

Overview

Mosul Dam faces a serious and unprecedented risk of catastrophic failure with little warning. A catastrophic breach of Iraq's Mosul Dam would result in severe loss of life, mass population displacement, and destruction of the majority of the infrastructure within the path of the projected floodwave.

Magnitude of Floodwave

The floodwave would resemble an in-land tidal wave between Mosul and Samarra', and would sweep downstream anything in its path, including bodies, buildings, cars, unexploded ordinances, hazardous chemicals, and waste; less than 6 inches of moving water is strong enough to knock a person off his feet, and 16 inches of moving water can carry away most automobiles. Flooding south of Samarra would resemble that of Hurricane Katrina, with standing water that pervades much of Baghdad for weeks to months. As floodwaters recede, mud and waste-covered remnants of previous infrastructure will be left behind.

- Flood water could reach depths greater than 45 feet in some parts of Mosul City in as little as one to four hours, giving residents little time to flee.
- Flood water could reach Tikrit in one to two days.
- Flood water could reach Baghdad in three to four days and have depths of up to 33 feet in the river channel.

Immediate Aftermath: Displacement, Loss of Life, Infrastructure Destruction

The approximately 500,000 to 1.47 million Iraqis residing along the Tigris River in areas at highest risk from the projected floodwave probably would not survive its impact unless they evacuated the floodzone. A majority of Baghdad's 6 million residents also probably would be adversely affected—experiencing dislocation, increased health hazards, limited to no mobility, and losses of homes, buildings, and services.

- Iraqis who are able to escape the floodzone probably would flee initially to higher ground and attempt to return home or remain in nearby areas post-flood. IDPs who do choose to leave their home areas probably will seek out locales they perceive have less infrastructure damage, fewer restrictions posed by armed actors, and better availability of aid and essential services.
- Iraqi IDPs are likely to move again if basic services like electricity and access to clean water and humanitarian assistance are not available.

The flood will severely damage or destroy large swaths of infrastructure and is expected to knock offline all power plants in its path, causing a sudden shock to the Iraq electricity grid that could shut down the entire Iraqi system.

Irrigated agriculture in the affected area would be damaged or destroyed, probably requiring significant and immediate cleanup of hazardous material and reconstruction of irrigation infrastructure.

- Two-thirds of Iraq's high-yielding irrigated wheat farmland is in the Tigris River basin and probably would be heavily damaged.

Evacuations to Mitigate Loss of Life

Prompt, localized, self-directed evacuations to higher ground probably would be the most likely means of saving lives of the roughly 500,000 to 1.47 million Iraqis living in the most dangerous area of the flood path.

- On average, Iraqis between Mosul and Tikrit probably could travel 3.5 miles (6km) away from the riverbank to reach safety, and should seek highest ground possible. However, necessary evacuation distances are likely to be greater in areas with rivers and wadis that feed into the Tigris, as these are also likely to flood.
- Residents of **Mosul** probably could avoid the initial floodwave by moving at least 3.5 miles (6km) from the current banks of the Tigris and avoiding all rivers and wadis feeding into the Tigris.
- Residents of **Tikrit** probably could reach safety by moving at least 3 miles (5km) from the riverbank.
- Residents in some areas between Tikrit and Samarra probably would need to travel about 4 miles (6.5 km) from the riverbank to reach safety.
- **Samarra** residents west of the riverbank probably could move roughly 4 miles (6.5km) away from the river bank to reach safety. Samarra residents on the east side of the river probably would need to flee farther—potentially around 10 miles (16.5km)—to avoid being cut off by multiple streams of water when the major irrigation canal floods.
- Those evacuating areas just south of Samarra', including Baghdad, would have to travel farther to avoid flooding because the terrain begins to flatten downstream of Samarra', creating a much larger floodplain.
- Some parts of **Baghdad** would be flooded, which could include Baghdad International Airport.

Much of the territory projected to be damaged by a dam breach is contested or ISIL-controlled, suggesting an authority-directed evacuation is unlikely, and that some evacuees may not have freedom of movement sufficient to escape.

- The lack of an authority-directed evacuation effort probably will result in some vulnerable groups—like the sick, disabled, and elderly—being left behind. IDPs in the floodpath are likely to be displaced again from areas where they are sheltering, and may lack physical, financial, or mechanical means, area familiarity, or information to effectively evacuate in the event of a flood.

