

AWARE Platform: Early Warning and Action Platform for Flood Resilience in Nigeria

Background/Context

As the climate heats up, the water cycle is twisting and contorting, unleashing a torrent of disruptions. More frequent, ferocious floods and droughts, unpredictable downpours, and gnawing erosion are just the tip of the iceberg. Poor water quality, disease outbreaks, and a host of uncertainties are all conspiring to rip apart the delicate web of life that sustains us. Nigeria is recognized as vulnerable to climate change impacts and ranked 160 out of 181 countries due to a combination of political, geographic, and social factors in the 2020 ND-GAIN Indexⁱⁱ. The ND-GAIN ranks 181 countries using a score which calculates a country's vulnerability to climate change and other global challenges as well as their readiness to improve resilience. The socio-economic impact of floods in Nigeria has been colossal. In 2012 more than 2.3 million people were

displaced, 363 lost their lives and 16 million people were impacted in various waysⁱⁱⁱ. The economic value of the loss was over US\$16.9 billion^{iv}. Again ten years later in 2022, another major flood led to the loss of 600 lives. Also, 3.2 million people were affected across 34 of the 36 states of the federation and the Federal Capital Territory. The Nigeria Bureau of Statistics in 2023^v reported the devastating impact of the 2022 flood to be in the range of US\$3.79 billion to \$9.12 billion, with the best (median) estimate at \$6.68 billion. The economic value of the agricultural-related losses due to the 2022 floods was about N700 billion. Agricultural lands, crops, infrastructure, and rural livelihood continue to be destroyed almost annually. Past efforts to mitigate flood risks in Nigeria from prevention to preparedness, have often been hampered by poor



2018 Floods in Lokoja (source: Afolabi Sotunde/Reuters).

coordination, inadequate resources, and lack of cutting-edge tools, limited platform to integrate relevant data where such needed data are available. As climate change intensifies, the expected increase in extreme weather events leaves the country vulnerable. Now, a critical examination of all relevant disaster management organizations, technical institutions, humanitarian organizations, and civil societies needs to have robust coordination in promoting holistic and systemic flood risk management is crucial. Nigeria's government and institutions must identify gaps and deploy more concrete, workable approaches to shield vulnerable Nigerians and their livelihoods from the devastating impacts of future floods.

Multi-stakeholder interventions and gaps

Nigeria has several ministries, departments and agencies of government that are directly or indirectly charged with the responsibility for weather and flood forecasting, early warning systems, flood and disaster management, water and land resources management, climate resilience and disaster victims' support. These institutions include the Nigeria Meteorological Agency (NiMet), Nigeria Hydrological Services Agency (NIHSA), Nigeria Space Research and Development Agency (NSRDA), Nigeria Emergency Management Agency (NEMA), Federal Ministry of Environment (FMEnv), Federal Ministry of Water Resources and Rural Development (FMWR), and Federal Ministry of Humanitarian and Disaster Management (FMHDM), among others.

On its part, the Nigeria Hydrological Services Agency (NIHSA) has the mandate to carry out hydrological activities and related services for the assessment of the nation's surface and groundwater resources in terms of quantity, quality, distribution and availability in time and space, for efficient and sustainable management of the available water resources. To be able to effectively carry out its mission to provide information on the status and trends of the nation's water resources including its location in time and space, extent, dependability, quality and the possibilities of its utilization and control through the provision of reliable and high quality hydrological and hydrogeological data continuously, it currently operates with a hydrological monitoring system of about two hundred and seventy hydrometric river gauging stations, a far cry from the World Meteorological Organization's (WMO) recommended four hundred and eighty-two (482) network density.

