JUNE 2021

Early Warning and Early Action for Increased Resilience of Livelihoods in the IGAD Region

Executive Summary

A FEINSTEIN INTERNATIONAL CENTER WORKING PAPER

Daniel Maxwell, Erin Lentz, Cori Simmons, and Gregory Gottlieb

Tufts UNIVERSITY
FRIEDMAN SCHOOL OF NUTRITION SCIENCE AND POLICY
Feinstein International Center

Food and Agriculture Organization of the United Nations

Sida

Citation: Daniel Maxwell, Erin Lentz, Cori Simmons, and Gregory Gottlieb, “Early Warning and Early Action for Increased Resilience of Livelihoods in the IGAD Region: Executive Summary.” Boston: Feinstein International Center, Tufts University, 2021.

Corresponding author: Daniel Maxwell

Corresponding author email: daniel.maxwell@tufts.edu

Feinstein International Center, Friedman School of Nutrition Science and Policy
Tufts University
75 Kneeland Street, 8th Floor
Boston, MA 02111 USA
Tel: +1 617.627.3423
Twitter: @FeinsteinIntCen
fic.tufts.edu

Acknowledgements

Thank you to the individuals who spoke with us; we learned a great deal from their frank conversations. Samantha Jorgensen, Clare Kane, Megan Morris, and Mariana Navarro Catalan provided excellent research assistance. FAO-IGAD supported this research with funding from SIDA. This work and any remaining errors are our own.

The authors

Contents

The East Africa region is amongst the most food insecure areas of the world and the number of crises affecting the East Africa region will likely continue to increase due to the effects of climate change. Multiple calls have been issued for better preparedness, early warning, and early action to reduce the scale of food insecurity. A recent study on food security information systems in East Africa noted that despite years of attention, the link from early warning-early action (EW-EA) is not as effective as it could be. New technologies involving remote sensing, satellite imagery, computational modeling, and artificial intelligence are all competing to improve early warning and humanitarian information systems, but it is not always clear why these new technologies are being developed or what needs they fill.

This study was commissioned by the FAO Subregional Office for East Africa to examine the links between early warning and early action in East Africa and what role(s) predictive analytics and machine learning can play in supporting EW-EA. This study reviews existing systems and new trends in predictive modeling to make recommendations to FAO, to IGAD, and to IGAD member states.

A. Components of an Early Warning-Early Action System

The report briefly reviews "humanitarian diagnostics" including what are traditionally thought of as "early warning" systems. Some of this terminology is important to understanding the findings and recommendations presented here and the report itself.

1. Baseline Analysis

Baseline assessment or analysis is a snapshot in time intended to capture "normal" or "usual" status.

2. Early Warning

Early warning (EW) has always tracked hazards and assessed the risk of those hazards causing damage to people and their livelihoods, i.e., **causal factors** including seasonality, relatively fixed drivers (like geography and infrastructure), variable factors (such as climatic and environmental drivers), macro-economic factors, political factors, production estimates, markets and prices, population movements, and conflict.

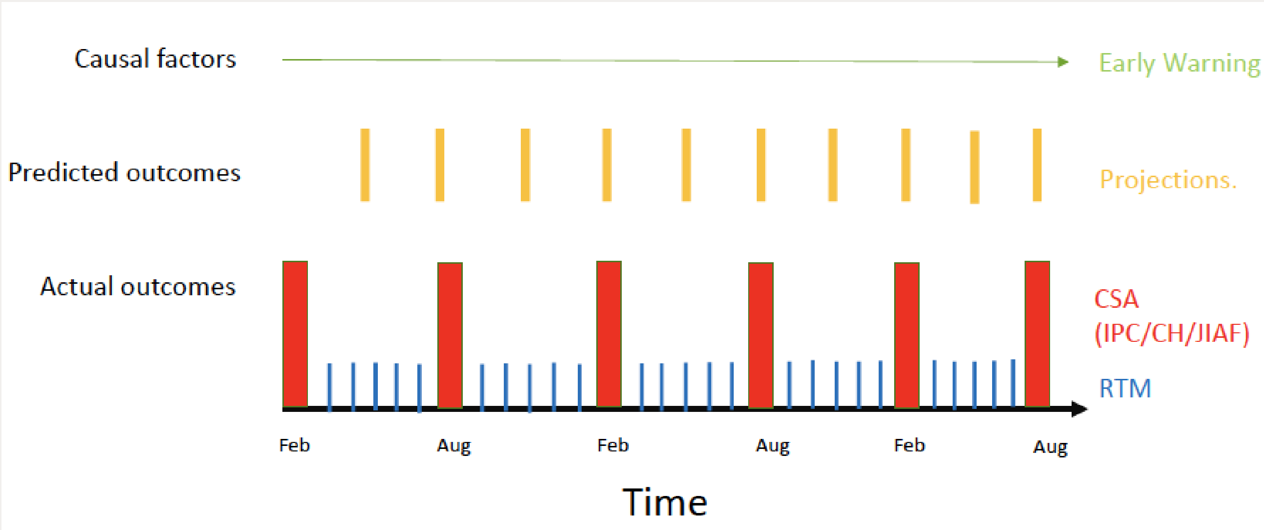
3. Current-Status Assessment

This includes the institutionalization of the Integrated Food Security Phase Classification (IPC) tools that report figures on the current status of populations, classifying them into **phases** or severity categories and providing a **population in need (PIN)** figure in each phase for each geographic unit. These analyses are usually based on the World Food Programme's Food Security and Nutrition Monitoring Survey (FSNMS) or Emergency Food Security and Nutrition Assessment (EFSNA), supplemented by SMART (Standardized Methods for Assessment of Relief and Transition) surveys, as well as other current-status data and contributing factors.

