IRI Technical Report 10-01:
Report on Training of Health Professionals on Climate and Health

International Research Institute for Climate and Society
Earth Institute at Columbia University

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Executive Summary

The role of climate in health is currently enjoying a high profile among the international community in terms of demonstrating climate risk management and adaptation to a changing climate. The effect of climate variability and change on heath is a serious issue for most sub-Saharan African countries. Among the diseases that have public health importance in Ethiopia are malaria, meningitis and acute watery diarrhea. Understanding the relationship of climate and health in Ethiopia would be a tremendous help in early containment of these diseases.

In Ethiopia, before the establishment of a Climate and Health Working Group (CHWG), which includes the Federal Ministry of Health and the National Meteorological Agency among other partners, the sharing of information among the two key players was minimal. The goal of this working group is to create a climate-informed health sector that routinely requests and uses appropriate climate information to improve the effectiveness of health interventions. In order to meet its goals, the working group, in collaboration with the International Research Institute for Climate and Society (IRI), organized a six-day training course for health professionals on climate and health.

In this training, the Summer Institute course 'Climate Information for Public Health' (held for the past two years at IRI in New York), was adapted and implemented. The Summer Institute has involved four Ethiopian participants, one from the National Meteorological Agency (NMA), and three from the Ministry of Health. They played a key role in facilitating some of the course lectures themselves and in identifying local professionals who could also contribute to the curriculum.

The general goal of the six-day training was to build the national capacity in order to utilize climate information for decision-making in the health sector at national and regional state levels. The training was comprised of three components: core lectures, practical sessions, and short recap presentations by the participants.

Sixteen participants were involved in the training. The selection of the participants was done in consultation with the Federal Ministry of Health. Participants came primarily from the Public Health Emergency Management Units of regional and federal health bureaus and were chosen for their roles in the decision-making around the prevention and control of climate-sensitive diseases.

Three types of evaluation were carried out, a pre- and post-test, as well as an overall evaluation. The pre- and post-test helped to evaluate the level of knowledge about climate and health before and after the training. The latter helped in evaluating the organization of the overall training. Generally, the evaluations revealed that the training helped to increase the knowledge of the links between climate and health, as well as the use of climate information for decision-making in the public health sector.

This training is the first of its kind organized in Ethiopia, especially at a national level. Most of the participants agreed on the suitability of the content, design and delivery of the course and showed their interest in organizing similar training initiatives in their respective home institutions. It is possible to recommend that this training should be extended to the regional health bureau level, with the already trained participants taking the primary responsibility of facilitating these follow-on activities with the close support of the CHWG. The collaboration of the regional branch offices of the National Meteorological Agency, with respect to using climate information, would play a crucial role in this endeavor. The most important point is to sustain this training and update its contents accordingly. The future research agenda and evidence generation efforts of the CHWG and its members should also focus on other climate-sensitive diseases. Even though participants did not indicate there were always established ties to local universities in different parts of the country,

these potential partnerships should be addressed in sharing the knowledge of the use of climate information for public health decision-making and in prioritizing locally important diseases.

The training was held at UNECA, Addis Ababa, Ethiopia, between November 31st and December 5th, 2009. Financial and technical support was provided by IRI with funding from the Google.org sponsored project "Building Capacity to Produce and Use Climate and Environmental Information for Improving Health in East Africa".

Team Members

Organizers:

Adugna Woyessa (EHNRI/FMoH, alumni of the Summer Institute 2008), Daddi Jima (EHNRI/FMOH/CHWG, alumni of the Summer Institute 2009), Gilma Mantilla (IRI, Columbia University) and Hiwot Teka (CHWG) were responsible for organizing the training.

Logistics team:

Abonesh Kebede (AMA) and Abere Mihretie (AMA/CHWG)

Evaluation team:

Adugna Woyessa (EHNRI/FMoH), Gilma Mantilla (IRI, Columbia University) and Hiwot Teka (CHWG)

Authors of this report:

Hiwot Teka (MSc), Adugna Woyessa (MSc), Daddi Jima (MD, MPH) and Gilma Mantilla (MD, MSc)

Welcome Message

Opening Speech – *Dr Daddi Jima, Chairman of CHWG Ethiopia, Deputy Director General*

Ethiopian Health and Nutrition Research Institute (EHNRI)

Dear guests and training participants,

On behalf of the Ministry of Health, and on behalf of the Climate and Health Working Group (CHWG) of Ethiopia, I would like to welcome you all to the opening ceremony of this important training workshop. I would especially like to welcome those of you who came from the USA after a long journey just to support this training.

The CHWG of Ethiopia is honored to organize this important training, which deals with "the use of climate information for health" and lasts for six consecutive days. This training is the replica of, with some adaptation to our country situation, a similar training that was given to participants from different African countries by IRI at Columbia University in its Summer Course Program. In 2008, two and, in 2009, three of our colleagues including myself participated in the training. Thank you IRI for giving us those opportunities, and I hope similar high-level trainings will continue in the future.

This training was proposed, as part of the exercise to consolidate the knowledge we got at the end of the 2009 Summer Course at IRI. And it is realized by the great effort of the CHWG of Ethiopia and with financial and technical support from IRI.

There is now widespread consensus among the scientific community that the earth is warming, that this is mainly due to human activities, and that this will continue for at least the next several decades. Climate change is an emerging risk factor for human health.

It is clear that the effect of climate variability and change on health is a serious issue and it becomes a universal agenda. The impact on health includes cold and heat stress; major disasters; a wide range of malnutrition; the occurrence and expansion of vector-borne and water-borne diseases.

Therefore, we have to react to this through mitigating the causes and through the development of adaptation measures. We have to cope with the effects of climate change through policy change to reduce disease burdens, injuries, disabilities and deaths!

One of the adaptation measures is the use of available climate information in order to be able to pre-plan for the change of policies, strategies and measures such as advocacy, preparedness and awareness creation.

To use the climate data effectively, there must be a well-trained and oriented human resource. Therefore, this training is part of the capacity building process for concerned sectors.

The main aim of this training is to bring together health professionals and meteorological specialists so that a health person can appreciate the importance of climate as a determinant of health, AND so that a met specialist can make sense, in terms of health, out of the met data he/she is collecting.

Additionally, this training enables the participants to be aware of the different data sources and libraries available to us to use, such as that of the IRI Data Library, and the different data analysis tools that we can use to make sense out of and generate climate information for health.

This will ensure effective utilization of the available data for forecasting of health hazards and will allow us to take preventive measures and also ensure early detection of the occurrence of health impacts.

One of the challenges we have here in Ethiopia is a lack of trained human resources and an under-developed data sharing and user system. Appreciating this problem, the Climate and Health Working Group (CHWG) was established in 2008 with the objectives of creating awareness on the impact of weather and climate on health; developing effective and functional means for the health sectors and beneficiary communities to routinely use appropriate climate information for estimating populations at risk of climate-sensitive diseases (where and when – including early warning systems), and stimulating their partners in the climate/environment community to identify needs, create relevant products and supply appropriate services.

Some of the achievements of the CHWG include conducting awareness creation workshops and organizing capacity building trainings like this one. The CHWG will continue with this effort.

Finally, I would like to take this opportunity to extend my gratitude to all the members of the CHWG, and its collaborators, with special thanks to the Anti-Malaria Association and the International Research Institute at Columbia University, for technical as well as financial support to organize this training.

I would like to thank again the IRI team and other in-country tutors who are willing to share their experience during the course of this training.

Thank you so much.

Agenda

DAY 1- November 30, 2009		
Facilitator: Hiwot Teka – Gilma Mantilla		
Time	**Title of presentation**	**Presenters**
8:30-9:00 AM	Registration	
9:00-9:15	Welcoming Note	Daddi Jima, FMoH
9:15 –9:45	Introduction to the course (objectives – methodology to follow) Introduction of Participants (pretest)	Hiwot Teka
9:45- :10: 30	ENSO Impact on Seasonal Climate and Society	Kassa Fekadu, NMA
10:30-11:00	*Coffee break*	
11:00-11:45	Climate Risk Management in Public Health	Gilma Mantilla, IRI
11:45-12:00	Q & A, Discussion	
12:00-1:30 PM	*Lunch*	
1:30-2:15 **2:15-3:00**	Introduction to Climate and Climate Information Climate and Weather Information in Ethiopia	Ousmane Ndiaye, IRI Melesse Lemma, NMA
3:00-3:30	*Coffee break*	
3:30-5:30	**Practical Session**: Overview of the IRI Data Library	Remi Cousin, IRI
DAY 2- December 1, 2009		
8:30-8:45 AM	Summary of the day before	Participants
8: 45 - 9:30	Concepts in Public Health and Epidemiology	Adugna Woyessa, EHNRI
9:30-10:15	Making Sense of Associations	Tony Barnston, IRI
10:15-10:45	*Coffee break*	
10:45-11:30	Introduction to Cluster Analysis	Remi Cousin, IRI
11:30-12:00	Q & A, Discussion	
12:00-1:30 PM	*Lunch*	
1:30-2:15	Analyzing Trends	Fikre Enquselassie, AAU
2:15- 3:00	Climate and Malaria Mapping	Adugna Woyessa, EHNRI
3:00-3:15	*Coffee break*	
3:15 -5:00	**Practical Session:** Statistical Analysis of Climate and Health Data	Remi Cousin, IRI

DAY 3- December 2, 2009		
Facilitator: Hiwot Teka		
Time	**Title of presentation**	**Presenters**
8:30-9:00 AM	Summary of the day before	Participants
9:00-10:00	Climate and the Transmission Dynamics of Vector-borne Diseases	Meshesha Balkew, AAU
10:15-10:45	*Coffee break*	
10:45-11:45	Malaria Vector Abundance and Rainfall	Meshesha Balkew, AAU
11:45-12:00	Q & A, Discussion	
12:00-1:30 PM	*Lunch*	
1:30-3:00	**Practical Session:** Correlation of Rainfall and Malaria Incidence	Assefaw Getachew, MACEPA/PATH
3:00-3:30	*Coffee break*	
3:30-5:00	**Practical Session** : Using the Climate Suitability for Malaria Transmission Tool in the Health Map	Remi Cousin/ Gilma Mantilla, IRI
DAY 4- December 3, 2009		
Facilitator: Hiwot Teka		
Time	**Title of presentation**	**Presenters**
8:30-9:00 AM	Summary of the day before	Participants
9:00-9:45 **9:45-10:30**	Understanding Predictions and Projections in Climate Ethiopian Experience	Ousmane Ndiaye, IRI Girmaw Gezahgne, NMA
9:45-10:30	Climate Variability and Change on Health	Assefaw Getachew, MACEPA/PATH
10:30-10:45	*Coffee break*	
10:45-11:30	Malaria Early Warning and Early Response Systems	Adugna Woyessa, EHNRI
11:30-12:00	Q & A, Discussion	
12:00-1:30 PM	*Lunch*	
1:30 – 3:00	**Practical Session:** Seasonal Forecasting of Malaria in Botswana	Tony Barnston, IRI
3:00-3:30	*Coffee break*	
3:30-5:00	**Practical Session:** Seasonal Forecasting of Malaria in Botswana	Tony Barnston, IRI
6:30-9:45	Event	CHWG

