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Final Report to USAID Office of Foreign Disaster Assistance
From the International Research Institute for Climate Prediction
Columbia University
Lamont Doherty Earth Observatory

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Program Title: "Capacity Building in Regional Climate Prediction and Applications for the Greater Horn of Africa"
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Time period covered by this report:
September, 1999 to March, 2002

I. Reporting Summary

Objective #1: Implementation of the Regional Seasonal Climate Prediction System (RSCPS). A regional climate prediction model has been developed is now installed and running on the new IBM 6000 computer at the Drought Monitoring Center in Nairobi. Output analysis is being conducted by the IRI-trained regional participant. System upgrades and additional hardware were purchased near the end of the project period to ensure that the computing facilities remain up to date.

Objective #2: Extended Training of DMCN personnel at the IRI. Three month training was completed for two representatives from the Greater Horn in the Regional Downscaling of Climate Forecasts Workshop conducted at the IRI in Spring of 2001. The applications specialist from the DMC also participated in one month of training at the IRI, working closely on workshop development and communications issues. Systems administrators from the DMCN participated in a total of three weeks of intensive training conducted by IBM, as well as additional time one-on-one with IRI systems personnel, insuring capacity to run and maintain the computing facilities at the DMCN

Objective #3: Workshops for Applications of Climate Forecasts. A half-day workshop on Improving Communications Skills at the National Met Services was conducted for the representative of the NMSs in advance of the 7th Greater Horn of Africa COF, a workshop on "Understanding and Using Seasonal Climate Forecasts" was run with users attending the 7th GHACOF, and a very successful two-day Media workshop for journalists from each country in the Greater Horn on improving reporting on seasonal forecasts was conducted in Jinja, Uganda in advance of the 8th GHACOF in August of 2001.

Objective #4: Applications Projects. The three needs assessments planned were all completed successfully: a survey of 43 institutions in the Greater Horn potentially using climate information, a survey of 240 households in an agro-pastoral zone of Kenya, and a survey of 323 pastoralists in northern Kenya, southern Ethiopia. Analyses and final reports contain useful indicators of the needs of these important user communities.

Budget narrative

Cost savings were realized on hardware purchases due to falling computer prices over the period between the original budget and final purchase. Two IBM RS 6000 computers, software, operating system upgrades, and additional hardware for the DMC Nairobi were all purchased within the original budget for a single super computer originally defined. The primary savings on indirect cost was achieved as a result of the increase in the subcontract to the University of Nairobi, who managed all the surveys as well as the major media workshop conducted in Jinja, Uganda. Because Columbia University agrees only to charge indirect costs on the first $20K of a subcontract, having the subcontractors run the workshop allowed for a more substantive workshop to take place.

Budget details will come under separate cover from Columbia University accounting.

II. Program Overview

The program "Capacity Building in Regional Climate Prediction and Applications for the Greater Horn of Africa" was designed to capture the growing capability of seasonal climate forecasts to improve societal management of climate variability in the Greater Horn. As such, developing regional and national capacity to provide and utilize timely and skillful forecasts was a key goal of the effort. Assessing the needs of a variety of user communities with respect to climate information was a parallel goal. Specific project objectives were:

1. *Implementation of the Regional Seasonal Climate Prediction System (RSCPS)*, involving the development of a framework for implementing regional numerical forecast products and increased computational capacity at the Drought Monitoring Center in Nairobi;

2. *Extended Training of DMCN personnel at the IRI*, in numerical modeling techniques, computer systems administration, and in the area of applications of forecasts;

3. *Workshops for Applications of Climate Forecasts*, including a major workshop for representatives from the Media;

4. *Applications Projects*, comprised of three surveys assessing the climate information needs of regional institutions, pastoralists, and agro-pastoralists.

The targeted population of this overall effort includes both the Meteorological service providers and the user communities that potentially apply forecast information in resource management and disaster preparedness in the Greater Horn of Africa.

