DuraGIRE

Learning brief

November 2025

Towards an integrated Early Warning System (EWS)

In the Ouémé Delta, recurrent floods endanger human lives and livelihoods. It is therefore essential to improve disaster prevention. The DURAGIRE programme aims to enhance the Early Warning System's effectiveness, accuracy, and local relevance. By combining hydrological modelling, community engagement, and inter-institutional coordination, the prorgramme has helped establish the foundations of a more responsive and more inclusive mechanism.

This learning brief presents the main advances, the challenges that still need to be addressed, and the prospects for a system capable of issuing timely alerts that involve all actors in risk management.

Summary

Support for the Early Warning System within the DURAGIRE programme has changed dynamics at several levels: technical, institutional, and community.

By facilitating collaboration among national and local actors, improving the quality of forecasts, and expanding the dissemination of alerts through more accessible formats, DURAGIRE has contributed to building a more inclusive system that is grounded in local realities.

The progress observed reflects a shared commitment: national institutions that are better coordinated, local authorities that are more engaged, and communities that are gradually being equipped to anticipate and respond to floods.

However, despite the promising developments, progress must be consolidated. The system is built on fragile foundations: technical innovations that need stabilisation, local mechanisms that require strengthening, and most importantly, the need for sustainable financing.

The continued success of the improved Early Warning System will rely on the ability of stakeholders to maintain and sustain this momentum over time. This will require continued training efforts, fostering strong community ownership, institutionalising best practices, and promoting shared governance at all levels.

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1. Introduction

1.1 Establishment of the Early Warning System (ESW) in Benin

Benin faces recurrent flooding, particularly in the Ouémé Delta, with significant impacts on populations and economic activities. Since 1970, 22 major flood events have been recorded, including the 2010 event, which affected fifty-five municipalities. Climate change is increasing the intensity and frequency of high rainfall events, and the subsequent floods are worsened by deforestation. The impacts are exacerbated by poorly regulated urbanisation, and weak risk governance, all of which increase the vulnerability of communities.

Integrated Water Resources Management (IWRM) has been introduced in Benin since 1998 to better address risks associated with extreme climatic events. The first Early Warning System (EWS) was established in 2014 through the EU-funded SAP-Benin project. It was built on coordination between the Directorate-General for Water (DG Eau), the National Agency for Civil Protection (ANPC), now the Beninese Agency for Civil Protection (ABPC), and community-based disaster-risk-reduction platforms. Although this system laid the foundations for a national mechanism, it remains limited in its ability to reach the most vulnerable groups and to ensure the effective protection of people and their socio-economic activities.

An Early Warning System is structured around four pillars: knowledge of risks, monitoring and forecasting, alert dissemination, and preparedness and response. These components must operate together within an integrated, accessible, and inclusive mechanism.

2. Assessment of the Early Warning System

2.1 Methodology

The DURAGIRE project conducted a participatory assessment of the EWS, involving national institutions, municipalities, and local platforms. A questionnaire was used to gather stakeholders' perceptions of the strengths and weaknesses of the system in place since 2014. The assessment highlighted a lack of coordination between the technical EWS (SAP-T) and the community-based EWS (SAP-C), as well as limited information flow from the local to the national level. These findings were further explored during a multi-stakeholder workshop on 20–21 June 2024, which provided a platform to share a common vision for systems improvement and to define concrete actions.

2.2 Operation of the current EWS

The current EWS is based on an inter-institutional framework centred on the Inter-Institutional Forecasting and Alert Unit (CIPA),[1] overseen by the Directorate-General for Water (DGEau). Several institutions contribute to its operations, including Météo-Bénin, the Directorate-General for Water (DGEau), the Benin Institute of Fisheries and Oceanographic Research (IRHOB), the National Water Institute (INE), the Directorate of Information Systems (DSI), the Directorate-General for Environment and Climate (DGEC), and the Beninese Agency for Civil Protection (ABPC).

The system relies on a network of 68 hydrometric stations, eight of which are prioritised for the EWS, located in Bétérou, Savè, Kaboua, Atchérigbé, Zangnanado, Bonou, Athiémé, and Malanville. Data from these stations are transmitted automatically to a central server in Akpakpa, where they are analysed to produce colour-coded alert thresholds according to risk intensity.