DAY 5- December 4, 2009		
8:30-9:00 AM	Summary of the day before	Participants
9:00-10:00	Introduction to Remote Sensing	Tufa Dinku, IRI
10:00-10:30	*Coffee break*	
10:30-11:30	Epidemic Detection	Yonas Tadios
11:30-12:00	Q & A, Discussion	
12:00-1:30 PM	*Lunch*	
1:30-3:00	**Practical Session:** Monitoring Epidemic using Threshold	Yonas Tadios
3:00-3:30	*Coffee break*	
3:30-5:30	**Practical Session:** Remote Sensing Tools in the Health Map Room	Remi Cousin, IRI
DAY 6- December 5, 2009		
8:30-9:00 AM	Summary of the day before	Participants
9:00-10:30	**Practical Session:** Probabilistic seasonal forecasting and Its applications	Ousmane Ndiaye, IRI
10:30 – 10:45	*Coffee break*	
10:45-12:00	**Practical Session:** Probabilistic seasonal forecasting and Its applications	Ousmane Ndiaye, IRI
12:00-1:30 PM	*Lunch*	
1:30-3:00	GIS Applications in Public Health GIS Applications in Public Health Sector: Ethiopian Experience	Meron K/Michael, UNECA Negusu Worku, WHO
3:00-3:30	*Coffee break*	
3:30 -4:45	Introduction to Decision Analysis	Daddi Jimma, FMoH
4:45-5:15	Final Remarks – Next steps	Daddi Jimma, FMoH
5:15- 6:00	Overall evaluation	Hiwot Teka

Learning Goals and Abstracts

Day 1:

Learning Goals

- To understand the central role of ENSO in determining the environmental and social impacts of climate.
- To understand how the predictability of ENSO is used to benefit society.
- To understand the concept of Climate Risk Management in public health.
- To be able to define the terms: weather *vs*. climate, climatology, climate variability *vs*. climate change, climate anomalies, and climate data *vs*. climate information (forecast products, monitoring products).
- To understand temporal and spatial scales or resolution and the data related to describing different scales.
- To be aware of the IRI Data Library and the different data and analysis sources it contains.

Impact on Seasonal Climate and Society

Kassa Fekadu

ENSO (El Niño-Southern Oscillation) is a system of interactions between the equatorial Pacific Ocean and the atmosphere that influence the seasonal climate such as rainfall and temperature in many parts of the world. Climate conditions associated with ENSO impacts on agricultural production, water availability, disease outbreaks, energy demand and supply, food availability, and many others. In this presentation, to introduce in general, ENSO is the only one of several influences on seasonal climate; indeed there are other influences on seasonal climate including sea-surface temperatures in other ocean basins like the Atlantic or Indian Ocean. Seasonal climate, and therefore ENSO, are the main factors that affect people and their environment. In particular, in the case of Ethiopia the recurrent occurrences of rainfall failure that are causes of drought are the effects of ENSO on seasonal climate conditions, and the effects of these climate conditions on society.

Recommended readings

McPhaden MJ, Zebiak SE, Glantz MH (2006). ENSO as an integrating concept in Earth Science, *Science* **315**:1740-1745.

Climate Risk Management in Public Health

Gilma Mantilla

During the past decade, the global health community has advocated for, planned and begun resourcing global health initiatives focused on the needs of the poor - as indicated by the UN Declaration on the Millennium Development Goals, Roll Back Malaria and the Global Fund for Aids TB and Malaria. The arrival of climate change on the global health centre stage, was marked by the address on climate change and global public health in November 2007 by Margaret Chan Director-General of the WHO - "Climate change will affect, in profoundly adverse ways, some of the most fundamental determinants of health: food, air, water." This was formalized in May 2008, when 193 member states represented at the World Health

Assembly adopted a new resolution on health protection from climate change - signaling a high level of engagement from the health sector in this new global agenda.

As societies, in general, and the health community, in particular, start to adapt to climate change, will this new agenda detract from, or support the pro-poor global health agenda that has been so long in the making? Climate knowledge and information can form a bridge between these two agendas - managing the climate related risks of today while improving our understanding of the risks of tomorrow.

Recommended readings

Campbell-Lendrum D., Bertollini R., Neira M., Ebi K., McMichael A.. (2009). Health and climate change: a roadmap for applied research. In Protecting Health from Climate Change. The Lancet. Vol 373**.**
http://download.thelancet.com/flatcontentassets/pdfs/climate-comment.pdf

Introduction to Climate and Climate information

Ousmane Ndiaye

This lecture provides an overview of basic concepts in climate and a common understanding of what climate information is and its limitations. It will start by defining weather, climate and climate change and introducing the concepts of different time and space scales. It will then focus on what defines climate at a given scale, starting from the global (planetary) scale and ending at a given location or point. The terms climatology and climate variability will be introduced and the concept of remote influences on climate, or teleconnections, will be discussed using the example of ENSO.

Following a review of data sources and different types of datasets, a brief overview of the most common analyses used to extract climate information will be given.

Climate and Weather Information in Ethiopia

Melesse Lemma

In Ethiopia, the National Meteorological Agency is the one responsible for establishing, administering and maintaining meteorological stations. It is also mandated to collect all meteorological observations recorded in the country. Practically, the NMA is the source of weather and climate information in Ethiopia. Hence, this lecture is designed to discuss the weather and climate information in Ethiopia.

The lecture begins with introducing and defining the terms, data and information. It summarizes what data processing incorporates and explains meteorological data collection. It further deals with steps taken to assure the quality of meteorological data and the methods employed to fill missing data gaps. Available types and number of stations in country will be presented. The rainfall and temperature distribution and their patterns over Ethiopia will be emphasized pictorially. The climate zones of Ethiopia, as laid out using the Koppen classification system, are part of the lecture. Finally, the lecture focuses on meteorological data users.

Overview of the IRI Data Library

Remi Cousin

This session serves as an introduction to the IRI Data Library. It includes a presentation of what the Data Library is and how its capabilities make it a unique resource for accessing, displaying, analyzing, and downloading climate, environmental, and epidemiological data. Participants will learn how the Data Library is organized, how to find and select data, how to perform simple arithmetic analyses, how to create customized maps and graphs, and how to download data and images. How the Data Library is related to the IRI Map Rooms will also be discussed. At the end of the session participants will complete a set of group exercises that demonstrate how to perform common tasks and simple analyses.

Day 2:

Learning Goals

- To introduce the primary functions of epidemiology in investigating and managing disease risk based on available evidence.
- To identify the direction and quantify the strength of a possible association between two variables, based on sample data
- To illustrate how multivariate data can be stratified into groups using cluster analysis, to identify patterns of behavior.
- To introduce the great impact of climate on malaria vector and parasite development that further determines not only the geographical distribution of the disease but also the intensity of transmission.
- To demonstrate the global, regional, and local distribution of malaria parasite, vectors as well as malaria burden in different geographic regions using maps.
- To learn how epidemiological data are organized in the Data Library and how to calculate various statistical measures of epidemiological and climate data
- Understand when and why trend data analysis is performed
- Prepare, analyze and present data trend

Concepts in Public Health and Epidemiology

Adugna Woyessa

This lesson is intended to answer those questions by describing what epidemiology is, how it has evolved and how it is used today, and what some of the key methods and concepts are. The focus is on epidemiology in public health practice, that is, the kind of epidemiology that is done at health sector. Moreover, tools for summarizing data, measuring infection, temporal and spatial variability of disease occurrence, analyzing and interpreting disease patterns, disseminating findings as well as recommending appropriate health interventions will be considered.

Making Sense of Associations

Tony Barnston

In this talk, "associations" refers to relationships between two variables, such as rainfall and malaria incidence. Once we identify the two variables of interest, we may want to introduce a lag time between them. For rainfall and malaria in Botswana, for example, due to the

dynamics of the mosquito life cycle and malaria transmission, we find that the peak of the rainfall season precedes the peak of malaria incidence by about 2 to 3 months. Therefore, in studying the association between rainfall and malaria we consistently use rainfall data occurring 2 to 3 months earlier than the malaria incidence data, building a data set covering many years.

The next step is to evaluate the strength of the association; i.e., to determine how closely related the malaria incidence is to the rainfall. While there are several methods to quantify the strength of the association, here we focus mainly on the linear correlation coefficient. Once the correlation coefficient is obtained, consideration is given to its statistical significance – i.e., the likelihood that the coefficient could have occurred only by chance, given the size of the data sample analyzed. We also discuss the implication of a strong (or statistically significant) correlation regarding a causal relationship between the two variables.

Finally, we show how the association can be used to make predictions for one of the variables when the value of the other variable is available. For example, when the amount of rainfall has been observed (or forecast), the correlation coefficient can be used to predict the malaria incidence in advance of its occurrence.

Common complicating issues in the use of correlation to describe the strength of association and for prediction are discussed, such as skewness in one or both variables, the presence of outliers, and non-linear relationships between the variables.

Recommended readings

Wilks, D. S., 2006: *Statistical Methods in the Atmospheric Sciences.* Second Edition. Edition. Academic Press, 648 pp.

Wonnacott, T. H., and R. J. Wonnacott, 1990: *Introductory Statistics*. Fifth Edition. Chapters 15, 17. John Wiley & Sons, 711 pp.

Introduction to Cluster Analysis

Remi Cousin

In *multivariate* data analysis, identifying any shared behavior between locations or variables is a key simplifying step. The goal of this lecture is to illustrate how multivariate data can be stratified into groups using cluster analysis, to identify patterns of behavior. The resulting clusters or patterns may in turn lead to an improved understanding of the processes that generated the data. Clusters may also provide a concise representation of the large-dimensional data sets to facilitate the identification of associations between climate and health data.

Remi Cousin (IRI) delivering a lecture on cluster analysis

We shall illustrate how cluster analysis partitions a set of observations into mutually exclusive groupings of similar elements, based on their similarity according to some "distance" measure. We will understand how

the K-means method works to minimize the scatter within each cluster, its practical implementation, including how to choose the appropriate number of clusters, and how to interpret the results. Examples will include July temperatures at US cities, and malaria data gathered for Eritrea. We consider such questions as the following: Do the patterns identified by cluster analysis always correspond to "real" underlying processes, or could they result from random data? When is cluster analysis a good choice for analyzing health and climate data?

Recommended Readings

Ceccato P., Ghebremeskel, T., Jaiteh M., Graves P.M., Levy M., Ghebreselassie S.,Ogbamariam A., Barnston A. G., Bell M., del Corral J., Connor S.J., Fesseha I.,Brantly E.P., Thomson M.C. (2007). Malaria Stratification, Climate, and Epidemic Early Warning in Eritrea. American Journal of Tropical Medicine and Hygiene, 77(Suppl 6): 61–68Morse S.S.

Analyzing Trends

Fikre Enquselassie

Public health agencies have a long tradition of monitoring trends in rates of disease and death and trends in medical, social, and behavioral risk factors that may contribute to these adverse events. Trends in observed rates provide invaluable information for need assessment, program planning, program evaluation, and policy development activities. Examining data over time also permits making predictions about future frequencies and rates of occurrence.

Typically in public health, trend data are presented for rates arising from large populations over relatively long periods of time (e.g. ten or more years). For example, the national vital records system is a good source for trend analysis of infant mortality and other death rates.

In contrast to descriptive trend analysis, research studies of changes over time have followed a somewhat different analytic course. Because research data are usually sample data, statistical procedures, including sophisticated approaches such as time series analysis and formal forecasting techniques, are commonly used.