4. Projections

Projections provide an estimated PIN figure by geographic location and phase classification in the short- and medium-term future (2–3 months and

Figure 1. Diagnostics: Relationships between EW, Projections, CSA, and Real-Time Monitoring



Source: Lentz et al. 2020

CSA	Current-Status Assessment
IPC	Integrated Food Security Phase Classification (standard for current-status assessment)
CH	Cadre Harmonisé (same protocol as IPC, used in West Africa)
JIAF	Joint Intersectoral Analysis Framework
RTM	Real-Time Monitoring

4–6 months). While the current-status assessment is based on real numbers (i.e., empirical data), projections are based on assumptions about what is likely to happen to the current numbers. Those assumptions ideally reflect a thorough analysis of early warning factors, the development of scenarios, and a judgment about which is the "most likely" scenario. The **projected PIN** is probably the single most important piece of actionable information that comes out of the entire system—because it refers to the future and at a range of time when governments, donors, agencies, and even local communities can still act—albeit mostly in terms of emergency preparedness; mitigation actions require a longer time frame.

5. Real-Time Monitoring

Real-time monitoring (RTM) tracks changes in the context and notes whether current humanitarian conditions are improving or deteriorating. It thus serves as a form of "hotspot identification." RTM is not the same as early warning because it happens in real time, but in some situations, it may be the only means of identifying rapidly worsening situations. Figure 1 shows that different types of diagnostic information are collected at different times and inform different information activities.

Constraints to early action have long been assumed to relate simply to a lack of finances to enable a response. While finance is a critical component, having strong **contingency planning** in place, that lays out exactly what has to must happen, is critical in cases requiring more than one single response. Effective EW-EA also requires **response analysis**, or careful selection of interventions.

6. Links to Early Action

Early action is defined as "actions taken to reduce the impact of specific disaster events" (FAO 2021). Anticipatory action is action taken even before a shock occurs to prevent, mitigate, or reduce the impact of the shock. The links between early warning and early or anticipatory action are not always clear or effective in practice. Some early action decisions are based on a **trigger** system. These signal-driven systems may use Current-Status Assessment (CSA) information or EW information on hazards. A trigger does precisely what is implied—it triggers a pre-set action. The pre-set action may be a more in-depth assessment of the situation, or it may be an actual response. A **scenario** is a more in-depth assessment of the situation, noting multiple causal factors and potentially multiple outcomes. Scenarios are more useful for an overall response than for a single action but require further judgment with regard to the appropriate response.

B. Mapping EW-EA Systems in East Africa/IGAD Region

Our review found that country- and regional-level EW systems consistently include a small set of core set of hazards (i.e., factors associated with food insecurity) and a core set of outcomes. However, there is also significant variation across systems. All countries have a country-led system, and nearly all work with Famine Early Warning System Network (FEWS NET). Table 1 summarizes some of the main characteristics, by country. Several also host NGO and UN systems. Most EW systems track remotely sensed climate and vegetation indices; production and prices are also commonly tracked, albeit slightly less so. Other hazards, such as displacement, pests and disease, and conflict are less consistently tracked. IPC acute food insecurity (AFI) outcomes, food insecurity, and nutrition outcomes are commonly collected. Other, key outcomes such as WASH are not. The wide range of hazards not covered, the different actors involved, and the lack of key outcomes is challenging for analysts within (and across) countries seeking to make sense of different streams of information collected by different agencies, using different processes, and tracking different information.

Detailed information on regional systems is presented in Report 1, and a brief description and assessment of individual country systems are presented in Report 2. Parts of those reports are reproduced here.

Table 1. Characteristics of EW-EA Systems in IGAD Region

Component	DJI	ERI	ETH	KEN	SOM	SSD	SUD	UGA
EARLY WARNING								
IPC: Type of analysis								
AFI	**		**	**	**	**	**	**
AMN				**	**	**		**
CFI	**							
FEWS NET	Remote		**	**	**	**	**	**
Gov't-led system	**	**	**	**	New	**	**	**
UN-led system			VAM	VAM	FSNAU	FAO&VAM	VAM	
NGO-led system			multiple	KRCS	BRCiS	REACH	?	
Seasonal assess't	**		**	**	**	**		
Sentinel sites				**				
Real-time monitoring					**	**		
Data: Hazards								
Climate	**	**	**	**	**	**	**	**
Prices/Markets		urban	**	**	**	**	**	**
Vegetation	**	**	**	**	**	**	**	**
Production		**	**	**	**	**	**	**
Pests/DL	?		**	?	?	?	**	**
Conflict						?	limited	
Displacement					**	**	limited	?
Data: Outcomes								
Food security	**		**	**	**	**	**	**
Nutrition	**		**	**	**	**		?
Health	**		**	?	**	?	?	?
WASH			?		price only	?	?	?

