Early Warning System for Monitoring Livestock Nutrition and Health for Food Security of Humans in East Africa

Narrative Summary

Developing methodology and technology to address the informational needs of pastoral communities, relative to emerging forage conditions in response to climatic conditions, has been the major thrust of the GL-CRSP Livestock Early Warning Systems (LEWS) project in East Africa. The LEWS team, led by Texas A&M University, in collaboration with a large network of National Agricultural Research Systems (NARS), non-governmental organizations (NGOs), and development agencies in Ethiopia, Kenya, Tanzania, and Uganda, has assembled an integrated suite of technology that is capable of providing estimates of livestock forage availability, deviation from normal, and percentile ranking for a large portion of these four countries. The system uses the PHYGROW plant growth model and is driven by satellite-based weather. Using geo-statistics, point-based model simulations are linked with satellite greenness images (NDVI) to create maps of forage supply and its deviation from normal every ten days using an automated analysis system. When coupled with a 90-day forecasting system, information such as current forage conditions relative to historical conditions, conditions at the same time during the previous year, and likely forage response in the next 90 days can be provided. This information is updated every ten days with situation reports and maps distributed via WorldSpace radios, email, Internet, CDs, and newsletters, impacting over 400 organizations and 300 decision-makers in the region. Critical to the process is automation of the modeling process, in which biophysical models are linked with satellite monitoring weather systems in collaboration with the Famine Early Warning System Network (FEWS NET), Earth Resources Observation Systems (EROS), and National Oceanographic and Atmospheric Administration Rainfall Estimate (NOAA RFE) satellite-based weather data. These automated products are found on the web sites http://cnrit.tamu.edu/ aflews and http://cnrit.tamu.edu/rsg/rainfall/rainfall.cgi, where daily deviations in forage production are computed along with daily satellite weather and dekadal NDVI or greenness data, processed by Texas A&M University Center for Natural Resource Information Technology and the Asociation for Strengthening Agricultural Research in East and Central Africa (ASARECA) Crisis Mitigation Office. To assist pastoralists in assessing the nutritional well-being of their free-ranging livestock, a series of fecal near-infrared reflectance spectroscopy (NIRS) nutritional profiling laboratories have been established in each country that allows extension or NGO personnel to determine how emerging conditions of the forage are impacting the performance of the animals. The fecal NIRS assessment provides an estimate of dietary crude protein (CP) and digestible organic matter (%), and a nutritional balance analysis (NUTBAL) model is used to predict changes in weight and body condition and help determine least-cost solutions to mediating

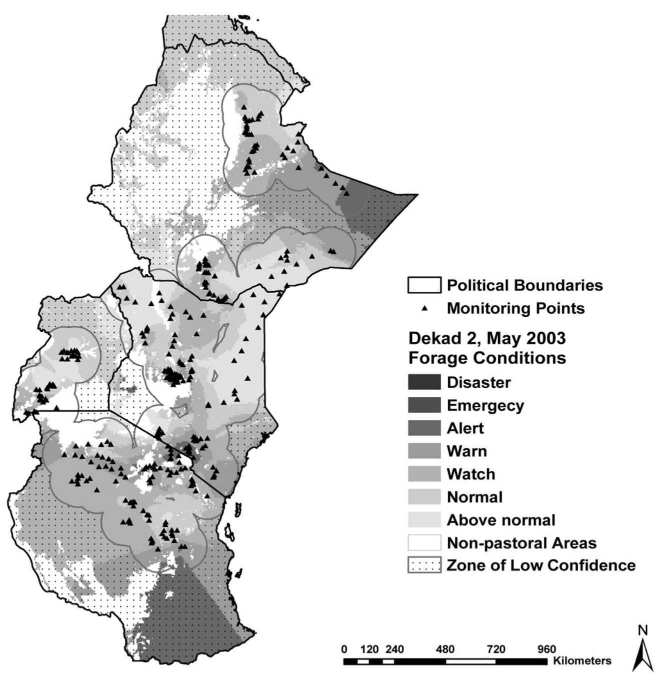
deficiencies where feedstuffs are available. A GLOBAL 2003 calibration equation emerged from this project allowing worldwide distribution of the system across Africa, South America, and other major livestock producing regions of the developing world.

Research

Activity One: Institutionalization Process for LEWS

Problem Statement. The primary problem addressed this past year was fully operationalizing rangeland/ livestock monitoring systems in each of the LEWS regions in Kenya, Uganda, Tanzania, and Ethiopia to initiate the institutionalization process, which will better support needs of early warning, relief and crisis mitigation agencies.

Figure 1 - Spatial extent of LEWS monitoring points and zones of computational confidence established in the past five years.



Approach. This past year was spent expanding LEWS monitoring sites and working with appropriate ministries, and agencies within those ministries, to effectively utilize the LEWS information output within their organization.

Progress. There were an additional 22 monitoring sites added in the Somali region of Ethiopia in collaboration with the Drought Preparedness and Prevention Commission (DPPC), Save the Children-UK, and Hope for the Horn (Figure 1). Eleven sites were recently set up across Southern Sudan by Dr. Gabriel Turacha of Vétérinaires Sans Frontieres (VSF)-Germany in coordination with the FAO-Food Security Assesment Unit (FSAU) office in Nairobi. Thirty sites have been established in Northwest Tanzania in collaboration with the Association for Strengthening Agricultural Research in Eastern and Central Africa-Animal Agriculture Research Network (ASARECA-AARNET). The total number of monitoring sites established in East Africa was 311. A major workshop was conducted with all relevant institutions in Ethiopia on the LEWS technology package, information acquisition, and report writing. DPPC will be the primary governmental organization within Ethiopia that will coordinate information flow with all the NGOs operating in the LEWS coverage areas of Eastern and Southern Ethiopia.

The Tanzania Minister of Water Development and Livestock allocated federal budget items for LEWS and has requested that LEWS zonal coordinators expand sites into the coastal region and southwestern Tanzania where pastoral cattle are also located. LEWS is facilitating this process, helping with model tuning and servicing the model output back to the zonal coordinators.

In Kenya, the Ministry of Agriculture and Rural Development has split off the livestock program to a new Ministry of Livestock Development. We are in the process of moving the district reporting office and realigning the equipment for the new realities of this ministry. In Uganda, the Member of Parliament that heads the science and technology committee requested that we provide a plan for institutionalization beyond the National Agricultural Research Organization's (NARO) current LEWS system. Our LEWS coordinators are in discussion with him at this writing, working on modalities of funding and structure.

At the regional scale, a mechanism has been established where monthly "Greater Horn of Africa" Food Security Bulletins are issued, in which LEWS information is featured. This goes to over 400 people in key ministries, NGOs, and donor/relief organizations in East Africa. This is part of the International Governmental Authority on Drought and Development (IGADD) process and will eventually be taken over as the IGADD newsletter. The primary partners besides LEWS/GL-CRSP on this newsletter are FEWS NET, United States Geological Survey (USGS), World Food Programme (WFP), Drought Monitoring Center (DMC), Desert Locust Control Organization, Regional Center for Mapping of Resources for Development (RCMRD), and Kenya Met Office.

RANET (World Meteorological Organization system) and Arid Lands Information Network (ALIN) have stabilized the flow of information from the LEWS servers to their WorldSpace radio containers broadcasted to satellite radios scattered throughout the region. LEWS has helped establish 32 nodes but the number of total communication points is unknown as anyone with a WorldSpace radio and computer can receive these reports throughout Africa.

The backbone of this process is the agreement with the Center of Natural Resource Information Technology to maintain the LEWS server site and ensure that the computational and reporting capacity is maintained beyond the life of the project. This framework allows the host countries to focus their scarce resources on outreach and mitigation activities and, if they so desire, gradually evolve to take over the technical aspects of the automated computational system. Keeping this in mind, we have worked on several fronts to improve the data, the models, and the automation techniques. The following improvements were made in the last year:

1. The PHYGROW model's start/stop algorithm was reworked to allow faster load time between simulations. We improved the model's ability to handle temperature profiles of a species in a more dynamic manner.
2. The LEWS server was converted to a grid-computing environment linked to dual processor rack-mount computation servers to allow 20 PHYGROW simulations to run at the same time.
3. In an agreement with Dr. Chris Funk, University of California Santa Barbara and now FEWS NET/EROS, we were able to acquire the 1961 to 1996 Collaborative Historical African Rainfall Model (CHARM) rainfall data for the entire continent of Africa on a 11x11 km grid. We compared the CHARM data to the NOAA RFE rainfall data and purely generated rainfall data using the Weather Generator (WXGEN) for the Environmental Policy Integrated Climatic

model (EPIC) that was geo-corrected. We found that the CHARM data gave a greater match to the NOAA RFE rainfall data that we have used to drive our models since 1998; however, the yields were somewhat lower. We investigated the cause and found it to be related to the smoothing algorithm used where the 10-d dekadal data was distributed using a function that smoothes the distribution of values across all 10 days. The data lacked discontinuity of typical rainfall events and did not reflect dry-wet day proximities. Therefore, we looked at the World Meteorological Organization (WMO) weather generator coefficients for Africa and developed a surface spline of all 12 coefficients for each month. This database will be made available to the public soon. With each 11x11 km grid now capable of generating spatially explicit data, we ran 50-year simulations of weather in each grid. The CHARM data for each grid was paired with the WXGEN data for all 50 of the 10-d dekads. We designed a program that would find the dekad in the generator file that had the closest amount of rainfall. Then, the percent rainfall by day for the generator dekad would be multiplied by the CHARM summed decadal data to create a statistically more natural distribution of the rainfall. The corresponding daily minimum and maximum temperature and solar radiation from the generator were acquired to help build the complete weather file. These data now form the foundation data to drive the 311 PHYGROW runs for the LEWS sites and all deviations from normal forage standing crop generated from these event-corrected CHARM data. This is being made available to the public.

Demand for our web-based products included:

1. Situation reports distributed every ten days (http://cnrit.tamu.edu/aflews). The African LEWS website gets over 614 hits per day with 136.1 GB in 80 countries compared to 120 hits per day with only 2.1 GB of data download in 49 countries reported last year. Kenya remains the largest user in East Africa.
2. 39 MB of rainfall data downloaded from (http://cnrit.tamu.edu/rsg/rainfall/rainfall.cgi) in 27 countries this past fiscal year compared to 24 MB reported the prior fiscal year.

