Communicating MEACAM Forecasts in an Early Warning System

MEACAM Research Report #4

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Introduction

Purpose of the report

This research paper outlines how hazard predictions and exposure information from Mercy Corps' **Middle East Anticipatory Climate Action Model (MEACAM)** can be integrated into an early warning system (EWS). MEACAM provides agricultural drought and flood predictions, identifies affected locations, and estimates the population and hectares of cropland exposed to the forecasted hazards in Iraq, Syria, and Yemen. The MEACAM platform is free to use and automatically updates flood predictions every three hours and agricultural drought predictions every 14 days.

MEACAM's early warning information aligns with the first two pillars of the United Nations Office for Disaster Risk Reduction (UNDRR) early warning system: disaster risk knowledge, and hazard detection, observation, monitoring, analysis, and forecasting.[1] This report reviews the components of an EWS, considers how MEACAM fits within an EWS, and identifies the steps and actors involved in the development of an EWS in Iraq, Syria, and Yemen. This report draws on a review of relevant literature, professional experience implementing an EWS,[2] and engagement with key stakeholders in Iraq, Syria, and Yemen.

Natural hazards in Iraq, Syria, & Yemen

Iraq: Drought and flooding are becoming more common across the whole of Iraq. A precipitous drop in rainfall levels in recent years, compounded by rising average temperatures and soil salinization, has led to longer drought periods in southern Iraq that have contributed to migration from highly impacted areas.[3] Even the relatively milder and wetter Kurdistan Regional Government (KRG) has been severely negatively impacted by drought, with recent significant agricultural droughts during the 2021,[4] 2022,[5] and 2025[6] winter growing seasons negatively impacting largely rainfed grain crops grown in the region.

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[1] United Nations Office for Disaster Risk Reduction, Early Warnings for All December 12, 2024

[2] MEACAM consultant Romain Meunier (meunier.geo.expert@gmail.com) has implemented early warning systems in Comoros and Morocco.

[3] International Organization for Migration, Migration, Environment and Climate Change in Iraq August 9, 2022

[4] Food and Agriculture Organization, The Republic of Iraq Drought in northern parts of the country June 11, 2021

[5] Jabal et al., Assessment of agricultural drought in Iraq employing Landsat and MODIS imagery Open Engineering, 2022, 12(1):583–600

[6] The Insight International, Water levels at Dukan dam in Kurdistan plunge to 24% capacity June 23, 2025

Flooding is another common hazard in Federal Iraq and the KRG. The damage caused by flash floods is worsened by poor urban infrastructure, namely the absence of adequate drainage systems in cities like Dohuk,[7] Erbil,[8] and Baghdad.[9] According to the Iraq Ministry of Water Resources,[10] river flooding is not a major concern in Federal Iraq, primarily due to the prevalence of drought conditions and lower inflows from upstream countries. However, a dam failure – particularly the Mosul Dam – could trigger severe flooding.[11] River flooding is a relatively greater threat in the KRG, though there have been no recent river flooding events apart from during periods of heavy rainfall, when flash flooding is more common.

Extreme heat is a significant and increasingly common[12] natural hazard in Iraq, where summer temperatures can exceed 50 degrees Celsius,[13] causing health problems such as heat stroke and dehydration. Extreme heat events are projected to increase in Iraq over the next 50 years,[14] which will likely contribute to more out-migration.[15] Accelerated desertification caused by worsening drought conditions can both threaten respiratory health and disrupt air transportation.

Syria: Drought, flash flooding, and wildfires are the primary natural hazards facing Syria. Drought has already negatively affected rainfed grain growing operations in the northeast in 2021,[16] 2022,[17] and 2025.[18] Winter rainstorms and spring snowmelts often result in flash flooding that frequently damage IDP camps, primarily those in the northwest, which cause secondary displacement and economic losses.[19,20] Wildfires can ignite in Syrian forests and shrubland during dry years and spread quickly due to strong winds. Destructive wildfires