The Nigerian Meteorological Agency (NiMet) is a Federal Government Agency charged with the responsibility to advise the Federal Government on all aspects of meteorology; project, prepare and interpret government policy in the field of meteorology; and to issue weather (and climate) forecasts for the safe operations of aircrafts, ocean going vessels and oil rigs. The Agency also observes, collates, collects, processes and disseminates all meteorological data and information within and outside; co-ordinates research activities among staff, and publishes scientific papers in the various branches of meteorology in support of sustainable socio-economic activities in Nigeria. NiMeT deploys the Seasonal Climate Prediction (SCP) as an early warning tool for planners, decision-makers and operators in the various rainfall-sensitive socio-economic sectors including aviation, agriculture, water resources management, environment, marine, oil & gas transportation, telecommunication disaster risk management, health, construction etc.

Table 1 contains other institutions with their mandates relating to flood and disaster management. The various institutions are established by government laws and are mandated to operate government policy aimed at addressing issues around water resources, flood and disaster management. The institutions engage with the public and partners almost exclusively without a clear platform for building synergy. The weak partnership among these institutions has been attributed to the lack of a robust platform for the integration and coordination of assets, personnel, policy, and practices towards flood mitigation in the country.

Possible overlaps and duplicity of roles and efforts, inadequate hydrological networks across the length and breadth of the country, funding, capacity (technical and personnel) and lack of synergy with other stakeholders in the intervening space, remain daunting challenges to ensuring early warning and safety of the most affected people during floods. Lack of alignment in particular, has contributed to the inefficiency in responding effectively and timeously to flood risk issues in the country. Stakeholders have confirmed that flood risks have become a major concern due to their consequences on human life and the socioeconomic landscape of the nation. Increased variability in intra-annual precipitation will likely increase the frequency and intensity of these events, and increased temperature will raise evapotranspiration.

Table 1: Public Institutions Involved in Early Warning Systems and Disaster Risk Response in Nigeria

Institution	Major mandates
Nigerian Meteorological Agency	<ul style="list-style-type: none"> All aspects of meteorology – aviation, agriculture marine and maritime, water resources, disaster management, oil and gas, environment sectors and General advisories to the Government
Nigerian Hydrological Agency	<ul style="list-style-type: none"> Assessment of Nigeria’s surface and groundwater resources – quantity, quality, distribution, and spatial characteristics, Flood forecasting and prediction of inundation across rivers and catchments
Federal Ministry of Environment – Flood and Erosion Control Department	<ul style="list-style-type: none"> Flood prediction, early warning system establishment and implementation, erosion control, Awareness creation on flood and early actions
National Space Research and Development Agency	<ul style="list-style-type: none"> Development of indigenous capabilities in space science and technology, providing satellite data and services – early warning signals of environmental disaster; national planning, and Advisories to the government
Federal Ministry of Humanitarian and Disaster Management	<ul style="list-style-type: none"> Develop humanitarian policies and provide effective coordination of National and International humanitarian interventions.
Federal Ministry of Water Resources – Irrigation and Drainage Department	<ul style="list-style-type: none"> Implementing irrigation and drainage programs and policies of the Federal Government of Nigeria
National Emergency Management Agency	<ul style="list-style-type: none"> Coordinating federal emergency preparedness, planning, management, and disaster assistance functions



IWMI team with Dr Clement Nze, DG NIHSA and NIHSA Management staff and other management staff.



Hydrometry activities in Nigeria (Credit: NIHSA)

The AWARE Platform

The AWARE Platform is part of the CGIAR Initiative of Climate Resilience ([ClimBer](#)) to transform the adaptation capacity of land, water and food systems. The focus is to build capacity that matches local needs with available tools to promote “governance for resilience”. The AWARE platform is a digitally enabled governance coordination from early warning to early action to strengthen anticipatory action mechanisms to improve the timely decision-making process before the disaster strikes. The platform is targeted for use by government departments and agencies, humanitarian organizations, and funders. The first step for its effective use involves identifying the risks to communities and developing plans to mitigate those risks. This work is carried out using tools provided in the Platform’s Early Action dashboard. The International Water Management Institute promotes disaster risk management options using innovative tools and technologies in Africa and Asia. The AWARE is a flood forecasting tool and drought early warning system

that uses advanced remote sensing technologies in developing countries Early Warning, Early Action, Early Finance.

