More Mexican States Could Face Water Stress By 2050

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Without adaptation to climate change, as many as 20 of Mexico's 32 states face high exposure to water-related stress by 2050 under S&P Global Ratings' scenario analysis, up from about 11 today.

This report does not constitute a rating action.

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The findings of this research do not currently form part of the base case for our ratings on Mexican local and regional governments (LRGs).

Water stress occurs when demand for water exceeds available supply or when poor water quality restricts its use, according to the European Environment Agency. S&P Global Ratings believes Mexican states' exposure to high water stress, if left unaddressed, could influence long-term economic growth in the country. In this research paper, we are seeking to better understand the scale of Mexico's potential exposure to this environmental risk and its distribution across the country. The scenarios presented here provide insight into the potential exposure of Mexican states to the specific physical climate risk represented by water stress.

This research uses S&P Global Sustainable1's Climate Change Physical Risk dataset to explore Mexican LRGs' exposure to water stress over the next 30 years. S&P Global Sustainable 1 is separate and distinct from S&P Global Ratings. Certain activities of these business units are kept separate from each other in order to preserve their respective independence and objectivity.

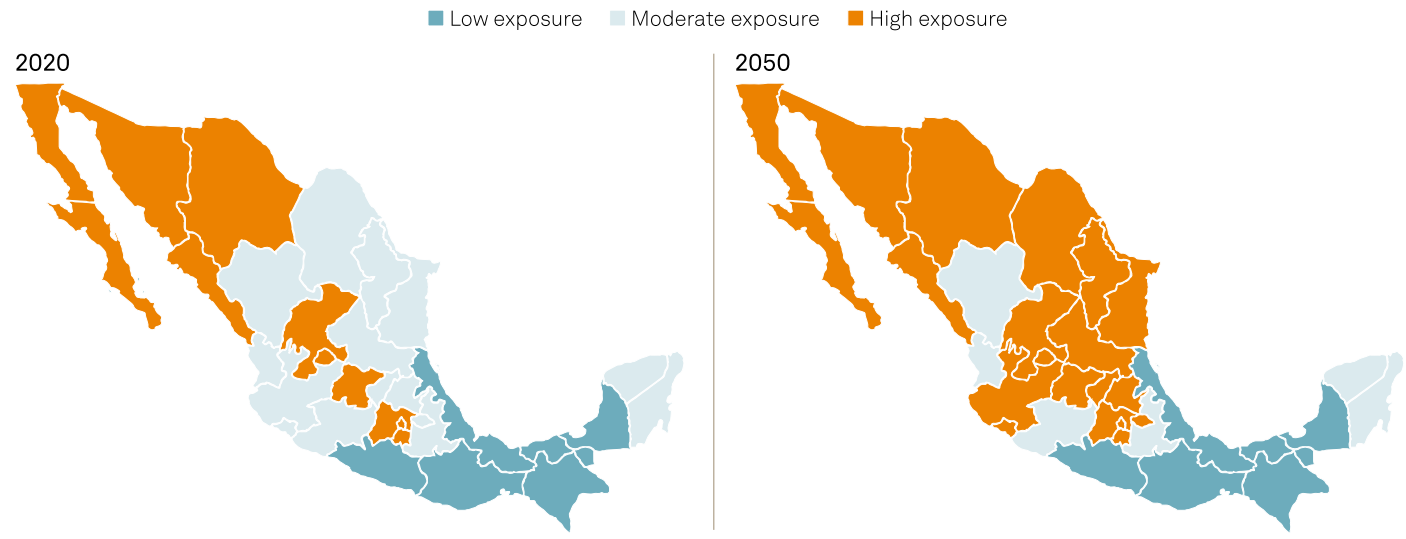
The stress scenarios reflect Shared Socioeconomic Pathways (SSPs) from the Intergovernmental Panel on Climate Change (IPCC) and incorporate broad changes in socioeconomic systems. This paper presents findings as of 2050 through SSP2-4.5--a moderate emissions scenario--noting often small differences among the SSPs for the midcentury, owing to historical emissions.