Component	DJI	ERI	ETH	KEN	SOM	SSD	SUD	UGA
EARLY ACTION								
Responsible body	Ministry of Interior	Gov't ministries	NDRMC	NDMA NDOC	Multiple	MHADM agencies	FS TS ministries	
Links								
Triggers				some	**	INT		
Gov't agency	**	**	**	**	**	**	**	**
Clusters						**	**	?
Contingency planning	?		**	NDMA	??	?	?	?
Scalable safety net			PSNP	HSNP				
Other ("surge," crisis modifier, "no regrets")			**	**	**	?		?
Source: Key Informant Interviews								

AFI	Acute food insecurity
AMN	Acute malnutrition
BRCiS	Building Resilient Communities in Somalia (NGO consortium)
CFI	Chronic food insecurity
DL	Desert locust
FAO	Food and Agriculture Organization
FSNAU	Food Security and Nutrition Analysis Unit (Somalia)
FSTS	Food Security Technical Secretariat (Sudan Ministry of Agriculture)
HSNP	Hunger Safety Net Programme (Kenya)
KRCS	Kenya Red Cross Societys
MHADM	Ministry of Humanitarian Affairs and Disaster Management (South Sudan)
NDOC	National Disaster Operations Centre (Kenya)
NDRMC	National Disaster Risk Management Commission (Ethiopia)
NDMA	National Drought Management Authority (Kenya)
NGO	Non-governmental organization
PSNP	Productive Safety Net Programme (Ethiopia)
UN	United Nations
VAM	Vulnerability and Mapping (World Food Programme)

C. Predictive Analytics and Machine Learning Efforts to Improve EW-EA Systems

Predictive analytics (PA) for EW systems hold great potential **for East Africa EW-EA information systems**. PA is "technology that learns from experience [historical data] to predict the future behavior of individuals in order to drive better decisions" (Siegel 2016: 15). Predictive analysts often use **machine learning (ML)** techniques to generate predictions.

PA has recently received a great deal of interest in the practitioner, researcher, and donor communities because it offers a way to synthesizing large amounts of data to generate diagnostic evidence.

A summary of models, including outcome measures, data requirements, and modeling choices is presented in Table 2, which is organized by outcome: food security and nutrition measures, IPC-based measures, and hazards. While the food security and nutrition models reviewed here focus on nowcasting, both early warning forecasting and nowcasting are pursued with IPC-based models. Several of the models remain in the “proof of concept” phase, reflecting challenges identifying adequate data for external validation. Table 2 shows there has been significant research on prediction of hazards. Generally, among the studies reviewed, the researchers commonly use secondary data to forecast the likelihood of hazards for scenario development. Some new work has examined the use of hazard-based predictions (e.g., droughts and floods) for trigger-based systems, such as forecast based financing. More detailed analyses of specific issues are in Report 3.

The successful incorporation of predictive analytics into a humanitarian diagnostics system will require modelers, analysts, and decisionmakers to make choices about what their objectives for the model are, and what they prioritize in their models. Some choices depend on the broader goals of the humanitarian diagnostic system. Others depend on data availability, capacity, and usability. As of yet, there is little sustained, formal coordination between modelers and end users. This adds to the risks that PA can decrease transparency about the assumptions made (sometimes implicitly by modelers) and how these assumptions influence the outcomes. Collaboration and transparency between end users and modelers are essential to ensuring models are solving the right problems. Further, participation of affected and at-risk populations in model development, validation, and data collection can result in better models and greater accountability.

At least for the time being, many perceive human analysts remain better suited to identifying hard-to-predict drivers (e.g., locusts, COVID-19) relative to more predictable, higher frequency hazards (e.g., drought). Yet, EW systems are already in place, and “dropping” a PA model into an existing EW system

Table 2. Selected predictive analytics models that focus on food security and related hazards

				Role in system		Timing		Data	
Authors	Location	Spatial scale	Modeled outcome	Scenario	Trigger	Fore casting	Now casting	Second-ary	Primary
FOOD SECURITY AND NUTRITION MEASURES									
Knippenberg et al. (2019)	Malawi	Household-level predictions within several villages	Resiliency, rCSI	x		x			x
Lentz et al. (2019)	Malawi	IPC zone, Admin 3 (traditional authority) and Admin 4 (village)	rCSI, HDDS, FCS	x			x	x	
Baez et al. (2020)	Malawi, Tanzania, Mozambique, Zambia, Zimbabwe	Admin 1 (province)	Children at risk of stunting		x		x	x	
Fraym (2020)	Nigeria, Pakistan	1 km squared	Localized Food Insecurity Index (from IFPRI’s Global Hunger Scale)	x			x	x	

