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**Morocco**

# MENAdrought in Morocco: Strengthening capabilities to manage drought risk

## About MENAdrought

Launched in 2018, the MENAdrought project empowers the governments of Jordan, Lebanon and Morocco (countries in the Middle East and North Africa [MENA] region) with the tools to anticipate, prepare for, and mitigate the worst impacts of drought. The project is helping build self-reliance so the three countries can effectively manage the impacts that droughts have on water and food security, and in turn limit the social and economic damage resulting from drought.

Led by the International Water Management Institute (IWMI) with support from the United States Agency for International Development (USAID), MENAdrought pools the resources and expertise of global leaders in the field of drought monitoring, forecasting and management.

MENAdrought uses an approach based on three pillars to improve drought risk management. The pillars are: developing drought monitoring and early warning systems; conducting impact and vulnerability assessments; and elevating the importance of drought mitigation, preparedness and response.



## Water and drought in Morocco

The series of droughts in Morocco since the 1970s is indicative of a long-term drying trend. Climate projections call for a warmer and drier future, which strengthens the imperative for improved drought management.

Morocco is particularly vulnerable to drought impacts because its economy and labor force are highly dependent on agriculture. The sector employs approximately 40% of the economically active population – and nearly 80% of the rural population – and contributes between 14% and 20% of gross domestic product. Farmers working with livestock and rainfed cereals are the most exposed to drought impacts.



Dried out agricultural land in Amizmiz region in Morocco  
(photo: Pierre Restoul/IWMI).



## Pillar 1: Monitoring and early warning systems

MENAdrought developed early warning systems in Morocco that indicate current drought conditions and predict drought conditions in the upcoming months. These systems enable managers to take action to help curb the worst impacts of drought. This occurs through a map-based monitoring system using an enhanced Composite Drought Index (eCDI) to detect drought impacts on rainfed agricultural systems, as well as seasonal precipitation forecasting tools.

The eCDI uses remotely sensed and modelled data and includes anomalies of precipitation, vegetation health, root zone soil moisture and day-night land surface temperature as a proxy for evapotranspiration. To produce the eCDI, these indicators were normalized and weighted.

Each month, the system produces eCDI values for every 5x5 km pixel on the map at a national level. Pixels are categorized as 'no drought', 'moderate drought', 'severe drought' or 'exceptional drought' in relation to their percentile value. [Monthly drought maps are produced](#) within eight days of the new month.

The MENAdrought team also developed convolutional neural network (CNN) models to improve the outputs of global precipitation forecasts for Morocco. The project's CNN model can accurately forecast precipitation with lead times of 2.5 months in semi-arid to subhumid agroecological zones. This precipitation data could be used in hydrological models to predict streamflow and agricultural models to predict crop yield and production.

MENAdrought has developed a crop type mapping software that generates maps that are used as an input for drought vulnerability assessments and a market information system. The Directorate of Strategy and Statistics staff of the Moroccan Ministry of Agriculture will run this procedure at regular intervals to identify the location and area of major crop types and to monitor and predict crop yield and fallow pasture/rotation dynamics.



## Pillar 2: Assessments of vulnerability to drought

MENAdrought assessed which communities, economic sectors and environments are most impacted by droughts and why they are vulnerable. The project team then examined the economic and social costs of this vulnerability. These studies can help guide drought risk management planning so that interventions target the underlying causes of the vulnerability.

IWMI conducted case study analyses in the important Souss-Massa region, which has a complex water resource system servicing both agriculture and urban communities.

Morocco had major droughts in 1981, 2001, between 2018 and 2020, and in 2022 which have proved costly in social and economic terms. The MENAdrought assessment found the costs of drought between 1980 and 2015 on the livestock sector to range from USD 822 million to USD 4.99 billion depending on the livestock replacement cost used. The megadrought of the early 1980s was particularly severe and decimated 35% of small ruminants. The wheat costs were more economically significant overall, with a total of USD 16.36 billion. Health costs were estimated to be approximately USD 1.27 billion.

In drought years, water availability in Morocco can fall below the United Nations 'absolute water scarcity' threshold of 500 m<sup>3</sup>/year/capita, and inflows to reservoirs can fall below 30% of an average year. The population's exposure to these water resource impacts has increased because the availability and quality of water resources have decreased, while per capita demand has increased.

The Government of Morocco undertakes a range of short-term coping interventions in the livestock, and rainfed and irrigated agriculture sub-sectors, namely fruit trees, as well as for municipal water supplies and financial and labor market interventions. For example, through the provision of fodder and feed, the aim is to ensure livestock herd survival (reducing sensitivity to drought impacts). The government undertakes labor stimulus programs during deep droughts. These provide alternative employment opportunities for rural people and communities affected by drought. Jobs are often focused on infrastructure maintenance and repair and some can have adaptation elements.

The multi-risk insurance product developed by the Moroccan insurance firm MAMDA is a core pillar of the country's drought coping and adaptation strategy. The product is primarily for rainfed cereals and is subsidized to a varying degree by the central government.



Dried out well in Sidi Bou Othmane, Morocco  
(photo: Pierre Restoul/IWMI).





## Pillar 3: Mitigation, preparedness and response

The severe multi-year droughts in Morocco spurred several national policy development initiatives as well as international research and development collaborations related to drought risk management. Since the mid-1990s, the Government of Morocco has been making serious efforts to move away from a crisis-response approach to one of drought-risk management.

Morocco has had a legal framework for executive decision-making on drought declaration and coordination on drought responses for decades. The Ministry of Agriculture decided that MENAdrought activities should be undertaken with local government and specifically the Souss-Massa Hydrological Basin Authority (Agence du Bassin Hydraulique de Souss Massa, [ABHSM]).

To enhance mitigation, preparedness and response planning, IWMI worked closely with ABHSM to prepare a drought action plan (DAP). The DAP will help government agencies in Souss Massa consider what drought impacts are most important for them to address first, from their point of view, and how to do so with the available resources, policy context, and constraints they face.

To develop the DAP outline, MENAdrought worked with ABHSM to prioritize impacts they wished to address in the first iteration. They chose to focus on water resource degradation in the Chtouka aquifer. They developed the plan through working sessions and 'write shops' that brought together ideas, experiences and insights from many stakeholders.

Recommended preparedness actions include institutional capacity building, development of detailed contingency plans and guidelines related to inter- and intra-sectoral water allocation and reallocation during drought events, establishing information sharing mechanisms, and improving environmental monitoring systems and associated data quality.

The recommended mitigation measures focus heavily on regulatory enforcement and associated social norms, primarily related to groundwater abstraction. For example, they include information campaigns to raise awareness of water sustainability issues, normalize compliance with regulations, and increase acceptance of the values underpinning the regulations. Likewise, they include supporting social processes and multi-stakeholder platforms related to long-term water use.



Failed wheat crop, Morocco, 2019 (photo: Michael Major/Crop Trust).

## Additional reading

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## Partners

**Primary partners:** International Water Management Institute (IWMI); National Drought Mitigation Center, University of Nebraska-Lincoln; Daugherty Water for Food Global Institute, University of Nebraska; Goddard Space Flight Center, National Aeronautics and Space Administration (NASA); and Johns Hopkins University.

**National leader:** Moroccan Ministry of Agriculture, Fisheries, Rural Development, Water and Forests (MAFRWF).

**National partners:** Hassan II Institute of Agronomy and Veterinary Medicine; Ministry of Equipment, Transport, Logistics and Water; National Department of Meteorology (DMN); various regional directorates of agriculture (DRA); various river basin agencies (ABH); and various regional offices for agricultural development (OMRVA).

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