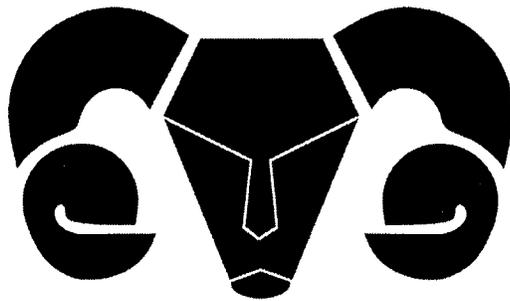


ANNUAL REPORT 2008  
GLOBAL LIVESTOCK CRSP



# **GLOBAL LIVESTOCK CRSP**

## **ANNUAL REPORT 2008**

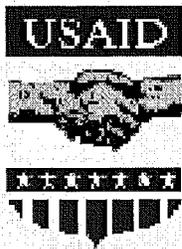


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**Cover Photo by Michael Kock, field veterinarian for the Wildlife Conservation Society and HALI project team member.** *The GL-CRSP Health for Animals and Livelihood Improvement (HALI) project is working with pastoralists in Iringa District, their livestock, and wildlife in the Wildlife Management Areas of nearby Ruaha National Park, to monitor and prevent the transmission of zoonotic diseases, diseases that can be passed from animals to humans, and vice versa. The Barabaig pastoralist woman, pictured, milks her livestock in the Idodi Division of Iringa District, Tanzania. Zoonotic diseases, like tuberculosis, can be transmitted through the consumption of raw milk.*

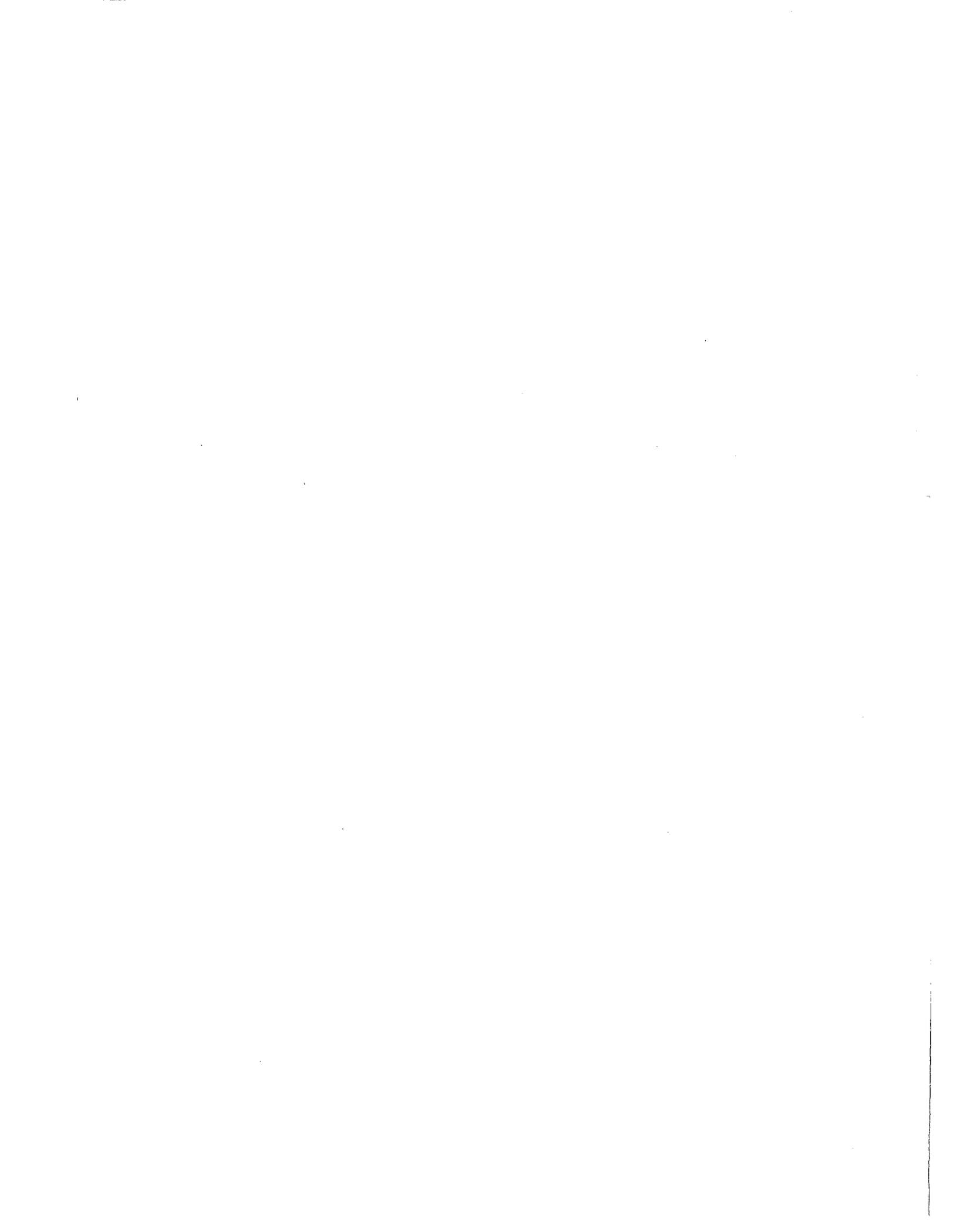


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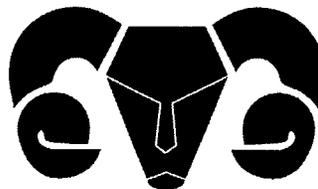
# **PREFACE**

Each year, the Global Livestock Collaborative Research Support Program publishes an annual report in compliance with grant requirements. The 2008 Annual Report documents work completed during the fiscal year, October 2007 to September 2008. The principal investigators for each project submit reports on research funded by the GL-CRSP and each report is the expression of the principal investigator. All individual reports give the name, address, telephone number, and email address of the principal investigator for that project. Inquiries are welcome.

Annual Report Coordinator  
Susan L. Johnson



# TABLE OF CONTENTS



<b>FOREWORD</b> .....	<b>i</b>
<b>PROGRAM OVERVIEW</b> .....	<b>vi</b>
<b>KEY PROGRAM ACHIEVEMENTS</b> .....	<b>1</b>
<b>PROJECTS</b> .....	<b>15</b>
<b>HUMAN WELFARE AND NUTRITION</b>	
Enhancing Child Nutrition Through Animal Source Food Management (ENAM) .....	17
Increasing Animal Source Foods in Diets of HIV-infected Kenyan Women and their Children (HIV Nutrition Project - HNP).....	25
<b>NATURAL RESOURCE MANAGEMENT</b>	
Sustainable Management of Rural Watersheds: Biophysical, Livestock and Human Interactions in the River Njoro Watershed (SUMAWA) .....	31
Grazinglands and Greenhouse Gases (3G) .....	44
<b>RISK MANAGEMENT</b>	
Pastoral Engagement, Adaptation, and Capacity Enhancement in Afghanistan (Afghan PEACE) .....	49
Forage Monitoring Technology to Improve Risk Management by Herders in the Gobi Region of Mongolia (GOBI Forage) .....	54

Mali Livestock and Pastoralist Initiative (MLPI).....	59
Livestock Information Network and Knowledge System for Enhanced Pastoral Livelihoods in East Africa (LINKS) .....	62
Livestock Trade in Ethiopia and Kenya (LiTEK) .....	71
Improving Pastoral Risk Management on East African Rangelands (PARIMA) .....	74
<b>ZOONOTIC DISEASES</b>	
Avian Flu School (AFS) .....	85
Health for Animals and Livelihood Improvement in the Rungwa-Ruaha Ecosystem in Tanzania (HALI).....	91
<b>GL-CRSP SMALL GRANTS PROJECTS</b>	
Afghanistan Livestock Workshop (ALW) .....	101
<b>TRAINING AND HIGHER EDUCATION.....</b>	<b>103</b>
<b>APPENDIX</b>	
Project Funding.....	117
Collaborating Institutions .....	119
Publications.....	123
Glossary .....	136

**FOREWORD**

**THE CRSP CONUNDRUM: GOOD PROGRAMS POORLY PERCEIVED**

**Montague Demment, Director, GL-CRSP  
and David Wolking, MSc Candidate, GL-CRSP/UC Davis**

The Collaborative Research Support Programs (CRSPs) have a 30-year history with the United States Agency for International Development (USAID – Agency), and are, along with the core funding to the Consultative Group on International Agricultural Research (CGIAR), the last significant remnant of Title XII activity within USAID. While external opinions of the CRSPs are generally positive, within the Agency there are mixed views as to their value. To some degree the situation of the CRSPs may be reflective of a broader relationship between the university community and USAID in the area of agriculture. The outputs of these university-led programs under Title XII placed emphasis on building human and institutional capacity in developing countries and generating new knowledge and technologies to improve agriculture. With the exception of creating new technologies, the other outputs are ones whose real impacts are a challenge to measure. How does one fully assess the impact of the lifetime contribution of a PhD? How does one capture the true value of new knowledge through evaluations that lack the time frame to effectively trace the cascading impacts of research on further technology generation?

The issue, we suggest, may be much more fundamental today and impacts the perception of the value of research and human and institutional capacity building. There are two main forces at play. In the university community, a strong force rewards basic research, as universities engage in an ever-evolving role as generators of basic science, and faculty are subsequently rewarded in its pursuit. The other force originates not from within the university, but from substantial and consistent funding sources, such as the National Science Foundation (NSF) and National Institute of Health (NIH), which attract university proposals and talented university intellect. The lack of opportunity for funds to engage the agricultural sector of universities in development has meant that many highly creative scientists have turned away from international development problems to pursue projects with more available opportunities and funding.

The Agency has seen its capacity and role erode over the last several decades. Its leadership in the U.S. foreign assistance portfolio has been carved away and its staff cut. The process has caused many devoted personnel to retire or seek other positions outside the Agency. The remaining staff is now burdened with heavy workloads, often with periodic pulses of demand that outweigh capacity. In this environment, there is a diffuse and important impact on Agency function, as well as its partners and the types of supported programs. In general, this situation does not support research, capacity building, or engagement of universities. We would like to explore this perspective through a discussion of the perception of the CRSPs within USAID.

**What is the Contribution of the CRSPs to Agricultural Development?**

This question is often raised by senior officials at USAID about the CRSPs. Over the past 30 years, the CRSPs have represented a major portion of USAID's agriculture, research and higher education portfolio, but have, in general, been perceived negatively by some within the Agency. This negative perception has recently intensified due to EGAT office budget cuts, staff reductions, and the programmatic request level

stipulated for the CRSPs by Congress. The CRSPs are vulnerable to criticism in this environment. For one, they have characteristics and priorities not entirely in line with the Agency's current approach, though they may align well with Agency's goals. Their emphasis on research, long-term degree training and long-term commitment to host country partners has run counter to the recent operational environment of an Agency emphasizing short-term impact. They are considered by some as static and unresponsive, an earmark for universities and research largely unrelated to Agency needs. Perhaps most of all, there appears to be significant misunderstanding of CRSPs accomplishments and their impact.

### Getting It Wrong: The Problem with Research

One of the diffuse but clearest impacts of staffing cuts at the Agency has been on the perceived role of research in the development process. In the past, USAID was a preeminent intellectual leader, along with the World Bank, in international development. The staffing cutbacks have removed much of the technical capacity of USAID (for example, USAID in 2008 had only two engineers, 16 agricultural experts, and 17 education experts), while reductions in overall staff have placed great pressure to process projects rapidly. Well-trained technical professionals know the literature in their area of expertise, understand the value of published work in the design of new projects, and generally bring the value of science into daily functioning of the Agency. While many good technical people remain within USAID, their greatly diminished numbers place extraordinary demands on them, and their role as technical advisors is therefore diluted.

*"Within USAID, the vast potential of the CRSPs remains greatly underutilized and unappreciated."*

Knowledge should be the basis for the design and implementation of projects. In the world of science, one uses what has been learned and documented to design the path forward. The first part of any proposal for funding makes a logical case based on knowledge generated by previous research, to support the design of the proposed project. The logic is supported by citations of appropriate referenced work. This approach is the product of an evidence-based culture that uses what has been learned to generate new projects and ideas that are better suited to address new challenges.

The World Bank, for example, utilizes this evidence-based approach in the development and design of its projects. The Bank has a considerable internal investment in research and uses that information along with other sources to develop project proposals. The projects must have, as we understand, a component justifying the design based on relevant citations and lessons learned. In short, they have built into their development culture the fundamental process of tapping research for program design and analysis. This culture provides research with a natural and important role in the development environment based on the underlying assumption that we learn from what we and others have done, thus designing and implementing more efficient and effective programs. Research catalyzes effective development projects and activities, which in turn generate more research: a positive feedback loop well worth the investment.

We note that this evidence-based approach has been eroded through time at USAID, diminishing the importance of research in Agency culture. This atrophy has led to a general perception of research as superfluous and wasteful, and not linked to development outcomes. We concur; generating knowledge is wasteful if it is not used. As a result, within USAID, the vast potential of the CRSPs remains greatly underutilized and unappreciated.

## Putting Value Back into Research

In order to appreciate research, its impact must be examined. Unfortunately, research impact is difficult to measure. Universities have grappled with this problem for years and are often criticized for the counting of publications and the categorization of journals as an over simplistic mechanism that fails to capture any true value or impact. So how does one devise a series of measures that truly reflect the progress of research? We recommend a change in the way universities and USAID interact to ensure that university strengths are fully used to strengthen USAID's efforts.