Key Takeaways

- The number of Mexican states exposed to high water stress will almost double to 20 (about 60% of states) by 2050, from 11 (34%) in 2020, under all scenarios covered in our analysis, without adaptation measures.
- States facing the greatest risk are already short of water and may experience decreased economic growth as the frequency and intensity of droughts increase.
- An increase in investments in water infrastructure over the long term could weaken some states' and municipalities' budgetary performance and result in higher debt, but go some way to building resilience to water scarcity.

Graphic 1

The number of Mexican states highly exposed to water stress could almost double by 2050



Estimate based on analysis under a moderate stress scenario (SSP2-4.5). Source: S&P Global Ratings.

Drought Is A Recurring Issue In Some States

Water stress and drought are not new for many Mexican states, but their impact has intensified. There is no universal definition of drought, and there are many different types. U.N.-Water defines drought in hydrological terms as deficiencies in surface and subsurface water supplies measured as stream flow, lake, reservoir, and ground water levels. In the past three years, public reports show that low water availability has directly affected the lives of tens of millions of people in Mexico. Comisión Nacional del Agua (CONAGUA), which regulates and administers Mexico's water resources, reported that, in July 2022, eight of the country's 32 states were experiencing extreme to moderate drought. S&P Global Ratings believes this trend could worsen as early as this decade, given the increasing incidence of droughts; inadequate investment in water infrastructure, supply, and conservation; and limited water resources.

Mexican states that use more ground or surface water than is available face greater water stress than states with similar consumption levels but a larger supply. Likewise, for states in very dry areas, despite a relatively smaller population, industries that require large amounts of water could put strain on the water supply. For states with abundant water resources, it would take a much larger population and higher economic activity to stress water levels.

According to S&P Global Sustainable1's data, the number of Mexican states exposed to water stress will increase--absent preventive measures--to 20 in the next three decades under a moderate stress climate scenario (SSP2-4.5) from 11 states on average in this decade. The extent of water stress exposure will differ by geography, population density, and economic activity.

Shared Socioeconomic Pathways Defined

The IPCC established the Shared Socioeconomic Pathways (SSPs) as a set of scenarios for projected greenhouse gas emissions and temperature changes. The SSPs incorporate broad changes in socioeconomic systems, including global population growth, economic growth, resource availability, and technological developments:

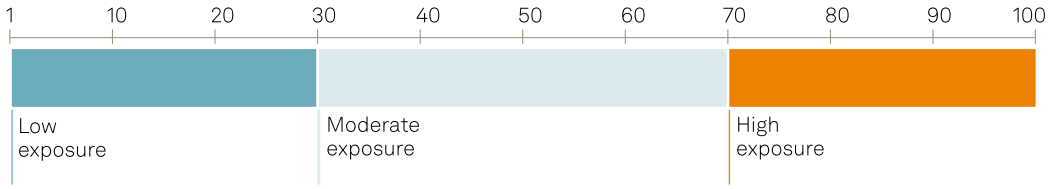
- **SSP1-2.6** is a low emissions scenario in which the world shifts gradually, but consistently, toward a more sustainable path. This SSP aligns with the Paris Agreement's target to limit the average increase in global temperature to well below 2 degrees Celsius (2°C) by the end of the century. The global temperature is projected to increase by 1.7°C (a likely range of 1.3°C-2.2°C) by 2050 or by 1.8°C (1.3°C-2.4°C) by the end of the century.
- **SSP2-4.5** is a moderate emissions scenario, consistent with a future with relatively ambitious emissions reductions but where social, economic, and technological trends don't deviate significantly from historical patterns. This scenario falls short of the Paris Agreement's aim of limiting the global temperature rise to well below 2°C, with a projected increase of 2.0°C (1.6°C-2.5°C) by 2050 or 2.7°C (2.1°C-3.5°C) by the end of the century.
- **SSP3-7.0** is a moderate-to-high emissions scenario, in which countries increasingly focus on domestic or regional issues, with slower economic development and lower population growth. A low international priority for addressing environmental concerns leads to rapid environmental degradation in some regions. This SSP projects a global temperature increase of 2.1°C (1.7°C-2.6°C) by 2050 or 3.6°C (2.8°C-4.6°C) by the end of the century.
- **SSP5-8.5** is a high emissions scenario, in which the world places increasing faith in competitive markets, innovation, and participatory societies to produce rapid technological progress and development of human capital as a path to sustainable development. This SSP projects the global temperature increase at 2.4°C (1.9°C-3.0°C) by 2050 or 4.4°C (3.3°C-5.7°C) by the end of the century.

