International Research Institute for Climate and Society
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Learning from experience: a summarised review of early warning systems

Moving towards Early Action 2016

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World Vision®

EVERY CHILD FREE FROM FEAR

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Edited by Melany Markham

Executive Summary

During the Horn of Africa famine in 2011, agencies, donors and the international community failed to prepare and respond early enough to prevent massive suffering. [1]
Retrospective analysis found that climate information, such as forecasts for below-average rainfall and measurements of below average vegetation, coupled with analyses of socioeconomic conditions, could have been used to catalyse early action (EA) before the drought occurred. [2]

This underscores the need for timely information and the need for appropriate action that could save lives and livelihoods before a crisis.
With the increase in frequency of disasters, there is a need to improve early warning systems (EWS) for EA to reduce the risks faced by children and their families. As a consequence, the term early warning, early action (EWEA) has become increasingly common among those responding to slow-onset disasters.

Effective EWS are one that catalyses action early, yet the main challenge to building an effective EWS is the lack of strong evidence as to what information leads to action.
Climate information is critical and pervasive in EWS. Numerous types of climate data exist, such as forecasts, predictions, outlooks, projections and scenarios (Mason et al. 2015). The three main characteristics of each are: timescale; lead time and target period, but reliable historical data is necessary to establish 'normal' conditions, which are then used to assess the magnitude of events relative to 'normal'. How climate information is then used is important when considering the influence it has on action and decision-making.

Climate-related, sector-specific EWS are driven by both the availability of forecasts that allow sufficient lead time for appropriate action (such as distributing bed nets to prevent malaria, as a result of high rainfall) and the confidence in the forecast.
Evaluating the socio-economic impact of action is challenging and can lead to inconclusive results. [3] Quantifying the impact of action based on a forecast when no disaster occurs is challenging and remains a key barrier to evaluating impact. As a result, some agencies have adopted a 'no regrets' approach to taking actions based on uncertain climate information. No-regrets action increases resilience, and this is the basis for 'sustainable growth in a world of multiple hazards'. [4]
Case study analysis has identified both opportunities and challenges including the development of effective, holistic EWS, setting up EA funding/contingency funding with clear trigger mechanisms, effective information partnerships, understanding forecasts, evaluating impacts and action planning.
World Vision's approach includes three key components:

1. collection and analysis of EW data;
2. translation of EW data into EA through information management and clearly defined decision-making, systems and procedures at each level; and
3. recommendations for EA.

'A complete and effective early warning system comprises four inter-related elements, spanning knowledge of hazards and vulnerabilities through to preparedness and capacity to respond. Best practice early warning systems also have strong inter-linkages and effective communication channels between all of the elements'.
UNISDR, 2006

1Hillier & Dempsey 2012
2Hillbruner & Moloney 2012
3 Mason et al. 2015
4 Barnes et al. 2007
5 Siegel n.d. Retrieved 30 October 20166

Fields of failed crops in Ethiopia

Since 2006, World Vision has been active in implementing EWS, evolved from food security information in Ethiopia to a multi-hazard EWS in both the Eastern and Southern African regions. World Vision's EWS was tested by the recent El Niño which was catastrophic in Central America, East Africa (particularly Ethiopia), the Pacific and Southern Africa. With more than ten years' experience in resilience building World Vision has and has actively contributed to the policy dialogue on reducing risk and promoting EWS through the Sendai Framework for Disaster Risk Reduction.

Despite the developments and improvements to EWS across different agencies and organisations, there remains a lack of clarity and agreement needed from an effective EWS and how to ensure that EWS provoke efficient and effective for EA. Therefore, the purpose of this review is to:

- Learn from existing practices on EWS
- Inform an EWS that will improve EA

Introduction

With the increase in frequency of disasters and better information systems, there is a need to improve EWS for EA to reduce exposure of risks to children and their families. The lack of robust evidence on what effective EWSs look like is a real challenge.[7]

One of the main drivers for a review of EWS was the failure of agencies, donors and the international community to prepare and respond to the Horn of Africa drought and famine in 2011. Retrospective analysis found that climate information, such as rainfall forecasts and deviations from average vegetation, coupled with analyses of socioeconomic conditions, could have been used to catalyse EA before the drought occurred.[8] The cost for delayed action has also been recognised in highlighting the need for EWS, by humanitarian organisations as well as donors.[9] This underscores the need for timely information and for appropriate action that can save lives and livelihoods before a crisis.[10]

Unfortunately, the lessons of the 2011 famine were ignored, and many governments and NGOs were slow to act when issued early warnings ahead of this year's El Niño. As severe as the 1982 drought that ravaged the Horn of Africa, the most recent El Niño affected over 60 million people. In a further effort to institutionalise the structures and processes needed to mitigate future climate-related disasters, the United Nations appointed in July 2016 two Special Envoys for El Niño– Mary Robinson and Macharia Kamau. The Envoys have set out to develop a global 'blueprint' for a more concerted and integrated global approach for mitigating and responding to future El Niño/La Niña events and other slow-onset climate disasters.

At a meeting in March 2016 that brought together INGOs and UN organisations, a commitment was made to develop Standard Operating Procedures (SOPs) mitigate the impacts of slow-onset disasters. The SOPs are a collective agreement to implement EAs, within agreed timelines, once EWS indicate a medium to high risk of an El Niño or La Niña event happening.[11] It aims to ensure that the system delivers effectively and can monitor its performance.[12]

The SOPs contains four key elements:
1. Risk analysis and early warning
2. Coordination and information management
3. Programming
4. Financing

This collective work has also highlighted the need for advocacy to support the operational effort. In the future, the aim is that SOPs be expanded to address all slow-onset climate disasters. EWS and EA also need to be linked, but the probability of the weather phenomenon and their expected impact differentiated. Concrete actions, monitoring and basic accountability need embedding in the SOPs and financing mechanisms have to be in place in for implementation.

Early Warning Systems

The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organisations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.

UNISDR (2009)

7 Hillier & Dempsey 20122
8 Hillbruner & Moloney 2012
9 Chatham House 2012.
10 Coughlan de Perez et al. 2016.
11 The exact thresholds for activation of the SOPs will be further defined during the SOPs development exercise.
12 Carabine et al. 2015.

An effective and holistic EWS could include a reserve fund for preparedness programmes as part of the action plan for high risks areas. Funding consortia has also been proven successful and could be a future strategy as financing for development increasingly prioritises scalable outcomes.

Formalising the relationships that exist within existing international structures is necessary to coordinate an action plan and linking key stakeholders is one of the main barriers to implementing effective EWS systems. Others include unclear roles and responsibilities, media coverage and the politics of affected countries and donor governments.

