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Early Warning as a Public Service: Embedding Multi-Hazard Resilience into eGovernance Systems”

Roop Kishan Dave *

International Association of Disaster Management(IADM), United Telecom (India), Renewing and Empowering Society's Progress, Enhancing Capabilities through Technologies (<https://www.respect.org.in/>)

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Abstract

Multi-hazard Early Warning (MHEWS) must transition from donor-dependent, siloed technical projects to a permanent public service embedded within national eGovernance, Digital Public Infrastructure (DPI), and Spatial Data Infrastructure (SDI). This integration leverages existing citizen-centric platforms—digital identity, service portals, USSD/IVR/SMS channels, and geospatial intelligence—to deliver timely, trustworthy alerts while activating whole-of-government workflows (shelter activation, logistics, ESF mobilization) (UNEDSA,2024)

The UN EW4All initiative (target: universal coverage by 2027) provides a global framework, yet its sustainability hinges on national ownership. By aligning EW4All's four pillars with eGovernance architectures, countries realize a “Dual Dividend”: strengthened digital infrastructure for all sectors and equitable last-mile resilience. Examples include India's integration of NDMA alerts into UMANG/Common Service Centres, Ukraine's Diia app for real-time hazards, and Kenya's expanding DPI-CBS linkages (UNEDSA, 2024)

This paper outlines commonalities between domains, a phased integration roadmap (governance → platform → operationalization → scaling), KPIs, and recommendations for legal mandates, Resilience Integration Units, CAP interoperability, blended financing, and PPP models. Institutionalizing Early Warning as a core eGovernance service ensures redundancy during telecom outages, accountability through shared dashboards, and long-term fiscal sustainability—transforming resilience into routine, risk-informed public service delivery.

Keywords Early warning systems; eGovernance; Digital Public Infrastructure; Multi-hazard resilience; EW4All; Dual dividend

1. Introduction

Governments worldwide have invested heavily in eGovernance for service delivery. Parallel donor-supported Early Warning Systems (EWS) for hydromet, seismic, epidemic, and other hazards often remain disconnected, limiting reach and collapsing post-project.(UNDRR 2024).

The United Nations' Early Warnings for All (EW4All) initiative, launched in 2022, provides a historic mandate to ensure every person on Earth is protected by multi-hazard early warning systems by 2027(WMO,2023). Yet despite billions invested in eGovernance platforms worldwide — spanning digital identity, citizen portals, procurement systems, and accountability dashboards — resilience management remains disconnected from these same digital governance architectures. This institutional separation persists even though multi-hazard early warning systems (MHEWSS) and

* Corresponding author: Roop Kishan Dave

eGovernance share critical commonalities: digital infrastructure, citizen reach, accountability mechanisms, and inclusivity goals.

This paper argues that treating Early Warning as an essential public service under the national eGovernance umbrella is the only path to credible, scalable, and sustainable EWS — delivering Dual Dividends of resilience and enhanced digital inclusion.

2. Conceptual Foundations

2.1. Multi-Hazard Resilience Framework (MHRF) and EW4All

The Multi-Hazard Resilience Framework (MHRF) provides a structured approach for managing diverse hazards through coordinated monitoring, alerting, response, and recovery (WMO,2025). It includes hydromet monitoring, epidemic surveillance, seismic networks, logistics management, and risk communication. MHRF harmonizes hazard-specific systems into a unified resilience architecture aligned with the Sendai Framework, the Paris Agreement, and SDG 13.1. At its nucleus sits Early Warning Systems, serving as the operational trigger connecting risk knowledge to anticipatory action (WMO, 2025). The UN EW4All initiative organizes action around four operational pillars:

- **Pillar 1** – Disaster Risk Knowledge (UNDRR)
- **Pillar 2** – Detection, Observation, Monitoring, Analysis, and Forecasting (WMO)
- **Pillar 3** – Warning Dissemination and Communication (ITU – CAP)
- **Pillar 4** – Preparedness and Response Capabilities (IFRC)

EW4All's success depends on integration into national digital governance platforms that provide reach, trust, and institutional continuity (UNDRR, 2024).