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[7] Floodlist, Iraq Kurdistan Region – 4 Killed in Duhok Flash Floods May 6, 2018
[8] Floodlist, Iraq – Severe Floods Hit Erbil, Kurdistan October 31, 2021;
Floodlist, Iraq – Deadly Flash Floods in Erbil, Kurdistan December 17, 2021
[9] Reliefweb, Iraq: Floods - Mar 2025
[10] MEACAM team engagement with the Ministry of Water Resources, August 2025.
[11] Annunziato et al., Impact of flood by a possible failure of the Mosul dam JRC Science Hub, European Commission, Report EUR 27923 EN, 2016
[12] Hashim et al., Identification of the extreme daily maximum temperatures and their frequencies and intensities in Iraq International Journal of Innovative Research and Scientific Studies, 2025, 8(2):2997–3012
[13] Al Jazeera, Extreme heat hits Iraq, as temperatures exceed 50 degrees Celsius August 4, 2023
[14] Potsdam Institute for Climate Impact Research (PIK) and adelphi, Climate Risk Profile Iraq July 2022
[15] Human Practice Network, Extreme heat, drought and displacement in Iraq March 13, 2024
[16] CA-SYR, Drought, Pollution and the Euphrates: measuring agricultural water stress in northeast Syria August 2021
[17] CA-SYR, Measuring Agricultural Production: drought and the 2018 to 2022 growing seasons in northeast Syria July 2022
[18] Karam Shaar Advisory, Ringing the Alarm Bells: Syria May Be Facing Its Worst Drought in Decades April 2025
[19] Reliefweb, Syria: Floods - Jan 2021
[20] Floodlist, Syria – Floods Cause Severe Damage to Displacement Camps March 19, 2023

erupted in July 2025[21] in rural northern Lattakia and the surrounding governorates, destroying cropland and homes and causing large-scale displacement.[22] The 7.8 magnitude earthquake in February 2023 caused major primary and secondary damage in Syria, including river flooding from a dam collapse;[23] notably, destructive seismic activity is historically uncommon in the country.

Yemen: Flash flooding, drought, cyclones, and extreme heat are the major natural hazards that most commonly impact communities in Yemen. Flash flooding is perhaps the most common natural disaster in the country and is generally caused by heavy rainfall from mountainous areas that accumulate and flow via wadis into lowlands at high speeds and volume. These floods frequently damage and destroy homes and cause loss of life and crop damage, with recent major floods occurring in 2024[24] and 2025.[25] Flooding disproportionately affects IDPs because camps are often placed in flood-prone areas.[26]

Drought is arguably the second-most consequential natural hazard facing Yemen because higher temperatures and drier rainy seasons exacerbate precarious economic conditions and worsen food security.[27] Extreme heat is a significant natural hazard facing Yemen that causes illness and lowers crop yields; the World Bank estimates that 7.2 million people are exposed to extreme heat, most of them along the western and southern coastal plains.[28] Cyclones also make landfall along Yemen's Indian Ocean coast. The most recent, Cyclone Tej in October 2023, caused significant damage from storm surges and flooding in Al-Mahra and other coastal governorates.[29]

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[21] Reliefweb, Syria: Wild Fires - Jul 2025
[22] Anadolu Agency, Syria battles forest fires in Latakia countryside November 22, 2025
[23] Reliefweb, Syria: Floods - Feb 2023
[24] Reliefweb, 2024 Yemen Floods Disaster Brief, August 2024
[25] Reliefweb, Yemen: Floods - Aug 2025
[26] In 2024, REACH conducted a flood risk assessment of IDP sites in Yemen, and categorized 37% (672/1830) of the assessed sites as at high or critical risk of flooding.
[27] World Bank, Yemen Country Climate and Development Report 2024
[28] ibid.
[29] Sana'a Center for Strategic Studies, Cyclone Tej Underscores Yemen's Climate Crisis Ahead of COP 28 The Yemen Review, September-October 2023

Early Warning System pillars and communication approach

Concept of an Early Warning System

As defined in United Nations General Assembly Resolution 69/284, an EWS is an "integrated system of hazard monitoring, forecasting, and prediction, disaster risk assessment, communication, and preparedness activities, systems, and processes that enables individuals, communities, governments, businesses, and others to take timely action to reduce disaster risks" before hazardous events occur.[30]

Figure 1 outlines the four pillars of an Early Warning System. These apply to any hazard and are guided by a centralized Disaster Risk Management (DRM) Plan that assigns roles and responsibilities and facilitates coordination among actors. An effective DRM Plan assigns clear roles and responsibilities to stakeholders according to their operational capacity, ranging from hazard monitoring to implementing response plans.

