Bridging health and climate knowledge in West Africa

Workshop report

28 May – 1 June 2012
Hotel Palm Beach
Ouagadougou, Burkina Faso

A joint effort of

START

Climate Systems Analysis Group, University of Cape Town

Africa Adaptation Programme, UNDP

ACMAD

AMMA

ICSU Regional Office for Africa

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EXECUTIVE SUMMARY

Background

Effective management of infectious diseases and other human health risks remains a formidable challenge in Sub-Saharan Africa, where response mechanisms for disease outbreaks are often insufficient relative to the risk, and where public health systems are under-resourced, overburdened, and lack sufficient coverage into rural areas. Given that the distribution and seasonal cycle of a significant proportion of infectious diseases in Africa are influenced by climate, incorporating climate information into epidemic response measures could help to reduce the substantial toll that high disease burdens exact on development.

Recognition in Africa of potential junctures where climate and health communities could join forces in managing climate-sensitive diseases has increased in recent years. However, the process of moving from concept to action has been slow and halting, as noted by Omumbo et al. (2011)[1] who described significant needs in the areas of policy, practice, services and data, and research and education. Currently, the lack of timely and relevant information about the important seasonal climatic conditions that drive disease dynamics hampers the ability of public health services to respond effectively through epidemic early warning systems and other means. Addressing this critical information gap by integrating relevant and actionable climate information into disease control strategies could significantly enhance Climate Risk Management and contribute to building the necessary foundational capacity for adapting disease control strategies to emerging risks linked to climate change. Promoting climate change adaptation in the health sector is a common priority across National Adaptation Programme of Actions (NAPA[2]) from Sub-Saharan African countries, though evidence suggests that little or no concrete actions have been taken. A review of 41 NAPAs showed that 39 (95%) countries in Africa consider health as being a key sector that will be impacted by climate change. However, only 23% (9/39) of these NAPAs were considered to be comprehensive in their health-vulnerability assessment.[3] Collaborations between the health and climate sectors aim to bridge this critical gap.

Workshop description

A workshop to examine how climate information can be better utilized to inform the management of climate-sensitive diseases in West Africa was held in Ouagadougou, Burkina Faso from 28 May to 1 June 2012. The workshop involved 35 participants from 12 African countries, and featured a range of expertise including climatology, meteorology, hydrology, disease epidemiology, public health management, and mass media/communications (Appendix 2). The workshop was co-organized by START

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1 Climate and Health in Africa, 10 Years On workshop report http://iri.columbia.edu/publications/id=1090

2 http://unfccc.int/cooperation_support/least_developed_countries_portal/submitted_napas/items/4585.php

3 Manga L, Bagayoko M, Meredith T, Neira M (2010). Overview of health considerations within National Adaptation Programmes of Action for climate change in least developed countries and small island states. WHO. Pp 6.
http://www.undpadaptation.org/undpcc/files/docs/publications/submited/Health_in_NAPAs_final.pdf

(SysTem for Analysis, Research and Training), CSAG-UCT (Climate Systems Analysis Group-University of Cape Town), UNDP's Africa Adaptation Program (AAP), ACMAD (African Centre of Meteorological Applications for Development), AMMA (African Monsoon Multidisciplinary Analyses, and ICSU-ROA (International Council for Science, Regional Office for Africa). The workshop was supported by the Swedish International Development Cooperation Agency, through a grant to ICSU-ROA, and the US National Science Foundation, and was intended to advance the Global Framework of Climate Services in Africa as well as contribute to ICSU ROA program on impacts of global environmental change in Africa.

The workshop sought to encourage shared learning between the climate and health communities on a range of issues including:

- how seasonal climatic conditions impact disease dynamics, and what seasonal and other climate parameters are important to the health community for managing climate-sensitive diseases;
- how seasonal climate information is derived, packaged and presented by the climate community, and the possibilities and limitations for generating and presenting seasonal climate information in a more relevant way for decision making on disease control;
- approaches for making decisions on disease control in the context of climate change, given differences between decision-making times scales for present disease control compared with time scales for climate projections;
- needs and opportunities for presenting climate model data on future climate projections, such as through the CORDEX-Africa program, in a manner that can effectively support adaptation planning for controlling climate-sensitive diseases; and,
- critical institutional and policy bottlenecks and barriers as well as opportunities for improving integration between climate and health communities in managing climate-sensitive diseases.

The workshop featured a combination of plenary presentations, followed by discussions, and working-group sessions that required active engagement between climate and health experts to analyse and interpret climate information from past trends and future projections in the context of disease management. As such, the workshop provided opportunity for experts from climate and health, predominately from the West Africa region, to communicate with and learn from one another. Also explored was the role of the media as partners in communicating to decision makers.

