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Mexico Crop Travel: Winter Corn in Sinaloa

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Crop analysts from USDA Washington- Foreign Agricultural Service and personnel from Office of Agricultural Affairs/Mexico City travelled to Sinaloa, Mexico in March 2024 to observe the impacts from prolonged drought conditions, water restrictions, and excessive heat on the critical winter corn production. Water restrictions led to a reduction in both the corn planted area and yield potential in Sinaloa. USDA estimates marketing year (MY) 2023/24 corn production at 23.3 million metric tons, down 17 percent from last year.

In Mexico, roughly 90 percent of corn planted on average is white corn and is the nation's main grain for human consumption. The corn tortilla is a primary staple food in the Mexican diet, with a per capita tortilla consumption of 75 kg per year. Corn in Mexico is grown in two seasons—the summer season accounts for 70 percent of production. It is mostly rainfed and planting starts with the onset of the rainy season. Peak planting occurs in June, July, and August; harvest occurs mostly in November and December (figure 1). In contrast, winter corn is predominatly irrigated and planting occurs in November and December and harvest occurs in May and June. Sinaloa is the most important state for winter corn production, accounting for 68 percent of winter production (figure 2). Sinaloa accounts for about 20 percent of national corn production. The corn, nearly all irrigated, was at risk due to the poor recharge of water in the local reservoirs coupled with excessive heat.

Sinaloa's winter corn production depends on recharge of its reservoirs which normally occurs from Pacific tropical storms. For the MY 2023/24 crop, near-record low rainfall distribution for the rainy season led to significantly low reservoir water levels (figure 3), jeopardizing winter corn crop prospects. Though reservoir levels were at a deficit and corn operations were at dire need of soil moisture supplies, farmers and industry sources informed the USDA team that winter corn early planting benefited from Tropical Storm Norma which provided ample rainfall to the main producing corn areas in northern Sinaloa, in late October (figure 4). As a result, rainfall from the storm event saved roughly 20 percent of the national crop.

The USDA team toured the main winter corn producing municipalities, Culiacán and Ahome, located in northern Sinaloa. Combined, Culiacán and Ahome account for over 50 percent of the state's winter corn production. During the visit, the team met with farmers, cooperators, and millers, and collected over 225 field data points (figure 5). Winter corn crop conditions observed were average to slightly above average, however local farmers still expressed dissatisfaction due to accustomed yield results achieved over the past few cycles that surpassed current expectations. Corn yield from the fields visited were reported as achieving 14 tons per hectare (t/ha) in the past, which is larger than the state-wide corn yield in Iowa. According to farmers, expected yields would be about 15 percent lower than normal, or 12 t/ha. For Sinaloa, however, average corn yield is 12 (t/ha), and stakeholders discussed that potential yield could be as low as 10 t/ha. Another factor that has likely impacted yield potential is excessive heat at grain-fill (figure 6). Satellite-derived percent of average seasonal greenness shows the crop conditions in MY2023/24 to be worse than in MY 2022/23 for Sinaloa (figure 7).

Multiple sources explained that this was the worst season due to the lack of water supply. The benchmark for worst year was the MY2010/11 season when a cold snap in early February 2011 that lasted nearly a week damaged winter corn in the state of Sinaloa, with temperatures plunging to minus 8 degree Celsius in some locations (https://downloads.usda.library.cornell.edu/usda-esmis/files/5q47rn72z/cv43nx187/5138jf37r/worldag-production-03-10-2011.pdf). During meetings and field visits, the team discussed with farmers irrigation practices, allocation of water, and responses to the lack of water. The following details were captured:

Irrigation Practices: In the region travelled, three types of irrigation practices are used for corn. The most common (90 percent) is gravity irrigation where tubes are placed in the irrigation ditches and water flows into the fields (figure 8). Typically farmers will have 4 to 5 irrigations per season. There is some drip irrigation of corn (8 percent), however, it is more costly and harder to maintain. Drip irrigation for higher value vegetable crops is easier to justify. The remaining irrigation practice is pivot (2 percent).