Examining trends for malaria in relation to trends of climate change is essential for monitoring health status of the population in a defined geographical area.

Recommended readings

Wilks, D. S., 2006: *Statistical Methods in the Atmospheric Sciences.* Second Edition. Academic Press, 648 pp.

Wonnacott, T. H., and R. J. Wonnacott, 1990: *Introductory Statistics*. Fifth Edition. Chapters 11-14. John Wiley & Sons, 711 pp.

Climate and Malaria Mapping

Adugna Woyessa

This topic gives insight into the components of malaria transmission with much emphasis on climate that limits its epidemiology. Malaria maps developed so far at global, regional and local level will be introduced to participants and appreciated. The value added in using maps to guide coverage of interventions and intended impacts will be appreciated as well as further importance to investment and development will be discussed.

Recommended readings

Craig M.H., Snow R.W., le Sueur D. (1999). A Climate-based Distribution Model of Malaria Transmission in Sub-Saharan Africa. *Parasitology Today,* **15**(3): 105-111.

Omumbo J.A., Hay S.I., Snow R.W., Rogers D.J. (2005). Modelling malaria risk in East Africa at high spatial resolution. *Tropical Medicine and International Health*, **10**(6): 557-566.

Feachem, R.G.A., with A.A. Phillips and G.A. Targett (eds) (2009). Shrinking the Malaria Map: A Prospectus on Malaria Elimination. Chapter 1 and 6. San Francisco: The Global Health Group, Global Health Sciences, University of California, San Francisco.

Practical Session: Statistical Analysis of Climate and Health Data

Remi Cousin

This session includes a set of practical exercises in the Data Library that demonstrate how to use it as a tool to conduct some simple exploratory data analyses on health and climate data. The structure of epidemiological data in the Data Library is discussed, and participants will learn how to visualize time series. A number of exercises demonstrate how to produce histograms of data distributions and how to calculate several descriptive statistics of central tendency and dispersion. A final exercise demonstrates how to calculate district averages of gridded climate data.

Day 3:

Learning Goals

- To introduce basic concepts of the dynamics of transmission of vector-borne diseases and its relationship with climatic factors.
- To understand the relationship of rainfall and abundance of malaria vector
- To develop skill of identifying possible association between precipitation and malaria incidence
- To describe a health indicator in relationship to the climate.
- To introduce the climate suitability tool for malaria.

Climate and the Transmission Dynamics of Vector-borne Diseases

Meshesha Balkew

The role of climate in the transmission dynamics of vector-borne diseases in the context of replication of disease agents in their vectors and breeding, survival, distribution, abundance and longevity of vectors will be discussed. Due attention will also be given to the impact of climate change on the pattern of disease transmission and the geographical distribution of some diseases.

Recommended readings

Gage Kenneth L., Burkot Thomas R., Eisen Rebecca J.,and Hayes Edward B. (2008) Climate and Vector borne Diseases. *Am J Prev Med*; 35(5).

Elnaiem Dia-Eldin A., Schorscher Judith, Bendall Anna, Obsomer Valerie, Osman Maha E.,MekkawiI, Abdelrafie, Connor Stephen,. Ashford, Richard, and Thomson Madeleine C. (2003).Risk mapping of visceral leishmaniasis: The role of local variation in rainfall and altitude on the presences and incidence of Kala-azar in Easter Sudan*. Am. J. Trop. Med. Hyg.,* 68(1), 2003, pp. 10–17.

Thomson Madeleine C., Elnaiem Dia-Eldin A., Ashford, Richard and Connor Stephen. (1999). Towards a Kala-azar risk map for Sudan: mapping the potential distribution of *Phlebotomus orientalis* using digital data of environmental variables. Tropical Medicine and International Health. Vol 4. No.2, pp 105-113.

Malaria Vector Abundance and Rainfall

Meshesha Balkew

Rainfall is one of the climatic factors that impact the local distribution, abundance, survival and longevity of malaria vectors. Rainfall is a source of water for the creation and maintenance of breeding habitats. It is also a source of humidity that influences the activity, survival and longevity of adult mosquitoes. The amount and distribution of rainfall can have either a favorable or deleterious effect on vectors. The discussion will be geared towards understanding such effect by referring to past entomological studies.

Recommended readings

Coetzee M, Craig M. and Le Sueur D. (2000). Distribution of African Malaria Mosquitoes Belonging to the Anopheles gambiae Complex. Parasitology Today, vol. 16, no. 2

Practical Session: Correlation of Rainfall and Malaria Incidence

Assefaw Getachew

Epidemiologists are always keen at looking for relations between different variables and try to predict one from the other. There are many reasons that one would expect the two variables are related. For example, although malaria incidence and rainfall are not concurrent events, it is known that in areas where availability of surface water is a limiting factor for malaria transmission, rainfall lagged by 2-3 months is often associated with increased incidence of malaria. In this practical session participants will be asked to explore data on precipitation and malaria incidence, analyze the association between these two variables and discuss its

application for forecasting and malaria early warning system. Expected outputs of this group exercise are to tackle the problems below and present in a plenary.

1. Synthesis of a hypothesis for the association;
2. Compute the correlation between malaria incidence and precipitation at various lags;
3. Determine the lag-time for the maximum positive correlation and its significance;
4. Explain if correlation necessarily implies prediction? Discuss and provide examples;
5. Discuss how this association could be exploited for forecasting and early warning system.

Practical Session: Using the Climate Suitability for Malaria Transmission Tool in the Health Map Room

Remi Cousin

This exercise presents a clickable map interface that describes where, when and for how long the combination of climatic conditions (rainfall, temperature and humidity) may be suitable for malaria transmission on the African continent. The tool presented has applications in intervention targeting (when and where to administer interventions) and also in impact evaluation. Trainees will learn how to navigate the tool and review descriptive outputs. They will also use it to discuss the effects of climate on malaria transmission and the effects of this on the assessment of the impact of an intervention.

Day 4:

Learning Goals

- To understand predictions and climate projections with an emphasis on the interpretation and limitations of the available information
- To understand climate variability and change impact on health
- To understand how climate variability and change play in driving the burden of infectious diseases
- To appreciate the role of public health in assessing sensitivities, vulnerabilities and mitigating impacts
- To understand why climate information needs to be coupled with health information to inform public health decisions
- To understand the research gap as well as caveats and challenges of assessing climate variability and change impact on health.
- To illustrate how climate/ weather information could be used in malaria early warning and early response systems as a typical example to climate-sensitive diseases of public health significance.
- To understand how multiple linear regression works to make predictions for a variable given two or more predictors.

Understanding Predictions and Projections in Climate

Ousmane Ndiaye

The objective of this lecture is to provide the participants with an understanding of the rationale behind different types of predictions and projections with an emphasis on the interpretation and limitations of the available information. We will start by reviewing the concepts of different time and space scales and related uncertainties. The main factors behind the predictions/projections will then be introduced and the main tool, numerical

models, briefly presented. The ensemble technique and probabilistic approach to climate prediction will then be introduced. The necessity of bias correction, downscaling and verification procedures will be discussed and finally, we will interpret and discuss examples of climate predictions and projections.

Understanding Predictions and Projections in Climate: Ethiopia Experience

Girmaw Gezahegne

This course mainly focuses on Ethiopian climate and its prediction techniques. As a background, Ethiopian climate classification and the atmospheric systems which affect the Ethiopian climate will be discussed. The history of Ethiopia season prediction will be dealt as well. To predict seasonal climate of Ethiopia mainly statistical technique is applied. Some of the other methods are analog, teleconnection and probability. Each method will be explained explicitly. These methods may also useful for health sector.

Eventually, a case study of simulation of Ethiopia July, August and September (JAS) rainfall and atmospheric systems using NCEP Coupled forecast System (CFS) will be presented.

Impact of Climate Variability and Change on Health

Assefaw Getachew

Understanding the science of climate change and its impact on health is a multidisciplinary complex subject. Few generalists could have a deeper knowledge of both climate and health science, which most health professional lack. Dissemination of information on health impacts of climate change to the neediest society with very high vulnerability but, low adaptive and/or mitigation capacity is constrained by this knowledge gap. Scientists have the professional and morale obligations to relay their consensus to the end users, hence they need to establish a system to minimize this gap and use this opportunity and channel to reach policymakers, health professionals, donors, and the society at large to influence knowledge, attitude, and practice and thereby bring about a change in the adaptive and/or mitigation capacity of the human system. In line with this, IRI is one of the global centers of excellence in disseminating knowledge and transferring skills of understanding the climate science and society globally and to the most needy and vulnerable developing countries in particular through organizing and sponsoring training courses such as this one. The aim of this lecture is to provide an overview of the health impacts of climate change as per evidences emanating from the recent IPCC report. The lectures will overview the impact on the general health condition of society with special emphasis to infectious diseases, particularly malaria. The content of the lecture includes:

- Climate change and Infectious Diseases
- Extreme Events and Weather Disasters
- Thermal Stress (Heat Waves; Cold Spells)
- Air Pollution
- Food Yields and Nutrition
- Coastal Water Issues
- Sensitivity, Vulnerability, and Adaptation
- Research into the relationship between Climate Change and Health: Caveats and Challenges

Recommended readings

Kim Knowlton, Barry Lynn, Richard A. Goldberg, Cynthia Rosenzweig, Christian Hogrefe, Joyce Klein Rosenthal, Projecting MPH, and Patrick L. Kinney. (2007) Heat-Related Mortality Impacts under a Changing Climate in the New York City Region. *American Journal of Public Health.* **97**:2028–2034.

"Climate change and human health: risk and responses: revised summary 2008"

Washington, D.C.: PAHO, © 2008 http://www.paho.org/English/DD/PIN/climatechangeEN.pdf

Confalonieri, U., B. Menne, R. Akhtar, K.L. Ebi, M. Hauengue, R.S. Kovats, B. Revich and A. Woodward, (2007). Human health. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 391-431.

http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter8.pdf

Malaria Early Warning and Early Response Systems

Adugna Woyessa

In this lecture participants will learn the trends of climate change and changing patterns of malaria epidemiology. The mechanisms through which climate might impact on health will be presented and emphasis will be given to infectious diseases for the purpose of this lecture. The importance of vulnerability monitoring, seasonal climate forecasting, environmental monitoring, and case surveillance in malaria early warning and early response will be discussed.

Recommended readings

Thomson, M. C., F. J. Doblas-Reyes, S. J. Mason, R. Hagedorn, S. J. Connor, T. Phindela, A. P. Morse, and T. N. Palmer, (2006). Malaria early warnings based on seasonal climate forecasts from multi-model ensembles. *Nature*, **439**: 576-579.

Connor, S.J. and Thomson, M.C. (2005 . Epidemic malaria: preparing for the unexpected. SciDevNet.Dossier on Malaria. Policy Brief. www.scidev.net

Thomson, M.C., Mason, S.J., Phindela, T., and Connor, S.J. (2005). Use of rainfall and sea surface temperature monitoring for malaria early warning in Botswana. American *Journal of Tropical Medicine and Hygiene*, **73**: 214-221.

Dasilva, J., Garanganga, B., Teveredzi, V., Marx, S.M., Mason, S.J., Connor, S.J. (2004). Improving epidemic malaria planning, preparedness and response in Southern Africa. *Malaria Journal*. **3** (1):37.