Recommendations

International non-governmental organisations (INGOs)

• Develop principles for EWS for EA and develop partnerships
• Work in coalitions and/or consortia to seek funding for EWS for EA
• Build a holistic approach EWS for EA
• Use evidence base, including value for money, to showcase benefits for agencies and communities which have acted early to fundraise and influence senior leadership
• Include knowledge of EWS into job specifications and annual reviews and develop a minimum standard for EWS knowledge
• Embed EWS for EA into development programming and humanitarian response through project models, national office strategies and programme design, monitoring and evaluation.
• Develop partnerships with key organisations, such as National Met Offices, FEWS Net and relevant ministries, for data gathering, analysis and action planning.
• Involve the community in risk analysis, action planning and feedback on successes and challenges. Explore the potential for innovative approaches to link/engage stakeholders.
• Identify context-specific indicators through collaborative discussions with key sector experts and key partners and include conflict and health indicators to avert disease outbreaks and violent conflict as well as increase coordination for action plans.
• Ensure timely, appropriate and verifiable information is shared with key stakeholders (internal and external partners) so that actions are taken at the right time. This requires partnerships with national met offices and external agencies.
• Develop clear communication and dissemination systems tailored to key stakeholders – i.e. senior management, government, partners and communities

Donors

• Provide a separate funding stream for EA and routine data collection and analysis.
• Conduct field trips for government representatives to see EWS for EA activities underway
• Promote inter-governmental peer-to-peer learning.

Media

• Collaborate with national to local media to disseminate EW information
National governments
• Agree on a joint EWS led by national governments
• Develop pre-defined action plans based on agreed thresholds
• Increase the climate expertise at national hydrological and meteorological offices
• Design and update current EWS for EA in collaboration with national hydrological and meteorological offices and other key stakeholders.
• Work with relevant ministries to develop standard operating procedures

Communities

• Build capacity of communities and staff to understand climate and weather forecasts, monitor risks and develop early actions (EAs)

Definitions of EWS

In Reducing Disaster: Early Warning Systems For Climate Change (Singh and Zommers 2014), no single definition exists, although UNISDR's 2009 definition emphasises that an EWS is a social process that aims to avoid the hardship caused by natural disasters. The terminology of EWS and EWEA focus on the social processes that lead to decision-making to prepare and respond to natural disasters.

Methodology

Focus on EWS for slow onset emergencies in Africa lessons forecasting for slow onset hazards rather than rapid onset hazards such as earthquakes, hurricanes and typhoons. For the purpose of this review on EWS for EA and disaster preparedness based on climate information, data was collected through qualitative methods. The methodology used to conduct this review is threefold. External and internal reviews of EWS for EA were conducted as were interviews with key internal informants and external experts.

The external review employed three methods. First, a Boolean Google search of reviews of EWS was undertaken using the keywords and terms: early warning system*, disaster preparedness, feedback mechanisms, community response, community decision-making, and end-to-end decision-making. In addition, requests for information sharing on EWS review and experience were sent to the Start Network Anticipation group and the OCHA Standard Operation Procedures Rome Drafting group. Together, this research request has reached more than 30 non-government agencies working in forecasting as well as UN institutions. Additionally, attendance at the World Bank's Understanding Risk Conference presented the opportunity to explore the latest thought in EWS. A chain-referral method from the conference to gather further information from key actors met was achieved. Over 190 papers, reports and online resources were reviewed with a fairly even coverage across each region and on EWS, risk assessments and analytical tools, and on how information is used to inform decision-making.

Climate Information

An EWS should connect climate information to decision- making and manage climate risks.[13] Climate information is a valuable component of an EWS; however, if integrated without proper scrutiny, it could render EWS useless. For EWS, climate information must be timely in relation to action. [14] While weather describes conditions at a particular place and location, climate describes how the atmosphere behaves over long periods of time at a particular location or over regions.[15] Historically, climate information is a descriptor and calculated by taking the mean monthly precipitation value for many years. [16]

Occurring at 2-10 year intervals, El Niño and La Niña are neither a climate nor weather events. [17] Both are considered modes of the El Niño-Southern Oscillation, the interaction between the equatorial Pacific Ocean and the atmosphere that incites a 'domino effect' in weather conditions on a global scale.[18] Other types of climate variability that impact local weather conditions are the Indian Ocean Dipole, which affects rainfall patterns in East Africa[19] and the Indian monsoon.[20]

13 Vaughn et al. 2016
14 Dinku et al. 2014
15 NASA 2005
16 IRI Data Library. Accessed 2016.
17 Philander 1983
18 IRI ENSO Maproom
19 Behera et al. 2005
20 Saji & Yamagata 2003

A World Vision staff member helps conserve soil with maize plants in Malawi

Data sources

Availability, access and use are perhaps the most important characteristics of climate information in EWS. Climate information is usually gathered from weather stations or satellites. Increasingly, information from both station and satellite is available online, but both data sources have limitations.[21] In many regions, station data is not available at high spatial or temporal resolutions, so users need to extrapolate the weather conditions in the 'gap' of the data. To fill in the gaps presented by station data, satellites are often used. Satellite data can be valuable to analysts as a single dataset can be used across geographic areas and time periods during which inconsistent recording protocols exist. Increasingly, satellite and station data can be merged, and this information has a variety of applications for inclusion within an EWS.

Climate information for EWS

One of the more acute challenges of EWS is linking actions to forecasts. Forecasts and actions both have time periods that need to be considered and aligned. Examples of successful preparedness actions are outlined in Coughlan de Perez et al. 2016 and include prepositioning stocks and cleaning drains. Another key component of taking action includes understanding the risks associated with 'acting in vain'. Acting in vain, in the context of EWS, is taken to refer to the intersection of 2 conditions: 1. An action is taken before a potential impact influenced by the consideration of prognostic climate information and 2. The potential impact, either climatic or not, does not occur. In other words, the forecast triggered a 'false alarm': the stakeholders involved in the EWS have a collective risk

21 Mendelsohn et al. 2007

aversion to 'acting in vain', the level (within the forecast) at which action taken can be raised. While 'acting in vain' will decrease, so will acting 'appropriately' before the impacts.[22] Further, the persistence or 'lifetime' of an action is also an important consideration in the scope of an EWS.[23] An assessment of the lifetime of an action's effect is useful in determining the risk for effect duplication. For example, if an EWS triggers the same action (i.e. distribution of bed nets) multiple times (numerous forecasts of flooding) within a narrow timeframe, further action may not be needed (bed nets given one month prior are still useful for the next month). However, if taken, the effect is duplicated.

Health and climate data

EWS for health impacts has been explored for various epidemics and situations and should be included in EWS for EA. The predictive capacity of climate and weather variables has been explored for various vector-borne (malaria and Rift Valley fever) and water-borne (cholera) outbreaks.[24] The relationship between extreme temperatures forecasts and their actual occurrence has been explored to develop an EWS that determines the human impact of a heat wave and the preventative measures that can be taken.

To promote an EA that will decrease the impacts on health, the forecasts that predict health risk need assessment and the timescales on which each particular geophysical variable or hazard could be forecast. For example in the case of malaria, which has been noted to increase with increased rainfall, the skill of forecasting rainfall on seasonal and short-medium terms (1-14 days) is an important step in developing an EWS.[25] It is also important to note that actions taken must be defined in conjunction with the forecast being used. If the length of time in taking EA aligns with a skilful forecast that can produce on that time scale, then including such prognostic information on rainfall and associating it with an action of providing bed nets is useful inclusion into an EWS for EA.

However, if the distribution of bed nets or other malaria prophylaxis takes 20 days, a 10-day forecast, regardless of skill, is irrelevant in triggering that set of actions. Thus, a seasonal forecast showing a high probability of increased precipitation over the next 2 months could inform the distribution of bed nets.