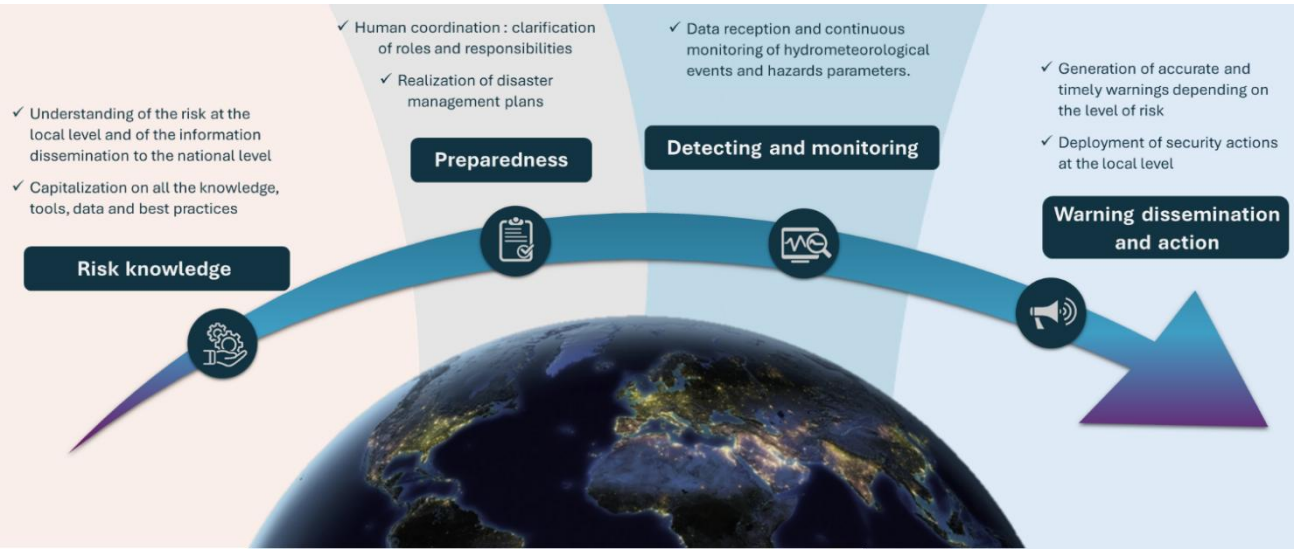

Figure 1. The four pillars of an early warning system.

Communication approach in an EWS

Accurate, timely, and clear warning information allows those at risk of a hazard to take appropriate action in advance and minimize potential physical harm or property loss. An EWS defines the indicators that trigger appropriate warning messages and how they are

[30] United Nations Office for Disaster Risk Reduction (UNDRR), Early Warning System

disseminated. Warning messages must be presented in a structured and meaningful way to ensure that alerts reach the entire at-risk population.

Graduated risk communication

Graduated risk communication is the standard method to communicate the severity of a hazard in an EWS and facilitate the progressive mobilization of stakeholders according to the severity of a hazard. An example of graduated risk warnings is outlined in Figure 2.

LEVEL OF RISK	HOW TO BEHAVE	LEVEL OF SEVERITY
0	No risk	No or very low severity
1	Be vigilant	Low severity
2	Be prepared	Moderate severity
3	Be safe	High severity
4	Reinforce your safety	Major severity

Figure 2. An example of graduated hazard alerts.

Graduated hazard alerts are commonly disseminated at the geographic scale that forecasts are produced (e.g., sub-district) to facilitate the appropriate mobilization of human, logistical, and technical resources. Geographically precise messages ensure that safety instructions for exposed populations are adapted to the expected magnitude of the event.

Graduated risk communication using MEACAM

The organization of early warning information into graduated risk levels is the element of EWS communication most relevant to the MEACAM platform. The agricultural drought and flood predictions produced by the MEACAM platform are not yet delivered as graduated alerts; however, these forecasts can be adapted into graduated alerts using model outputs, namely predicted values and accuracy metrics.

