Talking Interoperability

A dialogue series for advancing interoperability in the social protection sector

Early Warning to Early Action: Interoperable Systems for Shock-Responsive Social Protection

This brief summarises key learnings from the dialogue on Early Warning to Early Action: Interoperable Systems for Shock-Responsive Social Protection held on January 20, 2026. The brief was prepared by Amirhosein Rahbari based on the presentation by Alexander Jaeger, Senior Social Protection and Climate Change Specialist – World Bank; Joe Zaarour, Digital/AI Social Protection Advisor – World Food Programme (WFP); Mulder Nkutumula, Disaster Risk Finance Specialist – Malawi's National Local Government Finance Committee (NLGFC); Sandy Gordon Camacho, Business Administrator – Costa Rica's Post-Disaster Needs Assessment (PDNA) and the Disaster Recovery Framework (DRF), with contributions from Nina Bekele, Product Partnerships, Social Impact – Google, and Athanase Akumuntu, Acting Chief Digital Officer – Rwanda's Ministry in Charge of Emergency Management (MINEMA) and the Ministry of Environment. The session was moderated by Kim Arora, Knowledge Management Advisor – GIZ.

Please **click here** to access the recording and presentation slides.

Overview

This learning brief outlines how linking early warning systems with social protection through interoperable data systems enables anticipatory action before a shock hits. The first part explains how early warning forecasts automatically trigger pre-agreed protocols, releasing financing and activating responses through existing social protection infrastructure, such as social registries and

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payments. The second part highlights real-world applications, including Malawi's drought-triggered shock-responsive programme and Costa Rica's GeoSinirube for geospatial targeting.

I. From Early Warning to Early Actions

Early warning and anticipatory action are critical for mitigating the impacts of predictable shocks. Countries increasingly face overlapping shocks, including those induced by climate change and market disruptions. Acting early reduces the human and economic consequences of these hazards. **Anticipatory action** enables pre-agreed support linked to forecasts before expected shocks to reduce impact. This means having financing, logistics, stakeholders, protocols, and Standard Operating Procedures (SOPs) in place before a shock occurs, as building new systems during a crisis is inefficient and ineffective. Pre-defined thresholds then signal when to activate these prepared responses. **Early warning systems** tell us what's coming, where, when, and how severe it might be. They monitor and forecast risks that may drive hunger or humanitarian crises, triggering anticipatory action.

Translating data into actionable forecasts requires a structured process. It begins with risk knowledge, understanding who and what is exposed to hazards, followed by continuous real-time hazard monitoring and forecasting. A critical component is the effective warning and communication of timely alerts to decision-makers and communities so that they mobilise resources. The final step is preparedness and response, which involves activating predefined measures when agreed-upon risk thresholds are met.

Forecasts must be converted into clear risk levels and actionable scenarios, informing decision thresholds that define when anticipatory measures should start. Developing these thresholds relies on synthesising data from multiple sources, such as land and earth observation, and systematically combining scientific models with local knowledge (e.g., seasonal rainfall patterns). Establishing transparent activation criteria based on these thresholds is fundamental to ensuring a timely response and accountable decision-making.

Interoperability enables reliable data exchange for early action. Interoperable systems reduce delays through shared data standards and workflows, allowing early warnings to directly trigger actions, such as adjusting social protection programmes. Ultimately, this infrastructure relies on clear roles, agreements, and secure protocols to ensure safe and coordinated data exchange, forming the essential data pipeline for predictive capabilities.

Effective data interoperability relies on core quality principles. These are **accuracy** (data correctly represents real-world values), **completeness** (all required fields and attributes are present), **timeliness** (information is updated frequently enough for operational use), and **synchronisation** (systems refresh data on agreed schedules). Trust is built through **provenance** (each dataset is traceable to a verified source) and robust **governance** (covering access, privacy, security, lifecycle, and responsible use).

The operational backbone of early warning consists of specialised systems and data pipelines. Key WFP's platforms include **HungerMap LIVE** for real-time food security monitoring, Platform for Real-time Impact and Situation Monitoring (**PRISM**) for hazard-vulnerability analysis and early action planning and **AIMS** for tracking post-shock impacts. These are supported by Geospatial Platforms (e.g., GeoNode/DataCube) and diverse data inputs such as satellite imagery, long-term rainfall series, and food security analysis frameworks like the **IPC**. This ecosystem integrates localised forecasts from National Meteorological Agencies and relies on multi-stakeholder coordination, as seen in Rwanda (Box 1).