2.2. eGovernance as Enabling Backbone

eGovernance represents the digital transformation of public administration, delivering interoperable services through national digital identity systems, citizen service portals, procurement workflows, accountability dashboards, and mobile-first platforms. It forms the trusted, everyday interface between governments and citizens (UNDESA, 2024)

At its core are three interdependent layers that provide a ready foundation for embedding Multi-Hazard Early Warning Systems (MHEWSS):

Digital Public Infrastructure (DPI): Foundational “rails” including digital identity, payments, and secure data exchange layers.

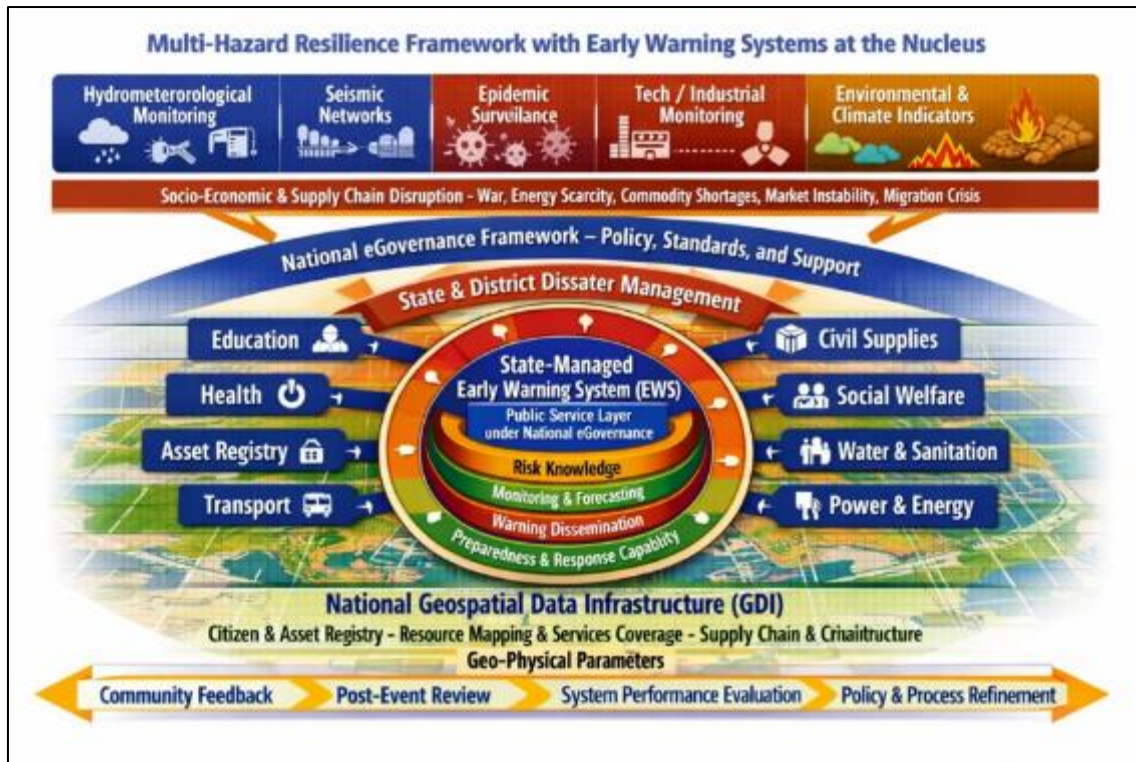


Figure 1 Convergence of eGovernance and MHEWSS1

- **Spatial Data Infrastructure (SDI):** Provides location intelligence through hazard maps, earth observation, sensor networks, and geospatial analytics (sector-agnostic).
- **Citizen-Facing Delivery Channels:** Proven last-mile tools such as USSD, IVR, SMS, mobile apps, community service kiosks, and radio integration.

According to the United Nations E-Government Survey 2024, all 193 UN Member States are advancing digital government, with a strong upward trend in resilient infrastructure. The global E-Government Development Index (EGDI) has improved markedly (UNDESA, 2024). Estimates suggest hundreds of billions of dollars are spent annually on digital transformation, creating robust platforms that already manage routine public services on a scale.