Agricultural drought predictions: The MEACAM platform identifies agricultural drought in areas with a large amount of cropland by counting the number of months within the one- to two-month forecast window in which cropland health indicators are predicted to fall below the long-term average. Currently, agricultural drought is categorized as Drought Watch (some predicted underperformance) or Drought Warning (consistently predicted

underperformance).[31] These categories can be adjusted to create graduated alerts by linking the predicted numeric value[32] of cropland underperformance to a risk level. For example, if predicted cropland health is much lower than the long-term average,[33] then areas where predictions are within that threshold can be assigned a very high level of risk, and areas with less extreme thresholds can be assigned less severe risk ratings. The average margin of error[34] of predictions that were previously generated for each spatial unit (hexagon) could also be used to inform risk levels. For example, an agricultural drought categorization in hexagons with higher prediction accuracy can be assigned a higher risk level than the same categorization in hexagons with lower prediction accuracy.

Flood predictions: The MEACAM flood prediction module comprises a user-defined heavy rainfall threshold that is applied at the national scale and a percentile-based heavy rainfall threshold and satellite-derived flood predictions at a localized level. MEACAM relies on ECMWF[35] forecasts; therefore, the cumulative rainfall forecast uncertainty can be assigned to graduated risk levels. For example, heavy rainfall forecasts with a high level of certainty can be assigned a higher risk than that same quantity of rainfall forecasted with a high level of uncertainty. Similarly, the risk level attached to satellite-derived flood predictions can be related to the predicted probability of the presence of water.[36]

Transmission Flow

The transmission flow of hazard alerts requires the following elements:

- Define the content of the message using the graduated approach (WHAT)
- Identify the transmission chain and recipients (WHO)
- Determine the communication channels (HOW)
- Establish the transmission timing (WHEN)

[31] Mercy Corps, MEACAM Research Report: Drought in Focus May 7, 2025
[32] Meaning percent and absolute difference.
[33] For example, a predicted NDVI more than 0.2 below the long-term average, or a NDVI more than 50% below the long-term average NDVI percentage difference of 50%.
[34] Mean absolute error (MAE) and/or mean absolute percentage error (MAPE).
[35] European Centre for Medium-Range Weather Forecasts (ECMWF), Near-Realtime IFS Atmospheric Forecasts
[36] Currently, MEACAM uses a static flood probability threshold (80%). Future technical development of the MEACAM platform should enable forecasts of floodwater depths, which can more directly be related to a severity rating.

The information needed to meet these requirements is drawn from each pillar of the EWS. Specifically, the third pillar provides forecasts that define "WHAT" hazard and threat level and identify areas that are exposed to the hazard (WHO). The second pillar defines the channel(s) used to communicate hazard alerts (HOW), and the dissemination plan established in the fourth pillar specifies the timing of the message (WHEN).

The Common Alerting Protocol

The Common Alerting Protocol (CAP) is essential for communication in an EWS. The CAP is a standardized message format designed for all media, all hazards, and all communication channels. It includes critical information on the predicted hazard – including the areas affected and severity – and the associated early actions. These messages must be delivered in a universal or very similar format for each hazard to maximize clarity. The standard CAP format produces a single alert for simultaneous distribution across multiple channels, including emergency sirens, SMS alerts, and radio broadcasts. A CAP can be considered the bridge connecting "detecting and monitoring" (Pillar Three) and "warning dissemination and action" (Pillar four).

Community Early Warning Systems

Proposed by the International Federation of Red Cross and Red Crescent Societies (IFRC), a Community Early Warning System (CEWS) is another approach to implementing an EWS.[37] Although often referred to as the "last mile" in an end-to-end EWS, a CEWS is better understood as the "first mile", where warning information must reach and be acted upon. Communities are the first responders in protecting their households and disadvantaged individuals. This is echoed in the Hyogo Framework for Action[38] (HFA), which similarly identifies a "people-centered" approach that recognizes the community's role as producers and facilitators of early warning information. In the countries covered by the MEACAM platform (Iraq, Syria, and Yemen), a CEWS is an effective interim solution until the government or ruling authority operationalizes a centralized EWS.

[37] International Federation of Red Cross and Red Crescent Societies, Community Early Warning Systems: Guiding Principles
[38] United Nations International Strategy for Disaster Reduction, Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters World Conference on Disaster Reduction, Kobe, Japan, January 18-22, 2005

Communicating Drought and Flood Hazards Warnings

Drought: Alerts for any type of drought – meteorological, agricultural, or hydrological – should communicate the risk level and the appropriate measures to limit or suspend non-essential water use or other risk mitigation actions. Agricultural drought alerts should reach the general population, but direct communication channels with farmers and agricultural cooperatives must also be established to ensure information on mitigation measures reaches the most vulnerable groups. Due to the slow onset of drought, alerts should be continuously updated after the initial warning to reaffirm the accuracy of the forecast and remind stakeholders to implement early actions.