This example is meant to stress the importance of contextualising the actions and the forecast skill for a particular climate hazard on various lead times, outlining the potentially prevented impact regarding lag time between climate hazard and potential impact, and understanding the intermediate processes that may amplify or dampen the priority of particular actions. Further, it should be reiterated that the preceding example was presented to describe EWS based on short-term or medium-range weather forecasts—deterministic forecasts occurring on a lead time with less uncertainty than probabilistic seasonal forecasts (Palmer 2000). With the goal to inform danger level threshold development tailored to the beneficiaries of the EWS, comprehensive sector specific risk assessments should be conducted. This will contribute toward closing the gap between EWS implementation and decrease in socioeconomic impact (WMO 2015).

"Responding to early warnings related to social, political and environmental hazards ... can save lives."

22 Lowe et al. 2013
23 Coughlan de Perez 2016
24 Thomson & Connor 2001; Anyamba et al. 2008; Mendelsohn & Dawson 2008
25 Hay et al. 2002, Pascual et al. 2008

FAO in Somalia

In work that began in May 2015, the United Nations Food & Agricultural Organisation were at the forefront of analysing ENSO and the impacts it was predicted to have on agriculture in 'at risk' countries. FAO's EWEA team consolidated EW information for senior management and linked it to EA recommendations in a global report that identified funding priorities. This Global EWEA report highlighted the countries most at risk of food insecurity over a 3-6 month period. The main goal was that FAO supports national governments to build up systems that would enable them to identify risks and develop action plans and to strengthen the organisation's internal EWEA capabilities.
This worked particularly well in Somalia where donors quickly provided funding for the EA and this decision was rewarded. For the risk of floods, river banks were reinforced, flood barriers built and breached riverheads repaired. Despite increased rainfall and water volume, no flooding occurred. 4, 910 hectares of land was saved - an area which can produce 22 tonnes of maize or enough to feed 2 million people for a month (see Managing short-term crisis' and mitigating long-term risks).

From this experience, we can conclude that:

1. EA needs to be developed in local offices through a variety of sectoral experts
2. A protocol is needed for UN agencies and other key agencies on how to deal with slow onset hazards
3. A dedicated fund is needed to ensure Early Warning Action Plans can be implemented - FAO has created an internal EWEA fund and has earmarked €3 million as seed funding to leverage more funding other donors.
4. Evidence on return on investment must be shown at the right time for continued donor support.
5. The timing of the implementation of EAs is critical - calculations are needed for each sector to estimate the time needed (procurement, for example) and define the threshold to have the desired outcome.

In order to achieve this, technical leads must be brought together to share data, knowledge of activities, lead times and the links to each sector. This makes action plans more complicated and so better communication is needed so that action can be better coordinated.

Key components of EWS

Responding to early warnings related to social, political and environmental hazards and stresses protects development investments, community livelihoods – and can save lives.

Quantifying the exact return on investment is difficult due to the high number of variables involved and the difficulty in measuring the hypothetical impact of an averted disaster. World Vision has been working on disaster risk reduction since the Asian Tsunami in 2004 and has increased the focus on developing EWS. EWS for EA can promote child wellbeing and can protect communities and their children.

Through a survey of both primary and secondary data sources, consultations with over 30 subject matter experts and robust engagement with INGOs, the blueprint comprises of three components: collection and analysis of EW data; translation of EW information into EA through information management and clearly defined decision-making rights, systems and procedures at each level; and recommendations of EA for a range of stakeholders.

1) Collection and analysis of EW data: data is collected at the local, national, regional and global levels, through primary and secondary resources.

2) Translation of EW information into EA through information management and clearly defined decision-making rights, systems and procedures at each level. Once collected, the data is analysed at both the National and Regional levels. 'The changing context on the ground will itself dictate the analytical urgency. By tying the rate of data communication and analysis to the community context, we capitalise on internally developed best practices and use staff time and organisational resources more efficiently'.

3) Recommendations of EA for a range of stakeholders. A set of agreed actions by a range of actors across the organisation and externally. These range from programme implementers to advocacy personnel and marketing staff. Different channels of information dissemination are needed for the different levels of EW stakeholders. Methods and technologies should be identified to meet the stakeholder's needs.

Findings

Opportunities

The evidence highlights several opportunities: a holistic approach; EA funding/ contingency funding; capacity building; and partnerships for information, forecasts, impacts and action planning.

A holistic approach

With the 2015-2016 El Niño, there has been the opportunity to learn from our current ability to act early across various regions. A positive finding is that that World Vision created a coordination group to share impacts and advocate in key policy arenas. The EWS working group developed a system through a 'backcasting' approach where the decision-making elements were given priority in designing the system.
An effective EWS is much more than a collection and analysis of EW information. It is also imperative to invest in effective information management systems and clearly defined decision-making procedures.

EA & Contingency Funding

It is clear that EA is supported when there is funding in place. In World Vision Ethiopia flexibility in the use of funding of up to 20% was put in place for Area Development programmes for preparedness and response. In addition, the National Emergency Reserve Preparedness Fund 3%/ year was also made available to fund preparedness activities. In the case of the impacts of El Niño, this funding was not enough to prepare all ADP's to El Niño impacts and more funding was needed.

Another model of funding, as illustrated by the RCCC is the FbF mechanism which sets up funds available based on EA plans developed. Similar to this is the FAO funding which has been earmarked to develop EA plans and to leverage further financing for their delivery.
Finally, the Start Network's FOREWARN Anticipation fund and SomReP highlight the opportunity to seek funds for EA as a collective. They also underscore the opportunity to manage the risks of EA as a network of agencies and to conduct value for money assessments for EA to influence donors and development agencies.
A range of financial models is available. However, administering EW funds as a network seem to be the most promising in managing risks. A combination of agencies' earmarking funds for EA with joining a network of agencies could be a powerful way of moving closer to institutionalising effective EWS and EA across development and humanitarian programming.

Capacity building

People are fundamental to effective EWS and efforts to improve EWS should address different levels and users of information. FAO's work during El Niño focuses on national governments to strengthen systems in order to identify risks and consequently develop action plans. SomReP and the RCCC build the capacity of volunteers or community committees so that they can understand the risks that they face and World Vision's experience in Ethiopia further expounds this approach by integrating indigenous knowledge with other indicators to improve EWS.

Forecast based Financing

The Red Cross Red Crescent Climate Centre (RCCC) in cooperation with the German Red Cross (GRC) has developed an approach called Forecast-based Financing (FbF). FbF has emerged to address the consistent failure early warnings to be followed by action, especially in developing countries. When a strong enough forecast arrives, funding is automatically released to fund defined action before hazards turn into disasters.

FbF provides a system whereby risks, potential impacts and the reliability of forecasts are combined to provide triggers for action when a specific forecast threshold is reached. A shift from a traditional early warning, this approach is based mainly on the impact-based forecasting model. FbF changing the current aid funding orthodoxy by using real-time decision-making to fund EA.

FbF relies on a set of predetermined actions embedded in 'standard operating procedures' (SOPs), which are implemented once certain forecasting parameters reach a level of probability. Each action is budgeted and this is key to ensuring that, once the probability increases funding will automatically be used to take EA.