Yet, most eGovernance strategies still treat multi-hazard resilience as external. Early Warning should be delivered through the same trusted platforms citizens use daily (ITU, 2023). This existing infrastructure provides the perfect vehicle for operationalizing EW4All’s four pillars, generating powerful synergies and the Dual Dividend of enhanced resilience and stronger digital governance.

2.3. Commonalities and Synergies

Both domains share citizen-centricity, shared digital infrastructure, accountability dashboards, and a focus on inclusivity. Embedding alerts in routine service portals improves action rates and generates powerful synergies (ITU, 2023; IFRC, 2023).

Table 1 Dimensions and Benefits of Integrating EW4All into eGovernance

Dimension	Benefit of Integration	Illustrative Example
Infrastructure Efficiency	Leverages existing ICT and eGovernance platforms for resilience delivery, reducing duplication	Hazard alerts disseminated via national service apps already used for healthcare, welfare, or agriculture
Citizen Reach & Trust	Embeds early warning into familiar governance workflows, enhancing inclusivity and credibility	SMS or app alerts linked to national ID and social protection systems, reaching marginalized groups without extra cost

Operational Readiness	Automates logistics and service continuity through integrated digital triggers	Forecasts activate pre-positioning of relief supplies via government procurement and supply chain systems
Accountability & Transparency	Tracks resilience KPIs alongside governance indicators, reinforcing trust and oversight	Dashboards show shelter readiness and alert dissemination rates next to education, health, and welfare metrics
Regional Harmonization	Aligns protocols and data standards across borders through interoperable governance systems	Cyclone alerts shared across SAARC countries via CAP standards embedded in regional eGovernance platforms
Cost Effectiveness	Maximizes donor pledges by embedding EW4All into existing digital governance infrastructure	EW4All alerts delivered through national eGovernance portals without parallel, siloed systems
Sustainability	Embeds resilience into mainstream governance budgets and service delivery	National eGovernance financing includes early warning maintenance as a core public service
Donor Leverage & Dual Dividend	Converts billions in EW4All pledges into simultaneous gains in resilience and digital governance	Government / Donor investments expand grassroots digital platforms while achieving universal early warning coverage by 2027

3. The Missing Link: Why Convergence is Essential

Despite sharing citizen-centric goals, digital infrastructure, accountability mechanisms, and inclusivity mandates, Multi-Hazard Early Warning Systems (MHEWSS) and eGovernance remain institutionally siloed in most countries. Hazard alerts are typically managed by meteorological or disaster agencies, while citizen services operate through ICT or administrative ministries. This separation is not primarily technical, but governance related. Five structural pillars explain why convergence is essential and how embedding MHEWS into national eGovernance delivers credible, rapid, and sustainable outcomes.

3.1. Early Warning as a Public Service

Early warnings must be repositioned from a time-bound, donor-funded technical project to a core public service — as fundamental as electricity, water, healthcare, or education. eGovernance platforms already deliver these services as citizen entitlements with dedicated budgets and institutional continuity. When MHEWSS is embedded within national eGovernance strategies, it gains the same legitimacy, funding stability, and accountability. This repositioning ensures long-term sustainability beyond donor cycles and aligns with the demand-driven, government-owned model required for credible EWS.

3.2. The Institutional Gap Between MHEWSS and eGovernance

Both domains target the same populations and rely on overlapping digital infrastructure (data lakes, interoperable platforms, communication networks). Yet they are governed separately, funded by different streams, and managed on parallel systems. This institutional gap — rather than any technological barrier — is the primary obstacle. Bridging it through coordinated governance structures (e.g., Resilience Integration Units) unlocks whole-of-government coordination and eliminates duplication.

3.3. Trusted Channels vs. Emergency Channels

Citizens interact daily with eGovernance through familiar, trusted interfaces — national service portals, USSD/IVR/SMS gateways linked to digital identity and social protection systems. These channels carry inherent credibility. In contrast, standalone emergency apps or one-off SMS alerts suffer from low open rates, trust deficits, and digital fatigue. Embedding alerts into routine eGovernance channels increases action rates, ensures inclusivity (especially for women, elderly, rural, and disabled populations), and leverages existing registration databases for targeted, personalized delivery.