Practical Session: Seasonal Forecasting of Malaria in Botswana

Tony Barnston

Botswana straddles what is termed the "fringe area" of malaria transmission in southern Africa. This is an area, at the geographical margins of stable malaria transmission, that is

mostly arid but experiences seasonal epidemics of malaria associated with increased precipitation. Unlike many regions of sub-Saharan Africa, Botswana has a very effective malaria surveillance system where malaria is notifiable and records of incidence are up to date. The national malaria control programme has developed a climate based Malaria Early Warning System (MEWS) modeled according to WHO recommendations. The MEWS has been in place since 1982 and integrates confirmed case monitoring with monitoring of climate variables.

This exercise analyzes the relationship between malaria incidence and rainfall and discusses the application of forecasts in disease prediction and control. The malaria incidence time series is also used to discuss the long term trends in disease and vulnerability changes that may have effects on the trends.

Day 5:

Learning Goals

- To understand remote sensing as a tool to monitor environmental data where field data are sparse.
- To identify and access environmental data from Internet based sources (health map room).
- Understand the concepts around epidemics and epidemic detection
- See and familiarize the different thresholds to be used to decide what is abnormal/epidemic
- Familiarize the above concepts using reported data series

Introduction to Remote Sensing

Tufa Dinku

Remote sensing is the science of obtaining information about an object through the analysis of data acquired by a device (sensor) that is not in contact with the object (remote). As you read these words, you are employing remote sensing. Your eyes are acting as sensors which analyze the electromagnetic waves (visible light) reflected from this page. The light your eyes acquire is analyzed in your mental computer to enable you to explain the words. Apart from the eyes, more sophisticated sensors have been developed to measure the electromagnetic waves in domains outside the visible range. By measuring the electromagnetic waves in domains from Gamma rays to Microwaves, we can retrieve information on objects we want to study. This lecture will introduce the concepts of remote sensing and will show how to use satellite images to monitor rainfall, air temperature, vegetation status and water bodies.

Recommended readings

Ceccato P., Dinku T. Introduction to Remote Sensing for Monitoring: Rainfall, Temperature, Vegetation and Water Bodies. Notes.

P. Ceccato, S.J. Connor, I. Jeanne, M.C. Thomson (2005). Application of Geographical Information Systems and Remote Sensing technologies for assessing and monitoring malaria risk. *Parasitology* **47**: 81-96.

http://www.parassitologia.net/PDF/No.%2047/ceccato.pdf

Epidemic Detection

Yonas Tadios

Epidemics is a very contextual concept, in order to define an epidemic one needs to know and understand the geographic area ("community or region"), time period ("occurrence"), what is "normal expectancy" for that area or time period, what do we mean by "cases" (case definition) and what is regarded as "excess". Calling something an epidemic is also more of a political and pragmatic decision, rather than a scientific one.

This lecture will introduce these and other concepts around epidemic and epidemic detection; it will also show the different thresholds to be used to decide what is abnormal or epidemic with practical exercises.

Recommended readings

Hay Simon I, Simba Milka , Busolo Millie , Noor Abdisalan M , Guyatt Helen L. , Ochola Sam A. and. Snow Robert W. (2002).Defining and Detecting Malaria Epidemics in the Highlands of Western Kenya*. Emerging Infectious Diseases*.Vol. 8, No. 6.

Teklehaimanot Hailay Desta , Schwartz Joel , Teklehaimanot Awash , and Lipsitc Marc Alert Threshold Algorithms and Malaria Epidemic Detection.(2004). *Emerging Infectious Diseases* Vol. 10, No. 7.

Cullen J.R., Chitprarop U., Doberstyn E.B., and Sombatwattanangkul K. (1984). An epidemiological early warning system for malaria control in northern Thailand. Bulletin of the World Health Organization. 62 (1) 107-114.

Monitoring Epidemic using Threshold

Practical Session

In this session, students will;

1) See and work with health datasets as they are usually presented
2) Understand the statistical basis of different malaria epidemic thresholds (third quartile, mean plus 1 or 2 standard deviations, moving average plus 1 or 2 standard deviations, cumulative sum)
3) Be able to use a health dataset on malaria in Excel to decide which 'normal' years on which to base an epidemic threshold.
4) After selecting base 'normal' years, estimate epidemic thresholds by various geographic and time units using Excel
5) Estimate how many epidemics there were in the selected example areas in the year. (Participants will be assigned subzones randomly from a selected list to work on).
6) Present and justify their findings
7) Provide a clear definition of a malaria epidemic
8) Know what to do if there are missing data.

The materials provided will be as follows:

1) Excel dataset of malaria cases by subzone and month for Eritrea 1996 to 2003 (Malaria Eritrea Subzone Month 1996_2003.xls)

2) Modified WHO Excel file for calculating epidemic thresholds by various methods (epidemic_threshold_calculation_sheet_PG 01jun2008.xls).

Practical Session: Remote Sensing Tools in the Health Map Room

Remi Cousin

In this exercise, we will learn how to use the Map Room to visualize data on rainfall, temperature, vegetation and water bodies; to extract time series; to extract anomalies and to download data, images and integrate those into Arc View.

Day 6:

Learning Goals

- To introduce Seasonal Forecasting and its applications in health
- Describe basic GIS concept,
- Discussing GIS functions relevant to public health arena
- Discussing issues regarding the mapping and analysis of health data,
- Cite specific examples of GIS applications in the field of Public Health (e.g. Accessing health facilities web based, Malaria, AWD, Leishmania, Leishmania/HIV Co-Infection and etc …)
- Demonstrating Web based online accessing health facilities
- To understand how researchers can help decision makers to understand where uncertainty is coming from and what might be done to reduce it.

Probabilistic Seasonal Forecasting and its Applications

Ousmane Ndiaye

Although it is impossible to forecast the weather more than a few days in advance, the science of seasonal climate forecasting is premised upon an ability to predict the general weather conditions over a prolonged period of time, without trying to predict the precise weather at any specific time during that period. The forecasting is possible only because sometimes, and primarily within tropical latitudes, the atmosphere is sensitive to unusual conditions at the earth's surface, and especially at the sea surface. Unusual sea temperatures can result in changes to the heat and moisture supplied to the atmosphere that in turn can disrupt weather conditions in many parts of the globe. However, all seasonal climate forecasts involve a great deal of uncertainty, and a key aspect of forecasting at such time scales is to estimate the uncertainty in the prediction reliably. In this presentation different ways of producing seasonal forecasts with associated estimates of uncertainty will be discussed. A practical exercise, in which a set of seasonal forecasts for Botswana are constructed, will be conducted.

Recommended readings

Mason S.J. (2008). Chapter 2: "Flowering Walnuts in the Wood" and Other Bases for Seasonal climate Forecasting. In: Thomson M.C. *et al.,* eds. *Seasonal Forecasts, Climatic change and Human Health.* Springer Science + Business Media B.V. 2008. pp. 13-29.

GIS Applications in the Public Health Sector

Negusu Worku and Meron Kinfemicheal

Increasingly, public health practitioners are using Geographic Information System (GIS) as a method to provide a spatial perspective on the geographic distribution of health conditions.

A GIS contains a database, maps, and a method to link elements of computer hardware and software that integrates maps, graphics with a database related to a defined geographical space and also integrated set of tools within an automated system capable of collecting, sorting, handling, analyzing and displaying geographically referenced information.

A GIS is as its heart, a simple extension of statistical analyses that join epidemiological, sociological, clinical and economic data with reference to space. A GIS system does not create data but merely relates data using a system of references that describe spatial relationships - (a geographical data may be spatial or descriptive in nature).

Consequently, GIS facilities the assessment of the impact of interventions which presumably would result in reductions of disease occurrence that could be visualized on a map.

Thus, it is apparent that the use of GIS in epidemiology follows from the heritage of John Snow who produced a map of the cholera outbreak in Broad Street, Golden Square, London.

Introduction to Decision Analysis

Daddi Jima

A decision is not intent or an idea but is an irrevocable commitment of resources to implement an action or actions to achieve some objective. Any subsequent change in the decision or attempt to cancel it will result in additional resources having to be spent. The strict relationship between a decisions and the use of resources makes management decisions significant in economic and financial terms; decisions are important.

Making decisions is certainly the most important task of a manager and it is often a very difficult one. Decision Analysis (DA) is the discipline comprising the philosophy, theory, methodology, and professional practice necessary to address ***important decisions in a formal manner***. Decision analysis offers individuals and organizations a methodology for making decisions. Graphical representation of decision analysis problems commonly use influence diagrams and decision trees.

This lecture will introduce on how to use Decision Analysis tools, such as decision tree and influence diagrams.

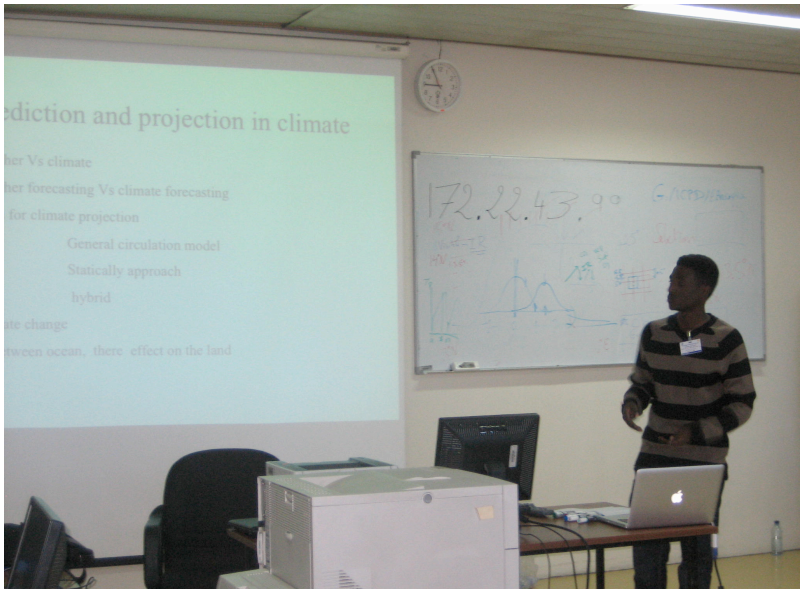
Recommended readings

Owens D, Shachter R, Nease R.(1997). Representation and Analysis of Medical Decision Problems with Influence Diagrams. Medical Decision Making. Vol 17/No 3.