The cross-seasonal effect of El Niño in Peru was used to develop the SOPs and the time between forecasts and action was analysed. A low and medium probability for floods triggered EAs under the SOPs and were implemented successfully. The actions included training Red Cross volunteers and local DRR committees, strengthening homes, distributing chlorine tablets and hygiene promotion campaigns.

RCCC has piloted FbF since 2008 in more than fifteen countries. In several of these, including Peru, Uganda, Togo and Bangladesh, EA has been triggered. The approach has significant cost-savings. In Bangladesh, where flood warnings trigger the distribution of cash transfers, every dollar that funds EA saves three dollars in beneficiary losses.

Key findings:

1) Understanding risks are essential to determining the thresholds and EA.
2) It is hard to adapt traditional practice and so national partners need to be guided. FbF aims at reinforcing government DRM strategies.
3) Design understandable thresholds to ensure sustainability. Thresholds must be scalable (river basin, regional, or national level) rather than localised.
4) Stay flexible. Actions are prioritised based on lead times, implementation capacity, value of money, social acceptability, impact, and consequences of 'acting in vain'.
5) More evidence is needed. Developing robust but flexible methodologies is important if the approach is to be widely adopted.
6) Advocacy for more flexible funding is how forecast-based EA and preparedness will be funded.

Partnerships for information, forecasts, impact and action planning

Partnerships are also imperative, especially to improve the quality of weather and climate information available. During El Niño World Vision's partnership with IRI, allowed a range of practitioners to consider forecasts and the increased probability of risk. The SOP currently being developed recognise the need for UN and other key agencies to share risk information and forecasts and jointly develop action plans as the NGOs involved in the Start Network are doing.

Barriers

EWS require several components and weakness or breakdown in any part of the system can result in its failure.[26] A 2013 report from the Science for Humanitarian Emergencies and Resilience presents a mixed picture with good examples on EWS in South Asia and the Caribbean but less progress on national risk assessments and the integration of EWS and risk assessments. Data from Africa, the Caribbean and South Asia lacked enough detail to be conclusive.

Organisational barriers

1. Culture of risk avoidance in the humanitarian response sector - the 'fear of getting it wrong'
Reducing the penalties for failure is a positive incentive for EA.[27] A change of mind is needed for slow-onset emergencies as EA requires acting on uncertainty. However, with funding and reputations at stake, there is a powerful incentive to delay humanitarian intervention until livelihoods have been lost. Staff fear that their risk mitigation measures will be questioned if there is no evidence of success if the crisis is averted. If an agreement has not been made on no regret strategies, then acting early may be a financial and reputational risk.

The scarcity of funding creates an environment in which waste avoidance becomes a priority. Additionally, the information requirements of many donors become easier to meet as the disaster grows (and thus becomes easier to quantify). Overcoming this reluctance to act – and learning how to calculate the risks we must take responsibly – is perhaps the most challenging barrier to EA. The traditional humanitarian response model embraces the philosophy of 'hurry up and wait.' It is much easier to prioritise action, mobilise surge capacity and launch new programming once a disaster is defined, documented and undeniable. This operational model, however, is tailored towards rapid onsets disasters and inadequate when applied to a slow-onset crisis.[28]
2. Insufficient financing for EA
Short-term, unpredictable funding, and the void of earmarked funding for EWS, continues to be a challenge. Drought responses are chronically underfunded; the 2011 Horn of Africa Response to Drought (HARD), for example, received roughly 20 percent of the requested funding. If responsibility for funding action is segmented (e.g. dissemination of information, capacity building, maintenance and upkeep of hydro-meteorological stations), it may lead to a disconnected system. Thus both the scarcity of funding for EA, and the lack of EWS and EA being fully prioritised and funded, impact any real ability to act before a disaster takes root.
3. Lack of decision-making capacity
The need for timely, accurate and predictive information makes information management a key task in the proposed EWS. Any EWS must take steps to triangulate, verify data and provide timely dissemination. However, the delayed response in the Horn of Africa did not result from a lack of dependable information or warning. The existence of FEWS Net drought warnings in early 2011, for example, failed to motivate large-scale action (despite their demonstrated accuracy). Decision makers are not always able to efficiently access the information most relevant to them and trust that there is an agreed interpretation of data to set off a trigger for action. Thus, inadequate information management is a key inhibitor of EA.
4. Projects rather than Institutionalization
For EWS to be adopted, scaled up and integrated into local government policies and development plans/ policies, a shift is needed in prioritising funds and making them available for EA. Funding is needed for both an

A change of mind is needed for slow-onset emergencies as EA requires acting on uncertainty.

26 UNISDR 2006; Kundzewicz 2013
27 Kelly et al. 2012.
28 ibid, p.6

organisational EWS as well as EWS at each Area Development Programme through access to latest climate information and other trends. Thus, there is a need for linkages across EWS from local to national levels and coordination of the information collected and shared and actions taken.

5. Narrow focus on preparedness

For most organisations, an EWS which is narrowly focused on disaster preparedness or response and will not lead to disaster risk reduction, climate change adaptation programmes. Community-based disaster risk reduction must include latest climate information to be effective.

6. Weak information management and content

The capacity to collect the necessary data is challenging on a number of levels. EWEA must benefit beneficiaries and build community resilience. If predictions of EW are not accurate, actions should be seen to reduce vulnerability and encourage resilience. Effective EWS may be different for different end users, such as professional disaster managers and AP communities. Weather station data or remote sensing and earth observation are needed in each AP to inform programming regularly so that EWS can be based on community needs. Sharing information in the best way (TV, radio or mobile phone) in the right language to different communities is also a challenge.

7. Insufficient warning interpretation at community level

In addition to local coping capabilities, national or sub-nationally developed warning systems are not always appropriate for, or applicable to, local communities. For an effective EWS, it is necessary to link local risk and hazard assessments, and for communities to participate in the design and communication of the system fully.

8. Missing guidance for appropriate actions

Within World Vision, staff endorsed EWS in principle but were clear that the current Buster reports provide guidance on what steps to take for the hazard/index levels generated by the report. However, the capacity and culture of reviewing and applying the recommendations are low. Similarly, staff largely welcomed the Buster feature that allows for the user to track the status of recommended actions, but few make use of this feature, either for tracking their departments' progress or for accountability across departments involved in the response.

9. Focus on information rather than utility

Information does not necessarily lead to positive decision-making. The Horn of Africa crisis did not suffer from a lack of information but lack of action due to internal and external barriers. In Mauritania, the BUSTER tool helped World Vision raise an early alarm as well as mobilise funds from two institutional donors. Although the Buster effectively flagged potential problems tied to national elections, it did not capture the riots that followed, nor provided much insight for how the NO might deal with a situation of urban unrest. In Malawi, early warning reports were instrumental to triggering the reallocation of ADP funds to reduce risks in flood prone areas.

10. EWS accuracy and appropriateness

Without an agreement on indicators and process, it is difficult for an EWS to gain recognition and support. Disagreement can lead to duplication of efforts by various agencies, conflicting messages and disengagement from early warnings by key stakeholders. Local to national EWS should be linked and should reinforce each other in order to lead to appropriate action.

