EARLY WARNING LATE ACTION: WHY IMPACT MATTERS

The Need for Impact Based Forecasts to Support Anticipatory Humanitarian Action in the Greater Horn of Africa

Kenya Red Cross

ICHA International Center for Humanitarian Affairs
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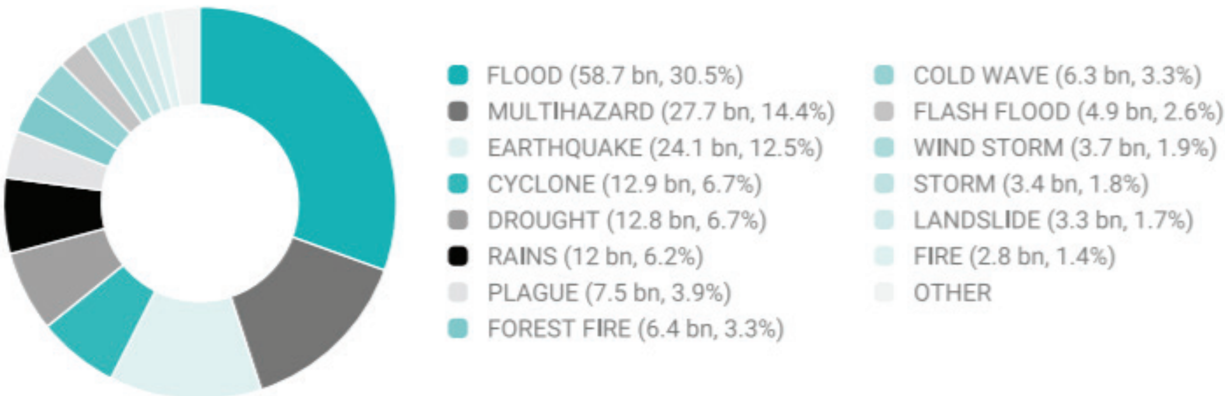
LIST OF ABBREVIATIONS

DRR	Disaster Risk Reduction
FbF	Forecast-based Financing
GFCS	Global Framework for Climate Services
GHA	Greater Horn of Africa
GRFC	Global Report on Food Crises
HIGHWAY	High Impact Weather Lake System
IARP	Innovative Approaches to Response Preparedness
ICPAC	IGAD Climate Prediction and Applications Centre
KMD	Kenya Meteorological Department
MHEWS	Multi-hazard Early Warning Service
NCAS	National Centre for Atmospheric Science
NMHS	National Meteorological and Hydrological Services
NOAA	National Oceanic and Atmospheric Administration
OSM	OpenStreetMap
RCRC	Red Cross Red Crescent
SENAHMI	Peruvian Meteorological Service
SHEAR	Science for Humanitarian Emergencies and Resilience
SWIFT	Science for Weather Information and Forecasting Techniques
WISER	Weather and Climate Information Services for Africa
WMO	World Meteorological Organization

HUMANITARIAN EFFECTS OF WEATHER AND CLIMATE

Globally, there is recognition that flood and drought events, in the context of high vulnerability and exposure and low capacity, are a major cause of humanitarian disasters and economic losses. This is reiterated in the 2019 Global Assessment Report on Disaster Risk Reduction that indicates 17.2 million people were newly internally displaced due to climate-related disasters and natural hazards in 2018, with 883,000 new internal displacements recorded between January and December 2018, of which 32% were associated with flooding and 29% with drought. Further, economic losses recorded were USD 58.7 billion (30.5%) due to floods and USD 12.8 billion (6.7%) due to floods (Figure 1).



Source: UNDRR data

Figure 1: Distribution of total economic loss (constant 2010 $) in 83 countries by hazard, 2005- 2015[1]

In the Greater Horn of Africa (GHA)- focusing on Ethiopia, Kenya and Somalia- droughts in 2016/17 and 2019 resulted in 17.1 million and 15.3 million people requiring humanitarian assistance respectively. Out of these, 2.1 million and 5.8 million people were internally displaced due to the droughts in 2017 and 2019 respectively (Oxfam, 2019[2]).

