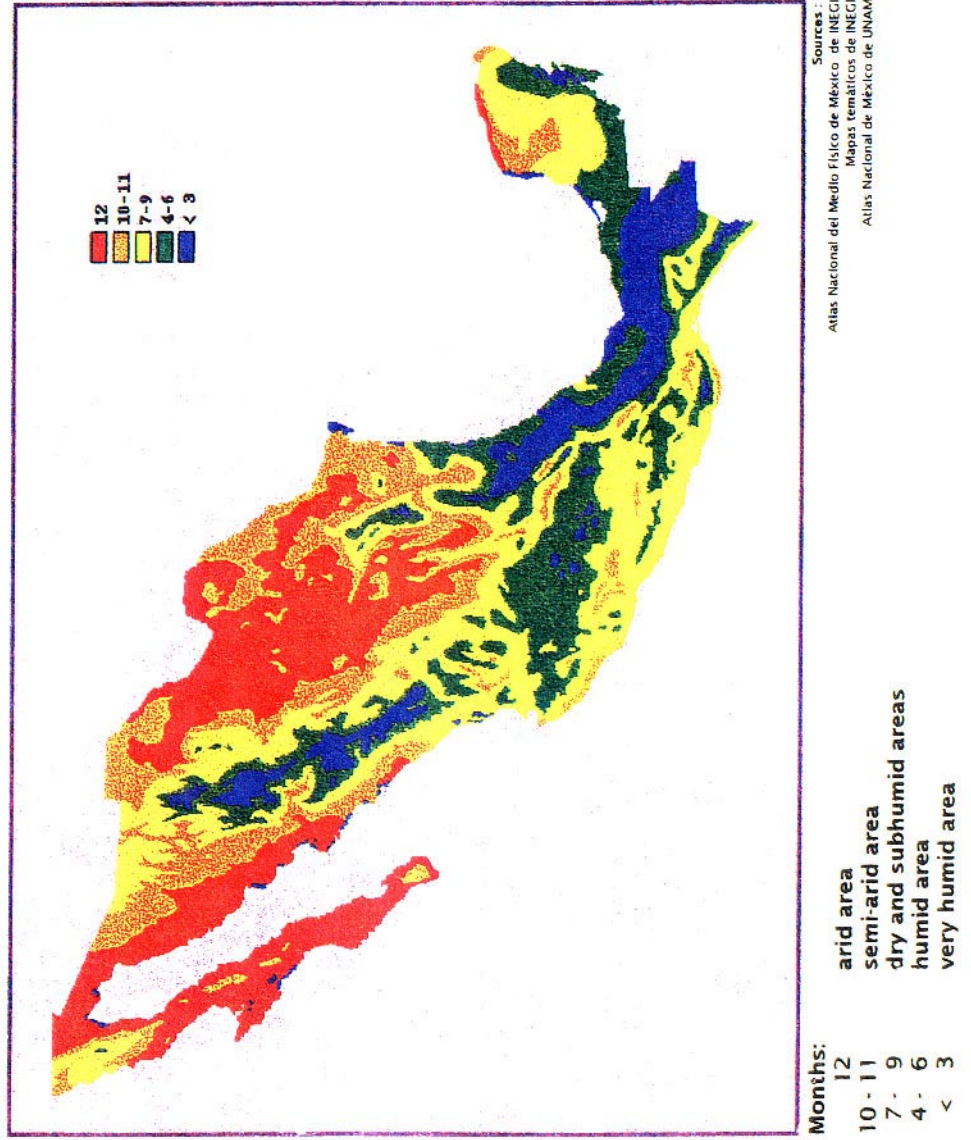
2. Index of Aridity



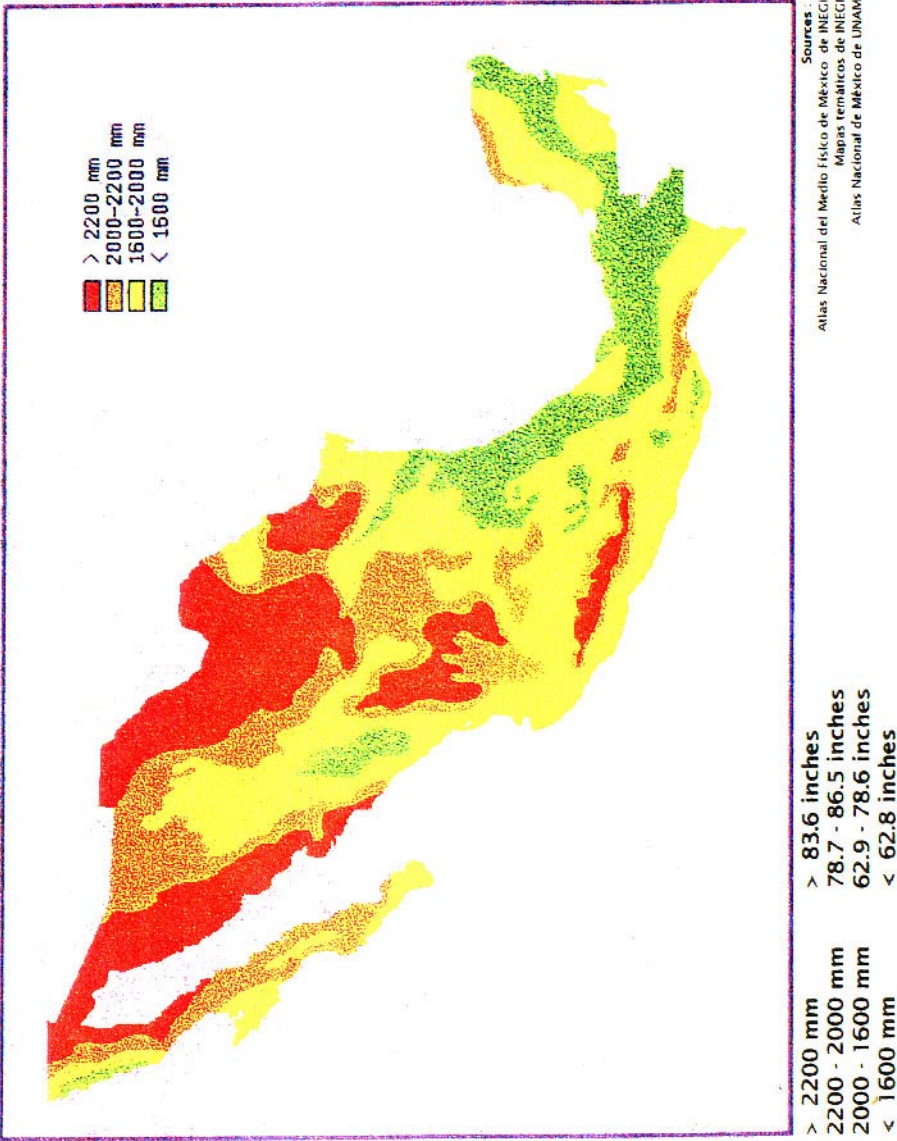