Box 1: Rwanda's Coordinated Early Warning System

Rwanda's early warning and response system is led by the Ministry of Emergency Management (MINEMA) and relies on strong inter-agency coordination. Key operational partners include meteorological, security, local government, health, infrastructure, agricultural, and space agencies, supported by technical partners such as the WFP. This collaboration is institutionalised through a multi-layered structure of committees, including the high-level National Disaster Management Committee and the operational National Disaster Management Technical Committee (NADIMATEC).

Rwanda is leveraging specific predictive models and overlaying these predictions with population, social hazard, and infrastructure datasets for targeted landslide management. The system effectively uses satellite and remote sensing data for hazard detection and is now moving to incorporate social data for improved decision-making. This data is crucial for identifying the most vulnerable, locating them during a disaster, and enabling shock-responsive social protection through better risk profiling, prioritisation, and targeting. Achieving this requires interoperability between the Early Warning Information System and the national social registry.

Effective early warning systems must be adapted to local hazards and institutional systems. This requires aligning the workflows of diverse national stakeholders, including meteorological, water, housing, space, social protection, and disaster management agencies. For instance, **Malawi** is institutionalising anticipatory action through structured national dialogue platforms and technical working groups. Similarly, **Rwanda** is leveraging specific predictive models, such as the Google Flood Hub for riverine and flood forecasting (Box 2).

Box 2: Google's Role in Disaster Forecasting and Anticipatory Action

Google contributes to national early warning systems and anticipatory action programmes in two ways:

1. Global Alert Dissemination: Google uses its global platforms—Search, Maps, and Android—to provide alerts and safety resources from authoritative sources.

2. AI Research and Forecasting Models: Through Google Research and Google DeepMind, the company develops AI models, such as the model for flood forecasting, specifically riverine floods, which can forecast events up to seven days in advance in over 150 countries. This model is applied in practice to inform local

early warning systems, such as in Rwanda, and to act as a trigger for anticipatory action programmes, as seen in Nigeria.

Integrating Early Warning and Social Protection Systems

For an early warning alert to become an actionable response, a key challenge is the last-mile problem: ensuring that identification, targeting, and payment systems are fully operational, which demands complex coordination across government, international institutions, and NGOs.

Social protection systems offer a central solution due to their existing infrastructure, national ownership, and long-term sustainability. These systems save essential resources and time by providing a rights-based framework and a regular interface with vulnerable populations, both before and after shocks. A shock-responsive approach utilises this infrastructure through vertical expansion (increasing benefits to existing beneficiaries) or horizontal expansion (temporarily adding new beneficiaries), leveraging core components like registries, targeting mechanisms, and payment systems.

Integrating early warning with social protection requires connecting parallel process structures (Figure 1) through both technical and institutional means. Technically, this involves linking hazard forecasts to social registry data, creating geographic and vulnerability overlays for targeting, and establishing automated trigger mechanisms with human oversight for real-time tracking. Institutionally, it necessitates multi-stakeholder coordination with pre-agreed roles between meteorological, disaster, and social protection agencies, and integration into a layered disaster risk financing strategy that combines contingency funds, donor resources, and insurance solutions.

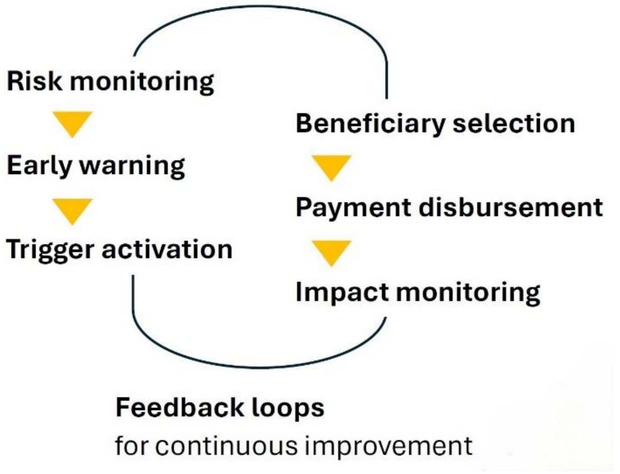

Figure 1: Connecting parallel process structures. Source: Talking Interoperability #22 Presentation

This integrated approach delivers measurable impact by saving lives, protecting assets, and serves as a cost-effective approach. The direct impact includes a faster response with assistance delivered within days instead of months, which reduces the depletion of critical household assets like livestock and productive tools, prevents acute malnutrition, and reduces displacement. Economically, anticipatory action is highly efficient, with evidence showing that every $1 invested can save $2-7 in later response costs by reducing the need for expensive emergency interventions and lowering long-term recovery needs. Furthermore, it leads to system strengthening, building more resilient national institutions and improved government capacity and credibility for future shocks.