In 2018, heavy rainfall together with significantly high water levels in most major river basins and water catchments caused flooding in the Region. This led to displacement of about 300,000 people in Kenya, 97,000 in Ethiopia and 219,000 in Somalia (FEWSNET, 2018)[3]. Other impacts from the 2018 floods included damage to infrastructure like roads and houses, disruption of critical services like schools and health services as well as several acres of crops were submerged in the flood waters. Such close occurrence of droughts and floods undermines people's capacity to manage the impacts and slow down development progress. The situation is worsened by climate change that increases the frequency and severity of extreme floods and droughts. This has led to an increasing focus on disaster risk reduction (DRR), which includes a push to move from just emergency response to anticipatory early actions that are implemented before disasters occur.

SCIENCE AND TECHNOLOGY FOR HUMANITARIAN ACTION

With a vision of contributing to safety of life and property and economic development, Hydro-Meteorological Services and climate science have in recent years intensified the development of weather and climate forecasts to support disaster risk reduction. This is emphasised in the

[1]GAR19 https://gar.unisdr.org/report-2019
[2]Oxfam, 2019. Committed or complacent: A failing response to the 2019 Horn of Africa drought crisis https://www.oxfam.org/en/research/committed-or-complacent
[3]See http://fews.net/east-africa/alert/may-11-2018
[4]GFCS https://gfcs.wmo.int/disaster_risk_reduction

Figure 2: Climate adversity was the key driver of food insecurity in the IGAD Region in 2018. ***Source: Global Report on Food Crises (GRFC 2019)***[5]

Global Framework for Climate Services (GFCS)[4] that has DRR as one of the key priorities, aimed at enhancing the delivery of climate services to build society's resilience to disasters.

A number of advances in weather and climate science forecasts have been made in Africa, such as the development of forecasts and warnings on severe weather in Eastern, Southern and Western Africa[6]. In Eastern Africa, these forecasts can give an indication of heavy rainfall that may potentially cause floods. An example is shown in Figure 3 where the Kenya Meteorological Department (KMD) gave warning of heavy rains to occur between 1st and 3rd March 2018 in a number of places across the country. It was noted in Kilavi et al. (2018)[7] that heavy rainfall did occur between 1st and 6th March 2018. Floodlist[8] records show that the rainfall caused about 150 people to evacuate their homes while others were marooned, and roads became making it difficult to distribute relief supplies to those affected.

Following the recommendation from the 69th Executive Council session of the World Meteorological Organization (WMO) in May 2017[9], the first objective seasonal forecast for the GHA Region was produced for the June to September 2019 season, by the IGAD Climate Prediction and Applications Centre (ICPAC)[10]. The objective forecasts take advantage of improvements in seasonal climate models that are run by various institutions globally, and systematically combine the results into a consolidated regional forecast. This is a step change from earlier practice where subjective expert judgement was used to merge individual national forecasts into spatially coherent regional outlooks. Objective forecasts now have the potential to readily tailor seasonal forecasts to support specific uses, such as in predicting the probability of rainfall scarcity that may lead to drought. The forecasts can now be consistently developed and reproduced, hence the longer-term skill can be objectively evaluated so as to inform the reliability of basing decisions on these seasonal forecasts.