Authors	Location	Spatial scale	Modeled outcome	Role in system		Timing		Data	
				Scenario	Trigger	Fore casting	Now casting	Second-ary	Primary
IPC									
Coughlan de Perez et al. (2019)	Ethiopia, Kenya, Somalia	IPC zone	IPC classifications	x	x	x	x	x	
Choularton and Krishnamurthy (2019)	Ethiopia	Admin 3 (woreda)	IPC classifications and transitions	x			x	x	
Krishnamurthy et al. (2020)	Theoretical	IPC zone	IPC transitions	x	x	x		x	
Andree et al. (2020)	21 countries	Admin 2	IPC transitions	x	x	x		x	

Authors	Location	Spatial scale	Modeled outcome	Role in system		Timing		Data	
				Scenario	Trigger	Fore casting	Now casting	Second-ary	Primary
HAZARDS									
Dreschler and Soer (2016)	Ethiopia (theoretical)	Admin 3 (woreda)	Drought	x		x		x	x
Funk et al. (2019)	FEWS NET countries	Subnational	Drought	x	x	x		x	
Gros et al. (2019)	Bangladesh	Admin 4 (community)	Poverty and wellbeing		x	x		x	x
McNally et al. (2019)	Africa	Gridded streamflow per capita	Water scarcity index	x			x	x	
Arsenault et al. (2020)	Africa and Middle East	IPC zone	Drought	x		x		x	x
Getirana et al. (2020)	Niger, Chad: Volta	River basins	Flood prediction	x		x		x	x
Kuzma et al. (2020)	Global		Localized conflict	x		x		x	
Matere et al. (2020)	Kenya	Admin 3 and Admin 4	Forage Condition Index	x		x		x	x
Shukla et al. (2020)	SADC countries	0.25 x 0.25 degree spatial resolution	Drought (root zone soil moisture)	x		x		x	
van den Homberg et al. (2020)	Philippines	Admin 2 (municipalities)	Typhoons		x	x		x	

is not straightforward, even if the goal is to provide complementary data for triangulation. Incorporating PA into EW systems will likely require analysts to think across multiple information streams in order to create coherent scenarios. Further, setting up the data gathering processing, and platform, and updating and interpreting the model all takes institutional commitment and capacity building of both the analysts and decisionmakers.

Nonetheless, PA offers several opportunities. First, important for future research is to assess the value that models add. On average, cost savings could result from EA, even if models make mistaken predictions relative to intervening later, after crises unfold. Second, forecast-based financing and impact-based financing have the potential to bridge the development-humanitarian divide by producing predictions that lead to both early action in response to humanitarian crises and longer-term development-based funding. Donors could support expanding the flexibility of EW systems to take advantage of PA.

D. Key Issues Emerging

Two dominant themes emerged from the analysis of existing EW-EA systems. First, there is plenty of information but frequently a sense of confusion about what the information means or what to do about it. Second, the sense is that this information has no strong link to early (or even responsive) action. These issues are closely related and can be broken down in greater detail. This section reviews issues related to (1) data and data collection, (2) analysis, (3) the role of PA in analysis, (4) the linkage from information and analysis to early action, (5) other (non-information-related) constraints on early action, and (6) the COVID-19 pandemic. A separate sub-section addresses key issues related to predictive analytics and artificial intelligence and the extent to which these can help address some of the issues raised here.

We present findings in order, beginning with information collection, analysis, use of predictive analysis, the links of action to early warning, and other constraints on early action.

1. Information and Data

"Too Much Information" and Confusing Outcomes

Numerous bodies are engaged in some kind of information collection and analysis, but information is often missing or inadequate, or it is too much, too contradictory, or simply doesn't add up to a coherent picture. Information is generally adequate for humanitarian response, but it is largely not facilitating early action in terms of prevention or mitigation.

Lack of Data/Data Quality Issues

Certain kinds of information needed to trigger action may be missing, or of limited reliability, including drivers of crisis, outcomes (such as mortality), or critical information that helps turn assessment data into future projected need—particularly accurate population estimates. In addition to the lack of data, concerns emerged about the quality of the data available.

Data Sharing (and the Lack of Data Sharing)

The ability of systems to share data, and the unwillingness of managers or owners of data to share it, is a major constraint to good analysis.

Information about What?

Respondents expressed concerns that information about current-status outcomes tended to dominate over predictive information, which means that "action" is largely limited to ex post response, not mitigation and prevention. Among outcomes, food security information dominates over nutrition, health, and WASH.

Links between Local and National Information Systems

A number of smaller, more localized, or even community-based information systems are in operation, but often linked only to a single organization and not well integrated into national systems.