III. Program Performance

Objective I: Implementation of the Regional Seasonal Climate Prediction System (RSCPS)

Hardware purchase and installation

Two IBM RS 6000 Model 270 computers plus AIX software were purchased under the project. One computer is now installed at the Drought Monitoring Center in Nairobi and its mirror system is installed at the IRI in New York. Having identical systems has allowed for training and model development to occur in both environments with no complications on transferability. Both systems were purchased within the budget originally identified for one with equal computational power, due to the increased efficiency and lower costs of computers as time passes.

Due to an order oversight, the IBM machine residing at the DMC was originally purchased with only one set of processors, while the machine at the IRI had two sets. This error was identified by our systems expert, who traveled to Nairobi to assist in the installation. The additional processors for the DMC have been purchased and installed so that the two systems are now identical as was intended.

Additional equipment purchased for the DMC includes: one Hewlett Packard Color LaserJet 8500 printer, capable of handling large format output; one HP black and white LaserJet 8000N printer; a 7331-305 8mm tape library, and one 7332-220 4MM DDS –4 Tape cartridge autoloader.

Regional climate model development and testing

The centerpiece of the regional seasonal climate prediction system is a high-resolution regional climate model - the Regional Spectral Model (RSM) developed by NOAA's National Centers for Environmental Prediction (NCEP). This is configured to the GHA region and is "driven" by global-scale climate prediction information taken from lower resolution global models. The project installed the NCEP RSM version 97 on the IBM workstation at the Drought Monitoring Centre, Nairobi (DMCN), and used the ECHAM Atmospheric General Circulation Model (AGCM), developed at Germany's Max Planck Institute, for providing the large-scale information.

Considerable effort is needed to configure the regional model to maximize the prediction performance for the region and to prepare essential data sets. Li Qiang Sun developed a program to "nest" the RSM within ECHAM AGCM at IRI, as well as the RSM post-processing package (the software that turns the model's raw output into meaningful output like rainfall maps). Matayo Indeje conducted a number of numerical experiments to obtain the optimum model resolution, domain size, and to optimize various parameterizations (e.g., convection scheme).

Underpinning data sets that were generated include (i) a six-member ensemble run with ECHAM4.5 AGCM-RSM CVS nesting at 55 km horizontal spacing for October-December covering the period of 1997-1999, completed by M. Indeje on the IRI IBM and SGI machines and the NCAR IBM, and (ii) a single run of the ECHAM3.6 AGCM-RSM version 97 at 80 km horizontal spacing for the period of 1990-1999 completed by J. Mutemi and T. Dejene at the Drought Monitoring Center.

The output results of the historical runs of the regional model were tested against measured data. This showed that the system captured the main regional-scale features of rainfall forced by the large-scale sea-surface temperature and modified by the local orography (hills, mountains) and that the within-year, and year-to-year, variability of rainfall and circulation patterns were well reproduced. This collaborative work between the IRI and the DMC on model validation is continuing beyond the end of the USAID-funded project.

System configuration, trouble shooting

Once the two computing systems were installed, IRI staff were made available to facilitate installation of the modeling software, and necessary support systems. Some of this was achieved remotely, via e-mail. However, some problems needed to be solved on site. Our expert staff person, Labao Lan, traveled to Nairobi for 10 days to work with the DMC systems staff to correct problems and assist in synchronizing the IBM systems at the DMC and IRI. Matayo Indeje also visited to guide the conduct of the numerical experiments and to provide related training. Accomplishments included:

1. Setting up software system, configuration, end-user support and day-to-day maintenance
2. All the training and modeling required software/libraries installation and testing on both ziwa (the machine at the IRI) and dmcnrs1 (the DMC machine)
3. Data transfer between ziwa and dmcnrs1 for running the RSM model
4. Troubleshooting in hardware, software and networking
5. Special technology used to adapt those programs/software which are not ready for IBM environment and special expertise used in system crash rescue and recovering

Activities continued throughout the year include consulting for the Drought Monitoring Center partners in all aspects (system set-up, reconfiguration, software installation, system hardware maintenance and diagnostics, data transfer and troubleshooting) in the IBM system administration by email and phone, and making both systems (ziwa and dmcnrs1) identical.