On the other hand, generation of better risk data has increased, given its importance to both short - and long-term climate smart DRR planning and implementation. This has been supported by the existence of early warning systems that monitor

[5]GRFC 2019 http://www.icpac.net/wp-content/uploads/IGAD-2019-online.pdf
[6]WMO Severe Weather Forecasting Demonstration Project https://www.wmo.int/pages/prog/www/swfdp/
[7]Kilavi et al., 2018 https://www.mdpi.com/2073-4433/9/12/472
[8]See Floodlist report http://floodlist.com/africa/kenya-floods-march-2018
[9]WMO 69th Executive Council session https://library.wmo.int/doc_num.php?explnum_id=3645
[10]ICPAC is the WMO mandated Regional Climate Centre and is responsible for eight member countries, namely: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan and Uganda (which are in the IGAD member states) as well as Burundi, Rwanda and Tanzania http://icpac.net/

Kenya Meteorological Service
Department of Environment & Natural Resources
Ministry of Environment, Water & Natural Resources

P.O.Box30259-00100,NgongRoad,Dagoretti-Corner,Nairobi.
Tel: +2542038567880-5,+254724255153-4Email:director@meteo.go.ke

Heavy Rain Advisory

Message Type:	Heavy Rain
Message Update No.:	One
Date of Origin:	27th February 2018, 1200UTC
Validity:	1st March to 3rd March, 2018
Severity:	Mild to Moderate
Certainty:	Moderate Probability of occurrence (33% to 66% chance)
Message Description:	An increase in rainfall is expected over various parts of the country from Wednesday 28th February 2018. However, this is not the proper onset of the March-May rainfall season. Heavy rainfall of more than 50mm in 24 hours is likely to occur from Thursday 1st March 2018 in counties in Western, Rift Valley, Nyanza, and Central including Nairobi area and Southeastern lowlands.The heavy rainfall is likely to continue on Friday 2nd March over counties in the South Coast, Western, Nyanza, Rift valley, Northern, Central including Nairobi and Southeastern lowlands. On Saturday 3rd March 2018 Counties in Western, Nyanza, Rift Valley, Central and Southeastern lowlands are expected to continue receiving heavy rainfall in the afternoon. The rains will reduce in intensity over the Eastern, Coast and Northern regions but moderate rainfall will continue over the rest of the country.
Area(s) of Concern:	The counties to be affected by the heavy rainfall include: Kisii, Kericho, Bomet, Narok, Migori, Kakamega, Kajiado, Nakuru, Kwale, Marsabit, Turkana, Samburu, Nairobi, Nyeri, Kiambu, Muranga, Kitui, Machakos, Makueni and TaitaTaveta.
Instructions:	Residents urban areas are advised to be on the lookout for flashfloods. In dry river beds moving water may suddenly appear. Soil erosion may occur in areas that have been dry and have bare soils. Continue listening to local media as updates will be provided if conditions change significantly. Further advisories will be issued as we follow up on the progress of this weather event.
Message Addressed to:	National Disaster Operations Centre, Kenya Red Cross, Key Ministries, Media, Office of the Presidency, County Directors of Meteorological Services (CDMs)
Originator:	Director, Kenya Meteorological Department-Nairobi.

Figure 3: Heavy rain advisory issued by KMD on 27 February 2018 for the period between 1–3 March 2018

various indicators, in response to Target G[11] and Priority 1[12] of the Sendai Framework. Innovative technology such as drones, satellite imagery, crowdsourcing information through social media and volunteer mapping such as on OpenStreetMap (OSM)[13] , amongst others, are being used to generate risk data and risk assessments. Risk assessments have become pivotal in disaster prevention, mitigation, preparedness and response.

[11]Target G- Substantially increase the availability of and access to multi-hazard early warning systems
[12]Priority 1- Understanding disaster risk
[13]OSM https://www.openstreetmap.org/about

Even with advances in climate science and the use of technology that can support anticipation of risk, the reality is that humanitarian action and finance for action is still driven by ex post impacts of flood and drought events. An example of this is the 2016 –18 drought in the GHA. As demonstrated by the timeline of major events in Figure 4, appeals to fund emergency response actions in Ethiopia and Kenya were done months after seasonal forecasts for high probability of below average rainfall in the GHA region (and the subsequent national forecasts) were released. This implies that though the seasonal forecasts indicated the chance of rainfall scarcity, the information did not trigger funding to support those who may have been affected. It raises question on how useful are the current seasonal forecasts in showing potential need for humanitarian action.

