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IWMI International Water Management Institute

Policy Brief

MENAdrought: Toward drought management in Lebanon

Key messages

- Lebanon faces an increasing risk of drought, in part due to the effects of climate change on average precipitation and temperature.
- An initial needs assessment identified barriers to information sharing, lack of drought definitions, and knowledge gaps on drought impacts as key problems for current drought monitoring and management.
- Key outputs of the MENAdrought project include the development of an operational drought monitoring system (DMS), assessments on drought impacts and vulnerability, and support for the development of a Drought Action Plan (DAP) that links the drought monitoring system with policy and governance processes for drought preparedness, mitigation, and response actions.
- The DAP is the 'policy vehicle' that takes the technical information from the DMS and enables its application in policy decision-making.
- The Drought Technical Committee (DTC) that developed the DAP has built a solid framework for inter-ministerial collaboration.
- The Lebanese government needs support to capitalize on these working relationships and support the DTC to implement the DAP preparedness, mitigation and response actions, and embed it in government practice.
- Additionally, support is needed to improve seasonal precipitation forecasting and operationalize it alongside the DMS.

Introduction

Periods of drought in the MENA region have become more pronounced due to rising temperatures and changes in precipitation patterns caused by climate change. Water evaporates and transpires from plants faster, which contributes to the increased risk of droughts, as well as the length of drought periods. The impacts of droughts in MENA affect nearly every segment of society and sector in the economy, and they can have profound effects on livelihoods and households in the long term.

A country facing novel drought challenges

Lebanon is a water-rich country compared to the rest of MENA. Consequently, drought management has not featured prominently in the government's agenda. But, in recent decades, multiple factors have led to unprecedented periods of drought, particularly during 2001, 2008, 2013 and 2014. In 2014, Lebanon received half its annual average rainfall, which

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 drought mitigation, preparedness and response planning.

led to a significant reduction in water availability. This drastic drought coincided with rapid population increases due to refugee influxes, as well as shifting socioeconomic conditions to create a perfect storm. Following severe drought impacts, policymakers developed policy and investment strategies to prepare for future droughts and work towards making Lebanon a drought-resilient country.

Assessing Lebanon's needs

MENAdrought developed novel technical and policy tools for drought monitoring and management. As a first step, MENAdrought assessed the needs of Lebanese stakeholders for drought monitoring and management. The assessment identified key knowledge and institutional gaps related to: (i) drought incidence and severity; (ii) sources of vulnerability to drought and their impacts; (iii) how drought vulnerability relates to management policies and systems, and (iv) institutional coordination, governance, and drought management plans and the institutional capacity to deliver them.

Addressing the needs

Government officials subsequently prioritized several discrete priority impacts to address through development of a DMS and a DAP that includes preparedness, mitigation, and response components. To meet identified needs related to drought definitions and declaration procedures, the DAP relies on information from the DMS to support drought response decision-making.

Development of a drought monitoring system

The map-based DMS uses an enhanced Composite Drought Indicator (eCDI) produced using remote sensing (satellite) and environmental modelling data to identify anomalies for each month, relative to average conditions in that month since 2000. These anomalies include factors like precipitation, vegetation condition, soil moisture, and a proxy for evapotranspiration.

Data generated for these factors was used to produce an eCDI index value for each 5x5 km region in the country. This allows policymakers to categorize different regions of Lebanon into one of four drought-risk levels simply, effectively, and quickly: no drought, moderate drought, severe drought, or extreme drought.

Furthermore, eCDI results were analyzed statistically to produce potential 'trigger' thresholds. These threshold 'triggers' aim to inform policy makers about the need for drought management actions. In Lebanon, triggers are based on the Drought Severity and Coverage Index and reflect experts' judgment. Lebanese officials are eager to explore other options for triggers in the future.

We anticipate Lebanese agencies will be able to produce the eCDI independently by the end of 2022, provided conditions in the country (electricity and internet availability) permit its final installation. With this system, Lebanon has a powerful tool for early detection of the impacts of drought.

MENAdrought also tested seasonal forecasting using Artificial Intelligence (AI) techniques. While improvements were made throughout the project, the predictions were not accurate enough for results to be implemented in policy processes. We are confident that the method is appropriate, and would be successful with additional work.

Mapping drought impacts and vulnerabilities across Lebanon

A major aim of the MENAdrought project is to assess which communities, ecosystems, economic sectors and stakeholders are at most risk from drought, and what are the reasons for that risk.