Flooding: Flood alerts should identify the location(s) of forecasted heavy rainfall or other predictive flood indicators (e.g., flood predictions by MEACAM or GloFAS) and be tailored for the general population and emergency response actors. Warning messages delivered to emergency response actors should signal the activation of location-specific response plans, including coordination with local actors and resource mobilization. Flood alerts sent to the general population should clearly state when flooding is forecast to occur along with the recommended actions – in accordance with the predicted flood severity – to minimize hazard exposure. These actions range from travel warnings (e.g., avoiding flooded areas when traveling by automobile), to mitigation steps (e.g., preparing flood barriers), to evacuation orders.

Type of communication channels

Table 1 outlines possible communication channels to deliver hazard alerts. The most common dissemination channels (e.g., SMS; social media posts), which are colored in green, are feasible in most contexts, including Iraq, Syria, and Yemen.

Type of communication vector		Targeted users	Advantages	Challenges / Limits
	SMS	Citizens; emergency response stakeholders	Automation, execution speed, and content that can include hyperlinks	Limited number of characters, dependent on phone network performance
	Targeted phone call	Emergency response stakeholders	Flexibility and customization, particularly in message content. The "human" dimension of the exchange	Manual action, which can be time-consuming during a crisis; dependent on phone network performance

	Social Media	Citizens	Ease of access, very popular, interactive	Reliability of information/marginal official content; dependent on internet performance
	Media Radio/TV	Citizens	Ease of access, high visibility	"Passive" communication method; must be based on precise, clear, and reliable content (relay of meteorological agencies)
	Announcement over mosque loudspeakers	Citizens	High persuasive capacity, easy to implement	Limited range, requires strong coordination with emergency response stakeholders (content of message and speech)
	E-mail	Emergency response stakeholders	Automation, execution speed, enriched content that can be illustrated and accompanied by hyperlinks	Limited visibility during crises, dependent on internet performance
	Fax	Emergency response stakeholders	Automation, official content	Limited visibility during crises, reception delays
	Website	Citizens	Ease of access, rich and interactive content, high visibility	Dependent on internet performance, "passive" communication method
	Pre-recorded vocal message	Citizens, emergency response stakeholders	Flexibility and customization, especially in message content (multiple languages and dialects possible)	Dependent on phone network performance
	Social media notification (e.g., WhatsApp)	Citizens	Cost-effective and unlimited (no operator fees); Interactive (internet links)	No visibility on deliverability and is dependent on more than one application
	Cell broadcast	Citizens	Large volume of messages that can be sent simultaneously to a specific geographic area	Complexity in the technical and technological setup between the government and telecom operators; no traceability after sending

Table 1. Possible communication channels for disseminating early warning messages. The colors indicate their feasibility in Iraq, Syria, and Yemen. **Green** indicates existing communication channels; **Orange** indicates uncommon but easy-to-deploy communication channels; **Dark Gray** indicates communication channels not yet established in these contexts.

Risk communication and governance

Political instability directly affects implementation of an EWS because cohesive governance – whether national or collaborative among autonomous regions – is essential to establishing CAPs and permitting and promoting the dissemination of hazard alerts. This is especially relevant in countries with fractured governance like Syria and Yemen, where authority is split between internationally recognized governments and de-facto authorities, hindering the establishment of a centralized EWS with national coverage. The issue is less severe in Iraq, where governance is divided between Federal Iraq and the KRG. The occasional tensions between these regions do not significantly impact the implementation of a national EWS because both governments independently have the capacity – though unrealized – to implement an EWS.

Since early warning messages should reach the maximum number of people over the widest possible geographic area, a bottom-up communication tree that leverages local actors is more suitable than top-down approaches in highly fractured and conflict contexts. For example, in Iraq, Syria, and Yemen, mukhtars are influential local figures that can relay alerts to at-risk populations. Similarly, local councils in Yemen may also act in this role because they are a governing body drawn from and elected by the community, and have remained functional in most parts of the country throughout the conflict.[39]

Enhancing the use of existing communication channels

To maximize its reach, an EWS should leverage multiple communication channels. Telecommunications, such as SMS alerts via national carriers, are ideal channels for early warning alerts because cellular networks cover large geographic areas and are functional in most contexts. In countries such as Iraq, Syria, and Yemen, early warning SMS alerts would likely be sent to devices that are connected to specific cell towers or in defined geographic zones where the hazard is forecasted to occur. Alerts sent through this channel would need to be developed or approved by the government or ruling authority, to facilitate their transmission by national carriers.