Activity Two: Spatial Extrapolation Technique Development

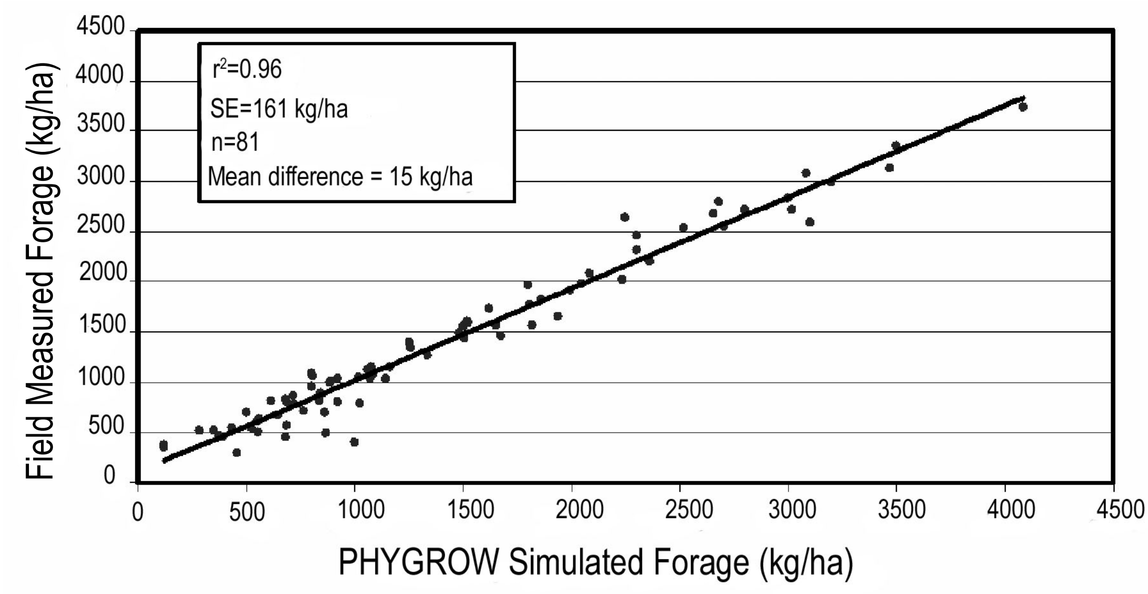
Problem Statement. The PHYGROW model forms the foundation of a toolkit used in the development of a Livestock Early Warning System in East Africa (LEWS) of the Global Livestock Collaborative Research Support Program (GL-CRSP). The system is used for monitoring the impact of emerging weather events on forage supply for livestock in the pastoral regions of East Africa. Primary inputs for the model include: soil parameters, plant community characteristics, and livestock management decision rules, which are driven by satellite-based gridded weather data for a particular location to simulate daily forage available for livestock and wildlife. LEWS has created a new range of forage monitoring products, expected to complement the existing early warning systems in East Africa to aid in the decision-making process, particularly in the pastoral regions. Regular verifications are conducted to demonstrate that the model simulation output of the available forage agrees with observations in the field and to ensure that the input parameters and logical structure of the model are correctly represented.

Approach. Over the past 18 months, the LEWS zonal teams selected 81 sites across the region for intensive sampling with 22 sites measured in this past year. Fifty 0.5 m^2 quadrats were sampled for each monitoring site representing the 11 x 11 km grid using a comparative yield method, where forage biomass is visually estimated on all quadrats using a ranking method and only 15 quadrats were clipped and estimated to develop a regression equation (Haddock and Shaw 1975). The regression equation is used to convert the rankings into actual forage values. Since PHYGROW estimates grazed forage for each of the target herbivores, only forage available to livestock was measured in the field. The fifty quadrats were distributed along five transects, located across the selected grid for verification. The sites were re-sampled if the field sampler's visual estimate and associated clipped samples resulted in r^2 values less than 0.80. More training was provided to the field enumerators having difficulty estimating standing forage values. Simple linear regression was used as a test for the relationship between sampled forage on offer and PHYGROW-simulated total available forage for a target livestock species. Only herbaceous species were used for this analysis.

Progress. As indicated in the earlier section, we were able to add 22 new monitoring sites in Eastern Ethiopia that greatly expanded our ability to cover much of the Somali and Afar region of Ethiopia. We completed our final series of verification of the LEWS predictions of standing crop. Using the PHYGROW model as a point sample linked with satellite weather has proven effective with an R^2= 0.96 and SEP= 161 kg/ha (Figure 2). Final sets of verification studies are currently underway in the region by LEWS zonal coordinators.

One of the major challenges that we faced this past year was converting point based 90-d forage forecasts from the 300+ points into a regional map. The event-corrected CHARM rainfall data that was generated allowed us to have a much more robust forecasting analysis since the rainfall behaved more like real rainfall in the PHYGROW model and allowed

Figure 2 - Relationship between PHYGROW-simulated forage and actual field measurements across East Africa.



greater synchronization with the historical 10-day NDVI values starting in 1981 to present. The problem was determining how to continue the forage forecast with corresponding NDVI data for the 90-day forecast. We finally developed a pattern matching approach where the 300+ LEWS monitoring points were statistically compared with the dekadal record of NDVI data and those historical images with the highest spatial match provided a mechanism to co-krig future forage conditions 60-d out from the current conditions. We are now in discussions with the International Research Institute for Climate Prediction at Columbia University (ref. Dr. Maxx Dilley) to coordinate our forecasting technique with their emerging NDVI forecasting methodology. Currently, they feel comfortable with a 90-d forecast but have a goal for a 180-d forecast. This component of our work will be continued in the upcoming Livestock Infomation Network and Knowledge System (LINKS) project as it is critical for us to be able to predict likely outbreaks of Rift Valley Fever relative to livestock movement patterns and potential livestock market volumes in the region.

We have established the MAPSERVER program on the http://cnrit.tamu.edu/aflews web site with all the major land and program features that allows users to build their own maps with customized features. All of the LEWS data system will be moved over to this data structure to allow greater coupling of activities in LINKS with the LEWS analysis. The geo-spatial techniques have been well accepted in the development community. Through diligent efforts by Dr. Demment, the LEWS technology package was provided the opportunity to be showcased at the Ministerial Conference and Expo on Agricultural Science and Technology Conference in Sacramento, California. The conference was sponsored by the U.S. Department of Agriculture (USDA), the U.S. Agency for International Development (USAID), and the U.S. Department of State.

Over 45 agricultural ministers attended the briefing made by Dr. Stuth and personal briefings provided by Drs. Stuth and Kaitho to the Ministers of Agriculture from Kenya, Tanzania, Uganda, Rwanda, Cameroon, Sri Lanka, South Africa, Swaziland, Botswana, Senegal, Djibouti, Mali, and Honduras.

Activity Three: Enhanced Effectiveness of NIRS Fecal Profiling Monitoring Technology to Improve Livestock Management in East Africa

Problem Statement. The primary problem addressed with this activity was establishing regional analytical capacity to utilize NIRS technology for nutritional management of livestock in East Africa. The capacity in the region to address nutritional issues of free-ranging livestock has been established in all LEWS countries. The development and deployment of a more robust calibration equation in the region would improve the capacity of NARS and extension personnel to support nutritional profiling of livestock in pastoral regions.

Approach. All of the LEWS diet:fecal pairs generated in Ethiopia, Uganda, Kenya, and Tanzania were combined from research conducted in Ghana by a World Bank-funded Ph.D. student, International Livestock Research Institute (ILRI) projects in Nigeria, Niger, and Ethiopia, and projects in Australia, Argentina, Canada, and the U.S. to form a global calibration equation for cattle, sheep, and goats. The diet:fecal pairs were subjected to modified partial least squares analysis using the WinISI (Inservice Inspection) software.

Progress. All NIRS laboratories were established on schedule for each of the four countries. We were able to send the Tanzanian staff to Sweden for training by First in Food Analysis (FOSS) International staff. This was fully paid for by FOSS. We also provided training to the Ethiopian lab and numerous other scientists interested in NIRS technology at a 3-day workshop sponsored by ILRI in Addis.

Given the scope of experiments conducted in LEWS, the diet:fecal pairs created in East Africa were added to the GANLAB Global Equation and are currently being transferred back to all the labs created in East Africa. Since all the NIRS machines are calibrated to the Texas A&M machine, all advances made by the Grazingland Animal Nutrition Laboratory (GANLAB) can be directly transferred to the labs in East Africa with a simple email attachment. Any lab in the region can transfer their samples or equations by email between labs as well. The GLOBAL 2003 calibration equation statistics for cattle, sheep, and goats from samples created in the USA, Canada, Australia, Argentina, Nigeria, Niger, Ghana, Ethiopia, Kenya, Uganda, and Tanzania are presented in Table 1.

One of the critical components of the NIRS system is the NUTBAL PRO software that is

Table 1 - NIRS fecal profiling calibration statistics for the new GLOBAL 2003 prediction of crude protein (CP) and digestible organic matter (DOM) in cattle, sheep, and goats.

Species/Nutrient	N	R^2	SEC
Cattle			
CP	953	0.95	0.87
DOM	794	0.91	1.51
Goats			
CP	214	0.99	0.53
DOM	213	0.94	1.46
Sheep			
CP	337	0.95	0.98
DOM	213	0.94	1.46

used to translate the NIRS diet quality predictions into animal performance. Recent observations of young livestock on sub-maintenance diets in East Africa, South America, and West Texas have indicated that protein requirements and basal metabolism are altered, requiring an adjustment to the NUTBAL nutritional requirement and gain/loss functions. Also, overly fat dry open cows were being overpredicted in performance and we had to search the literature and make adjustments to gain efficiency as a function of body condition and the ratio of energy to protein in the diet. Both of these adjustments have allowed NUTBAL PRO to be one the most rigorously tested nutritional software packages under real-world conditions and suitable for use in tropical Africa.

We had indicated in our prior workplans that we would start a student to develop a NIRS fecal calibration equation to predict diet protein and digestibility of donkeys in Africa. The LEWS component in Ethiopia had identified this need but failed to recruit a student and organize the research. Therefore, when the University of Asmara indicated that the Netherlands Organization for International Cooperation in Higher Education (NUFFIC) would fund a Ph.D. student, Negusse Kadine, to train in the application of NIRS technology for rangeland animal management, we accepted him into the Department of Rangeland Ecology and Management at Texas A&M University (TAMU).

Mr. Kadine then organized and conducted a stall-feeding trial where ten donkeys were fed 100 different mixed rations of natural forages and crop residues commonly found in East Africa (the research was conducted at the Equine Research Center at TAMU). This study has been completed. Fecal NIRS can be used to determine crude protein (CP) and digestible organic matter (DOM) of donkeys.

Calibration statistics for CP were R^2 =0.96, SEP=0.77, and DOM R^2=0.92, SEP=1.75. *In vivo* digestibility was derived from 4-d, 24-hour a day total fecal collections. While CP was determined by the Hack method to derive ort adjusted, whole-diet values. The Mpala Research Center (MRC) in Laikipia District of Kenya has just shipped common forages available to donkeys and zebra to the Kenya Agricultural Research Institute (KARI) research center at Naivasha to conduct a mirror study in East Africa. MRC is most interested in determining if the donkey fecal profiling technology can be used to determine the diet quality of free-ranging zebra. KARI staff are currently conducting the experiment at Naivasha and will scan the samples and conduct the *in vivo* DOM analysis, wet chemistry for CP and P, and then transfer the spectra and lab results to the U.S. for analysis with the U.S.-derived samples. As part of Mr. Kadine's Ph.D. program specified by NUFFIC, he is reviewing the nutritional requirements and gain prediction code of the NUTBAL goat component and conducting a weight performance trial to test the current performance algorithms in the model. The final phase of his dissertation research will focus on testing the final system in Eritrea in 2004.

Table 2 - Household statistics and gender composition of the drought perception survey, conducted in pastoral communities of Kenya, Tanzania, and Uganda.