Allocation of Water: CONAGUA (Comisión Nacional del Agua) is responsible for adminsitration, regulation, and protection of water for Mexico. Its goal is to guarantee water for health and sanitation. CONAGUA monitors the reservoirs of Mexico and works with local irrigation districts to allocate water. In Sinaloa, there are eight districts and each district, in turn, is made up of several "módulos." For example, the irrigation district of Rio Fuerte, Los Mochis is 140,000 ha and has "módulos" ranging in size from Sant Rosa módulo of 14,000 to 23,000 ha. Local farmers can be president of the "módulo." Farmers pay a fee based on the

number of hectares but not based on the amount of water used. The fees range from 2,400 pesos/ha to 4,000 pesos/ha. The control of the water into the field is managed by a “canalero” who opens and shuts the channel for the field. During the MY2023/24 season, CONAGUA and the irrigation districts restricted the amount of water which reduced corn area in Sinaloa. Further, the number of irrigations were restricted to 2 to 3, instead of the normal 4 to 5. Before the season could end, and in some places before the last irrigation could be applied, CONAGUA shut off water discharge from the Josefa Ortiz de Dominguez reservoir in early April 2024 to preserve the remaining amount of water for health and sanitation (figure 9). In northen Sinaloa, the three most important reservoirs for agricultural use are Josefa Ortiz de Dominguez, Miguel Hidalgo y Costilla, and Luis Donaldo Colosio.

Mitigating Responses: Farmer and industry officials reported that their top concern was water, followed by land rents, and then labor costs. Farmers and water managers mitigated the effects of low water levels for corn in Sinaloa in MY 2023/24. Corn area was reduced, and frequency of irrigation was reduced.Without the ability to plant corn, farmers switched to lower water-use crops such as chickpeas, sorghum, and safflower. Additionally, some farmers adapted their irrigation practices to every other row receiving water. This worked well when the corn variety used was a shorter stature. Additionally, several farmers discussed drilling wells, with one farmer discussing the lack of permits needed to drill a 12 meter-deep well. However, well drilling would incur another high input cost which farmers expressed may be a deterrent, unless support could be provided. Future mitigations need to effectively price water based on volume of water, not on hectares. Currently, farmers receive water based on the number of hectares; they have no incentive to maximize water-use efficiency. If they receive water for 5 irrigations, then they will use the water allocated. Industry is working with farmers to increase the use of more efficient drip irrigation instead of the commonly used gravity irrigation. A deterent for switching to drip irrigation is lack of trust. If farmers cannot see the water in the fields, they do not think they have received all of the allocated water.

Mexico’s corn production is estimated 17 percent lower from a year ago primarily due to the drought damage that affected the summer crop. The drought led to one of the highest corn area lost on record (figure 10). Harvested area is 11 percent lower than in MY 2022/23. The losses would have been signifcantly larger if the tropical storm Norma had not arrived in time to recharge reservoirs for the winter crop.

Contributions to this report from the Office of Agricultural Affairs Mexico staff are very much appreciated, as well as the support for logistics and travel to Sinaloa.

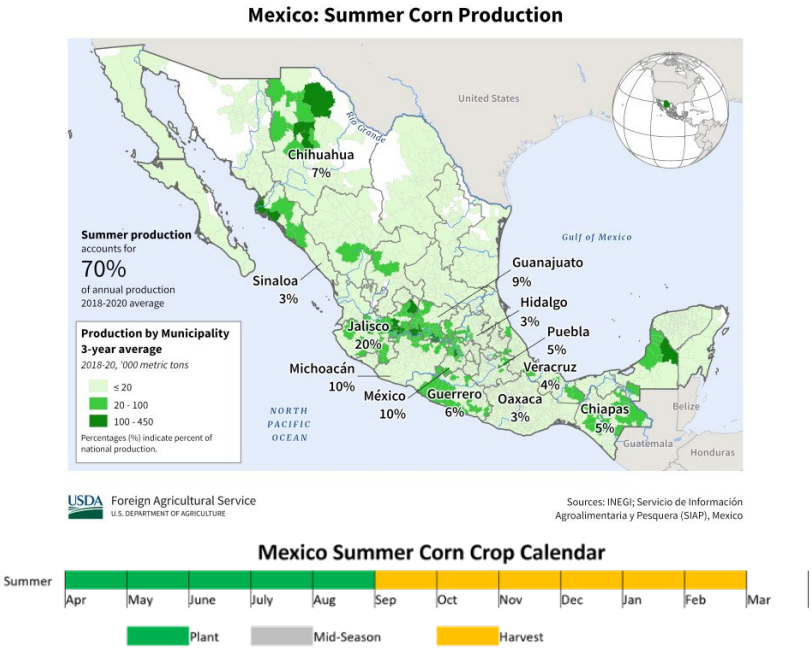


Figure 1. 2023/2024 Summer corn (main crop – ~70% of annual production). It is about 90% rainfed. Jalisco is the main producing state.