3.4. Multi-Service Delivery Logic

Integration enables a unified multi-service model across G2G, G2C, and G2B interactions. Forecasts automatically trigger procurement, logistics, and ESF (Emergency Service Functionaries) workflows through the same platforms used for routine administration. Citizens receive warnings alongside health, agricultural, or welfare services. This logic ensures that Early Warning activates the full spectrum of government response before public dissemination — critical for anticipatory action and sectoral applications such as climate-smart agriculture.

3.5. Economies of Scale and the Dual Dividend

Integrating EW4All into eGovernance maximizes the impact of existing investments and donor pledges. Rather than building parallel infrastructure, MHEWSS rides on national DPI/SDI platforms — reducing costs, eliminating duplication, and delivering a powerful Dual Dividend:

- **Dividend 1:** Strengthens national digital infrastructure for all sectors.
- **Dividend 2:** Extends equitable last-mile outreach, accountability, and resilience.

Global evidence demonstrates that this integrated approach not only yields higher benefit-cost ratios (typically 4:1 to 10:1 or more) but also ensures system redundancy during telecom outages through secure government backbones.

3.5.1. Empirical Examples of Integration in Practice

Several countries have already moved toward embedding Multi-Hazard Early Warning into national eGovernance platforms, offering valuable lessons:

- **India:** The National Disaster Management Authority (NDMA) integrates multi-hazard alerts (including cyclone and flood warnings via SACHET) with the Unified Mobile Application for New-age Governance (UMANG) and Common Service Centres. This allows citizens to receive warnings through the same trusted channels used for pensions, health services, and agricultural advisories, demonstrating strong Dual Dividend outcomes (GSMA, 2025).
- **United States:** FEMA's Integrated Public Alert and Warning System (IPAWS) unifies multiple pathways (Wireless Emergency Alerts, Emergency Alert System, NOAA Weather Radio) under a single authenticated national platform. It serves as a model of whole-of-government coordination and multi-channel delivery.
- **Japan:** The J-ALERT system delivers rapid, multi-channel warnings through satellite-linked municipal networks, activating sirens, loudspeakers, and mobile alerts within seconds (Wikipedia, J-Alert).
- **Ukraine:** The Diia super-app seamlessly integrates real-time air raid and hazard warnings into everyday eGovernance services (digital IDs, tax filings, etc.), proving resilience even under geopolitical stress.
- **Singapore:** LifeSG and MyEnv applications deliver location-specific weather, pollution, and disease outbreak alerts through centralized citizen profiles (LifeSG).
- **Bahrain:** The MyGov app embeds civil protection alerts directly into routine government service delivery (<https://www.iga.gov.bh/en/article/information-and-egovernment-authority-siren-alert-feature-activation-on-the-mygov-app>).
- **Philippines and Fiji:** PAGASA integrates forecasts into national platforms, while Fiji links tsunami alerts to municipal e-service kiosks (<https://dict.gov.ph/egov-digital-platforms>).
- **Kenya:** Ongoing expansion of Digital Public Infrastructure (DPI) with Cell Broadcast Services (CBS) under the EW4All roadmap is aligning early warnings with national eGovernance and sectoral platforms (e.g., agriculture and climate services), paving the way for the proposed Nairobi Declaration on Early Warning as an Essential Public Service.

These examples illustrate that integrating MHEWSS with eGovernance is achievable across diverse contexts — from advanced economies to developing nations — and consistently delivers higher sustainability, broader reach, and operational redundancy compared to siloed approaches.

4. Integration Architecture

Integration of eGovernance and EW4All is a governance necessity. eGovernance provides infrastructure and workflows; EW4All provides risk knowledge and triggers. Together, they create a unified system where alerts activate government functions and reach citizens through trusted channels. It transforms early warning from a reactive communication tool into a proactive governance function (UNDRR, 2024; IFRC, 2023). In addition to the multiple benefits integration also creates redundancy: while most modern EWS rely heavily on cellular networks—with limited national-scale failover

capacity—eGovernance backbones provide secure, always-on channels that maintain continuity of government operations even during telecom outages.