3. Annual Precipitation



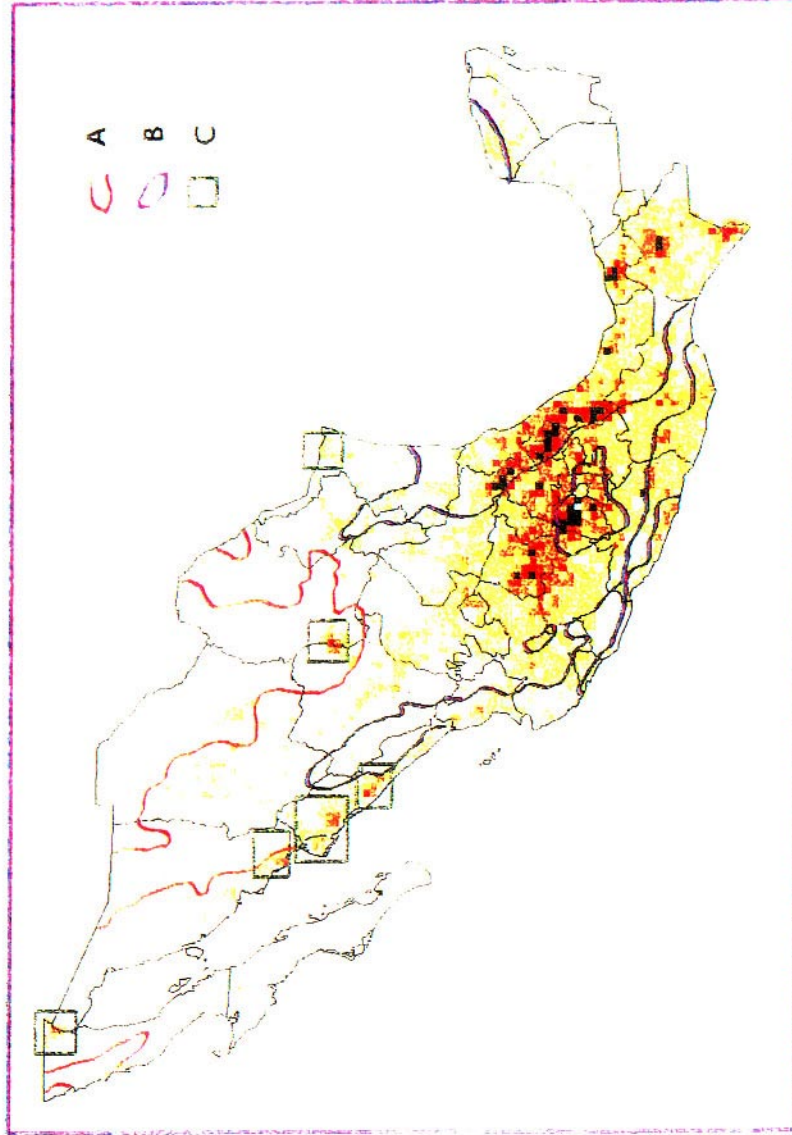
4. Average Number of Dry Months Per Year