The first day of the workshop focused on examining three regionally important diseases, malaria, meningitis and Rift Valley fever, which have strong seasonal climate dimensions, and to explore various decision-making processes for managing these diseases in the context of climate information, that which is available and that which is needed.

On Day 2 the participants broke into five working groups (two for malaria, two for meningitis and one for Rift Valley fever) consisting of a mix of climate and health

experts and, in some groups, media communications experts. The focus of the working groups was to examine in greater detail what is known about the climatic dimensions of each of these diseases and what are important non-climate dimensions that influence the severity of epidemics and that may interact with climate at seasonal time scales. The groups also explored possible control responses to disease outbreaks with a particular focus on how effectively information is transmitted and where mismatches occur between providers and users of climate information.

The working group activity on Day 2 helped to frame the subsequent group work on Days 3 and 4 of the workshop, which involved using data on past climate trends and future climate projections to explore management of climate sensitive diseases. Climate data were made available to the working groups through the Climate Information Portal (CIP) created by the University of Cape Town's Climate Systems Analysis Group. On Day 3 the working groups used the CIP to explore links between past climate information and past epidemics of the three focus diseases, and on Day 4 there was a plenary session on understanding uncertainty in climate model projections followed by a working group exercise on examining the extent to which projections of future climate change may help to inform adaptation planning in light of future disease management considerations. The key objectives of Day 3 and 4 activities were to increase understanding of how to interpret and apply climate information, and to provide a real-world situation of how climate information (past and future) is commonly packaged and presented in order to solicit feedback from the health community on the relevance and usefulness of that information for managing climate-sensitive diseases.

Outcomes of the workshop

A major theme running through the workshop concerned the need to reduce the communication barriers and capacity gaps that exist between providers and potential users of climate information such that climate information can be derived and presented in a way that is more relevant to decision making priorities of user groups, and user groups gain greater skill and knowledge of how to most effectively use climate information.

The workshop helped to foster shared learning around climate-sensitive diseases. The climate community gained understanding of the types of climate parameters that health experts need to make decisions on how to manage these diseases, while the health community gained insights into the potential of using climate information to better manage diseases. However, the workshop also revealed the considerable challenges in moving from a workshop setting in which ideas are put forth on how to bridge perceptual and communications gaps to the reality of initiating activities to promote effective integration between climate and health communities to better address disease management concerns.

Both communities have a long way to go to achieve such integration. It was abundantly clear from this workshop that the standard way in which seasonal climate forecasts are presented, as tercile probabilities of above-normal, normal, and below-normal seasonal rainfall quantities at regional scales is woefully inadequate, both in the types of

information presented and in its temporal and spatial scales. This is a finding consistent with past fora on climate and health. To better manage climate sensitive diseases, the workshop participants concluded that the health community needs information on such parameters as temperature, humidity, onset and offset of the rainy season, seasonal rainfall distribution, and wind speed and direction, and at spatial aggregations where disease management decisions are made, such as at district levels as opposed to regional scales. Delivering such information to the health community would require the climate community to overcome significant technical, institutional, and policy hurdles. The issue of packaging of climate information extends to climate model projections as well, which are typically limited to monthly rainfall and temperature anomalies. While acknowledging uncertainties about future climatic conditions and technical limits of the models, the participants expressed the need for much more nuanced and varied data from climate model projections.

Another important outcome of the workshop is that it helped inform CORDEX-Africa[4] efforts to understand end-user needs for climate projections information, and thus to provide a basis for shaping how climate projections information is packaged and presented. The insights gained through this workshop will also be useful in guiding subsequent efforts by the CORDEX Africa program to understand and incorporate end-user needs, for health as well as for other sectors in Africa.

The on-hands exercises with the Climate Information Portal (CIP) helped to engender deeper understanding of how to critically interpret data from climate portals, and of the potential pitfalls that can be encountered in using climate portal data, which was underscored by an extensive discussion of using envelope analysis that captures a range of different climate model projections rather than presenting a single mean value of a particular projection. The CIP is slated to be a key repository of climate change projections derived from the CORDEX Africa analysis, thus exercises that build familiarity with the CIP can help to advance 'portal literacy' amongst different users of climate projections data.

Participants from the health community acknowledged that obstacles stemming from inappropriate supply of climate information are coupled with limited research evidence on their side on how seasonal climatic conditions influence the activity of vectors, hosts, and disease dynamics. Additionally, the participants voiced concerns that the health community in Africa needs to innovate with respect to the types of data it collects, and how it collects them so that it can use climate information more effectively. As it currently stands, the health community is ill equipped to know what climate information to demand, and to have appropriate and sufficient health data to use climate information effectively.