2. Analysis

Information and Analysis of Conflict

A frequent missing component is information or analysis of conflict: the relative dearth of conflict analysis, and the inability to include the information that is available on conflict because it is considered too sensitive. This relates to early warning both about conflict itself, and about the food security or humanitarian consequences of conflict. Given the extent to which conflict is a driver of crisis and displacement in the region, these are significant gaps in the analysis.

Timeliness of EW Analysis

Early warning information has traditionally been based on seasonal patterns. However more recently, global information demands have pushed early warning—or at least the projected PIN numbers—towards deadlines that are often quite dissociated from local seasonal patterns. In particular, the demands of the global Humanitarian Needs Overview (HNO) and Humanitarian Response Plan (HRP) do not match with seasonal assessments, meaning that some planning is based on out-of-date information.

Current Status or Predictive Analysis?

Currently there is much more focus on current-status assessment and not enough on predictive analysis, especially the projections of populations in need (PIN) number, which has become the most sought after piece of information in the entire analytical process. While the projected PIN numbers are based on a number of assumptions about what is likely to happen, only rarely are these assumptions formally monitored, or if they are, it rarely comes together in any formal (or public) analysis.

3. The Role of PA in Early Warning Analysis

The role of predictive analytics and machine learning is found in detail in Report 3.

Modelers and End Users Face a Series of Choices

Applications of PA are developing quickly, but as of yet, there are no established "best practices." The assumptions and choices embedded within models can contribute to different models reaching different conclusions. For EW system users, it will be critical to engage modelers, decisionmakers, analysts, and donors in collaborative discussions about what is feasible and to identify the most appropriate assumptions for models.

"Looking for Keys under the Street Light" Syndrome

Models are only as good as the data they are built on. The easy availability of certain data (i.e., remotely sensed data) can overly focus attention on these data at the risk of missing other factors that may be as or more important.

Novel and Rare Events Are Currently Challenging for PA Models to Predict

PA is most helpful in monitoring the "usual" drivers of food insecurity. Human analysts will likely remain essential in monitoring and addressing less easily identifiable drivers and their impacts. PA can be used for nowcasting and forecasting for areas without data but require caution because places without data may systematically differ from places with data.

Scenario-Driven Models Are Often Complementary to Existing Systems

No model is entirely comprehensive and, for that reason, scenario-based models are complementary to EW systems, not replacements.

Trigger-Based Models Are Increasingly Common

Currently, trigger-based models are used mostly for single-hazard/single-response actions, such as forecast-based financing. Whether PA can generate reliable and valid triggers for multiple hazards remains to be seen.

Ethics, Bias, Privacy, and Equity Concerns

PA raises several ethical concerns. The first is **inaccuracies, biases, and inequalities** in historical data can replicate and amplify inequalities, including racism and sexism, urban bias, and class privilege. A second major concern is about **data privacy**. As new data sources become more common, privacy concerns also increase. As models become more "automated" in decision-making, a growing concern is that analysts and others place **excessive trust** in predictive analytics. PA may have **limited external validation**, meaning the usefulness and applicability of some models may not be adequately evaluated. Most modelling approaches have only **limited local engagement** and **accountability to affected populations**; and most lack **gender disaggregated data** and are blind to **social inequalities**.

4. Linkage from Information and Analysis to Early Action

More accurate predictions may not be the binding constraint to improved EW and EA.

Information Often Has No Clear Links to Early Action

Inadequate information may be a constraint, but the more serious problem is the lack of links between information and action so action is frequently late, misdirected, or non-existent. There are a variety of reasons for this. These are outlined below.

The Link that Initiates Early Action

Information to initiate early action can be summarized as "triggers" and "scenarios." Scenarios are the more long-standing mechanism and provide an overall picture of what the short-term future will likely look like. "Triggers" are intended to put in motion an action—whether preventive or responsive—immediately when a certain threshold in one or more carefully selected indicators is surpassed. Triggers work best when limited to a single driver and a single outcome—for example, significantly diminished rainfall as the trigger and crop failure as the outcome. But so far, no single trigger has worked for multi-causal crises with multiple human outcomes.

Limited Regional Integration

Early warning information is frequently not shared across borders or regionally. With the exception of the IGAD Centre for Prediction and Analysis of Climate (ICPAC) for climatic information, and the regional Food Security and Nutrition Working Group (FSNWG), there are few mechanisms for information sharing.

Inadequate Links to Affected Communities

The "customers" of early warning are usually perceived as national governments, donors, and agencies—both humanitarian and developmental. But there are relatively few links to at-risk communities.

PIN Figures as "Early Warning," Humanitarian Response as "Early Action"

Too often, users' focus is on the population-in-need (PIN) figures found in IPC projections as the only required "early warning" and budgets for humanitarian aid—especially food assistance—as the main "early action."

Limits to Contingency Planning

While good information, financing, and a rapid decision-making mechanism are three critical components of EW-EA, contingency planning and response analysis are often overlooked until it is too late.

Limits on Evidence and Learning

A major concern is the inconsistent learning from experience over time and repeating mistakes related to EW-EA.

A preference by some actors for hard evidence, rather than probabilistic forecasts, also limits the perceived usefulness of some evidence.