11. Missing health indicators and lack or cross-sectoral coordination

Current EWS have significant gaps for health indicators. In Ethiopia, this meant that when rain followed drought, a cholera outbreak ensued. Without monitoring health indicators, EA was impossible, and response to the outbreak was the only option. Current government health services are presented with significant challenges in gathering health data and, when the information is available, experts are needed to develop early plans that include health actions.

12. Lack of understanding coping strategies

Presently, the Coping Strategy Index is the principle data-point used to gauge stress in an effected population. However, some coping strategies

... warning systems are not always appropriate for, or applicable to, local communities.

represent temporary or seasonal actions taken by affected populations, rather than general distress. For instance, rural-urban migration in pastoralist communities is often temporary by design, and not necessarily an indication of existing or irreversible damage to traditional livelihoods.
Similar to the roles and responsibilities for financing for EWS, the distinct roles, responsibilities and mandates of different agencies engaged in EWS are unclear. Typically, there are a large number of agencies and organisations involved in supporting an EWS but no guiding framework, policy or vision. Coordination remains a challenge under these circumstances. Most government agencies with early warning mandates are focused on emergency preparedness and response without necessarily linking up with other parts of government or agencies. This issue is amplified when transnational cooperation is required.

Institutional Barriers

International NGOs

There are a large number of agencies and organisations involved in supporting an EWS, and coordination and cooperation remain a challenge, particularly where there is no guiding framework, policy or vision. This is critical as agencies tend to focus on preparedness and response, without tackling the underlying causes of risk. Coordination and cooperation challenges are significantly multiplied in areas where transnational cooperation is required.

Media

Media coverage significantly influences public fundraising when it comes to humanitarian responses; However, what the El Niño response showed is the media coverage is not always necessary in terms of the amount of funding raised. However, in the case of slow onset disasters like drought, targeting specific channels like The Washington Post or the Financial Times that are read by key decision-makers could be useful in attracting the right kind of funding early on when early warnings are first issued.

National Governments

Although World Vision's work with some national governments creates strong relationships, at other times, this can be a limiting factor. National governments often see themselves as culpable should an emergency be declared and so will only do so the situation is acute. As a consequence, EWS are severely compromised when warning information is withheld, and this is often a critical factor in the translation of warnings into action.

National governments may also be slow to act depending upon national politics, the capacity of national institutions, the strength of civil society and the independence of media. Developing effective EWS is especially challenging when there are restrictions on data collection and information sharing. When this occurs, legitimacy and acceptance of EWS can be undermined.

Donor Governments

At the same time, donor governments can be slow to mobilise resources until credible data is available. Reluctant to fund disasters that have yet to occur is understandable given the limited aid budgets and the scale of the current disasters that the global community is grappling with. Compelling images of disasters that are broadcasted globally help release funding – increasing political pressure as well as providing evidence of a disaster. Donor governments responsiveness to early warnings may also depend on their geopolitical or historical relationship with the affected country. There is growing evidence that donors are becoming more sensitive to the value in releasing funding based on early warnings.

The Start Fund

The Start Fund is an NGO-managed pooled fund aimed at catalysing EA using forecasting information to fund action. Since September 2015, the Fund (up to £11 million per year) has trialled anticipatory interventions and has been activated four times in Sri Lanka, Ethiopia, Zambia and Pakistan. All of these involved some form of joint risk analysis and preparedness activities. Initial results indicate that decisions are made earlier because the fund incentivises EA.
ECHO have committed funds specifically for forecast-based actions, improving forecasting information and developing tools to appraise the effectiveness and efficiency of action. Smaller grants are aimed at preparedness, coordinating analysis and joint assessments of markets. A small drawdown fund is also available for agencies to conduct joint risk assessment and information gathering and analysis.
The Start Network convenes a group called FOREWARN that looks at how to improve systems to enable agencies to act earlier. The group meets on a monthly basis to raise awareness and find applications for coordinated action on approaches to risk analysis, use of forecasting information, MEAL for anticipation, EA interventions, etc. The group plays a technical advisory role for the Start Fund, including in the development of national iterations. The work has unintentionally improved forecast-based coordination and decision-making among the NGOs who manage the fund.

Conclusion

A set of common principles have emerged from this review which can be used to develop an EWS for EA or to review current practice:

1) People-centred - empower individuals and communities to 'act in sufficient time and in an appropriate manner to reduce the possibility of personal injury, loss of life and damage to property and the environment' (UNISDR 2006 p.2).

2) 'No-regrets' - actions by households, communities, and local/national/international institutions that can be justified from economic, and social, and environmental perspectives whether natural hazard events or climate change (or other hazards) take place or not. 'No-regrets' actions increase resilience, which is the ability of a 'system' to deal with different types of hazards in a timely, efficient, and equitable manner. "Increasing resilience is the basis for sustainable growth in a world of multiple hazards".[29]

3) Demand-driven - work with agencies, ministries, specific countries where there is a desire to improve current practice. Understanding the perception of risks from these stakeholders' perspectives.

4) Champion EWS for EA - to influence upper management, governments and donors through evidence in a timely manner.

5) Work with governments – work at different levels and contribute to the overall disaster risk management strategy of the respective government.

6) Build on existing strengths of the agency or partners - this will allow for progress to be made and identification of partnerships to fill gaps.

The principles of EWEA can guide a holistic approach to creating links across communities, agencies and national governments for an effective EWS. However, the right climate information for an effective EWS needs to be confidently forecast with defined risks so that actions are not futile. However, there are limits to how much development and humanitarian actors can interpret forecasts without consulting climate experts. Increased use of climate information and a greater understanding of how to link this information to disaster risk reduction and preparedness should be a goal of future capacity building in EWS. Building capacity of staff in different sectors to make use of information and build cross-sector action plans needs to improve for EWS. Linked to this is the earmarking of funding for EA.

Through World Vision's evolving experience in EWS, it recognises that EWS are much more than the data collection and analysis. Effective EWS include the collection and analysis of EW data, the translation of EW information into EA through clearly defined decision-making, systems and procedures and recommendations for EA for a range of stakeholders. This should be done in partnership with National Meteorological and Hydrological Services.

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29 A no-regrets approach may not be fitting depending on hazard, location, forecast and other variables. Future research is needed to evaluate the cost of acting in vain and selection of suitable actions.

Recommendations

Opportunities

- Develop and adopt principles for EWS for EA to guide policies, focus investments and develop partnerships.

- Provide a separate funding stream for EA and routine data collection and analysis. Use the rising evidence base to influence senior leadership/donors perception of the cost saving benefit of pre-disaster investment, based on weather forecast and climate outlooks.

- Work in coalition to seek funding for EWS for EA and manage risks of the decision to act early.

- Build a holistic approach EWS for EA which includes decision-making, bridging humanitarian, government and development departments.

- Build capacity of communities and staff and develop needed guidance to: understand climate and weather forecasts, understand and monitor current risks and develop cross-sector EAs that can be taken up at the community level.

- Explore capacity of climate expertise at national hydrological and meteorological offices, and/or at regional centres for climate research/ forecasting and develop partnerships.

- Design and update current EWS for EA in synergy with national hydrological and meteorological offices and key stakeholders. Advocate for formalised agreements with the met services, and support them in outlining climate risk and climate forecast information.