Education Campaign Crucial for Evacuation Warning Success

The success of any self-directed evacuation is likely to hinge on effective crisis communications in educating and warning at-risk populations ahead of a breach. In a breach evacuation scenario, advance preparation of the downstream population, including information on where to go, and prompt warning at the first sign of collapse would be imperative to saving lives because the downstream populations could have only hours or days to receive and act on any warning.

- Educating flood-zone populations of the risk of a breach and what to do in advance would improve the credibility and efficacy of evacuation warnings, helping Iraqis be better positioned to save themselves. Evacuation warnings that occur in the narrow window between the detection of a breach and the impact of a flood wave would be subject to electrical blackouts, technical and bureaucratic delays, or rejections by communities that probably would not grasp the urgency and scope of the threat, suggesting that prior awareness of risk could improve mobilization time in the event of a breach.

- An education campaign could frame messages within indigenous understanding of flood events. Flood path populations living in Iraq's politicized media environment may find warnings of a tsunami-like wave difficult to believe and probably are unaware of the possibility, scale, and quickness of flooding that would result from a breach. However, many Iraqis have experienced periodic flooding of the Tigris River—including floods late last fall that resulted in several deaths and thousands displaced—and may find a resiliency campaign that includes localized, dam-specific information more credible.
- An education campaign could help local police prepare to direct an evacuation and create and stockpile emergency shelters, and allow Iraqis to familiarize themselves with escape routes. Information on the necessity of carrying basic supplies could help displaced Iraqis survive until they are able to obtain humanitarian assistance.

Best Practices for Evacuation Warnings

Timely warnings delivered via multiple, credible information channels probably would be most effective in convincing Iraqis to evacuate in the event of a catastrophic breach of Mosul Dam.

- **Timely.** Warnings that reach the flood path population within minutes to hours after a dam breach would be crucial to ensuring enough time to evacuate, especially in northern areas in and around Mosul where flooding could occur in less than an hour. Timeliness would require a clearly-defined chain of command for authorizing the evacuation warning, and distribution of dissemination plans and prepared messages.
- **Credible.** Communication platforms, messengers, and messages that comprehensively represent the local religious and ethnic communities in the flood path would improve message credibility. For example, messages delivered by nationally and locally influential Iraqi figures—such as tribal leaders, community leaders, and security or religious authorities—are more likely to resonate than those delivered solely by the central government or an international actor.
- **Robust.** Using several different information channels to build redundancy of the warning would improve reach. Flood path populations have varying access to cellular devices, satellite television, and the Internet, and potential country-wide power cuts resulting from a breach could further complicate information dissemination.
- **Connected.** All components—including the detection of a breach, the decision to warn, and the dissemination of a warning—would have to be interconnected to avoid a single point of failure.

Relief Effort

The amount and spread of people in need along the 300-mile floodpath almost certainly will overwhelm the capacity of any one aid actor to provide assistance, suggesting a coordinated response focusing on regional provision of aid by several best-placed actors could help meet widespread needs. Immediate humanitarian needs post-flood almost certainly will include access to safe water, food, shelter, sanitation, medical, and livestock assistance. Safe water and sanitation facilities will be immediate priorities in order to stave off dehydration and water-borne diseases.

- Infrastructure damage along the floodpath almost certainly will deprive large groups inside and outside of the floodpath of crucial services like electricity and safe water, compounding overall humanitarian needs.

- Facilitating IDP returns to areas along the floodpath will require clearing of bodies and debris, cleanup and removal of hazardous materials and waste, extensive rebuilding of affected infrastructure, reestablishing access to basic services and resources, and providing livelihood assistance. Although water probably will recede quickly north of Samarra, Baghdad probably will experience several weeks to months of standing water, which will delay recovery efforts.

Aid actors almost certainly would need to utilize a variety of delivery methods and strong coordination practices to reach IDPs along the floodpath.

- Damage to ground infrastructure probably would render airlifts or air drops as the timeliest form of aid delivery post-flood, but delivery amounts would be limited by cargo weight restrictions and dependency on air space and airfields, many of which are in areas under ISIL control or would also be damaged or inoperable because of flooding. Three inches of standing water can ground airplanes, rendering an airport unusable.
- Sea shipments or cross-border convoys could provide larger amounts of aid but major ports and border crossings are far from the affected area, increasing delivery time and reliance on ground infrastructure that may not be secure or operational. The floodwave could dislodge and redeposit IEDs, which would further hamper the aid response.
- Prepositioning life-saving aid in regional hubs, although far from the floodpath, probably would help counteract potential delays in procuring sufficient amounts of aid.
- Immediate strong coordination efforts between humanitarian actors and bilateral donors almost certainly would improve the aid response by minimizing duplication of efforts.