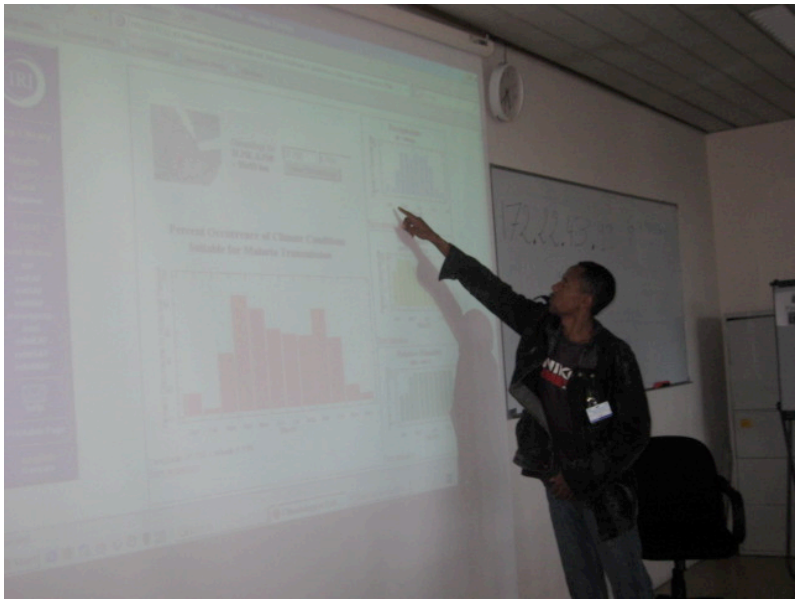
If you will begin with certainties, you shall end in doubts, but if you will content to begin with doubts, you shall end in almost certainties. --
Francis Bacon

Daily Student Feedback

A student was nominated each day to present the major points from the previous day's lecture and practical sessions. Accordingly, five presentations were delivered throughout the training. This helped the students to summarize and comprehend the concepts of the lectures, practical sessions and discussion points.



Mr. Nebiyu Negussu, participant from the Somali Regional Health Bureau, delivering a recap presentation



Mr. Gole Ejeta, participant from the Federal Ministry of Health, delivering a recap presentation

Evaluation

All the participants of the course were given the opportunity to evaluate and give their feedback on the presentations and overall organization of the training.

Three types of evaluation were carried out, these were a pre- and post-test and an overall evaluation. The pre- and post-test were envisaged to evaluate the improvement of an individual in this new course in Ethiopia for participants of different backgrounds. These evaluations were also expected to provide insight on how the course was conducted and on the overall gain of knowledge by this first group of participants. The evaluations were also intended to guide the course coordinators, facilitators, and others in ways of improving the methods, contents, and other aspects of the course should the training be repeated in a similar setting. Course coordinators and facilitators contributed to the evaluation on the organization of the overall training. Generally, the evaluations revealed that the training helped to increase the knowledge of the links between climate and health, as well as the use of climate information for decision-making in the public health sector.

Methods

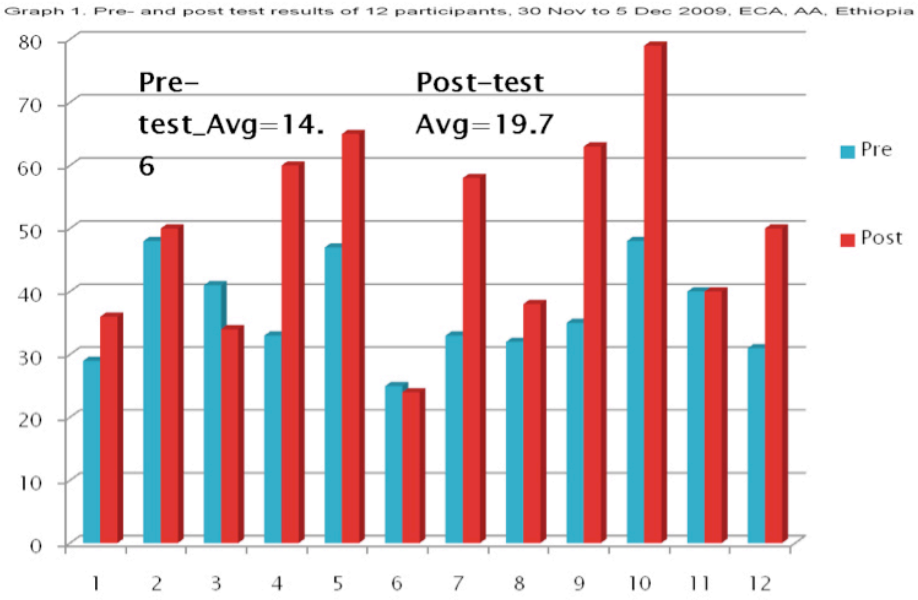
In order to gauge the level of the starting point knowledge of participants, a pre-test was given on the first day. On the final day, they were given a post-test to evaluate the differences in understanding among the participants and in order to see how the trainees progressed individually throughout the training. The pre- and post-test included 20 questions (10 True or False Questions, 6 Multiple Choice Questions, and 4 Open-Ended Questions, with a total score of 40 points). In addition, participants completed an overall evaluation. This questionnaire included 30 questions, which helped to evaluate the course content, global transferability of the course, course design, and delivery. This evaluation was intended to help the organizers to understand the weaknesses and strengths of the training, so as to plan other relevant trainings in the future.

Results from Pre- and Post-test

In this first training of its kind, *Training of Health Professionals on Climate and Health* in Ethiopia, of the total 16 participants, 12 of them completed both the pre- and post-test examination. Thus, comparison of individual performance is available only for this group of 12.

Participants taking post-test

Figure 1 : Pre- and Post-test Results



In the pre-test examination, the minimum score received was 25% and the maximum was 48%. All participants scored below 50% (the average was 36.83% with five participants scoring between 40 and 48).

On the post-test examination, seven participants scored above 50% with a maximum score received of 79%. Of the 12 participants to complete both the pre- and post-tests, nine of them showed an increase in their post-test scores (see fig 1) with an increased average score of 49.75%.

Even though the sample size of the participants was very small and further statistical analysis is not feasible, it is possible to conclude that the participants demonstrated positive changes in their knowledge of climate and health after taking this course. Comparing the average of both the pre- and post-test, there is a difference of just under 13%. This being said, the participants were exposed to a vast amount of information and new skills in a short time frame, which might help explain both the gains and, in some cases, the losses in pre- and post-test scores.

This evaluation method was intended to be informative on individual performances following completion of the course, whereas the general course evaluation reported on below was intended for broader feedback on the content, relevance, organization and implementation of the course.

Results of the Overall Evaluation

The purpose of the overall course evaluation was to obtain feedback and to learn how participants perceived the training of professionals on climate and health. It had four themes including course content, global transferability of the course content, course design, and course delivery. The first theme focused on how participants perceived the course's content as it related to their expectations and the objectives of coherence, engagement, and clarity. The second theme, global transferability, asked whether the course was relevant to the trainee's geographic region and organization and whether it could be successfully reproduced in their respective home institutions.

The third theme, course design, focused on how the course in general was orchestrated, incorporating feedback on whether it allowed participants to learn at their own pace, helped to reinforce their understanding of the content, and on whether they had enough time and opportunity to engage in practical, hands-on work. Finally, the course delivery theme was designed to track whether participants had had similar courses before or not, and to measure the appropriateness of the materials distributed, the facilities of the course, and the cooperation and knowledge of the facilitators.

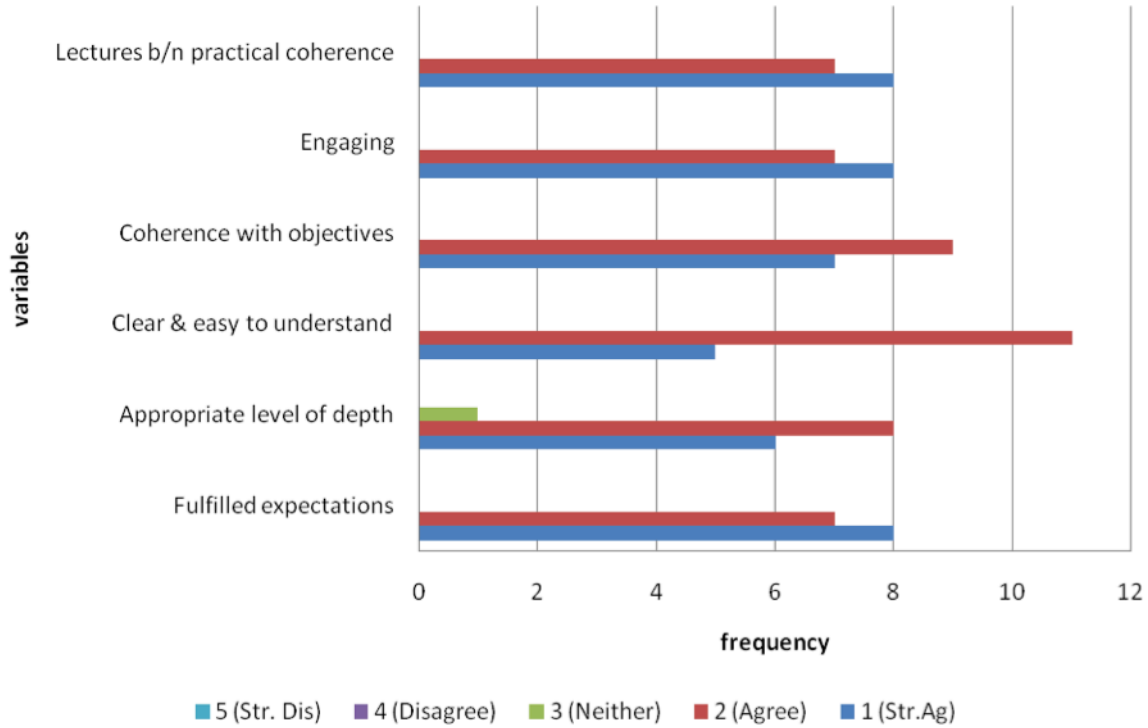
Details on the content of the overall course evaluation can be found in Appendix d. The responses of the 16 participants are summarized and presented below.

Course Content

This part consisted of eight items with six closed-ended and two open-ended questions. For the closed-ended questions, a summary of participant responses is provided below (Graph 1). Almost all of the respondents were very satisfied with the content of the course. In the six closed-ended questions, either half or more than half of participants, agreed or strongly agreed with the contents of the course.

In the open-ended questions, respondents identified different topics as the most instructive to them. Some of the topics such as: links between climate and health, early warning and response, climate, vector-borne diseases and climate, and the data library were identified as the most instructive for a majority of the trainees.

Graph 1. summary of participants evaluation on the course content, UNECA, Addis Ababa, Ethiopia, 30 Nov to 5 DEc 2009



Global Transferability of Course Content

This section was comprised of five items with open-ended responses. A summary of the main points identified and their justifications are compiled in the table below (Table 1). The number of responses is included and additional comments are also present in some cases. Most of the respondents replied that the course was relevant to their geographical region and organization and also indicated the course could be reproduced in their home institution. As most of the respondents indicated that the time allocated for the practical sessions was too short, this could be improved upon in future trainings.