Figure 4 also shows that humanitarian action is still responsive to needs, based on observed impacts brought out by needs risk assessments, rather than anticipatory based on potential impacts as implied by forecasts. Question is, have improvements in forecasting and risk data and assessments changed the way humanitarian action is taken? Why is humanitarian action and finance mainly triggered by risk assessments and not by rainfall forecasts or a combination of forecasts and risk assessments?

THE CASE FOR IMPACT BASED FORECASTS

If current humanitarian action is triggered by disaster impacts, then it is reasonable to expect that forecasts of potential disaster impact will trigger anticipatory action, compared to a

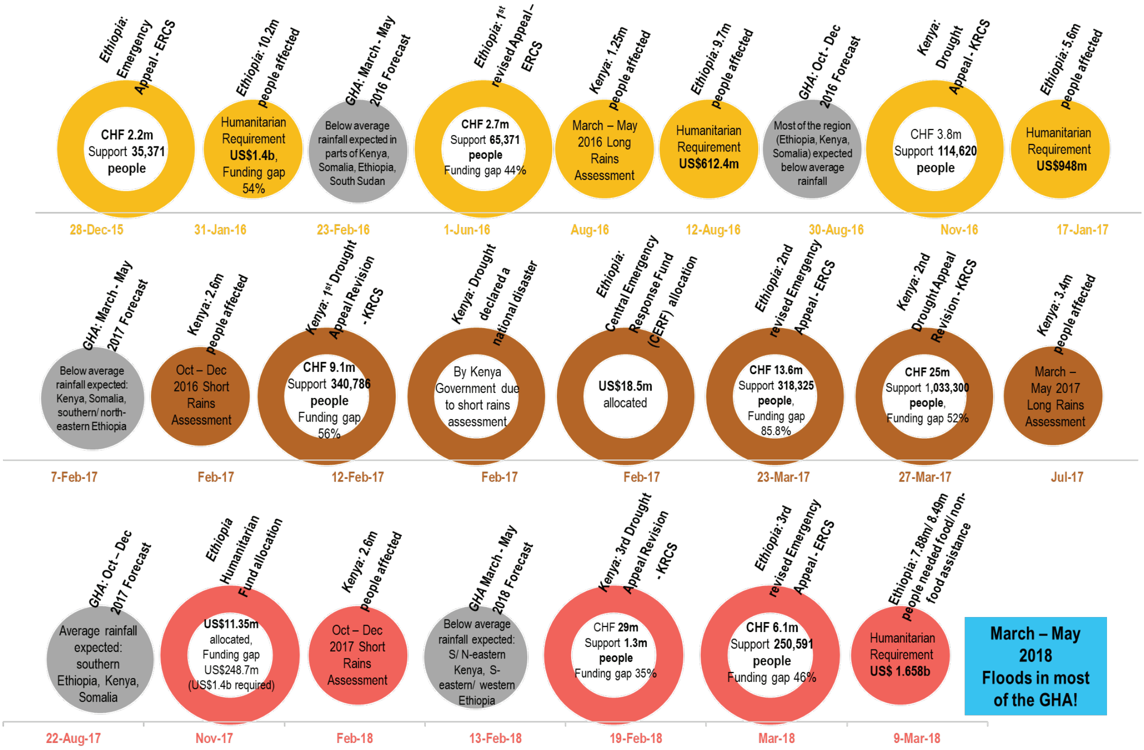


Figure 4: Timeline of 2016 – 2018 drought events showing when appeals for funding were made, numbers of people affected based on risk assessments, and forecasts released. Note that the events are not exhaustive, but presents major ones recorded in available online literature. *Sources: IFRC Appeals http://www.ifrc.org/en/publications-and-reports/appeals/?p=1, UNOCHA bulletins and Humanitarian Requirements Documents for Ethiopia https://reliefweb.int/, post-rains assessments for Kenya from National Drought Management Authority http://www.ndma.go.ke/index.php/resource-center/all-downloads and ICPAC forecasts for the GHA region http://rcc.icpac.net/index.php/long-range-forecast/regional-consensus-climate-outlook-statement*