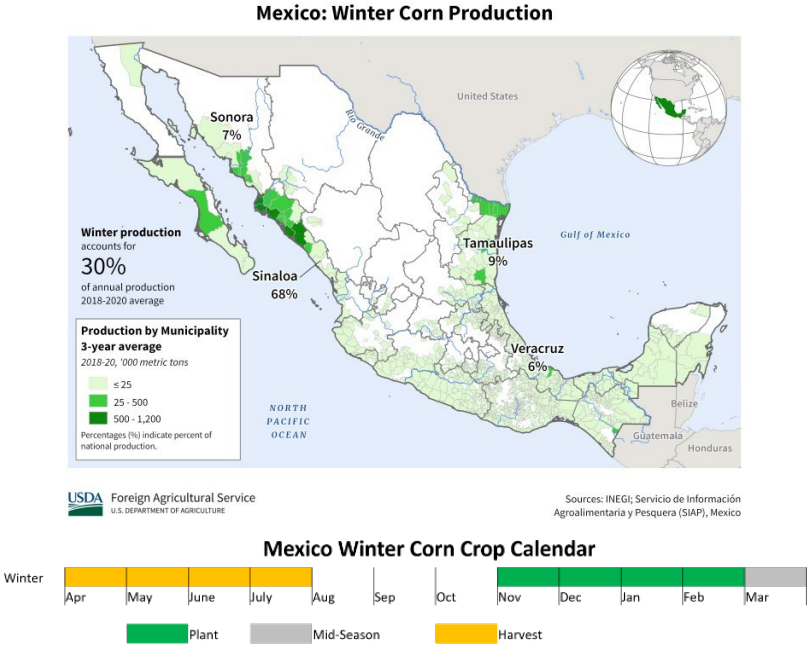
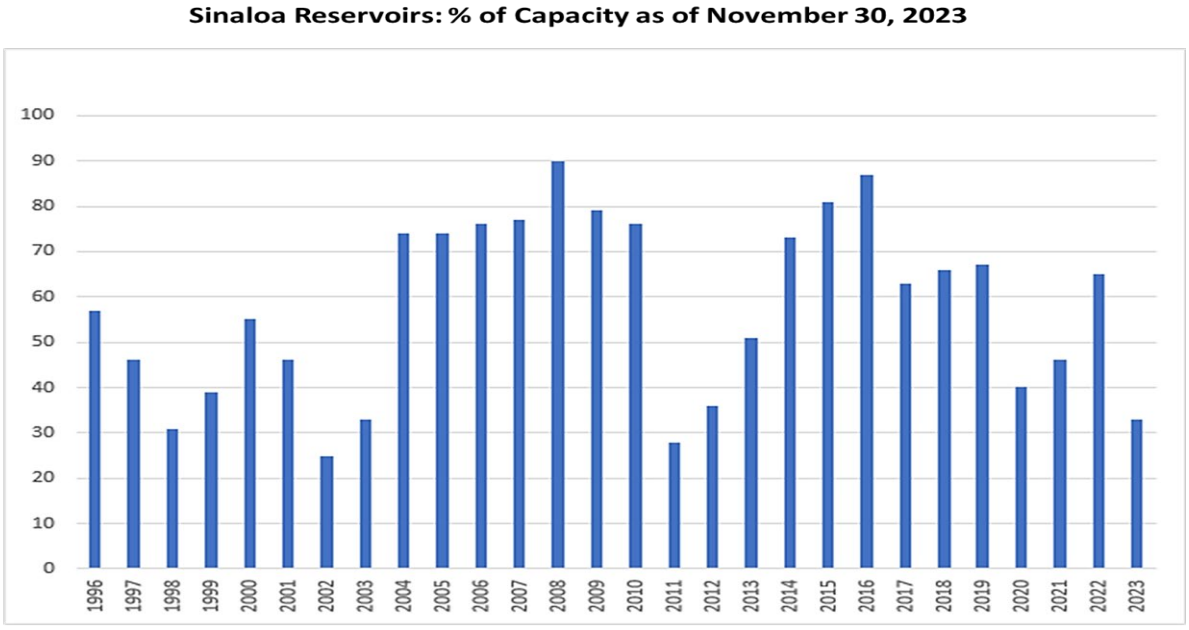


Figure 2. 2023/2024 Winter corn (minor crop - ~30% of annual production). It is about 60% irrigated. Sinaloa is the main producing state.