Since 2020, the SAPI-Bénin tool, developed by the DGEau, has enabled the generation of alert bulletins for both authorities and the population. It combines two models:

a. **SAPI-G**, based on the Global Flood Awareness System (GloFAS), which anticipates floods up to 12 days in advance, and
b. **SAPI-Q**, which uses local station data to produce more detailed three-day forecasts.

Bulletins produced by the DGEau are validated by CIPA and then transmitted to the ABPC, which disseminates them to the National Disaster Risk Reduction and Climate Adaptation Platform (RRC ACC) and local authorities. In the event of a high-risk situation, the Minister of the Interior can issue direct alerts to the population. The technical EWS has improved in effectiveness through the SAP-Benin and OmiDelta[2] projects, which enhanced its predictive capacity.

[1] The CIPA brings together several key institutions involved in managing climate and natural disaster risks. These institutions collect, store, analyse, and disseminate essential data for hazard monitoring.
[2] Omidelta is an initiative launched in 2017 and primarily funded by the Embassy of the Kingdom of the Netherlands in Benin to support the water and sanitation sector.

A beacon has been installed to monitor water levels and anticipate flooding. DURAGIRE - July 2025.

The community-based EWS, established by VNGI through OmiDelta, aims to strengthen local response. It is based on:

- local disaster-risk-reduction and climate-adaptation platforms (e.g., RRC ACC),
- reinforced concrete markers installed at strategic locations with visible colour codes, and
- a pre-alert mobile application to transmit observations to the ABPC and local municipalities.

Deeply embedded in the local social fabric, this system relies on trusted community figures, such as village chiefs, which promotes public engagement and ensures effective circulation of alerts.

2.3 Advantages and limitations of the current EWS

The EWS allows floods to be anticipated several days in advance, thanks to an extensive network of stations that collect real-time data on rainfall and water levels, combined with the use of high-performance models that enhance the reliability of alerts. It generates regular bulletins that facilitate decision-making. The gradual integration of a community dimension represents an additional advantage, improving local responsiveness. The installation of hydrometric markers in certain villages, the involvement of local platforms, and the development of mobile pre-alert tools mark a significant shift towards a more participatory system.

However, despite these strengths, the EWS remains limited in several respects:

Limited hydrometeorological data: The system lacks reliable, centralised data. Weak connectivity between stations and national databases undermines coherence. The absence of precise real-time measurements of key parameters (water levels, rainfall, elevation) constrains the quality of forecasts.

Communication and integration deficits for local data: Data from the community EWS are often incomplete or unusable. The absence of graduated scales on local water level markers prevents accurate estimation of water depth. These data are not yet integrated into the technical EWS, limiting their consideration.

Deficient infrastructure: Many stations and markers are in poor condition or are poorly maintained. Vandalism, land tenure issues, and lack of awareness contribute to this situation. Other weaknesses relate to energy supply, the absence of servers, and non-compliance with data exchange protocols.

Insufficient coordination between local and national actors: The connection between central structures and local platforms remains irregular. The lack of a formal, durable framework hinders information flow and shared decision-making.

Alert dissemination not adapted to local realities: The dissemination channels, via WhatsApp, focal points, and community educators, remain vulnerable, particularly in isolated areas. The formats used (SMS, radio) are sometimes inaccessible to people with limited reading and writing skills, people with disabilities, or underserved populations. The lack of inclusive media limits the reach of messages.

Partial community ownership: A lack of training and resources limits community engagement. Insufficiently equipped, local platforms struggle to fulfil their role in the alert chain.

Financial sustainability to be ensured: The EWS does not yet have a mechanism for long-term funding. Without a clear economic model, the maintenance of infrastructure, update of tools, and continuity of service are at risk.

"The alert bulletins we receive remain too generic: for example, a red alert may be announced for an entire commune such as Zagnanando, while some villages or districts are actually flooded and others are not. This makes it difficult to carry out an accurate and localised assessment of the situation."

Paul KASSINHIN

Regional Director, South, ABPC

3 Measures to improve the EWS

3.1 Identification of vulnerable areas and risk classification

The DURAGIRE programme, in partnership with VNGI, RHDHV, and the National Water Institute (INE), conducted a series of complementary studies to better characterise high-risk areas and refine their classification.

This process took place in four steps:

Inventory of vulnerable areas: Questionnaires sent to focal points of the RCC ACC communal platforms allowed the compilation of an initial list of exposed villages, cross-checked with ABPC data.