Barriers

Unclear roles and responsibilities

• Defining roles and responsibilities

• Agree on a joint EWS led by the national government and on indicators and thresholds and on roles and responsibilities of different agencies.

• Develop pre-defined action plans based on agreed thresholds through cross-sector discussions with both development and humanitarian experts. These can expand on existing contingency plans.

Media coverage

• Target key financial and international affairs media with stories about the savings that could be made when early warnings are first issued to advocate for EA funding.

National governments

• Work with relevant ministries to develop coordination as well as information sharing through standard operating procedures and memorandums of understanding.

Donor governments

• Organise field trips for key politicians to see EWS for EA activities underway and highlight cost savings that can be shared with their electorate.

• Promote inter-governmental peer-to-peer learning.

Appendix

Forecasting

Of the many types of forecasting information available to predict climate or weather conditions in the short and long-term, each includes a timescale, lead-time and target period. In general, lead-time decreases and confidence increases. However, a decrease in lead time also decreases the available time to take preventative action (Figure 2) Climate information, including prognostic climate information, exists across a variety of timescales including weather (minutes to days), climate variability (3 weeks to years) and climate change (decades and centuries).

The change in uncertainty is not constant. In Figure 4, a 'rebound' of certainty can be seen when comparing forecasts on the 2-weeks and months timescales to the forecasts on the seasons and years timescale. This is shown by a shrinking of the space between the black lines. This rebound is due to shifts in the methods of forecasting as well as a shift in the presentation of the forecast.

Prognostic climate information is presented as either deterministic or probabilistic.[30] An example of a deterministic forecast is that the high temperature and expected rainfall for Addis Ababa, Ethiopia in three days from now will be 10 C and 20 mm respectively. Seasonal forecasts

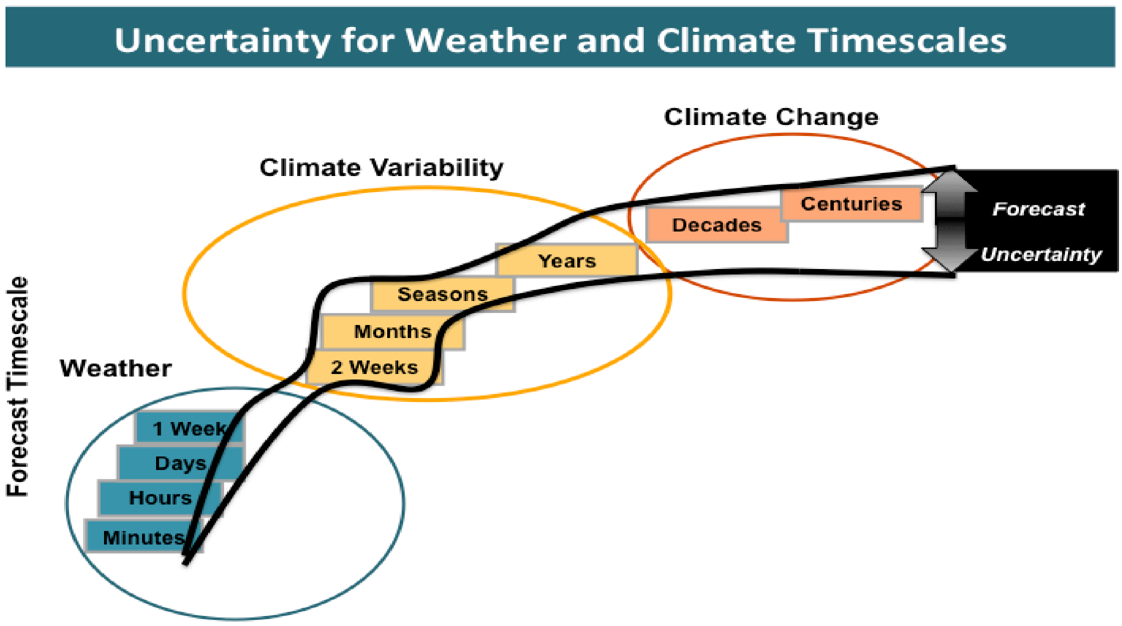


Figure 2

30 Bickford 2013

31 Barnston et al. 2003
32 Mason et al. 2015

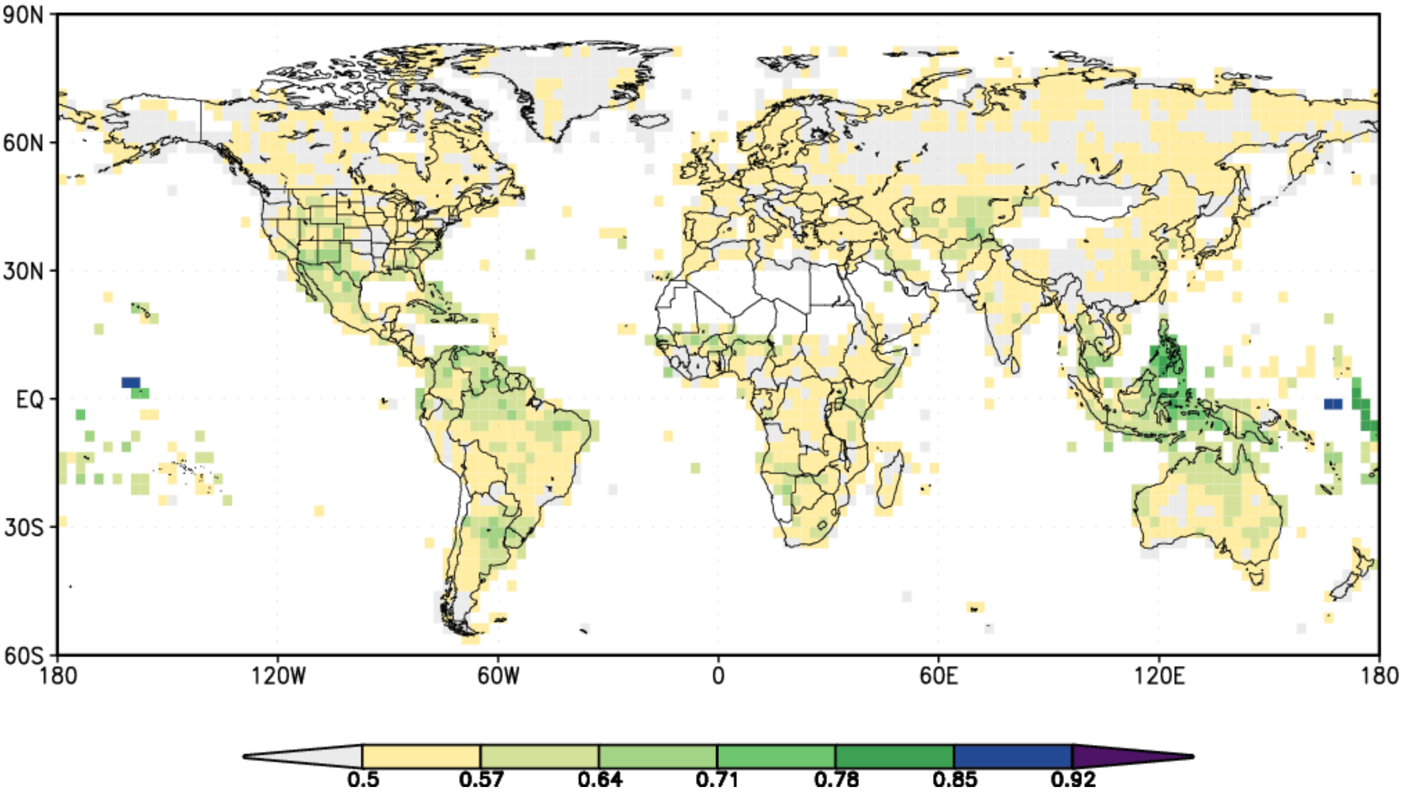


Figure 3 -Map showing skill score of IRI seasonal precipitation forecasts on a 1-month lead time for all three month periods, in a year. Deeper greens indicate areas that experience a higher level of seasonal forecast skill regardless of target month, on a 1-month lead time. Seasonal forecast skill fluctuates depending on target month and lead time. This map shows the total skill for all seasons (three month periods), answering the question: In general, considering all seasons, which areas globally have the highest seasonal precipitation forecast skill at a 1-month lead time.