[39] Baron, A. et al., The Essential Role of Local Governance in Yemen Sana'a Center for Strategic Studies, October 2016

The Emergency Telecommunications Cluster (ETC) is one useful mechanism to facilitate the dissemination of early warning alerts in emergency contexts. The ETC is a global partnership of humanitarian, private, and government actors led by the World Food Programme that provides communications services and support to humanitarian responders and local communications providers during crises, particularly in contexts where governance is contested and infrastructure is degraded. The ETC is a useful partner to coordinate the dissemination of early warning alerts but is not designed as a direct public alerting channel. Notably, the ETC ceased operations in Iraq in 2019[40] and is slated to halt operations in Syria in December 2025.[41] However, it remains active in Yemen, where it delivers essential shared communication services in 10 common operational areas.[42,43]

Early warning alerts can be sent over other digital and physical communication channels. As internet accessibility and smartphones adoption increases worldwide, it has become more feasible to communicate hazard alerts on social media platforms (e.g., Twitter/X; Facebook) using accounts managed by government actors, trusted civil society organizations, or citizens in affected areas. Physical communication of hazard alerts is another possible channel. For example, imams can broadcast urgent warnings – such as flash flood alerts – via mosque loudspeakers.

[40] Reliefweb, ETS Syria Situation Report #74 - September - October 2025 | Emergency Telecommunications Cluster November 5, 2025
[41] ibid.
[42] Emergency Telecommunications Cluster (ETC), Yemen
[43] Sana'a, Aden, Hajjah, Ibb, Marib, Taizz, Al Mokha, Al Mukalla, Al Hodeidah, and Sa'ada.

Potential communication roadmap for MEACAM platform

In Iraq, Syria, and Yemen, the MEACAM platform is best positioned to serve as an information source for a centralized EWS system managed by the government or ruling authority. The information provided by the platform provides an appropriate lead time for emergency response and early action. Furthermore, MEACAM hazard predictions are available through an API, which facilitates connectivity to a centralized EWS. In the absence of a functioning centralized EWS in these countries, the information provided by the MEACAM platform can be used by aid actors to trigger localized early action interventions. However, aid actors must, at least, make the relevant governing actors aware of such initiatives. MEACAM highly recommends that these actors collaborate with specialists to develop early warning triggers and communication strategies before delivering early action programs.

Below are summaries of progress toward establishing government-led, centralized early warning systems in Iraq, Syria, and Yemen that cover multiple hazards, including agricultural drought and flooding.

Iraq: No EWS is currently active in Federal Iraq though significant efforts are being made to develop such a system. According to key informant interviews conducted by the MEACAM team,[44] the Ministry of Environment is working on a national Disaster Risk Reduction strategy in collaboration with UNDRR and other UN partners. The strategy has not been published at the time of writing, but it will outline priority needs to implement disaster preparedness and early warning initiatives in the country.

A recently published UNDRR report[45] highlighted several challenges to implementing disaster preparedness and an EWS in Federal Iraq. The report identified weaknesses across all four pillars of an EWS, starting with significant gaps in satellite imagery analysis and hazard, vulnerability, and exposure mapping, and the limited integration of existing hazard risk information into national policies and planning. The availability and accuracy of hazard forecasts is hindered by a reliance on external weather forecasts due to the limited capacity

[44] The MEACAM team engagemed with a technical advisor from an aid agency that is currently working on early warning initiatives in Federal Iraq and the KRG, November 2025.
[45] United Nations Office for Disaster Risk Reduction, Anticipatory Finance Landscape: Iraq

of the Iraqi Meteorological Organization and Seismology Center to produce independent weather forecasts, in addition to an insufficient number of automated weather stations to provide geographically comprehensive weather monitoring.