The AWARE platform focuses on translating early warnings into concrete actions that can mitigate the impact of a hazard or disaster. For example, early actions can include evacuation plans, pre-allocation of resources, reinforcing infrastructure, pre-financing agreements across humanitarian actors, and community preparedness. More importantly, the AWARE platform brings in a wider spectrum of stakeholders, including government officials, emergency responsive managers, humanitarian organizations, and the local communities at risk. It encourages them to take preventive actions before disaster strikes to minimize its effects and, most importantly, save lives. Table 2 is a comparison of the current method to the early warning system and AWARE’s approach.

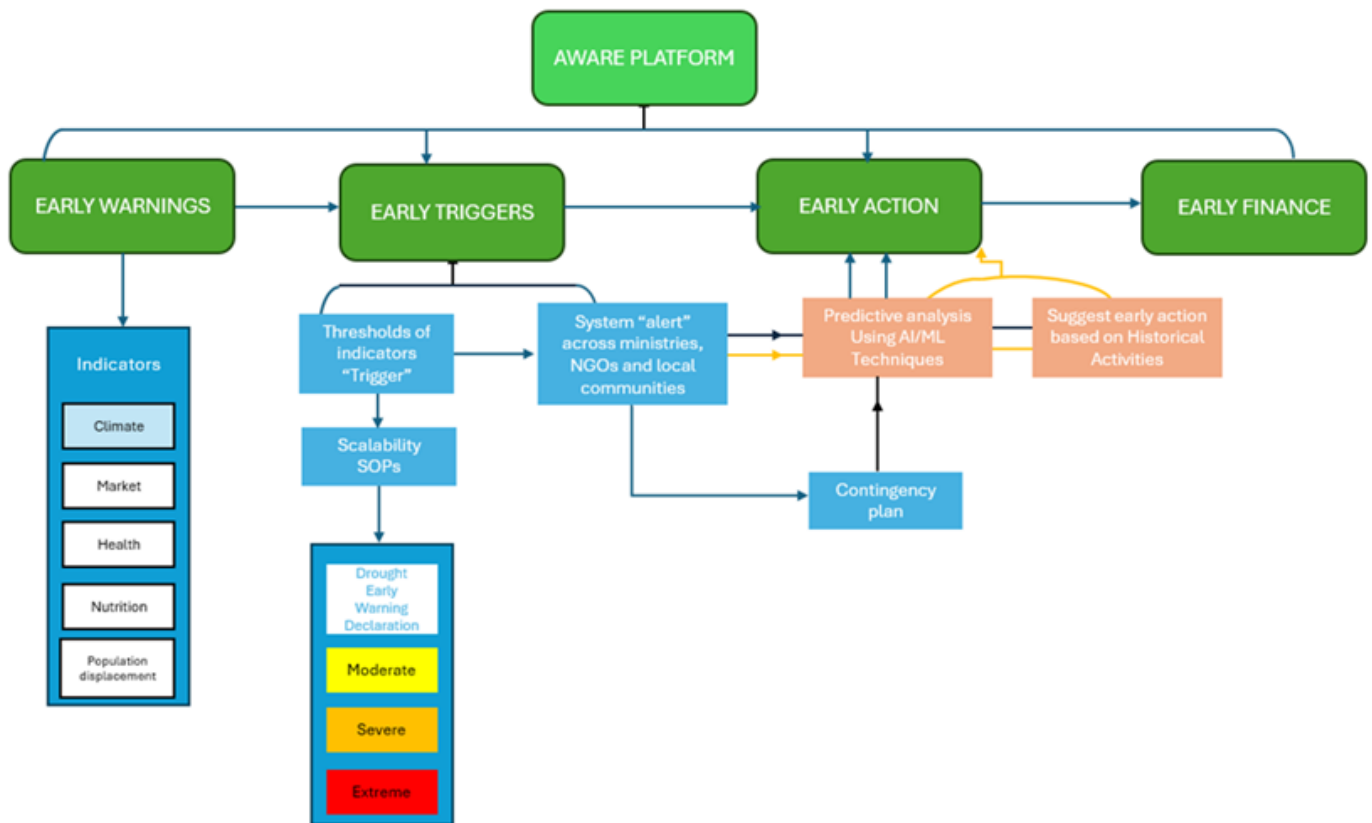


Figure 1. Conceptual Framework of the AWARE Platform

Table 2: Differences between the current Early Warning System (EWS) and AWARE

Characteristics	Current EWS	AWARE
Framing Problem	Their approach focuses on reacting to and mitigating the consequences of climate and disaster events by addressing immediate risks and hazards to minimize their impacts.	AWARE frames the problem holistically, addressing underlying risk drivers, anticipating future hazards, and considering long-term climate uncertainties and vulnerabilities.
Goal	To deliver timely and accurate information to alert stakeholders about imminent hazards, enabling immediate response actions, informed decisions on evacuations, emergency response, and resource allocation.	Goes beyond mere alerts, promoting proactive risk reduction and resilience-building. It facilitates anticipatory actions, early preparedness, adaptive capacity building, and fosters a culture of resilience to minimize hazard impacts and address underlying causes of vulnerability and risk.
Timing	Focus on detecting and alerting stakeholders about imminent or ongoing risks and hazards.	Enables proactive preparedness and response measures by providing warnings and triggering actions before a hazard occurs.
Risk perception	Responding to past patterns and events. Often rely on historical data and established thresholds to determine risks.	Incorporates a forward-looking risk assessment, climate, and disaster risk projections, and considers emerging risks and uncertainties in seasonal climate change.
Action-oriented Approach	Lack emphasis on proactive actions, often leaving stakeholders to determine appropriate responses on their own.	Emphasizes early actions, finance, and response, bridging the gap between warning and action. Engages stakeholders to develop preparedness and response plans, ensuring actionable measures to mitigate risks and reduce impacts.
