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Severe Droughts Becoming Recurrent, More Persistent in Mexico

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During recent years, severe and extreme droughts in Mexico and their consequent water deficits have become more recurrent and persistent, according to historic records and the experiences of those who have lived through these events.

In Mexico, agriculture consumes more than 85% of the available water. When the available water is insufficient to satisfy agricultural requirements, impacts can be acute. In extreme cases, lack of water has caused severe economic, social, and environmental crises, and recovery from these crises has taken much time and money.

The regions that are most affected by drought have some common characteristics: they are the most vulnerable regions, they are more productive than other regions, and they have a greater demand for water than other regions do. The north, northwest, and northeast regions, in which are located the most important irrigation zones and most of the industrial plants, constitute 70% of the country, but these regions receive less than 40% of the country's total rainfall. The southeast region, constituting 30% of the country, receives 60% or more of the total rain; in this part of the country, the rivers are larger with regular flows, and there are wide humid zones where irrigation is unnecessary. (Figure 1 shows the main hydrogeographic regions of Mexico.) The few remaining nonirrigated areas, which benefit from summer rains, have also been drastically affected by drought, because they do not have alternate sources of viable water or fast response capabilities.

The droughts of recent years have caused acute deficits even in typically humid zones, with adverse effects. During the first half of 1998, wildfires reached historic highs. This was exacerbated by rains in late 1997 that caused greater-than-normal undergrowth. In early 1998, the humidity diminished, and plants dried out and were converted into highly flammable material, increasing the risk of fire. In addition, the start of the normal rain season was delayed more than a month, further aggravating the problem and allowing environmental pollution and smoke to reach new levels.

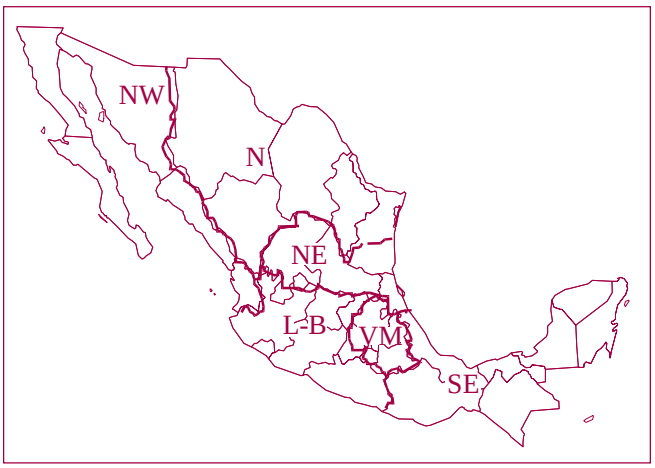

Figure 1. Main hydrogeographic areas of Mexico. NW = Northwest; N = North; NE = Northeast; L-B = Lerma-Balsas; VM = Valle de Mexico; SE = Southeast.

All of these conditions were thought to be the result of El Niño, which reached an acute phase during winter 1997. During May and June 1998, the change to La Niña also favored adverse environmental conditions. It was not until late July that rainfall returned to normal, ending the problem of fires and pollution, but the rains that did occur were so intense for a short period of time that they resulted in floods and excessive water. Also, hurricanes, particularly along the coast of the Pacific Ocean, were of a magnitude that resulted in severe damages to the population, infrastructure, and social and economic stability of wide areas.

During the 1998 water year, the rains were lower than normal, and through the end of October, they had reached 96% of the historic normal on a nationwide scale, although some areas registered lower levels, mainly those areas where irrigation zones are located. The concentration of the rains in a shorter

period of time (from mid-July to mid-October) was insufficient to reach normal or greater than normal values. In general, in spite of the damage they cause, hurricanes in Mexico are expected and well regarded because their presence means that rain will fill dams, guaranteeing a good agricultural season and enough water for regionwide crops. In 1998, hurricanes as well as seasonal and intense rains caused serious damages, but unfortunately they only occurred in the coastal low zones and not in the mountainous areas, where their benefit would have exceeded the damages. In the 1998 hurricane season, damages were acute and the infrastructure was severely affected in the irrigated lowland agricultural areas. Because of these damages, the water that collected in the dams as a result of the hurricanes was difficult to access.

Because of recurring severe droughts and floods, the federal and state governments of the most affected areas frequently have provided aid to the population, in order to support social and economic stability and mitigate the negative effects of these hazards. Because of the severity and areal extent of some droughts, the federal government has had to declare the affected areas disaster zones, so that emergency programs could be initiated to mitigate the effects. In these cases, the National Water Commission (CNA), the federal agency responsible for coordinating water use, works with agencies of the affected states and municipalities to diminish damages and allow conditions to return to normal as soon as possible.