Drought monitoring is the shared responsibility of the Iraq Meteorological Service, Ministry of Agriculture, Ministry of Water Resources, and Ministry of the Environment. Flood warnings are issued by one or more of the following bodies: the National Operations Committee, Iraqi Civil Defense Directorate, and Governorate Emergency Cells.[46] Early warning alerts, even those informed by external forecasts, are not implemented because there are currently no standardized protocols for issuing warnings, nor have any early warning communication channels been established. Preparedness and response capabilities in Federal Iraq are hindered by a lack of coordination and a low level of community engagement in preparedness activities.

Despite present capacity deficiencies, the MEACAM team observed that the ministries involved in early warning are very interested in applying and producing hazard risk monitoring and early warning information. The Ministry of Water Resources expressed its interest in satellite technologies to monitor and predict river levels, while the Ministry of Construction and Housing and Ministry of Municipalities and Public Works showed interest in remotely sensed water quality indicators to fill data gaps where monitoring stations are not yet built. However, representatives of both ministries noted that funding remains a barrier to developing and potentially implementing such tools and analyses.

In the KRG, EWS initiatives are led by the Joint Crisis Coordination Centre (JCC), which manages a regional EWS for flooding and seismic activities.[47] In August 2025, the MEACAM team visited Erbil and met with the KRG's Climate Change Directorate[48] and the Directorate of Water and Sewage of the Kurdistan Region. Neither organization was involved in an early warning initiative, though both showed interest in becoming more involved. In an interview with the MEACAM team, an engineer working on DRR for the KRG

[46] Governorate Emergency Cells comprise the representatives of the Directorate of Public Health Division, Ministry of Migration and Displaced, local NGOs, and United Nations office at the governorate level. Al-Shamsi, M.T.M., Disaster risk reduction in Iraq Jàmbá: Journal of Disaster Risk Studies, 2019, 11(1)
[47] United Nations Office for Disaster Risk Reduction (UNDRR), Anticipatory Finance Landscape: Iraq
[48] The Climate Change Directorate operates under the Board of Environmental Protection and Improvement.

suggested that mukhtars have been underutilized as an early warning communication channel in the KRG, indicating a potential opportunity for more local involvement in EWS efforts led by the JCC.

Syria: Since the Assad government fell in December 2024, the new government has centralized disaster preparedness and early warning efforts in Syria by creating the Ministry of Emergency and Disaster Management (EDM) in March 2025,[49] and then formally dissolving the White Helmets and placing all its personnel and equipment under the authority of the EMD in June 2025.[50] The EDM does not currently have an EWS in place but is planning to develop a centralized multi-hazard information system that will contain early warning information used to inform triggers and associated alerts. An EWS for flooding will be developed internally by the EDM and for drought by a special unit within the Ministry of Agriculture.[51] The EDM will communicate through multiple channels, including SMS alerts coordinated with the Ministry of Communications and Information Technology and direct engagement with governorate counterparts for local dissemination. During a meeting with the MEACAM team in November 2025, members of the EDM said that the new government welcomes efforts by aid actors to support disaster preparedness and early warning, such as MEACAM forecasts. They also asserted that existing efforts should be integrated within the EDM's forthcoming information system, and that future initiatives must be aligned with the EDM's priorities and developed in close collaboration with other relevant government stakeholders.

Yemen: Territorial and administrative divisions have prevented the development of a centralized EWS in Yemen, though the internationally recognized government (IRG) delivers early warning messages to the public and there is a promising early waning initiative being developed by the IRG and UN agencies. The Civil Aviation & Meteorology Authority (CAMA) currently provides extreme heat, flood, and locust early warning messages and bulletins that are distributed via social media (Facebook and Twitter/X) and shared with governorate-level leaders and counterparts, who are responsible for activating the local

[49] LBCI, الشرع: نعمل على بناء جيش وطني يحافظ على أمننا وأنشأنا وزارة الطوارئ والكوارث لمواجهة أي تحديات وضمان الاستجابة لأي حادث March 29, 2025

[50] Syria TV, أعلنت حل نفسها في وزارة الطوارئ.. الخوذ البيضاء تطوي عقداً من الإنسانية في سوريا June 3, 2025

[51] MEACAM engagement with the Ministry of Agriculture, November 2025.

information tree.[52] The flood alerts provided by CAMA are based on forecasted ECMWF 48-hour rainfall accumulations with trigger thresholds defined using the agency's expert knowledge of weather patterns across the country and information from counterparts at the governorate level.[53] The IFRC's Climate Centre and World Meteorological Organization is currently working with CAMA to formalize graduated hazard alerts.[54]