4.1. Multi-Level Framework (Regional, National, Local)

Integration of Multi-Hazard Early Warning Systems (MHEWSS) with eGovernance must occur across **three interdependent levels** — regional, national, and local — because hazards do not respect administrative or political boundaries, while resilience must be delivered consistently to every citizen.

- **Regional Level** Hazards such as cyclones, river basin floods, and epidemics transcend national borders. Regional integration enables harmonized protocols, shared risk data, collective forecasting, and cross-border alert dissemination. Institutions such as the African Union (AU), South Asian Association for Regional Cooperation (SAARC), Caribbean Disaster Emergency Management Agency (CDEMA), and IGAD provide the institutional scaffolding. For example, cyclone alerts can be shared across SAARC countries via Common Alerting Protocol (CAP) standards embedded in interoperable regional eGovernance platforms, ensuring consistent, interoperable warning delivery across borders (WMO, 2023). This structural alignment exposes a clear institutional gap: the systems that deliver everyday public services and the systems that deliver life-saving warnings operate in parallel rather than as a single, integrated public service.
- **National Level** The national level serves as the **core operational anchor**. Embedding EW4All into national eGovernance strategies elevates Early Warning from a donor-funded project to a permanent public service with dedicated budget lines, legal mandates, and institutional continuity. It enables anticipatory financing, automated logistics and ESF activation, and systematic monitoring of resilience KPIs alongside conventional governance indicators (health, education, agriculture). National platforms also ensure alignment between DPI, SDI, and sectoral systems.
- **Local Level** This is where resilience becomes tangible for citizens. Digital government platforms at municipal and community levels bridge the last mile by integrating alerts into familiar citizen services, public dashboards, and local service centers (kiosks, USSD gateways, community radio). Communities receive warnings through the same portals used for school enrollment or agricultural advisories, while preparedness actions (shelter activation, drills, stockpile mobilization) are triggered automatically. Local integration ensures inclusivity for vulnerable groups often excluded by digital divides or geographic isolation.

This multi-level framework creates a seamless, vertically integrated system where regional coordination informs national policy, and national platforms empower effective local action — fully aligned with the principle of Early Warning as an essential public service under the national eGovernance umbrella.

4.2. Phased Roadmap (Indicative)

Operationalizing integration requires a sequenced approach that builds institutional foundations before deploying technical solutions. However, countries differ widely in their institutional maturity, digital infrastructure, and governance capacity. A rigid, time-bound roadmap is therefore neither realistic nor desirable. Instead, the following four-phase framework provides **directional guidance** that countries can adapt to their own readiness levels, policy environments, and implementation pathways.

- **Phase 1 – Governance & Regulation:** Establish a Resilience Integration Unit (RIU) within national eGovernance structures, positioned to coordinate across ICT, disaster risk management, meteorological, and sectoral ministries. Define legal mandates for early warning as a public service and conduct comprehensive stakeholder mapping to ensure institutional ownership, cross-sectoral buy-in, and clear lines of accountability from the outset.
- **Phase 2 – Platform Integration (6–12 months):** Build or designate a national data lake to consolidate hazard feeds from hydromet, seismic, epidemic surveillance, and environmental monitoring systems. Adopt Common Alerting Protocol (CAP) standards for interoperability across all alerting channels. Link hazard information directly to citizen-facing applications, service portals, and public dashboards, ensuring that warnings flow through trusted governance channels rather than standalone emergency systems (ITU, 2023).
- **Phase 3 – Operationalization (12–18 months):** Retrofit shelters with digital monitoring systems that report capacity, supply levels, and readiness status in real time. Automate logistics workflows for emergency supply chains, linking forecast triggers to procurement, warehousing, and distribution systems. Crosstrain personnel across ministries to ensure coordinated preparedness — so that ICT professionals understand disaster protocols, and disaster managers can leverage digital governance tools (IFRC, 2023).
- **Phase 4 – Evaluation & Scaling (18–24 months):** Conduct national simulations that test end-to-end system performance — from hazard detection through alert dissemination to community response. Monitor resilience

KPIs alongside conventional governance metrics to demonstrate integrated value. Align national systems with regional frameworks for harmonization and scalability, ensuring that lessons learned feed back into continuous system improvement (WMO, 2023).