Scalability or Surge and Links to "No Regrets" and Crisis Modifiers, Forecast-Based Financing

A number of strategies can put early action into motion, but most require prior planning. The most commonly discussed strategy in the notion of scalable social safety nets: Kenya and Ethiopia having the best working programs in the region. Others include the "surge approach," "crisis modifiers," and "no regrets" programming.

5. Other Constraints on Early Action

While information may be one constraint on early action, there are several others.

(Lack of?) Capacity Building

A major constraint on early action is the lack of capacity building efforts, both on the information and early warning side and on the early action and contingency planning side.

The Politics of Information and Analysis

A recently completed study (Maxwell and Hailey 2020b) highlighted the way in which political interests sometimes undermine good information collection and analysis. The normative view is that governments should lead information systems, but this becomes a much more complicated issue where governments are parties to conflicts that at least partially cause the emergency.

Flexibility and Accountability

Ear-marked funding allows little flexibility in the way allocated funding can be spent, making rapid early action difficult. "Crisis modifiers" are supposed to address this concern but do not fully address the issue of flexible funding within a rapidly changing situation. Accountability mechanisms for EW-EA are largely still missing

Learning from the Experience of the COVID Pandemic

Finally, the COVID-19 pandemic of 2020 touched every country in the region and changed the way early warning systems have operated in 2020. Many learnings from the pandemic are summarized in Report 1. These include **unanticipated shocks and how systems adapted**, including remote data collection, remote analysis and changed responses. But many gaps remain. The pandemic highlighted **urban contexts**, where the pandemic (and secondary impacts of lockdowns) hit hardest. A more common improvement in information systems was more emphasis on **real-time monitoring**, with information needs and planning shifting from week to week.

What Is Working Well

Some findings regarded experience with publicly led scalable safety nets as the most effective means of linking an early warning system to a ready-made response mechanism. The use of trigger mechanisms has proven valuable where a single hazard can be monitored and tied to a specific action. The region has a wide range of experience with no-regrets programming and crisis modifiers. There is scope to scale up all of these mechanisms.

E. Selected Recommendations to FAO and IGAD

Below are some key recommendations growing out of the study. The full set of recommendations is in Report 1. The key findings above were presented as moving from data to analysis to linkages, which is how EW-EA systems are often assessed. However, our primary recommendation is to "reverse engineer" the EW-EA system. First, consider the actions that can be taken to mitigate known or expected shocks, and then derive the information needs (including PA) from those considerations.

1. Plan from Known and Likely Hazards and Actions

Improve Contingency Planning and Plan from Interventions back to Information Needs

Typically, information systems are designed based on what other information systems are doing. To enable early or anticipatory action, it would make more sense to start with an analysis of hazards and potential shocks, and identify all actions to mitigate those shocks first. Not only is there a need to revisit the information systems on which early action depends, but also to revisit the process of planning what to do if and when hazards threaten to turn into actual shocks. Even when funding may be available, action plans are not ready. The link from early warning to early action relies on contingency planning.

This would entail addressing several questions long before an information system is designed (or redesigned in most cases):

- What are known or expected hazards?
- What **could** be done to mitigate known or expected hazards?
- What capacity would be needed to implement the action? Does that capacity exist?
- What information would be needed?
- How would it trigger action?
- How far in advance would it be needed?

Identify Early Actions for Conflict

Conflict is either the single biggest, or second biggest, threat in the region, yet we still lack direct and effective early action mechanisms to deal with conflict. This remains a major challenge—one on which IGAD should be positioned to lead.

Coordinate the Multiple Demands on Timeliness

Early warning for early or anticipatory action must be timed according to the likelihood of the hazard or potential shock. In much of the IGAD region, one of the major expected shocks is the "hungry season." But other hazards may have other timelines. The need for information to inform early action must be balanced with the need for information Humanitarian Response Plans (HRPs). These two demands for information rarely align perfectly.

Share Information across Borders

Crises cross borders in the IGAD region. But information is only sporadically shared between countries. IGAD should lead on this.

Involve At-Risk Communities!

Just as at-risk communities must be involved in both the collection and dissemination of EW information, they are central to any early action planning. This is too frequently forgotten.

Learn from Existing Success

Numerous examples are available in the IGAD region to draw on to improve both early warning and early action, including scalable safety net programs in Ethiopia and Kenya, "no regrets" programs, the use of crisis modifiers, and forecast-based financing. All of these should be studied and their lessons applied more widely.

2. Information and Analysis

Focus Information Needs on Contingency Planning

Embrace an "ecosystem of information," but build coordinated analysis within it. Information should be prioritized according to what is needed to actually make early action work, including early warning about hazards and risk, but also current status assessment, projections of future status, and, increasingly, real-time monitoring.

Strategically Embrace PA/ML

Many actors are interested in or are using PA. PA appears best suited to predicting common hazards. To assess and monitor rare events, real-time monitoring systems should be bolstered, and human analysts will remain essential. Therefore, it is unlikely that existing EW systems will be entirely replaced. Currently, efforts to improve information systems and to respond to the actual needs or gaps in existing systems with PA are limited. These links need to be identified and strengthened. Further, modeling should be subject to the same constraints as conventional information gathering: in what way does it enable early or rapid action?