4 CORDEX-Africa is a training program, spearheaded by the University of Cape Town's Climate Systems Analysis Group, to advance knowledge and skill development in interpretation, analysis and application of downscaled climate projections information for Africa. See http://www.csag.uct.ac.za/cordex/

The workshop participants agreed that achieving the degree of innovation and integration needed to effectively use climate information for disease management requires political will, institutional flexibility, an enabling policy environment, and capacity building at multiple scientific, policy and practitioner levels. While the workshop made good strides in defining the problem, it fell short in engaging key decision maker groups in beginning to identify key entry points for action. An iterative process of discovery, debate, and action will be needed to tackle the complex issues associated with managing climate-sensitive diseases; it cannot be achieved through workshops alone.

Key recommendations

The workshop produced several recommendations with respect to advancing integration of climate information into climate sensitive disease control. These are:

- Avenues for channeling demand for health-relevant climate data and forecasting products need to be identified, sensitized, and exploited more fully if countries are to move from business-as-usual seasonal climate forecasts towards actionable climate products to inform early warning systems and other disease control strategies.
- Climate science has significant potential to assist the health sector in advancing understanding of managing disease outbreak risks but that potential can only be realized if climate scientists work in an integrated fashion with researchers and disease control programmes to develop new approaches for deriving and packaging data. The issue of packing climate information applies to climate portals as well.
- Lack of access to relevant sectoral and climatic data presents a significant impediment to developing robust disease management responses. Measures need to be put in place that addresses this need for open data policies.
- A common platform for understanding, communicating and implementing results is needed. Aligning data sets where possible between health and climate would be useful for knowledge generation that supports a platform.
- Appropriately targeted training of the media on key aspects of climate change science is absolutely critical to improve communication of climate science and its link with development to the public. Raising awareness of the problem can help to create demand for relevant and actionable information.
- Institutional structures and arrangements need to be put in place that enable and encourage collaboration between relevant government ministries, which lead to more integrated responses to disease outbreaks. Ministerial silos, such as between national meteorological services and health, currently create disincentives for coordinated, integrated action.
- Actions to support education and capacity building are key to achieving sustained progress in managing climate sensitive diseases. Such actions should include the development of appropriate curricula on health and climate for secondary and tertiary education (including schools of public health) and targeted training tailored to the

needs of different decision maker groups in order to help raise awareness and build advocacy for action.

- Trans-disciplinary research on health and climate is needed at national and regional levels, and doing so will require greater support from national governments together with the donor community. The partners in this workshop pledge to work together to advance this cause in Africa.

SUMMARY OF WORKSHOP PROCEEDINGS

DAY 1

1. Health and climate—setting the stage

Presentations on the first half of Day 1 served to beginning framing key issues that were discussed over the subsequent days of the workshop. The presentations consisted of an overview of health and climate with an emphasis on malaria (by Judy Omumbo), an overview of AMMA (the African Multidisciplinary Monsoon Analysis) program and its societal programs (by Arona Diedhiou), and a progress report on CORDEX Africa and what lies ahead for the program (by Abdoulaye Sarr and Chris Lennard).

The health overview presentation focused on possible entry points for using climate information in managing malaria at seasonal timescales. The presenter noted some success through pilot programs in a few African countries, e.g. Botswana to link seasonal forecasts of the onset of the rainy season with malaria early warning systems[5]. There were also a few shortcomings noted with respect to the quality and type of climate and health data. On the climate side, seasonal forecast resolution at regional levels is too coarse to be useful for malaria control planning and deciosn-making, which occurs at district levels, while unlike the climate community, the health sector lacks long-term data sets to look into the past to understand influence of climate on diseases.

The presentation on AMMA focused on health and climate issues. One of the main objectives of AMMA is to provide the underpinning science that relates variability of the West African Monsoon to issues of health, water resources, and food security for African nations, and to contribute on defining and implementing relevant monitoring and prediction strategies. AMMA contributes to a better understanding of the potential influence of climate changes and to the improvement of early warning systems in public health domain. Potential impacts on diseases from climatic and environmental variables such as precipitation, temperature, winds, humidity and dust concentration at intra-seasonal, seasonal and interannual timescales was also discussed.

Another crucial issue discussed concerned the availability of data at local and regional scales. For this purpose, importance of CSAG's Climate Information Portal and

[5] Thomson et al (2006).Malaria early warnings based on seasonal climate forecasts from multi-model ensembles. Nature, **439**(7076): 576-579.

CORDEX Africa scientific program was mentioned for their ability to deliver appropriate climate data for impact studies over Africa.