5. Average Annual Evaporation



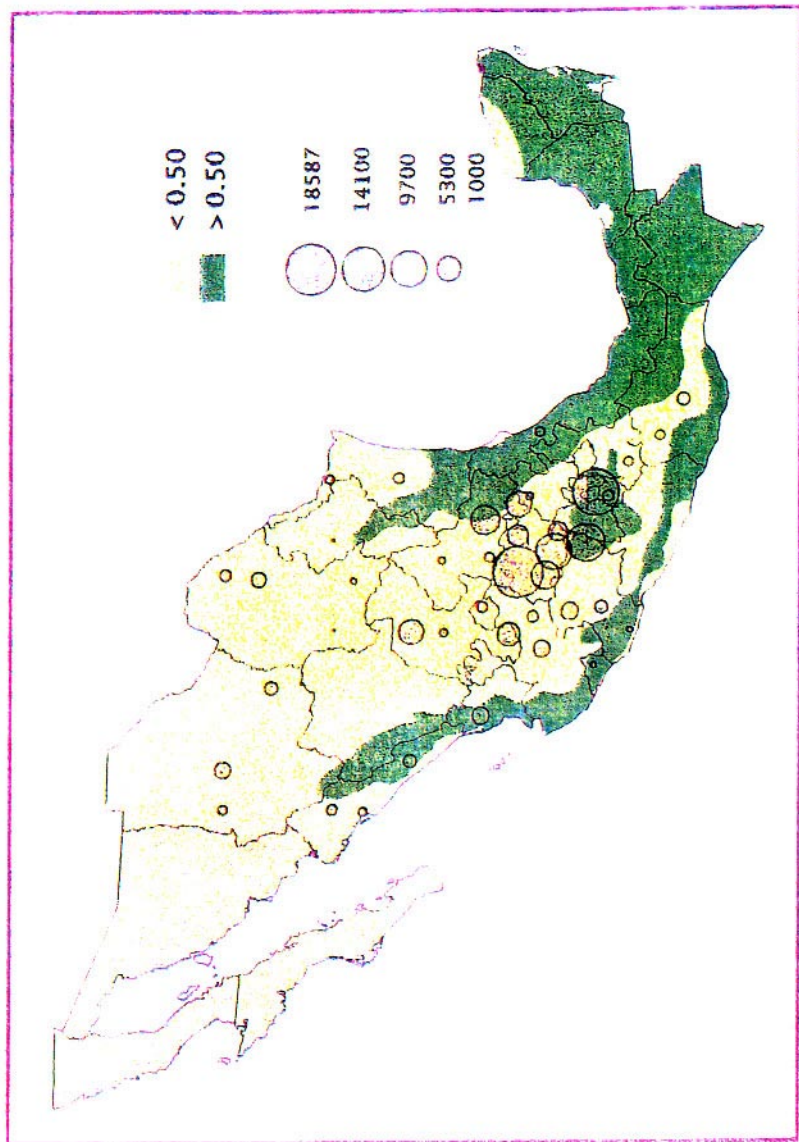
6. Aridity and Density of Rural Population



Sources :
X Censo de Población y Vivienda, 1990
INEC (Código)
Atlas Nacional de México de UNAM
Sistema de Información Geográfica y Estadística de la
Frontera Norte (COLEF-ORSTOM)

A- Transition from arid to dry area
B- Transition from dry to humid area
C- Arid area with irrigation
Density of rural population (living in localities of less than 2500 inhabitants) in 1990 (X Mexican Census).