Collaboration	May involve multiple stakeholders, but lacks sectoral integration and collaboration.	Promotes multi-sectoral collaboration and coordination, integrating knowledge, expertise, and resources across sectors and communities to enhance preparedness and response for locally led adaptation strategies.
Technology and Data Integration	Does not fully leverage technological advancements and relies more on traditional data sources and communication channels.	Leverages technology, data analytics, and communication tools to integrate and interoperate different data streams for timely and accurate risk assessment.
User Friendliness	Has a traditional design, requiring specialized knowledge to interpret information, with complex interfaces and limited accessibility, especially for vulnerable communities.	Aims to be accessible to a wide range of users, prioritizing clear communication, intuitive interfaces, and user-centric design.
Relevance of System	Focuses on specific hazards or sectors such as meteorological events or natural disasters, providing valuable information within their scope. However, may not address broader systemic risks or emerging climate change challenges.	Adopts a holistic and integrated approach, considering multiple hazards, climate projections, and socio-economic factors to provide a comprehensive understanding of risks and their impacts across sectors.
Outcomes	Focus on issuing alerts and warnings to inform stakeholders about potential hazards, with the ultimate outcome measured by the number and timeliness of the warnings issued.	Focuses on tangible outcomes, aiming to trigger early actions, preparedness measures, and resilience-building initiatives based on the information provided. The success of AWARE is measured by its contribution to risk reduction, impact minimization, and adaptive capacity enhancement.
Communication	Typically employs one-way communication channels where experts or authorities disseminate information to end-users, limiting active community and stakeholder participation and engagement.	Prioritizes two-way communication and stakeholder engagement, facilitating dialogue, feedback loops, and participatory processes. Aims to ensure that information is not only shared but also understood, contextualized, and acted upon collaboratively.
Resources	Require substantial resources, including infrastructure, technology, and human capacity. They often rely on centralized data collection and analysis, which can be expensive and time-consuming.	Utilize shared resources and technological advancements such as remote sensing, satellite imagery, and crowdsourced data to enhance data collection and analysis. Emphasizes the integration of existing resources, knowledge, and expertise within a multi-stakeholder framework to maximize collective capacity and achieve resource efficiency in addressing risks.