This first session concluded with an update on the CORDEX Africa initiative presented by Chris Lennard (CSAG) and Abdoulaye Sarr (National Met. Office, Senegal). They explained how CORDEX has focused on Africa in its initial phase and many climate model downscaling centres participating in CORDEX have provided data for analysis over the continent. To assess these simulations, three analysis teams were formed in 2011, and are responsible for West Africa, East Africa and Southern Africa. The goals of these teams are to (a) provide climatological assessments of the model data to determine if the models adequately reproduce key characteristics of each region's climate, (b) work with the vulnerability/impacts assessment community to tailor information to these specialized needs, and (c) foster collaborations between early career scientists in both the climate and vulnerability, impacts and adaptation (VIA) communities. Four workshops were held in 2011 and 2012 to accomplish these goals, the most recent one being to write up the climatological assessment for journal publication in time for consideration in the IPCC 5th Assessment Report. Over the next year, once downscaled projection data (1951-2100) become available through CORDEX, CSAG plans to run another analysis workshop as well as another 'writeshop' to write up and publish these results. Additionally, CSAG plans to continue to have meetings whose participants are drawn from both the climate and VIA communities to develop key research question and information needs that are critical in addressing climate related vulnerabilities within Africa currently as well as into the future.

2. Focusing on climate sensitive diseases

In the afternoon of Day 1, three speakers led the group through a presentation and discussion of malaria, meningitis and Rift Valley fever. These three regionally important climate-sensitive diseases served as case study examples that carried through working group exercises during the remaining days of the workshop. The main points of the presentations and discussions included:

Malaria: The presentation, given by Judy Omumbo from Oxford University, explored what constitutes useful climate information for managing malaria epidemics and examined areas where the health community should innovate in order to better utilize climate information. Climate information needed by the health sector, such as the length of the rainy season and the number of days between rains are not captured in seasonal forecasts, nor are regional spatial scales represented in seasonal climate forecasts meaningful for administrative units (i.e. districts) where decisions about malaria control occur. The relationship between climate and transmission dynamics is not adequately elaborated in many cases and she noted that for malaria, for example, it would be useful to have a better forecasts of when the transmission period is expected to begin and end. This period is linked to the characteristics of the rainy season and occurs at much finer spatial scales than what is provided by currently available seasonal climate forecasts.

Information on morbidity and mortality levels is quite limited and where available, reflects only cases reported in hospitals, a fraction of the overall disease burden. As such,

these data are inadequate for planning disease control and climate information could provide added value to control programmes.

Without adequate climate data during the transmission period there is no real understanding of whether control measures are suppressing malaria or whether seasonal climate shifts are responsible for a change in the severity of an epidemic. The focus on climate and health should therefore focus on the vector and what is happening at local scales, and the effort should squarely involve the national malaria control bodies.

Rift Valley Fever (RVF): The presenter, Jacques André Ndione from the Ecological Monitoring Centre (CSE) in Senegal, provided a comprehensive description of RVF disease dynamics and then described recent progress in understanding the climatic dimensions of RVF in West Africa. RVF is a viral zoonotic disease that can be transmitted between livestock and humans, and most strongly impacts pastoralists' health and livelihoods as well as those involved in slaughtering and processing meat who may come in contact with infected animal blood. Environmental and climatic conditions have a strong influence on RVF transmission. In 2010, RVF occurred for the first time north of the Senegal River in Mauritania causing significant disease outbreak and high economic losses. Heavy rainfalls late in the rainy season following a prolonged dry spell, combined with the close proximity of livestock to water sources, triggered the epidemic. Under these rainfall conditions both *Aedes* and *Culex* mosquitoes (vectors) appeared late in the season, which helped to intensify the transmission risk. Unseasonal rainfall results in more plentiful pastures allowing herders to put their animals out but also increasing risk of infection.

While greater understanding is needed of the environmental, socioeconomic, and climatic dimensions of RVF in West Africa, sufficient knowledge exists to begin formulating early warning approaches for RVF outbreaks. For example, it is known that a prolonged dry period followed by an unseasonably heavy rainfall late in the season has a strong influence on increasing transmission risks, and forecasting skills are sufficient to forecast large rainfall events. A key challenge is whether a 10-day forecast period is adequate to mobilize control measures. Developing actionable messages that sensitize both vulnerable populations and institutions responsible for RVF control is critical, for the latter group, a case needs to be made for mandating long-range weather forecasting by the national met services during disease conducive periods.

Meningitis: The presenter, Pascal Yaka from the Burkina Faso National Meteorological Service, described the characteristics of the disease in West Africa, and identified areas of need for stronger disease management. The greatest global disease burden for Meningococcal Meningitis (MCM) occurs in the Sahelian Meningitis Belt, stretching from Senegal to Ethiopia, with Burkina Faso and Niger experiencing the greatest outbreaks. Transmission of MCM is airborne and is exacerbated by dust storms occuring during the long dry season in the Sahel combined with poorly ventilated, crowded housing conditions. Mortality is high in Sahelian countries due to poverty, lack of public health services, lack of laboratory capacities for detection, poorly coordinated

mechanisms to issue disease outbreak alerts during susceptible periods, and unaffordability of vaccines.