Water Stress Represents High Physical Risk For Mexico

Using its Climate Change Physical Risk dataset, S&P Global Sustainable1 assigns scores from 1 (the lowest risk) to 100 (the highest risk) to assess the exposure of a given location to different climate hazards, including water stress. Scores greater than 70 indicate high exposure to the climate hazard. The data shows that, in this decade (2020-2030), 11 of Mexico's 32 states face high water stress (with scores of 70 or higher). Of these 11, the states with the greatest exposure are Baja California and Baja California Sur in the north, Aguascalientes in the Bajío region (central part of the country), and Mexico City. The remaining seven states are in the north, Bajío, and the Mexico City metropolitan areas (Mexico, Morelos, Sonora, Chihuahua, Sinaloa, Zacatecas, and Guanajuato).

Graphic 2

The three different levels of exposure to water stress



Source: S&P Global Sustainable1, which defines water stress as the projected future ratio of water withdrawals to total renewable water supply in a given area.

By 2050, under a moderate emission climate scenario (SSP2-4.5--which implies a 2°C rise in the global mean temperature by 2050 compared with the pre-industrial period), the number of states exposed to high water stress (with scores of 70 or greater on the 1-100 scale) will rise by nine, without measures to adapt. These nine additional states are Nuevo León, Tamaulipas, Coahuila, and San Luis Potosí in the north; Querétaro in the Bajío region; Tlaxcala and Hidalgo in the center; and Colima and Jalisco on the Pacific coast.

In contrast, S&P Global Sustainable1 identified only six states that have low exposure to water stress (with scores of 1-30) in this decade, and that will likely remain the case until 2050, absent adaptation: Chiapas, Oaxaca, Guerrero, Campeche, Veracruz, and Tabasco. Southern Mexico, where these six states are located, has fewer arid ecosystems and lower industrial activity than in other regions. S&P Global Ratings therefore expects these states' exposure to water stress to remain low. However, the SSP scenarios don't account for potential changes in the six states' social and economic structures, such as rising prosperity, that may increase the use of water.

Demand from industries and populations increases water stress risk

Factors such as population growth or water-sensitive economic activities amplify states' vulnerability to water stress. Population and the economic structure are therefore key elements determining exposure to water stress. Water-sensitive industries include agriculture, food/beverage production, textile manufacturing, chemicals, construction, auto manufacturing, power generation, and tourism.