	Kenya	Tanzania	Uganda
Total Number of People Surveyed	338	246	86
Percent Female	47.3%	13.8%	11.6%
Percent Male	52.7%	86.2%	88.4%

Activity Four: Institutional Capacity Building

Problem Statement. The primary issue facing LEWS during this final year of the program was to build the skills of the technical support staff in the use of the LEWS toolkit for active monitoring and decision-making in national Emergency Warning System agencies, IGAD and FEWS NET, and critical NGOs. It is imperative to leave a network of skilled personnel in key organizations to ensure that the technology can be moved forward by the respective organizations. However, we need to determine an effective way of organizing the information interpretation and delivery process.

Approach. As outlined earlier, we have established a mechanism for institutions in East Africa to acquire, interpret, and distribute information from LEWS. Over 400 key decision-makers in East Africa get the LEWS reports. A monthly newsletter on conditions in East Africa is distributed to key government offices and reports are provided to over 30 NGO communication nodes in the region. We have conducted workshops on the LEWS system with key entities in Ethiopia, Kenya, and Tanzania. To gain a better understanding of the effectiveness of the current institutional outreach activities, we conducted a pastoral community survey during the past year of 26 pastoral communities involving 607 heads of pastoral households.

Progress. ***LEWS Pastoral Perception Survey.*** The community surveys indicated that 23.9% of heads of households in these 26 pastoral communities were aware of LEWS, and when linked with our communication nodes, zone of coverage, and prior coping mechanism survey statistics conducted by LEWS and ASARECA, over 114,000 households and 2 million people are influenced

Table 3 - Composition of the communities surveyed in Kenya, Tanzania, and Uganda.

Country	% Pastoralists	% Agropastoralists	% Other
Kenya	76.5%	22.7%	0.8%
Tanzania	63.1%	36.9%	0.0%
Uganda	6.6%	92.2%	1.2%

by LEWS outreach activities, impacting 1.4 million km^2 of rangeland, 40 million cattle, 30 million sheep, and 32 million goats. The primary goal of the survey was to determine what pastoral communities perceived as a "deviation from normal" forage conditions relative to the LEWS computations of forage supply, forage deviation, forage percentile ranking, and NDVI. The main objectives were to determine how the current LEWS analysis tracks the pastoral decision process to move livestock in reaction to drought, and to provide a basis for the refinement and improvement of communication strategies for the dissemination of LEWS information and technological outputs.

Overall, 30.1% of the people surveyed in East Africa were women and 69.1% were men (Table 2). Pastoralists comprise about 48.7% of the people surveyed in East Africa (Table 3). The remainder consists of predominantly agro-pastoralists (50.6%). Only 0.7% were pure farmers and ranchers. The communities interviewed were predominantly pure pastoralists in Kenya and Tanzania and agropastoralists in Uganda.

The communities interviewed were asked to suggest places where LEWS information could be placed. Community leaders and extension and village government offices were most frequently mentioned. About 23% of the respondents suggested a Chief's residence as the most suitable home for LEWS information, citing the easy access of information to all community members. They felt that the best way to deliver the information would be through the chiefs, with assistance from local extension agents in the oral explanation and interpretation of the LEWS information for their respective communities.

An equal number of respondents (23%) chose extension offices as the ideal place for LEWS information, citing the fact that many extension agents live within those communities. Extension agents in those areas also serve as community site monitors, and would ensure that the information reaches the community, and that the products are explained and interpreted for the community. Throughout all the interviews, it was evident that the communities have a great respect for the extension agents.

Village government offices, community centers, and district agricultural and veterinary offices were also widely mentioned as central locations for the placement of LEWS information. Common to all these offices is the fact they each work closely with the pastoral communities and have developed their own unique methods of communication with them.

The majority of the respondents indicated that they needed more time to evaluate LEWS information for the following reasons:

1. They needed time to build confidence in LEWS outputs relative to events they can observe.
2. They needed more time to evaluate LEWS outputs in relation to current weather patterns that seem to have been changing drastically in recent years.

However, most of these communities indicated that the LEWS information is potentially useful in showing where there is available forage so they could explore alternative forage resources in a timely manner. They also expressed an interest to get the information on a regular basis. There was a consistent suggestion that including livestock market prices would add value to the LEWS reports. Actions taken by those influenced by LEWS information included:

1. Moved livestock.
2. Moved the livestock and contemplated selling some of the animals but didn't do so because it rained soon afterwards.
3. Sold livestock.
4. Sought permits to move and stock routes.
5. Sent young men for reconnaissance.
6. Avoided burning grass and cleaned wells and dams.

Southern Kenya LEWS Community Outreach Pilot Site. The community communication survey carried out early in the year 2003 indicated that all communities desire to have the LEWS forage prediction outputs every month. In addition, the information is to be communicated to these communities through the existing project Site Monitors or another government officer, preferably one that is involved in livestock extension service. Following up on these findings, two of the existing monitoring sites were selected for pilot test runs to discover the effectiveness of the information flow and its reception by the communities. The communities selected were Mbirikani and Magadi, both in Kajiado. Initial community meetings were convened by the project's zonal coordinator at each location, together with the extension service providers and the site monitors where:

1. First, the subject of forage availability and adequacy was introduced.
2. The community's perceptions were captured through a facilitated discussion and the consensus written down and mounted in a convenient place for everybody in attendance to see.
3. This was followed by a display of the LEWS output, highlighting the contrasts and similarities as applicable.
4. The forage deviation trend lines developed by the communities earlier were revisited. Through consensus, appropriate adjustments were made on the basis of prevailing weather conditions.
5. Lastly, follow-up meetings were agreed upon. In the subsequent months, the site monitors were given the outputs to take to the communities.

In addition, a discussion was held in June in Magadi with some of the community members during a site verification exercise within the Olkramatian Group Ranch. They expressed surprise at how the LEWS predictions were closer to the emerging forage situation than their own estimates. Before the long rains, the Magadi community had feared that a small lake known as Kabongo would dry up and if that were to happen, then massive livestock losses would be experienced. Whereas they had foreseen a great deficit because the long rains had been delayed, there was instead plenty of pasture and any livestock movements were mainly to take advantage of quality rather than search for quantity.

Similarly, the community at Mbirikani had expected a bounty of forage because the long rains had not only come on time, but they had come from the direction usually associated with good rains. At that time however, PHYGROW showed a possible drop in forage below normal. In subsequent months, it turned out that actually forage was below normal.

The site in Mbirikani, a Group Ranch, has been considered ideal for this project because the management committee is very strong and is able to make and enforce decisions on pasture utilization. However, when droughts become as frequent, as they have been in recent years, their authority is undermined because the basis for decision-making is weakened. Herds then move anywhere for survival. The rich, who can afford to transport water, move their livestock closer to the Kyulu hills while the rest move out of the ranch in various directions. In both scenarios, an element of changing weather patterns seems to be in play, thus making traditional indicators less reliable. Plant and spatial indicators, for instance, seem to be affected most.

In all areas, monthly follow-ups are necessary to build community confidence in the outputs, which are on the right track so far. The process, however, should also be institutionalized at the local level so that communities can continuously get this information. The major worry has been sustainability – will the LEWS outputs be available beyond the project's life? Pastoralists and other stakeholders express concern that since PHYGROW analysis, based at Texas A&M University, is controlled by foreigners, its future as a tool for sustained use locally is doubtful. Therefore, government commitments to building mirrored capacity will need to be a priority in the future, even though the system is quite stable for the foreseeable future, and Texas A&M University has made a long-term commitment to maintaining the system indefinitely.

Capacity Building Workshop. A capacity building workshop on Livestock Early Warning Tools was organized by LEWS for the Early Warning Department (EWD) of the Disaster Prevention and Preparedness Commission of Ethiopia (DPPC) and Allied Institutions on February 10 – 20, 2003 at Nazareth, Ethiopia. The workshop, fully sponsored by the GL-CRSP, was administered by LEWS.

The National Disaster Prevention and Preparedness Committee (NDPPC) of Ethiopia is responsible for the overall decision-making on all matters related to disaster prevention and management. The EWD takes the lead in the development of improved procedures for regular data collection, analysis, and dissemination at the national level. The EWD has put in place four different teams to carry out the above noted activities. These are:

1. Crop monitoring team
2. Market and pastoral surveillance team
3. Documentation team
4. Field surveillance team

The workshop was an attempt to improve the efficiency of institutions involved in early warning to implement a timely detection and declaration of a disaster in the pastoral regions of Ethiopia. The poor infrastructure in these regions is a major obstacle to timely monitoring of the livelihood of pastoral communities and dissemination and communication of early warning reports to the decision-makers and users; as a result, the reporting of early warning information has not been effective in the pastoral areas of the country. The reporting systems used by the different organizations involved in early warning are not uniformly deployed. Therefore, there is an urgent need for improvement in communication facilities like telephone, radio, internet, and fax machines in key areas in the pastoral regions.

The workshop brought together 14 participants representing various agencies involved in early warning and food security issues in the pastoral regions of Ethiopia, including DPPC, Disaster Prevention and Preparedness Bureaus (DPPB) for the pastoral regions of Ethiopia (Oromia, Somali, Afar and Southern Nations, Nationalities and Peoples), and non-governmental organizations (Save the

Children-United Kingdom and Hope for the Horn), and the Ethiopian Agricultural Research Organization. The objectives of the workshop were to:

1. Bring together agencies involved in early warning and food security issues in the pastoral regions of Ethiopia in order to compare their approaches, methods, and experiences.
2. Present the latest scientific information on the LEWS technology and reporting system with regard to forage monitoring and 90-day projections employed as an early warning tool.
3. Discuss ways of tailoring LEWS analysis and reports to suit the overall early warning information needs in Ethiopia and to identify information and delivery gaps.

Human Resource Development. The LEWS project has had a tremendous impact on NARS and NGOs working in the region. The workshop and subsequent joint field exercise with key NGOs and DPPC in Ethiopia greatly expanded the LEWS human resource network. We have summarized that network below to demonstrate the depth and breadth of impact on human capacity building in the region.