The potential exists to better integrate seasonal climatic data, such as temperature, humidity, and wind speed and direction into predictive models for MCM, which in turn could help to inform early warning systems. The presenter described a couple of recent initiatives that could advance this effort through involving partnerships between climatologists, national meteorological services, and health experts. For example, in Burkina Faso the S2E-ARGOS project works to involve the health sector at local levels in meteorological data collection and analysis. In addition, since 2009 the Burkina Faso meteorological service has, on an annual basis, provided a forecast of seasonal meningococcal meningitis incidence trends in Burkina Faso and Niger based on climatic and medical information derived by meteorological and health experts. This forecast is done a few months before meningitis outbreaks begin to surge. Regionally, the Banjul Action Plan, through which the HealthMet project related to National Health-Climate Working Groups on climate sensitive diseases in Burkina Faso and Mauritania (with Mali, Niger and Nigeria slated to join in the near future) provides opportunities for information gathering and sharing, collaboration, training, and resource mobilization between the climate and health communities.

Following the three overview presentations, Chris Jack from CSAG led a discussion of climate, health and decision-making that picked up on some key issues from the presentations. His discussion was intended to prepare the group for Day 2 discussions, and centered around how decisions are being made—what decisions are needed or being made and by whom; where is the information produced and how is it accessed; and what research or organizational networks are involved.

Ernest Afiesimama, left, (Nigeria National Met. Office) and Dan Boakye, right, (University of Ghana) in a discussion about malaria.

DAY 2

1. Sharing knowledge on climate and climate-sensitive diseases

On Day 2, the workshop participants convened in five working groups— two for malaria, two for meningitis and one for RVF. The groups consisted of approximately two-thirds climate and one-third health experts. Some groups also contained a media person. The groups, picking up from where they had ended on Day 1, examined what is known about climate dimensions of their focus disease and what the important climatic trigger points are for these diseases during onset of an epidemic, continuation of the epidemic, and its end point. The groups then looked at responses to disease outbreaks with a particular focus on the

effectiveness of information flow—where are there successes, what are the weak points, what is missing in terms of institutional responses and capacity to communicate and act, and where is there mismatch between health and climate information supply and demand. A key objective of this exercise was to encourage more direct communication between climate and health experts in order to jointly identify points where climate and health communities need to work better together to more effectively deal with management of these climate sensitive diseases.

Discussion about Rift Valley fever.

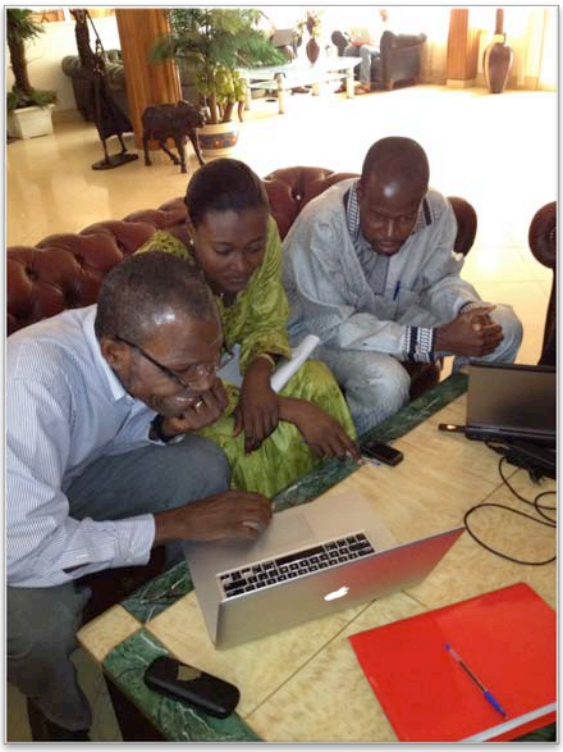
In the afternoon of Day 2, the participants met back in plenary to share what they had learned. The following is a summary of those discussions.

RVF: The group concluded that climate is not adequately perceived (by RVF control strategies at national levels) as an important factor in the transmission dynamics of RVF. Managing RVF requires documenting abundance of the reservoir (rats) and the vector (*Aedes* and *Culex* mosquitoes), understanding important transhumance concerns, chiefly exporting livestock, better monitoring indicators of the disease, such as animal abortions, strengthening capacity for laboratory analysis, and developing contingency plans.

The climate and health experts were in agreement that climate forecasts need to be generated to indicate probability and distribution of dry spells and heavy rainfall, such as in 10-day forecast increments. However the climate experts noted that such probabilistic forecasts are quite challenging to produce accurately. The climate people noted that the group work allowed them to better understand the complex disease dynamics at play and all the factors that have to be considered in addition to climate. The group also discussed how decision systems and public health hierarchies differ across countries, thus there is a need for a regional coordination mechanism so that when conditions are favourable for an outbreak, resources can be mobilized to control the movement of livestock. The need for interdisciplinary working groups was also stressed.