II. Case Studies: Integrating Data Systems for Anticipatory Action

Linking Early Warning to Shock-Responsive Social Protection in Malawi

Malawi's Social Support for Resilient Livelihoods Project establishes a scalable safety net system that directly links early warning to social protection and pre-arranged financing to improve resilience. The system is activated by a sophisticated early warning system, primarily utilising the PRISM tool to monitor drought conditions. Malawi's Department of Climate Change and Meteorological Services (DCCMS) pilots the PRISM tool in drought-prone districts, integrating satellite data on rainfall, soil moisture, and vegetation health with socioeconomic indicators. Drought signals from this system trigger shock-responsive decisions, activating programmes like the Social Cash Transfer Programme (SCTP) or Climate-Smart Public Works Programme (CSPWP). These responses employ the Malawi Social Registry (MSR) to identify affected households.

Activation relies on a two-tiered trigger system and a multi-criteria district selection process. The primary, parametric trigger uses satellite data on early and full-season rainfall to capture drought impact. This triggering mechanism is applied to six drought-prone districts with targeting data and e-payments systems already established (South: Chiradzulu, Blantyre, Thyolo, Mwanza, Nsanje Neno and Chikwawa; Central: Ntcheu, Nkhotakota; North: Karonga). A secondary trigger acts as an evidence review, using ground conditions or other "softer" sources to verify whether the parametric triggers reflect the situation on the ground and to capture impacts not detected by satellite data. This includes disasters other than drought and drought effects missed by the primary trigger. The secondary trigger also allows for scale-up in districts beyond the initial six. When triggers are met, districts are selected for activation based on five criteria: drought risk, food security/vulnerability, poverty levels, systems readiness (like registry updates and digital payments), and the presence of other interventions to avoid duplication.

Establishing a shock-responsive SCTP is a key pillar of the government's Disaster Risk Financing Strategy. This mechanism provides pre-agreed finance so that, once the trigger system activates a response, it facilitates both vertical expansion (increasing benefits for existing SCTP beneficiaries) and horizontal expansion (temporarily adding new beneficiaries from the CSPWP), typically through a monthly transfer of MWK 50,000 for three months.

Progress to date demonstrates a successful layered financing strategy. A layered financing strategy combines risk transfer (e.g., USD 22mn ARC Ltd[1] insurance in 2025) with contingent financing (e.g., USD 37.5mn from the government's IDA allocation in 2025). Since 2021, the system has been repeatedly activated, including a major scale-up for the 2024 El Niño drought, protecting

[1] The African Risk Capacity Limited (ARC Ltd) is a hybrid mutual insurer and financial affiliate of the African Risk Capacity Group.

approximately 600,000 people. The mechanism has also been adapted for other shocks, such as providing vertical and horizontal expansion cash transfers in response to Cyclone Freddy and an urban cash intervention during a currency devaluation price shock. Pre-agreed rules and financing significantly sped up the response, with scale-up approvals occurring within two weeks post-season.

Future directions aim for nationwide expansion and shock diversification. Going forward, priorities include expanding the mechanism **from 8 to all 28 districts** and linking the trigger mechanism to **other social protection programmes**. To improve coverage, the system will also provide mechanisms and triggers for **flood- and storm-prone areas** in the North and South. Furthermore, plans are in place to strengthen **fiscal resilience** by layering additional disaster risk financing instruments, with support from partners like the Global Shield Financing Facility. Finally, **rigorous evaluations of past payouts** are essential to learn from current implementation and identify opportunities for improvement.

Integrating Geospatial Technology into Social Protection: The Costa Rican GeoSinirube Initiative

The Costa Rica GeoSinirube initiative aims to strengthen the responsiveness of the adaptive social protection system through a precise geospatial technology tool. Its overall objective is to identify factors affecting populations in poverty, extreme poverty, and vulnerability with a precise geographic approach. By mapping exactly where vulnerable families are, the system enables comprehensive, tailored solutions and facilitates targeted disaster response. This represents a key transition: from relying on various fragmented data platforms to operating a unified geospatial system which integrates the National System of Information and Single Registry of State Beneficiaries (SINIRUBE) with detailed hazard data and geo-referencing household addresses.