*Making Problem Solving the Core of Development Research.* Those of you who have followed the GL-CRSP know that we started in 1995 with an approach called the "Problem Model." This concept involved approaching stakeholders, listening to their priority problems, and then identifying which problems required new knowledge or technologies in order to solve. Focus on the problem-solving component then helped define the composition of the project team and drive the research agenda. Most of the identified problems were large with a complex array of underpinning lower level issues. This web of issues, or Problem Model, formed the basis for a project's work plan (and the array of MS and PhD theses for developing country students). The challenge for the CRSPs and USAID is to develop a process by which problem solving can be aligned with USAID goals, recognizing the challenges of aligning long-term programs with shifting development needs. This point is not insignificant and may require the Agency to make tough decisions about long-term priorities, even accepting that the CRSPs cannot be everything; instead the CRSPs represent an important tool in the USAID portfolio with its own set of strengths and limitations.

Over our 10 years, GL-CRSP projects have evolved from doing more fundamental research that helped generate knowledge and better define the issues surrounding a problem to research that looks at the effectiveness of implementation efforts developed to solve the problem. In short, our projects often morphed from research to extension to implementation, and then to research on implementation. The latter we call action-oriented research.

An example of this evolution is our PARIMA project, whose Problem Model involved the creation of mechanisms for pastoralists in East Africa to cope with risk. They began with studies to quantify risk and understand pastoralists' perceptions of risk. These results led to investigations of the mechanisms used to cope with risk and evolved into interventions that were monitored and tactically supported by the PARIMA team and its partners. By designing a research element into the implementation phase, a dynamic level of interaction and real-time monitoring of project impact and results can be obtained. By standardizing this process, these impacts can be compared with other programs and a measure of program efficiency and efficacy developed. In such a model, researchers are able to interact with and monitor their projects, analyzing which particular interventions work the best and why. The "why" is a critically important component in this process because it enables the development of a framework for lessons learned that serves to improve future design. Measuring impact alone loses the "why."

Through this process, the science of risk in pastoral societies was advanced, mechanisms for dealing with risk designed and tested, local capacity built to enable people to cope with risk, and knowledge of what interventions worked and did not work was learned. All types of research, from more fundamental to applied to action, were critical to PARIMA's success. In the end, what emerged was a body of knowledge and concepts that were not only locally successful (e.g. women's groups exporting 50,000 head of small ruminants from pastoral areas of East Africa to markets in the Middle East), but influenced a wide range of development projects in the region and on other continents.

## So What to Do with the CRSPs?

*Alignment of CRSPs with USAID priorities.* The Agency and the university community should work together to establish a mechanism where knowledgeable people from both communities can discuss and agree on the topics for future CRSPs. The partnership between the universities and USAID, as defined in Title XII, should be one of mutual respect, intellectual engagement and joint decision-making. These topics should be more fundamental issues that will be relevant for a substantial time period, at least 10 years. This process would establish a basis for legitimacy in both communities.

Within a CRSP program there are a number of opportunities for aligning projects with USAID's global, regional and country objectives. In doing so, it is important to be accepted that the types of outputs that come from CRSPs have value and are of a different nature than those often supported in the shorter-term framework that predominates today. The challenge is how to design CRSP programs that support overall goals of the Agency at the global, bureau and country level by bringing the strengths of the CRSP programs to bear. The new and emerging emphasis on knowledge-based economic growth, smart power, and higher education's role in development are all supportive of this alignment.

*“The development community must recognize, as we do in almost all aspects of the US economy, the role that research plays in advancing all aspects of our lives. Development should not be any different.”*

*Communication.* None of the above can occur without strong, consistent and meaningful communication. Both partners in this relationship need to develop better mechanisms for interaction. We need to move from the often litigious dialogue to one of common sense and joined purpose. The lack of adequate staff in USAID has not helped the situation. Without time for adequate dialogue, partners are not involved in the early stages of program development, and decisions are made without reflective input from those impacted. The state of communications has a marked impact on the design of programs, inability to align with Agency needs, the perception of their impact of programs and their operational effectiveness. In the end, it is a lose-lose situation. A strategy must be designed so that communication is the lifeblood of the relationship.

*USAID Leadership.* The university community must support the reemergence of USAID as the leader for U.S. government (USG) foreign assistance. The loss of portfolio and direct control over resources has weakened the operational capacity of the Agency, demoralized many staff, and created an institution forced to focus on process more than creativity in development. The reduction of staff, mandated by the USG, has crippled the intellectual capacity of the Agency and weakened its effectiveness as a leader in international development. The university community has been and will continue to make these points to Congress and the Administration in support of rebuilding USAID.

*Restoring Research in USAID.* Properly targeted and designed, research can deliver a variety of essential development advances. It can solve problems, build capacities in country, make connections for host country scientists, and extend a wealth of knowledge, both new and old. As the reorganization of USG foreign assistance evolves, and agriculture, higher education, and smart power take their rightful place, the development community must recognize, as we do in almost all aspects of the US economy, the role that research plays in advancing all aspects of our lives. Development should not be any different. Restoration will take time, but we all must work to bring the science back to agricultural development.

The presidential appointees on the Board for International Food and Agriculture Development (BIFAD), an advisory board for USAID, have been making strides in this regard by elevating the research profile within USAID, by leading an effort to engage university deans of agriculture in the discussion, and by taking a more active role in building the partnership aspects of the USAID-university relationship. The challenge here is neither small nor short-term. The university community must work on all fronts, at the project, program, bureau and mission levels with USAID to accurately portray the effectiveness of research as a development tool. The same message must also be taken to Congress and the new Administration. Without these steps, the CRSPs will remain under-utilized, and Agency programs will fail to benefit from field research relevant to their development objectives and agenda; a sad fate indeed for a relationship with such promising potential.

## PROGRAM OVERVIEW

*The Global Livestock Collaborative Research Support Program (GL-CRSP) has expanded its research to address important topics in the international livestock development sector. The program, comprised of broad-based interdisciplinary projects, focuses on human nutrition, economic growth, environment, zoonotic diseases and policy linked by a global theme of agriculture at risk in a changing environment. The projects presently involve researchers from 18 U.S. universities, nine host country universities, 13 national research institutes, 35 governmental bodies representing the local, regional, and national levels, two United Nations organizations, and the International Livestock Research Institute (ILRI). The program is currently active in the following regions of the world: West Africa, East Africa, Afghanistan, and Central Asia.*

## HISTORY

Established in 1978 as the Small Ruminant CRSP (SR-CRSP), the Global Livestock CRSP is one of nine CRSP programs developed under Title XII of the International Development and Food Assistance Act of 1975. The CRSP model, pioneered by the SR-CRSP, was built on the structural strengths of U.S. land-grant universities and collaborative partnerships with international organizations. Four characteristics ensure the effectiveness of this model: 1) Collaboration with U.S. land-grant universities; 2) International training; 3) Long-term scientific relationships; and 4) Program cost-effectiveness.

## REENGINEERED

In 1995, the CRSP began a major restructuring of the program in response to USAID's own reengineering efforts and the changing needs of the international development community. The process, a comprehensive planning and assessment procedure, was initiated with priority-setting workshops in the three regions. As forums for client input, the workshops were intended to maximize the opportunity of regional professionals to present their views on the development issues confronting them. The problem models they developed established the scope for activities within the region. Assessment teams, selected in an initial competition, developed projects that addressed the top priorities within the regions. The problem model was the central component of the assessment process. Each team was charged with refining its problem model through in-field explorations. To ensure grassroots input, over 20 regional workshops involving 35 countries were conducted during the assessment period. The teams submitted final proposals, competing to be in GL-CRSP's current grant, and winners were selected. The process was designed to be problem-driven and has produced results-oriented projects.

## PROGRAM GOALS

The goal of the GL-CRSP is to increase food security and improve the quality of life of people in developing countries while bringing an international focus to the research, teaching, and extension efforts of U.S. institutions. This goal is to be achieved through collaboration between U.S. universities and other institutions, and national and regional institutions abroad that are active in livestock research and development.

## STRATEGIC OBJECTIVES

To achieve this goal, the following objectives have been identified:

- Improve the interaction between livestock production and natural resource use and conservation, and more effectively integrate livestock production systems with the rational use of natural resources.
- Decrease poverty and increase the security of people whose livelihoods depend on livestock by providing mechanisms to manage risk.
- Enhance the nutritional status - and decrease morbidity and mortality - of targeted populations, particularly children and women, through increased availability and utilization of animal source products, thereby increasing human capacity.
- Strengthen the ability of institutions in developing countries to identify problems in livestock production and develop appropriate solutions.
- Provide support to decision makers in developing policies that will promote: a) livestock production, marketing, and trade; b) human nutrition and child physical and cognitive development; and c) natural resource conservation and management.
- Develop and strengthen communication systems (including, but not limited to, extension) among livestock producers, policy makers, businesses, researchers, and consumers that promote greater market participation, increase human and institutional capacity, and improve policy.

## GLOBAL PLAN

Centered on a theme of managing risk in our unpredictable world, the GL-CRSP is developing the capacity to predict risk so it can be better managed, improve the tools to cope with risk, and contribute to the mediation of risk. By focusing on human nutrition, economic growth, environment, zoonotic disease, and policy related to animal agriculture and linked by a global theme of managing risk in a changing environment, the GL-CRSP has chosen to work in ecosystems and regions where human populations and natural resources are most vulnerable, and in most cases, where biodiversity is most valuable.

## TRAINING PLAN

The Global Plan has always recognized human capacity building as a fundamental component of research and development. Thus, the GL-CRSP design provides for a wide range of training possibilities and employs both traditional and innovative strategies to achieve its training goals.

**Degree Training.** The GL-CRSP provides funding for operational and research costs to both U.S. and host-country graduate students. Projects are encouraged to leverage funds to support tuition.

**Non-Degree Training.** Short-term training provides a cost effective means to build capacity. Training workshops and courses build capacity for not only students, but also host country community members, professors, researchers and other development professionals.

**The Jim Ellis Mentorship Program.** Named in honor and memory of Dr. Jim Ellis, a renowned scientist, mentor and GL-CRSP principal investigator, these awards provide partial support to students in order to improve the overall quality of their research. The Program provides funds to conduct research in specialized facilities or field settings away from their home campuses and to provide opportunities for greater diversity in collecting data and more creativity in its analysis than would otherwise be possible. The awards are intended to provide supplemental funds for students already working on GL-CRSP projects.

**Travel Grants for Students.** To encourage student participation at the GL-CRSP conferences, a select number of travel grants are awarded to students for presentation of their findings at the conferences. The awards permit students to inform others about their research and bring them in contact with researchers from other disciplines and projects.

**Build Capacity of Institutional Partners.** The GL-CRSP goal is to build both human and institutional capacity simultaneously within host-country partner institutions. Selective targeting of funds through project funding and program enhancement addresses key deficiencies within these partner institutions.

#### **CHARACTERISTICS OF GL-CRSP PROJECTS**

The Global Livestock CRSP incorporates a broad and complex perspective on international development based on the following principles:

- Research should be demand-driven and problem-oriented with considerable resources invested in problem assessment at the grass roots level.
- Impact should emphasize human outcomes, involvement of local communities, facilitation of research-extension links, and the building of partnerships with other stakeholders.
- Identification and communication of relevant policy issues should be a critical component of project planning and implementation.
- Integration of gender concerns and appropriate gender analysis should be an integral part of project research and results.

#### **GLOBAL LIVESTOCK CRSP PROJECTS**

The Global Livestock CRSP program is not a static set of activities but a constantly evolving and dynamic array of problem-focused projects. The iterative process that developed the original core of projects in 1997 continues as new research findings guide the GL-CRSP portfolio. In addition to the core portfolio of projects, the GL-CRSP also funds assessment team projects and a limited number of small grant projects on topics of special interest.

**Assessment Team Projects.** Before a project begins its research program, it completes a short assessment phase, usually three to nine months. During this phase, teams are given modest resources to conduct in-country workshops, planning and assessment. This process allows the teams to refine the problem model iteratively, determine and adjust team composition to fit the evolving problem model and ensure that colleagues are compatible and the team is functional. These teams then produce a research proposal for a final competition.

## **GL-CRSP ORGANIZATIONAL STRUCTURE**

The GL-CRSP is administered as a grant to the University of California, Davis, which, as the Management Entity, administers subgrants to participating U.S. institutions and maintains fiscal responsibility.

The *GL-CRSP Program Director* is responsible for program development, coordinating activities of the projects across and within regions, and overseeing the daily operations of the GL-CRSP.

The *External Program Administrative Council* provides advice and guidance on the scientific management of the Global Livestock CRSP.

The *Technical Coordinating Committee* provides intellectual exchange and input on programmatic planning for the CRSP to the Program Director and the Program Administrative Council.

The *Pool for External Evaluation of Research* provides objective evaluations of the CRSP programmatic process on an as-needed basis.

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## 2008 GL-CRSP KEY ACHIEVEMENTS

### GL-CRSP ACHIEVEMENT STRATEGY

The Global Livestock Collaborative Research Support Program (GL-CRSP) supports two major initiatives affecting future international development planning: the President's Initiative to End Hunger in Africa (IEHA) and the USAID Agriculture Sector Strategy (AgSS). All GL-CRSP project activities are structured to incorporate IEHA and AgSS objectives in addition to the research and development and capacity building activities unique to the CRSP model.

**Initiative to End Hunger in Africa.** The President's Initiative to End Hunger in Africa (IEHA) is a multi-year effort to help achieve the Millennium Development Goal of halving the number of hungry people on the continent by 2015. The initiative focuses on promoting agricultural growth and building an African-led partnership to cut hunger and poverty. The primary objective of the initiative is to rapidly and sustainably increase agricultural growth and rural incomes in sub-Saharan Africa.