Participatory vulnerability study: VNGI carried out field surveys incorporating criteria such as education level, poverty, gender, and age to construct a local vulnerability index.

Cross-risk analysis and modelling: INE and RHDHV combined this analysis with data from HEC-HMS and HEC-RAS models to identify the highest-risk areas and produce detailed maps of hazards, exposure, and adaptive capacity.

Village classification: The results made it possible to rank villages by risk level, guiding intervention priorities and resource allocation according to the needs of the most exposed communities.

3.2 Improvement of monitoring and alert services

The new EWS enhancements aim to strengthen forecast reliability, accessibility, and local relevance. They are structured around the following actions, developed in partnership with VNGI, Royal Haskoning DHV (RHDHV), and the National Water Institute (INE) through sustained technical collaboration.

Installation of smart gauges: 103 geo-referenced, colour-coded hydrometric gauges were installed in the most exposed areas. They enable real-time monitoring, reinforcing the interface between the community-level EWS and the technical EWS.

More precise modelling: Two models: hydrological and hydrodynamic (HEC-HMS for 14-day forecasts and HEC-RAS for detailed mapping) allow for flood anticipation and fine visualisation of risk zones. INE teams were trained in their use to ensure local ownership.

More targeted alerts: By cross-referencing model and gauge data, alerts are now sent to 56 villages and focus on strategic points, including critical infrastructure such as schools, health centres, and roads.

Enhanced environmental integration: Satellite meteorological data (GPM, GFS), topographic surveys, and hydraulic infrastructure mapping (dykes, dams) are now incorporated into simulations, making forecasts more realistic.

Partnership for data security: The Directorate of Information Services (DSI), the Agency for Information Systems and Digital Technology (ASIN), and the Beninese Society of Digital Infrastructure (SBIN) collaborate to ensure the reliability and security of digital data flows. This framework also supports the development of applications for faster alert dissemination.

"With the support of DURAGIRE, an integrated, two-way alert system is under development. It enables direct feedback from communities using information produced by the CIPA and transmitted via gauges installed at the entry points of watercourses. These gauges provide real-time data at a finer resolution, now covering districts and villages."

Paul KASSINHIN

Regional Director, South, ABPC

Simulation during a first aid training session for local platforms. DURAGIRE - May 2025.

3.3 Strengthening local response capacity

Dans le cadre des projets DURAGIRE et SDLG,[3] VNGI Within the framework of the DURAGIRE and SDLG5 projects, VNGI has helped operationalise 55 local RRC ACC platforms in accordance with the 2011 decree. These platforms, composed of 9 to 11 members appointed at village assemblies, are at the heart of prevention, alert dissemination, and local coordination of emergency response. They have received targeted training on their roles, first aid, and the use of the equipment provided to them (life jackets, megaphones, or batteries). In 2024, 89 peer educators and first responders were trained in 56 villages, and nearly 7,885 people were reached with awareness-raising activities in 86 villages across 13 communes.

"I really appreciated the training on first aid procedures. I have been an RRC ACC focal point since 2020, but I had never received training for these situations. This course gave me practical knowledge to act in cases of drowning or fire."

Léon AHOUANDJINOU

RRC ACC Focal Point, Aguégués commune

In parallel, the project supports the updating of communal contingency plans in partnership with ABPC and the NGO GBEWA through ANCB. The process includes participatory plan review, official validation, simulations, and the establishment of financing mechanisms. Seven plans have already been finalised, with a further seven underway. In the long term, the system will rely on ABPC's territorial network, with its 12 departmental offices and the planned establishment of communal civil protection centres.

4 Expected changes and impacts

4.1 Observed changes

Although the project is still being implemented, tangible transformations are already evident. The alert system has become more relevant, responsive, and coordinated thanks to several improvements.

Alert bulletins have been redesigned to be clearer, more localised, precise, and useful for communities. The creation of WhatsApp groups among national, communal, and community actors has sped up the transmission of alerts while facilitating feedback from the field. Interactions are now more dynamic, strengthening the upward communication aspect of the EWS. Local platforms (PL RRC ACC) are also better connected to ABPC offices, improving their integration into response mechanisms.

[3] The project "Sustainable Development for Improved Local Governance" implemented by VNGI and funded by the Embassy of the Kingdom of the Netherlands aims to strengthen integrated water resource management in five municipalities of the Lower Ouémé Valley for the period 2024-2026.