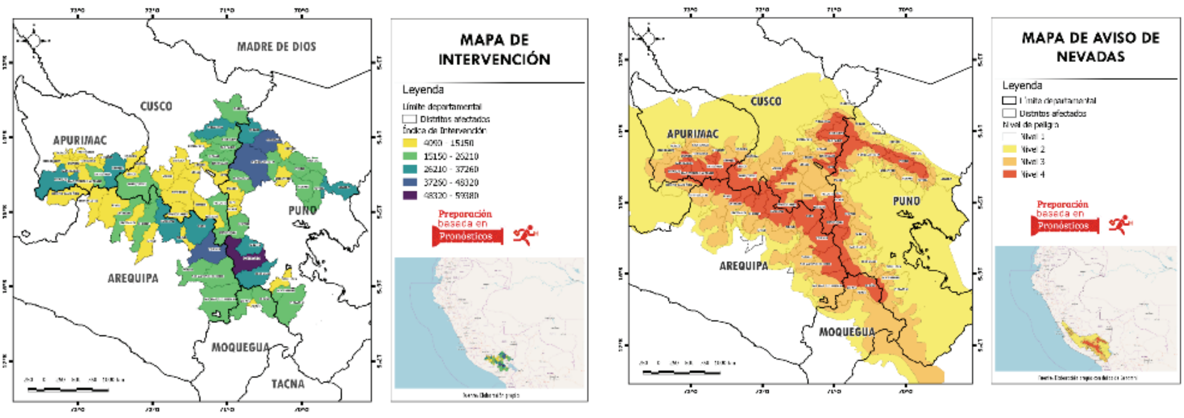


Figure 5: Impact based forecast (left) in Peru, with dark shaded areas showing hotspot areas that were most at risk of being affected by heavy snow fall. This was a generated by combining vulnerability information with the forecast of snow (right). If only the snow forecast was used, then action would have been triggered in the orange shaded areas, and yet some of the places (e.g. in Apurimac and southern Cusco, as indicated by the yellow/green shading) were not at high risk of getting impacted. *Source: Peru Early Action Protocol for Extreme Cold and Snowfall https://www.ifrc.org/en/publications-and-reports/appeals/?ac=&at=0&c=&co=SP245PE&dt=1&f=&re=&t=&ti=&zo=*

forecast of rainfall. It means a step change from forecasting 'what the weather/ climate will be, to what the weather/ climate will do', hence the development of impact based forecasts. This requires grounding science in the dynamic risk context by bringing in information on varying levels of vulnerability, exposure and capacity. Impact based forecasts are in essence a demand for specific type of climate services to support anticipatory humanitarian action.

WMO, in partnership with institutions such as the UK Met Office and National Oceanic and Atmospheric Administration (NOAA), among others, have driven the discussion on the need for hydro-meteorological services to move towards the production of impact-based forecast and warning services. This is with the vision that creating services that incorporate user perspectives will lead to more effective anticipatory action.

In the GHA, the first attempt at developing impact-based forecasts was done under the Multi-hazard early warning service (MHEWS)[14] project in Tanzania, aimed at reducing the impacts of extreme weather on coastal regions of the country. However, the project only managed to develop conceptual impact based service products. Building on MHEWS, the High impact weather lake system (HIGHWAY)[15] project is establishing weather based early warning system for fishermen in Lake Victoria, covering Kenya, Tanzania and Uganda, as well as Burundi and Rwanda.

The HIGHWAY project aims to turn marine weather forecasts into clear practical advice to mitigate impact. Results of impact-based forecast from this project are yet to be realised, and indeed much is to be done in the region in order to develop such kinds of forecasts. The region can learn from pilots of impact-based forecasts developed around the world. Some of these examples are presented below.

