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Climate Forecasting to Serve Communities in West Africa

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Abstract

The recent Red Cross experience acting on forecasts in west Africa provides examples of how climate information can be linked to decisions and serve development in low-income regions, and how climate and weather forecasts may become useful to communities at risk from climatic events, provided that the obstacles thwarting these communities' access to and use of forecasts are clearly identified and overcome.

Keywords: Climate variability, seasonal forecast, early warning-early action, community, Red Cross, West Africa, vulnerability, development.

1. Introduction

Since the late twentieth century, an improved ability to model ocean–atmosphere interactions has led to an increased ability to forecast climate variability at the seasonal-to-interannual timescale across the world [1][2][3]. In many areas of the world however, this increase in forecast skill has not translated itself into improved decisions and increases in social welfare, and climate forecasting has not fulfilled its promise of aiding society in better managing climate risk and better anticipating and preparing for climatic hazards.

West Africa, one of the world's lowest income regions, is one of such area where forecasts are not useful to society. Despite the significant potential of early information about likely climatic hazards to save lives and preserve livelihoods in this highly climate-sensitive region, only a few instances exist of successful transmission and use of available climate and weather forecasts and other climate risk management tools by policymakers and communities at risk across the region [4].

In Mali, the world's fifth poorest nation, the Direction Nationale de la Météorologie du Mali (DNM), Mali's meteorological institution, in the context of the Swiss cooperation-funded project, the "Projet Pilote d'Assistance Agro-météorologique aux Paysans", has been providing detailed agrometeorological forecasts to farmers since 1983, advising them on appropriate response strategies to likely climate conditions during the July-August-September planting season, and involving them in the process of data collection and analysis [4][5]. This has led to adoption of the advice by farmers and has contributed to an increase of about 30 per cent in cereal production [6].

Four countries removed to the east, in Niger, the world's poorest country, the Regional Centre for Agricultural Meteorology and Hydrology (AGRHYMET) has been training groups of pastoralist herders (Figure 1) on using custom-made real-time Normalized Difference Vegetation Index (NDVI) satellite image maps in order to locate green pastures where they may lead their herds with confidence.

These initiatives, however, remain uncoordinated at best, and haphazard and disjointed at worst, leading to the sorry observation that climate forecasting does not play a major role in the region.

Despite the existence of a regional outlook forum that issues an annual consensus-based forecast for the June-July-August (JJA) rainy season over west Africa – the PRESAO (Prévisions Saisonnières en Afrique de l'Ouest), hosted every year in May by the African Centre of Meteorological Applications for Development (ACMAD) – no decisions taken as a result of these seasonal forecasts can be traced; by and large, national civil protection departments, public health officials, dedicated disaster management agencies, humanitarian organizations, dam and water managers, urban slum dwellers, farmers, fishermen and other vulnerable groups across the region, all potential beneficiaries of climate knowledge, operate without using any climate information as input into their decision-making under uncertainty.

This paper documents one instance of a seasonal forecast duly transmitted and acted on by a humanitarian organization in west Africa, the International Federation of Red Cross and Red Crescent Societies (IFRC), which instigated a number of ground-breaking early actions based on the 2008 PRESAO seasonal precipitation forecast, presenting an outlook for a season with likely above-normal rainfall. The innovative application that the Red Cross made of the 2008 west Africa seasonal forecast charts a new course for how climate forecasts may be used to guide disaster planning and to lead to smarter, more informed decision-making in the region. Mostly, this use of forecasts to inform decision-making at the regional level serves to reveal the many obstacles still thwarting the transmission and use of forecasts by communities at risk at the ground level. Among these are the still too technical format of

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Figure 1. Herders in Tahoua region (Niger) learning to use custom-designed satellite image maps (Courtesy: AGRHYMET)

seasonal and shorter-range forecasts, their non-salience to the information needs of users and most of all the absence of any dialogue between climate forecasters at the national level and vulnerable communities.

This paper is organized in two large parts. The first part delves into the successful Red Cross experience using seasonal forecasts in 2008 to guide disaster planning and inform disaster management. Section 2 addresses the context of vulnerability to climatic events in west Africa. Section 3 introduces the content of the 2008 seasonal rainfall forecast, and presents an overview of the forecast-based decisions made by the IFRC West and Central Africa Zone Office (WCAZ), including mobilizing funds, pre-positioning relief items, training staff and establishing partnerships with scientific organizations in the region, as well as a description of the actions Red Cross national societies undertook at the national level once the seasonal forecast was transmitted to them. Section 4 presents an overview of the 2008 rainy season, and some of the impacts of the flood risk management measures undertaken by the Red Cross, and Section 5 outlines the remaining challenges to the use and dissemination of forecast to vulnerable communities.

The second part of the paper analyses the 2008 Red Cross experience using seasonal forecasts, and outlines the bottlenecks to community access and use of seasonal forecasts that emerged from this experience. Section 6 focuses on the obstacles to the transmission and use of climate information by vulnerable communities (the missing link), and presents the bottlenecks to the use of seasonal forecasts at community-level. Section 7 concludes with key lessons from this experience and suggestions for the way forward in order to enable community access and use of climate information.

2. Context of vulnerability to climatic events in west africa

West Africa is one of the world's lowest-income regions. Indeed, of the 22 countries that layer the bottom of the United Nations Development Program Human Development Index ranking, a composite index measuring life expectancy at birth, adult literacy rate and gross domestic product per capita, 15 are west African, in a region comprised of 17 countries [7]. All of West Africa's seventeen countries lie at the bottom of the human development ladder, and are classified among the 22 poorest countries in the world (except for Ghana and Mauritania that serve as outliers, occupying positions 135 and 137 out of 177 ranked).