LEWS/GL-CRSP Program, Central Tanzania

Country	Zone	Name	Position/Institution	Gender
Tanzania	Central	Angello J. Mwilawa	Zonal Coordinator	Male
Tanzania	Central	Ezekiel H. Goromela	Assistant Zonal Coordinator	Male
Tanzania	Central	Rashid S. Kidunda	Sokoine University	Male
Tanzania	Central	Vitalis Temu	Livestock Research Officer	Male
Tanzania	Central	Christopher Ulime	Senior Livestock Field Officer	Male
Tanzania	Central	C.M. Shayo	Head of NIRS laboratory	Male
Tanzania	Central	Coletha Ngwando	NIRS laboratory technician	Female
Tanzania	Central	Mary Dgodath Ngowi	NIRS laboratory technician	Female
Tanzania	Central	S.N. Mniko	RLA-DODOMA	Male
Tanzania	Central	Urassa R.	DALDO-MPWAPWA	Male
Tanzania	Central	E.L. Ollomi	RLA-SINGIDA	Male
Tanzania	Central	Mwachambi	DALDO–DODOMA	Male
Tanzania	Central	Kasanga	DALDO–KONGWA	Male
Tanzania	Central	S. Mtalo	DALDO–MANYONI	Male
Tanzania	Central	Karigo	DALDO–SINGIDA	Male
Tanzania	Central	Antalo	DALDO–KONDOA	Male
Tanzania	Central	Manetho	DALDO–KILOSA	Male
Tanzania	Central	J.E. Mghwira	Officer-in-charge-Mpwapwa	Male
Tanzania	Central	E.N. Pallangyo	RAA-Dodoma	Male
Tanzania	Central	Musa Midugu	RAA-SINGIDA	Male

LEWS/GL-CRSP Program, Northern Tanzania

Country	Zone	Name	Position/Institution	Gender
Tanzania	Northern	Margaret Nana Kingamkono	SARI, Arusha	Female
Tanzania	Northern	R.N. Mero	SARI, Arusha	Male
Tanzania	Northern	Phillemon Mushi	SARI, Arusha	Male
Tanzania	Northern	Marietha Z.Owenya	SARI	Female
Tanzania	Northern	Ndeshi S. Munisi	SARI	Female
Tanzania	Northern	Marcelina Minja	SARI	Female
Tanzania	Northern	N.F.Massawe	Research Coordinator, SARI	Male
Tanzania	Northern	R.Mtae,	TLTI, Arusha	Male
Tanzania	Northern	G. Ngwijo	DALDO, Monduli	Male
Tanzania	Northern	Elias Kea	DALDO	Male
Tanzania	Northern	David Chalamira	DALDO	Male
Tanzania	Northern	Martin Halid	DALDO	Male
Tanzania	Northern	Reginald Swai	DALDO	Male
Tanzania	Northern	Enrisha Msangi	DALDO	Male
Tanzania	Northern	Saideiya P.	DALDO	Male
Tanzania	Northern	Gillead Mtui	DALDO	Male
Tanzania	Northern	Richard Semwenda	DALDO	Male
Tanzania	Northern	Alijumaa Mkumbwa	DALDO	Male
Tanzania	Northern	Muze Msangi	DALDO	Male
Tanzania	Northern	Arnod Massawe	DALDO	Male
Tanzania	Northern	E.N. Ole Wavii	DALDO-Simanjiro	Male
Tanzania	Northern	Dr. F. Matunda,	DALDO-Mwanga	Male
Tanzania	Northern	N.S.Mollel	DALDO-Kiteto	Male
Tanzania	Northern	Dr. E.P.Osanga	DALDO-Same	Male
Tanzania	Northern	Dr. Rwegasira	DALDO-Monduli	Male
Tanzania	Northern	Dr. Uroni	DALDO-Babati	Male
Tanzania	Northern	B.M. Mwawado	DALDO-Karatu	Female
Tanzania	Northern	Dr. Uliky	DALDO-Hai	Male
Tanzania	Northern	Dr. Tigwela	DALDO-Mbulu	Male
Tanzania	Northern	Mr. Simon Soinda	Ngorongoro District Council	Male
Tanzania	Northern	S.A. Msuya	Mwanga District	Male
Tanzania	Northern	Mr. Lucas Ole Mukusi	Simanjiro District	Male
Tanzania	Northern	Mr. Bakari Lukuni	Same District	Male
Tanzania	Northern	Mr. Gabriel Bukhay	Babati District	Male
Tanzania	Northern	Mr. Leonard Ulotu	Hai District	Male
Tanzania	Northern	Mr. Isaac Bayo	Mbulu District	Male
Tanzania	Northern	Mr. Lembile S.Kone	Kiteto District	Male
Tanzania	Northern	Wilson Rutta	WORLD VISION, Arusha	Male
Tanzania	Northern	Gaspar Leboi	ERETO Pastoralist Council	Male
Tanzania	Northern	Helen Nguya	AIDRO, Arusha	Female
Tanzania	Northern	Martin Ole Saning'o	ILARAMATAK LORKONEREI, Arusha	Male

LEWS/GL-CRSP Program, Laikipia Zone, Kenya

Country	Zone	Name	Position/Institution	Gender
Kenya	Laikipia Zone	Zola Gibson	Laikipia Zonal Coordinator	Female
Kenya	Laikipia Zone	James Legei	Program Manager, OSILIGI	Male
Kenya	Laikipia Zone	Nick Gerogiadis	Mpala Research Center	Male
Kenya	Laikipia Zone	Claus Mortensen	Mugie Ranch	Male
Kenya	Laikipia Zone	Fred Lesakale	Wamba Community Development Program	Male
Kenya	Laikipia Zone	Michael	SARDP	Male
Kenya	Laikipia Zone	Abdi	SARDP	Male
Kenya	Laikipia Zone	Eric	Loisaba Koija	Male
Kenya	Laikipia Zone	Barnabas Ekeran	Laikipia Wildlife Forum, Rumuruti	Male
Kenya	Laikipia Zone	Daniel Lomoe	Laikipia Wildlife Forum, Luoniek	Male
Kenya	Laikipia Zone	Morias Kisio	Laikipia Wildlife Forum	Male
Kenya	Laikipia Zone	Joseph Lomart	TUKASOMA	Male
Kenya	Laikipia Zone	Philip Valentine	Segera Ranch	Male
Kenya	Laikipia Zone	Wellington Okieno	WorldVision Kenya	Male

LEWS/GL-CRSP Program, Southern Kenya Zone

Country	Zone	Name	Position/Institution	Gender
Kenya	Southern	William Ngoyawu Mnene	LEWS/GL-CRSP Country Coordinator	Male
Kenya	Southern	Elizabeth Nduku Muthiani	Zonal Coordinator, South Kenya	Female
Kenya	Southern	Mr. Otieno	District Range Officer	Male
Kenya	Southern	Mr. Mwangi	District Livestock Production Officer	Male
Kenya	Southern	Jackson Wandera	SARDP, Kajiado	Male
Kenya	Southern	Mr. Sindyo	Game Warden, Kajiado	Male
Kenya	Southern	Mr. Mbuvi	District Livestock Production Officer, Makueni District	Male
Kenya	Southern	Michael Kiteng’e	Divisional Extension Coordinator, Makindu	Male
Kenya	Southern	Jeremiah M. Ngaya	Makindu Site, Makueni District	Male
Kenya	Southern	Mr. Maina	Assist. Site Monitor, Kasigau	Male
Kenya	Southern	F. Kiungu	Site Monitor, Kasigau	Male
Kenya	Southern	James N. Ituli	Technical Assistant, KARI Kiboko	Male
Kenya	Southern	Antony Mosu	Technical Assistant, KARI Kiboko	Male
Kenya	Southern	Robert Ngetich	Technical Assistant, KARI Kiboko	Male
Kenya	Southern	Charles Konde	Laboratory Technician, KARI Kiboko	Male
Kenya	Southern	Peter Mweki	Lab Technologist, KARI Kiboko	Male
Kenya	Southern	K. Mwaniki	Livestock Extension Officer, Makueni District	Female
Kenya	Southern	J.N. Mwanjewe	District Range Officer, Taita/Taveta	Male
Kenya	Southern	R. Mjomba	Ranch Manager, Kasigau	Male
Kenya	Southern	Francis Kunyanga	Site Monitor, Divisional Extension Coordinator, Magadi	Male
Kenya	Southern	Stanley Oloiputar	Site Monitor at Mbirikani, Assistant Range Officer, Kajiado	Male

LEWS/GL-CRSP Program, Northwest Zone Turkana District, Kenya

Country	Zone	Name	Position/Institution	Gender
Kenya	Northwest	Jane Jepchirchir Sawe	Egerton University	Female
Kenya	Northwest	James Eyapan	ALRMP, Lodwar	Male
Kenya	Northwest	Christopher Ajele	Ministry of Agriculture, Lodwar	Male
Kenya	Northwest	Gollo Guracho Kumbi	World Food Program, Nairobi	Male
Kenya	Northwest	Chris Erukudi	WORLD VISION, Lodwar	Male
Kenya	Northwest	Darlington Akabwai	CAPE UNIT - OAU IBAR	Male
Kenya	Northwest	Allyce Kureya	SNV, NDO, Nairobi	Female
Kenya	Northwest	Maria Twerda	NV, NDO, Lodwar	Female
Kenya	Northwest	Mbithi Mutungi	CAPE, Lodwar	Male
Kenya	Northwest	Eris J.B. Lothike	OXFAM, Lodwar	Male

LEWS/GL-CRSP Program, Northern Zone (Marsabit), Kenya

Country	Zone	Name	Position/Institution	Gender
Kenya	Northern	Joseph Njoroge Ndung'u	KARI Marsabit	Male
Kenya	Northern	Aphaxard J. N. Ndathi	Marsabit	Male
Kenya	Northern	George A. Keya	Director, KARI Marsabit	Male
Kenya	Northern	M. B. Halake	Coordinator ALRMP, Marsabit	Male
Kenya	Northern	Alex Ali Guleid	MOARD, Marsabit	Male
Kenya	Northern	Chachu Tadicha	Coordinator CIFA, Marsabit	Male
Kenya	Northern	Simon Munyao	Coordinator ITDG, East Africa	Male
Kenya	Northern	Sora Adano	Project Manager, CEC, Marsabit	Male
Kenya	Northern	Alfred Ngonze	KWS	Male
Kenya	Northern	Huka Duba	Food for the Hungry International, Marsabit	Male
Kenya	Northern	Bernard Wafula	MOARD, Isiolo	Male
Kenya	Northern	A. A. Ali	ENNDA, Isiolo	Male

LEWS/GL-CRSP Program, Southern Zone (Borana), Ethiopia

Country	Zone	Name	Position/Institution	Gender
Ethiopia	Southern	Ato Assefa	Adami Tulu Research Institute	Male
Ethiopia	Southern	Alemu Adare	SORDU, Yabello	Male
Ethiopia	Southern	Bayissa Hatewu	EARO Holetta	Male
Ethiopia	Southern	Amsalu Sisay	Adami Tulu Center	Male
Ethiopia	Southern	Abdissa Abalti	Adami Tulu Center	Male
Ethiopia	Southern	Ashenafi Mengistu	Adami Tulu Center	Male
Ethiopia	Southern	Daniel Molla	FEWS NET	Male
Ethiopia	Southern	Teshome Erkineh	Early Warning Dept., DPPC	Male
Ethiopia	Southern	Beletu Tefera	Early Warning Dept., DPPC	Female
Ethiopia	Southern	Zinash Sileshi	EARO	Female
Ethiopia	Southern	Getachew Haile	OARI	Male
Ethiopia	Southern	Dubale Adamasu	Farm Africa	Male
Ethiopia	Southern	Suleiman S. Mohamed	SCF-UK	Male