MENAdrought led various efforts, including: (i) surveying different government stakeholders on priority impacts and sources of vulnerability; (ii) developing a case study on drought

Photo: Lien Arits / IWMI

vulnerability in Hermel-Baalbek (northeast Lebanon) related to market access, finance and debt, food security, gender, and wider agricultural themes; and (iii) developing a case study on the relationships between fragility and migration, and drought in Rachaya (southwest Bekaa).

Another key output of MENAdrought's work in this space is the creation of a drought hazard map showing which parts of Lebanon face a higher risk of drought (Figure 1). The map is based on eCDI results from the past two decades. The map identifies areas of high drought hazard: Tyre in southern Lebanon, Bint Jbeil in Nabatieh, and Rechaya in Bekaa. Lower hazard areas identified include Marjeyoun in Nabatieh, Baalbek and Hermel in Bekaa, north Lebanon, and parts of Mount Lebanon, north of Beirut.

Agriculture sector vulnerability to drought and the impacts of drought on smallholder farmers, herders, and rural communities

MENAdrought's early work identified agriculture and water supply as the two most vulnerable sectors, and subsequent work focused on agriculture given the focus of the DMS on agricultural drought impacts.

MENAdrought's studies focused on systemic sources of the agriculture sector's vulnerability to drought: environmental, socioeconomic, governance, financial, and market. Environmental drivers (such as rainfall deficits or reduced spring discharge) interact with these systems, for example, through the high price of fuel and lack of export channels due to conflict, resulting in impacts on communities. Figure 2 highlights a wide array of issues influencing the sector's vulnerability to drought.

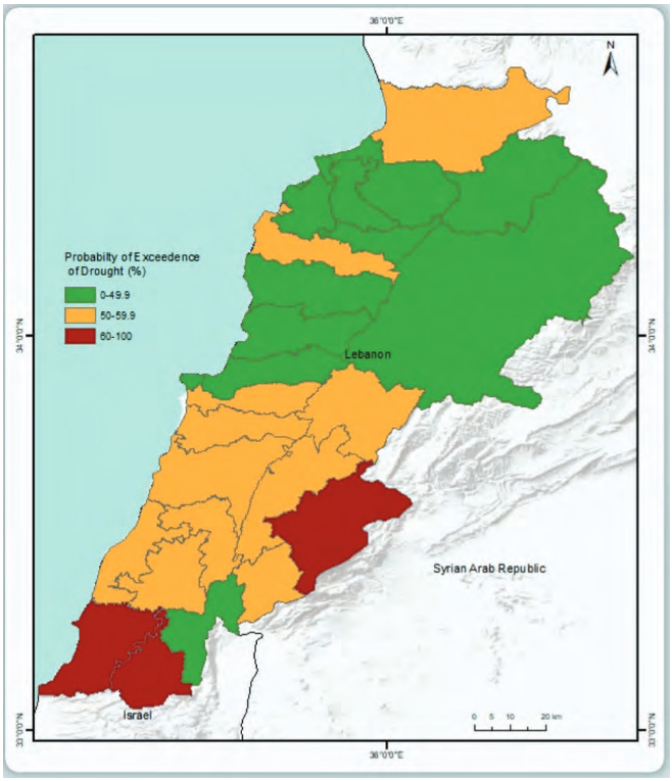

Figure 1. Drought hazard map showing which parts of Lebanon face a higher risk of drought.

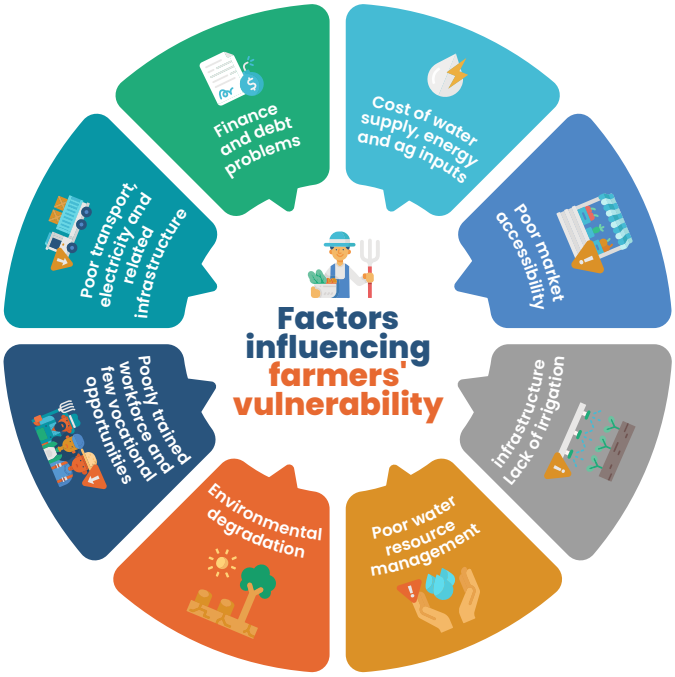

Figure 2. Factors influencing farmers' vulnerability.