Objective 2: Extended Training of DMCN personnel at the IRI

Downscaling training course

The two experts involved in the model configuration and validation at the Drought Monitoring Center, J. Mutemi and T. Dejene, were brought to New York to participate in the IRI Intensive Course on Dynamical Downscaling of Seasonal to Inter-annual Climate Predictions, from 15th January to 6th April 2001. This first-ever advanced training course was aimed at communicating the state-of-the-science on "downscaling" - the science and technique of converting global-scale predictions down to the scales of regions, basins, farms, etc required for actual decision-making. The 13 participants were a well-qualified set of individuals drawn from universities and national and regional meteorological institutions throughout the developing world. The course comprised lectures plus individual studies - modeling using the NCEP-RSM and statistical analysis, applied to two cases - a wet year and a dry year - for the each participant's region.

The participants gained skills in planning and undertaking their own investigations, the ability to compare different methods and different regions, and experience in presenting the results of their studies. An example relevant to the GHA was a study of the circulation in the vicinity of the Red Sea region to the north of Ethiopia, where the land-sea contrast was triggering strong local scale time-mean circulations. This shared intensive training course has given the GHA participants a much greater confidence in operating the installed model and in interpreting and communicating its output.

Applications Specialist visit

Simon Gathara from the Drought Monitoring Center spent a total of one month at the IRI in November of 2000, working primarily with IRI applications staff on workshop materials and communications activities. His participation made a real contribution to our efforts in the region, and provided a context for further activities undertaken by the DMC.

Specific accomplishments:

- Initial drafts of materials for User's Workshop at COF 7 completed. Participated in Communications group meetings, redrafted decision scenarios into appropriate East African context.

- Assisted in selection of representative Met Stations for downloading of monthly time series to be used in User's Workshop activities.

- Developed suggested content list for National Museum of Kenya exhibit on climate forecasting. Arranged for contribution of large-format visual materials from the IRI.

- Drafted content and format for a general information brochure on climate and climate forecasting to be produced by the DMCN.

- Briefed IRI staff on status of DMCN pilot projects.

- Met with all relevant IRI staff on related projects (Neil Ward on downscaling initiatives with Matayo Indenje; Liqiang Sun and Labao Lan on status of IBM computer and preparation for regional scale modeling initiative under RCPA; Jim Hansen on crop modeling activities in the Greater Horn)

Systems administration training

The training activities include those conducted internally (IRI/DMC) and externally (IBM). The internal training included ten days hands on training by IRI systems administrator Labao Lan, of the IBM system administration at the DMC for two key systems administration personnel (Ben Owuor and Bushman Owuor), and others as appropriate. The topics covered as follows:

1. System installation and operation
2. System boot/shutdown, setup and configuration
3. IBM system management interface tool
4. Disks and file systems management
5. Networking configuration and customization
6. Users and security
7. Day-to-day system administration duties
8. Software installation and configuration (licensed and non-licensed)
9. System backup and restore techniques
10. System monitoring and analysis
11. Hardware diagnostics and problem analysis
12. System crush and recovery

Additionally, related to the operating system upgrade performed in spring of 2002, two days training/demo of the AIX V4 and V5 at the IRI, the difference between V4 and V5 and migration from V4 to V5 for Ben and Bushman.

The external training with the IBM Learning Center included:

1.IBM Course Q1114, AIX System Administration, for Ben (November 2000).
2.IBM Course Q1314, AIX 5L System Administration I: Implementation, for Ben (March 2002)
3.IBM Q1313, AIX 5L Basics, for Bushman (March 2002).

Each of these courses lasted one week, and covered all aspects of maintaining the computing facilities purchased under this grant for the DMC.

Objective 3: Workshops for Applications of Climate Forecasts

The original project proposal called for one workshop in the Greater Horn of Africa. We were able to conduct one large and two small workshops by adding onto existing activities conducted by the DMCN.

Communications Skills at the Met Services

A training session was run with representatives of the National Met Services who had assembled at the Drought Monitoring Center for training and preparation of their seasonal forecasts, in advance of the 7th GHA Climate Outlook Forum in February 2001. The focus of the session, "Improving Communications Skills at the National Met Services", was to work with Met Services representatives on communicating uncertainty in forecast announcements. Recognizing the difficulty of communicating about probabilistic forecasts, our goal was to help the meteorologists develop lay terminology for difficult concepts, develop better linkages with the media, and think about format of the bulletins and press releases they produce in disseminating seasonal forecast announcements. The two hour session provided an opportunity for the IRI representatives and other Met providers to discuss opportunities and limitations to communicating difficult material.