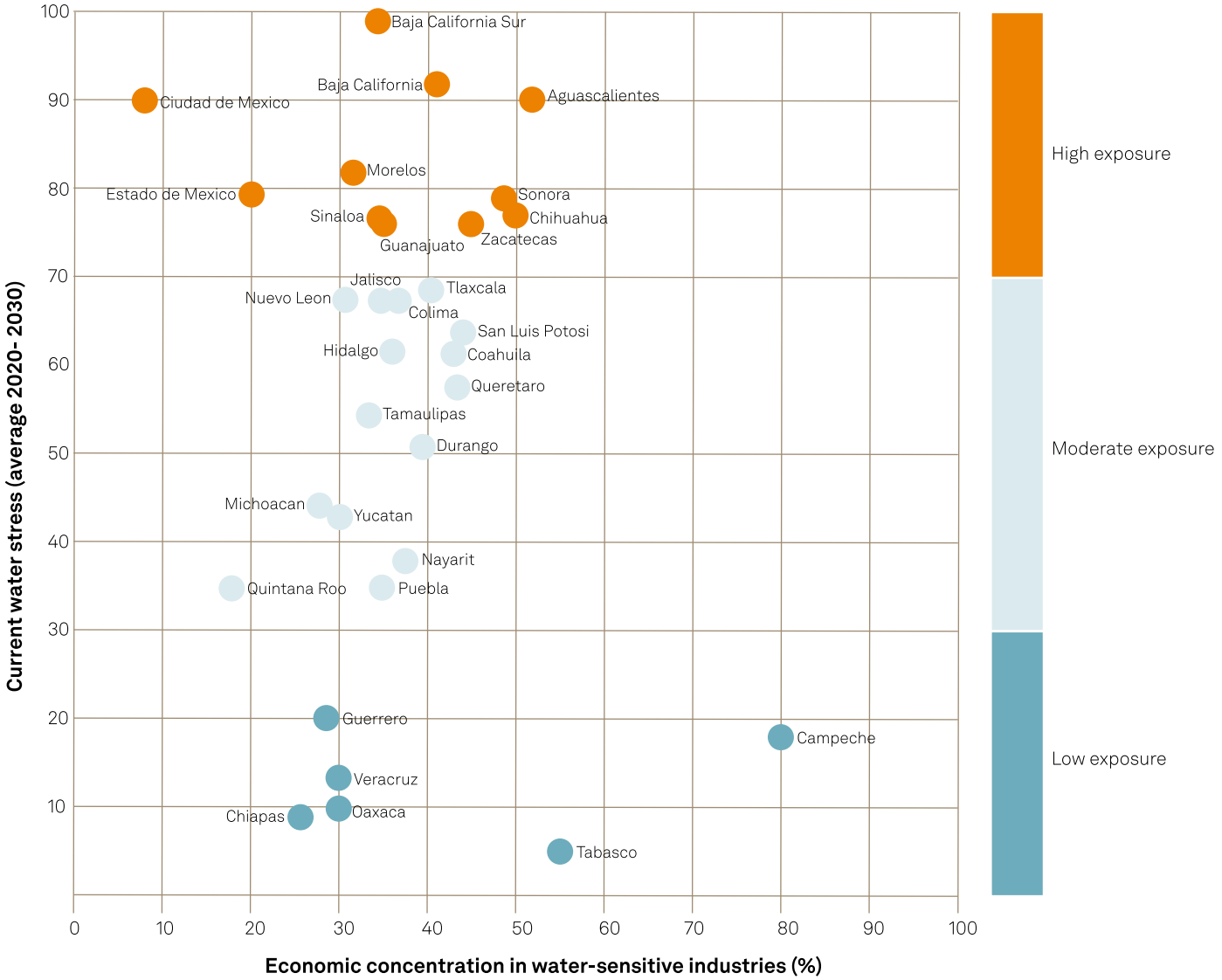
S&P Global Sustainable1 and S&P Global Ratings consider water intensity--that is, direct and purchased water consumption as a function of a company's revenue--to be an indicator of sensitivity, since companies with high water demands are more likely to be adversely affected by

water supply shortages or increased water costs. An economy that's dependent on water-sensitive sectors, particularly in parched regions, could face higher costs related to ensuring the availability of water resources to support those sectors' growth and, at the same time, address potential declines in economic activity.

Mexican states whose economies already rely heavily (more than 40% of activity) on water-sensitive industries include Baja California, Sonora, Chihuahua, and Zacatecas in the north; and Aguascalientes in Bajio (see graphic 3). These states are already exposed to high water stress under the moderate scenario (SSP2-4.5) in this decade. On the other hand, S&P Global Sustainable1 expects the water-stress exposure of states such as Campeche and Tabasco, with water-sensitive economic sectors--for example, oil extraction--to remain low until 2050, owing to abundant local water sources.

Graphic 3

Exposure to water stress is already high in 11 states



Source: S&P Global Sustainable1

Various levels of exposure to water stress may influence Mexico's long-term economic growth because, without measures to build resilience to the threat, high water stress may result in water scarcity. The U.N. defines water scarcity as scarcity of available water due to physical shortage, or scarcity of access due to the failure of institutions to ensure a regular supply or a lack of adequate infrastructure. Since water is a critical input for certain manufacturing processes, frequent water disruptions may increasingly affect investment decisions and prompt relocation of water-sensitive industries to less exposed states. This could constrain the economic growth prospects of states with high exposure to water stress.

Other causes of water stress include scarce water resources due to low rainfall (sometimes exacerbated by La Niña conditions), and an arid climate. All these factors are present across much of northern Mexico, but also in the Bajío region and the densely populated states in the Mexico City metropolitan area. From both a credit and community welfare perspective, many Mexican states' vulnerability to water stress is compounded by what we view as chronic underinvestment in water and other critical infrastructure compared with peers. This underinvestment, in turn, affects supply.