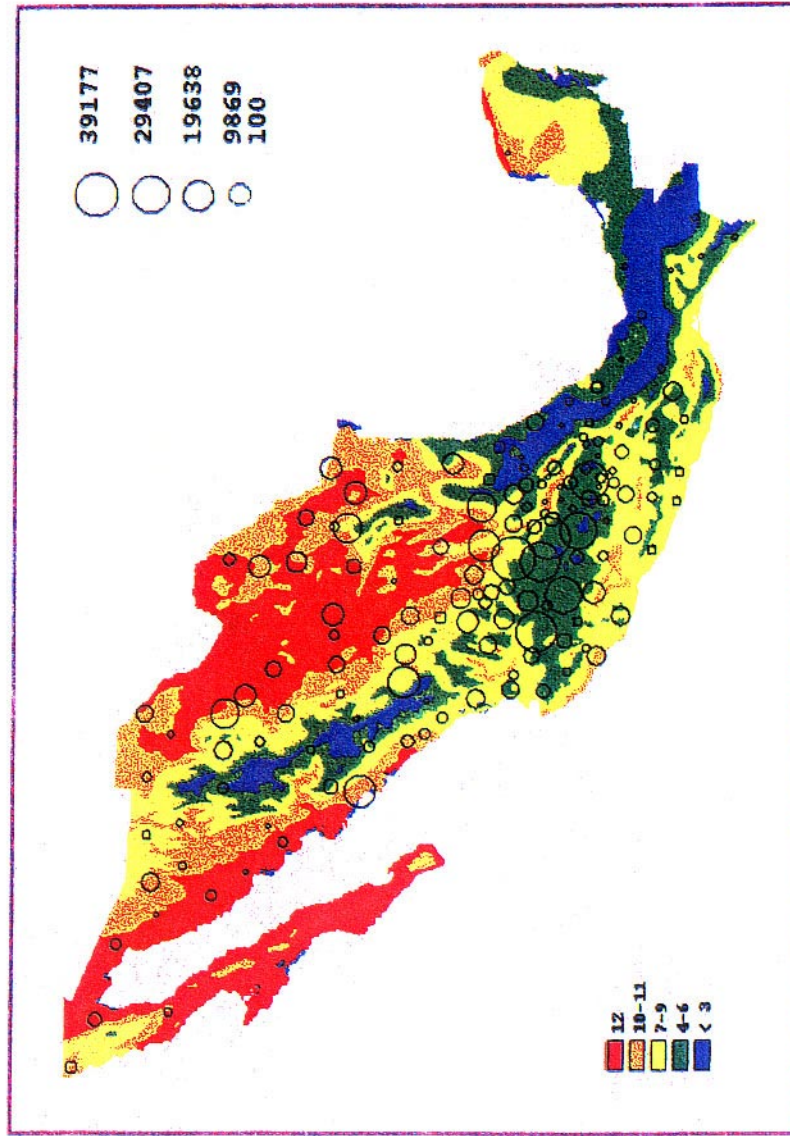
7. Rural Migration and Aridity



- Arid and dry areas (< 0.50)
- Humid area (> 0.50)
- Flow of Mexican migrants in 1993, living and working in the US, surveyed on their return to Mexico (spatial distribution according to the region of last residence in rural localities of Mexico).

Sources
Survey on Mexican US migratory flow (COLIF)
Atlas Nacional de México de 1950
Sistema de Información Geográfica y Estadística de la Frontera Norte (COLIF-ORSTOM)

8. Number of Dry Months and Migration



Number of dry months and flow (estimation for 1993) of Mexican migrants living and working in the US, surveyed on the border on their return to Mexico (spatial distribution according to their region of birth in Mexico, rural and urban localities).

Sources:
Survey on Mexican-US migratory flow (COLEF)
Atlas Nacional de México de UNAM
Sistema de Información Geográfica y Estadística de la
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