In Peru, the Red Cross Red Crescent (RCRC) Movement has been working with the Peruvian Meteorological Service (SENAHMI) since 2015 to co-produce triggers for early action, inspired

[14]MHEWS was a project under the Weather and Climate Information Services for Africa (WISER) programme in Eastern Africa, funded by UK Aid. https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/business/international/wiser/mhews-project-summary.pdf

[15]HIGHWAY is one of the current WISER projects https://www.metoffice.gov.uk/about-us/what/working-with-other-organisations/international/projects/wiser/highway.
FbF https://www.forecast-based-financing.org/about/

by the impact based financing concept. This is through the Forecast-based Financing (FbF)[16] approach that aims to anticipate disasters, prevent their impact, if possible, and reduce human suffering and losses.

The process in Peru has led to the design of forecast triggers for early action to be taken ahead of cold waves, extreme rainfall and floods. The triggers integrate historical disaster impact information, vulnerability data and forecasts, to produce relevant decision making information that allow the Perivuan Red Cross to know when and where they should act ahead of potential disasters, and who should be targeted based on their likelihood to be impacted.

In June 2018, the impact based forecast (see Figure 5) was used to trigger humanitarian distribution to mitigate suffering from extreme cold and heavy snow[17]. This involved distribution of nearly 400 family packages containing heavy coats for adults and children, tarpaulins, and animal-care kits with vitamins and antibiotics for alpacas. The action was done ten days before the Peruvian Government declared a two-month state of emergency after an assessment by civil defence.

In Mongolia, the National Meteorological and Hydrological Services (NMHS) has co-developed an impact based forecasting service in partnership with Ngoya University of Japan, for Dzud hazard[18]. Dzud is a phenomenon characterised by severely cold weather that causes large numbers of livestock to die. The impact-based forecast indicates, on a seasonal basis, where there is a high likelihood of mortality of livestock. The UN Food and Agriculture Organisation and the Mongolian Red Cross are using it to trigger anticipatory humanitarian action. In December 2017, the Mongolia Red Cross used the impact-based forecasts to trigger assistance for 2,000 pastoralist households, providing them with unrestricted cash grants of USD 100 and animal care kits. Quasi-experimental research showed that this FbF action that was activated in anticipation of Dzud was effective in reducing livestock mortality and increased offspring survival rates.

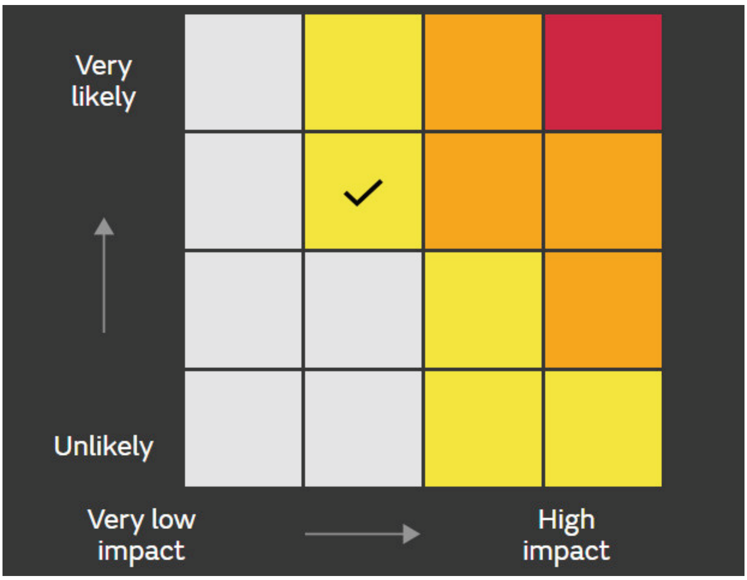


Figure 6: Impact – likelihood matrix that is used by the UK Met Office to issue warnings of severe weather. ***Source: UK Met Office https://www.metoffice.gov.uk/weather/guides/warnings***