LEWS/GL-CRSP Program, Uganda

Country	Zone	Name	Position/Institution	Gender
Uganda	Central/S.Western	Cyprian Ebong	NARO	Male
Uganda	Central/S.Western	Felix Bareeba	Makerere University	Male
Uganda	Central/S.Western	Rose Omaria	NARO	Female
Uganda	Central/S.Western	Steven Byenkya	NARO	Male
Uganda	Central/S.Western	Grace Ebiyau	NARO	Female
Uganda	Central/S.Western	Charles Sudhe	NARO	Male
Uganda	Central/S.Western	Everlyn Komutunga	NARO/Agro-Meteorology	Female
Uganda	Central	Kitaka, G.	Veterinary Officer, Nakasongola	Male
Uganda	Central	Eswagu, J.	Site Monitor, Wabinyonyi	Male
Uganda	Central	Sekatte, J.	Site Monitor, Nabiswera	Male
Uganda	Central	Bugeza, J.	Site Monitor, Lwampanga S	Male
Uganda	S.Western	Kawooya, E.	Veterinary Officer, Sembabule	Male
Uganda	S.Western	Lule, G.	Site Monitor, Lugusuru	Male
Uganda	S.Western	Kakoza, U.	Site Monitor, Ntusi	Male
Uganda	S.Western	Barigye, J.	Veterinary Officer, Mbarara	Male
Uganda	S.Western	Bagatuzayo, W.	Site Monitor, Kanyaryeru	Male
Uganda	S.Western	Kitimbo, J.	Site Monitor, Kikaatsi	Male
Uganda	S.Western	Aziku, L.	Site Monitor, Isingiro	Male
Uganda	Central/S.Western	William Olaho-Mukani	MAAIF	Male
Uganda	Central/S.Western	A. Hakuza	MAAIF	Female
Uganda	Central/S.Western	Majugu, A.W.	Department of Meteorology	Male
Uganda	Central/S.Western	Mwesigwa Shem	Ministry of Disaster Preparedness	Male
Uganda	S.Western	Dr. Musinguzi	GTZ Pastoral Development Project	Male
Uganda	Central/S.Western	Andrew Mutengu	FEWS NET	Male
Uganda	Central/S.Western	Agnes Atyang	FEWS NET	Female
Uganda	S.Western	Mr. Rusoke	ULAMP	Male
Uganda	Karamoja	Michael Oyet	Oxfarm GB	Male
Uganda	Karamoja	Alinga Hellen	Karamoja Agro-pastoral Development Project	Female

Activity Five: Pastoral Livestock Marketing in Northern Kenya and Southern Ethiopia (joint with the PARIMA project)

Problem Statement. The main issue in this activity was the need to identify priority interventions to promote more timely livestock sales in relation to stress periods. The role of LEWS was to organize information into a spatial context and initiate first order movement and a marketing model using the results generated by PARIMA on ground analysis.

Approach. This past year represents the last year of a three-year collaboration between the PARIMA group and LEWS, with primary participants including Drs. Chris Barrett, Peter Little and Jerry Stuth. Laban Macopiyo, a Ph.D. student at TAMU from Kenya, was partially funded by this component to work with the outcome of the surveys and analysis conducted by Drs. Barrett and Little on market issues and intervention constraints, with a goal of helping to construct an agent-based livestock movement and marketing model. The reader is referred to the PARIMA section of the annual report to see the findings of the surveys. This report focuses on the model development issues.

Progress. ***Model Structure.*** The model has been developed using both geographic-information-systems (GIS) and agent-based modeling under the Java environment. A planned publication will provide detailed descriptions of how these environments have been integrated. ArcGIS 8.2 GIS was used to develop and process initialization maps. Map analysis and output display has been carried out in the Java development and deployment environment. The Java environment was also used to develop an agent-based decision environment and used to conduct simulations in which independent agents (i.e., individual cattle herds & herders) interacted with one another and the environment in space and time. During a simulation, each agent developed a unique history according to the rules assigned to its type of object. The agent-based model consisted of an observer interface (interface control, display-animation, and time schedule) and a model environment (equations describing ecological and behavioral features of modeled agents). Simulations were conducted locally via command-line statements but are eventually targeted to be run remotely via a web-based interface.

Interactions between the modeled agents and their environment across the Eastern African landscape and surrounding areas were simulated. The total area modeled was 580 km x 580 km. Using a daily time step, the model simulated interactions among agents over a 150-day period (plans are underway to extend this), representing the migration season of the pastoralists in the region.

Livestock Movement Patterns. Our first objective was to develop a model capable of simulating the daily movements of livestock herders and their cattle as they travel from the homefront locations to foraging areas. By identifying feeding areas frequently visited by the livestock for a given landscape as well as patterns of large-scale movements of pastoral livestock, it is hoped that results of this modeling effort could be used by policy managers to predict and focus intervention efforts in times of drought, disease outbreaks, source of cattle market supplies, conflict, etc. Although the primary interest was livestock movement, these movements were a function of the movements of the pastoralist, which in turn is a function of the physical characteristics of the available feeding areas, available forage, conflict, cultural practices etc. Therefore, the dynamics and interactions between the agents and their environment was simulated. The focus was on dynamics that occur within the seasonal movement of the livestock, and also seasonal and annual changes in variables such as habitat quality, number of livestock, seasonal trigger for new movement, and ethnic territorial and land use limitations.

Feeding Areas. This object type was created to represent physical locations on the landscape. While feeding areas remained stationary, their attributes were dynamic. Feeding areas maintained information about the grazing suitability of a given location for cattle, distances among feeding areas, and the presence of other agents (i.e., consumption by other cattle herds, etc.).

A feeding area represented an 11 km by 11 km area on the landscape, and was considered to be homogenous with regard to all attributes throughout this area. For example, the grazing suitability for cattle across the entire 11 km square area was represented as an attribute of a single feeding area. This approach was used so that landscape-level features could be captured without the necessity of having detailed knowledge of microhabitat characteristics within an 11 km cell (work is underway to reduce this cell resolution as new data becomes available). Furthermore, this spatial scale approximates the level of detail needed to simulate the relatively long-distance movements between grazing and water sites of livestock, particularly in times of drought.

Grazing cattle are not evenly distributed across the landscape, reflecting their foraging preferences. Several factors likely contribute to this patchy distribution. First, the availability of permanent water, settlement, and the quantity and quality of forage have been documented to influence movements by livestock. Second, impediments to movement also likely influence the range use of cattle. For example, various ethnic communities can only graze in areas where other "friendly" communities reside, while agricultural land use and disease vector infestations play a major role to preclude the use of forage resources in specific areas. Finally, accessibility has also been shown to influence the movements of cattle and overall patterns of range use.

A mathematical function was created to describe the grazing suitability for cattle on the landscape. Grazing suitability was determined from five principal components: (1) amount of standing crop available to livestock, (2) slopes at the site, (3) ethnic compatibility, (4) distance from permanent/seasonal water, and (5) time since previous occupation by the cattle herd. Each component was parameterized and a final product of suitability of a site for each of these components produced.

Herds. The herd object type was created to represent cattle in an 11 km by 11 km area containing several cohesive herds (approximately 30-50 head each), as they graze and move across the landscape. Because cattle often aggregate at or near settlements where there is permanent water, 186 of these sites were located as the initial locations for the cattle herds (this value keeps being adjusted as more data on water points get collected and collated).

We assumed that humans manage the grazing process using a "win-switch" foraging strategy. Research indicates that cattle may utilize spatial memory and employ a "win-switch" foraging strategy where cattle (via humans in this case) find a productive site (i.e., "win") but then routinely move (i.e., "switch") to another location rather than continuing to forage at the productive site until the expected net energy gain drops below that of other locations, as predicted by optimal foraging theory. This strategy may promote rapid regeneration of vegetation at the productive site. Cattle also utilize spatial memory to avoid recently grazed areas and have been shown to avoid locations with depleted food resources for up to eight days. Field studies also documented that when cattle switched foraging areas, they tended to move to adjacent sites rather than traveling to more distant areas.

Movement rules were programmed for cattle herds in the model to simulate a win-switch strategy with spatial memory. Although cattle herds occur on both sides of the international boundary between Kenya, Ethiopia, and Somalia, we prevented movement across this international boundary for the time being until the rate of cross–border transfer has been adequately parameterized. To determine grazing quality, the grazing suitability value was adjusted on a daily basis to reflect the decreased preference of cattle for recently visited sites, and their increased preference for adjacent sites. The decrease in grazing quality due to previous occupation by a cattle herd declined over time, and was eliminated when eight days had passed since the occupation. Once the grazing quality of each feeding area was updated, the movement rule for a cattle herd was simply to move to the feeding area with the greatest grazing quality.

The forage grazing quality variable $f(t)$ for each feeding area was used to describe a site's relative attractiveness to a cattle herd and represented the dynamic attractiveness of a feeding area to a given cattle herd based on its unique history. The desire to move to a cell with higher forage value (forage at time t) is captured by this factor of forage quality and is calculated as follows:

$$f(t) = a_h f(q)$$

where

$$a_h f(q) = \mathrm{Min}[\sum_i f^i, 1]$$

where

a_h is a parameter estimate
$f(q)$ is the forage quality
f^i is the summation for the factor for accessible forage

The forage that is closest to the source contributes most to the function of forage quality $f(q)$. Other factors that influence the presence of forage include slope factors, ethnicity, and a memory factor accounting for the last time since visitation at a particular site. $f(q_j)$ was determined by:

$$f(q_j) = [(\alpha f_j - \beta S_i Cos(A_{ij} - a_j)]/\delta_{ij})(\Delta t^H)(\varepsilon_j)$$

where
$f(q_j)$ is the forage quality factor for cell $_j$
f_j is the standing forage crop at cell j in *tonnes/ha*
S_i is the slope percent at cell i
A_{ij} is the azimuth to cell j
a_j is the slope aspect at cell i
δ_{ij} is the distance between cells i and j
Δt^H is time since last grazing
ε_j is a factor for ethnic acceptance

Other factors such as conflict and disease will be incorporated in due time as reliable data becomes available.

Simulations. Each simulation of the livestock movement model produced two general types of output. Maps detailed the cumulative visits by cattle herds to feeding areas across the modeled landscape, and tables of information detailed the distances moved by cattle during a simulation, rates of consumption at the sites, resource pressure at the sites, etc. The resultant patterns produced by the model (maps) were examined as well as the underlying processes that generated these patterns (individual movements). The determination and tweaking of the appropriate values for some of the parameters for the model is an ongoing research problem with good progress.

The model requires another year to complete but the basic functionality and spatial representation of the dynamics has been attained, reflecting a first-order set of rules derived from the PARIMA-LEWS program and from LEWS field teams in the region. Of particular note is the improved data on livestock density compiled by the LEWS teams and the new updated trekking hours maps for livestock to go to primary, secondary, and terminal markets.

Activity Six: Pilot study on application of integrated communication and computing analysis for improving livestock market information infrastructure and situation analysis in East Africa.

Problem Statement. The primary concern of this activity was to determine if new short message services of cell phones linked to a receiver/message server that is integrated with a 2-way internet satellite system linked with a centralized analysis system can be effectively configured in a manner that is valued by decision-makers at multiple levels concerning livestock marketing information.

Approach. Working with Ian Moore, head of information systems technology at ILRI-Nairobi, TAMU Telecom, TAMU Distance Ed Center, and Verdisys Corporation, we conducted an IT analysis for setting up a two-way Internet satellite system to link a distance education center at the ILRI Nairobi campus. In addition, we tested two software packages in use of the short message service (SMS) cell phone text messaging systems reporting sales information from the Nairobi, Garissa, and Isiolo livestock markets.

Progress. In collaboration with the TAMU Telecommunications Physical Plant and the TAMU Distance Ed Technology Development Center, we negotiated an agreement with Verdisys Corp (Houston, TX) for a VSAT 2-way Internet satellite hub that was located on the ILRI campus in Nairobi and recently installed. The system has email and internet browser capacity, two phone/fax lines that are direct into the TAMU telecom system, a SMS text and voice cell phone server, and a high speed broadband video conferencing capacity. LEWS provided the equipment and ILRI provided the server and conference rooms and has agreed along with the International Centre for Research on Agroforestry (ICRAF)-Nairobi to pay the monthly fee of over $1600/month indefinitely. TAMU Telecom is paying for the two phone lines indefinitely and maintaining all distance education equipment and personnel on the U.S. side. We were also able to negotiate video conferencing licenses with WAVE3 (http://www.wave3software.com/download_ center.html) that allow computer-to-computer meetings with digital cameras for low cost distance education concepts in the future of LINKS. The initial cost is $190 USD per unit and then $15 USD per year maintenance. The constraint of the system is that the computer needs to be a newer generation Pentium microprocessor.