The initiative has six focal themes:

1. Science- and technology-based solutions and innovations, developed for agriculture, contribute to agricultural growth by increasing the productivity and profitability of food and export products and decreasing risks.
2. Efficient agricultural trade and market systems contribute to agricultural growth by raising African competitiveness in export and domestic markets, connecting African farmers to consumers and integrating African countries into global markets.
3. Developing human capital, infrastructure, and institutions is a fundamental building block of agricultural growth.
4. Environmental management contributes to agricultural and rural sector growth through the conservation and production of environmental goods and services that generate public and private economic benefits.
5. Community- and producer-based organizations contribute to agricultural growth by providing a wide variety of business, training, and leadership development services, and a political voice to the economic interests of farmers, who are normally too poor and too scattered to be heard.
6. Integrating vulnerable groups and countries in transition into sustainable development processes recognizes that hunger and poverty are not immutable issues but are often human-made problems to which human-made solutions may already exist.

**USAID Agriculture Sector Strategy (AgSS).** The USAID/EGAT Agriculture Sector Strategy (AgSS) is based on the Agency's 2003 policy document entitled "Foreign Aid in the National Interest." The document emphasizes the importance of targeting the smallholder by addressing policy reform, expanding participation in global trade, and improving market and rural finance systems. These objectives are achieved through improved education, better information systems, sustainable use of natural resources, more environmentally sound agricultural systems and improved support for research and application of agricultural technologies.

The AgSS has four strategic directions: 1) Mobilize science and technology and foster a capacity for innovation to reduce poverty and hunger; 2) Expand global and domestic trade opportunities and improve the capacity of farmers and rural industries to act on them; 3) Bridge the knowledge divide through training, outreach, and adaptive research; and 4) Promote sustainable agriculture and sound environmental management.

The GL-CRSP has developed a project portfolio addressing the IEHA themes and AgSS directions by integrating project research and development activities with Agency objectives and indicators. The GL-CRSP 2007-2008 portfolio is comprised of 13 research and development projects focusing on critical topics related to the broader definition of animal agriculture, including, but not limited to: human health and nutrition, poverty reduction, risk management, natural resource management, and zoonotic disease characterization, prevention, and response.

### **2007-2008 GL-CRSP PROJECT PORTFOLIO**

**Grazinglands and Greenhouse Gases Project (3G).** Resulting from research conducted by the completed GL-CRSP projects Livestock Development and Rangeland Conservation Tools for Central Asia (LDRCT) and Co-Benefits of Grassland Regeneration of Abandoned Wheat Areas for Carbon Sequestration, the 3G project is producing a scientific volume that helps managers and development agents to incorporate rangeland and pasture conservation and management projects as candidates for generation of credits.

**Afghan Livestock Workshop (ALW).** In May of 2008, representatives from various agencies attended a GL-CRSP-sponsored Afghan Livestock Workshop organized by the Advancing Afghan Agriculture Alliance (A4) in Kabul. The workshop focused on harnessing the collective experiences of the different organizations to identify key priorities in their activities, explore possibilities for program collaborations, and to develop strategies for raising livestock awareness at the producer, ministerial and donor levels.

**Avian Flu School Train-the-Trainer Program (AFS).** AFS is a multi-tiered, train-the-trainer program designed to educate animal health, public health, and agricultural extension workers about H5N1 highly pathogenic avian influenza (HPAI), enabling them to deliver this information at the community level in developing countries.

**Enhancing Child Nutrition through Animal Source Foods Management Project (ENAM).** In response to the primary constraints to the quality of young children's diets, the ENAM project is implementing micro-credit programs and entrepreneurial and nutrition education interventions in three regions of Ghana and is assessing their effect on income, Animal Source Food (ASF) expenditures, and children's ASF intakes and nutritional status.

**Gobi Forage Livestock Early Warning System Project (GOBI).** The GOBI Forage project was initiated in 2004 to adapt Livestock Early Warning System (LEWS) technologies developed by the GL-CRSP in East Africa for Mongolia to improve risk management by herders and other stakeholders in the Gobi Region.

**Health for Animals and Livelihood Improvement in the Rungwa-Ruaha Ecosystem, Tanzania Project (HALI).** The HALI project was established in 2006 as a stakeholder-driven research and capacity-building program to assess the effects of zoonotic disease and water management on animal health, biodiversity, and livelihoods in the Ruaha ecosystem, Tanzania.

**Increasing Animal Source Foods in the Diets of HIV-Infected Kenyan Women and their Children Project, HIV Nutrition Project (HNP).** HNP is researching the use of food as a means of enhancing and preserving the immune status, lean body mass and quality of daily living of drug-naive HIV-infected women, and to support the growth, health and cognitive development of their vulnerable children in the Turbo Division of Uasin Gishu District in Kenya.

**Livestock Information Network and Knowledge System for Enhanced Pastoral Livelihoods in East Africa Project (LINKS).** The LINKS project developed from the GL-CRSP LEWS project, which established and applied a suite of technologies to provide a regional decision-support framework for livestock early warning. The LINKS project is placing LEWS technology inside a broader livestock information and analysis system that is designed to improve livestock markets and trade, thereby enhancing the well-being of pastoralists in eastern Africa.

**Livestock Trade in Ethiopia and Kenya Project (LiTEK).** The LiTEK project was developed to synthesize results of recent research about livestock marketing in eastern Africa. The project produced the book, *Pastoral Livestock Marketing in Eastern Africa: Research and Policy Challenges*. It is currently documenting results of the PARIMA project's research for a forthcoming manuscript.

**Mali Livestock and Pastoralist Initiative (MLPI).** Building on the successes of the LEWS, LINKS, GOBI Forage, and Pastoral Risk Management (PARIMA) projects, MLPI represents the integration of livestock market information systems and risk management programs designed to reduce risk and improve livestock marketing options for pastoralists in northern Mali.

**Improving Pastoral Risk Management on East African Rangelands Project (PARIMA).** The PARIMA project was established in 1997 and conducts research, training, and outreach in an effort to improve welfare of pastoral and agro-pastoral peoples with a focus on northern Kenya and southern Ethiopia. Foundation concepts include the exploration of opportunities to better diversify incomes and assets and how to improve access to natural resources, information, and various public services.

**Pastoral Engagement, Adaptation, and Capacity Enhancement Project (Afghan PEACE).** The PEACE project is focused on the development of the Afghan livestock sector by supporting policy planning, pastoral land tenure conflict resolution, and introduction of GL-CRSP LEWS and LINKS technologies to improve rangeland management and livestock production and marketing at the stakeholder and government level.

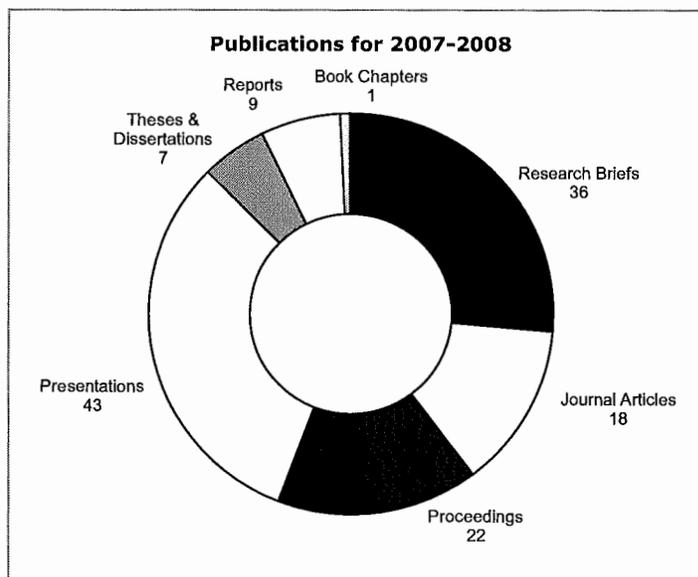
**Sustainable Management of Rural Watersheds: Biophysical, Livestock, and Human Interactions in the River Njoro Watershed (SUMAWA).** The SUMAWA project is a multidisciplinary research effort focusing on biophysical, livestock and human-related factors governing watershed processes for the purpose of improving long-term sustainability of rural watersheds in Kenya and East Africa. Two components build on SUMAWA research: Development and Marketing of Point-of-Use Household Filters for Drinking Water Improvement (POU-WID) and Water and Sanitation-Related Conditions and Disease Burdens in the River Njoro Watershed (Njoro Water).

**KEY ACHIEVEMENTS**

*The Global Livestock CRSP supports demand-driven research focused on a problem model and facilitates collaborations and partnerships to implement sustainable solutions and address core development issues. GL-CRSP projects have integrated research and development activities that incorporate IEHA themes and AgSS strategic objectives and indicators as they pertain to: agriculture enabling environment, applied research and technology, biodiversity, capacity building, community mobilization, conflict mitigation, food security, gender, higher education, HIV/AIDS, micro-enterprise, policy, and water. Key achievements from 2007-2008 in these areas include the following:*

**General Program Achievements 2007-2008**

- Through GL-CRSP projects, thirty-six individuals (19 females and 17 males) were supported in long-term degree training programs in nutrition, veterinary medicine, agricultural economics, range science, human ecology, and hydrology, with two individuals completing PhD programs, two completing MSc programs, and two completing their Bachelor's degrees this year. In addition, a total of 8,295 attendances (6,543 females and 1,752 males) were recorded at GL-CRSP short-term knowledge and technical skill training programs on topics ranging from nutrition, health, and livelihood enhancement, to livestock marketing, database management, and appropriate technology development.
- In 2007-2008 GL-CRSP project research was disseminated through 18 peer reviewed journal articles, 65 presentations and proceedings given by project team members, seven dissertations and theses completed by GL-CRSP supported graduate students, nine reports to partners and affiliates, and one book chapter. As a result of this research, the GL-CRSP will produce 36 Research Briefs distilling project results and practical implications of those results for the scientific and development communities.
- In 2007-2008, GL-CRSP projects leveraged a total of \$5.1 million, an increase from 2007 of over one million US dollars. FY08 included \$1.1 million in USAID buy-ins for support of project research and intervention activities.



## Key Achievements for the AgSS and IEHA indicators in 2007-2008

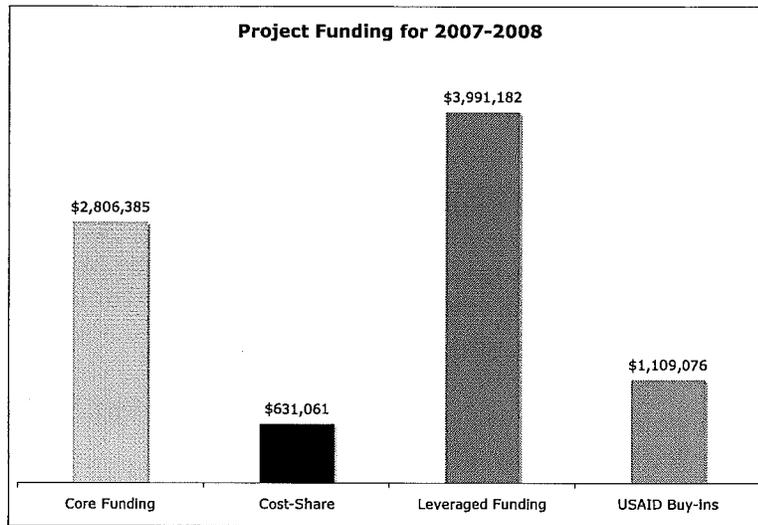
### AGRICULTURE ENABLING ENVIRONMENT

- In fiscal year 2008, online access of the LINKS project's market information was recorded at 43,800 visits/month, while short message service (SMS) requests among project stakeholders were reported at 8,850 SMS/month. Combined with weekly market information updates posted on boards in livestock markets, and dissemination of information through local print media, approximately 525,000 pastoralists in Kenya, 700,000 rural residents in Ethiopia, and 300,000 rural residents in Tanzania can potentially benefit from provision of LINKS market information.
- Building on technology developed by the GL-CRSP LEWS/LINKS project and successfully transferred to Mongolia by the GL-CRSP Gobi Forage project, the Mali Livestock and Pastoralist Initiative (MLPI) is currently adapting and field-testing a new version of the Livestock Market Information System (LMIS). In addition, MLPI is researching three new activities aimed at enhancing pastoral livestock production and management, including an examination of burgu (a cereal grain) management strategies for livestock, supplemental feeding strategies for livestock nutrition improvement, and livestock fattening enterprises for market towns. At the end of September, market data for the LMIS was being collected by 32 MLPI-trained market monitors from six markets, with four of these in Northern Mali and two at the terminal markets near Bamako. The collection of this data represents the first market data that has been collected and made available to users on a near real time basis in Mali.
- In Tanzania, over 500 community leaders and public officials have been trained in the basics of poultry vaccination for Newcastle disease and the benefits of improving poultry health through the Avian Flu School (AFS). Furthermore, to build the sustainable capacity for the poultry vaccination and biosecurity improvement objectives of the project, AFS formed farmers groups and trained group

leaders across three wards in Tanzania: Mlowa, Ufukoni, and Mzumbe. To date, AFS has formed 37 farmer's groups in Mzumbe ward, with leaders from 20 groups receiving training on formation and sustaining groups, writing of group constitutions, and work plans. A total of 345 farmers, group leaders, veterinarians and other animal health workers attended these AFS workshops, including 132 women. Group formations are underway in Mlowa and Ufukoni wards.