Understanding Probabilistic Forecasts

The Workshop on "Understanding and Using Seasonal Climate Forecasts", was conducted as part of the Users workshop at the 7th GHACOF in Arusha, Tanzania. The goal was to work with a wide variety of users to improve their understanding of the probabilistic aspect of seasonal climate forecasts. Approximately 50 participants, with varying amounts of education, worked in groups. Real climate data sets were analyzed to explore tercile boundaries of the three categories of below normal, normal and above normal rainfall. Then a "spinner" game was tested wherein participants worked with a game of chance to explore possible outcomes given a set of predicted tercile probabilities. Discussion groups were conducted in the evening with a specialist from Columbia University on uncertainty and decision making.

Difficulties encountered were 1) the range of education and experience among participants led to situation where some were finished with their exercise and bored while others struggled. 2) Depending on the user, the benefit of understanding the details of how to calculate tercile boundaries may or may not outweigh the time and expense of the process. It may be that for many applications, a very broadly defined categorization of below normal, normal and above normal may suffice.

Improving Reporting on Climate in the GHA

A workshop for representative from the Media in each of nine countries in the Greater Horn was conducted over two days in Jinja, in advance of the 8th GHACOF in August, 2001. A total of 28 participants attended and were supported to stay on through the GHACOF that followed. Participants represented both the print and broadcast media. Countries with at least two participants were Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda.

The activities conducted included lectures on basic climate information, and a decision making activity to help journalists make the connection between the way in which

information is presented to the reader and the way readers make decisions based on that information. Discussion of vocabulary, phrasing, and translation emphasized avoiding sensationalism and conveying uncertainty. A writing exercise with peer evaluation helped reinforce concepts and provided practice.

Participants' recommendations included:

- Need to include editors in training (they hold power over what goes to print), and science writers
- Also could include some Met Service people – improve communication between Media and Met
- Include more work on translation (technical → lay language)
- Include more lecture/discussion on applications of seasonal forecasts
- Press releases need much improvement
- Follow up with support for networks, materials, additional workshops

Objective 4: Applications Projects

Institutional Needs Assessment

An assessment of institutional users of climate information was undertaken to better understand the climate information needs of organizations working in the Greater Horn Region.

Methods: The assessment took place in two parts: 1) a written survey mailed and e-mailed to users in all ten countries of the region, and 2) on-site interviews with representatives from institutions with climate information needs. The written surveys were mailed and completed between January and March 2001 using IRI consultants at the University of Nairobi. The on-site interviews were conducted in three cities: Nairobi (June 18-23), Addis Ababa (June 26-30), and Dar es Salaam (July 1-5). On the whole, the assessment involved government agencies, NGOs, IGOs, and private industry working in a variety of areas, including:

- Food Security (9)
- Disaster Management (3)
- Early Warning Systems (3)
- Livestock Resources/Research (4)
- Natural Resources / Environmental Management (5)
- Energy/Water (4)
- Banking (1)
- Agriculture and Agricultural Research (10)
- Media (3)

As the focus tended to be in climate sensitive sectors, the institutions were most often users of climate information, or in the least, affected by climate variability in their own activities. Of the 43 organizations participating, 33 (77%) identified themselves as

current users of climate information. The majority of these users were familiar with DMCN products (73%) and their respective national meteorological services' products (79%).

The assessment sought to measure the importance of climatic conditions in the selected institutions' activities and planning processes. For those currently receiving climate and weather information, the survey and the interview posed questions to determine:

- the sources of climate information
- time intervals when it is received
- communication channels through which the information is received
- reliability of receiving the information
- timeliness of the information
- presentation of probabilistic forecast information
- usefulness of forecast information in their activities
- accuracy/reliability required by users

For those not currently receiving any climate information, the survey and interview tried to assess:

- relative importance of climate/weather in the institution's activities
- familiarity with national and regional climate information providers
- knowledge of the types of forecasts and data products available
- if they might find the information useful in their activities.