In west Africa, climate variability within the seasonal-to-interannual timescale constitutes a practical problem with monumental social ramifications. More than half of the active population on average is employed in the agricultural sector [8], and only 7 per cent of the total cultivated land is irrigated or under some other form of water management [8]. In countries such as Niger or Burkina Faso, as much as 90 per cent of the active population is employed in the rainfed agricultural sector [8]. Across the region, a growing majority also lives in ill-planned urban shantytowns built on flood plains where they settled during the prolonged drought period that gripped the Sahel from the early 1970s to the late 1980s ([9]; driving peasants out of the countryside and into peri-urban settlements where they are today exposed to the vagaries of a changing climate [10][11].

Against this context of high vulnerability to climate variability and low coping capacity, slight changes in expected rainfall patterns can affect at once hundreds of thousands of vulnerable people who either depend on the rains for their livelihoods in the countryside or are directly exposed to the damages caused by excessive rainfall in urban areas where there are no adequate sewage systems to drain waters during wet spells.

This extreme vulnerability to climate variability makes the region an ideal potential beneficiary of the type of seasonal climate information provided through the Regional Climate Outlook Forums (RCOFs) [12]. West Africa's Seasonal Outlook Forum, PRESAO, was established in 1998, and has occurred annually each May to provide a consensus forecast for the coming July-September rainfall season. The PRESAO brings together scientists and hydrologists from National Meteorological and Hydrological Services (NMHSs), and climate forecasting centres from across the region (ACMAD, AGRHYMET) and the world (Met Office, Meteo France, the International Research Institute for Climate and Society [IRI], the National Oceanic and Atmospheric Administration Africa Desk, the World Meteorological Organization), to discuss and agree on the forecast for the July-August-September rainy (JAS) season over west Africa. This consensus forecast issued at the end of the PRESAO forum is the most authoritative voice on conditions most likely to prevail over the upcoming JAS season in west Africa, Cameroon and Chad.

3. The 2008 West Africa seasonal precipitation forecast: cause for concern

In May 2008, the consensus-based forecast issued at the PRESAO announced that the JAS rainy season over west Africa had enhanced probabilities of above-normal rainfall, implying that the region was likely to experience increased risk of heavy rainfall events [13]. Indeed, national, regional and international forecasters gathered at the PRESAO predicted that the 2008 rainy season was likely to be wetter than usual over most parts of west Africa, in particular throughout much of the Sahelian belt from Senegal to Cameroon. The PRESAO forecast, issued on 21 May 2008 by ACMAD, warned of a negative sea-surface temperature anomaly over the equatorial Pacific Ocean, with associated unusually warm conditions over the tropical Atlantic and increased probabilities for higher-than-normal rainfall in the region (probabilities of 0.45 and 0.50 in zones I & II, respectively; see Figure 2). Against a historical probability of 0.33, these probabilities for above-normal rainfall were unusually high, and warranted heeding. Although the seasonal rainfall forecast refers explicitly only to the seasonally integrated rainfall, and not to individual heavy rainfall events that are the primary cause of flooding, it seems reasonable to assume that the actual risk of flooding will increase during a year in which the total rainfall is expected to be unusually high, although further research on the extent to which this assumption is valid is clearly warranted.