Malaria: The climate experts within the malaria groups expressed how the session gave them a better appreciation of the complex dynamics of the disease and interactions between vector, parasite, host, and environment., Both climate and health experts gained insights on where climate information could be more effectively applied to inform control

efforts. For example, one of the important factors is to understand how climatic conditions define the geographical distribution of malaria, and climate seasonality influences the start and end of transmission seasons. An approximately two-week lag between when the vector becomes active and disease manifestation occurs and improved forecasts may allow the exploitation of this lag-period to the benefit of malaria control. Understanding transmission gets more at the underlying factors where climate actually has an important influence. The two malaria groups noted that the climate community is in a relatively good position to provide data but in order for the data to be useful, they need to know the information needs of the health community. On the flipside, health data are presently collected and aggregated in a manner that is not useful for mapping to climate data, and there is a general dearth of long-term health data that can be used to match to climate data to more fully understand the climate dimensions of disease outbreaks.



Ben Lamptey (Regional Maritime Univ., Ghana), Ramatoulaye Lazoumar (National Hospital of Niamey), and Pascal Yaka (Burkina Faso National Met. Service) use the Climate Information Portal (CIP) to understand climate information in the context of meningitis.

Meningitis: The first group begun its presentation by describing the various climatic factors (wind, dust, humidity, rainfall, aerosol concentration, and high temperatures) and non-climatic conditions related to housing, settlements, migration, poverty, and vaccination status that contribute to meningitis outbreaks. They then described the challenges in bringing climate and health communities together for managing meningitis, noting the lack of collaboration between the two communities and the lack of precise models to predict spatial-temporal distribution of the disease. To underscore the problem, Ramatoulaye Lazoumar, a medical doctor from the National Hospital of Niamey, described how the Meningitis management committee in Niger, which meets monthly to chart out control strategies, contains no members of the Niger national meteorological services, even though their expertise is needed to help advise on weather factors to consider in managing outbreaks.

The second meningitis group reiterated the report of the first group with respect to climatic and non-climatic factors that contribute to the disease. They then described a number of potential entry points for encouraging more proactive and robust disease management strategies. These included:

- Promoting policy briefs to inform decision making,

- Promoting inter to trans-disciplinary research on climate and health, using the example of Health-Nets, and Ecohealth,
- Reinforcing links between health excellence centers and climate offices at national and regional levels,
- Promoting action-oriented research that uses health data and correlated with regional modeling outputs (CORDEX data) and/or local observations data, satellite observations (such as of aerosol characteristics) and other environmental data, and;
- Developing curricula on climate and health for universities and medical schools.

2. Role of media in communicating science to the public

Day 2 ended on a different note from the preceding sessions, with Ama Kudom Agyemang, representing the Media Capacity Building project of AAP and the International Center for Journalism, presenting on the importance of media in reaching decision makers. The presenter began her talk by noting that climate change has moved from being a science-environment issue to being one that is front and center in development and that cuts across all strata of society and virtually all sectors. Thus, climate change has become an important issue for the media. She explained that the ability of the media to accurately report on climate change is hampered by poor understanding of the underlying issues, though the media's climate literacy is beginning to improve.

The presenter emphasized the need for media to be more fully included in science and policy discourse, given that the media acts as a bridge between scientists and policy makers on one hand, and the public and vulnerable communities on the other. Media can facilitate the exchange of experiences related to climate risks as well as showcasing positive examples of climate change adaptation measures, and in doing so sensitize the public. Ms. Agyemang finished her presentation by imploring the participants to consider media involvement at the planning stage of a project and not as an after thought, in that way important communications capacity can be developed, by both researchers and media professionals.

DAY 3

1. Using climate observations to understand disease outbreaks

Building on the previous day's discussion on the climate dimensions of malaria, meningitis and RVF, the same working groups convened on Day 3 to begin applying climate data to gain understanding of past disease outbreaks in the West Africa region. Climate data for this exercise was accessed through CSAG's Climate Information Portal (CIP), which provides observational climate data derived from the region's weather stations that are presented as monthly rainfall totals and maximum and minimum temperatures, generally for the period from the 1970s or 1980s through 2000. The health experts within the groups either brought health data with them, or they used knowledge of a past disease outbreak in the West Africa region over a particular place and period to

see what the climate data indicated or did not indicate that would be of use in estimating the climatic influence on the disease.