"Before the DURAGIRE programme, flood alerts took time to reach communities. Since the co-development workshop for the system, several problems have been resolved. Information is now effectively exchanged between national and local actors, with a noticeable reduction in transmission delays thanks to social media, SMS, and local platforms."

Victor OGOUOLA
Director of Land and Environmental Affairs,
Bonou commune

At the institutional level, more coordinated governance is gradually taking hold. DGEau, Météo-Bénin, and ABPC now communicate regularly to harmonise their interventions and jointly define EWS developments. This dynamic promotes better role coordination and strengthens the effectiveness of the national alert system.

4.2 Expected longer-term impacts

Although the initial results are encouraging, more time will be needed to fully assess the project's outcomes, particularly regarding the strengthening of local resilience, the evolution of institutional relationships, and the empowerment of communities in risk management. These outcomes are outlined below:

A more effective system adapted to local realities: One of the main anticipated outcomes is the emergence of a EWS that is more precise, reliable, and rooted in local conditions. The integration of HEC-HMS and HEC-RAS models now enables finer resolution forecasts down to the village level, based on better understanding of vulnerabilities and environmental characteristics. In parallel, the diversification of dissemination channels (SMS, radio, WhatsApp, posters) and the simplification of messages, including in local languages, should improve access to information for the most vulnerable populations. Ultimately, these improvements aim to ensure alerts are understandable, timely, and actionable.

Enhanced community-level response capacity: The alert system improvements should allow communities to anticipate floods more effectively, protect their assets, and evacuate in time. This capacity relies on the structuring of PL RRC ACC platforms, training of peer educators and first responders, awareness campaigns, simulation exercises, and the updating of communal contingency plans. These plans, linked to the National Disaster Response Fund (FONCAT), will support faster and more coordinated local responses.

Greater involvement of local authorities: Communes are expected to play a more active role in EWS management. Through DURAGIRE, their responsibilities are now clearer, particularly concerning infrastructure maintenance, local coordination, and adaptation of alert messages. Strengthening municipal services and community relays promotes better coordination across institutional levels while enabling more inclusive and locally adapted communication for vulnerable populations.

Improved protection of people, livelihoods, and territories: In the long term, the system aims to reduce human, economic, and social losses from floods. More precise alerts will allow communities to adjust agricultural or fishing practices according to forecasts. Protection of critical infrastructure, food security, and more resilient land-use planning should be better ensured, thereby enhancing overall resilience in at-risk areas.

5 Lessons learned and perspectives

5.1 Success factors

The DURAGIRE project has contributed to the co-development of a more integrated and effective Early Warning System (EWS), strengthening both the national technical component (SAP-T) and the community network (SAP-C). This synergy has initiated a structural transformation of the system. Among the key success factors, the quality of partnerships within the consortium was essential. Collaboration between Royal HaskoningDHV and the National Water Institute on the technical side, and between VNGI, SNV, and ANCB on the community side, enabled coherent and complementary sharing of expertise.

The project's facilitation role proved central. The DURAGIRE team did not impose solutions but guided stakeholders through a process of ownership and adaptation, respecting local realities. This approach resulted in participatory assessments that allowed institutions and local authorities to identify their own observations and priorities. It also strengthened cooperation between national and local levels, improving information flow and coordination among DGEau, ABPC, communes, and local RRC ACC platforms.

Attention to inclusivity, such as in visual gauges, simplified alert messages, and accessible formats, ensured that the needs of vulnerable populations were better addressed.

However, this dynamic remains partially unfinished. Certain technical or institutional innovations are not yet stabilised or widely implemented. Their consolidation depends on stronger commitment to institutional structuring, data security, and, above all, sustainable financing. The project has laid the foundations for significant change but learning and consolidation efforts continue.

5.2 Challenges to address

The challenge of sustainable financing

Despite the progress achieved by DURAGIRE, one of the main challenges remains the absence of a long-term financing mechanism to ensure the continuity and effectiveness of the EWS, particularly at the community level. Maintenance of gauges, updates to digital tools, and the equipping of local platforms require regular resources. Initial discussions on sustainable financing options took place during an inter-institutional workshop, but implementing concrete solutions requires joint commitment from the State, local authorities, and technical and financial partners. Without a structured economic model, the technical and institutional advances of the EWS risk not being consolidated over time.