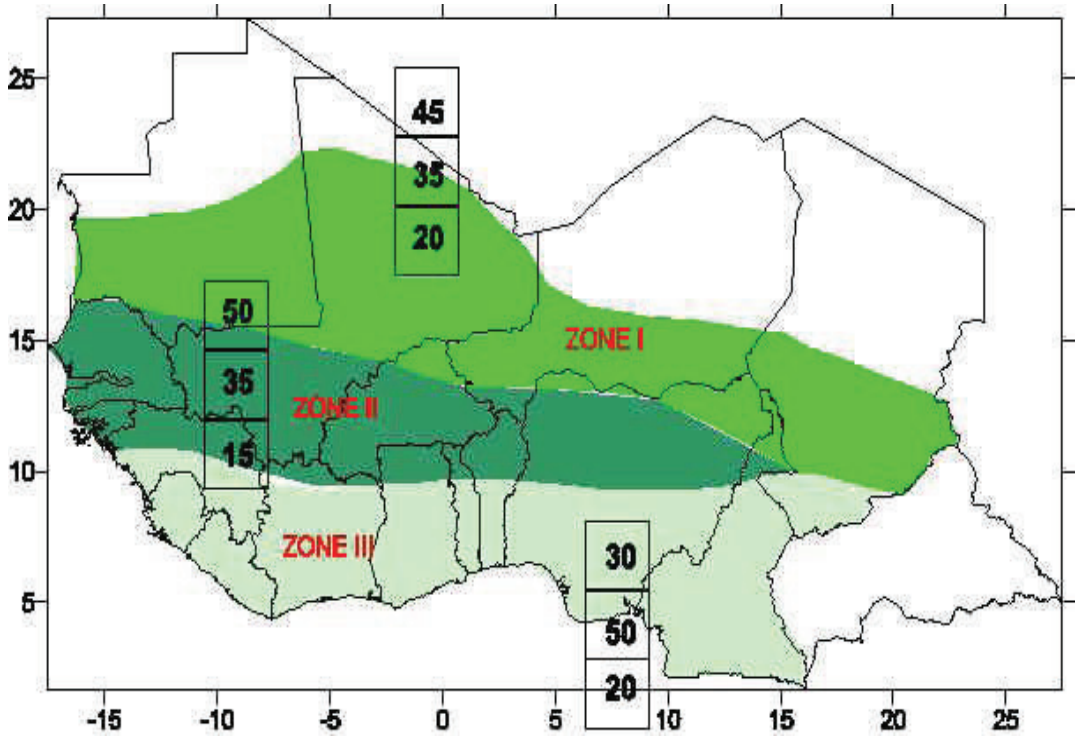

Figure 2. The 2008 PRESAO forecast: probability forecast for precipitation over July-August-September (Source: ACMAD [13]) (Most likely conditions: Zone 1-Wet; Zone 2-Very Wet; Zone 3-Normal)

The multi-model seasonal precipitation forecast for Africa issued by the International Research Institute for Climate and Society echoed the same warnings, indicating probabilities for above-normal rainfall over west Africa similar to those of the PRESAO forecast (0.50 and 0.45), albeit with slight differences in the geographic area at risk at the northern and southern frontiers of the Sahel.

The IRI map of extreme seasonal rainfall (more than the 85th percentile) for June-July-August was even more alarming, signalling west Africa, most precisely Senegal, the Gambia and neighbouring countries as the only areas in the world with highly enhanced probabilities of rainfall extremes (Figure 3).

Thus as of May, all the main sources (national, regional, international) converged and asserted that the upcoming season was likely to be much wetter than usual over most parts of west Africa. The assumption seemed warranted that flooding risks within the region were sufficiently enhanced to be of serious concern.

In May 2008, a confluence of favourable factors led the Red Cross, leading humanitarian organization in the region endowed with an extensive network of volunteers at the community level, to receive and act on the 2008 PRESAO seasonal forecast. First, a new partnership between the IFRC and IRI at the global level sent an intern to the IFRC West and Central Africa Zone Office (IFRC-WCAZ) in the summer of 2008 with the mission to assist its disaster management unit in better understanding and incorporating climate information into its decisions. The presence of this in-house climate scientist at the IFRC-WCAZ proved to be instrumental in translating the seasonal forecast into lay language that Red Cross disaster managers could understand once the forecast reached the Office [14]. Second, in 2008 the Red Cross Disaster Management Coordinator for West and Central Africa, Youcef Ait-Chellouche, became highly keen on initiating a dialogue with climate scientists regionally, and after discovering the existence of a regional IRI partner (ACMAD), even attended the PRESAO-11, the first time a humanitarian actor ever attended the scientific forum.

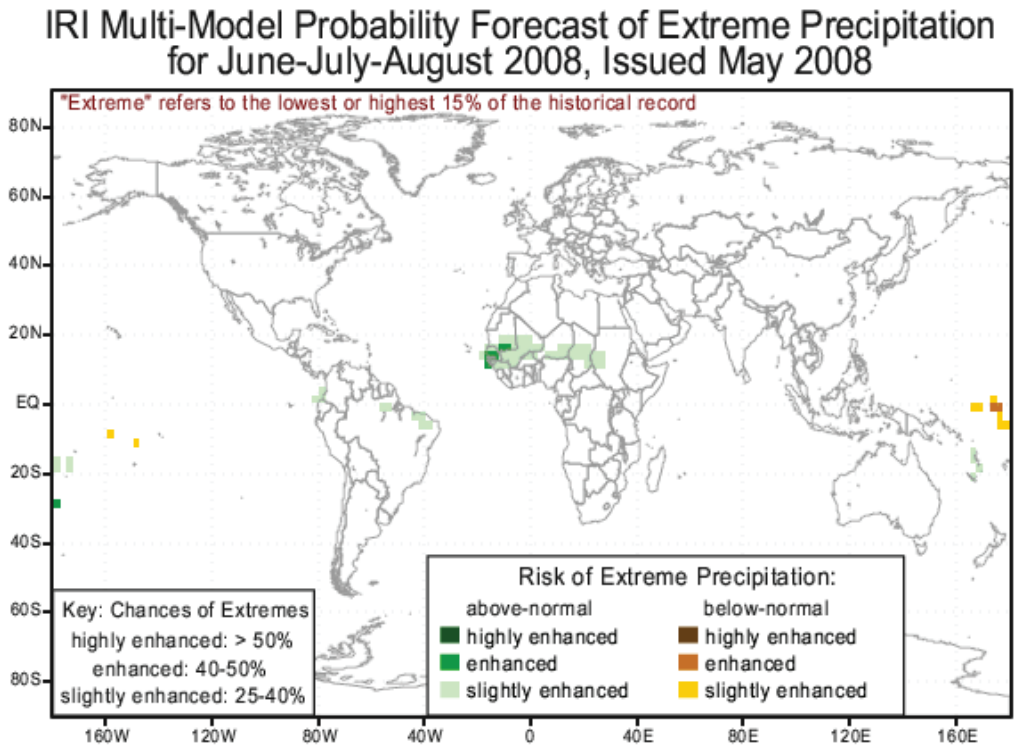

Figure 3. Areas of the world likely to be at risk of extreme precipitation in the JJA season (Source: IRI)

Finally, the severity of the 2007 floods, still fresh in the institutional memory of disaster managers in the region who could acutely remember the devastation and frenzied response operations during the previous year's rainy season, put Red Cross disaster planners in a favourable disposition towards increased preparedness.