### APPLIED RESEARCH AND TECHNOLOGY

- A Survey and Impact Evaluation Study was conducted on the Gobi Forage project in the fall of 2007. Results indicated that Gobi Forage technology has been exceedingly well received, with over 70% of herders having some degree of familiarity with Gobi Forage products. Almost half of the surveyed herders reported that they had used Gobi Forage information to guide livestock movements (51%), provide supplemental feed (49%) or change their rotational grazing strategy (40%). Almost one third (35%) reported a net profit and increased income resulting from these actions. An overwhelming majority (93%) of government officials found Gobi Forage products to be "very useful" in advising herders on grazing management and livestock movement.
- HALI project team members have expanded existing technologies at the Sokoine University of Agriculture (SUA) Faculty of Veterinary Medicine's research and diagnostics program, and introduced four new technologies to detect and characterize bacterial and protozoal pathogens. They have been transferred to SUA, and are in routine use with staff and students trained by HALI, who are now competent in running all analyses. These technologies serve as the diagnostic tools within an integrated ecosystem management program designed to characterize and prevent disease transmission at the interfaces of animals-humans-and the environment.
- SUMAWA research has found aquaculture to be feasible within the River Njoro watershed. Tilapia and catfish were successfully raised in demonstration ponds of 20 by 20 meters; however, tilapia was found



to be more adaptable to the prevailing regional weather. Based on these results, the Ministry of Fisheries has assisted farmers in the establishment of 112 fishponds in Nakuru and Molo districts. It is estimated that a single 20 by 20 meter pond is capable of generating income equal to 17 acres of maize, or roughly \$1,600 USD.

**BIODIVERSITY**

- The Afghan Pastoral Engagement, Adaptation, and Capacity Enhancement (PEACE) project has identified 225 plant species and has been developing the data set that will be used in the Livestock Early Warning System component’s “Phygrow model” for forage prediction. This information can also be used to develop vegetation classifications for some of Afghanistan’s Rangelands. These specimens have been mounted for use as herbarium specimens, and the collection will be retained with the PEACE project until the Ministry of Agriculture can properly house the specimens.
- A possible species new to science was discovered by PEACE project team members during the plant species identification process. The species belongs to the genus *Ochotonophila*, a genus in the Caryophyllaceae family. To date, only three species of *Ochotonophila* are known to exist in the world; and all are from Afghanistan.

- To date, the GOBI Forage Technology Suite covers over 75,000,000 hectares, representing a significant range of biodiversity potential for conservation including critical habitat and plant species. Stakeholders using GOBI Forage products to reduce the number of animals grazing during drought periods, decreased potential losses in plant species biodiversity, and minimized destruction of plant cover and exposure of soils to wind and water erosion, preventing a reduction of water quality to streams and lakes used for drinking water due to sediment loading.
- SUMAWA team members have been actively seeking and identifying species of flora and fauna in the River Njoro watershed. Team members have positively identified 67 samples of benthic macro-invertebrates (bottom-dwelling animals without backbones visible to the naked eye) to the family level. As part of participatory efforts, 94 medicinal plants have been identified and mapped in the upper watershed, including trees and a range of vegetation facing extinction due to neglect of environmental conservation and indiscriminate clearing for cultivation and the timber trade. To further characterize and document biodiversity in the watershed, assessment of River Njoro riparian vegetation composition, percent vegetation cover at livestock watering points, grazed and non-grazed sites, and sediment sampling of tributaries have been conducted.

**CAPACITY BUILDING**

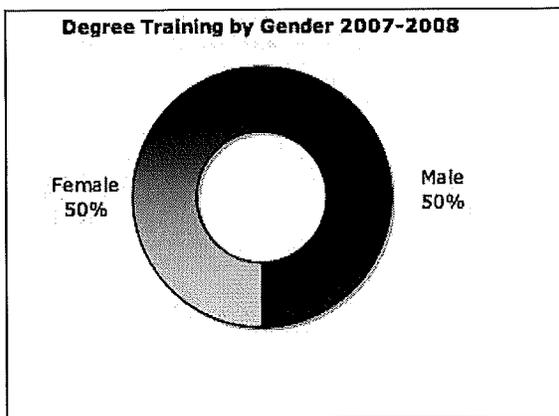
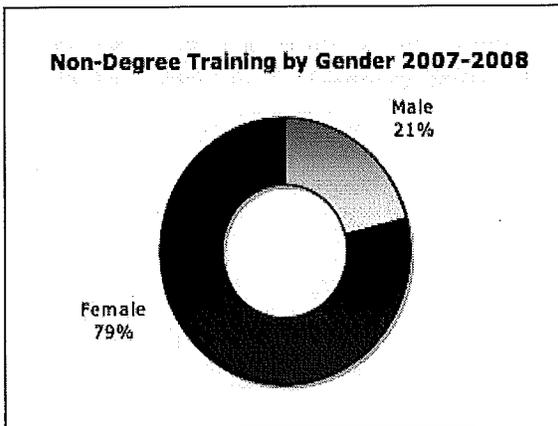
• A village poultry centre established by the Avian Flu School (AFS) at the Sokoine University of Agriculture is scheduled for launch in December 2008, as part of the project's efforts to create an Africa-specific poultry health curriculum for training field veterinarians. AFS team members from Ghana, Togo, Uganda, Kenya and Tanzania conducted and evaluated the Poultry Health and Disease (PHD) Pilot Course featuring the new poultry health curriculum and field guide in Morogoro, Tanzania. Twenty-one field veterinarians from across Tanzania attended the pilot course. In addition to the village poultry center and poultry disease handbook, the AFS has developed and initiated the field-testing of an Africa-specific guide to clinical diagnoses of poultry diseases. This past year, AFS team members

collected and tested samples from more than 200 sick chickens to validate the guide to clinical diagnoses of poultry diseases.

• The ENAM project has strengthened local capacity in Ghanaian communities through various successful nutrition and entrepreneurial trainings. Team members executed a peer education program teaching group facilitation skills and delivery of nutrition and entrepreneurial education in six communities. To date, 12 women have been identified and trained as peer counselors in nutrition. Furthermore, 180 caregivers of young children have been trained on nutrition, health, entrepreneurship, and animal husbandry. As a culmination of the project's efforts over the year, a dissemination workshop was held over two days in August 2008 with international, national, regional, and community presence. A total of 90 people attended and actively participated in reviewing the intervention progress, issues of sustainability, and how to scale-up project operations.

• As a collaboration with the GL-CRSP's Avian Flu School (AFS) project, 31 participants in ENAM project communities completed a training session on the promotion of human and animal health and the avoidance of disease. In addition, program participants were engaged in the construction of appropriate chicken coops, and provided with extensive instruction on poultry care and management, and marketing.

• LINKS project stakeholders at the local level have developed resource mobilization strategies to facilitate expansion and sustainability of the LINKS market information system. Through advocacy, persuasion, and negotiation with stakeholders, the West Pokot county council in Kenya has ceded 20% of the revenue collected from the Chepareria market to support data collection/reporting and maintenance of the market infrastructure. This is a pioneer achievement not experienced at other LINKS sites and represents a new model for local market financial sustainability within the LINKS network. Additional communities are now being



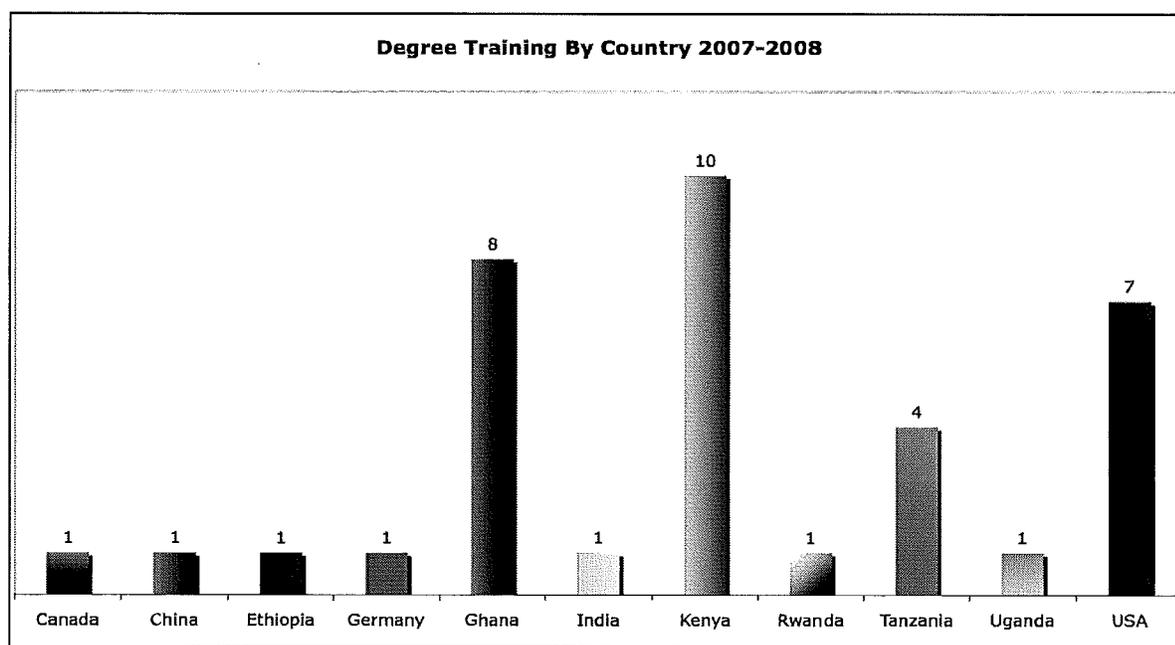
encouraged to follow West Pokot's example, and support their markets from resources generated from local wealth.

**COMMUNITY MOBILIZATION**

The SUMAWA project assists with numerous activities that promote watershed health in the River Njoro watershed, Kenya. To reverse the adverse trend of reduced vegetation cover and deforestation, the Njoro River Water Resources Users Association and SUMAWA have established six tree nurseries with the potential to produce over 100,000 seedlings per season. SUMAWA has also initiated a school greening program in eight schools within the watershed. Altogether the schools have planted 10,000 trees in their compounds and are busy establishing tree nurseries for the production of seedlings. With respect to the River Njoro itself, when livestock drink in the river, they directly contaminate a community water source with their feces and urine. As a medium-term solution to protect communities in the River Njoro watershed from such contamination, SUMAWA assisted with the construction of two livestock water troughs, thus removing the animals from direct contact with the river water and improving water quality for local communities.

In collaboration with the District Veterinary Office in Tanzania, the HALI project organized its first education and outreach event on zoonotic disease, celebrating World Rabies Day in Makifu Village, one of the project's 21 study villages near the Ruaha National Park and Wildlife Management Areas in the Iringa District, Tanzania. An estimated 550 people, including approximately 300 children attended the event on September 28th, which featured an educational video, awareness and prevention brochures, and options for treatment and response regarding the disease.

The Kenya Livestock Marketing Council, a major partner in the Kenyan National Livestock Market Information System (NLMIS) with a registered membership of 4,000 livestock stakeholders, estimates that about 5% (525,000) of pastoralists have access to market information produced by the LINKS project network, with an estimated 3% of these (15,750) using personal mobile phones and the LINKS short message service (SMS). In addition, the Ministry of Information disseminates LINKS market information through NURU, a monthly newsletter published in the Swahili language, which has a readership of over 20,000 in parts of eastern and northern Kenya. It is estimated by the Ministry that



70% (14,000) of the readers actively benefit from the livestock marketing information disseminated through the newsletter.

- Local stakeholders benefiting from LINKS involvement have made collective decisions on priority areas of support to livestock marketing, including the development of resource mobilization strategies to facilitate expansion and sustainability of the LINKS system. In the West Pokot and Baringo districts of Kenya, LINKS stakeholders organized district forums to map out livestock market development plans, including alternative strategies for disseminating information to producers, and organizing producers into local marketing groups. In addition, the West Pokot county council has ceded 20% of the revenue collected from the Chepareria market to support data collection/reporting and maintenance of the market infrastructure. This is a pioneer achievement not experienced at other LINKS sites, and represents a new model for local market financial sustainability within the LINKS network. Additional communities are now being encouraged to follow West Pokot's example, and support their markets from resources generated from local wealth.

- The application of incremental achievements of the PARIMA project over many years led to the creation of 60 voluntary, collective action groups in southern Ethiopia having a membership of over 2,300 people (76% of whom are women). During 2008, all of these groups were graduated and aggregated into over 20 officially sanctioned and legally supported cooperatives. No PARIMA-sponsored group has failed in their development progress over the past seven years.

#### CONFLICT MITIGATION

- One of the components of the Afghanistan PEACE project is to help the Department of Kuchi develop a strategy to solve conflicts across Afghanistan. PEACE has engaged the Department of Kuchi by providing their provincial directors with peace and negotiation training. In addition, on November 4-7th, 2007, 26 Kuchi Representatives from 23

provinces attended a peace and negotiation training workshop organized by PEACE and implemented by the Sanayee Development Organization (SDO). The objective of training Kuchi representatives was to help them to be better prepared to solve a variety of conflicts in their provinces.