Further, numerous issues exacerbate the vulnerability of smallholder farmers, herders, and rural communities in Lebanon. These include: the increasing costs and associated rise in debt, and declining profitability of agriculture; general rise in the cost of living; increase in cost of water and reduced water availability; decreasing food security; a poorly trained workforce who has few training opportunities; lack of irrigation infrastructure; problems related to existing water policies and regulations, and enforcement of them; soil degradation; finance and debt problems; and market access problems, which are partially due to unpredictable cropping patterns.

Drought impacts interact with these issues and can result in a rise in social tensions; mental and physical health impacts (increased incidence of WASH-related diseases, gender-based violence); sale of assets; shifts away from agriculture (i.e., farmers leaving farming and doing other work); and temporary or permanent migration, primarily to cities in Lebanon.

A Drought Action Plan is now on the table

MENAdrought supported the Lebanese DTC to produce a DAP that includes drought preparedness and mitigation components to be undertaken outside of a drought cycle. It also includes drought management response actions to minimize the impacts of an ongoing drought. All components target five priority impacts (Table 1).

The DAP contains recommendations for its own finalization and implementation of its policy and governance framework for drought management. The Lebanon DAP is in a 'ready to go' state, ready for when the need arises, and parts of it are already being implemented.

TABLE 1. Priority impacts addressed by Lebanon's DAP.

Priority impact	How DAP addresses the impact
Reduced quality of domestic water services	
Domestic water services often deteriorate during drought conditions. Tangible impacts to consumers include supply becoming less reliable, more expensive, and less equitable. Utilities and service providers also face impacts from declining customer satisfaction and declining revenues.	Actions to mitigate and respond to drought impacts on water quality, the equity and equality of water distribution, degradation of installed equipment, the financial sustainability of utilities, and customer satisfaction.
Reduced availability of domestic water	
Drought periods lead to shortfalls in the availability of domestic water because of increased demand for water, limited resilience in distribution networks, and the additional energy needed to pump water.	Actions to mitigate and respond to drought impacts on the physical availability of water, energy supplies, non-revenue water, and competition between water users.
Reduced storage levels in reservoirs and dams	
As inflows decline and demand increases during droughts, water stored in reservoirs and dams is drawn down.	Actions to enable the stocking and restocking of reservoirs, and to better manage water demand.
Reduced yields in irrigated agriculture	
Irrigated agriculture is, generally, more resilient to drought conditions than rainfed agriculture, so long as water is available for irrigation. Intense droughts can see restrictions placed on irrigation, however, leading to yield losses in drought sensitive crops.	Actions to rationalize water use intensity and strengthen resilience in irrigated agriculture including in relation to drying springs, lack of climate information, increased risks of pests and disease, and poor soil water management.
Reduced yields in rainfed agriculture	
Rainfed agriculture is highly exposed to drought impacts, and small farmers and those living in rural poverty are disproportionately affected by the direct impacts of drought on their livelihoods and principal sources of income.	Actions to improve resilience in rainfed agriculture by improving access to climate information, drought tolerant varieties and techniques, strengthening support and extension services, and reducing livestock losses.

Recommendations for future work

MENAdrought's recommendations address all aspects of the drought effect chain through suggested future work on policies and governance, development of technical tools, and generation, sharing, and application of usable information from those tools (Table 2).

Conclusion

Lebanon has suffered from severe droughts in the past and will continue to feel the impacts of drought, which will become increasingly more frequent as the climate changes. The impacts of these droughts will be particularly hard on vulnerable Lebanese farmers.

The root causes of vulnerability for Lebanese farmers and the water sector stem from a wide range of interacting environmental, social, economic, and governance factors.

The MENAdrought project has helped the Lebanese government establish a monitoring system and develop a drought action plan to structure how it addresses some of these underlying aspects of vulnerability. This includes identification of preparedness and mitigation actions to take before drought hits as well as response actions to reduce impacts once drought arrives.

The monitoring system provides robust, regular, and easily understood information on drought to support the escalation of responses. When drought first appears, responses focus on communicating to various stakeholders that they should be alert and begin planning actions if the situation deteriorates.