In the context of this incipient drive to reach out to climate scientists, when the 2008 seasonal forecast reached the IFRC West and Central Africa Zone Office warning of a heightened risk of heavy rainfall conditions, and this information was translated into language that they could understand, the Red Cross disaster managers sprang into action, setting in motion a number of early action strategies based on the information contained in the seasonal forecast.

3.1 Linking early warning with early action: actions undertaken by the ifrc based on the seasonal precipitation forecasts

3.1.1 First pre-emptive appeal in Red Cross history issued based on seasonal forecast

Based on the PRESAO seasonal forecast 2008 and the IRI June-August seasonal forecast, the first action that the IFRC undertook was to draft a zonal Flood Contingency Plan. Then it issued a funding request to the Disaster Relief Emergency Fund (DREF), an internal Red Cross funding source, requesting a total of CHF 298 376 (US$ 284 167) in order to prepare for imminent floods in the region, through the pre-positioning of non-food relief items (blankets, mosquito nets, soaps, bottles, tents, etc.) in Dakar (Senegal), Yaoundé (Cameroon) and Accra (Ghana) that would serve to benefit up to 35 000 beneficiaries in the advent of a flood. The IFRC-WCAZ office explained in this document its worry that catastrophic floods were looming, invoking the ACMAD forecast and IRI as its sources of information, explaining that these were mere probabilities of likely occurrence but ones that still warranted action, affirming its desire to stand ready for these floods in the case that they indeed occurred.

This DREF request was granted.

Following the success of the DREF, an historic preliminary emergency appeal for flood preparedness in west and Central Africa was issued on 11 July, requesting US$ 730 000 in contributions from humanitarian donors to fund preparedness activities throughout the region. Both PRESAO and IRI maps were again included in this appeal as justification for the need to get ready and prepare for announced floods. It was clearly explained therein that the forecast was in terms of probabilities.

This was the first time in the history of the Red Cross movement that funds were requested in advance to prepare for an emergency based on seasonal forecast information. It constitutes a positive instance of climate information duly transmitted and acted on.

It also disproves the argument that donors do not fund preparedness activities. Faced with solid scientific predictions by a credible humanitarian organization, donors were indeed willing to provide funding for early preparedness actions. One of the winning arguments used by the Red Cross was to request funding to implement "no-regrets" strategies, such as buying and pre-positioning non-perishable relief items that could be reused in successive years if the forecast floods did not occur that year.

Unfortunately, donations from the preliminary appeal did not arrive until late August, after flood disasters were already underway. The IFRC was able to use funds immediately available from the DREF, however, to pre-position emergency stocks in Dakar, Accra and Yaoundé [15].

3.1.2 Additional Red Cross disaster relief personnel trained

Following the forecast of a high-risk rainy season, the IFRC-WCAZ trained in early July twelve Regional Disaster Response Team Leaders (RDRTLs), to be deployed to the field within 48 hours of the advent of a disaster in the region to coordinate relief operations and conduct a rapid assessment of damage and needs.

These RDRTLs were specifically trained in understanding medium-term weather forecasts (6-day forecasts were made accessible online via the IFRC online Disaster Management Information System through its collaboration with IRI) so that they would be able to monitor throughout the rainy season hazards coming towards their countries, and write national flood contingency plans using as input accurate real-time meteorological information. Additionally, at the end of the training, all RDRTLs were provided with travel insurance (rendering them deployable within 24 hours of the onset of a flood disaster in the region) and were asked to prepare a flood contingency plan for their respective countries, by 15 July at the latest [14].

3.1.3 Secured inflow of climate information through outreach and formal partnerships with regional climate centres

The 2008 experience created a thirst within IFRC-West Africa for additional climate information, as well as a strong desire to reach out to regional climate research centres as a pathway to secure access to reliable and trustworthy climate information at the regional level.

Thus, formal partnerships were initiated and drafted in late July with both ACMAD and AGRHYMET. All throughout the 2008 rainy season, IFRC-WZAC reached out to these scientific partners, inquiring about likely atmospheric conditions in given countries, requesting additional information and constantly refining its information needs, and demanding information that addressed those needs. This process culminated in the signing of a memorandum of understanding between ACMAD and IFRC-WCAZ on 23 March 2009, the first ever partnership accord signed between climate scientists and humanitarians in the region.

3.2 Linking early warning with early action at the national level: Actions undertaken by national Red Cross societies

After the initial region-wide preparations had been put in place, more direct actions at the local level were taken by national branches of the Red Cross in response to shorter-range forecasts.

In Ghana, where the 2007 flood disaster was made much worse by the sudden discharge of water upriver at the Bagre Dam in Burkina Faso in late August, the Volta River Authority and its Burkinabe counterpart, SANOBIL, agreed upon a control regime to protect communities along the Black and White Volta rivers during rainy season 2008, predicted to be high-risk. Volunteers of the Ghana Red Cross thus set out to advise fishermen not to go out on the river from 21 to 23 August, the announced period of excess spillage from the Bagre Dam. Putting into practice Early Warning-Early Action undoubtedly saved lives and reduced damage in August and September of that year [16].