4.2.1. Last-Mile Connectivity as a Core Design Principle

Last-mile connectivity must be treated as a foundational design principle rather than an afterthought. The EW4All roadmap already emphasizes national gap analyses and multi-channel strategies, but true inclusivity and sustainability are achieved only when early warning is fully embedded in national eGovernance platforms.

A powerful and proven channel in this regard is **Unstructured Supplementary Service Data (USSD)**. USSD enables interactive, menu-driven information delivery via simple short codes (e.g., *501# in Kenya) on basic feature phones — requiring no internet, no smartphone, and no app download. This makes it uniquely suited for reaching rural, low-income, and digitally marginalized populations, including smallholder farmers, women, elderly, and persons with disabilities.

4.2.2. USSD in Practice: Sectoral Examples

In the context of climate and agricultural risk — as highlighted by co-presenter Mr. Henry Mibei at the ICT4D 2026 Nairobi breakout session — USSD delivers actionable intelligence directly to farmers. Kenya's KENAFF *501# service provides real-time weather forecasts, pest and disease early warnings (e.g., fall armyworm), market prices, and biocontrol advisories. Farmers receiving such alerts through PRISE-supported programs achieved significantly higher yields. Similarly, India's mKisan platform has delivered over 10 billion location-specific agricultural advisories to nearly 90 million farm families.

Wider anticipatory action programs across Eastern Africa have reached millions using USSD and SMS, with every dollar invested generating up to 7 dollars in avoided losses through timely actions such as destocking, early planting, or pest management.

By integrating USSD into national eGovernance delivery platforms (alongside IVR, SMS, apps, and community kiosks), countries ensure:

- **Universal Reach:** Alerts reach every doorstep without additional infrastructure.
- **Dual Dividend:** The same channel strengthens both EWS credibility and broader agricultural/extension services.
- **Resilience:** Functions during internet or smartphone outages when cellular voice/SMS networks remain partially operational.

This USSD-centric approach, embedded within DPI and eGovernance, operationalizes the principle that **Early Warning must ride on existing national rails** rather than creating parallel systems. It transforms last-mile delivery from a persistent weakness into a sustainable strength.

4.3. KPIs for Measuring Integration Success

Effective integration of Multi-Hazard Early Warning Systems (MHEWSS) with national eGovernance must be tracked through clear, actionable performance indicators. These KPIs go beyond traditional alert dissemination metrics to evaluate whole-of-government activation, citizen experience, and system resilience — with particular emphasis on leveraging eGovernance platforms for sustainability and redundancy.

Key performance indicators include:

- **Percentage of Alerts Disseminated Through eGovernance Platforms** (portals, apps, dashboards, USSD/IVR gateways, kiosks, and automated workflows) *target: ≥70% within 24 months of integration*. This is the primary indicator of successful embedding and measures the shift from siloed to mainstream public service delivery.
- **Time-to-Alert Across All Digital Channels** (including eGovernance systems, telecom, and local service centers), disaggregated by channel and vulnerable groups.
- **Percentage of Shelters and Critical Facilities Digitally Monitored and Automatically Activated** (including real-time triggers for staffing and resource allocation via eGovernance workflows).
- **Citizen Feedback Scores on Alert Accessibility, Usability, and Trust** (language, clarity, channel preference, and action taken), collected through integrated eGovernance feedback mechanisms.

- **Number of Ministries and Emergency Support Functions (ESFs) Using Integrated Dashboards** (reflecting whole-of-government adoption and operational readiness).
- **Continuity-of-Government Performance During Telecom Outages** (percentage of critical workflows, including alert generation, ESF activation, and logistics, that remain functional through secure eGovernance backbones) *a critical resilience metric demonstrating the superiority of integrated systems over telecom-dependent standalone EWS.*
- **Percentage of Anticipatory Actions Triggered Automatically** (logistics pre-positioning, welfare disbursement, stockpile mobilization, and inter-agency coordination) through forecast-linked eGovernance triggers.