We purchased cell phones and scratch cards and distributed those to a select group of collaborators at the four Nairobi terminal markets and the Garissa and Isiolo secondary livestock markets to test the concept of receiving and transmitting price/volume information by kind and class of animal. A first-order SMS text code system was devised for effective transmission. The cost per market day was $0.13 USD or $6.80/year for weekly markets. Currently, the test has involved reporting three times a week for the daily Nairobi markets. The Kenya Livestock Marketing Services Division (LMSD) in the Ministry of Livestock and Fisheries Development in Kenya provided monitors in each of the test market locations to help test the concepts of sampling herds, reporting body condition, and training needs of monitors. The results of this test formed the basis of the upcoming LINKS project which will be integrated into the LMSD strategic plan for a national livestock marketing information system.

First Order Reporting/Retrieving Protocol. The SMS system can be used to send reports from the field on market prices according to specific markets, animal kinds, breeds, and classes. If a monitor is registered in the system, they will need to know their monitor code to send a message from the field. This is usually designated by their initials, unless there are already conflicting initials in the system, at which time an alternate code would be assigned to them. The following tables represent typical codes to send messages that are currently being tested. It should be noted that only the marketing code aspect of the system was tested as the other activity codes are to be an active part of the LINKS/GL-CRSP project.

Market codes.

Market Name	*Code*
Nairobi	NAI
Garissa	GAR
Isiolo	ISI

Monitor codes.

Monitor Name	*Code*
Kristen Zander (example only):	KCZ
Jerry Stuth (example only):	JWS

Message kind codes.

Message kind	*Code*
Conflict	C
Water	W
Disease	D
Market	MK*
*(only code currently being tested)	
Forage conditions	F
Personal message	PM

Message type codes.

Message type	*Code*
Send	S
Receive	R

Camel, goats, sheep, and horses would be coded the same way as the cattle classes below, using CA, G, S, and H as the middle indicator for animal kind.

Animal class codes.

Animal class	*Code*
Immature cattle female	ICF
Immature cattle male	ICM
Immature cattle castrate	ICC
Immature cattle all	ICA
Mature cattle female	MCF
Mature cattle male	MCM
Mature cattle castrate	MCC

Breed codes.

Breed name	*Code*
Boran	B
Zebu	Z
Mixed	M

A monitor in the field would dial the SMS cell phone, which is attached to an Active SMS process waiting for incoming calls. The process is launched when a call is received, and parses the information from the message and places it into a database. The codes above are used to lookup the appropriate natural language text, so that users can receive information from the system once it has been summarized. Below is an example of a monitor sending in information on the Nairobi market on October 31, 2003:

*MK S NAI JWS 10/31/03 ICF*B*5* 10000*57 MCF*Z*4*12370*432*

First, the monitor sends the appropriate code designating what kind of message is being sent. Here, it is a market message. Using the lookup table provided, they would know to begin the message as "MK". Next, they tell the system whether they are sending or requesting information, by designating "S." The market that they are sending is "NAI," or Nairobi, as parsed from the lookup table. "JWS" is the sender and is verified by the system as a valid user in the system. If someone attempts a send on the system that cannot be validated in the lookup table, the system will place the message in an unparsed table and send notification that there was an unauthorized attempt to use the system. The date that the market information was collected on is entered next.

Following this set of static information, the user can enter as many classes of animals as possible in one message, up to 156 characters, which is all that a single SMS message can accept. This part of the message is divided by the asterisk character. The format of the entry is class code, breed code, body condition score, price, and volume. Multiple entries are separated by a space. The first entry above tells the SMS system that 57 head of immature female cattle, Boran breed, average body condition score of 5, were sold at the Nairobi market for an average price of 10,000 Kenya shillings. The user should assume that the price is in local currency. The second entry sends a message to the system that 432 head of mature female cattle, Zebu breed, average body condition of 4, were sold at the Nairobi market for an average of 12,370 Kenya shillings.

Each night the SMS system makes a call to the results table and summarizes the current day's information. The system assigns grades to sets of body condition score classes using the following breakdown:

Body Condition	Grade
< 3	Emaciated
3 - 4.9	Thin
5 - 7	Moderate
> 7	Fat

For example, there may be four entries for mature female cattle in the Nairobi market for the date October 31, 2003. If one entry was body condition 4, another 5, another 6, and another 7, the system would assign thin to the BCS 4 result, fat to the BCS 7 results and perform a weighted average calculation for volume and price on the two entries that fall into the moderate category. It will also assign a status of "no data" to those categories where data is not available, such as emaciated in the previous example. This process is creating a filled data set, which people can query for market conditions.

After the data set is filled each night, the data is ready to be retrieved by interested parties. These users will send a receive message to the system formatted like this:

MK R NAI B MCF

This text indicates that it is a market message kind, receive type, for the Nairobi market. The user is requesting information on the Boran breed, indicated by the "B" in the text, and would like the volume and prices for all grade of mature female cattle at this market. The system will return a message for the last date entered into the system by the market monitors to the caller's cell phone that will read like the following:

NAIROBI Mature cattle female Boran 10/31/2003 Moderate KES8450 Vol 526 Thin KES5200 Vol 46 Fat KES10100 Vol 23 Emaciated KES4000 Vol 19

The KES in the example above indicates the currency code for the country where the call is being placed. If there was no information in the database on emaciated cattle for the closest date to the time when the call was placed to the system, the emaciated volume and price would read KES0 Vol 0, to indicate that no emaciated cattle of this type were sold at the Nairobi market on the specified date.

Gender

Overall, the LEWS program has impacted the full spectrum of gender including an array of age groups. Because information flows to communities and not select individuals in families, the impact is less gender-specific in nature. However, how the information is used can impact decision-making at the household level as it relates to gender and age. Obviously, decisions to sell and move animals, particularly large animals, are a male-dominated decision in East Africa. However, much of the small stock decisions relative to sales are under the purview of wives of those male decision-makers. Elders in the form of village leaders have a large influence on the sense of urgency to react and how to react to drought information. The reader is referred to the section on the perception survey to determine how LEWS was affecting the decision-making process and how gender was impacted.

There are two categories of women that are impacted by the LEWS project. The United States and in-country women team scientists and in-country women within the targeted pastoral communities. This past year we had two female graduate students and one female systems analyst working in the TAMU-LEWS project in the U.S. One recently completed her program and went to work for the University of Wyoming Extension Service. Currently, there are seven in-country women team scientists involved in the LEWS program. Two of the female scientists are the country coordinators for LEWS in Ethiopia and Tanzania. Three of the women are zone coordinators and the other two women are site managers. There are also site monitors who are women. The following are their specific responsibilities, by country.

United States. A female M.S. graduate student, Ms. Zola Gibson completed her M.S. program at TAMU, graduating in December 2003. She verified the prediction of PHYGROW in Laikipia district and surveyed pastoral communities on their perceptions of drought. She worked with the Mpala Research Centre (http://www.nasm.edu/ceps/mpala) in Central Kenya. Ms. Kristen Zander plays a key role in development of software for the LEWS project and is completing a M.S. program on factors affecting adoption of the nutritional management technology in the context of information technology.

Ethiopia. Dr. Zinash Sileshi, Animal Scientist, was the in-country coordinator for LEWS. She is also the director of the Livestock Research Program for the Ethiopian Agricultural Research Organization (EARO). Dr. Sileshi stepped down as the country coordinator recently due to other commitments and nominated Mr. Dereje Fekadu, at EARO Holetta to succeed her. The LEWS project contact within the Disaster Prevention and Preparedness Commission (DPPC) of Ethiopia is Ms. Belatu Tefera, team leader for the pastoral surveillance team. The DPPC is expected to be the home for the technology developed by LEWS, and the process of institutionalizing is currently underway.

Tanzania. Ms. Stella Bitende is the National Coordinator of LEWS in Tanzania. She was Assistant Director - Livestock Research, Ministry of Agriculture & Co-operatives, Division of Research & Development. Her position has provided a focal point for consultation on technical and operational details of the relevant commodity and research for the sub-program. In her capacity as a Lead Scientist, Ms. Bitende represents the sub-program on collaboration issues with external partners in research and development as the need arises. Ms. Bitende is now country coordinator for Heifer International at the close of the LEWS project. Ms. Margaret Kingamkono, of the Ministry of Agriculture in Arusha, is the LEWS Northern Tanzania coordinator, implementing many new innovations in the communication of LEWS information with pastoral communities.

Uganda. Ms. Grace Ebiyau is a Site Assistant/Technician in Uganda. She has been a member of the LEWS team from its beginning, collecting and processing a major portion of the original samples and data. Dr. Emily Twinamasiko coordinates fecal sampling activities in southwest Uganda. She is the National Research Coordinator for veterinary medicine and animal health. Two female technicians at Namulonge Agricultural and Animal Production Research Institute (NAARI) have been active on the project. They are Ms. Agnes Namagembe and Ms. Clementine Namazzi. They have participated in vegetation characterization, training of field staff, fecal sample collection and processing. Three of the nine weather stations monitors are women.

DANIDA is funding a Ph.D. program at Makerere University for Mrs. Rose Omaria, who is a practicing veterinarian in Uganda. Mrs. Omaria was provided intensive training funds by LEWS to come to TAMU to learn how to use the NIRS technology to develop pregnancy-testing calibrations for cattle and goats. Recent breakthroughs in pregnancy testing with NIRS at GANLab make this a very important training event

Kenya. Mrs. Jane Sawe, a lecturer at the Department of Animal Science, Egerton University, has joined the LEWS zonal team in Northwestern Kenya. Ms. Elizabeth Muthiani has taken over coordination of the southern Zone of LEWS in Kenya. We were also able to negotiate a new MS student, Ms. Briget Ochieng of the Tegemeo Institute at the University of Nairobi to place her in a program to begin the process of investigating price efficiency between the Nairobi cattle markets and the two main markets in Garissa and Isiolo.

Pastoralist Women. All of our Zonal and Country Coordinators have been advised to be gender sensitive in employment for the project activities and in planning, training, and technology development for livestock production. This was done in recognition of the important role that women play as livestock resource managers within pastoral societies in the target. Accordingly, the LEWS program addresses itself to various types of livestock and spatial/temporal availability of feed. Within many pastoral societies, livestock ownership and management are typically specific, with women owning/gaining income from small types of livestock and men controlling the larger ones. Engendering LEWS efforts facilitates the integration of socioeconomic concerns such as division of labor and equitable access to resources.

In addition, many of the site monitors selected for monitoring in the pastoral areas are women. Extensive efforts have been made to identify households headed by women for inclusion into our monitoring route programs in all of the host countries. Three of the 15 households in southwestern Uganda are headed by women. However, women are known to be key players in livestock management and husbandry in East Africa, even in the households headed by men.