At the beginning of the agricultural year, CNA sets the allocation of the water to be used in each

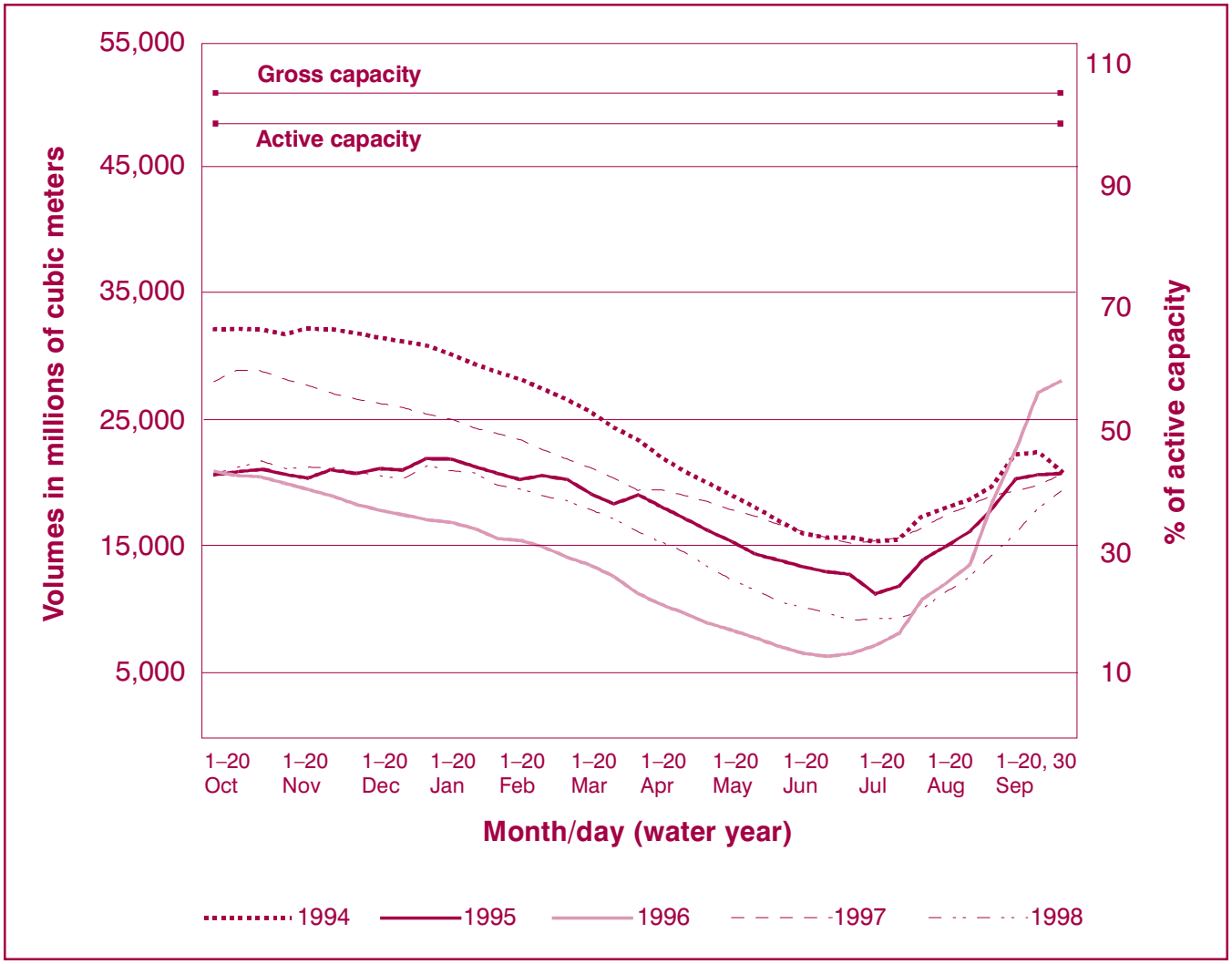

Figure 2. Storage in reservoirs for irrigation in Mexico.