These KPIs should be embedded into national eGovernance monitoring dashboards and reported alongside conventional service delivery metrics (health, education, agriculture). Regular simulation exercises and independent audits will ensure accountability and continuous improvement. By prioritizing eGovernance platform dissemination and outage resilience, countries can objectively demonstrate the Dual Dividend: stronger digital infrastructure *and* more credible, sustainable Early Warning Systems.

5. Implementation Barriers and Mitigation Strategies

Despite the clear benefits of integration, embedding Multi-Hazard Early Warning Systems (MHEWSS) into national eGovernance frameworks faces institutional, political, technical, and resource-related barriers. Ministries often resist cross-sectoral mandates, legacy systems limit interoperability, and political-economy dynamics can delay adoption. These challenges can be systematically addressed through targeted mitigation strategies focused on **legal mandates, inter-ministerial coordination, open standards, and institutional ownership.**

- **Legal Mandates** A foundational barrier is the absence of clear legal provisions recognizing Early Warning as a core public service. Mitigation requires embedding MHEWSS explicitly into national eGovernance, Digital Public Infrastructure (DPI), and Disaster Risk Management legislation. Laws should mandate interoperability between hazard monitoring systems and citizen-facing eGovernance platforms, enforce accessibility standards for vulnerable groups, and require inclusion of Early Warning maintenance in medium-term expenditure frameworks. Such mandates elevate Early Warning from a discretionary project to a statutory entitlement, ensuring long-term sustainability and accountability.
- **Inter-Ministerial Coordination** Siloed governance structures between ICT, meteorology, disaster management, and sectoral ministries (health, agriculture, transport) hinder convergence. The recommended solution is the establishment of a **Resilience Integration Unit (RIU)** a dedicated cross-ministerial body anchored within the lead eGovernance or ICT ministry. The RIU would coordinate stakeholder mapping, standardize Standard Operating Procedures (SOPs), align workflows across Emergency Support Functions (ESFs), and oversee phased implementation. This mechanism bridges the institutional gap identified in Section 3.2 and ensures whole-of-government ownership.
- **Open Standards and Interoperability** Technical fragmentation from proprietary or incompatible systems remains a persistent obstacle. Adoption of open, internationally recognized standards — particularly the **Common Alerting Protocol (CAP)**, ITU emergency communication protocols, and API-based interoperability frameworks — is essential. These standards enable seamless data exchange between hydromet systems, SDI layers, DPI rails, and eGovernance delivery channels (including USSD gateways). Mandating open standards reduces vendor lock-in, lowers long-term costs, and facilitates regional harmonization (e.g., SAARC, AU, or IGAD protocols).
- **Strong Institutional Ownership** Sustainable integration ultimately depends on national ownership rather than donor-driven projects. Clear custodianship must be assigned for each EW4All pillar, with performance-linked accountability mechanisms. Political leadership at the highest level (e.g., Cabinet or Presidential oversight) combined with dedicated budget lines within national eGovernance financing frameworks ensures continuity beyond electoral cycles and donor funding periods. This ownership model directly operationalizes the repositioning of Early Warning as an essential public service under the national eGovernance umbrella.

Addressing these barriers through a coordinated package of legal, institutional, technical, and ownership measures transforms potential obstacles into enablers of credible, rapid, and sustainable EWS implementation.

Recommendations

- **Elevate EWS as public service in eGovernance strategies**
- **Citizen-centric delivery via trusted channels**

- **Legal/policy mandates and RIUs**
- **Infrastructure integration, standards (CAP, APIs), financing (hybrid DPI model)**
- **PPP enablement and regional harmonization**
- **Push for EW as essential service**

6. Conclusion

Early warning has evolved from a standalone technical project into a core governance function. By embedding Multi-Hazard Early Warning Systems (MHEWSS) within national eGovernance, Digital Public Infrastructure (DPI), and Spatial Data Infrastructure (SDI), countries can transform it into an essential public service — as reliable and accessible as electricity, water, or healthcare.