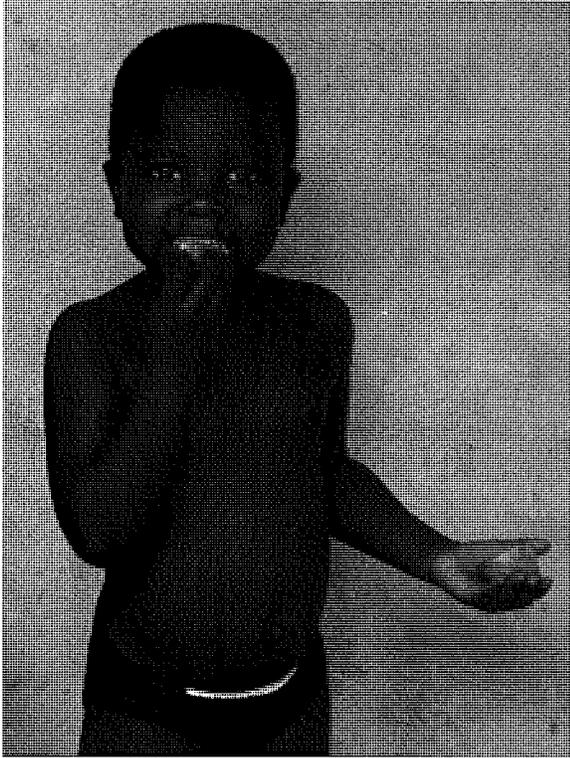
- The Intergovernmental Authority on Development (IGAD) Conflict Early Warning System (CEWARN) uses the Livestock Early Warning System (LEWS) developed by the LEWS/LINKS projects to identify areas of forage deficiency as a potential resource-based conflict indicator. Through CEWARN, LEWS/LINKS technology helps to provide a critical tool for decision-makers in the initiation of interventions for conflict prevention and mitigation.

- Since 2001, PARIMA has held a series of annual cross-border meetings between Ethiopia and Kenya. Policy makers, pastoral leaders, and representatives of governmental and non-governmental organizations are present. The purpose of the meetings has been to forge cross-border partnerships and cooperation dealing with trade, natural resource management, and defusing ethnic tensions.

#### FOOD SECURITY

- As a result of the ENAM project's nutrition education and micro-enterprise development activities in Ghana, household food insecurity has decreased in the intervention communities. In 2007-2008, 180 women were trained in income-generating activities, including those that can directly provide food for the household, such as crop trading and poultry production. Project research also shows that ENAM participants spent on average 11,925, 3,935, and 3,211 Ghanaian cedis per week more on livestock meat, eggs, and milk, respectively, than did non-participants, greatly enhancing the quality of diet among vulnerable Ghanaian households involved in ENAM education activities.

- HNP team members performed a Food Security Assessment using a 24-hour recall interview, the Household Diet and Diversity Score (HDDS) and the Household Food Insecurity Access Score



*A child having an afternoon snack in one of the ENAM communities in Ghana. Through nutrition education training, the project teaches caregivers important lessons on child nutrition and health. The lessons highlight the importance of giving children healthy snacks, such as fruits or eggs, in between meals to ensure they are meeting their daily nutrient requirements. Photo by Kimberly Harding.*

(HFIAS). Results indicate that of the 31 female participants, approximately 50% of the households have no source of income and rely on self-sustenance or good will for food. Therefore, the majority of participating households could not afford at least three meals in a day. Over 75% of participants reported no intakes of egg, meat or fish within the past 24 hours.

- The LINKS project's Livestock Market Information System (LMIS) databases provide the most comprehensive price information on livestock in East Africa, covering the highest number of markets as well as the longest time period. The Kenya Food Security Steering Group (KFSSG) has recommended that LINKS data be used to construct thresholds for use as early warning and food security indicators in consultation with market sector working groups, to

determine the status of food security among East African livestock producers, and to provide policy makers with information necessary for decision making.

## GENDER

- An AFS assessment of the socioeconomic impact of a chicken Newcastle disease vaccination project found that mothers and children from project village households consumed eggs more frequently than mothers and children from control village households. In addition, women in project villages reported higher measures of empowerment than women in control villages, and households in project villages showed a trend towards less household food insecurity.

- ENAM has focused its efforts on women, as they are the primary child caregivers in Ghana. In 2007-2008, ENAM implemented weekly community meetings in the three project villages that consisted of training on income-generating activities and skill building, including training in agriculture, childcare as it relates to nutrition and health, and business in the setting of community women's organizations with female attendances totaling 4,567. Furthermore, case studies on 18 women and their families were used to examine how gender factors into the most and least successful participation in ENAM interventions. ENAM delivered workshops to 57 women that explored gender roles and ways in which women can derive benefit from their roles.

- SUMAWA researchers focus on gender relationships in the River Njoro watershed. Water treatment, for example, is generally a female gender-specific role. POU-WID has therefore targeted mothers and women in the project's outreach and research endeavors. After a period of household trial use of the BioSand Filter (BSF) water treatment method, researchers reported over 95% acceptability of the BSF by mothers in high-risk, vulnerable households. Additionally, SUMAWA team members implemented a participatory three-dimensional mapping exercise, the results of which showed that women are able to locate medicinal plants mainly

found along the river and in open fields as opposed to men who located plants deep in the forest. This is due to gendered responsibility in the community. Research findings on gendered-knowledge of medicinal plants will help to target interventions aimed at watershed restoration and preservation of medicinal plants.

- The membership of the collective-action/micro-finance cooperatives mentored by the PARIMA project stands at 2,300 (an increase of 215 members since 2006-2007). Women represent 76% of the members, and much of their efforts are focused on improving household milk marketing, a predominately female task. PARIMA has initiated research that seeks to understand how gender relations among pastoralists have been affected by the formation and efforts of these collective-action groups.

#### HIGHER EDUCATION

- Thirty-six undergraduate students at the University of Ghana participated in a groundbreaking multi-disciplinary course entitled, "Nutrition, Sustainable Livelihoods and Extension," developed by the ENAM project. The course is the first of its kind, linking agriculture with nutrition in Ghana. A plan was made and funding was secured to develop a curriculum for a short course with the same topic for agriculture and nutrition-based practitioners, in collaboration with the university, government, and non-government institutions and organizations.
- The three faculties of veterinary medicine at the University of Nairobi in Kenya, Makerere University in Uganda, and the Sokoine University of Agriculture in Tanzania are utilizing portions of the Avian Flu School (AFS) curriculum in the instruction of veterinary students in poultry medicine, ensuring attention to village-level poultry production and health issues for all up and coming veterinary health practitioners. In addition to building the local capacities of these universities through applied training in village-level vaccination and poultry health, AFS also builds the training capacity of the ministries of health, agriculture and veterinary

services by training staff of these ministries to conduct animal health workshops on Avian Flu and other topics, including adult training methods. Between 18 and 22 faculty and ministry staff have been trained to teach others in each of the AFS project countries of Tanzania, Kenya, Uganda, and Ghana.

- As part of the Utah State University-PARIMA study abroad program, four American undergraduate students traveled to Ethiopia to expand their knowledge of international development issues. The course was developed by PARIMA team members in order to expose U.S. university students to issues pertaining to agriculture, poverty and natural resource management in the developing world. Accompanied by relevant readings and Egerton University faculty affiliated with the PARIMA project, the students evaluated the effects of globalization on Ethiopia's economy with respect to livestock production, in addition to visiting several collective action groups initiated by PARIMA.



*HALI team member Howard Kombe prepares equipment for tuberculosis testing of livestock in the Idodi division, Iringa district, Tanzania. Photo by David Wolking.*

## HIV/AIDS

- HALI project research investigating zoonotic disease indicates that 75% of family members in the 159 vulnerable study households have never been tested for tuberculosis. Vulnerable groups, including those infected with HIV, are at higher risk of contracting infectious diseases being studied by HALI, especially tuberculosis. As the majority of households in the HALI study are located more than a one-hour walk from a health clinic or dispensary, HALI project efforts to investigate disease and provide education and prevention programs in these marginalized communities are critical to promoting their health and inclusion in disease prevention and treatment programs.
- HNP team members completed the implementation of a pilot and assessment of methods with 15 women and their children involving supplemental nutritional biscuits. The women commented that the biscuits made them feel better. Researchers also determined that non-nutrition biscuits needed to be provided to other members of the household as an incentive for participation. Additionally, two bed nets per family were distributed to all participants to reduce incidence of HIV infection as a result of mosquito bites.

## MICRO-ENTERPRISE

- The ENAM project continues to see success with the 35 credit and savings associations, all of which have completed micro-credit loan cycles with a 100% repayment rate. The ENAM project has further increased the sustainability of these micro-credit activities by linking rural banks in each study region with the six ENAM community Credit and Savings Associations (CSAs). With assistance from Freedom from Hunger, ENAM transferred the CSAs' loans to the three private banks, Akyimpem Rural Bank, Fiagya Rural Bank, and Naara Rural Bank. Additionally, 11 local staff members (three women and eight men) from rural banks have been trained on micro-credit for rural communities and child nutrition and health.
- The collective-action efforts of PARIMA have led to the mobilization of people in four districts in southern Ethiopia. During 2007-2008, all 60 of the voluntary, collective-action/micro-finance groups were graduated and aggregated into over 20 officially sanctioned and legally supported cooperatives. No PARIMA-sponsored group has failed in their development progress over the last seven years. PARIMA conducted training on peer-mentoring, micro-finance, and small business management with

*PARIMA-Ethiopia study abroad students, from left, Kelly Sivy, Annie Wilson and, second from right, Ashley Champlin and Leah Hazlett, far right, meet with leaders from a PARIMA-mentored collective action group in Ethiopia's southern rangelands. Photo courtesy of PARIMA.*



1,651 pastoralists that will help them better engage in micro-finance. As a result, participants report more success and confidence when seeking to increase their incomes and diversify their livelihoods.

## POLICY

- USAID-Mali, as part of their Accelerated Economic Growth Initiative, has identified an overall goal of improving the productivity and income of producers in the northern regions of Mali by enabling them access to technologies and through the capacity building of all actors involved in the development of an extensive livestock system. The MLPI, building on the successful integration of GL-CRSP Livestock Market Information Systems (LMIS) at the national levels in Mongolia and Kenya, and the regional level in East Africa, is working with USAID-Mali to transfer LMIS technology to Mali and to develop an integrated extension approach to reduce risk and support and enhance the production and management strategies of pastoral herders.
- In May of 2008, representatives from various international and Afghan implementing agencies attended a GL-CRSP-sponsored Afghan Livestock Workshop (ALW) held in Kabul, Afghanistan facilitated by the Afghan PEACE project and organized by the Advancing Afghan Agriculture Alliance (A4). Participants identified four program areas that offer opportunities to raise livestock sector growth: capacity building; information for analysis, decision-making, and policies; value-chain development; and advocacy. A committee was formed to engage senior planners in the Ministry of Agriculture, Irrigation, and Livestock (MAIL) in putting policies and strategies into practice and to communicate the results of the livestock workshop. Communication with MAIL has been established, and advisors to the new Minister have been responsive.
- In the Iringa District, Tanzania, AFS project community mobilization activities for vaccinating chickens have been so effective that the District has formally adopted poultry vaccination as a district-wide priority development program. Declaring

May 5, 2008 “Kuku Day” (Chicken Day), officials launched a district-wide Newcastle vaccination program based on the results of the AFS village-level Newcastle disease and Avian Flu control project.

- In an effort to complement their pastoral risk management program with a Livestock Early Warning System (LEWS), the World Bank’s Sustainable Livelihoods Program (SLP) has identified the GOBI Forage project as a valuable addition in providing a LEWS component to its programming and has expressed interest in funding the program in an additional eight aimags (the largest administrative units in Mongolia). Funding for the program is contingent upon the “Development Credit Agreement” between the World Bank and the Government of Mongolia, which was under review by parliament at the end of fiscal year 2008. The initial phase of this move toward institutionalization would be focused on capacity building and technology transfer to the national host entity, with the long term goal of establishing an independent, sustainable, forage forecasting and delivery program operated by a Mongolian national institution.

## WATER

- HALI project research into water use by pastoralists in the Ruaha ecosystem, Tanzania indicates that 67% of the 159 study households reported sharing drinking water with livestock, while only 18% thought sharing water with livestock posed a disease transmission risk. In addition, 65% reported that wildlife entered their drinking water. So far, HALI water quality investigations into water sources in the region have identified 19 species of *Salmonella* bacteria as well as the protozoal parasites *Giardia* and *Cryptosporidium*, illustrating a greater need for public health education targeting appropriate water treatment options, along with overall improvements to water quality for consumption.
- Twelve months of fecal pollution monitoring along the length of the River Njoro by the SUMAWA project shows the river to be fecally-contaminated at extremely elevated levels at numerous locations and for extended periods of the year. Average fecal coliform

levels detected in river water was 8,000 CFU/100 ml, exceeding the United States Environmental Protection Agency (EPA) threshold for use as a water supply source and for human contact and recommendations for livestock water supplies. As a result, team members have posted billboards advising residents not to use the water before treatment with chlorine or boiling. Furthermore, application of gene-based microbial source tracking in the Njoro watershed confirmed that smallholder cows in the Njoro watershed are responsible for the vast majority of gross fecal contamination of river water in this watershed.

- In fiscal year 2008, LINKS began the development of new monitoring tools under the NASA/LEWS project in northern Kenya and southern Ethiopia designed to assess water resources and predict water shortages. The intended beneficiaries of the water resource tools are pastoral communities, who are often water constrained and marginalized, and who often make decisions on when to initiate migration in order to ensure adequate water supplies and forage for their households and herds.

- SUMAWA has been instrumental in the implementation of the BioSand Filter (BSF), an intermittently operated slow-sand household filter for treating contaminated water in the home, developed and tested at the University of California, Davis and Egerton University in Kenya. After household trials and further research, forty-seven households in the Njoro watershed purchased the BSF in last fiscal year, and all 47 continue to use the BSF for their water purification needs. POU-WID team members also engaged representatives from the Kenyan Ministry of Public Health in negotiations on officially introducing the BSF as a household water treatment technology in Kenya.