In Togo, in response to the 2008 seasonal forecast, a communication system was established to enable the circulation of information from the national Red Cross headquarters to contact focal points in the regions, districts and communities at risk. The small community of Atiegou Zogbeji located north of Lome provides a successful example of Togo's early warning communication system [17]. When riverbed water levels reached dangerous levels, the community leader went through the flood-prone community with a loudspeaker, spreading the message that floods were coming and asking people to evacuate. With just an hour and a half notice, the population of 2 000 was able to evacuate. When the floodwaters arrived, physical damage occurred, but not loss of life [16].

In the Gambia, in response to being informed of the seasonal forecast and participating in the RDRTL training, the Gambia Red Cross held its own National Disaster Response Team (NDRT) training, in which volunteers and branch officers from seven different districts were trained in disaster preparedness. As a result of this training and preparation, the Gambia Red Cross proved very efficient in performing a post-flood needs assessment and submitting a funding request within two days of flooding (a process which generally took them several weeks after the flood event).

By and large across the region in 2008, most countries received needed relief supplies from the Red Cross in a matter of days after the flooding. In contrast, the year before it took on average forty days to deliver many relief items and services. A preliminary quantitative comparison between the costs of flood response alone (2006 and 2007) and the cost of flood response with Early Warning-Early Action (2008) also showed a 33 per cent lower cost per beneficiary [16].

4. The 2008 rainy season in brief

All in all, the heavy rainfall events that transpired throughout the July-August-September rainy season in west Africa confirmed the forecasts issued by IRI and ACMAD for the region at large, and even demonstrated geographical similitude with the seasonal predictions in most areas. (See Figures 4 and 5; ten out of the twelve severe flood events that took place occurred in Zone I, where a positive rainfall anomaly had been predicted as the most likely outcome; only two floods, in Togo and Cameroon, were not consistent with the seasonal forecast, which did not predict above-normal rainfall at all in the Zone III Gulf of Guinea countries, low probability of occurrence of 0.3; refer to Figure 2).

Furthermore when the floods came, the Red Cross movement on the ground was already aware, informed and ready to intervene, thanks to the following preparedness measures endeavoured by the IFRC-West Africa Zone Office with a one-month lead time:

(a) Increased mobilization of additional financial resources;

(b) Increased flood response capacity in the region, training of additional regional-level disaster response support personnel and a wide distribution of the early warning among other partner humanitarian organizations and government institutions.

These initiatives contributed to raising awareness at the national level in the countries at risk, where humanitarian actors were able to initiate national-level actions to prepare for the announced likely floods. In the words of Jerry Niati, Assistant Disaster Management Coordinator at the IFRC in Dakar, “In 2007, we were just being asked to do things; in 2008 we were in control, initiating action by raising awareness and sharing forecast information” [18].

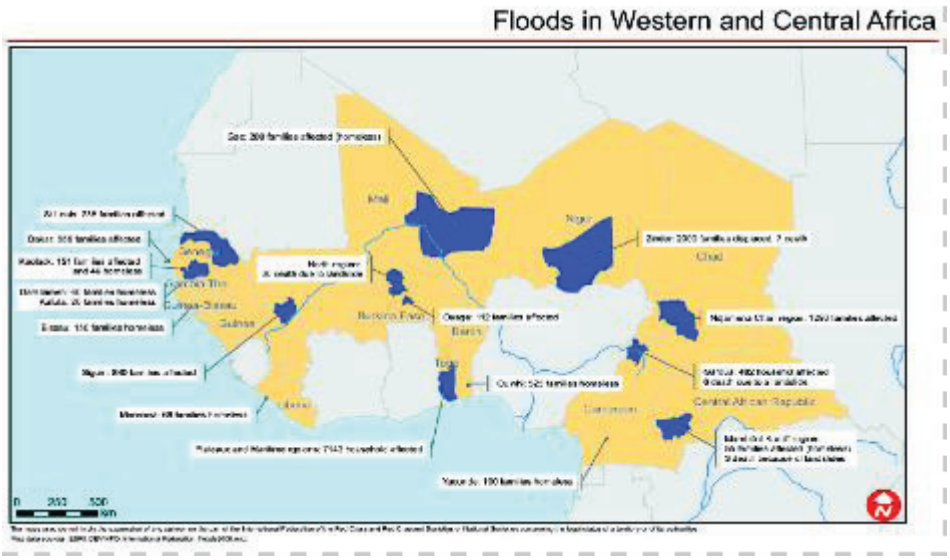

Figure 4. Flood situation in west Africa as of September 2008 (Courtesy: IFRC/Dakar [19])