This paper has demonstrated that the missing link between MHEWSS and eGovernance is not technological but institutional. The five structural pillars — repositioning Early Warning as a public service, bridging the institutional gap, leveraging trusted channels over emergency-only systems, enabling multi-service delivery, and realizing economies of scale through the Dual Dividend — provide a compelling rationale for convergence. Global evidence from India, the United States, Japan, Ukraine, Singapore, Kenya, and others confirms that this integrated approach delivers higher benefit-cost ratios, greater inclusivity, and operational redundancy during crises.

The synergy is powerful and self-reinforcing: risk knowledge informs national dashboards, forecasts trigger automated logistics and ESF activation, and alerts reach citizens through familiar eGovernance channels they already trust. When Early Warning rides on existing national platforms rather than parallel donor-dependent systems, countries achieve sustainable last-mile reach while strengthening digital governance for all sectors.

The window for action is finite. As the UN EW4All initiative targets universal coverage by 2027, governments and donors must seize this opportunity to embed multi-hazard early warning into national eGovernance frameworks. This demands robust techno-legislative provisions, Resilience Integration Units, open standards (especially CAP), blended financing, and strong political ownership. The proposed Nairobi Declaration on Early Warning as an Essential Public Service offers a timely catalyst for this shift.

Ultimately, treating Early Warning as a core component of national eGovernance is the quickest, most credible, and most sustainable pathway to building resilient societies. It delivers the Dual Dividend of strengthened digital infrastructure and enhanced protection for lives and livelihoods — the foundation of good governance in the 21st century.

Compliance with ethical standards

Disclosure of conflict of interest

The author declares no conflicts of interest.

References

- [1] Bahrain Information & eGovernment Authority (iGA). Siren Alert Feature on MyGov App. <https://www.iga.gov.bh/en/article/information-and-egovernment-authority-siren-alert-feature-activation-on-the-mygov-app>
- [2] GSMA Case Study (2025). India's SACHET Public Warning System: A Case Study in Mobile Alerting. https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/gsma_resources/indias-sachet-public-warning-system/
- [3] International Federation of Red Cross and Red Crescent Societies (IFRC). (2023). Early warning, early action. <https://www.ifrc.org/our-work/disasters-climate-and-crises/climate-smart-disaster-risk-reduction/early-warning-early>
- [4] International Telecommunication Union (ITU). (2023). Common Alerting Protocol and call to action. <https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/Common-Alerting-Protocol-and-Call-to-Action.aspx>
- [5] J-Alert (Japan). J-Alert: Nationwide Instant Warning System. <https://en.wikipedia.org/wiki/J-Alert>

- [6] Kenya – Early Warnings for All Initiative (2025). <https://www.undrr.org/news/kenya-launches-early-warnings-all-initiative-enhance-disaster-preparedness>
- [7] Philippines – PAGASA integrates forecasts into national platforms. See DICT eGovernment platforms: <https://dict.gov.ph/egov-digital-platforms>
- [8] Singapore LifeSG. <https://www.life.gov.sg/>
- [9] United Nations Department of Economic and Social Affairs (UNDESA). (2024). United Nations E-Government Survey 2024: Digital Government in the Era of Resilience. New York: United Nations. Available at <https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2024>
- [10] United Nations Office for Disaster Risk Reduction (UNDRR). (2024). Global status of multi-hazard early warning systems 2024. <https://www.undrr.org/reports/global-status-MHEWS-2024>
- [11] USA – FEMA. Integrated Public Alert & Warning System (IPAWS). <https://www.fema.gov/emergency-managers/practitioners/integrated-public-alert-warning-system>
- [12] World Bank. (2021). GovTech: Putting People First. Washington, DC: World Bank.
- [13] World Meteorological Organization (WMO). (2023). Overview of the Early Warnings for All: Executive Action Plan 2023–2027. <https://public.wmo.int>
- [14] World Meteorological Organization (WMO). (2025). Global Status of Multi-Hazard Early Warning Systems 2025. Geneva: WMO