Sector	Water
Sub-sector	Flood management
Technology name	Rainwater Collection
Option name	Flood early warning
Scale	Large-scale
Availability	Available
Technology to be included in prioritization?	Yes

Background/notes

The purpose of a flood warning service is to detect and forecast threatening flood events so that the public can be alerted in advance and can undertake appropriate responses to minimize the impact of the event. This is a particularly important technology in developing countries, where flooding results in massive loss of life and property.

Flood warnings are a highly important adaptive measure where protection through large scale, hard defenses, is not desirable or possible. This may be the case if defenses would cause adverse environmental or social problems, or where the cost of defense construction would be prohibitive.

A flood warning process has two distinct stages: (1) flood warning and (2) response.

The flood warning stage requires constant monitoring of meteorological conditions. This allows detection and assessment of threatening events to take place before it hits a community. Forecasts may also be made to help decision-makers model how an event is likely to develop, how significant it will be upon arrival, and what sections of the population are likely to be at risk. This is necessary because simple detection of an event will not provide enough time to undertake appropriate responses. To achieve monitoring and forecasting, it is likely that a flood warning system will include meteorological and tidal detection systems and river and coastal flood forecasting models.

Once an event exceeds a given threshold, a warning will be issued. This message is likely to be disseminated to the 'at risk' population through a number of channels. The media, services such as the police and fire departments and basic signals such as sirens and flags all play important roles.

After the 'at risk' population have been warned, the second stage of the flood warning service is initiated: the response. Communities in the hazard zone are required to take action to minimize their exposure to the danger and to reduce the consequences of flooding. It is important that appropriate actions are communicated to the public through awareness raising campaigns, prior to an emergency. Doing so will mean actions can be quickly taken, helping to mitigate the consequence of flooding to the greatest degree.

Advantages of the technology:

Flood warning systems provide advance warning of flood events which can potentially allow:

- The risk to life to be minimized;
- Evacuation of vulnerable groups;
- Residents to move assets (e.g. food, livestock, personal effects) to safer locations;
- Timely operation of flood control structures (e.g. storm surge barriers, temporary flood defenses, etc.) to prevent inundation of property and land;
- Installation of flood resilience measures (e.g. sandbags, property flood barriers);
- Pre-event maintenance operations to ensure free channel conveyance.

If warnings can be disseminated to the public, it will also be possible to give communities advice on what to do in the event of a flood, as well as providing further information to limit losses. This may include areas to be evacuated, evacuation routes and the location of refuges for evacuees. It is likely that advice and guidance can be issued through the same channels used to notify communities of the flood risk and be made available prior to flood events.

***Disadvantages of the technology**:* A flood warning system is not sufficient on its own to reduce risk; people's reaction to warnings – their attitude and the nature of their response – has an important bearing on the effectiveness of a warning system. Flood warnings must be disseminated to local communities and responses must be made to minimize risks. Without these elements, the effectiveness of flood warning systems is compromised. It is, therefore, highly important that warnings be communicated effectively to the public and that emergency responses are implemented. It is essential that the public is educated about appropriate responses to flood warnings, in advance of a flood emergency. It is also essential that the flood warning system is accurate. System inaccuracies may lead to complacency if previous warnings were unfounded, or fear by causing unnecessary anxiety. In order for a flood warning system to be successful, it is essential that communities heed the warnings issued – this requires the public to trust the agency providing the warning.	
Implementation assumptions (How the technology will be implemented and diffused across the subsector)	It is possible to implement flood warning systems together with other adaptation measures, as part of an integrated flood risk management plan. Complementary actions could be part of a protection, accommodate or retreat approach. The costs involved in implementation of a flood warning system could be offset through the construction of multi-purpose shelters, which could also serve as schools, health facilities and agricultural extension centers. Technology used for detecting flood risk may also be used for forecasting rainfall when flood risk is low. This could benefit agricultural practices in these regions.
Impact statements **(How the options impact countries development priorities)**	
Countries social development priorities	• Contributes to flood security priority by warning population • Leads to saving of property and human life • Leads to increase in income of rural population • Reduces migration to urban areas from rural communities
Countries economic development priorities	Lack of flood management system can halt economic development and hinder human health and well-being. Good flood warning system helps to increase efficiency of flood reaction and reduction of economic damages.
Countries environmental development priorities	• Reduces negative consequences of flooding for environment
Other considerations and priorities such as market potential	Some private companies will be interested in paying to get more accurate information on expected floods.
Costs	
Capital costs over 10 years	The costs of implementing flood warning systems are expected to differ widely, depending on the level of sophistication of monitoring and forecasting technologies. Some of the key factors which contribute to variations in the cost of flood warning systems are provided below: • Extent of meteorological monitoring network • Cost of sourcing meteorological data • Set up costs of warning dissemination system and its degree of sophistication

	• Training and employment costs of meteorological data analysts
	• Cost of associated measures:
	  o Provision of flood shelters
	  o Creation of evacuation routes
	  o Awareness raising
	  o Training of emergency services
	
	Approximate costs for application of flood early warning system may be around 200,000-250,000 USD.

Operational & maintenance costs over 10 years	There will be a need for operational and maintenance costs of around 10,000 USD.
Other costs over 10 years	Additional costs (around 40,000 USD over 10 years) will be needed to provide necessary capacity building activities for users.