are probabilistic and can be used to identify where and when temperature and precipitation conditions will occur: When averaged over a period of the next 1-3 months (say Jan-Feb), it could be expected to be above or below the historical 1-3 mean (for example, the mean conditions for Jan-Feb for 1970-present.[31] Probabilistic is the term that refers to a forecast presented as the probability of a shift in a likely outcome, usually above-average, below-average and average. With timescales climate forecasts, uncertainty is relatively higher in the 2-weeks and months period.

Depending on the season, uncertainty can vary widely, and this has implications for EWS as, depending on the lead-time (as determined by the length of time needed to take action), some regions or seasons may be precluded from consideration.

Global gradients of seasonal forecast skill and temporal variations of skill across seasons at a single point are important considerations in designing an EWS which links forecasts and actions at the 2-4 month timescale. For example, in the central Sahara Desert region lack forecast skill regardless of season, while other regions experience quite a significant shift in skill based on target season and lead time. From a practitioner perspective, relative to designing an EWS, it is important to be aware of the right questions to ask relative to the spatio-temporal shifts in skill, in addition to inquiring if a region of interest simply has the skill or not. When producing information on a minute to hourly basis, or 'nowcasting', the challenge is the lack of historical data available at that timescale, limiting calculation of anomalies, and thus identification of potentially hazardous conditions.

Bolivia is a country that exhibits a shift in forecast skill depending on the season. In evaluating seasonal forecast skill for precipitation in Bolivia on a 2-month lead time for each 3-month period in a year, skill is low (Figure 4). Simply knowing the heightened skill during JJA may not be enough to understand the value of the climate information. Skill, depending on the season, can be more or less valuable to a decision maker. For example, during JJA in Bolivia, there are low values of precipitation—a forecast for above average precipitation during JJA, therefore, may not manifest as an increased risk of flooding.

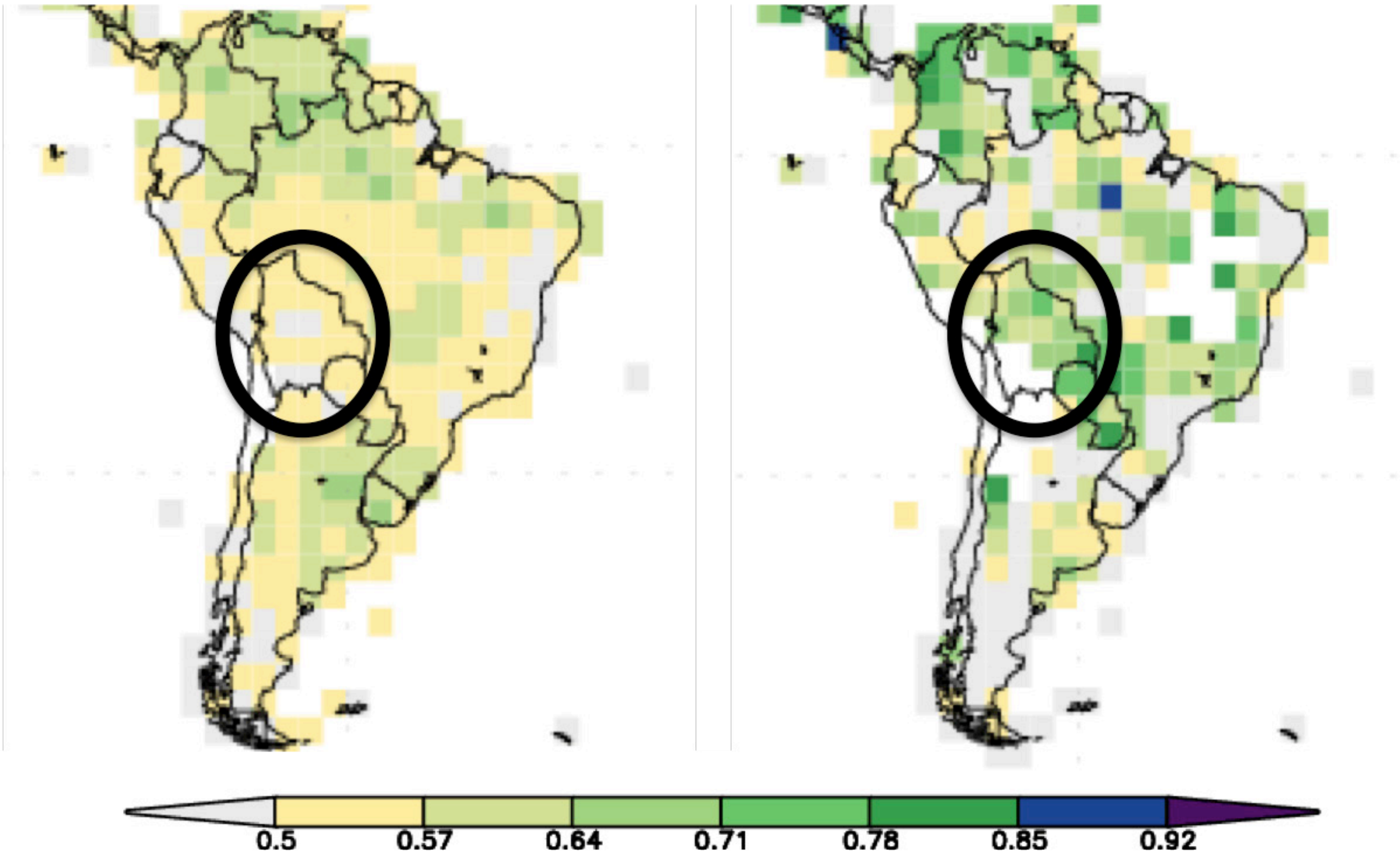


Figure 4-Skill score over South America for seasonal precipitation forecasts on a 2-month lead time, as defined by the general relative operating characteristic (GROC). Yellows indicate areas of relatively lower skill, while deeper greens and blues indicate areas of relatively higher skill. The map on the left shows seasonal precipitation forecast skill of 2-month lead time forecasts for each 3-month period in a year—note the overall low skill in Bolivia (circled). The map on the right shows seasonal precipitation forecast skill of 2-month forecasts for the June-July-August period- note the darker greens in eastern and northern Bolivia, indicating a relatively high skill during that period.