Making alerts more accessible

The current dissemination system relies on WhatsApp groups to transmit alerts from the national level to communities via focal points, peer educators, and first responders. While effective in some areas, this system remains limited in isolated localities or among less literate populations, often without access to the Internet or digital tools. To reach these groups, complementary channels are essential, such as SMS to basic phones with coded tones. Other solutions, such as voice messages, community radio, audible or visual signals, and notice boards, should be more widely used to ensure inclusive, timely, and universally accessible alerts at no cost to users.

Improving the reliability and richness of forecast data

The quality of the EWS depends directly on the robustness and diversity of hydrometeorological data. It is crucial to strengthen collaboration between DGEau, Météo-Bénin, and IRHOB to improve information sharing and feed forecasting models more effectively. Incorporating finer resolution field data and better accounting for environmental factors such as sedimentation or land-use changes will help adjust alert thresholds and improve the reliability of flood forecasts.

A stronger role for communes and greater local ownership

To ensure the sustainability of the EWS, communes must be more actively involved in its management. Currently, responsibilities for infrastructure maintenance, such as gauges, remain poorly defined. It is essential to clearly identify the actors responsible for maintenance and to condition any new installation on the rehabilitation of existing infrastructure. Strengthening the role of communes in coordination, planning, and resource mobilisation is indispensable. Similarly, community ownership of the system remains partial. For the EWS to be considered useful, awareness-raising, training, and support for local actors must be intensified, with messages adapted to cultural and social contexts.

Insufficient protection for vulnerable populations

In the Ouémé delta, many communities remain highly exposed to flooding, lacking sufficient means for anticipation or evacuation. Women, children, older people, and people with disabilities are the most affected, suffering secondary impacts of floods such as service disruption or loss of income. Strengthening their resilience requires targeted actions: social protection, safeguarding livelihoods, and explicitly taking their needs into account in adaptation strategies.

5.3 Perspectives for a more effective and inclusive EWS

Strengthening communication and alert dissemination
The next steps aim to consolidate achievements and ensure the sustainability of the EWS by reinforcing local ownership. Priority actions include updating the pre-alert application developed under the Omidelta programme. The improved version will allow village-level forecasts to be sent and observations from local platforms to be collected. Contacts of focal points will be integrated to facilitate communication in case of an incident. A new alert bulletin format, simplified and enriched with graphics, tables, and images, will be co-developed with stakeholders. It will aim to improve readability, shorten production times, and ensure rapid and comprehensible alert dissemination, notably by reducing the number of intermediaries.

Testing the new EWS during the 2025 flood season
A full-scale test is planned during the 2025 flood season to evaluate the operation of the integrated EWS. It will cover the technical component (HEC-HMS and HEC-RAS models, data exchanges, information management) and the community component (transmission and reception of alerts via the new channels). This test will help identify gaps, adjust tools, and strengthen system ownership among the relevant actors.

Enhancing protection for the most exposed populations
Beyond alerts, complementary measures are necessary: relocation plans for high-risk areas, social protection mechanisms (safety nets, targeted support), and investments in resilience infrastructure (dykes, shelters, retention basins). These actions aim to better protect people and their livelihoods and reduce the economic losses associated with flooding.

Towards sustainable financing and scaling up
The sustainability of the EWS relies on the establishment of durable financial mechanisms. The project steering committee has begun advocacy with national authorities in this regard. Commitments have been made to gradually transfer certain responsibilities to the State, with support from some budgetary partners. A key issue concerns expanding the mandate of the National Disaster Response Fund (FONCAT), currently focused on emergencies, to include prevention and risk preparedness.

The integrated approach developed with DURAGIRE is designed to be extended to other river basins in Benin. Advocacy is underway to mobilise technical and financial partners to expand the system to vulnerable areas of the Ouémé, Mono, Niger, and Pendjari basins. This extension aims to strengthen resilience across all territories exposed to climate risks.

About DURAGIRE: DURAGIRE (2024–2026) strengthens the resilience of populations in the Ouémé delta against water- and climate-related risks. The successor to OmiDelta, it operates across four pillars: IWRM governance, local organisation, sustainable investments, and an early warning system. Funded by the Government of the Netherlands, it is implemented by SNV, VNGI, and ANCB along with their partners.

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