The purpose of the exercise was for the participants to gain familiarity with the CIP and to discover, from both climate and health perspectives, what information the CIP provided that was useful and what information did it not provide that would be needed to make an informed decision about seasonal climate dimensions for disease management. The exercise also helped to reinforce communication and two-way learning between climate and health experts. Following the exercise, the groups reported their findings on the experience of using the climate portal and on its potential and limitations for application to health issues. As described below, the groups consistently highlighted the mismatch that exists between how climate data is packaged and presented and what the climate data needs are of end users.

Chris Lennard, left, and Chris Jack, right, from CSAG lead discussions on the Climate Information Portal

RVF: This group looked at RVF cases in the Ferlo region of Senegal, and attempted to link that data (mosquito vector concentrations, concentration of rainwater pools, and RVF infection rates) to climatic conditions in the CIP. They found that climate parameters in the CIP were useful but they needed more information, related to the number of individual rain events and the length of the dry spell in order to better match climate data to health data. More point stations data and more recent data were also needed.

Malaria: One of the malaria groups reported difficulty of mapping health data to climate data in that the climate data were available for the 1980s and '90s while malaria datasets contained missing values over this period. The climate time series also ended at 2000 so it was not possible to look at the most recent decade where health data are more readily

available and up to date. The presentation of rainfall data at monthly aggregations was also problematic in that daily rainfall information for determining the length of period between rains is needed to assess the potential for forming breeding pools. Such accessory information would be helpful in order to more effectively use climate data. The spatial distribution and aggregation of climate data also proved problematic. Health data are summarized according to administrative districts, the unit at which disease control management decisions are made, whereas the CIP data are derived from weather stations, which are predominately located in urban areas. This situation results in rural areas being underrepresented in climate data, while decisions about disease control strategies have a strong rural component. Data quality was also identified as an issue in that data quality and consistency of standards in health data collection are problematic, whereas climate data is relatively more consistent and standardized.

Malaria: The second malaria group reported some of the same issues with respect to coverage of climate data. For example, the nearest climate data available on the CIP was 200 kilometres away from the focus area that they chose to look at, and they needed data more recent than 2000. The group concluded from their analysis of climate and health data available to them that malaria seems to consistently lag behind rainfall but that they need data on the vector to better explain malaria outbreaks. In order to do that they required more finely aggregated rainfall data and would need humidity and wind speed and direction data, which is not available from the CIP. The group emphasized the need for climate data that would allow health experts to understand the extent of the transmission zone so as to be able to develop early warning measures.

Meningitis: The two meningitis groups reported similar issues with the CIP, i.e. that the data stops at 2000 so it is not possible to look at more recent epidemic situations, and that additional climate parameters are needed (wind direction, humidity, rainfall, temperature) and at finer spatial and temporal scales.

In the general discussion that followed, concerns about climate data expressed in previous plenary discussions were again voiced. These concerns included the inability of the health sector to derive useful information from probability-based seasonal climate forecasts, lack of awareness within the health community of how climate information might help to manage diseases, and a lack of incentives within national governments to develop interdisciplinary efforts such that would allow health and climate to develop integrated activities.

2. Understanding and working with uncertainty

In the afternoon of Day 3, the workshop transitioned from integrating health information needs with observations of recent climate trends to that of considering health information needs for addressing disease risks associated with future climate change. This new direction began with an examination of uncertainty—what are key sources of uncertainty, where do they occur in space and time, and how can decisions be made, and robust messages about climate change developed, in light of uncertainties.

The exploration of uncertainty began with 'Crossing the River', a narrative game about making a decision about risk (in this case crossing a river) with imperfect information about the degree of that risk, onto which more information is added in layers to see how that affects decision making. The intention of the game, in the context of this workshop, was to begin thinking about working with a range of climate projections versus working with one single climate model projection or an average value of multiple model projections. The analogy of crossing a river to climate data portals, is that many portals present a single value to represent a climate change projection, e.g. it will get 10% wetter and 2.5° C warmer by 2070 (a single depth of the river), versus other approaches such as the CIP, which show a range of projections that an ensemble of climate models indicate for future change (river with multiple possible depths). The latter 'envelope' approach indicates where there is close agreement among the models (a narrow envelope) versus a wide envelope in which there is poor agreement among the models. The width of the envelope gives at least a partial indication of the relative degree of uncertainty about projections of future climate change.

Day 3 concluded with a series of hypothetical seasonal climate forecasts with an increasingly detailed set of conditions, to emulate the Crossing the River game but with climate information. The objective of this session was to give the groups a set of hypothetical information in layers and have them examine 1) what the information implies in terms of the particular disease and 2) what would be their response, what decision would they make based on that information? Following the exercise the groups reported back about the degree of the relevance and usefulness of the information, i.e. to what extent did the climate information allow them to make decisions and how confident could they be in those decisions.