[16]FbF https://www.forecast-based-financing.org/about/.
[17]FbF action in Peru https://www.climatecentre.org/news/1008/new-state-of-emergency-in-snowbound-peru-districts-includes-earlier-fbf-distribution-sites
[18]This has been integrated in the Early Action Protocol for Dzud in Mongolia https://www.ifrc.org/en/publications-and-reports/appeals/?ac=&at=0&c=&co=SP354MN&dt=1&f=&re=&t=&ti=&zo=

The UK Met Office is operating an approach for impact-based forecasts, which are issued as warnings when severe weather with the potential to cause impacts is expected. The types of weather phenomena for which the impact based forecast are developed are: Rain, thunderstorms, wind, snow, lightning, ice, and fog. Impacts covered include damage to property, travel delays and cancellations, loss of water supplies, power cuts and, in the most severe cases, bring a danger to life in the UK. The warnings are given a colour (yellow, amber or red) depending on a combination of both the level of impact the weather may have and the likelihood of those impacts occurring. This is presented in the form of a matrix (Figure 6). Included in the forecast is advice and guidance from partners, such as Civil Contingencies, on how to stay safe in severe weather.

Using learning from the FbF pilot projects by the RCRC Movement and other initiatives, the National Red Cross Societies in Ethiopia, Kenya and Uganda, in collaboration with various institutions including NMHS in the three countries and ICPAC, are implementing FbF at national-scale.

The work involves establishing an early warning early action system that enables actions to be taken anywhere in the three countries where the forecast indicates a high risk of severe drought and flood impact. Such a system requires impact-based forecasts, so as to target cost-effective and timely anticipatory actions for the most vulnerable people. This is being implemented under the Innovative Approaches to Response Preparedness (IARP)[19] Programme, integrating the FbF approach with data preparedness and cash transfers.

A key result from IARP's work in designing the anticipatory system has been the collaborative prioritisation of flood and drought impacts (Figure 7), to bring clarity on what challenges the impact based forecasts and the triggered early actions aim to address. Co-exploration and negotiations on what impacts are forecastable is a next step, considering the current state of scientific knowledge, technical capacities and risk data availability and quality.

THE WAY FORWARD

Impact based forecasting is not yet the standard practice for NMHS nor disaster managers in the GHA. A step towards making this business as usual will include practical and technical guidance on how impact based forecasts can be developed, distilling methodology and processes from trials and pilots. Further, testing of different approaches to identify which impact based forecasting approaches are more viable for different types of contexts is needed. Programmes such as WISER, Science for Humanitarian Emergencies and Resilience (SHEAR)[20] and IARP are investing in exploring these questions and generating learning and evidence of what works. This will be useful in prototyping and getting impact based forecasting approaches into operational systems, such as through update of the guidelines for multi-hazard impact based forecasting that were developed by WMO in 2015[21].

Investments in modernising and enhancing scientific capacity of NMHS are also needed to deliver impact based forecasting, as it is a new service demand to protect those at highest risk of suffering from high-impact weather and climate events.

An example of such an initiative is the GCRF African Science for Weather Information and Forecasting Techniques (GCRF African–SWIFT) programme. GCRF African–SWIFT[22] Programme aims to deliver a step change in African weather forecasting capability from hourly to seasonal

[19]IARP is funded by the IKEA Foundation, and technically supported by the Netherlands Red Cross, British Red Cross, 510 and the RCRC Climate Centre.
[20]SHEAR http://shear.org.uk/
[21]WMO Guidelines on Multi-hazard Impact-based Forecast and Warning Services https://library.wmo.int/index.php?lvl=notice_display&id=17257#.XdQ9gWgzY2w
[22]GCRF African-SWIFT is led by the National Centre for Atmospheric Science (NCAS), and funded by UK Research and Innovation Global Challenges Research Fund. The programme is implemented in Ghana, Kenya, Nigeria and Senegal. Consortium partners are NCAS, University of Leeds, University of Reading, CEH, UK Met Office, ACMAD, ICPAC, ANACIM, UCAD, GMet, KNUST, NiMet, FUTA, KMD, and University of Nairobi, and WMO as an advisory partner.