Climate Risk And Our Ratings On Mexican States

The scenarios in this research provide insight into the potential exposure of Mexican states to the specific physical climate risk represented by water stress. Climate risk accounts for just one set of risks that may influence our credit rating analysis. States will have differing levels of financial buffers to absorb the impact of physical climate risks, including water stress. There is also uncertainty about state governments' future policy responses to manage and adapt to such climate hazards, as well as uncertainty regarding the actual path of climate change under the different scenarios presented here. Given these uncertainties, the findings of this research do not currently form part of the base case for our Mexican LRG ratings. Furthermore, no credit ratings have changed to date as a result of water stress, despite some budgetary and debt impact.

Each state's water stress is determined not only by water scarcity or drought frequency, but also by the type of industries, water demand, and measures taken (or planned) to address water risk. In this sense, water stress is a useful metric for understanding states' exposure to water risks.

Nevertheless, when assessing the creditworthiness of LRGs, we incorporate the adverse physical effects of climate change, where material and visible, into our analysis. As such, changes affecting climate risk can influence our LRG ratings and outlooks and may directly affect the main credit factors--economic, budgetary performance, financial management, and debt assessments--and indirectly affect other credit rating factors (see "Methodology For Rating Local And Regional Governments Outside Of The U.S.," published July 15, 2019).

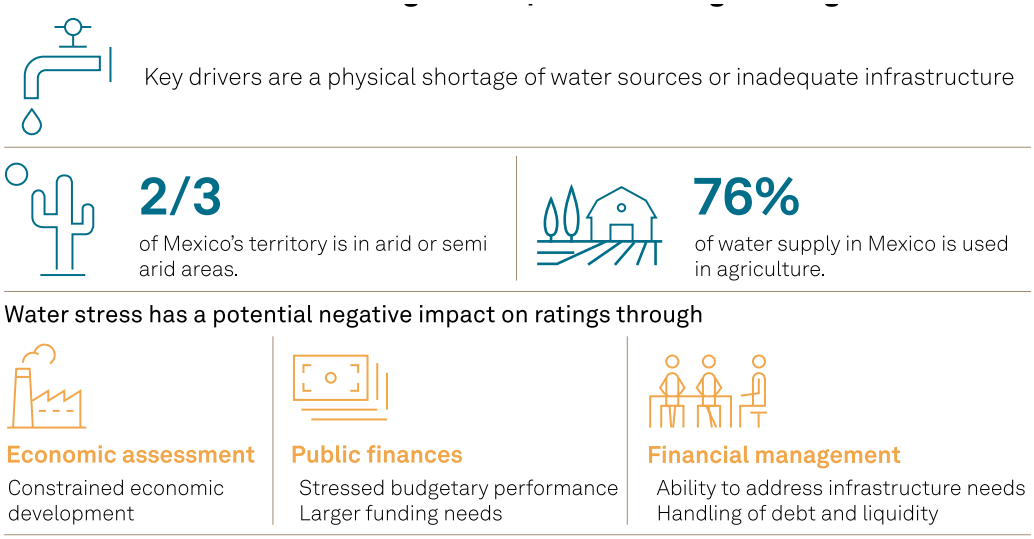
As the financial impact of high water stress on Mexican states becomes clear--for example, if significant capital outlays for water infrastructure begin to squeeze budgets--we incorporate those risks into our credit analysis. We already do so, and will continue to do so in future. As strains on water resources increase, risks to LRGs include deterioration of economic growth and public finances, and disruptions in the water supply to the population that could lead to social unrest or emigration. These factors could push federal and local governments to implement costly emergency measures, weakening their financial performance.

Water Stress Can Curb Growth And Increase Debt

As exposure to water stress increases, it could constrain economic growth among vulnerable states, such as those in Mexico's northern region, Bajío, and Mexico City metropolitan areas. At the same time, exposure to high water stress may amplify political and economic pressures to increase water-related spending. Given that many Mexican LRGs rated by S&P Global Ratings have very weak liquidity compared with global peers, such spending could dent their budgetary performance by reducing fiscal buffers, increasing the need for extraordinary transfers to water utilities, or raising the share of capital expenditure on water infrastructure.

Graphic 4

Mexico's water problems could hurt states' credit profiles



Source: S&P Global Ratings.