Improve Conflict Analysis

Although mentioned as a general concern in the previous recommendation, if conflict is a major driver of crisis, and conflict mitigation actions are identified, there is a strong case for strengthening the analysis and early warning for conflict.

Broaden the Information Base and Improve Information Sharing and Availability

Food security information dominates EW systems; good and representative information on nutrition, health, WASH, conflict, and mortality outcomes are often lacking. Information about humanitarian crises or the drivers that can lead to crises **must** be treated by all as a "public good"—meaning paid for by public funds (whether from a government or an international donor) and meant to identify, anticipate, and prevent public harms. As such, it should be made available to all actors and to the public. Adopting region-wide standards on the kinds of information that systems need to regularly collect and analyze would be a step towards addressing these constraints, but in many cases the constraints are political, not technical.

Build Real-Time Monitoring into Information Systems

The events of 2020 have made it clear that EW systems cannot adequately identify and anticipate all hazards; nor are all early warning predictions necessarily accurate. This calls for greater investment in real-time monitoring—to track both novel and unexpected hazards, as well as to track the extent to which predicted hazards are having the predicted impacts—temporally, spatially, and socially.

Prioritize Capacity Building

The specific capacity gaps vary by country but the need for capacity building is linked to the issue of the leadership of systems, whether government, UN, or civil society.

Disaggregate Data in the Analysis

Humanitarian information systems have long been criticized for overlooking gender, age, and other vulnerable groups or social categories—on the assumption that shocks and hazards affect everyone.

3. Cross-Cutting Recommendations

Clarify the Role of Government

The role of government in information and analysis needs to be clarified. There is little argument that governments **should** lead these systems; but there are numerous examples in which government-led systems have politicized information and analysis, and even covered up humanitarian crises. And in some cases, there no agreement on how independent systems can be merged into a government-led system without the loss of the independence. There is no one-size-fits-all solution to this dilemma, but dialogue is needed.

Face Ethical Issues Head On

Gathering and analyzing information of any kind when it may live in perpetuity on a server somewhere presents ethical dilemmas. The use of predictive analytics only heightens these concerns. They have to be addressed in context.

Learn from Mistakes and Learn from COVID

Across the region, there is much to be learned from the trial and error of both implementing early action plans and designing early warning systems. The lessons need to be taken on board and learned from to avoid reinventing the wheel. At the same time, while 2020 represented many setbacks, it also brought many improvements that were perhaps long overdue. While none of this should **replace** existing systems or methods, they collectively add to the range of options for EW-EA systems in the region.

Depoliticize Information, Analysis, and Action

Information is power, and power can subvert or manipulate or squelch information. And without information, early action to prevent or mitigate shocks is impossible. All actors need to work together to ensure independent, rigorous analysis.

Build in Accountability and Involve At-Risk Communities

Much of the linkage between information, analysis, and action is conducted by governmental or external systems, many of which have few linkages to the communities they ostensibly exist to protect against hazards and risk. The goals of EA are to minimize harm to and support the resilience of affected populations. To do so, EW-EA systems must better incorporate accountability to those affected populations.

References

Andree, B. P. J., Chamorro, A., Kraay, A., Spencer, P., & Wang, D. (2020). Predicting Food Crises (No. 9412; Policy Research Working Paper). The World Bank. https://doi.org/10.1596/1813-9450-9412

Arsenault, K. R., Shukla, S., Hazra, A., Getirana, A., McNally, A., Kumar, S. V., Koster, R. D., Peters-Lidard, C. D., Zaitchik, B. F., Badr, H., Jung, H. C., Narapusetty, B., Navari, M., Wang, S., Mocko, D. M., Funk, C., Harrison, L., Husak, G. J., Adoum, A., ... Verdin, J. P. (2020). The NASA Hydrological Forecast System for Food and Water Security Applications. Bulletin of the American Meteorological Society, 101(7), E1007–E1025. https://doi.org/10.1175/BAMS-D-18-0264.1

Baez, Javier E., Varun Kshirsagar, and Emmanuel Skoufias. (2019). Adaptive Safety Nets for Rural Africa: Drought-Sensitive Targeting with Sparse Data. World Bank, Washington, DC.

Choularton, R. J., & Krishnamurthy, P. K. (2019). How accurate is food security early warning? Evaluation of FEWS NET accuracy in Ethiopia. Food Security, 11(2), 333–344. https://doi.org/10.1007/s12571-019-00909-y

Coughlan de Perez, E., van Aalst, M., Choularton, R., van den Hurk, B., Mason, S., Nissan, H., & Schwager, S. (2019). From rain to famine: Assessing the utility of rainfall observations and seasonal forecasts to anticipate food insecurity in East Africa. Food Security, 11(1), 57–68. https://doi.org/10.1007/s12571-018-00885-9

Drechsler, M., & Soer, W. (2016). Early Warning, Early Action: The Use of Predictive Tools in Drought Response through Ethiopia's Productive Safety Net Programme (Policy Research Working Paper). The World Bank. https://doi.org/10.1596/1813-9450-7716

FAO. (2021). "Early Warning Early Action: FAO in Emergencies." http://www.fao.org/emergencies/fao-in-action/ewea/en/?page=5&ipp=10&no_cache=1&tx_dynalist_pi1[par]=YToxOntzOjE6IkwiO3M6MToiMCI7fQ==.