Source: *Comisión Nacional del Agua* (CONAGUA)

Figure 3. Comisión Nacional del Agua (CONAGUA) reported average Sinaloa reservoir levels at 28 percent capacity, considerably lower compared to 69 percent at this same time last year. Data is from November 23, 2023, or roughly the beginning of the planting season for winter corn in Sinaloa.

Hurricane Norma – Supplied Much Needed Rainfall

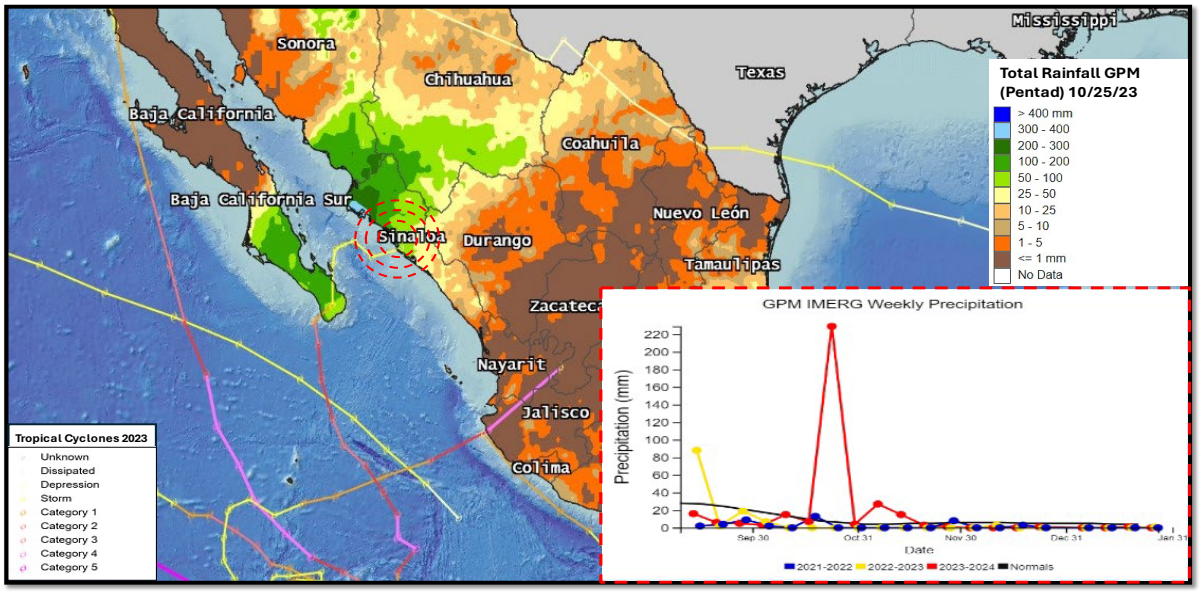


Figure 4. In late October 2023 Tropical Storm Norma made landfall over northern Sinaloa. Over 200 mm of rainfall fell during this rain event benefitting November crop planting. Sources: NOAA National Hurricane Center, NASA Global Precipitation Mission.

Observed Locations

Culiacan ~27% production in Sinaloa

- Water source irrigation drip and elevation
- Average production – 1.5 million metric tons
- Average yield– 11.4 t/ha
- Average area– 134k ha

Los Mochis ~27% production in Sinaloa

- Water source irrigation drip and elevation
- Average production – 1.48 million metric tons
- Average yield– 12.7 t/ha
- Average area– 116k ha