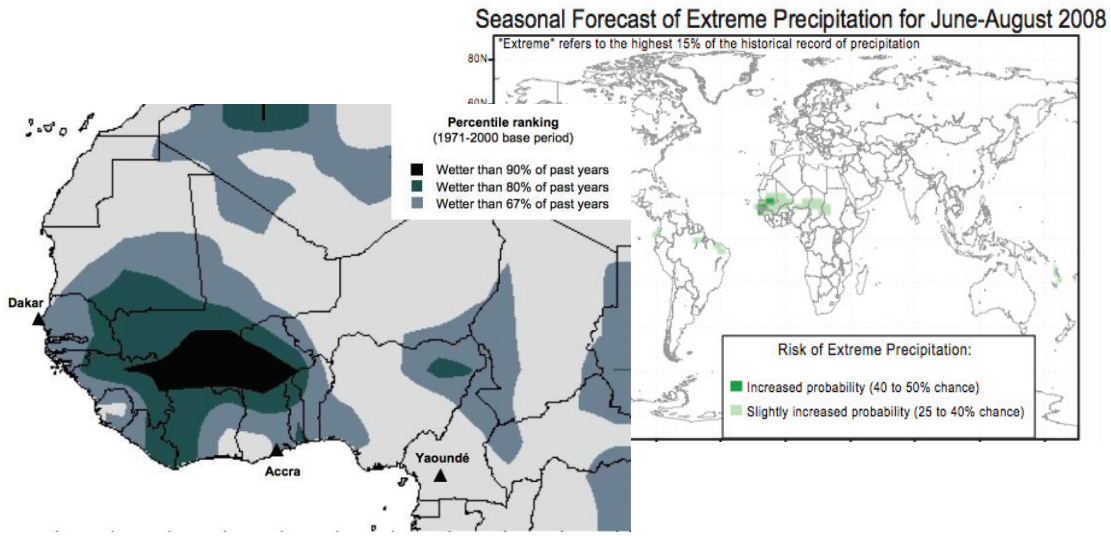

Figure 5. Actual rains (left) and forecast rains (right) and location of stocks pre-positioned by IFRC (Courtesy: IRI)

5. Remaining challenges: linking early warning with early action at the community level

Despite the remarkable nature of the IFRC-WZAC achievements at the regional level (reasonable bet placed on the seasonal forecast using no-regrets strategies, use of climate information as input for contingency planning and strategic decision-making and allocation of resources), a critical look at these achievements raises the following questions: Did the increased preparedness to announced floods at the regional and even in some instances national level translate itself into increased preparedness at the community level? Were vulnerable populations at the community level ready? Did they receive the seasonal forecast information and did they link any of their decisions to this forecast? Had the early warning information trickled down to the people who needed it most – the vulnerable populations and communities whom the floods were predicted to hit?

The Red Cross 2008 experience with using seasonal climate forecasts most of all helped to identify and confirm the many bottlenecks thwarting the trickling down of climate information to vulnerable communities, and their use of it.

6. The missing link: obstacles to the transmission and use of climate information by vulnerable communities

Most interesting about the 2008 experience using seasonal forecasting was its ability to reveal the remaining gaps preventing transmission and use of forecasts by Red Cross volunteers at the grassroots level and the communities they serve. The Red Cross 2008 experience acting on seasonal forecasts reveals that five main obstacles thwart the trickling down of climate information to communities at risk, and their use of it. This section considers these obstacles.

6.1 The wide gap separating National Meteorological and Hydrological Services and vulnerable communities in the region

Institutions responsible for climate/weather forecasting at the national level (national meteorological forecasting services, hydrological departments, climate modellers within the national universities) seldom reach out to vulnerable groups and potential users of their information at the community level in the region (except for the notable examples outlined in the Introduction). Many factors account for this sorry state of affairs.

The first of them is the institutional framework of climate information circulation in many west African countries. By and large, National Meteorological and Hydrological Services are housed within ministries of aviation or transportation; they deliver their routine forecast bulletins to aviation decision-makers, and at best to technical departments within the government with extension workers at the local level (departments of agriculture, fishing or livestock); even then, however, the forecasts are often transmitted as confidential information. Given the context of governance and the low level of public goods delivery in the countries of the region, these confidential forecasts often end up in the drawers of government officials, without any action, ex ante nor ex post, ensuing from the forecasts. As a result of only servicing this limited segment of society (government officials, aviation decision-makers), NMHSs only provide climate information that meets the information needs of these two users.

Secondly, meteorological information is in most cases not tailored to meet the information needs of vulnerable group decision-makers at the sub-national level. There is no direct outreach to communities at risk on the part of NMHSs, which very often satisfy themselves with broadcasting their temperature or precipitation forecasts through media outlets inaccessible to the largest fringes of the population (for example, television) and in a language that the majority of the people do not understand (in the official languages, French, English or Portuguese). In essence, available climate information is thus not targeted to vulnerable communities, neither is it tailored to meet their needs or fit their decision-making timelines. Climate information is in this sense very much supply-driven.

Finally, even if they desired to initiate outreach programs to communities, west African NMHSs low capacity is in most cases a deterrent. Many factors are to blame for this feeble capacity of NMHSs in the region, among which are their small funding, the low priority level given to them in national budgets and in the Structural Adjustment Programs, which enervated the capacity of government agencies and which were adopted by most countries in the region during the 1980s [20] and the politicization of many NMHSs.

National Meteorological and Hydrological Services play a fundamental role in the overall scheme of salient climate information transfer to populations at risk because they dispose of local climatological and terrain information, which they can use to downscale region-wide forecasts and interpret what constitutes dangerous hazard thresholds. Additionally, their proximity to populations at the local level makes them best positioned to produce and disseminate information that is salient to the climate information needs of users at the grass-roots level.

As a result of the wide gap that separates providers of climate information from climate-vulnerable communities, however:

(a) No climate information is available at the grassroots-level to aid decision-makers in their decision-making process under uncertainty;

(b) There is no targeting and tailoring of climate information to meet the information needs of vulnerable communities;

(c) There is no inclusion of the user information needs as a driver in climate research (supply-driven research).

Overcoming these monumental obstacles will take sustained efforts to bridge the gap between providers of climate information at the national level and the communities at risk, as well as the initiation of meaningful dialogues between the two communities so that scientific outputs may be brought together with user needs [2]. Additionally, at an institutional level, giving NMHSs a clear mandate for serving society at large and transmitting salient forecasts to communities at risk in particular, in a way in which the latter can understand them, is a necessary prerequisite for enabling the circulation of information down to the community level.