In the discussion that followed, the groups shared common concerns about the general inability to make disease management decisions based on the climate information provided. With the first scenario, in which rainfall information was given as a percentage wetter or dryer on a seasonal basis, none of the groups were able to make an informed decision about how the climate forecast would affect disease dynamics. (It is worthwhile to note that this is how climate projections data are commonly presented.) The second and third scenarios, in which information about rainfall timing, temporal distribution and intensity, and information about wind speed, provided adequate information upon which to begin formulating disease management strategies, though the degree of confidence in the information was low and critical variables such as relative humidity, wind direction, aerosols concentration and more nuanced seasonal rainfall data was needed. One of the common observations that came out of this exercise, made by a few participants from both the health and climate perspectives, is that interdisciplinary problem solving is essential for making decisions about these complex systems.

DAY 4

1. Using climate projections to assess potential future disease risks under climate change

As with Day 3, the participants met in their five working groups and worked with CIP data on future climate projections. The objectives of this exercise were to introduce to the health experts concepts behind interpretation of climate model projections data, and to gain familiarity with the idea of envelopes of future climate and not just a single fixed value. The other purpose of this exercise was to discover, or reinforce from the previous day, the linkages and the extent of potential disconnect between what and how climate information is commonly packaged and presented and what climate information is needed to meet the information needs around disease management decisions.

During the feedback session after the exercise several health experts expressed how useful it was to have climate experts in the group to help interpret and explain the projections data. The exercise did not cover any new ground, compared with Day 3, regarding climate information needs of the health sector, though one of the malaria groups noted that the climate projections information did indicate that the length of the transmission period could increase, perhaps causing malaria in some areas to become less seasonal and more endemic, which would have implications on control measures such as requiring greater use of bed nets.

2. Observations from the Climate Systems Analysis Group with respect to the CIP

- For health applications of climate data, additional variables to those currently available on the CIP are needed; these include humidity, wind direction, length of the wet spell, rainfall intensity, length of dry spells and onset of rainfall.
- Threshold information would be useful – frequency of threshold exceedences for a particular variable and how long would exceedence would last.
- The health community needs climate data at finer time scales, from weekly to monthly, than is currently on the CIP.
- Spatially the health sector works from the district to the national scale. Is it possible to produce such information given the availability of existing climate data?
- More work with those who have access to metorological data is needed in order to incorporate that data into the CIP.

3. Communications

After the climate projections exercise, the workshop shifted to an examination of communication strategies for integrating climate information into various decision making contexts. Arame Tall (CCAFS advisor) facilitated a discussion on how to encourage effective communication. Key discussion points included the strong need for participatory approaches that involve communications experts and boundary organizations that would help the climate science community to better understand the information needs of end users at the outset of developing climate information products. Many of the points raised in this discussion reinforced the media communications session given on Day 2.

DAY 5

The workshop concluded with a discussion of key recommendations that could be taken to advance the climate-health integration effort; these are presented in the Executive Summary. In addition, there was a press conference in which the workshop organizers and others shared findings of the event with the Burkina Faso media.

Cheikh Kane, left, (ACMAD) and Judy Omumbo, right, (Oxford University) lead discussion on actions and recommendations.

ANNEX 1

Workshop agenda

Day 1

9h00 – 10h30	Introductions, aims and expectations, and review of the agenda
TEA	
11h00 – 12h30	Keynote presentations: climate sensitive diseases, and AMMA work plan on health
LUNCH	
13h30 – 15h30	Overview presentations on malaria, meningitis, and Rift Valley fever
TEA	
16h00-17h30	Presentations, continued

Day 2

9h00 – 10h30	Formation of breakout groups on the three diseases. In-depth discussion on diseases
TEA	
11h00 – 12h30	Discussion on diseases, continued
LUNCH	
13h30 – 15h30	Introduction to the Climate Information Portal (CIP)
TEA	
16h00-17h30	Role of media in communicating knowledge about climate sensitive disease

Day 3

9h00 – 11h00	Breakout groups work with the CIP on past climate data and disease (malaria, meningitis, RVF) outbreaks
TEA	
11h45 – 12h30	Groups report back on experience of working with CIP
LUNCH	
14h00 – 16h00	Crossing the River exercise, working with uncertainty
TEA	
17h00-17h30	Introduction to Day 4 activity

Day 4

9h00 – 11h30	Breakout groups work with the CIP on use of climate projections data for assessing future disease (malaria, meningitis, RVF) risk
TEA	

11h45 – 12h30	Breakout groups report back
LUNCH	
13h30 – 15h30	Reaching out to decision makers, how to bridge the gap
TEA	
16h00-17h30	Reflections on the week, perspectives and key messages

Day 5

9h00 – 10h30	Next steps, where to go from here
TEA	
11h00 – 12h00	Press conference with Ouagadougou-based media
12h00 12h30	Workshop evaluation and wrap-up
12h30	Workshop adjourned

ANNEX 2

List of participants

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