- Source SIAP

225 field data points captured

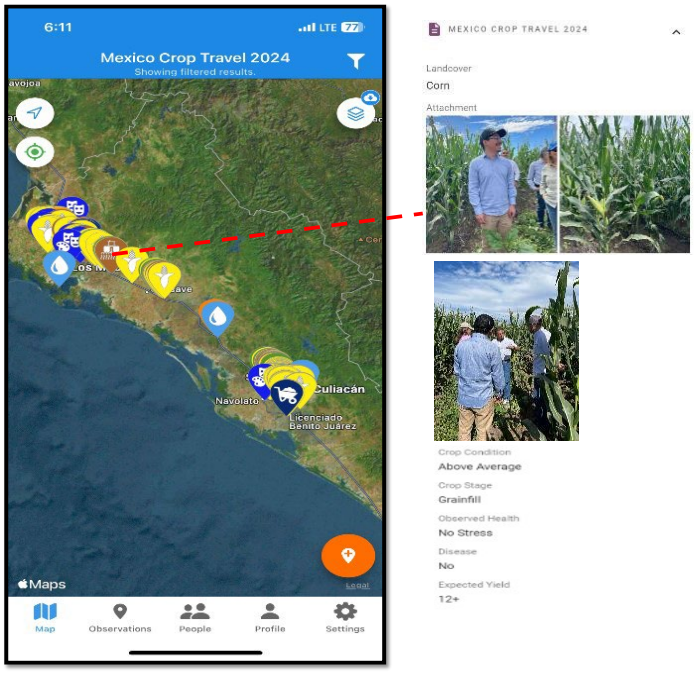
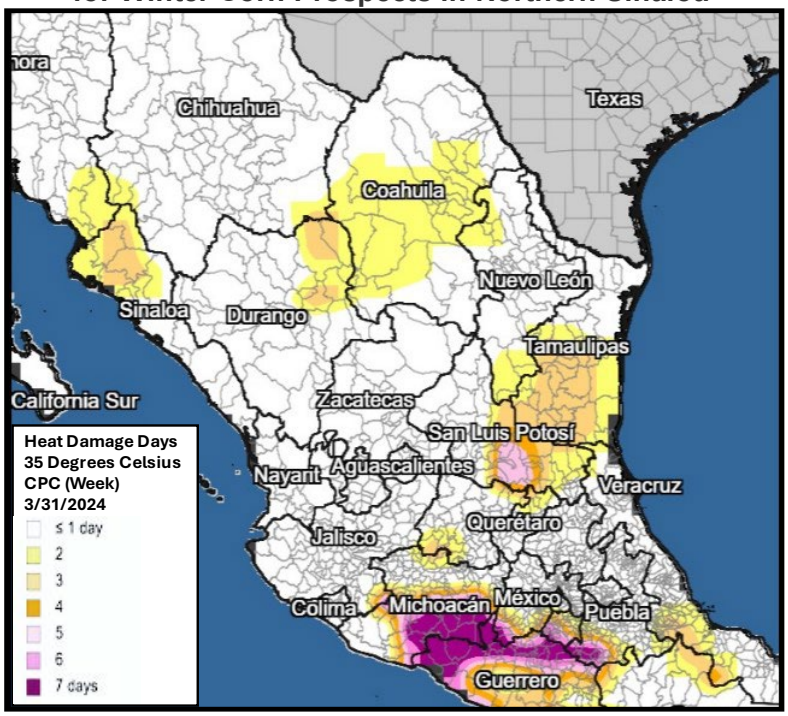


Figure 5. Using the MAGE mobile application, USDA analysts were able to capture over 225 field data points in Culiacán and Ahome (Los Mochis) municipalities as reference indicators for field validation.

Heat Damage Days (35 Degrees C) Causing Concern for Winter Corn Prospects in Northern Sinaloa



Source: NOAA Climate Prediction Center (CPC) Temperature Data

Figure 6. Corn can withstand a temperature threshold between 5° Celsius and 35° Celsius before being negatively impacted. Extended exposure further exacerbates the impact on corn prospects. On average corn in this region was at the grain-fill stage – where extreme high temperatures could result in stressed corn.