Policy

Processes of Institutionalization in East Africa

Based on early feedback from the ME, PAC, and EEP of the Global Livestock CRSP, the LEWS teams were challenged to design institutionalization plans for the coming years of the next funding cycle. These plans are summarized below by country.

Kenya. In Kenya there is an extensive planning program underway to reorganize the information flow from different Early Warnng System (EWS) organizations in Kenya under a single, self-reliant unit called the Early Warning and Food Information System Unit (EW&FISU) in the Ministry of Agriculture and Rural Development (MoARD). The MoARD has submitted a Technical Cooperative Program (TCP) to FAO to help this process to go forward. LEWS representatives, including the PI of the project, have met with Mr. James Oduor, coordinator in MoARD to discuss how LEWS could best be institutionalized in the reorganization process. The Arid Lands Resource Management project (ALRMP) is viewed by MoARD as a good working model through which LEWS technology could be integrated into the EW&FISU framework. Several meetings have taken place with Mr. Oduor and Mr. Maalim, National Coordinator of ALRMP in the Office of the President, to discuss the institutionalization of LEWS in Kenya. As of this writing, we have verbal commitment to identify key people in MoARD and ALRMP to liaison with LEWS teams and arrange training, set up networks, and establish computing capacity for the unit. The EW&FISU framework would ensure that all zones are covered by LEWS technology, considering that the mandate of ALRMP would be expanded to all pastoral regions of Kenya. Other collaborating organizations in the EW&FISU include the Kenya Meteorological Department, Department of Resource Survey and Remote Sensing, Central Bureau of Statistics, Ministry of Health, FEWS NET, FAO, and Arid Lands Resource Management Project.

Uganda. NARO has been identified as a focal point for LEWS because of its comparative advantage. NARO is under the Ministry of Agriculture, which is responsible for early warning. The stability of leadership in NARO supports the process of institutionalization in Uganda. An EWS unit is being established in NARO this year to remedy the high turnover in the Ministry of Agriculture. LEWS will be focusing training and infrastructure development in this unit.

Ethiopia. Continued dialogue with the national Early Warning Department of the Disaster Preparedness and Prevention Commission and Relief Agency has been maintained with the expectation that the technology and training will move forward once the systems function has been tuned to Ethiopia's extensive conditions, and the Ethiopian Agricultural Research Organization (EARO) has been set up with a functioning NIRS fecal profiling lab. The training workshop conducted on LEWS technology for the Early Warning Staff is an attempt to speed up the institutionalization process.

Tanzania. The Ministry of Agriculture has an established crop monitoring and livestock disease-monitoring program. The livestock component is linked with the Organization of African Unity-Interafrican Bureau for Animal Resources (OAU-IBAR). We are targeting the LEWS technology suite toward OAU-IBAR. The national coordinator of LEWS, Stella Bitende, is heading up the discussion with the Ministry of Agriculture and OAU-IBAR representatives. This discussion is in its infancy and we cannot provide any more insights on progress at this point in time.

ASARECA Crisis Mitigation Office. LEWS has invested in intensive training of an information officer and a biophysical modeling technical officer in the ASARECA Crisis Mitigation Office (CMO) located at ILRI-Nairobi (see capacity building section). The TAMU LEWS group has been working with the CMO to help integrate the LEWS concept into the ASARECA AARNET activities. Enhancing and upgrading the information capability of the office has involved collaboration with the International Livestock Research Institute's Information Dissemination Office. The goals of the Crisis Mitigation Information System are:

1. To facilitate data and information flow between the LEWS teams in East Africa (NARS and universities), ASARECA-CMO, and TAMU.
2. To facilitate data and information flow between the national and international

institutions involved in early warning regarding weather, agriculture, and livestock.

3. To facilitate the dissemination of livestock early warning alerts from the LEWS project to pastoral communities, local government leaders, and national policy makers in East Africa.

Forming Linkages with FEWS-NET and major regional organizations. A partnership has formed between FEWS NET and LEWS, along with the Regional Center for Mapping Resource Development (RCMRD), Drought Monitoring Center (DMC), USGS FEWS NET, World Food Program, and Desert Locust Control Organizations to produce a monthly bulletin titled "Greater Horn of Africa (GHA) Food Security Bulletin." Nine bulletins have been produced as of this writing. We also have established a working relationship where the Disaster Prevention Management and Coordination Unit of the United Nations acquires our monthly reports to contribute to the Kenya Humanitarian Update.

Outreach

The primary mechanism for outreach has been the establishment of a mechanism to automate and distribute 10-d and monthly situation reports to government agencies and NGOs working with pastoral communities via the WorldSpace radio network. In Kenya, we have built the capacity for the Ministry of Agriculture and Rural Development to distribute our reports to district officers over most of Kenya's rangelands. Our zonal coordinators serve as an additional mechanism to distribute reports every ten days and monthly to their network of district officers and NGOs working with pastoral communities. We have established a mechanism for translation of our reports and dissemination of the reports into the district offices and NGOs in northern Tanzania. The LEWS Tanzania team established a booth at the National Farm Show in 2002 and was able to brief attendees on the LEWS program, including the Prime Minister and Minister of Agriculture. Each country has different dissemination mechanisms, with NARO playing a stronger role in Uganda. In Ethiopia, EARO was the lead organization but with the reorganization and decentralization of government function into the provinces, we have had to work with the pastoral development commissions in the Somali and Oromia regions to place key people into those regions.

Developmental Impact

Environmental Impact and Relevance. The central thrust of the LEWS program is to provide information on impending drought with sufficient lead-time to allow the government, NGOs, and pastoral communities to react to the conditions in a timely manner and prevent resource degradation. Improved decision-making leads to the maintenance of critical plant cover and recycling of carbon back into the soil, which maintains the hydrological integrity of the ecosystem and results in less soil loss and vegetation of a higher ecological state.

Agricultural Sustainability. Timely decision-making by livestock owners concerning the availability of forage supply, movement, and the destocking and restocking of livestock will be valuable for sustainable livestock production in East Africa. The indigenous knowledge of the pastoral societies regarding range and livestock will be much more effective if they can have access to near real-time information on impending forage shortages for livestock and the location of forage supplies that minimize conflict during periods of restrictive conditions. A combination of the indigenous knowledge and modern science can be used by decision-makers to formulate clear mitigation strategies to reduce risk from weather extremes. Recent technology breakthroughs in computer modeling, weather monitoring, animal nutrition profiling, and communication infrastructures offer an unprecedented opportunity in accurately assessing the impacts of emerging weather events on forage supply for livestock and wildlife, and their ability to acquire nutrients to sustain themselves.

Some environmental impact will be realized in the decrease of land degradation. By notifying pastoralists of the changes (decreased nutrient composition) occurring to the range 6-8 weeks earlier than the current information provides, they have the opportunity to rotate (migrate) off the affected range before an irreversibly detrimental trend intensifies.

Contributions to U.S. Agriculture. Improved NIRS predictions of the diet quality of livestock will have a significant impact on the quality of predictions provided to ranchers throughout the U.S. via the national service lab at the Grazingland Animal Nutrition Lab, at Texas A&M University. Currently, this lab provides nutritional advisories to over 3,000 ranchers throughout the U.S. via the NIRS/NUTBAL nutritional management system. The technologies assembled and used in this project will be directly transferable to U.S. grazinglands. The new EQIP (Environmental Quality Improvement Program) has designated that the NIRS/NUTBAL nutritional monitoring program is eligible for incentive payments for over 35,000 livestock producers. The USDA Risk Management Agency adopted the concept of using biophysical models to generate forage loss assessment as a basis for the new national forage loss insurance program that will affect approximately 32% of livestock producers in the U.S. and over $695 million in forage assets. USDA RMA has accepted the feasibility study for this technology and has issued a task order for the insurance industry to implement the system over the next two years, with a first generation system tested in 2004, followed with full implementation in 2005.

The USDA Risk Management Agency recently approved funding as part of their partnership program to test the concept of blending ranch-specific weather data with the PHYGROW modeling system and livestock fecal profiling to provide a Forage Risk Assessment Management System (FRAMS) for the ranching industry. A pilot study has just been initiated for New Mexico, Texas, West Virginia, and Wyoming.

Contributions to Host Country. The contributions to the East African nations involved in the LEWS project include the ability to foresee and prevent, prepare for, and mitigate or resolve crisis and conflict in a more timely manner. The current set of monitoring programs offers information on initiating conditions (e.g., weather and remote sensing information) and a delayed post-effect (e.g., cattle weight and body condition loss) appraisal system. LEWS' state-of-the-art contribution, based on NIRS livestock fecal profiling technology and spatially referenced modeling of emerging forage/crop conditions, will add a new dimension to the existing monitoring programs in East Africa. The LEWS addition to the current monitoring programs allows more flexibility in decision-making from the household level to the policy maker by providing the ability to predict responses, such as impending livestock mortality by kind and class of animal, losses in forage supply, and decline in milk production. More timely destocking strategies will allow pastoralists to maintain their assets through crisis and assure greater ecosystem integrity, allowing the ecosystem to respond more rapidly after droughts run their cycle.

Also during this past year, the LEWS project has focused on the formation of human capital through a network of scientists and organizations across the East Africa region, which is founded on a common purpose and protocol to establish an advanced livestock early warning system that is regionally cohesive. The project has organized LEWS teams and relief monitoring agencies in East Africa to use the various technical modeling tools. Two issues that have become apparent in the interactions and exchanges of views between the teams during these gatherings are:

1. An improved collaborative approach and regional outlook on livestock issues among LEWS host countries. An awareness that most of the problems related to livestock production and development are cross-border problems.
2. Improved shared understanding and recognition of the importance of livestock in early warning systems. As is evident from the national agricultural early systems currently in place, the livestock sector in all of the host countries is either ignored or marginally covered. The policy makers of various livestock ministries in East Africa have intimated to the project that they are looking to the LEWS project to remedy this situation.

The national outreach specialists of ministries and NGOs were provided training in the use of the various biophysical models and the spatial analysis tools employed by this project. The goal is to enable the national institutions and their staff to become proficient in the use and application of these tools. Other educational and technical contributions include graduate training for some of the national scientists and technicians trained to use the instrumentation, and various workshops designed to establish monitoring routes and protocols. Other equipment (e.g., GPS units, computers, software, etc.) has been provided to the in-country team leaders and zone coordinators.

Linkages and Networking. The LEWS project is co-located in the ASARECA office at ILRI-Nairobi, Kenya, as part of the Crisis Mitigation Program. A portion of a program manager's time has been allocated from ASARECA crisis mitigation funds to serve as an ASARECA-CRSP-LEWS coordinator. This person works under the supervision of Dr. Jean Ndikumana, ASARECA Animal Agricultural Research Network Coordinator. ILRI has hired an information system manager for the Crisis Mitigation Office to facilitate the dissemination of information between the various LEWS teams, Texas A&M, and national and international organizations involved in early warning.

In Ethiopia, we intensified our working relationships with DPPC, Oromia Pastoral Development Commission (OPDC), the Somali Pastoral Development Council, and Save the Children-UK.

The LEWS project also strengthened linkages with the FEWS regional representative in East Africa and EROS FEWS NET.