Fraym. (2020). Localized Food Insecurity Index: White Paper. https://fraym.io/lfll-wp/

Funk, Chris, Shraddhanand Shukla, Wassila Mamadou Thiaw, James Rowland, Andrew Hoell, Amy McNally, Gregory Husak, et al. (2019). "Recognizing the Famine Early Warning Systems Network: Over 30 Years of Drought Early Warning Science Advances and Partnerships Promoting Global Food Security." Bulletin of the American Meteorological Society 100 (6): 1011–27.

Getirana, A., Jung, H. C., Arsenault, K., Shukla, S., Kumar, S., Peters-Lidard, C., Maigari, I., & Mamane, B. (2020). Satellite Gravimetry Improves Seasonal Streamflow Forecast Initialization in Africa. Water Resources Research, 56(2), 1–15. https://doi.org/10.1029/2019WR026259

Gros, C., Bailey, M., Schwager, S., Hassan, A., Zingg, R., Uddin, M. M., Shahjahan, M., Islam, H., Lux, S., Jaime, C., & Coughlan de Perez, E. (2019). Household-level effects of providing forecast-based cash in anticipation of extreme weather events: Quasi-experimental evidence from humanitarian interventions in the 2017 floods in Bangladesh. International Journal of Disaster Risk Reduction, 41. https://doi.org/10.1016/j.ijdrr.2019.101275

Knippenberg, E., Jensen, N., & Constas, M. (2019). Quantifying household resilience with high frequency data: Temporal dynamics and methodological options. World Development, 121, 1–15. https://doi.org/10.1016/j.worlddev.2019.04.010

Krishnamurthy, K., Fisher, J. B., Schimel, D. S., & Kareiva, P. M. (2020). Applying Tipping Point Theory to Remote Sensing Science to Improve Early Warning Drought Signals for Food Security. Earth's Future, 8(3), 14. https://doi.org/10.1029/2019EF001456

Kuzma, S., Kerins, P., Saccoccia, L., Whiteside, C., Roos, H., & Iceland, C. (2020). Leveraging Water Data in a Machine Learning–Based Model for Forecasting Violent Conflict. World Resources Institute, 40.

Lentz, E. C., Michelson, H., Baylis, K., & Zhou, Y. (2019). A data-driven approach improves food insecurity crisis prediction. World Development, 122, 399–409. https://doi.org/10.1016/j.worlddev.2019.06.008

Matere, J., Simpkin, P., Angerer, J., Olesambu, E., Ramasamy, S., & Fasina, F. (2020). Predictive Livestock Early Warning System (PLEWS): Monitoring forage condition and implications for animal production in Kenya. Weather and Climate Extremes, 27, 1–8. https://doi.org/10.1016/j.wace.2019.100209

McNally, A., Verdin, K., Harrison, L., Getirana, A., Jacob, J., Shukla, S., Arsenault, K., Peters-Lidard, C., & Verdin, J. P. (2019). Acute Water-Scarcity Monitoring for Africa. Water, 11(10), 1968. https://doi.org/10.3390/w11101968

Shukla, S., Arsenault, K. R., Hazra, A., Peters-Lidard, C., Koster, R. D., Davenport, F., Magadzire, T., Funk, C., Kumar, S., McNally, A., Getirana, A., Husak, G., Zaitchik, B., Verdin, J., Nsadisa, F. D., & Becker-Reshef, I. (2020). Improving Early Warning of Drought-Driven Food Insecurity in Southern Africa Using Operational Hydrological Monitoring and Forecasting Products. Natural Hazards and Earth System Sciences 20 (4), 1187–201. https://doi.org/10.5194/nhess-20-1187-2020

Siegel, Eric. (2016). Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die. Revised and Updated. Hoboken, New Jersey: John Wiley & Sons. https://learning.oreilly.com/library/view/~/9781119145677/?ar.

van den Homberg, Gevaert, C. and Georgiadou, Y. (2020). "The changing face of accountability in humanitarianism: Using artificial intelligence for anticipatory action" Politics and Governance 8(4). DOI: 10.17645/pag.v8i4.3158

The Feinstein International Center is a research and teaching center based at the Friedman School of Nutrition Science and Policy at Tufts University. Our mission is to promote the use of evidence and learning in operational and policy responses to protect and strengthen the lives, livelihoods, and dignity of people affected by or at risk of humanitarian crises.

Twitter: @FeinsteinIntCen

fic.tufts.edu