In addition, for all those surveyed and interviewed, the respondents were asked the lead time necessary for forecast information to be useful, the level of reliability required of forecasts, and their interest in participating in national and regional workshops.

Findings: The results indicated a number of areas where institutional users would like to see improvements in the service and climate information products that they are currently receiving from the DMCN and their national providers.

Institutions are active users:

- Among current users, 52% receive climate information from three or more providers of forecast and/or data information. A number of users mentioned using the different sources to confirm the reliability of forecasts and climate data.
- A number of institutions have used climate data and seasonal forecasts in their own applications and would like to further this aspect of their research.

Strengthen the relationship between institutional users and providers:

- A majority of the institutions interviewed demonstrated a strong need for climate information and an interest in participating in forecast updates, workshops, and trainings by the DMCN and/or the national meteorological services. During the interviews, many had voluntarily mentioned that they had been largely responsible for initiating and sustaining relationships with the DMCN and the

national meteorological service. They would like to see more outreach efforts by the providers.

Dissemination of the DMCN products:

- Of the total group, 93% have access to e-mail and 58% have access to the World Wide Web. The remaining 7% have plans to install e-mail within the next 1-3 years. In contrast, only 70% of users currently receive climate information by e-mail. It should be noted that the National Meteorological Services Agency (Ethiopia) and the Tanzania Meteorological Agency (TMA) do not currently disseminate by e-mail.
- The preferred channel of dissemination varied. During the interviews, institutions with reliable e-mail and Internet access cited e-mail or the World Wide Web as the preferred method. However, others noted delays with the postal service. For institutions with offices in rural areas, e-mail was largely unavailable and they therefore depended on the post.
- Of those receiving DMCN newsletters, 42% reported having disruptions in the delivery of the newsletter by e-mail and by post, leading to delays anywhere from a few days to weeks, and even being dropped from the distribution list. It should be noted that this question was not formally asked in the written questionnaire but was used during the interviews. Several responses about disrupted service were given voluntarily in the written questionnaires.
- Many organizations have said the forecasts delivered by e-mail are often late, which can compromise the usefulness of the product.
- E-mail could help to avoid complicated lines of communication within organizations. A number of organizations said that the climate information is often received at higher administrative levels but does not always reach the proper person.

Regional and National information:

- The importance of regional information varied with the institution. Institutions with activities spread across different countries or along borders tended to express a need for regional climate information. For example, nearly all food security organizations interviewed expressed a desire for regional climate information saying their activities are often affected by trans-boundary migration due to drought or extreme climate events. In contrast, those in government and private industry involved in agriculture seemed more concerned with national information relevant to agricultural zones.
- Of the 31 responses, 52% preferred national information, 35% wanted both national and regional information, and 13% wanted only regional information.

Forecast information:

- Discussions with the users revealed varying degrees of usage of the seasonal forecasts. While some believe that the probabilistic seasonal forecasts are particularly relevant to their work, others believe that they serve only as broad indicators of the coming season.

- Nearly all expressed a desire for further interpretations and recommendations based on the seasonal and monthly forecasts. In addition, they would like to see applications of the seasonal forecasts to potential impacts including seasonal climate prediction applied to vegetation/biomass, agricultural production, animal/crop diseases, eco-system, and water availability. Respondents indicated that forecasts applied to specific sectors could help them better use forecasting in their decision-making.
- A number of institutional users are currently applying or researching ways to apply seasonal forecasts to their own activities. Several expressed a willingness to collaborate with the DMCN and the national meteorological services to develop new applications.
- Several organizations underscored the importance of seasonal forecasts by hoping to use them in future proposals to donors.

Feedback on the DMCN Forecast Presentation:

- Questions posed in the written questionnaire and during the interviews revealed that institutional users were generally satisfied with the presentation and understood the probabilistic nature of the forecasts.
- Several said they would like to see less technical wording with an added section for recommendations on how to use the forecasts. They would also like to see more information on the reliability/accuracy of forecast information.
- Several said they would like explanations for the revisions/updates of seasonal forecasts.