## **HUMAN WELFARE & NUTRITION**

**ENHANCING CHILD NUTRITION THROUGH  
ANIMAL SOURCE FOOD MANAGEMENT (ENAM)**

**INCREASING ANIMAL SOURCE FOODS IN DIETS OF HIV-INFECTED  
KENYAN WOMEN AND THEIR CHILDREN (HIV NUTRITION PROJECT) (HNP)**



**ENHANCING CHILD NUTRITION THROUGH  
ANIMAL SOURCE FOOD MANAGEMENT  
(ENAM)**

**PROJECT DESCRIPTION**

*The Enhancing Child Nutrition through Animal Source Food Management (ENAM) project is intended to improve poor feeding practices and inadequate diet quality that contribute to childhood malnutrition in targeted communities in Ghana. The project monitors the multiple pathways that might increase availability, accessibility and utilization of animal source foods (ASF) in the targeted communities by supporting a small microcredit program for mothers of children between two and five years of age in conjunction with training on nutrition and business development. It is expected that increasing the amount of money controlled by women, as well as increasing their understanding of child nutritional needs, will result in the women's channeling of additional income towards the purchase of ASF, and also increase the feeding of these products to their young children, thereby enhancing their growth, health and cognitive development. The ENAM team is assessing how the microcredit programs and entrepreneurial and nutrition education interventions affect income, animal source food (ASF) expenditures, and children's ASF intakes and nutritional status. Project interventions and/or monitoring efforts are carried out in three locations in Ghana, corresponding to the country's different ecological zones: Navrongo, a savannah grassland area in the north, Techiman, a transitional forest area in the center, and Winneba, a coastal savannah along the southern coast. In each ecological zone, the project operates in two intervention communities and two control communities.*

**PRINCIPAL INVESTIGATORS**

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**SUMMARY OF ACHIEVEMENTS**

- The ENAM project has strengthened local capacity in Ghanaian communities through a package of successful nutrition, microcredit and entrepreneurial trainings. Team members executed a peer education program teaching group facilitation skills and delivery of nutrition and entrepreneurial education in six communities. To date, 12 women have been identified and trained as peer counselors in nutrition. Furthermore, 180 caregivers of young children have been trained on nutrition, health, entrepreneurship, and animal husbandry. As a collaboration with the GL-CRSP's Avian Flu School (AFS) project, 31 participants in ENAM

- project communities completed a training session on the promotion of human and animal health and the avoidance of disease.
- As part of the ENAM project, a dissemination workshop was held over two days in August 2008 with international, national, regional, and community presence. A total of 90 people attended and actively participated in reviewing the intervention progress, issues of sustainability, and how to scale-up project operations. Additionally the Nutrition Education Flipchart, developed by ENAM team members, was distributed at the dissemination conference.
  - As a result of the ENAM project's efforts in Ghana, household food insecurity has decreased in the intervention communities. The success of the ENAM model is due to the practical combination of entrepreneurial support packaged in such a way to include microcredit and nutrition education, whereby participants are not only trained in the importance of child nutrition but also supported in efforts to generate income and make it possible for families to afford and provide more adequate nutrition, namely animal source foods. In 2007-2008, 180 women were trained in income-generating activities, including those that can directly provide food for the household, such as crop trading and poultry production.
  - ENAM has focused its efforts on women, as they are the primary child caregivers in Ghana. ENAM has continued weekly meetings in the project villages. Training has included income-generating activities and skill building in agriculture, business as well as childcare as it relates to nutrition and health. Female attendances totaled 4,567. Furthermore, case studies on 18 women and their families were used to examine how gender factors into the most and least successful participation in ENAM interventions. ENAM delivered workshops to 57 women that explored gender roles and ways in which women can derive benefit from their roles.
  - Sixteen policy-level stakeholders at the Ministry of Food and Agriculture (MoFA), Ministry of Women and Child Affairs (MoWAC), and the Ghana Health Services (GHS; Ministry of Health) have participated in the ENAM project through meetings and attendance of the national conference to disseminate findings. As a result of the conference, a steering committee of key stakeholders and policy makers will be formed to work towards scaling-up project activities and implications.
  - Thirty-six undergraduate students at the University of Ghana participated in a groundbreaking multi-disciplinary course entitled, "Nutrition, Sustainable Livelihoods and Extension," developed by the ENAM project. The course is the first of its kind, linking agriculture with nutrition in Ghana. Curriculum for the short course was developed in collaboration with the university, government, and non-government institutions and organizations. ENAM also trained nine Master's level students (eight Ghanaian and one Canadian) in nutrition, agriculture extension, and home economics, all of whom completed fieldwork in the ENAM study sites.
  - The ENAM project continues to see success with the 35 credit and savings associations (CSA), all of which have completed microcredit loan cycles with a 100% repayment rate. The ENAM project has further increased the sustainability of these microcredit activities by linking rural banks in each study region with six of the ENAM CSAs. With assistance from Freedom from Hunger, ENAM transferred the CSAs' loans to the three private banks, Akyimpem Rural Bank, Fiagya Rural Bank, and Naara Rural Bank. Additionally, 11 local staff members (three women and eight men) from rural banks have been trained on microcredit for rural communities and child nutrition and health.
  - The ENAM project leveraged a total of \$80,685 in fiscal year 2008.

## RESEARCH BRIEFS

**Do Children's Dietary Intakes Fluctuate by Season in Rural Northern Ghana?**

*Authors: Kimberly Harding<sup>1</sup>, Grace S. Marquis<sup>1,2</sup>, Esi K. Colecraft<sup>2,3</sup>, Anna Lartey<sup>3</sup>, and Owuraku Sakyi-Dawson<sup>4</sup>* <sup>1</sup>McGill University, <sup>2</sup>Iowa State University, <sup>3</sup>Nutrition and Food Science Department, University of Ghana, Legon, Ghana, <sup>4</sup>University of Ghana

*Summary.* Food availability in rural communities is often dependent on season. Young children who are at risk of poor growth when food is scarce during the lean season may be able to improve their nutritional status when food becomes more abundant during the harvest season. This study examined seasonal differences in the diets of 190 children two to five years of age who were living in rural northern Ghana. Interviewer-administered questionnaires were used to collect information on children's diets at two time points: during the lean season before households began to harvest their staple crops of millet, maize and rice, and five months later after almost all crops had been harvested. Although children's diets tended to improve with the post-harvest season, the difference was smaller than expected, and most likely had been blunted by unexpected severe flooding that occurred between the two data collection periods. These findings demonstrate the potential influence of natural disasters in augmenting the seasonal risk of poor growth for young children.

**Dietary Intakes of Non-Pregnant, Non-Lactating Women Participating in the ENAM Project**

*Authors: Gloria Y. Kobati, Anna Lartey, Esi K. Colecraft, University of Ghana; and Grace S. Marquis, Iowa State University and McGill University*

*Summary.* Information on the dietary intakes of non-pregnant, non-lactating (NPNL) Ghanaian mothers is lacking. A cross-sectional survey was undertaken to compare the dietary intakes of NPNL mothers living in the Coastal (n=79) and Northern Savannah (n=89) zones of Ghana. Data collection included an interviewer-administered socio-demographic questionnaire and a 12-hour weighed food record over one working and one non-working day. A food frequency questionnaire was administered to cover one week's dietary intake, from which animal source food (ASF) diversity was determined. Results showed that cereal foods were consumed daily by all participants. Fish was the predominant ASF consumed by both groups of women. The diets of both groups of women did not meet their energy requirements and were low in some micronutrients, especially calcium. The overall quality of the diets was comparatively low for the northern women. About 68% of the northern women compared to 22% of the coastal women had low dietary diversity. Efforts to increase women's access to quality foods all year round are needed to improve women's nutrition.

ENAM Degree Training for 2007-2008					
Name (Last, First)	Nationality	Gender (M/F)	University	Discipline	Degree
Adjei, Gladys	Ghanaian	F	University of Ghana	Nutrition	MS
Bansa-Asem, Charles	Ghanaian	M	University of Ghana	Agriculture Extension	MS
Christian, Aaron	Ghanaian	M	University of Ghana	Nutrition	MS
Hagan, Linda	Ghanaian	F	University of Ghana	Home Economics	MS
Harding, Kimberly	Canadian	F	McGill University	Nutrition	MS
Homiah, Phillip	Ghanaian	M	University of Ghana	Agriculture Extension	MS
Kobati, Gloria	Ghanaian	F	University of Ghana	Nutrition	MS
Micah, Elizabeth	Ghanaian	F	University of Ghana	Nutrition	MS
Osei-Boadi, Katherene	Ghanaian	F	University of Ghana	Nutrition	MS

**Nutrition Education with Microcredit Provided to Caregivers of Preschool Children: Effect on Children's Animal Source Food Intake**

*Authors: Anna Lartey, Esi K. Colecraft, University of Ghana; Grace S. Marquis, Iowa State University and McGill University; Owuraki Sakyi-Dawson, and Benjamin Ahunu, University of Ghana*

*Summary.* Researchers examined the effect of providing microcredit with nutrition education given to caregivers of children two-five years of age. The caregivers were recruited into one of three groups i) Participants (PT; n=108) who received the intervention of microcredit with nutrition education; ii) Non-participants (NPT; n=98) who lived in the same community as the participants but did not receive the project intervention; and iii) Controls (CNT; n= 238) who lived in other communities that were not part of the intervention community and did not receive the intervention. Socio-demographic data were collected at baseline and each caregiver received four follow-up visits at four monthly intervals. At each visit dietary data were collected using a food frequency questionnaire and weighed food records.

Baseline characteristics including wealth rank status did not differ significantly among groups. By follow up three, children whose caregivers received the project's intervention (PT) had significantly higher intakes of protein, calcium and zinc. PT children consistently had high ASF diversity at each follow up period compared to the NPT and CNT groups. The combination of microcredit with nutrition education was effective in improving children's ASF intakes among these deprived rural communities.

**Effects of Microenterprise Development on Caregivers' Contribution and Household Consumption of Animal Source Foods**

*Authors: Phillip Anor Homiab, Owuraku Sakyi-Dawson, Esi K. Colecraft, and A. Mensab-Bonsu, University of Ghana*

*Summary.* Low income levels and lack of knowledge have been identified as key constraints to the use of animal source foods (ASF) in the diets of Ghanaian children. The ENAM project sought to increase ASF levels in children's diets by combining nutrition education with microenterprise development (i.e.,

microfinance and entrepreneurial development education) for caregivers of preschool-aged children. This study assessed effects of the intervention on participants' contribution to key household and child-related expenses as well as household purchases and consumption of ASF. Differences between participants and non-participants living in control communities were analyzed for significance using Mann Whitney test for non-parametric data and Student's t-test statistics. Microenterprise development coupled with nutrition education given to caregivers was effective in increasing both caregivers' contribution towards household expenses and ASF consumption at the household level. Participants of the ENAM project, for example, spent on average 19,825, 4,023, and 9,513



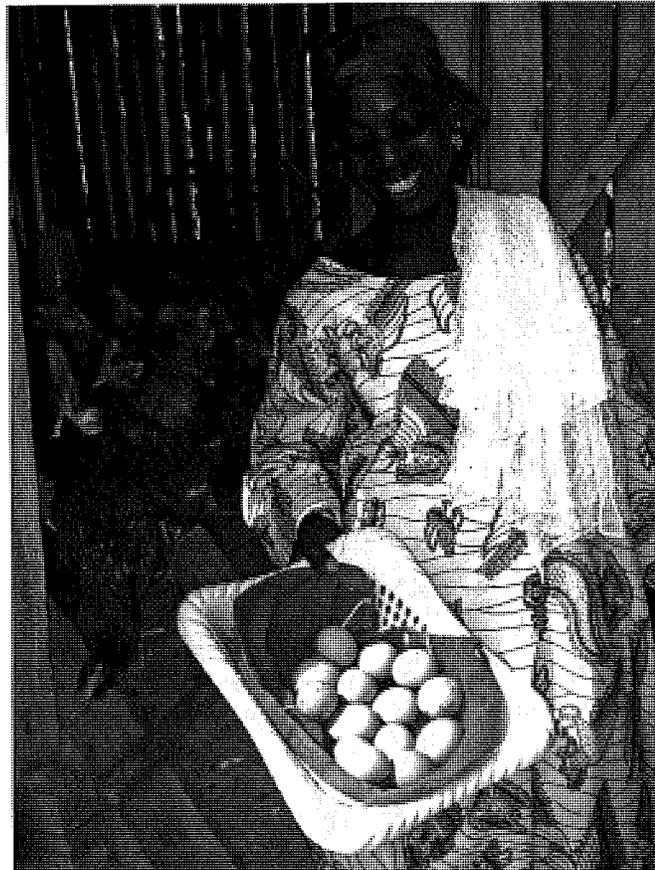
*A community chief presents an ENAM caregiver with a Peer Educator certificate. The project has trained 12 caregivers as peer educators to deliver the nutrition and entrepreneurial education lessons. Photo by F. Boadu.*

Ghanaian cedis per week more on household food, health care of children, and children's clothing and footwear, respectively, than did non-participants. Similarly, participants spent on average 11,925, 3,935, and 3,211 Ghanaian cedis per week more on livestock meat, eggs and milk, respectively, than did non-participants. The results suggest that nutrition education must be included in interventions to improve the quality of children's diets among poor rural households.

