

MENAdrought in Lebanon: 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 Lebanon

Lebanon is water-rich compared to other countries in the MENA region, so historically drought risk management hasn't been a government priority. However, the intense droughts of 1998–2001, 2008, and especially 2013–2014 had widespread socioeconomic impacts and served as a wake-up call.

In 2014, Lebanon received only half its annual average rainfall, reducing the volume of water available in rivers and aquifers. The 2014 drought, in combination with changing climate conditions, stressed water resources, rapid population increase due to refugee influxes, and shifting social and economic conditions, prompted Lebanon to prepare for future droughts.



Farmer on his way to deliver water to poor farming families in Bekaa, Lebanon (photo: Lien Arits/IWMI).



Pillar 1: Monitoring and early warning systems

The MENAdrought team first conducted a needs assessment in Lebanon to determine various stakeholders' requirements for drought monitoring and management. The needs assessment identified knowledge gaps about drought incidence and severity as well as impacts and sources of vulnerability to drought and their relation to drought management policies and systems.

MENAdrought developed early warning systems in Lebanon that indicate current drought conditions and predict drought conditions in the upcoming months. These systems enable managers to take actions 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 both irrigated and 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 Lebanon. 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 or agricultural models to predict crop yield and production.



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.

Based on the assessment of drought history over the past two decades, the team developed a drought hazard map that shows where drought is most frequent and severe. Areas of highest hazard include Tyre in Southern Lebanon, Bint Jbeil in Nabatieh, and Rechaya in the Bekaa.

The vulnerability assessment incorporated stakeholder characterization of drought impacts related to the agriculture and water supply sectors. The assessment describes the impacts that government officials should prioritize through drought management planning exercises at national and regional levels. Stakeholders consider the inland Bekaa region, which is primarily semi-arid, to be the most vulnerable region overall.

The study identified Bekaa and Baalbeck-Hermel as the most exposed areas in terms of agricultural activities and environmental risk factors, particularly amongst smallholder farmers. Common irrigation practices increase farmers' exposure to impacts, while poor municipal water supply infrastructure increases the water sector's exposure. Female-led households, children and Syrian refugees are particularly exposed to drought impacts.

Several other factors increase the sensitivity of the agriculture sector to drought in Lebanon. These include: the availability, cost, and quality of agricultural inputs including fuel, electricity, fertilizer and pesticides; a poorly trained workforce who has few training opportunities; irrigation infrastructure and problems related to existing policy and regulations and enforcement of them; soil degradation; finance and debt problems; and market access problems, which are partially due to unpredictable cropping patterns.

Water sector aspects of sensitivity have overlapping themes related to weak regulatory and planning frameworks, as well as enforcement of them. Major sensitivity factors connect to inadequate storage and aging distribution infrastructure. Political instability and the refugee influx from Syria have exacerbated these aspects of sensitivity because they have stressed natural resources and associated infrastructure, affected trade and pastoral migration routes, and led to price volatility of core agricultural inputs such as fuel and fertilizer.



Farmer in front of his artificial lake for agricultural use in Bekaa, Lebanon (photo: Lien Arits/IWMI).



Pillar 3: Mitigation, preparedness and response

To enhance mitigation, preparedness and response planning, IWMI worked closely with multi-ministerial, interdisciplinary teams across the Government of Lebanon, and at various levels – from technical drought monitoring to policy and management planning. The result is a drought action plan (DAP) that helps government agencies 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, government stakeholders prioritized impacts they wished to address in the first iteration. They chose to focus on the reduction in water storage, decrease in municipal water availability, decline in domestic water services, and reductions in yields from irrigated and rainfed agriculture, inclusive of mixed pastoral systems.

They developed the plan through working sessions and ‘write shops’ that brought together ideas, experiences and insights from many stakeholders.

Lebanon’s drought action plan builds on *Water Code 192* of 2020 and the *National Water Sector Strategy Update* of 2020, which signaled the intention to develop a national-scale drought mitigation plan and operational framework.

The project focal point is the Director of Water Resources of the Ministry of Energy and Water. A Drought Technical Committee was created to oversee the development of the plan.

The Lebanese DAP’s preparedness actions include actions related to legislation, policy, governance, coordination mechanisms, data collection and information sharing, and policy effectiveness.



Sprinkler irrigation use in a potato field in Bekaa, Lebanon (photo: Seersa Abaza/IWMI).

Additional reading

Fragaszy, S.R.; Jedd, T.; Wall, N.; Knutson, C.; Belhaj Fraj, M.; Bergaoui, K.; Svoboda, M.; Hayes, M.; McDonnell, R. 2020. Drought monitoring in the Middle East and North Africa (MENA) region: Participatory engagement to inform early warning systems. *Bulletin of the American Meteorological Society (BAMS)* 101(7): E1148–E1173. <https://doi.org/10.1175/BAMS-D-18-0084.1>

Fragaszy, S.; Fraj, M.B.; McKee, M.; Jobbins, G.; Fayad, A.; Fakih, M.; Lawrenson, L.; McDonnell, R. 2022. *MENAdrought synthesis of drought vulnerability in Lebanon: Final report*. Washington, DC, USA: USAID; Colombo, Sri Lanka: International Water Management Institute (IWMI). 67p. <https://doi.org/10.5337/2022.205>

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IWMI. 2022. *Developing an operational enhanced Composite Drought Index (eCDI) to support drought early warning in the Middle East and North Africa region*. MENAdrought Technical Fact Sheet. Colombo, Sri Lanka: International Water Management Institute (IWMI). 4p.

IWMI. Forthcoming. *Pillar 3 Report – Synthesis of MENAdrought development of drought mitigation, preparedness, and response management plans*.

IWMI. Forthcoming. *Drought history, impacts, and vulnerability assessment to inform and embed drought risk management approaches in Lebanon*.

IWMI. Forthcoming. *MENAdrought synthesis of drought monitoring, early warning, and seasonal forecasting tools and capability development*.

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: Ministry of Energy and Water.

National partners: American University of Beirut; Beirut and Mount Lebanon Water Establishment; Lebanese Agricultural Research Institute (LARI); Lebanese Meteorological Department-Directorate General of Civil Aviation; Litani River Authority; Ministry of Agriculture; Ministry of Environment; South Lebanon Water Establishment; National Center for Remote Sensing.

Non-governmental organizations: Agency for Technical Cooperation and Development (ACTED) and STAMMOSE.

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