If the drought worsens, the DAP guides decision-making and specific interventions. Agencies have already considered how best to spend their limited financial and human resources, so that eases their decisions about interventions once drought has occurred.

Now the Lebanese government needs support to capitalize on these systems, plans, and associated working relationships through support to the DTC to implement the DAP preparedness, mitigation, and response actions and embed it in government practice.

Additional reading

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TABLE 2. Recommendations to meet drought monitoring and management needs.

Need type	Specific need	MENAdrought work to address need	Recommendations for future work
Drought-specific policy, governance, and institutional relationships	Formalize drought monitoring and management mandate as well as inter-agency cooperation Improve public – private engagement on drought monitoring and management issues	Working with the DTC to develop the DAP	Support formalization of the DTC and DAP governance arrangements, for example, through an official application decree Unlock capacity through institutional analysis and engagement with key stakeholders (ministries, agencies, and others) to understand drought management's position within their strategic objectives and resourcing and governance processes Support implementation of DAP including through sector- and entity-specific planning processes Support establishment or reinforcement of oversight mechanisms for water management within local and regional authorities including municipalities Institutionalize drought impact reporting and statistics in Lebanon (in collaboration with the Department of Statistics), including the creation of a Drought Impact Reporting network
Technical information tools	Ongoing improvement of the drought early warning system (inclusive of forecasting)	Tested predictors of relevance for seasonal precipitation forecasting but was unsuccessful in producing accurate forecasts Ground truthing of remote sensing data was not possible because environmental monitoring data and statistics are discontinuous and quality control is not systematic	Continue research and development on seasonal forecasting using CNN techniques with additional predictors and training CNN models in parallel according to climate region groups Support the activities of a Drought Impact Reporting network
	Improve regulatory enforcement	The DAP specifies the regulations that should be targeted	Support the relevant ministry with development and deployment of information and tools to facilitate regulatory enforcement – examples include water accounting and wider water IT platforms for water management
	Improve environmental and agricultural monitoring data and data collection systems	Not a focus for MENAdrought	Development of stratified sample and monitoring protocols for hydrological monitoring purposes. Support targeted hydrological monitoring to improve integrated hydrological modelling capabilities, water accounting, eCDI improvements, staple crops yield forecasting, and rangelands monitoring Test application of high-resolution satellite imagery analysis and associated modelling approaches to support above
Information translation and sharing	Identify regions at highest risk of drought impacts to target interventions	Developed a drought hazard (climatological risk) map that shows where drought is most frequent and severe. Other components produced relevant information on exposure, sensitivity, and adaptive capacity	Undertake spatial vulnerability mapping focused on the water supply sector and/or specific agricultural sub-sectors (e.g., annual and perennial crops such as fruit orchards). Sub-items of this are to: Co-develop methods and application software, and train local staff in their use Undertake data collation and primary data collection given that robust quantitative measures of sensitivity and coping or adaptive capacity would not be available nationally
	Engage with intended audiences to create usable information products and stable information sharing networks	DTC worked with government officials and other stakeholders for validation of the eCDI The DTC produces drought progression bulletins targeted at drought management decision-makers	Support the activities of a Drought Impact Reporting network Engage with governmental, farming, agribusiness, agri-finance, and applied research organizations to develop targeted information and/or advisory products based on the monitoring and early warning system. Examples include technical (for extension services and water authorities) and non-technical (for user associations and farming communities) guidance materials
Drought-related financial risk management	Need for drought-relevant financial risk management products	Conducted a general review and targeted studies in Jordan that could inform future work in Lebanon	Using a Market Systems Development approach, map stakeholders determine specific needs for drought-relevant financial risk management products from farmers and herders and barriers to development of such products from financial institutions (formal, semi-formal, and informal), and propose several products for pilot testing including integration with related monitoring and modelling systems
Drought-related agricultural practice improvements	Understand the drought-crop connection: offer irrigation and planting guidance	The Lebanese Agricultural Research Institute (LARI) is on the DTC and uses the eCDI maps to assess the progress of the agricultural season Development of the drought mitigation compendium	Support LARI and agricultural extension services to increase uptake of efficient water and nutrient conservation technologies and practices through a Market System Development approach that considers institutional supporting functions for practice change and norms/rules incentives and facilitates market foundation through: market assessment, linking lead dealers with pioneer farmers, market chain support analysis for staple food commodities Support uptake through professional and private sector-oriented extension services

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Partners

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