**Impact of ENAM Project's Interventions on Caregivers' Health and Nutrition Knowledge and Animal Source Food Intake in Young Children in Ghana**

*Authors: Owuraku Sakyi-Dawson<sup>1</sup>, Grace S. Marquis<sup>2, 3</sup>, Anna Lartey<sup>1</sup>, Esi K. Colecraft<sup>1, 2</sup>, Ben Abunu<sup>1</sup>, Lorna M. Butler<sup>2</sup>, M. Reddy<sup>2</sup>, Helen Jensen<sup>2</sup>, Elisabeth Lonergan<sup>2</sup>, W. Quarmime<sup>1</sup>  
<sup>1</sup>University of Ghana; <sup>2</sup>Iowa State University; <sup>3</sup>McGill University*

*Summary.* Animal source foods (ASF) intake in young children has been associated with improved dietary quality and growth outcomes. The Enhancing Child Nutrition through Animal Source Food Management (ENAM) project provides Income Generating Activities (IGA), development services, and nutrition and health education to caregivers of two to five year old children in rural Ghana. The objective of this study was to assess the interventions' impact on caregivers' knowledge and ASF intake in their two to five year old children. Longitudinal panel data was collected at baseline and four follow-ups of four-month intervals each from project participant caregivers (n=104) and matched non-participants in intervention communities (n=75) and control communities (n=210) in three ecological zones in Ghana. Analysis involved comparison of means of differences of scores using ANOVA and relationships using Pearson's correlation (r), and standard multiple regression. The ENAM project's interventions have significant



*An ENAM caregiver displays the eggs her chickens are producing. She and other ENAM caregivers have been trained in poultry-rearing for egg production as an income-generation activity. Photo by Kimberly Harding.*

positive knowledge and nutrition outcomes on participants; however there has not been significant diffusion to populations not directly involved with the ENAM project. The benefits of the approach can therefore be multiplied by including cost-effective strategies to enhance diffusion. Examples of such strategies are peer education and partnerships with the private sector.

ENAM Non-Degree Training for 2007-2008			
Country	Male	Female	Total
Ghana	51	4567	4618

## Enhancing Backyard Poultry Enterprise Performance in the Techiman Area of Ghana: A Value Chain Approach

*Authors: Charles K. Asem-Bansah, Owuraku Sakyi-Dawson, E.E. Ackah-Nyamike, and Esi K. Colecraft, University of Ghana*

**Summary.** Backyard poultry enterprise is one of the ENAM project interventions designed to address the effects of poverty on household food security and child nutrition in Ghana. The value chain approach was used to examine how the involvement of different actors, activities of actors and relationships between actors, including value chain support services, affect its performance and how these can be improved. Using a case study research design, qualitative data were collected via group and individual interviews with community key informants, backyard chicken farmers, backyard chicken farm input dealers, backyard chicken farm product dealers, backyard poultry farm product consumers, traditional community leaders and extension service providers. Eighty respondents were interviewed, and findings revealed the existence of a significant market for indigenous backyard chicken. However, constraints such as diseases, poor market organization, low level of cooperation among producers, and limited levels of support services to the industry were preventing the industry from taking advantage of that opportunity. Team members also identified opportunities that exist to strengthen the weak links precipitated by the constraints along the backyard poultry value chain. Recommendations for the appropriate organization of intensive backyard

poultry egg production to ensure high performance and sustainability in the Techiman area are provided. In many cases, government intervention, assistance and regulation are necessary. For example, if the control of Newcastle disease, a major challenge to the enterprise, can become a free public good, a challenging obstacle to the viability of backyard poultry production can be removed.

## Using Case Studies to Understand Successful Entrepreneurship Among Women Participating in the Enhancing Child Nutrition Through Animal Source Food Management (ENAM) Project in Ghana

*Authors: Nana Akua Anyidoho<sup>1</sup>, Gloria Y. Kobati<sup>1</sup>, Lorna M. Butler<sup>2</sup>, Grace S. Marquis<sup>2,3</sup>, Esi K. Colecraft<sup>1</sup>, Owuraku Sakyi-Dawson<sup>1</sup>, Anna Lartey<sup>1</sup>, Ben K. Abunu<sup>1</sup>*

*<sup>1</sup>University of Ghana, <sup>2</sup>Iowa State University and <sup>3</sup>McGill University*

**Summary.** The Enhancing Child Nutrition through Animal Source Food Management (ENAM) project identified constraints to availability, accessibility and utilization of animal source foods (ASF) in



*A cooking competition gives ENAM caregivers a chance to demonstrate the knowledge they gained from the project's nutrition education lessons. The women's entries were scored based on appropriateness of food for a young child, inclusion of animal source foods, and hygiene practices used during food preparation and serving. Photo by Kimberly Harding.*

young Ghanaian children's diets. Based on the identified constraints, an intervention involving micro-enterprise development and nutrition and entrepreneurial education for caregivers of young children was implemented. Using case studies, researchers identified factors leading to 'successful' participation in the ENAM project and helped develop an understanding of how these factors operate to produce success. Twelve 'successful' and six 'less successful' ENAM participants were purposefully selected, using agreed-upon criteria of 'success' from ENAM participant focus groups. In-depth interviews were used with the selected women. Every respondent stated that they had derived some benefit from their participation in ENAM. Common strategies which appeared to play a role in the success of the women were identified, such as joining the CSA with an established IGA or mentorship in an IGA, having methods to buffer seasonal fluctuations, and being resourceful in loan management. In one case, Akua's story of success shows how the ENAM project gave her the opportunity and skills to take care of her family trading smoked fish and potatoes. The findings suggest ways in which ENAM, and other similar projects, can be even more beneficial to participants. For example, the project rewarded participants (with higher loans and incentives) based on their performance in the loan scheme and not child nutrition indicators. In the future, periodic feedback to the women about their children's diet and growth progress and an incentive system to reward progress may help reinforce child nutrition issues, making it more salient for the women.

### The ENAM Project Dissemination Meeting

**Authors:** Grace S. Marquis<sup>1</sup>, Esi K. Colecraft<sup>2</sup>, Kimberly Harding<sup>1</sup>, Owuraku Sakyi-Dawson<sup>2</sup>, Anna Lartey<sup>2</sup>, Ben K. Ahunu<sup>2</sup>, Gloria Kobati<sup>2</sup>, Lorna Butler<sup>3</sup>, Helen Jensen<sup>3</sup>, Manju Reddy<sup>3</sup>  
<sup>1</sup>McGill University, <sup>2</sup>University of Ghana, <sup>3</sup>Iowa State University

**Summary.** The Enhancing Child Nutrition through Animal Source Food Management (ENAM) project was developed to address the barriers to the availability, accessibility, and utilization of animal

source foods (ASF) in the diets of young children in rural Ghana. The project combined microcredit loans for mothers of children between two and five years of age with nutrition education and training in business development to enhance both their economic status and their knowledge about the nutritional needs of their children. Throughout the five years of development and implementation of the ENAM project, there has been a strong commitment to involve key stakeholders from government, non-government organizations (NGO), private sector, and communities. Initial project activities included a stakeholders' workshop in 2003 to identify the availability, accessibility, and utilization barriers and to develop a problem model that would guide an intervention to improve child nutrition. Throughout the project, different stakeholders have played key roles, including participating in training, designing curricula, and data analysis of project outcomes. A final stakeholders' meeting was held August 13-14, 2008 in Accra, Ghana with the following objectives:

- Present project results for all partners to discuss and provide confirmation of their interpretation;
- Give voice to community participants and rural bank staff so that their experience could be understood by other partners;
- Launch nutrition and entrepreneurial education materials that were developed for rural communities;
- Advocate for the promotion young child nutrition among health and non-health government ministries; and
- Plan activities related to scaling up and sustainability of project activities.

### PRESENTATIONS/PROCEEDINGS

Colecraft E.K., G.A. Adjei, A.A. Lartey, and G.S. Marquis. 2007. "Contribution of animal source foods to total iron intake of children in coastal Ghana." *FASEB Journal* 21: 672.6.

Colecraft E.K., G.S. Marquis, O. Sakyi-Dawson, A. Lartey, B. Ahunu, L.M. Butler, H.H.

Jensen, M.B. Reddy, E. Lonergan, and E. Canacoo. 2008. "Purchased ready-to-eat foods are positively associated with children's animal source food intakes in rural Ghana." *FASEB Journal* 22: 873.5.

Colecraft, E., G.S. Marquis, A. Lartey, B. Ahunu, O. Sakyi-Dawson, L.M. Butler, M. Reddy, H. Jensen, and E. Lonergan. 2008. "The magnitude and pattern of caregivers' purchase of ready to eat foods for young children in three ecological zones of Ghana." October, Cairo, Egypt: African Nutrition Epidemiology Conference.

Colecraft, E., G.S. Marquis, O. Sakyi-Dawson, A. Lartey, B. Ahunu, L.M. Butler, M. Reddy, H. Jensen, and E. Lonergan. 2008. "A food-based intervention to improve animal source food intakes among rural Ghanaian children: Lessons from the ENAM project." October, Cairo, Egypt: African Nutrition Epidemiology Conference.

Harding, K., G.S. Marquis, E.K. Colecraft, A. Lartey and O. Sakyi-Dawson. 2008. "A comparison of child nutritional status in two agro-ecological zones of Ghana: Is location an important determinant?" *FASEB Journal* 22: 873.11.

Kobati, G.Y., A. Lartey, E. Colecraft, and G.S. Marquis. 2008. "A comparison of the dietary intakes and nutritional status of mothers of 2 -5 year old children in the coastal and northern zones of Ghana." October, Cairo, Egypt: African Nutrition Epidemiology Conference.

Marquis G.S., Colecraft E.K., O. Sakyi-Dawson, A. Lartey, B. Ahunu, L.M. Butler, H.H. Jensen, M.B. Reddy, E. Lonergan, E. Canacoo, and R. Aryeetey. 2008. "Animal source food intake is lower in households with children who experience food insecurity." *FASEB Journal* 22: 680.4.

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Cairo, Egypt: African Nutrition Epidemiology Conference.

Sakyi-Dawson, O., G.S. Marquis, A. Lartey, E. Colecraft, B. Ahunu, M.L. Butler, M. Reddy, H. Jensen, E. Lonergan, and W. Quarmime. 2008. "Impact of ENAM interventions on caregivers' nutrition and health knowledge and ASF intake in young children in Ghana." October, Cairo, Egypt: African Nutrition Epidemiology Conference.

#### TEAM MEMBERS

Ben Ahunu, University of Ghana  
Lorna Butler, Iowa State University  
Emmanuel Canacoo, University of Ghana  
Esi Colecraft, Iowa State University/University of Ghana  
Helen Jensen, Iowa State University  
Anna Lartey, University of Ghana  
Elisabeth Longergan, Iowa State University  
Grace Marquis, McGill University/Iowa State University (*Lead Principal Investigator*)  
Manju Reddy, Iowa State University  
Owuraki Sakyi-Dawson, University of Ghana

#### COLLABORATING INSTITUTIONS

**Iowa State University, Department of Nutrition**  
(*lead institution*)  
Akyimpem Rural Bank, Ghana  
Fiagya Rural Bank, Ghana  
Freedom from Hunger, Ghana  
Ghana Health Services  
Ghana Ministry of Food and Agriculture/Women in Agricultural Development (WIAD)  
Heifer International, Ghana  
Makerere University, Ghana  
McGill University, Montreal, Canada  
Naara Rural Bank, Ghana  
University of Ghana, Legon, Ghana

**INCREASING ANIMAL SOURCE FOODS IN DIETS OF HIV-INFECTED KENYAN  
WOMEN AND THEIR CHILDREN (HIV NUTRITION PROJECT)  
(HNP)**

**PROJECT DESCRIPTION**

*The GL-CRSP HIV Nutrition Project (HNP) is researching the effect of protein quality and micronutrients in meat on the health and nutritional well-being of women living with HIV and the growth, health and cognitive development of their vulnerable children in the Turbo Division of Uasin Gishu District in Kenya. By means of a randomized nutrition feeding intervention, powdered dried beef will be added as an ingredient to a standard biscuit recipe to enhance the protein quality and trace element bio-availability of diets. Outcomes will be compared with those of like subjects who receive supplements with the same amount of energy, but with either soya or wheat protein. The study will show if meat in the diets of HIV-infected women and their children (1) protects the immune system and prevents severe infection, (2) prevents the loss of lean body mass, enhancing the quality of life and enabling women to carry out their activities of daily living, and/or (3) supports the growth and development of their vulnerable children. The intervention food with beef protein provides significantly more vitamin B12, lysine and bio-available iron, zinc and selenium when compared to the soya and wheat supplements. Deficiencies of these nutrients may hasten HIV disease progression.*

**PRINCIPAL INVESTIGATORS**

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*\*The HIV Nutrition Project experienced significant delays due to the post-election violence that challenged Kenya from late December of 2007 through March of 2008. The HNP study area, Turbo, was one of the most affected areas and therefore field activities were stopped for six months. The core team used this time to practice data collection techniques to maintain their skills.*

## SUMMARY OF ACHIEVEMENTS

- HNP team members obtained results from the Food Security Assessment in Phase I. Results indicate that of the 31 female participants approximately 50% of the households have no source of income and rely on self-sustenance or good will for food. Therefore, the majority of participating households could not afford at least three meals in a day. Over 75% of participants reported no intakes of egg, meat or fish within the past 24 hours.

- Researchers also completed the implementation of Phase II of the project, a pilot and assessment of methods with 15 women and their children. After the pilot study, the women commented that the biscuits made them feel better. Researchers also determined that non-nutrition biscuits needed to be provided to other members of the participants' households as an incentive for participation. Additionally, two bed nets per family were distributed to all participants to reduce incidence of HIV infection as a result of mosquito bites.

- According to a United Nations AIDS report, the majority of the adults living with Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome today are women. Furthermore, the number of women and girls infected with HIV has increased in every region of the world and is on the rise. This is most evident in sub-Saharan Africa, where close to 60% of adults living with HIV and AIDS are women. HIV Nutrition Project research focuses entirely on HIV-infected women of reproductive age in Kenya and their children. In the third and final phase of the study, team members have recruited 44 women and 24 girls, in addition to the 30 women in Phase I and 18 women and 11 girls recruited in Phase II.