Institutional Use of Climate Data:

- Institutions have a strong need for climate data such as precipitation for their own activities. They use the data for their own research, modeling, and monitoring purposes. While institutions actively seek data and detailed forecast information from their national and regional provider, they say that they are often stymied by a lengthy bureaucratic process, lack of clear pricing system, and different data formats.
- Many organizations have expressed a willingness to pay for climate data, particularly information on precipitation and temperature. However, several indicated that the lack of a standardized pricing system (or enforcement of the pricing system) prevents them from approaching providers. Several said they would like to see a regional clearing house to facilitate the availability of climate data on the regional scale.
- Several institutions said they would like to see data formatted for use with GIS and other computer applications.
- Users noted that the limited national network of rain stations, especially in arid regions, leaves them wanting for more information. Several noted their efforts in maintaining their own weather stations and trying to install new ones. However, in cases in each of the three countries, the institutions and the national meteorological services failed to make contact to share information.

The detailed report of this study, "Use of Climate Information in the Greater Horn: Assessing the Needs of Institutional Users" (IRI technical report no. 01-02), by Joseph Curry, can be found on the IRI web at
http://iri.columbia.edu/outreach/publication/report/01-02/index.html

Survey of Agro-pastoral farmers

This study looks at the awareness of and usage of climate forecast information in central Kenya in the aftermath of the 1997/98 El Niño event, and was conducted under the sub-contract by Dr. Robinson Kinuthia Ngugi at the University of Nairobi, Department of Range Management, under the direction of IRI staff. Household surveys were conducted in Machakos District, Kenya, in January 2001. Retrospective and concurrent awareness and application of seasonal forecast information was assessed for 240 households across a range of agroecological zones.

The specific objectives of the survey were:

1) to assess the current level of awareness and application of climate forecast information (traditional and meteorological) among the smallholder agro-pastoralists in Central Kenya;

2) to establish the current and potential value of climate forecasting information products for the target user group; and

3) to evaluate the effectiveness of existing methods of disseminating climate forecasting information products.

Methods: The assessment of climate information status in the survey area involved on-farm interviews by experienced enumerators using a written questionnaire. The questionnaire was administered to 240 households in six sub-locations in Machakos. Two sub-locations were randomly selected from each agro-ecological zone after which 40 households were selected and interviewed in each of the sub-locations. The survey was carried out during January 2001, which marks the end of the short rains and the beginning of the dry season.

Findings: The field survey data shows that majority of farmers in Machakos District are aware of the existence and importance of climate forecast information (meteorological or traditional) in their farm-level tactical and operational decision making processes. This result was surprising given the generally low usage recorded in other studies of this kind. The level of awareness seems to have steadily increased during the last four years, probably as a result of the impacts of the 1997/98 El Niño. Uses of information varied by agro-ecological zone and whether the forecast was for above-normal or below-normal rainfall. A greater number of farmers were familiar with strategies for using a forecast for above normal rainfall, perhaps as a result of their experiences with the heavy rains during the El Niño event of 1997/98.

Both traditional and scientific climate knowledge systems exist in Machakos, though not equally rooted, with some farmers being highly skeptical of the latter information base.

Traditional forecasts often predict variables of greater relevance to farm decisions that do scientific forecasts. It was evident from the survey that when both the traditional and scientific forecast information are available, both are applied. However, in the absence of meteorological forecasts, traditional forecasts together with previous experience remain the only basis for farm-level decisions pertaining to the coming season. Mechanisms for integrating the two knowledge systems could potentially improve comprehension of uncertainties and limitations to application for farm management, as well as form a basis for fitting scientific forecasts into existing decision processes.

Despite the relatively high degree of awareness of existence and role of climate information among the small-scale agro-pastoral farmers in the survey area, the most common general comment among the respondents was that the climate information should be made accessible to more users (farmers). One of the suggested methods of achieving this goal was dissemination of the forecasts in local languages. Radio was the most common source of forecast information, and for the few respondents currently not receiving forecasts, lack of awareness of existence of the information, lack of interest and/or lack of radios or televisions were cited as the main hindrances.