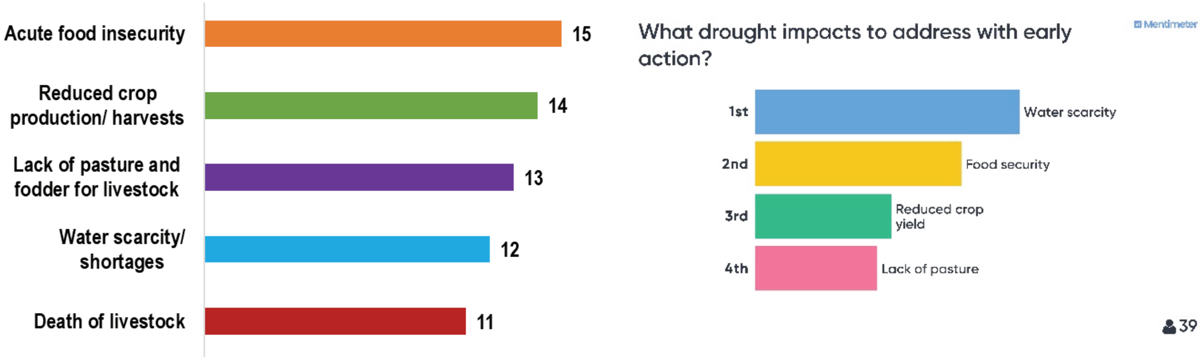


Figure 7: Results from multi-stakeholder discussions to prioritise drought impacts in Ethiopia (left) and Kenya (right), towards development of impact based forecasts

timescales, build research capability to continue forecasting improvements in Africa, and enhance understanding on how to tailor the provision and delivery of weather forecasts to inform action before high-impact events. Quite important for such initiatives will be to ensure that the science development does not happen in parallel or siloed spaces, but rather, it is connected to operational dialogue with practitioners who will implement early actions.

Equally important is the need to consolidate risk data, check its quality and enhance its availability, especially through open source platforms. Capacity for regular and consistent risk data collection and management will also need to be enhanced, for example, through review and improvement of existing early warning systems. This is in recognition that impact based forecasting requires an in-depth analysis of risk, with updates done in line with the dynamic nature of risk.

It is therefore critical that impact based forecasting services are co-designed and co-developed. Collaborative agreements between NHMS, DRM agencies, humanitarian actors, sectoral services, information management agencies, as well as with at risk communities are needed to sustain this kind of dialogue process. Taking this into account, the IARP programme in Ethiopia, Kenya and Uganda spent a significant amount of time getting various stakeholders interested and engaged in the process, setting up Technical Working Groups and signing memorandums of understanding with key institutions.

A question to be answered, however, is whose mandate is it to issue impact based forecasts generated from collaborative efforts, such that early action is triggered by all relevant institutions including governments? Work on sustainable institutional arrangements for impact based forecasting is still to be done!

THE IARP PROGRAMME

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ICHA International Center for Humanitarian Affairs
At the Kenya Red Cross Society
Inquire • Understand • Influence

South "C" (Bellevue) | Red Cross Road, Off Popo Road
P.O. Box 40712, 00100-GPO, Nairobi, Kenya. | Tel: (+254-20) 6003593/6002465/3950000 | Fax: (+254-20) 3950444
Mobile: (+254) 703 037000/722 206958/733 333040
Email: info@icha.net | Website: www.icha.net

Kenya Red Cross

South "C" (Bellevue) | Red Cross Road, Off Popo Road
P.O. Box 40712, 00100-GPO, Nairobi, Kenya. | Tel: (+254-20) 6003593/6002465/3950000
Fax: (+254-20) 3950444 | Mobile: (+254) 703 037000/722 206958/733 333040
Email: info@redcross.or.ke | Website: www.redcross.or.ke