Source: Amarnath et al., 2023^{vi}

IWMI has engaged with critical stakeholders in the water resources and disaster management sectors on the implementation of the AWARE platform in Nigeria. Experts drawn from Institutions, Ministries, Departments, Agencies of the Nigerian government, and NGOs are unanimous on the need to design new strategies for early warning systems in Nigeria. Climate-resilient landscapes require adaptation strategies to mitigate natural disasters, especially the increase in floods and droughts. The need for an integrated, multi-stakeholder action that employs a holistic approach to flood disaster management in Nigeria has therefore become necessary now. The adoption of the AWARE platform holds a paradigm shift in this regard.

The AWARE Operation

The AWARE platform empowers proactive decision-making and multi-level governance to mitigate disaster risks before they strike. It leverages existing national data and facilitates coordination across ministries, enabling timely action and investment ahead of extreme weather events.

Key features

- **Multi-level governance:** Promotes collaboration across institutions, scales, and sectors, ensuring clear roles and responsibilities for all stakeholders.
- **Integrated data:** Combines data from national infrastructure, systems, and satellite sensors to provide real-time information on key indicators.
- **Early Warning Dashboard:** Tracks five crucial indicators (climate, markets, health, nutrition, population displacement) and triggers warnings based on pre-defined thresholds.
- **Anticipatory action:** Enables proactive interventions based on early forecasts, like preparing communities months before a potential heavy rainfall.
- **Staged response:** Guides communities through “Preparedness,” “Readiness,” and “Active Status” phases based on the evolving threat level.

Benefits

- **Reduced disaster impact:** Enables early warnings and proactive responses, minimizing damage and protecting lives.
- **Improved preparedness:** Empowers communities to take action well before disasters strike, mitigating risks and ensuring well-being.
- **Informed decision-making:** Provides data-driven insights for authorities to prioritize investments and allocate resources effectively.
- **Enhanced coordination:** Facilitates collaboration across government agencies, streamlining disaster response efforts.

Overall, AWARE^{vi} represents a powerful tool for building resilience against climate hazards. By leveraging data, promoting inclusivity, and enabling coordinated action, communities and authorities can prepare for and respond effectively to disasters, safeguarding lives and livelihoods.

Experiences from Asia and other parts of Africa

The AWARE platform’s success in Senegal, Sri Lanka, and Zambia demonstrates the power of inclusive governance for early warning systems and building resilience. By involving diverse stakeholders and empowering local decision-making, AWARE creates an accountability framework that ensures timely responses to climate risks.

This emphasis on governance and participation is crucial for sustainable water management. Multi-level disaster risk management governance, where different levels collaborate effectively, fosters joint problem-solving and inclusive solutions. In Zambia and Senegal, actively engaging marginalized communities strengthened their preparedness and response to climate threats.

By integrating diverse data sources (as shown in Table 3), AWARE empowers stakeholders to take anticipatory actions. This model, proven effective in other countries, will be adapted to address Nigeria’s specific flood challenges, promoting early warnings and rapid responses.

Table 3: Satellite and other indices used to monitor climate, markets, health, nutrition, and population displacement on the AWARE Platform