The project pursues its objective through six specific goals: (1) designing the core IT architecture, (2) enhancing geographic data quality by reviewing and updating household data in Sinirube (3) developing a georeferenced portal with interactive maps and dashboards that display social and demographic data, (4) providing geospatial analysis informing disaster response, (5) creating tailored poverty analysis for indigenous territories, and (6) integrating a registry of care centres to improve services for persons with disabilities.

The initial product, GeoSinirube 1.0, integrated critical hazard and social data into a single analytical portal. This version incorporated various maps from national institutions, including hazard maps from the National Emergency Commission (CNE) detailing geological faults, landslide areas, and zones with flood potential (Figure 2). It also included maps of indigenous territories and the locations of care centres. Crucially, this geospatial analysis component allowed for the identification of populations exposed to emergencies by overlaying hazard zones with social data, indicating households in extreme poverty and segmenting vulnerable groups such as minors, seniors, and persons with disabilities directly on the map.

Figure 2: Overlay of CNE Maps with SINIRUBE Household Registry Data. Source: Talking Interoperability #22 Presentation

GeoSinirube 2.0, supported by the World Bank, integrates multidimensional poverty and social protection data to enhance its analytical capacity. This expansion incorporates a wide array of variables related to multidimensional poverty. These include detailed housing conditions (materials, occupancy, access to water, sanitation, and internet), population demographics (gender, ethnicity, age, disability, female-headed households, education level), and precise poverty levels. It also integrates social protection data, showing household insurance conditions and pension status, as well as employment information (formal, informal, unemployed). This allows for the creation of complex, multi-faceted scenarios to tailor intervention processes to specific household needs.

GeoSinirube's functionality is underpinned by essential operational and legal foundations designed for rapid, secure data sharing between government institutions. To ensure data accuracy and interoperability, interfaces have been developed to connect with other major institutions, such as the Costa Rican Electricity Institute (ICE) and the Public Services Regulatory Authority (ARESEP), to obtain and verify household geolocation data. The project also produces critical protocols and agreements, including an updated document on interconnection protocols, a shortened form for emergency care, and signed interoperability agreements with partner institutions. Furthermore, it establishes an internal protocol for updating information, formalises agreements with academia for ongoing support and validation, and develops a comprehensive contingency plan to ensure operational continuity during crises.

Key Challenges for Operationalising Anticipatory Action

The main obstacles to seamless data exchange between early warning and social protection systems are technical and institutional. Technical constraints include weak infrastructure, limited bandwidth, and shortcomings in data frequency, recency, and quality. A persistent gap is the absence of a shared understanding of the data lifecycle, including how information moves from field collection, such as soil humidity sensors, to analytical and decision-making systems. Clarifying this workflow ensures that all actors understand data sources, transformations, and readiness for use.

Institutional barriers stem primarily from unclear roles, mandates, and coordination mechanisms across agencies. As the Malawi example shows, once responsibilities, activation protocols, and available resources are clearly defined, data exchange becomes more feasible. Humanitarian organisations can play a neutral convening role, facilitating dialogue and reducing perceived risks around data sharing between disaster risk and social protection institutions.

Rwanda's experience illustrates that financing remains a constraint to scaling early warning systems. Although systems for landslides, storms, and floods are operational, progress towards a comprehensive multi-hazard system has been slowed by limited domestic funding. Despite support from partners such as WFP and GIZ, expansion remains gradual, underscoring the need for predictable and sustainable financing.

Data protection, privacy, and ethical management of sensitive information are central to system design and interoperability. Measures such as data minimisation, anonymisation, and the use of aggregated data at district or regional level enable timely triggers while safeguarding individual privacy. Particular care is required when handling sensitive variables, including ethnicity, to balance effective targeting with the risk of stigmatisation.

Conclusion

Linking early warning systems with social protection through interoperable data systems enables faster, more predictable, and more cost-effective responses to shocks. By translating forecasts into pre-agreed triggers and channelling support through existing social protection infrastructure, countries can move from reactive crisis response to anticipatory action that protects lives, livelihoods, and public resources. However, challenges remain, including technical limitations, unclear mandates, coordination gaps, and the need to safeguard sensitive data. The experiences of **Malawi** and **Costa Rica** demonstrate that when technical interoperability is combined with clear institutional roles, governance, and financing arrangements, early warning can reliably activate shock-responsive programmes at scale. Sustained investment in data quality, coordination, and safeguards will be essential to institutionalise these approaches and strengthen national resilience to future shocks.