Current efforts in Kenya to develop a radio-based climate information dissemination system provide opportunities to tailor information products to suit the needs of the user community. Additionally, mechanisms for more interactive forums could be developed in which farmers are able to participate in the process of knowledge development and inquiry regarding seasonal climate forecasts. Evidence of the effectiveness of such opportunities was provided to the leader of this project (Ngugi) during post-survey meetings held in the participating communities. Farmers that attended had a chance to discuss the information in local language, ask questions, and share their own interpretation of possible strategic plans for the upcoming season, helping to build confidence and remove the mystery currently surrounding forecast information. This sort of community-level involvement should be integrated into any information dissemination system for maximum benefit of seasonal forecasts to be realized.

The detailed report "Climate Forecast Information: The Status, Needs And Expectations among Smallholder Agro-Pastoralists In Machakos District, Kenya", by Robinson Kinuthia Ngugi, (IRI Technical Report no. 02-04) is available on the IRI web site: http://iri.columbia.edu/outreach/publication/report/02-04/index.html.

Survey of Pastoralists

The data for this assessment were collected by USAID's Global Livestock Collaborative Research Support Program (GL CRSP) Pastoral Risk Management (PARIMA) project on a subcontract under the grant reported here, and in collaboration with the University of Nairobi's Department of Range Management. The objectives of the data collection effort were to establish

- the extent to which pastoralists in northern Kenya and southern Ethiopia are aware of, make use of, and have confidence in externally generated forecasts of

the sort disseminated by the DMC in Nairobi through Ethiopia and Kenya's national meteorological services,

- the media through which pastoralists obtain such external forecasts,
- competing sources of climate forecast information in these communities, particularly traditional climate forecasting methods,
- the types of forecasts to which pastoralists pay attention and respond,
- forecast information content and timing most desired by pastoralists,
- how pastoralist households respond to different climate expectations,
- the relationship between pastoralists' price and climate expectations,
- how pastoralists' expectations of climate compare to DMC forecasts,
- their perception of the accuracy of external forecasts, and
- the range of traditional climate forecasting methods in use in the study region.

Methods: A two-stage survey was designed to bracket either side of the long rains of April-May 2001. The initial survey instrument was fielded from early March 2001 to early April 2001 and the follow- up module was implemented between early June 2001 and early July 2001. An open-ended questionnaire was also fielded to establish prevailing indigenous climate forecasting methods. The surveys were fielded among 323 households participating in PARIMA's multi- year study sample. There are approximately 30 households in each of 11 different sites, six in northern Kenya (Dirib Gumbo, Kargi, Logologo, Ngambo, North Horr and Suguta Marmar) and five in southern Ethiopia (Dida Hara, Dillo, Finchawa, Qorate and Wachile), spread over an area of approximately 124,000 km 2 (Figure 1). The sample spans several ethnic groups, including the Ariaal, Boran, Chamus, Gabra, Guji, Rendille, and Samburu. These households are surveyed quarterly on a variety of demographic, economic, agricultural and attitudinal topics. In the case of this climate forecasting research, logistical difficulties due to insecurity unfortunately disrupted our efforts in the Qorate site. The analysis reported therefore relies on data from just the other ten sites, six in northern Kenya, four in southern Ethiopia.

Findings: Improved climate forecasting as an instrument for assisting poor pastoralist populations routinely buffeted by climate shocks holds obvious appeal. Consequently, several research teams and development agencies are presently engaged in major efforts to develop and disseminate climate forecasting products for these peoples. The wisdom of these investments in the face of alternative uses depends fundamentally on the value of external climate forecast information to pastoralists. This question remains severely under-researched. The value of this information depends fundamentally on (i) people's access to the forecast, (ii) their confidence in the information presented, (iii) the extent to which the forecast provides information different from that they already possessed, (iv) the degree to which they update their beliefs on the basis of such information, and (v) the behavioral adjustments they make in response to changes in their beliefs. This study offers an initial, in-depth look at these issues among an ethnically heterogeneous sample of pastoralists across a relatively large area of southern Ethiopia and northern Kenya. The evidence offers several hopeful points for those championing improved climate forecasting as an instrument to assist vulnerable pastoralists.

First, we find that pastoralists readily understand and can themselves communicate probabilistic seasonal climate forecasts. In a risky environment, pastoralists can be expected to have a reasonably sophisticated understanding of the concept of uncertainty. Therefore worries as to the comprehensibility of such forecasts seem misplaced.