Alternatively, perhaps a forecast for a slight increase could be of interest if community consultation has identified the risk as such. Alternatively, a forecast with a strong signal for above average precipitation could be a boon for certain industries, such as some sub-sectors of the agriculture industry. However, the opportunity to experience any potential benefit could be missed if one is unable to evaluate and act on this uncertain information. Even during times of a forecast with a 'strong signal', uncertainty is present. In comparison, keeping with the Bolivia context, there is also heightened skill on a 2-month lead time for seasonal precipitation forecasts for February-April (FMA). With a relatively high amount of precipitation usually falling during FMA, a forecast for above normal conditions in FMA may lead to a situation of heightened risk for floods. However, similarly, without estimations of vulnerability and other socioeconomic factors determining if and how a shift (both spatiotemporal and magnitude of) of risk for societal impact will occur is difficult.

In conclusion, forecast skill for a specific location will likely vary based on target period, lead time and variable. It is important to consult with climate experts in order to increase the likelihood of proper interpretation of prognostic climate information.

Setting baselines

Data for past conditions is pertinent in establishing the context of current climate and weather conditions. Climate can shift from year to year, decade to decade and on a longer term climate change timescale. In the Sahel region of Africa, how depending on the historical context of interest, the trend can change magnitude and even sign (increasing or decreasing). (Figure 5)

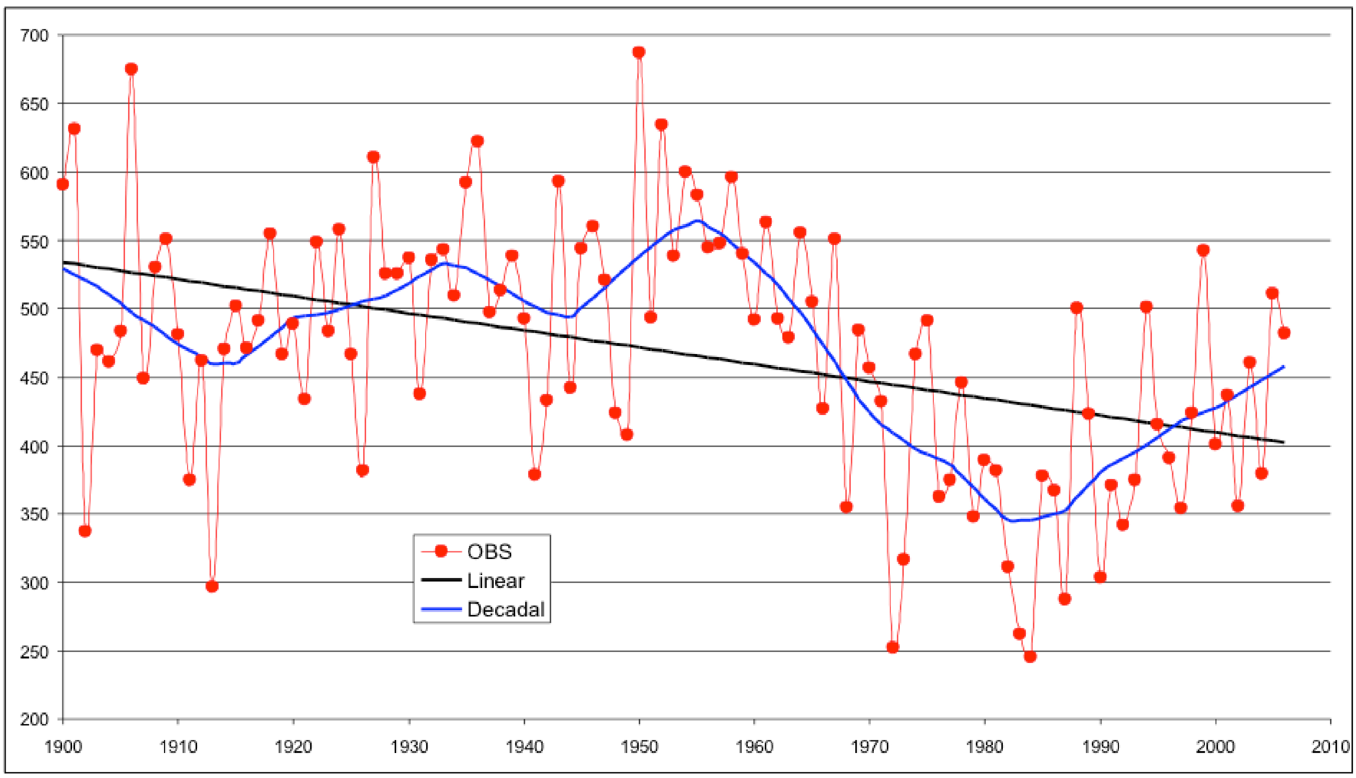
The red line depicts inter-annual variability, or year-to-year shifts. The circles (filled in with red) indicate annual rainfall totals with the time series showing variable amounts from year to year. The blue line depicts decadal averages. This line is important for assessing longer-term (10-30 years) shifts of clusters of climatic periods. For example, it can be seen in the time series that Sahel rainfall decreased from 1960-1980, then increased thereafter even up to the present period. It should also be noted that in both the period of decadal rainfall decline and increase, individual annual rainfall values of the opposite sign (relative to normal) were noted. The black line depicts long term changes in rainfall, or climate change induced rainfall shifts. It is noted that over the long term period of 1900 to the present, rainfall in the Sahel has declined.

In respect to the importance of having historical data to establish 'normal' conditions, this chart shows that normal is specific to the context. If data were only available from 1980 to the present, one might conclude that climate change is causing increased rainfall in the Sahel. Data availability going back to 1900 depicts a much different story, where rainfall is declining over the long term. Understanding the limitations of data due to data availability is an important part of assessing the value of EWS which uses climate information. Data availability impacts the definition of normal conditions and in short, only when normal is defined can extremes be identified.

Understanding normal and the significance of deviation

The value of current weather and climate information lies in their placement within a historical context. Timescales of current information can vary but are usually derived from daily, weekly, monthly and seasonal (3-month) periods (Mason et al. 2015). In some contexts, the absolute value of current information is less useful in decision-making processes, such as an EWS, as the value provides no context relative to what is the 'normal' or 'expected' value. For example, if a 1-week rainfall total is observed at 70mm, that could reflect normal conditions during the rainy season (August-October) in Tshopo Province in north-central Democratic Republic of the Congo (DRC) or even below normal conditions in certain locations. However, it could also indicate a significant increase in risk for potentially hazardous flood conditions in the Hardap Region of Namibia. To contextualise current climate information to represent the deviation from normal conditions a value referred to as an 'anomaly' can be calculated. For example, the 70 mm observed weekly rainfall value may be less than what is expected (a negative anomaly) for a weekly rainfall total during the rainy season in Tshopo, DRC, indicating a potential heightened risk of drought conditions, whereas that same 70 mm weekly rainfall value may be more than what is expected (a positive anomaly) for Hardap, Namibia, which can be indicative of an increase in flood risk.

Figure 5: Observed annual rainfall in the Sahel over 1900-2006. Source: Giannini, Saravanan and Chang 2003.



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