Region	Capacities, $m^3 \cdot 106$		Water in reservoirs available for irrigation, beginning of water year, $m^3 \cdot 106$							
			1996		1997		1998		1999	
	Gross	Active	A. Vol.	%	A. Vol.	%	A. Vol.	%	A. Vol.	%
Northwest	23,167	22,069	10,579	48	14,838	67	10,199	46	8,554	41
North	18,163	17,588	3,846	22	7,400	42	5,976	34	3,796	21
Northeast	2,018	1,752	836	48	917	52	680	38	925	52
Lerma-Balsas	6,071	5,090	3,919	77	3,269	64	2,618	51	3,897	76
Valle de México	1,010	918	809	88	650	70	527	57	688	77
Southeast	1,046	997	100		1,029	100	717	71	1,096	100
TOTAL	51,477	48,417	20,987	43	28,105	60	20,718	42	18,958	39

Table 1. Capacity and available volumes for each geographical region, in stored water, dams, and reservoirs at the beginning of each agricultural year. Source: CNA, 1998. GDUR, 10-day record of storage in dams of the Irrigation Districts. Internal Documents, Mexico. A. Vol. = available volume.

irrigation district, especially districts supplied by dams and reservoirs. The allocations are made based on previous revisions and analyses of requirements as well as current conditions and hydrologic forecasts for the winter season. If these conditions are unfavorable, then options to restrict the surface area sown and volume of water to be used are done. By the end of March, actual and possible developments are evaluated, based on environmental conditions and spring-summer crop programs, and adjustments are made accordingly. This constitutes risk management, because those involved are trying to mitigate the negative effects of a possible lack of water.

During the course of the water year, if a deficit occurs or is greater than expected, the usual measures for mitigation are water rationing and programs to improve water use efficiency. To accomplish these measures, CNA relies on water user associations and state and municipal governments, who carry out these tasks in such a manner that the socioeconomic conditions of the local population are affected as little as possible—especially that sector of the population that has the fewest resources and whose regular income comes from activities related to agriculture: journeymen, ditchers, machinery operators, crop collectors. Certainly, the small agriculturalists also benefit from these programs, but the basic objective is that they should suffer the least adverse change and minimum damage. Unfortunately, this goal is not always achieved, and in extreme conditions, even the more ambitious programs are insufficient to mitigate the effects. Even so, not taking action would have even more disastrous consequences, and recuperation time would be longer.

Another characteristic of droughts in Mexico is their areal extension: in general, they cover large areas, and local response actions contribute little to resolving the overall problem. Some areas are only slightly affected while other areas may suffer severe impacts. In particular, in the big watersheds of the north region, where rivers are the basic source of supply and groundwater is scarce, the options for mitigating drought impacts are more complicated, because new sources of water are scarce and expensive. Nevertheless, in extreme cases, emergency programs to dig deep wells to extract groundwater have been able to satisfy the most urgent needs, mainly for human consumption. Also, in some cases during the last 5 years, the situation has been so critical that even domestic water use has been severely restricted (i.e., water available for only a few hours of the day; limiting or punishing water usage for certain activities).

Table 1 shows the water available for irrigating at the beginning of the water year; Figure 2 shows the evolution of stored water in the last few water years. From an examination of Table 1, it appears that the 1996 water year had the most critical water deficit, with the most severe damages to agriculture and livestock, because by the middle of the year, minimum historical water levels were reached. But

during the rainy season, an amazing recovery occurred in storage, so that at the beginning of the 1997 water year, conditions were almost normal; nevertheless, 1997 was a difficult year, in which rain was not adequate to satisfy existing requirements and replenish storage. Therefore, 1998 did not begin as a normal year, and irrigated areas were adversely affected. Prospects for 1999 are not good, because initial storage volumes in dams are the lowest in the last 6 years, the precipitation forecast for winter 1998 was not promising, and La Niña, the cold and dry phase of ENSO, is persisting.

For the 80 irrigation districts of the country, which cover about 3.2 million hectares, there are 19 support programs for 1999; these restrict sowing to 652,454 hectares, or 55% of the total surface of those districts. Specific actions of these programs include the following: coating and piping of ditches, rehabilitation and digging of deep wells and pumping stations, rainwater collection (preparing the land for capture and retention of rainwater), substitution of autumn-winter crops for spring-summer crops where and when possible, and formation of advisory groups for watering supervision.

These actions, which would be carried out by water user associations, would help partially sustain the income of the local population. Jobs would be generated for the rural population, thus helping to diminish migration, avoid increasing impoverishment, and control social problems. For these projects, CNA has invested approximately US$37 million during the 1999 water year.

The areas where these actions will be carried out include districts in the states bordering the United States, districts in the most arid zones of the country, and basins that are shared with the neighboring states of Arizona, Texas, and New Mexico, where the hydrometeorological conditions are similar. In this way, we are advancing our ability to forecast critical situations and conduct risk management in the agricultural sector. If environmental conditions are not as severe as forecast, the plan will be adequate to mitigate the impacts; if the situation is more severe than predicted, the risks may be greater, but the early warnings of drought's occurrence will help prevent and mitigate the damages.

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