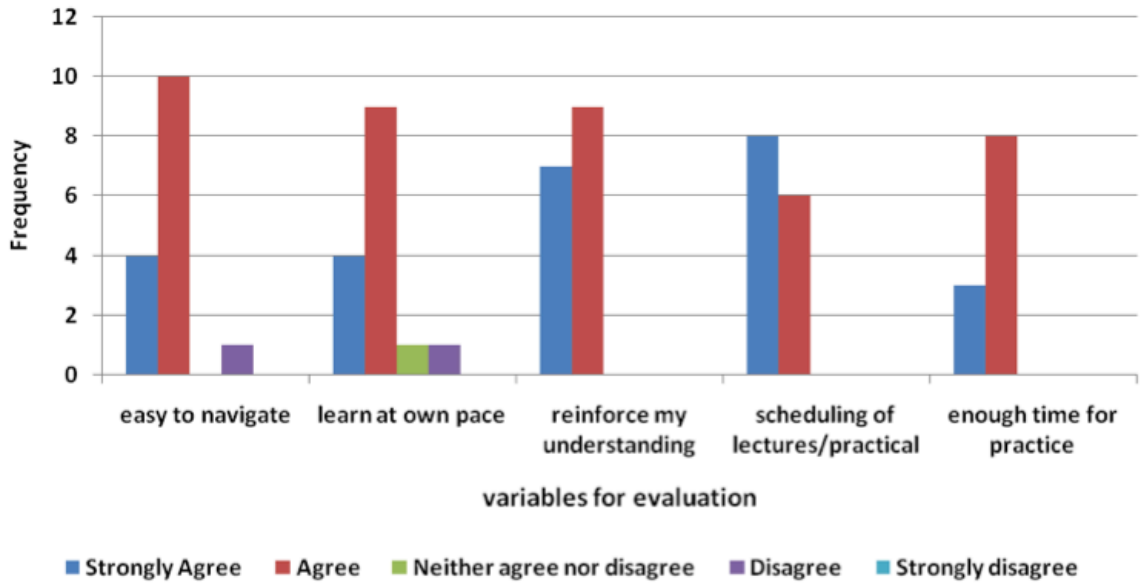
Table1. Summary of participant views on global transferability of the course content, UNECA, Addis Ababa, 30 Nov to 5 Dec 2009.

S.N	**Variables**	**Responses with comment**	
1	Relevance of the course to their respective geographical region or organization	Yes [9] But there is a challenge in applying at regional level	No [4] -"the content of the course is more relevant to climatologist" -"not applicable to regional state currently I work for"
2	Part of the course MOST relevant to their work	-climate prediction and its relationship with health, malaria early warning and response, climate and health/malaria, GIS, epidemic detection, climate/meteorological, data library, and epidemiology	
3	Part of the course LEAST relevant to their work	-Statistics (Regression analysis) [1], Remote sensing[1], and GIS application in public health[1] -All topics are relevant	-It was suggested to give more time to climate/meteorology parts and simplify the presentations to be understood easily by health professionals[1]
4	Change about the course	-the influence of climate and health, extend time allocated for the practical, extend time allocated for the course, include other climate-sensitive diseases including meningitis, cholera, and others, and include public health emergency	
5	Course could be reproduced	Yes [n=12],	-There is a possibility [n=1]

Course Design

This part was evaluated by respondents using six variables, in which the first five were closed-ended questions. These are summarized in the graph below (Graph 2). In most cases, the respondents replied that they agreed (red bar from the graph) and strongly agreed (blue bar) with the variables selected for evaluation of the course design. However, there were three responses that deviated from this. One respondent disagreed that the course was easy to navigate and that the course allowed him (her) to learn at their own pace. Another participant neither agreed nor disagreed on the same issue.

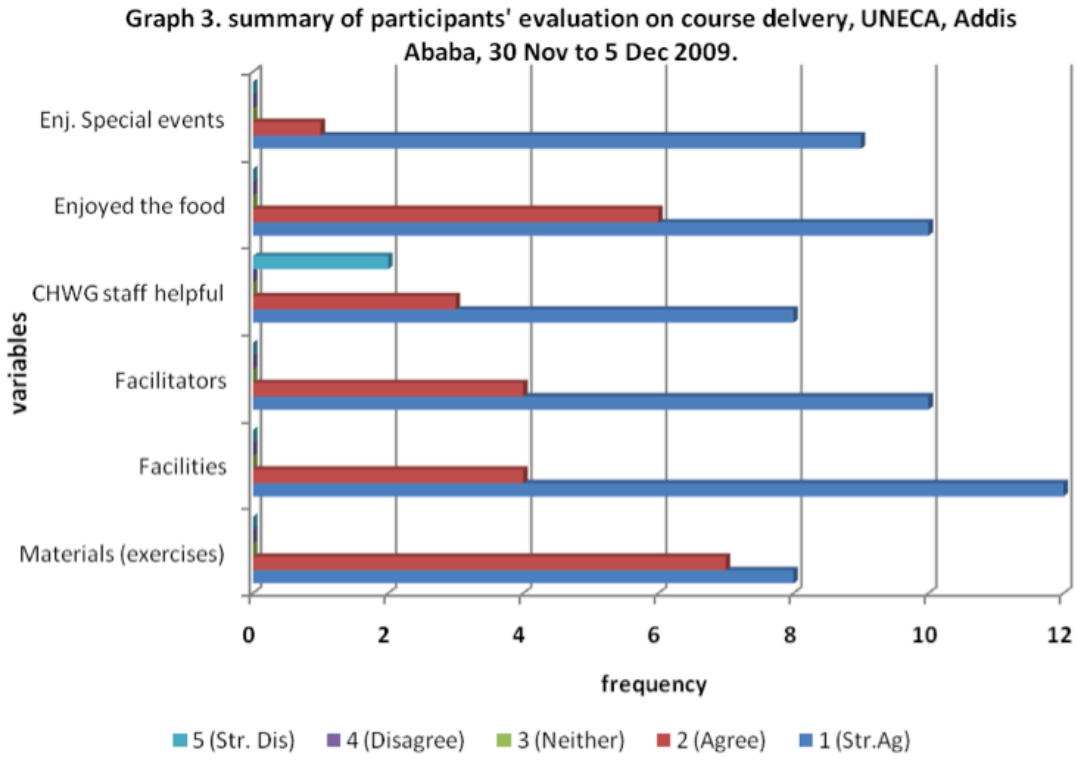
Graph 2. Summary of participants' evaluation on course design, UNECA, Addis Ababa, 30 Nov to 5 Dec 2009



In an open-ended final question in this section, some respondents suggested starting the GIS component immediately in the training, allocating more time for the practical session, lengthening the course to two weeks, and stressed the importance of punctuality of the facilitators and the need for sustainability of this training initiative.

Course Delivery

Most of the respondents strongly agreed with the course delivery as indicated in the graph below (Graph 3). Fourteen of the sixteen participants indicated they had not received a similar training before. There was variability among respondents regarding the duration of the course. Five respondents were of the opinion that it was too short, four replied that it was short, four commented it was enough, and uniquely one respondent believed it was unnecessarily long (not shown on the graph below). Participants did not indicate any significant problems during their week-long stay for the training.



Conclusions and Recommendations

This training initiative of professionals on climate and health, conducted in collaboration with the Climate and Health Working Group (CHWG) of Ethiopia and IRI, was the first of its kind to be organized in Ethiopia, especially at a national level.

The course provided an excellent opportunity to address the need for a more coordinated interaction between climate experts and health workers to improve decision-making processes in the public health sector. It brought 16 participants together from different regions, aiming to enabling them to realize the value that climate information plays in decision-making processes. It also sought enabled health experts to understand the complexity of integrating climate information to decision-making processes, as in, for example, the downscaling of climate models for regional and local health risk management.

On the whole, the course was a great accomplishment and was very well-received by the trainees. The course achieved its objectives, which were, on average, seen as clearly stated by the trainees and matched their expectations.

While the evaluations of the course indicated that participant expectations and objectives were met with great success, the major recommendations for future trainings were for more time to be allocated to the practical sessions and to include other climate-sensitive diseases like meningitis and cholera in the curriculum, as well as other public health emergency issues.

As a final point, all the trainees were positive about reproducing the course for their own regions. They recommended that this training should be cascaded to the regional health bureau level, in particular, and indicated they could lead efforts here as alumni of this course with close support of the CHWG. It was agreed that the collaboration of regional branch offices of the NMA be sought to support the sharing of their expertise on how to use climate information to improve public health decision-making.

Perhaps the most important point made by the trainees and to be reinforced here is the need for sustained training activities like this one and for the contents of the course to be updated as relevant. Even though participants did not indicate active engagement with local universities in different parts of the country was strong, these partnerships should be supported as critical in the sharing of knowledge on the use of climate information for public health decision-making, especially in identifying locally important priority diseases and strategies for their prevention and control.

Appendices

a. Profile Facilitators

1. **Mr. Asefaw Getachew** is a graduate of Addis Ababa University, Ethiopia (Biology Diploma, 1980; Biology and Chemistry BSc, 1986), University of Liverpool, LSTM, Liverpool, UK (Applied Parasitology & Medical Entomology M.Sc. 1998) and Columbia University, New York, USA (Climate & Society, MA, 2005). He is currently working as a consultant for Malaria Control and Evaluation Partnership in Africa/Program for Appropriate Technology in Health (MACEPA/PATH-Ethiopia) since joining the organization in 2008. He has been responsible for coordinating the National Malaria Indicator Survey (MIS-2007) at the Carter Center-Ethiopia. He has also served as the division and department head of malaria and other vector-borne diseases control department at Tigray Regional Health Bureau and various posts within the Ministry of Health. He has undertaken various projects, the outcomes of which have been published in international journals.

2. **Dr. Meshesha Balkew** has a B.Sc. in Biology (1984), M.Sc. in Biology (Insect sciences) (2001) from Addis Ababa University, Ethiopia and a PhD in Molecular Biology (2009) from University of Khartoum, Sudan. He joined Aklilu Lemma Institute of Pathobiology, Addis Ababa University as a research assistant in1987. He is currently a researcher and lecturer at the institute. His research interest is focused on leishmaniasis and malaria vectors with reference to the ecology, taxonomy, transmission dynamics, host preferences of sandfly vectors and reservoir hosts; and ecology and host preferences of mosquitoes, screening of local plants for their insecticidal/repellent properties against mosquitoes, insecticide resistance in mosquitoes, respectively. He has participated in the training of students and laboratory technicians on entomological techniques and served as coordinator for visiting students. He has undertaken various research and consultancy projects on the epidemiology of leishmaniasis and malaria and bioefficacy tests of insecticides for household use and treating long lasting mosquito nets. He has published various research findings in local and international journals and books.

3. **Dr Fikre Enquselassie** obtained a B.Sc. in Mathematics and M.Sc. in Mathematical Statistics from Addis Ababa University, Ethiopia. He earned an M.Sc. in Biostatistics from University of Newcastle (Center for Clinical Epidemiology and Biostatistics), Australia and PhD in infectious disease epidemiology from University of Warwick (Biological Sciences Department), UK. He began his career as an assistant lecturer in Asmara University and is currently an associate professor at the Department of Community Health, Addis Ababa University. He has been responsible for coordinating HIV/AIDS training and research program within INCLEN-Africa. He has been engaged in teaching various courses (Biostatistics, Epidemiology and Biostatistics, Clinical epidemiology and Biostatistics, Rural Community Health Training Program, Research Methodology, etc) to graduate and undergraduate students in Ethiopia and abroad. He has advised undergraduate, MPH and PhD students in public health, biomedical and clinical medicine, supervised resident graduate students in public health. He has participated in various consultancy services. He has served as a member of various committees within the Faculty, member of Editorial Board and consultant of various journals and is Chairman of the national steering committee for Field Epidemiology and Laboratory Training Program (2006-2009). He has various research results published in scientific journals and other publications.