Hazard	Index	Data source	Definition
Drought	Accumulated rainfall	National Aeronautics and Space Administration (NASA)'s - Global Precipitation Measurement (GPM) satellite system; Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) and observed records	Measure total amount of rainfall over a certain area during a specific time period.
	Dry Spell	NASA's - Global Precipitation Measurement (GPM) product.	Drought index based on number of dry days.
	Soil Moisture Condition Index	NASA's- Soil Moisture Active Passive (SMAP) product	Quantifies moisture levels at various depths in the soil.
	Integrated Drought Severity Index	IWMI	Combines data from meteorological, hydrological, and agricultural indices to determine drought severity levels.
Flood	Flood extent	European Space Agency (ESA) Sentinel-1 and Moderate Resolution Imaging Spectroradiometer (MODIS) NASA's Terra and Aqua satellite data	Measures the extent of flooding to support early action including emergency response mechanisms.
	Accumulated rainfall	National Aeronautics and Space Administration (NASA) - Global Precipitation Measurement (GPM) satellite system	Measures the total amount of rainfall over a certain area during a specific time period.
	GeoGlows or GloFAS	Global Earth Observation System of Systems (GEOSS) Water Sustainability Initiative and European Union - Joint Research Center (JRC)	Provides real-time and near-real-time data on a range of water-related indicators, including river discharge, precipitation, and temperature.
Landslide	Accumulated rainfall	Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)	Gridded rainfall time series.
	Accumulated rainfall	NASA's Global Precipitation Measurement (GPM) product	Measure of the total amount of rainfall over a certain area during a specific time period.
Market	Yearly food prices	UN World Food Programme	Maize (imported); Maize (local); Rice (ordinary, first quality); Rice (ordinary, second quality); Sorghum; Rice (imported)
Health	Malaria, Diarrhoea, Dengue	Department of Health	Provides information on lead time of health risks using information from rainfall intensity to support early action measures.
Child nutrition	Stunting, Underweight Wasting	Department of Health and UN World Food Programme	Provides early warning information on stunting and wasting in reference to historical data to support early action measures.
Population displacement	Total displaced (annual)	Disaster Management Organisations or United Nations	Provides historical information on the people displaced due to climate extremes to strengthen early action protocols.

Source: Amarnath et al., 2023

The Implementation of AWARE in Nigeria

The effective introduction and implementation of the AWARE Platform in Nigeria necessitate collaborative efforts and a strong partnership among stakeholders. This followed five critical pillars

The implementation of the system across diverse entities serves to create an institutional and governance framework that facilitates a well-coordinated response to climate hazards. The accountability measures embedded in the Platform's planning

clearly define the roles and responsibilities of key actors in the event of exceeding predefined thresholds and triggering warnings. By strengthening the linkages between early warning and response and dismantling information silos through its tools and data collection capabilities, the Platform becomes instrumental in nurturing resilience within vulnerable farming communities—communities that unfortunately bear the heaviest burdens of climate change impacts.



Conclusion

Climate change intensifies floods and other extreme events, demanding immediate and unified action. Stakeholders must urgently collaborate, pooling resources and expertise to respond swiftly, effectively, and comprehensively. The AWARE platform offers a powerful solution, seamlessly integrating diverse data sources to enable agile responses to floods and droughts.

Advanced early warning systems, intricately linked to risk management strategies, provide a potent tool for monitoring and mitigating impacts on agriculture and livelihoods. Nigerian stakeholders' commitment to unlocking the full potential of AWARE strengthens the nation's flood and disaster management ecosystem. Embracing this innovative platform is a crucial step towards building resilience in the face of climate-driven challenges.

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Acknowledgements

This work was carried out under the [CGIAR](#) initiative on West and Central African Food Systems Transformation (TAFS-WCA), which is grateful for the support of the [CGIAR Trust Fund](#) contributors.

CGIAR Initiative on West and Central African Food Systems Transformation (TAFS-WCA)

The CGIAR Initiative on West and Central African Food Systems Transformation (TAFS-WCA) aims to improve nutrition, incomes, and food security within the context of climate change in West and Central Africa through nutritious, climate-adapted, and market-driven food systems.

Citation: Oke, A.; Amarnath, G.; Cofie, O. 2023. *AWARE Platform: early warning and action platform for flood resilience in Nigeria*. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Initiative on West and Central African Food Systems Transformation. 10p.

Disclaimer: This work was prepared as an output of the CGIAR Initiative on West and Central African Food Systems Transformation (TAFS-WCA) and has not been independently peer reviewed. Responsibility for editing, proofreading, and layout, opinions expressed and any possible errors lies with the authors and not the institutions involved.



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