We assess the budgetary performance of many Mexican LRGs as weak or very weak (87% of rated states and 29% of municipalities), while we assess the economy as weak or very weak for more than 90% of rated LRGs. In addition, some have limited fiscal flexibility, or their budgetary performance doesn't reflect the full picture due to chronic underinvestment in infrastructure. If water-related investments rise, they could squeeze LRGs' liquidity and push up debt.

Government Response Can Influence Water Risk

Global water demand (for agricultural and industrial uses) is projected to increase by up to 30% by 2050, according to U.N.-Water. Governments have enacted measures to build resilience to the threat of water stress. These range from regulations and policies to improve water conservation, to building infrastructure, such as desalination plants. Other examples include measures to curb water use by charging users according to the level of consumption.

Given Mexican states' close financial ties with the central government, we expect increased spending on water infrastructure to come from a combination of direct federal funding from CONAGUA, federal transfers to states, and the states' own revenue. LRGs may also incur additional debt to finance investments or guarantee water utilities' debt, increasing their debt burdens.

Other water-stressed countries, including South Africa, Chile, and Saudi Arabia, are using a combination of measures to ease the worst impact. For example, they use regulations and policies for water conservation, supporting improvements in water quality and quantity through nationwide water management strategies.

We have observed that governments are also increasingly shifting toward desalination. Since 2010, the annual increase in the capacity and installation of desalination plants globally has been about 7% on average but was up by about 19% between 2020 and 2022 alone (to 20,956 plants), according to "State of the Art of Desalination in Mexico" (2022, Juan Rios-Arriola et al). Saudi Arabia, the U.S., and the United Arab Emirates have the largest installed water desalination capacity in the world. Desalination capacity in Mexico, meanwhile, has increased 2.4x since 2013, but remains low at nearly 750,000 cubic meters per day (m3/d) in 2022, compared with 11.9 million m3/d in the U.S.

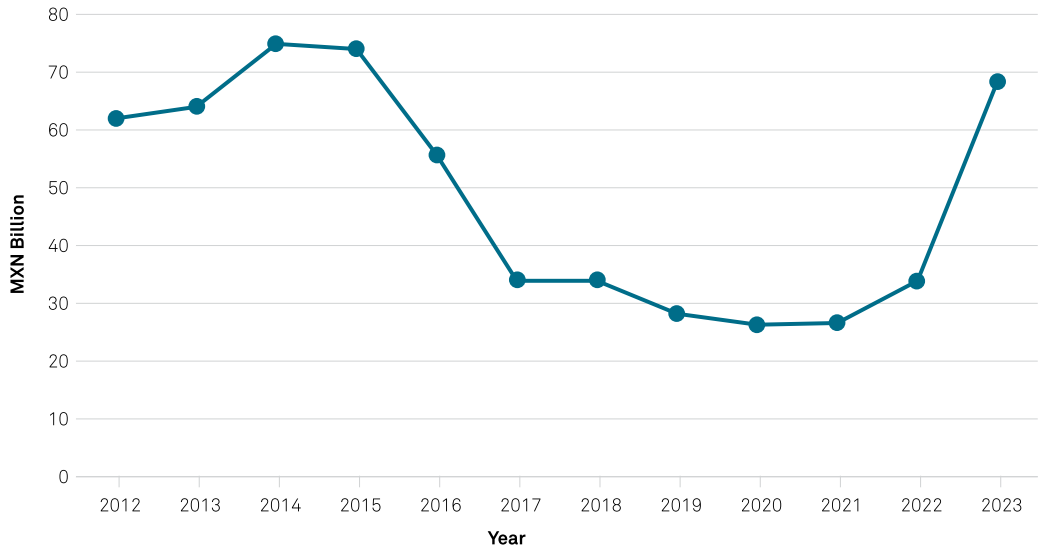
Funding For Water Infrastructure Has Risen

In Mexico, water provision services and fee collection occur at the municipal level, but water management follows the guidelines of higher levels of government. CONAGUA is the federal body that oversees the country's hydro assets, as stated in the National Water Law. It is the main body responsible for the administration, control, and protection of water infrastructure. Although federal funding for water infrastructure has decreased over the past 10 years, the increasing frequency and intensity of water shortages, along with social unrest stemming from extreme drought in northern Mexico, prompted policymakers to take action in 2022-2023.