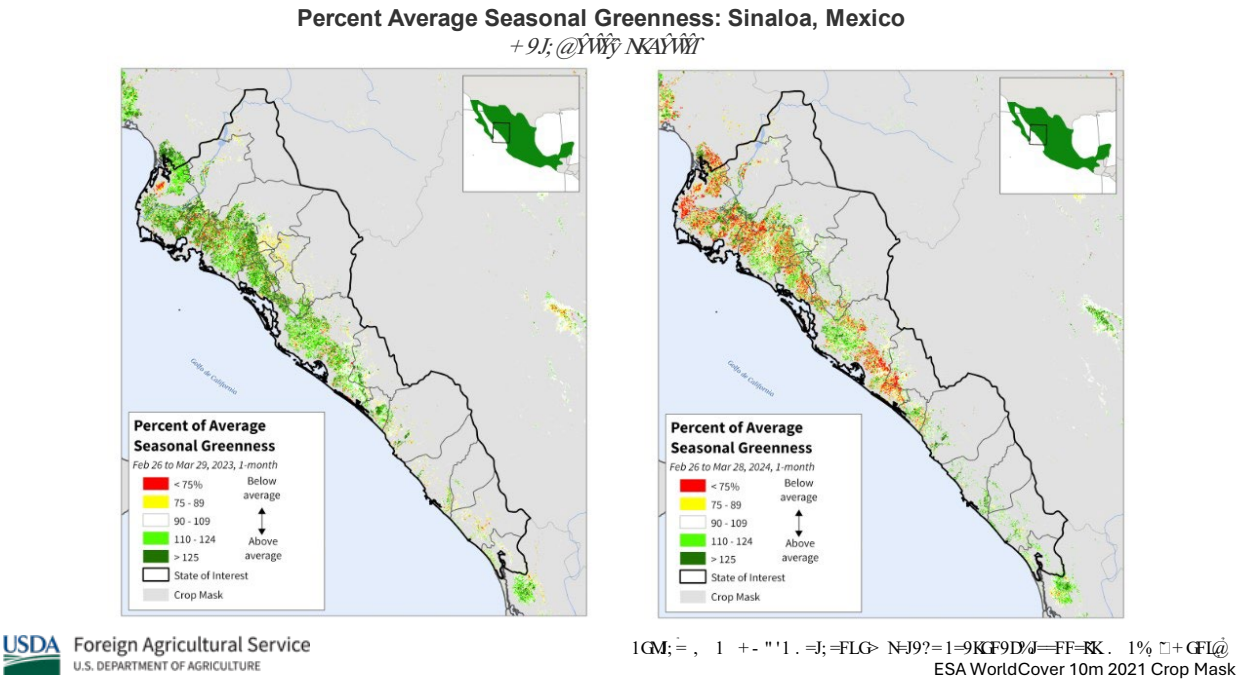


Figure 7. Percent Average Seasonal Greenness is used as an indicator to visualize the extent of crop conditions. In 2024, winter corn conditions are lower than 2023 during the month of March.

Figure 8. Photo courtesy of FAS-Washington in Culiacán, Mexico. Gravity irrigation method used to pump water into the corn fields.