4. **Mr. Melesse Lemma** graduated from Addis Ababa University, Ethiopia (B.Sc. in Physics, 1989), Poona (postgraduate diploma in Meteorology, 1993) and Reading University, Reading, UK (M.Sc. in Applied Meteorology, 2003). He has been working at National Meteorological Agency in various capacities as a meteorologist in Research and Studies Department and Forecast and Analysis Department. He is currently Team leader of Data Users Team. In addition to leading the team, he is responsible for conducting research activities in the area of climate change and weather forecasting, providing consultation services to meteorological data users, preparation of response to meteorological data requests and involved in the activities of meteorological weather prediction and numerical weather prediction as well as development of curriculum, occupational standards, teaching and learning materials. He has undertaken various research projects as well.

5. **Mr. Girmaw Gezahegn** obtained a B.Sc. in Mathematics from Addis Ababa University, Ethiopia in 1993, postgraduate diploma in Meteorology from Nairobi University, Kenya in 2001 and M.Sc. in Meteorology and Air Quality from Wageningen University, the Netherlands in 2006. His M.Sc. thesis was entitled 'Representation of nocturnal marine stratocumulus cloud by means of a mesoscale model (MM5)' and internship thesis was entitled 'Simulation of Ethiopian summer rainfall using NCEP Coupled Forecast System (CFS)'. He joined National Meteorological Agency as a meteorologist in 1998. His specific area of work deals with weather and climate prediction. He is currently involved in the performance verification of mesoscale NWP models in Ethiopia and sensitivity study of mesoscale NWP models.

6. **Mr. Adugna Woyessa Gemeda** has a B.Sc. in Biology (minor Chemistry) from Addis Ababa University. He also obtained his M.Sc. in Medical Parasitology (Biology) in 2001 from the same university. He started his career at Jimma Institute of Health Sciences (Jimma University at present) as teaching staff. He has served the Ministry of Health at different levels including program manager of malaria control program, Jimma Zone, Oromia Regional State; project coordinator and consultant to GFATM. Starting from 1997 up to present he is working for Ethiopian Health and Nutrition Research Institute (EHNRI) as malaria epidemiology researcher and focal person to a WHO initiated project, i.e., Evidence Informed Policy Network-Ethiopia. Currently, he is a PhD candidate at the School of Public Health, Addis Ababa University. His PhD project focuses on malaria epidemiology particularly on highland malaria. He took a three months WHO training on malaria and planning its control in 1996 held in Adama, Ethiopia. Afterwards, he continuously served as facilitator for different courses and coordinated related field activities. He published different papers on peer-reviewed journals focusing on highland malaria as well as co-authored with others on malaria epidemiology. He also contributed to reviewing different papers focusing on malaria submitted for publication on local journals. He participated in academic area as external examiner to postgraduate students at the School of Public Health, Addis Ababa University.

7. **Dr. Daddi Jima** is currently the Deputy Director General of Ethiopian Health and Nutrition Research Institute with main focus area on Public Health Emergency Management. He has served as Head of the Malaria and Other Vector-borne Diseases Prevention and Control team in the Ministry of Health, where his responsibilities included coordination of the overall activities. He is also Chairman of the National Climate and Health Working Group. He also works as Coordinator in the National Onchocerciasis Control program. He has partnered with the World Health Organization and the African Program for Onchocerciasis (APOC) on several projects. Dr. Daddi earned his MD from Jimma University in Ethiopia and his Master of Public Health degree from the National University of Ireland.

8**. Dr. Yonas Asfaw** worked as a Surveillance Officer in the Disease Prevention and Control Department of the Federal Ministry of Health. He was directly involved in disease preventive and control activities. His responsibilities included preparing disease specific appeals and proposals, analysis of national ISDR data and investigation of epidemics and implementation of control interventions, among other duties. He holds a Masters degree in Public Health from Addis Ababa University and MD from Jimma University.

9. **Mr. Negusu Worku** is a senior national staff of the World Health Organization–Ethiopia Country Office responsible for a Health Information Database Management [HIMS] for the entire program of the 22 confirmed disease surveillance for the country running the national database compilation, analysis, providing training to the Federal Ministry of Health, regional health bureau, zonal and districts health worker including Health information system and GIS – vulnerability analysis. He has coached MPH students of School of Public Health (SPH), Addis Ababa University quantitative and qualitative research methods and methodology using Epi-info Epidemiology statistical packages, SPSS, SAS and STATA from 1992 – 2002. Moreover, he has been providing public health database analytical support for Masters and PhD candidates of SPH in the area of HIV, TB, Nutrition, Malaria (ITNs Net effect operational research analysis), emergency preparedness and disease outbreak, Health Information system, Health Information management system, supporting the clinical epidemiology unit and other public health programs. From 2002 up 2009, he has been a staff member of Family Health International, US –Center for Disease Control [US – CDC], World Health Organization [WHO], UNICEF, WFP, CDC-HQ [Atlanta, Georgia, USA], WHO- South East Asia Regional Organization [WHO Regional HQ- India]. He has participated in the area of health information database management system for the national Behavioral Surveillance survey [BSS], National ART, National TB/HIV co-infection, polio and measles support both at national and international level, vulnerability study for Addis Ababa, supporting the national district level plan, National baseline survey on Emergency Obstetrics and New born Care [EoMNC], National Malaria, TB, HIV research database support and production of advanced analytical outputs – using medical and biostatistical methods – based on qualitative and quantitative methodology. He has vast experience in both Information technology, medical/health biostatistics and Epidemiology techniques, GPS and GIS technology, PDA with pendragon software, advanced database support at local and international level [India]. He has an international Applied Epidemiology training from Emory University – Rollins School of Public Health, Atlanta – supported and co-sponsored by US Center for Disease Control and Prevention (CDCHQ) with the Epidemic Intelligence Service (EIS) Program.

10**. Tony Barnston**. Director, Forecasting Climate, Prediction, Outreach. IRI**.** Prior to arriving to the IRI at the end of June 2000, Barnston was an operational seasonal climate forecaster and developmental researcher in empirical prediction methodology at the Climate Prediction Center of NOAA for 17 years. He has authored atlases, reports and journal papers on weather and climate, the best known of which were on statistical diagnosis of large-scale circulation patterns and on empirical climate prediction. With his forecast staff, Barnston ensures the production and routinely scheduled issuance of a range of IRI forecast products, including monthly forecasts of sea surface temperatures (including an ENSO outlook) and global precipitation and temperature. His goals are improvement of the accuracy of IRI's real-time forecasts, streamlining and automating the forecast process, facilitating development and delivery of versions of the forecast tailored to the needs and requests of partners and the user community, and training and capacity building in probabilistic climate prediction and implications for decision making.

11**. Rémi Cousin.** Staff Associate, Data Library. IRI. Rémi Cousin received his degree from l'Ecole Nationale Supérieure des Mines de Nancy (equivalent to Master degree) in

engineering with majors in geo-sciences, in 2005. After specializing in physical oceanography through internships in l'Institut de Recherche pour le Développement (IRD) and Mercator-Océan, Toulouse, France, and Universidad de Concepción in Chile, he worked for CLS (Collecte Localisation Satellite), a subsidiary of CNES, as a consultant at Mercator-Océan to develop user-friendly tools to run and post-process Mercator ocean models dedicated to operational oceanography. Rémi then worked at the Jet Propulsion Laboratory (JPL), Pasadena, California, to develop a public outreach and education website on ocean salinity in the context of the co-developed NASA satellite mission Aquarius, and to conduct research to support the activities of the OurOcean group, focusing on regional ocean models. Since 2008, Rémi has been a member of IRI Data Library to develop new functionalities and enable climate information communication and dissemination to end users.

12. **Dr. Gilma Mantilla**, Senior Staff Associate, Public Health**.** IRI. Dr. Gilma Mantilla is a Senior Staff Associate at the International Research Institute for Climate and Society (IRI). Her scholarly work has been mainly on Public Health. She is a graduate of Columbia University (Climate and Society MA, 2008), Rosario University, Colombia (Epidemiology 1998), Javeriana University, Colombia (Master in Health Management, 1993) and Escuela Colombiana de Medicina (Physician Surgeon, 1988). Before joining IRI, she was Colombia's Public Health Surveillance and Control Deputy Manager at the National Health Institute where she worked mainly to establish policies, plans, programs and projects in public health associated with the surveillance and control of infectious diseases; to redesign the National Infectious Diseases Surveillance System and to support operational research on issues like epidemics, outbreaks and disasters. In the IRI she is working on establishing tools and protocols for creation, integration and dissemination of knowledge and information related with climate and public health.

13. **Ousmane Ndiaye**. PhD candidate, Climate Studies, DEES, Columbia University. He is a meteorology professional at the Senegalese National Service (DMN) and was associated researcher to the "laboratoire de Physique de l'Amosphere Simeon Fongang" (LPASF) of the University of Dakar, Senegal. He has contributed to climate outlook forums and regional capacity building at the African Center of Meteorological Application for Development (ACMAD) and as expert in the CLIMAG (Climate and Agriculture) project, running the Regional Spectral Model (RSM). He was also coordinating the climate and health project in ACMAD. Currently he is finishing his PhD in Climate Studies at Columbia University.

14. **Tufa Dinku**, Associate Research Scientist, IRI . He received a B.Sc. in physics from Addis Ababa University and a post-graduate diploma in meteorology from India. He worked at the National Metrological Agency of Ethiopia for over a decade mainly in the satellite applications unit. Then he joined the University of Connecticut where he obtained M.Sc. (2001) and Ph.D. (2005) in Civil Engineering/hydrometeorology. Dr. Dinku had also an opportunity to work as a visiting scientist at the National Space and Aeronautics Administration/Goddard Space Flight Center. Dr. Dinku joined IRI in 2005. His main research interest is remote sensing of climate variables such as precipitation and temperature. His current research includes identifying global climate data sets (both satellite and conventional), assessing their quality, making adjustments whenever possible, and adapting these products for specific applications.

b) Profile Students

1. **Mr. Basazinew Alemu** has a diploma in comprehensive nursing and a B. Sc. degree in Public Health from Jimma and Gonder University. He has served as a matron and nurse in Pawe hospital, Benshangul Gumuz region. He has served as head of various health centers in Amhara Regional State. He is currently working in Amhara Regional Health Bureau as a Public Health Emergency Management (PHEM) preparedness officer. He has undertaken various short term trainings relevant to monitoring, prevention and control of various infectious diseases, etc.

2. **Mr. Abdulhamid Ahmed** obtained his diploma in nursing from Harar Nursing College and a B.Sc. degree in nursing from Haramya University. He has served as a beginner ward head in Hiwot Fana hospital and head of a health center. He joined Harari Regional Health Bureau from 2004 onwards; since then he has held posts such as HMIS expert and malaria prevention and control expert. Presently, he is the Public Health Emergency Management coordinator. He has participated in special trainings on surveillance and monitoring, climatic health related diseases, etc.

3. **Dr. Milliyon Wendabeku** obtained his M.D. from the Order of People Friendship Rostove State Medical Institute of the former USSR. He has served as general medical practitioner and held various posts related to communicable diseases in Benshangul-Gumuz region. He has held various posts in the Federal Ministry of Health since 2005. He has served as an expert and team leader on Integrated Disease Surveillance and Response/IDSR, response and national health and nutrition emergencies preparedness, emergency communication focal point at Ethiopian Health and Nutrition Research Institute (EHNRI). Currently, he is a resident of Field Epidemiology and Laboratory Training program (FELTP). He has taken various courses and professional trainings on public health emergency, infectious diseases, etc. He has served as a member of the technical working group of the National Emergency Food Reserve, member of the National Crisis Committee, Emergency Health and Nutrition and National Avian Influenza Council and Zoonotic Disease Council.