Second, those who hear external forecasts are roughly the same proportion of the population as those who own radios and access to and confidence in external forecasts is associated with market access and education. Therefore, as market access, education and wealth increase and communications technologies increasingly infiltrate pastoral communities, one might reasonably expect steady growth in access to and use of scientific climate forecasts.

Third, the overwhelming majority of those who report receiving modern forecasts find them at least somewhat useful and have at least some confidence in them. This suggests that building confidence in forecasting – whether through further investments in improving forecast skill or in developing new communication packages using existing media – is less a priority right now than is promoting the economic advancement that will both endogenously stimulate demand for meteorology-based forecasts and empower pastoralists to respond to forecast through ex ante optimal adjustments in resource allocation.

Rather, the pressing issues are the sorts of information provided by modern climate forecasting, pastoralists' updating of information, and their capacity and willingness to act on beliefs about climate. The data indicate that pastoralists are most interested in the onset date and the total amount of rainfall expected in the area of residence. Minimal interest is shown in the duration of the rains or in the total amount of rain expected in other areas. DMC produces and distributes a variety of forecast products, which include seasonal bulletins issued twice a year in February before the March-April- May rainfall and August before the September-October-November- December rainfall (Curry 2001a, Hammer et. al 2001). These forecasts are, however, not likely to be what the pastoralist receives via radio and television broadcasts, or by reading newspapers.

What the pastoralist is most likely to receive is daily weather reports produced by the Kenya Meteorological Department (KMD) and the National Meteorological Services Agency (NMSA) in Ethiopia. These reports have limited value to the pastoralists with regards to seasonal predictions. Where a seasonal forecast is disseminated, the information contained therein is oriented more towards crop cultivation than to pastoral production systems. These usually include crop weather reviews for coffee, maize, sugar, tea, horticulture, tobacco, wheat, and pertinent agricultural information such as onset date of rains in the highland areas and recommended planting dates. Forecast information for dairy and ranching production systems and for tourism are also produced (Curry 2001a, Hammer et. al 2001). These reports are likewise of little value to the pastoralist.

Ultimately, our results reinforce the conclusions offered by others (Glantz 1996, Broad 2000, Mahmoud and Little 2000) that those who are interested in helping mitigate climate-related risk among vulnerable populations, such as the Ethiopian and Kenyan

pastoralists we study, must be careful not to focus excessively on improving forecast skill or dissemination. These do not seem to be binding constraints at present, even if external forecasts are accessed by only a sharp minority of pastoralist respondents. Rather, greater attention needs to be given to the process by which pastoralists form their beliefs regarding climate – a process that as yet seems largely unaffected by modern forecasts, even among those who receive and express confidence in them – and what infrastructural and institutional advances are necessary to facilitate the use of climate forecast information within the livelihood strategies prevailing in these fragile systems.

The in-depth report "Assessing the value of climate forecasts information for pastoralists: Evidence from southern Ethiopia and northern Kenya", by Winnie Luseno et al., can be found on the IRI web site at http://iri.columbia.edu/outreach/publication/report/02-03/PastoralSurveyGHA.pdf.

Impact of programs

It was inspiring to hear the enthusiasm of a group of farmers who gathered in a mountain village in Machakos District at the end of the household survey conducted there, to hear the final results and discuss the seasonal forecast with the PI's and Dr. Ngugi one day in February. Their first question, spoken in Swahili, was "What can you tell us about the El Niño this year? We hear talk of another El Niño!." The fact, first of all, that these farmers had access to and interest in climate information, and, second, that they had ideas on what this might mean for their farm management that year, was proof that the focus on improving communication of forecast was paying off. Surely three years ago, when the 1997/98 El Niño struck, they did not know in advance what the implications might be for them. Now they see the value of advance climate information and are very open to possibilities for utilizing that information to improve their situations, rather than being victims of another disaster. (see Columbia Earth Institute newsletter, 04/01/02: http://www.earthinstitute.columbia.edu/news/). One hopes that this scene is being repeated throughout the Greater Horn, as a result of improved information and dissemination.