Collaboration with International Research Centers (IARCS) and Other CRSPs. The primary IARC collaborators are scientists located at the International Livestock Research Institute in Nairobi, Kenya and Debre Zeit, Ethiopia. The first NIRS laboratory was established at ILRI-Debre Zeit. We also assisted ASARECA at ILRI-Nairobi to establish a Crisis Mitigation Office, integrated with the LEWS reporting system, as a primary link to NGOs, regional organizations, national policy makers, and international early warning and relief organizations. ILRI has collaborated with LEWS on a SPAN grant with USAID focusing on capacity building for use of biophysical models.

Because several of our TAMU-LEWS team members are on the global project within the SANREM CRSP, there is strong collaboration between that component and GL-CRSP as it relates to modeling and monitoring technologies. The technical staff working with SANREM CRSP have interacted with the LEWS team members in Uganda, Kenya, and Tanzania as it concerns evaluation of the impact of smallholder dairy technology in those regions.

This past year we have established a two-way Internet satellite connection between TAMU's Internet II node and the ILRI-Nairobi campus. ILRI agreed to provide the monthly fees in collaboration with ICRAF to ensure long-term sustainability of the system. We were able to locate the SMS cell phone text messaging system within their server room, maintained by ILRI system administrators. ILRI provided the distance education conferencing room to help us provide training for the LEWS and future LINKS project personnel.

Other Contributions

Support for Free Markets and Broad-Based Economic Growth. An early warning system will allow a broader assessment of emerging conditions, which will aid in the level of preparedness and mitigation of the effects of drought. This reduced drought risk will help promote the pastoral assets, which in turn can bring about local economic growth and purchasing power. It will also give the local governments opportunity to concentrate on development rather than relief. This is likely to result in increased trade and the emergence of agricultural enterprises.

Contributions to and Compliance with Mission Objectives. Achievement of food security and improvement of the livelihood of the people in the Greater Horn of Africa by mitigating the effect of recurrent droughts and famine has been an important objective of the Greater Horn of Africa Initiative spearheaded by USAID. It is anticipated that the development of an improved early warning system, and finding better ways of linking it to responses from government and various donor agencies, will go a long way in meeting this objective.

Concern for Individuals. The project is designed to secure working relationships with households and individual pastoralists. The project recognizes the fact that the pastoralists, whose livelihoods depend on livestock, are the keys to the success of the project. To a large extent, the success of the project and sustainability will depend upon the participation and the commitment of the local people and the ability of the project personnel to empower, motivate and involve them. Pastoralists' wealth is in their livestock, thus early warning information provided by LEWS could help ensure continued financial security for individuals and their families.

Support for Democracy. A livestock early warning system will improve the capacity of the people in East Africa to monitor and understand the dynamics of food security within their borders and throughout the region. Alerts from a livestock early warning system, with respect to droughts and other natural disasters, will reduce mass movements of people and livestock, which have traditionally been sources of conflict. An improved early warning system such as this will create more stable and democratic societies where individual opportunity for prosperity and well-being is greatly enhanced.

Humanitarian Assistance. The need for humanitarian assistance usually emanates from poverty-related degradation of natural resources. An early warning system for livestock is essential both for food security, by protecting the natural resource base, and for disaster preparedness. A proactive early warning system will help in making people in the region less vulnerable to disasters by alerting them of an impending crisis and provoking a humanitarian assistance response from local and international relief systems (e.g., governments, donors, and NGOs). The United States government, through USAID/OFDA, spends a lot of money on humanitarian crisis created by drought in East Africa. On October 29, 2002, the U.S. Embassy in Addis Ababa declared a disaster in response to the continuing drought situation in Ethiopia. To date in FY 2003, USAID/Office of Foreign Disaster Assistance (OFDA) has provided more than $30.8 million to support emergency water and sanitation, health and nutrition, and agricultural recovery activities in drought-affected areas nationwide in Ethiopia alone. This past year, all food emergency needs in the country have been met for the first time. This improved response could be partly attributed to timely early warnings, which are being issued by the DPPC, FEWS, LEWS, and other agencies working in the country.

References

Haydock, K.P. and N.H. Shaw. 1975. The comparative yield method for estimating dry matter yield of pasture." Australian Journal of Experimental Agriculture and Animal Husbandry, 15: 663-670.

Leveraged Funds and Linked Projects

The LEWS project has been able to leverage funds and personnel from multiple sources to ensure that the program is moving forward and up-to-date technologies are being used in the project**.**

A total of $729,605 was leveraged this year alone within the group, not counting the normal cost share funds of Texas Agricultural Experiment Station salaries noted in the grant budget for 2001-02. Specific grants and funding levels are as follows:

DANIDA - $26,500 - Ph.D. training program for Ms. Rose Omaria. Ph.D. program is funded to develop pregnancy testing calibration equations for cattle and goats to meet both training and science objectives in the LEWS project. She is attending Makerere University and was given intensive short-term training at Texas A&M University GANLAB.

DANIDA - $25,070 - Ph.D. training program for Mr. Steven Byenkya. This is the final year installment on a compressed Ph.D. program at Texas A&M University. Mr. Byenkya is conducting research on modeling effects of brush encroachment on pastoral land capacity and traditional coping strategies as stated in the LEWS objectives.

NUFFIC - $41,939 - Ph.D. Training in range management for Mr. Negusse Kidane from Eritrea. This program is focusing on development of NIRS fecal profiling systems for equines and enhancement of the NUTBAL goat performance prediction model. Mr. Kidane will also be setting up LEWS monitoring sites in Eritrea in May 2004.

SANREM CRSP - $80,000 - Global decision support system for assessing the impact of policy and technologies related to food security – Year 5. Personnel in TAMU-

FEWS are value-added funded via funds in SANREM CRSP, as many of the technology/methodology enhancements help support efforts in LEWS as well as SANREM. Funded to Dr. Clark and Dr. Stuth.

USDA-NRCS - $66,000 - GSAT resource planning system development for assessing carrying capacity of rangeland systems. Technology developed in this program is used in the livestock movement and marketing technology being developed in LEWS/LINKS. Funded to Dr. Stuth.

USDA-NRCS - $180,000 - National animal nutrition and well-being program for the U.S. using the NIRS/NUTBAL PRO Nutritional Management System. This is the fourth and final year of funding. All technology generated in this program is deployed in LEWS. Funded to Dr. Stuth.

EU – ASARECA Crisis Mitigation Office - $150,000 - Funding of the personnel to support crisis mitigation information activities and collaborate with LEWS.

Noble Foundation - $35,000 - Development of early warning system technology for landowners. Funded to Dr. Stuth.

International Fertilizer Institute - $2,417 - GIS applications for LEWS. Funded to Dr. Stuth.

USDA-RMA - $95,000 - Development of integrated automation technology for spatial modeling of fire risk assessment on grazinglands. Funded to Dr. Stuth.

Kelleher Professorship - $27,679 - Enhancing decision-making of livestock producers. Provided to Dr. Stuth.

Training

In Progress

Stephen Byenkya, Ph.D., Dec. 2003, Range Science, Texas A&M University.

William Mnene, Ph.D., Dec. 2003, Range Science, University of Nairobi.

Peter N. Kamau, Ph.D., Dec. 2003, Range Science, Egerton University.

Negusse Kidane, Ph.D., Dec. 2004, Range Science, Texas A&M University.

Rose Omaria, Ph.D., Jan. 2004, Animal Science, Makerere University.

Zola Gibson, M.S., Dec. 2003, Range Science, Texas A&M University.

Kosi Awuma, Ph.D., Dec. 2003, Range Science, Texas A&M University.

Kristen Zander, M.S., Dec. 2003, Ag. Development, Texas A&M University.

Laban Macopiyo, Ph.D., Dec. 2004, Range Science, Texas A&M University.

Completed

Amsalu Sisay, M.S., Dec. 1999, Range Science, Alemaya University.

Sarah Ossiya, Ph.D., August 1999, Range Science, Texas A&M University.

Mohammad Hamid, Ph.D., August 2002, Range Science, Texas A&M University.

Short term: Workshops, Short Courses

All LEWS coordinators attended the GL-CRSP Program Conference in Washington, D.C. in October 2002.

Capacity Building in Livestock Early Warning Tools, February 10 -20, 2003, Nazareth, Ethiopia.

Collaborating Personnel

United States of America

Jay Angerer, Assist. Research Scientist, Texas A&M University.

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Paul T. Dyke, Research Scientist, Texas A&M University.

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Robert Kaitho, Assist. Research Scientist, Texas A&M University.

Clint Heath, Senior Systems Analyst, Texas A&M University.

Jerry W. Stuth, Kelleher Professor, Texas A&M University.

Doug Tolleson, Assist. Director, GANLAB, Texas A&M University.

Kris Williams, Lab Manager, GANLAB, Texas A&M University.

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Azage Tegegne, Animal Scientist, International Livestock Research Institute (ILRI).

Abule Ebro, Animal Scientist, Adami Tulu Agricultural Research Center.

Dawit Negessa, Lab Technician, ILRI.

Zinash Sileshi, Animal Prod. Researcher, Ethiopian Agricultural Research Organization.

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Getachew Haile, Animal Production, Adami Tulu, Oromia Agricultural Research Organization.

Dubale Adamasu, Animal Production, FarmAfrica.

Suleiman Mohamed, Economist, Save the Children - UK.

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Philip Leparteleg, Drought Preparedness Intervention and Recovery Program, Office of the President.

Mahboub Maalim, Arid Land Resource Management Project, Office of the President.

Nicholas Georgiadis, Director, Mpala Research Centre.

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Roger Kamidi, Data Analyst, ILRI.

Raphael Marambii, Information Officer, ILRI.

Russell Kruska, GIS Researcher, ILRI.

Salim Shaabani, Aridland Resource Management Project, Office of the President.

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Jean Ndikumana, Network Coordinator, ILRI.

Jane Sawe, Animal Production Scientist, Egerton University.

John Kariuki, Animal Scientist, Naivasha National Animal Husbandry Research Centre.

Francis Mwangi, Lab Technician, Naivasha National Animal Husbandry Research Centre.

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Suleiman Kaganda, Animal Scientist, Ukiriguru Agricultural Research Institute.

Rashid Kidunda, Range Ecologist, Sokoine University, Tanzania.

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Stella Niyikiza Bitende, Forage Scientist, Selian Agricultural Research Institute.

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Rashidi Kadunda, Range Ecologist, Sokoine University, Tanzania.

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Felix Bareeba, Professor, Makerere University, Uganda.

Stephen Byenkya, Forage Scientist, National Agricultural Research Organization.

Grace Ebiyau, Technician, National Agricultural Research Organization.
Cyprian Ebong, Livestock Production, National Agricultural Research Organization
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Emily Twinamasiko, Vet Medicine/Animal Health, National Agricultural Organization.

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Publications

Issued 12 Greater Horn of Africa Early Warning Bulletins, jointly produced with FEWS NET, USGS, DMC, UNEP, and KMO (http://cnrit.tamu.edu/aflews/bulletins.cgi?type=GHA).

Issued 12 monthly Situation Reports each for Kenya, Uganda, Ethiopia, and Tanzania via RANET, ALIN, and LEWS coordinators that reach worldspace satellite radios across the zone (http://cnrit.tamu.edu/aflews/bulletins.cgi?type=SR).

Issued 36 dekadal maps and situational reports over the web (http://cnrit.tamu.edu/aflews).

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