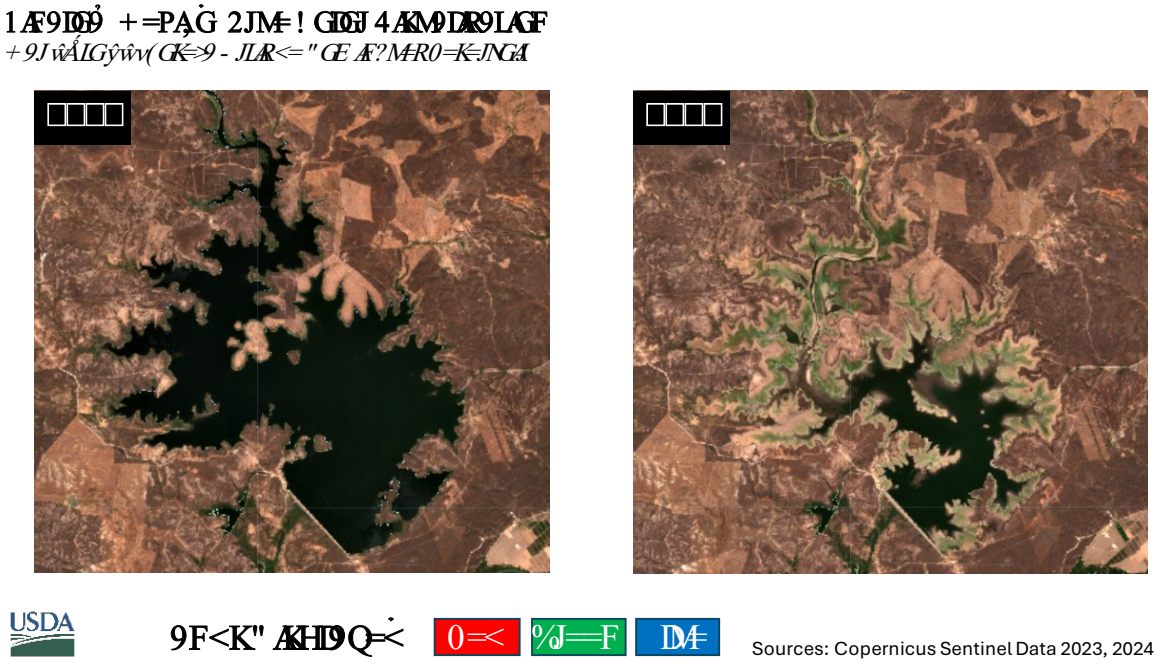


Figure 9. Sentinel-2 imagery shows the extent of water levels in the Josefa Ortiz de Dominguez reservoir. Insufficient rainfall coupled with extreme heat led to significantly low levels. As a result, the water commission restricted water use for agricultural purposes in early April 2024.

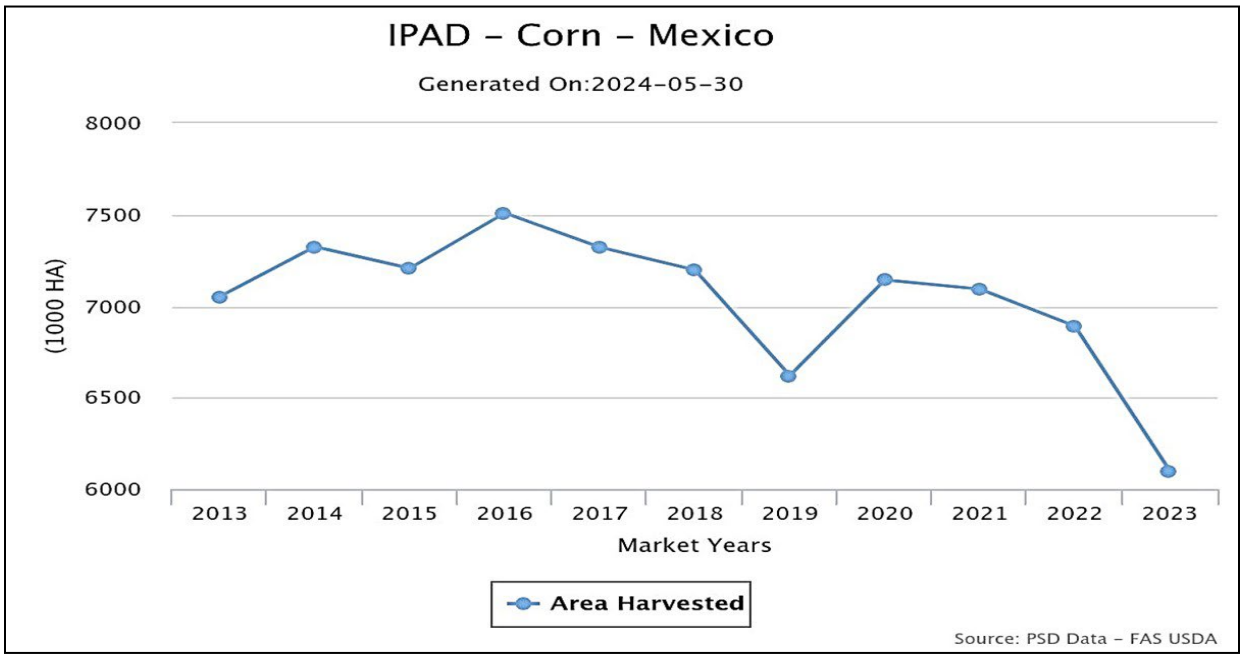


Figure 10. Historical area harvested series for Mexico. Limited water supply led to a 11 percent year-to-year reduction in area harvested.

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For more information and to access USDA FAS databases and reports please visit:

Current World Agricultural Production Reports
https://www.fas.usda.gov/data/world-agricultural-production

Production, Supply and Distribution Database (PSD Online)
https://apps.fas.usda.gov/psdonline/app/index.html#/app/home

Global Agricultural Information Network (Agricultural Attaché Reports)
https://www.fas.usda.gov/databases/global-agricultural-information-network-gain

Crop Explorer
https://ipad.fas.usda.gov/cropexplorer/

Global Agricultural and Disaster Assessment System (GADAS)
https://geo.fas.usda.gov/GADAS/index.html