The 2023 federal budget almost tripled the funding for water infrastructure from Mexican peso (MXN) 15.3 billion (about $0.8 billion) to MXN44.5 billion (about $2.4 billion), and roughly doubled CONAGUA's funding from MXN33.0 billion to MXN68.5 billion. We expect the federal government, through CONAGUA, to continue funding key infrastructure projects around the country and address, to some extent, the water-related vulnerability of certain regions.

Graphic 5

Mexico's water budget has increased but remains below 2014 and 2015 levels



Note: Values reflect the approved budget allocations for each fiscal year. Source: Secretaría de Hacienda y Crédito Público (SHCP PEF, 2012- 2023).

Mexico's national water law established 13 basin agencies across the country, organized around the country's 757 hydro basins. These basin agencies have representatives from the state, municipal, and federal levels to plan and administer local water resources. Water utilities provide water, sewage, and drainage services. In some cases, water utilities belong to a municipality, such as Guanajuato, which owns Sistema de Agua Potable y Alcantarillado de León. They may also be state-owned, self-supporting entities that provide services to metropolitan areas, such as Servicios de Agua y Drenaje de Monterrey in Nuevo León and Sistema Intermunicipal de los Servicios de Agua Potable y Alcantarillado in Jalisco.

Water Is Key To Mexico's Economic Development

Based on the observations presented in this research paper, we believe the need for Mexico to invest in water infrastructure will rise as water risks increase. The cost of such investments and inability to provide the population with reliable access to water could constrain the country's economic growth potential. As freshwater sources shrink and populations increase, water scarcity will, in our view, influence economic development, migration, and public infrastructure investment in Mexico. According to CONAGUA (the national water commission), nearly two-thirds of the country's land area is arid or semi-arid, and water scarcity is becoming an increasingly urgent issue, as well as a potential threat to local governments' economic and financial vitality.

Some companies in water-sensitive industries are beginning to move operations away from Mexico’s industrialized and highly drought-prone northern region. In 2022, severe drought in that region diminished the water supply for the population and industries, revealing the limits of the water infrastructure and states’ preparedness to address it. We expect economic and fiscal risks stemming from exposure to high water stress in Mexico will continue to rise and could ultimately weigh on LRGs' credit quality over the medium to long term.

We anticipate that Mexico's approach to mitigating water stress will include investments in existing infrastructure; construction of new reservoirs, wells, and desalination plants; and measures that encourage water conservation, such as volumetric charges, with users paying according to the level of consumption. One of the main challenges to increasing desalination capacity is the high investment cost, which has risen to nearly $500 million per project, depending on the installed capacity and technology, along with high operating costs. Desalination also has substantial environmental costs, including high energy requirements, discharge of brine, and wastewater generation.

Looking Ahead

Our base-case scenarios for our Mexican LRG ratings are not founded on the climate scenarios presented in this research report. Rather, S&P Global Ratings considers the current and potential pressure on an LRG's finances stemming from water scarcity and underinvestment in infrastructure where it has sufficient visibility to do so. Assessing the impact of physical climate risks can improve our understanding of an LRG's potential exposure, level of preparedness, and the potential future influence of climate risks on credit quality over the years to come.

The impact of water stress on our LRG ratings will depend in large part on the cooperation between various levels of government in planning and investing to ease water stress. We will continue to assess how Mexico approaches sustainable water management, economic growth, and planning and funding for water and related infrastructure. Strategies to secure sustainable economic growth come with costs and tradeoffs that will confront communities and policymakers as they strive to address water stress exposure.

Related Research

- Crunch Time: Can Adaptation Finance Protect Against the Worst Impacts From Physical Climate Risks?, Jan. 13, 2023
- Weather Warning: Assessing Countries' Vulnerability To Economic Losses From Physical Climate Risks, Apr. 27, 2022
- Model Behavior: How Enhanced Climate Risk Analytics Can Better Serve Financial Market Participants, Jun. 24, 2021

External Research

- State of the Art of Desalination in Mexico, MDPI, 2022, Juan Rios-Arriola, Nicolas Velazquez, Jesus Armando Aguilar-Jiminez, et. al.
- World Resources Institute (working paper: https://www.wri.org/research/aqueduct-country-and-river-basin-rankings)

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