4. **Ato Ferede Mosisa** earned a B.Sc. degree in health officer from Jima University. He has served as a head nurse at Gambela hospital and zonal maternal and child health expert. After joining Gambela Regional Health Bureau, he first served as maternal and child health expert. He is presently the Disease Prevention and Control Team Leader and IDSR focal person. He has participated in trainings on surveillance, monitoring, PMTCT, etc.

5. **Sister Fikre Bulti** has a diploma in comprehensive nursing from Nekemte School of Nursing and anticipates holding her B. Sc. in nursing from Jimma University. She has worked as a nurse in various capacities in health institutions. She has also served as the zonal coordinator and expert of different teams under West Wollega zone. After joining Oromiya Regional Health Bureau she has held the position of regional IDSR expert and is currently a Public Health Emergency Management Core Process owner. She has taken additional trainings on monitoring, threat preparedness and response, etc.

6. **Mr.Gole Ejeta** has held various positions at the Federal Ministry of Health after obtaining his B.Sc. in applied Biology from Gondar University. He has served as a malaria and other vector-borne disease expert/vector biology expert, national program coordinator/focal person of Ethiopian Onchocerciasis control program, national program coordinator/ focal person of Ethiopian Drancunculiasis eradication program and focal person of national visceral leishmaniasis control program. Additionally he has been involved in coordinating

the treatment protocols, algorithm, and national plan for pandemic influenza and case tracing as well as emergency nutritional assessment survey.

7. **Mr. Haftom Taame** obtained his B.Sc. degree in applied chemistry from Ambo University. After graduation, he held the post of a junior researcher and is now a Public Health Emergency Surveillance officer.

8. **Mr. Hailu Sebagades** earned his diploma in nursing and a B.Sc. in Public Health from Gondar College of Medical Sciences. He obtained an M.Sc. in infectious and tropical diseases from Aklilu Lemma Institute of Pathobiology. He has served as a nurse, clinician and head of health centers and district health office. He has held different posts in Tigray Regional HIV/AIDS secretariat office. He has also served as head of woreda health offices in different times. He has undertaken various research and surveys.

9. **Mr. Nebiyu Negussu** obtained a B.Sc. in Health Education and Promotion and a Master of Public Health in epidemiology from Jimma University. He is currently working under malaria and other vector-borne disease prevention and control department in Somali Regional Health Bureau.

10. **Mr. Tadele Tsehaye** has a B.Sc. in Environmental Health from Gondar University. He has an experience in field work and teaching. Currently, he is a student in the department of Epidemiology at School of Public Health, Addis Ababa University.

11. **Mr. Tessema Worku** has a diploma in Environmental Health Science from Haromaya University and currently due to obtain his bachelor in Environmental Health Science. He has worked as a malaria and surveillance focal person, head of Environmental Health departments in woreda health bureau and health center as well as head of the woreda health bureau. He is currently working in the communicable disease prevention team at the Dire Dawa Administrative Council Health Bureau.

12. **Mrs. Tsehaynesh Lema** obtained a B.Sc. degree in Biology and M.Sc. in Medical Microbiology from Addis Ababa University. She has been employed at Institute of Pathobiology, served as a laboratory technician in a hospital and participated in a project. She has undertaken various professional trainings since joining All African Leprosy, Tuberculosis, Rehabilitation and Training Center/Armauer Hansen Research Institute (ALERT/AHRI) from 1997.

13. **Miss Zayeda Beyene** obtained a diploma in clinical nursing from the then Mekelle Nursing School (now known as Mekelle Nursing Institute), a Bachelor of Science in Public Health from the former Gonder College of Medical Science (now known as Gonder University). She has served as a clinical nurse in health institutions and as a public health officer in health centers in Tigray region. Her responsibilities included examining and treating patients, compilation of surveillance data of the health center among others. She is currently a resident of Field Epidemiology and Laboratory Training Program (FELTP) at Addis Abeba University, Department of Public Health.

14. **Mr. Zekarias Adamu** earned a B.Sc. degree in Environmental Health Science from Haromaya University. He has served as environmental health science expert in Assosa hospital, Assosa. Since joining Benishangul-Gumuz Regional Health Bureau, he has held the post of Surveillance and Epidemic control and prevention Expert or Regional IDSR Focal Person. He has undertaken various trainings on ANC Sentinel Surveillance, Integrated Disease Surveillance and Response, Acute Watery Diarrhea (AWD) prevention and control, TB prevention and control, HMIS and Participatory Hygiene and Sanitation Transformation/PHAST/. He has participated on community mobilization and awareness

creation on AWD, malaria prevention and control programme and epidemic control and prevention activities.

15. **Ms. Mekdes Demisse** obtained a B.Ed. in Biology from Dilla College of Teachers Education and Health Sciences. She has a diploma in Biology from Awassa Teachers Training College. Her work experience involved working as a teacher in Dumerso Elementary and Junior Secondary School at Y/Chefaa wereda, Gedeo Zone and Wonago Junior and High School at Wonago wereda, Gedeo Zone. She has also worked in Capacity Building Office of Kochery wereda, Gedeo Zone. After joining Southern Nations and Nationalities Peoples Regional Health Bureau, she worked in HIV/AIDS Prevention and Control sector for four years. She is currently working in Public Health Emergency Management/PHEM. She has undertaken various professional trainings related to her responsibility.

c) Pre-test and Post-test Questionnaire

The content of both the pre-test and post-test questionnaires was the same as it was used as a measure of comparing the level of knowledge of participants before and after the training.

PRE-TEST AND POST-TEST EXAMINATION

PREPARED BY GILMA MANTILLA (IRI) AND ADUGNA WOYESSA (EHNRI)

INSTRUCTIONS

Please read the following instructions carefully before you start working on the examination part. The following questions are divided into three parts including true/false, multiple choices, and defining/ brief response questions. Each part has its own directions in which you will read carefully and give APPROPRIATE ANSWER. There is a deduction of **½** (half) marks for each wrong answer you give. THE TIME ALLOWED IS 30 MINUTES. GOOD LUCK!

1. Full Name: _____
2. Region: _____
3. Zone_____
4. District/Town_____
5. Position (work place) _____
6. Basic Training_____
7. Current Degree/Diploma acquired_____
8. Title (underline): Ato., Dr, Wzo., Wzt
9. Date _____
10. Participant CODE (To be assigned by course coordinators) _____

PART I. TRUE OR FALSE QUESTIONS

Give your response by putting T for the right and F for the wrong statements at the end of each question.

1. Climate is conditions averaged over long periods, generally at least 30–50 years.

2. Weather is an average condition of the atmosphere near the earth's surface over 10 year's period.

3. Climate is what we expect and weather is what we get.

4. Correlation is a way to measure strength of association between two variables.

5. Cluster analysis is a particularly useful method when you re classifying multiple attribute.

6. Advancement in GIS technology assisted the development of malaria risk map and seasonal predictions using satellite-derived environmental data.

7. The inter-annual variability of malaria is not related to climate variables.

PART II. MULTIPLE CHOICE QUESTIONS

Circle your response clearly using blue ball pen and put mark "X" if you finally change your answer.

8. Which of the following variables are climate related?

a. Rainfall
b. cloudiness
c. Sea Surface Temperature
d. Only a and c are correct
e. Humidity
f. All of above

9. Which of the following are sources of climate data?

a. Meteorological stations
b. Ocean observation
c. Satellite
d. Only a and c
e. All of above

10. Climate data is described using a variety of units of measure. How is rainfall measured?

a. Millimetres / day
b. Millimetres / every six days
c. Millimetres / ten days
d. all of the above
e. none of the above

11. Which one of the following is/are temperature dependent stages in malaria transmission?

a. sporogonic cycle (duration of parasite development)
b. gonotrophic cycle (duration of larval development)
c. daily vector survival
d. vector survival after period required for sporogony
e. all of the above
f. a and b are answers

12. Most of the malaria burden occurs in:

a. tropics
b. sub-tropics
c. temperate
d. a and b are answers

13. The major advantage of seasonal climate forecasting over case surveillance in malaria early warning system is due to its:

a. timeliness

b. accuracy

c. cost effectiveness

d. none of the above

PART III. BRIEF RESPONSE QUESTIONS

Give your response to the following questions briefly and precisely with readable hand writing.

14. Please list four climate-sensitive diseases.

_____
_____
_____
_____

15. Please define the following geographic terms used to describe climate information:

a. Latitude_____
b. Longitude _____
c. Geographic coordinate systems_____
d. Spatial scale_____
e. Grid _____

16. Please describe the following climatologic terms:

a. Climate variability _____
b. Climatology_____
c. Forecast _____
d. Anomaly_____

17. What is epidemiology? Describe its main components briefly.

_____
_____
_____
_____
_____

18. Please describe the following epidemiological concepts

a. Incidence _____
b. Prevalence _____
c. Risk ratio_____
d. Odds ratio_____

19. Please mention three uses of the climate information to improve health outcomes

_____
_____
_____
_____

20. Mention the two typical environmental conditions under which malaria epidemics occur within 'fringe' areas of transmission.

_____
_____

d) Overall Evaluation

SET BY GILMA MANTILA (IRI) AND ADUGNA WOYESSA (EHNRI)

Course Content

1. The content of the course fulfilled my expectations

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

2. The course content covered an appropriate level of depth

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

3. The content was delivered in way that was clear and easy to understand

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

4. The content was coherent with the objectives of the course

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

5. The course content was engaging

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

6. There was coherence between course lectures – practical sessions and the course objectives

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

7. What topics of the course were most instructive to you?

8. What did you learn that was most valuable?

Global Transferability of Course Content

1. Was the content of the course relevant to you geographical region and organization?

(Please provide details about what or was not relevant.)

2. What part of the course was the MOST relevant to your work?

3. What part of the course was the LEAST relevant to your work?

4. What would you change about the course to enhance your learning experience?

5. Do you think this course could be reproduced for your organization?

Course Design

1. The course was easy to navigate

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

2. The design of the course allowed me to learn at my own pace

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

3. The course design helped to reinforce my understanding of the content

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

4. The scheduling of lectures and practical sessions was intuitive and made sense

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

5. There was enough time and opportunity to engage in practical, hands-on work

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

6. Please provide us with any other comments you have on the course design

Course Delivery

1. Have you taken training courses like this before?

Yes/ No If yes, how does this course compare?

2. All the activities began on time

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

3. Course materials (i.e. exercises) were appropriate and helped me to learn the course content

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

4. Course facilities (i.e. computers, meeting spaces) were appropriate for the course

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

5. Course facilitators were available to answer the questions I had about the course content

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

6. CHWG staff was helpful in addressing my questions regarding travel, accommodations, or other personal matters

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

7. I enjoyed the hotel accommodations (if apply)

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

8. I enjoyed the food

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

9. I enjoyed the special events/dinners

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

11. Please provide us with any other comments you have on the course delivery.

12. Did you experience any significant problems this week? For example, was language a problem? Or were the materials too technical or challenging? Not challenging enough? Please describe below.

Yes / No

Comments:

Thank you for your responses, and for your participation in the Training of Professionals on Climate and Health 2009. If you have any other comments on the course lectures, practical sessions, logistics, please provide them below.

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