6.2 Language barriers

The second largest obstacle preventing the use of climate information by communities is the still far too technical content of forecast bulletins. Indeed, bulletins of NMHSs in the region are written and distributed in a scientific jargon that is not understandable by the layperson untrained in climate science. Also experience in bridging scientists and users has demonstrated that users generally need actionable information [21][22]. Making these forecasts more accessible to users by simplifying them, and highlighting the potential decisions/actions based on the forecast is a useful strategy to generate user interest in forecasts [23].

The 2008 experience also showed that Red Cross volunteers, to be able to serve as messengers of climate information at the community level, needed to be trained to understand the limitations and uses of the forecasts they were receiving, from the seasonal forecast to short-range weather advisories. Such training would enable them to fathom to what extent these forecasts could serve them, aid them in their decision-making under uncertainty (whether or not to stand ready for a flood) and facilitate their work as disaster relief workers at the community level. Only then could the IFRC-WCAZ office ensure that when forecasts were relayed to national and district level Red Cross branches, file workers at the latter levels would know what to do with them and link them to actual decisions and behavioural change. Additionally, such training would build their capacity to serve as relays of relevant climate

information at the community level, providing a much-needed link between climate scientists and vulnerable populations within their communities.

This need for increased capacity-building to understand and use forecasts applies to all of the community-level messengers of climate information and any organization serving as a boundary organization between scientists and community actors [24], for instance agricultural extension workers [21], local media and community radio announcers (who could benefit from training in climate journalism [4]) and potentially the local military bases.

6.3 Communication systems barriers

The Red Cross 2008 experience also revealed the paucity of communication channels between national-level producers of climate knowledge and community-level users. Across the region, no functional national multi-hazard Early Warning System (EWS) exists to effectively transmit information from forecasters to all vulnerable communities once a potentially dangerous meteorological event is detected. There exist no relays of climate information to the community level either, nor are there operational climate information sharing systems able to effectively transfer information from regional/national to district level, on to communities and back.

Radio, which remains the most effective means of reaching community-level stakeholders in the region [21], and, increasingly, cellular phones have a vital role to play in the process of disseminating time-sensitive climate information to communities at risk. The challenges facing the media, however, are to ensure that transmitted messages are salient, accurate, timely and understood [4].

6.4 Trust relationship between climate forecasters-messengers and communities

The issue of trust is of central importance in understanding whether community-level decision-makers will use received forecasts or not. Currently, due to the absence of any relationship with forecasters who produce information at the headquarters of national meteorological services in west Africa capital cities, communities in the region are oblivious to the availability and potential usefulness of climate information.

As information becomes increasingly transmitted to communities, however, we will need to pose the following questions: How will they respond to this new kind of information? Will they embrace it as an additional source of information and use it as input into their decision-making, or will they disregard it as untrustworthy and irrelevant? Will they trust the messengers? How will they react to the false alarms and false reassurances that any imperfect forecasting system sometimes produces and the oversimplifications that messengers sometimes make? [2].

Before communities can absorb incoming scientific information, they first need to deem its messengers trustworthy (with no vested interest in providing them with false information) and their message credible and reliable. Since trusting their message could mean shifting decisions and making costly and high-risk investments, such as changing usual crop diversification strategies for farmers or investing in additional gravel flood fortification for urban slum dwellers, their caution can be easily understood.

The Roncoli et al. [21] experimental research with transmitting forecasts to farmers in Burkina Faso found that in order for forecasts to be understood by and be useful to farmers, the forecasters needed to not only provide relevant information at the optimal time and in the most appropriate form and language, but also have credible sources deliver the information [21]. They also found that meteorological forecasts are not farmers' sole source of information, and that farmers will not rely heavily on these forecasts until they have proven reliable [21].

Thus to ensure forecasts are used at the national level, participatory processes must be repetitive [23]. This cannot be a one-time iteration, but a sustained process of knowledge transfer/sharing that builds understanding and trust in the forecasts over time.

Finally, it is important that forecast dissemination emphasizes that all outcomes are possible [21], does not attempt to oversimplify the forecast information (community-level stakeholders can understand probabilities [25] and that forecasters draw upon existing trusted communication media and organizations (communal radios, non-governmental organizations and agencies that operate in rural areas, technical extension services, development projects and local institutions) to serve as their community relays of climate information.

In 2008, in the communities the Red Cross worked with, building trust of messengers was not a major issue since Red Cross volunteers, as full inhabitants and members of the communities in which they serve, are generally well trusted by their communities; the Red Cross insignia itself stands as a symbol of trust. Thus, they were able to successfully play the role of community relays of climate information. This evidences the essential role that organizations solidly rooted at the community level (the Red Cross being just one example) can play as trustworthy messengers of climate information to the community level.

6.5 Scientific barriers

Africa constitutes one of the regions with the lowest predictive skill [1]. The density of meteorological stations is about one-eighth the minimum recommended by the World Meteorological Organization; many of these stations are non-functional and governments have failed to invest in equipment and trained personnel [4]. These data limitations along with others will need to be addressed for climate forecasting science be able to fully serve populations in the region, through increased investment in research and data equipment. Such investments are important so that national-level (NMHSs) and regional-level (ACMAD, AGRHYMET) providers of climate information may be able to answer some of the users' questions that they cannot currently answer due to the present limits of climate forecasting science. Questions of importance for farmers and others include: When exactly will the rainy season begin this year? Or when will wet/dry spells occur precisely throughout the season? Better skill and forecasting ability over the west Africa region will without doubt render climate information more salient to user needs.