Several initiatives are supporting the development of an EWS in Yemen. The Ministry of Water Resources, UNDRR, UN Development Programme, and UN Educational, Scientific, and Cultural Organization recently co-authored a national DRR plan focusing on priority areas for developing an EWS. Among aid actors, the Climate Change Working Group and Resource Management Working Group are coordinating early warning information and the implementation of early action interventions. Two anticipatory action consortiums comprising local and international NGOs – one led by the European Civil Protection and Humanitarian Aid Operations and another by the German Federal Foreign Office – coordinate the planning and implementation of early action interventions. The UN Office for the Coordination of Humanitarian Affairs is planning to broaden the coordination of these efforts. The MEACAM team was unable to identify early warning initiatives being developed or implemented in areas controlled by the Ansarallah-led de-facto authority and was unable to visit the area.

[52] MEACAM team engagement with CAMA engineer in Aden, October 2025.
[53] For example, in Yemen, 20mm of rainfall over 24 hours can be severe in areas along the Arabian Sea coast but typical in Sana'a.
[54] MEACAM team engagement with a technical advisor from an aid agency working on the initiative, November 2025.

Conclusion

Centralized early warning systems owned and managed by the government or ruling authorities in Iraq, Syria, and Yemen remain in various stages of development. The agricultural drought and flood predictions provided by the MEACAM platform can serve as a source of early warning information in support of these initiatives, though determining how to collate and integrate information and identify information gaps will take time. Once that process is completed, an early warning communication strategy will follow. Once early warning information is settled, the priority should be the development of a Common Alerting Protocol (CAP) for each hazard monitored by the EWS, in addition to strengthening coordination with national providers via telecommunications ministries and establishing or reinforcing local communication chains.

The communication chain in these three countries should be strengthened. The re-establishment and reinforcement of vertical coordination between national and local levels is needed to optimize the flow of early warning information, particularly with subnational regions that hold a contentious relationship with a central authority. For instance, in Syria, buy-in from the trusted local actors in regions where access by the central government is limited is essential to ensure that critical information reaches the local population. However, separate EWS initiatives appear to be the most realistic approach in Iraq and Yemen due to the autonomy of the KRG in Iraq and oppositional relationship between IRG and DfA-controlled areas of Yemen – however, the exchange of hazard warning information is viable in both contexts.

Iraq and, more recently, Syria have broadly entered the stabilization phase, meaning NGOs must continue to provide support that aligns with government-led EWS initiatives. Yemen remains an emergency context, therefore, aid actors should aim to play a larger role in the development of an EWS through coordination with multiple actors (e.g., ruling authorities, civil society organizations, and NGOs) and by providing close support in developing each pillar of an EWS. Aid actors will play a larger role in providing early warning information and early action interventions to informal settlements and IDP camps that they manage and serve – in coordination with local authorities – as part of highly localized EWS initiatives.

Based on EWS development experience and stakeholder engagement in Iraq, Syria, and Yemen, the following section describes a recommended multi-level and multi-directional early warning communication flow.

National-level officials are responsible for establishing a centralized EWS. Their core responsibilities include defining early warning triggers, developing Common Alerting Protocols (CAPs), coordinating among ministries and the private sector to disseminate telecommunication alerts, and establishing early warning response plans with regional and local actors.

Regional administrative bodies contextualize early warning response plans, disseminate national alerts through local channels, and coordinate with local actors and communities to operationalize response measures.

Local ("last mile") actors such as mukhtars, religious leaders, local councils, agricultural cooperatives, and NGOs ensure early warning alerts reach the community – especially in less accessible areas – and are the main actors responsible for facilitating the implementation of early action measures and mobilizing community-level response.

Top-down communication with bottom-up feedback. Top-down early warning alerts – from national to regional to local actors – should allow for bottom-up feedback because on-ground observations and experiences are essential to improve the quality of early warning information and refine response strategies.

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About Mercy Corps

Mercy Corps is a leading global organization powered by the belief that a better world is possible. In disaster, in hardship, in more than 40 countries around the world, we partner to put bold solutions into action — helping people triumph over adversity and build stronger communities from within.
Now, and for the future.

MERCY CORPS

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