This barrier comes last, however, because it is only marginal to the understanding of why communities are not absorbing currently produced climate information that is available and salient to their needs (for example, the outlook for JAS rainy season or the likelihood of heavy rainfall events).

6.6 Low local capacity to act on forecasts

Finally, when low income levels and other factors of vulnerability impede populations from being able to act on the received forecasts, they cannot follow up forecasts with actions, and cannot link early warning with early action. This is tantamount to not having received a forecast at all. This is a significant obstacle to the usefulness of forecasts to populations, one that cannot be resolved outside of the framework of development and poverty reduction.

Overcoming the first four obstacles to available climate information access and use by communities remains the most urgent priority for any organization attempting to reap the potential of existing climate information, enable community-level decision-making based on available early climate information and establish a link between climate forecasters and community-level decision-makers. (See Figure 6.)

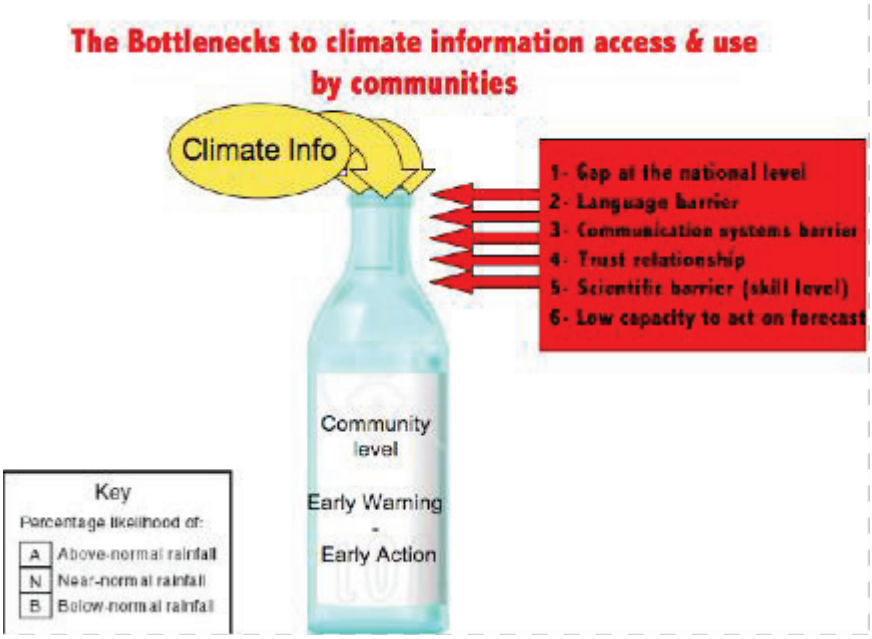

Figure 6. Bottlenecks to climate information access & use by communities

7. Conclusions

Climate forecasting possesses the incredible potential to serve communities in west Africa and aid them in better anticipating disasters and in better preparing for them. Many obstacles remain, however, to thwart the access and use of forecasts by communities. The following measures will be needed to move the IFRC experience acting on forecasts in west Africa in 2008 from being a single success story to generating meaningful and systematic early action based on forecasts at the national and sub-national levels:

(a) Bridging the gap between forecasters and community-level decision-makers and vulnerable groups: Initiating forums that bring together national-level forecasters and local-level stakeholders and open communication lines between the two will enable community access to contextual forecasts.

(b) Overcoming language barriers: The current format and content of the forecast bulletins routinely produced by National Meteorological and Hydrological Services constitute a limiting factor to vulnerable communities' uptake of forecasts. Simplifying the content of forecast bulletins and ensuring that they highlight potential actions/decisions that can be endeavoured by individuals and based on the forecast will render forecast information actionable and more easily absorbed by communities.

(c) Overcoming communication system barriers: Building the capacity of Red Cross volunteers and other trusted community-level actors (for instance, agricultural extension workers and in some cases, the local military) and media (for example, community radio) to serve as community relays of climate information is an example of how information sharing channels can be established from the national to district level on to communities drawing on existing institutions. This will be needed to enable the trickling down of timely and salient climate information to communities at risk.

(d) Developing a trust relationship between communities and providers of climate information is key; indeed communities will not incorporate new information that they do not trust or deem reliable.

(e) All these measures will prove ineffective, however, unless they are ongoing in tandem with development and poverty-reduction programs that strive to reduce the overall vulnerability of communities and enable them to build their resilience to all shocks (climatic, economic, social, political). Such programs are imperative to build the capacity of communities to act on received forecasts and empower them to link early information with early actions.

(f) Overcoming scientific barriers: Investing in climate research and data collection equipment to promote better skill and forecasting ability over the west Africa region is important so that climate forecasting may be able to continually deliver information salient to users' needs. The focus of current efforts ought to be, however, on making currently existing climate information (from seasonal forecast information to short-range weather advisories) widely available to and usable by communities that need it.

The experience of the Red Cross in 2008 demonstrates that Early Warning-Early Action based on forecast information is a concept that can be rendered operational in west Africa, provided there is a common desire from both climate scientists and user communities to work together and endeavour to overcome the plethora of obstacles thwarting communities' access and use of climate information.

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