*The biscuit production team uses locally available ingredients in the production of the iso-caloric nutrition intervention biscuit which differ in protein quality (meat, soy, wheat). Photo by Joseph Kinuthia*

- A main project base was established in a residential area in Eldoret, near the Moi University medical campus, that houses the project office, the food production kitchen, and a suite for visiting faculty and students. A quantity food production oven, food grinder and food mixer were also purchased for the food production kitchen.

- HNP collaborates locally with Moi University and the Academic Model for Providing Access to Healthcare (AMPATH). All staff are required to undergo various trainings to prepare them for data collection. Thirty field staff participated in a one-day training that included various pertinent aspects of HIV and research methodology, including the medical and nutritional management of persons with HIV and the need for confidentiality when conducting research. Furthermore, specific trainings in data collection techniques for anthropometry, nutrient intake, socioeconomic status, food security, morbidity time allocation, quality of life and cognitive development assessments have been administered to the field staff involved in data collection.

- The HNP leveraged a total of \$56,000 in fiscal year 2008.

**PUBLICATIONS**

Inui, T.S., W.M. Nyandiko, S.N. Kimaiyo, R.M. Frankel, T. Muriuki, J.J. Mamlin, R.M. Einterz, and J.E. Sidle. 2007. "AMPATH: Living proof that no one has to die from HIV." *Journal of General Internal Medicine* 22(12): 1745-1750.

Vreeman, R.C., S.E. Wiehe, E.C. Pearce, and W.M. Nyandiko. 2008. "A systematic review of pediatric adherence to antiretroviral therapy in low- and middle-income countries." *Pediatric Infectious Disease Journal* 27(8): 686-691.

Vreeman, R.C., S.E. Wiehe, S.O. Ayaya, B.S. Musick, and W.M. Nyandiko. "Association of antiretroviral and clinic adherence with orphan status among HIV-infected children in western Kenya." *Journal of Acquired Immune Deficiency Syndrome* 49(2): 163-170.

**PRESENTATIONS**

Ernst, J. and HNP Team Members. 2008. "Outcomes of HIV-Exposed Children in the USAID-AMPATH Partnership in Western Kenya:

Efficacy of a Total Prevention of Mother to Child Transmission of HIV (total-pMTCT) Approach." Presentation at the International AIDS Society Conference, August 2-9, Mexico City, Mexico.

Ernst, J. and HNP Team Members. 2008. "Updates of First line ART in Kenya." Presentation at the Annual Kenya Pediatric Association Scientific Conference, August 13-19, Nyali Beach Hotel, Mombasa, Kenya.

**FORTHCOMING PUBLICATIONS**

Wools-Kaloustain, K., S. Kimaiyo, L. Diero, A. Siika, J. Sidle, C. Yiannoustous, B. Musick, R. Einterz, K.K. Fife, and W.M. Tierney. "The clinical and immunologic outcomes of an antiretroviral treatment program in western Kenya." *Journal of Acquired Immune Deficiency Syndrome*.

HNP Non-Degree Training for 2007-2008			
Country	Male	Female	Total
Kenya	8	21	29
Total	8	21	29



*Arm muscle area is determined from measures of mid upper arm circumference and triceps skinfold and assessed as an estimate of lean body mass. Photo by Vickey Koske.*

**TEAM MEMBERS**

Zachayo Akula, HNP  
Rose Ayikukwei, AMPATH, Moi University  
David Ayuku, Moi University  
Linda Bahrami, University of California, Los Angeles  
Jacob Boen, HNP  
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**COLLABORATING INSTITUTIONS**

**Indiana University, School of Health and Rehabilitation Sciences (*lead institution*)**  
Heifer International, Kenya  
Moi University, Kenya  
Population Services International, Kenya  
University of California, Los Angeles

# **NATURAL RESOURCE MANAGEMENT**

**SUSTAINABLE MANAGEMENT OF RURAL WATERSHEDS: BIOPHYSICAL, LIVESTOCK  
AND HUMAN INTERACTIONS IN THE RIVER NJORO WATERSHED (SUMAWA)**

**GRAZING LANDS AND GREENHOUSE GASES (3G)**



**SUSTAINABLE MANAGEMENT OF RURAL WATERSHEDS:  
BIOPHYSICAL, LIVESTOCK, AND HUMAN INTERACTIONS  
IN THE RIVER NJORO WATERSHED  
(SUMAWA)**

**PROJECT DESCRIPTION**

*The GL-CRSP Sustainable Management of Rural Watersheds (SUMAWA) project is a multidisciplinary research effort focusing on biophysical, livestock and human-related factors governing watershed processes for the purpose of improving long-term sustainability of rural watersheds and threatened or endangered ecosystems in Kenya and East Africa. Through biophysical and human-oriented research, the SUMAWA team is creating a comprehensive watershed model that may be translated and transferred to stakeholders and policy makers who are the primary determinants of watershed and human health in the Njoro watershed of Kenya. On-going and completed activities such as workshops, participatory rural appraisal, school outreach, and watershed interventions continue to enhance project visibility and effectiveness. The SUMAWA project has two sub-projects, **Development and Marketing of Point-of-Use Household Filters for Drinking Water Improvement (POU-WID)** and **Water and Sanitation-Related Conditions and Disease Burdens in the River Njoro Watershed (Njoro Water)**.*

**PRINCIPAL INVESTIGATORS**

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Marion Jenkins (Lead Principal Investigator for POU-WID and Njoro Water components), Ph.D., Research Engineer, Department of Civil and Environmental Engineering, University of California, Davis, 3138 Engr III, Davis, CA 95616, Phone: (530) 754-6427, Email: [mwjenkins@ucdavis.edu](mailto:mwjenkins@ucdavis.edu).

### SUMAWA OF ACHIEVEMENTS

- SUMAWA staff and community members completed a three-dimensional mapping exercise of the watershed whereby residents mapped their resources and generated ideas for possible interventions for either maintaining or improving those resources.
- To reverse the adverse trend of reduced vegetation cover and deforestation, the Njoro River Water Resources Users Association (NRWRUA) and SUMAWA have established six tree nurseries with the potential to produce over 100,000 seedlings per season. SUMAWA has also initiated a school greening program in eight schools within the watershed. Altogether the schools have planted 10,000 trees in their compounds and are establishing tree nurseries for production of seedlings for further planting and for pupils to plant at their homes in collaboration with their parents.
- When livestock drink in the river, they directly contaminate a community water source with their feces and urine. SUMAWA research has documented fecal coliform levels in the River Njoro to be well above the World Health Organization's recommended threshold. As a medium-term solution to protect communities in the watershed from such contamination, SUMAWA assisted with the construction of two livestock water troughs, thus removing the animals from direct contact with the river and improving water quality for local communities.
- SUMAWA research has found aquaculture to be feasible within the River Njoro watershed. Tilapia and catfish were successfully raised in demonstration ponds of 20 by 20 meters, and the tilapia was found to be more adaptable to the prevailing regional weather. Based on these results, the Ministry of Fisheries in Kenya has assisted farmers in the establishment of 112 fishponds in Nakuru and Molo districts. It is estimated that a single 20 by 20 meter pond is capable of generating income equal to 17 acres of maize, approximately \$1,600 USD.
- SUMAWA team members have continued collecting and storing rainfall and runoff data from monitoring equipment for models, reports and public use. From this information, a preliminary decision support system has been in development that incorporates land cover change scenarios with runoff, economic and erosion models. The SUMAWA decision support system has been showcased in various government and non-government venues, and suggestions from these presentations are being used to further guide development of the system.



*Two members of Nesuit nursery fill bags with soil for transplanting. The project has established six tree nurseries in the watershed. Photo by Patterson Semenyi.*

- SUMAWA team members have been actively seeking and identifying species of flora

and fauna in the River Njoro watershed. For example, 67 samples of benthic macro-invertebrates (bottom-dwelling animals without backbones visible to the naked eye) have been positively identified to the family level, and as part of participatory efforts, 94 medicinal plants have been identified and mapped in the upper watershed, including trees and a range of vegetation facing extinction due to neglect of environmental conservation and indiscriminate clearing for cultivation and timber trade. To further characterize and document biodiversity in the watershed, assessment of River Njoro riparian vegetation composition, percent vegetation cover at livestock watering points, grazed and non-grazed sites, and sediment sampling of tributaries have been conducted.

- Since other strategies to reduce poverty in the River Njoro watershed through traditional small-scale maize and bean production have not succeeded, SUMAWA has assisted with the establishment of alternative enterprises for livelihood improvement within the watershed that are more suited to the regional constraints. Mid-watershed, population density is high and people have limited access to land. Here, SUMAWA has supported the Njoro River Water Resource Users Associations with mushroom and Artemisia production. Conversely, in the upper watershed, population density is low, and land is not a major constraint. SUMAWA has helped to develop a demonstration orchard for plums, pears, apples, guava and ribena to encourage household and commercial production.

#### NJORO WATER COMPONENT:

- An emerging new real-time gene-based microbial source tracking (MST) method has been validated for use in Kenya for the first time. Results show that three out of five existing quantitative PCR assays for the detection of host-specific fecal Bacteroidales 16S rRNA markers in water, developed in the United States and Europe, have high potential for application in Kenya to detect and distinguish human and cow

sources of environmental fecal pollution in water bodies, water supplies and other environmental water samples. One universal, one cow and one human assay demonstrated 100% specificity, and 100%, 94% and 65% sensitivity, respectively, in the Kenyan validation study. These results point to a new tool for assessing water pollution and water supply risks, and improving environmental management decision-making in Kenya and other developing countries.

- Water quantity has been adversely affected due to poor recharge as a consequence of diminishing forest and vegetation cover. The River Njoro is no longer a perennial river, and many boreholes have dried up. A comparison by the Njoro Water component of the hydrologic water balance and lake water level fluctuation behavior of Lake Nakuru in the River Njoro watershed over two historical periods, 1958-76 and 1994-1999, shows the lake's hydrologic balance has changed substantially since the 1970's, with the proportion of water entering the lake rapidly as surface water rather than perennially as groundwater having increased, causing lake level and salinity to fluctuate more rapidly and eroding the sustainability of lake levels.
- Finalized results from twelve months of fecal pollution monitoring along the length of the River Njoro shows this river to be fecally-contaminated at extremely elevated levels at numerous locations and for extended periods of the year, exceeding 100,000 colony forming units (CFUs) of fecal coliform per 100 ml. Average fecal coliform levels detected in river water from top to bottom and across all seasons was 8,000 CFU/100 ml, exceeding the US EPA threshold for use as a water supply source and for human contact. This level also exceeds recommendations for livestock water supplies. As a result, team members have posted billboards advising residents not to use the water before treatment with chlorine or boiling.
- Application of gene-based microbial source tracking in the Njoro watershed confirmed that

smallholder cows in the Njoro watershed are responsible for the vast majority of gross fecal contamination of river water in this watershed. Cow fecal markers were detected 78% of the time in river water samples taken from along the full length of the river, compared to 22% for human fecal markers, which were limited to particular middle and lower reaches where sewerage and septic tank discharge points are located. These results are especially important for poorer smallholder agricultural households who depend heavily on river water as their only source for human and animal water supplies, a situation typical of much of rural Kenya.

**POU-WID COMPONENT:**

- POU-WID has been instrumental in the implementation of the BioSand Filter (BSF), an intermittently operated slow-sand household filter for treating contaminated water in the home, developed and tested at the University of California, Davis and Egerton University in Kenya. After household trials and further research, 47 households in the Njoro watershed are now continually using the BSF for their water purification needs. POU-WID team members have also held a meeting with the Government of Kenya Ministry of Public Health on officially introducing the BSF as a household water treatment technology in Kenya.
- POU-WID team members have held community mobilization meetings to disseminate research findings from the BioSand Filter (BSF) trials and develop plans for local production and promotion of the BSF across communities of the Njoro Watershed. The Nessuit community dissemination meeting, for example, accommodated 22 participants (13 female and nine male), and the Njoro community dissemination meeting accommodated 26 (five female and 21 male). Furthermore, the water resource users association (WRUA) chapters in Nessuit, Njoro, and Baruti with estimated active membership at 25, 40, and 15, respectively, have collaborated with the POU-WID project

to identify locally sourced materials for BSF construction.

- Water treatment in the River Njoro watershed in Kenya is generally a female gender-specific role. POU-WID has therefore targeted mothers and women in the project's outreach and research endeavors. After a period of household trial use of the BioSand Filter (BSF) water treatment method, researchers reported over 95% acceptability of the BSF by mothers in high-risk, vulnerable households in the River Njoro watershed. Forty-seven households continue to use the BSF.
- High-risk, vulnerable rural and peri-urban households using unimproved water sources in Kenya make up of 54% of the country's rural population and the majority of that of the Njoro watershed. In a six-month trial, 30 households using the BioSand Filter (BSF), a water treatment technology introduced by the POU-WID component, have achieved a 54% reduction in childhood diarrhea disease and a 95% reduction in the bacterial contamination of source water in their homes.
- POU-WID has supported the establishment of a local small-scale BioSand Filter (BSF) production enterprise, "Maji Salama," now in operation based in Njoro Town, Molo District, Kenya. The business involves two entrepreneurs at the small factory located in Njoro Town and up to five active community-based BSF technician installers located across five communities in the Njoro watershed as part of the operating network. BSF construction materials are all procured locally in Nakuru, and skilled labor for construction is provided by the entrepreneur. The BSFs retail at the factory for Ksh 1500 (\$20) as of September 2008, and require an additional \$2 installation fee for the local community installer.
- The SUMAWA project leveraged a total of \$60,412 in fiscal year 2008. \$31,595 of that total was from USAID buy-ins. The Njoro Water

component leveraged a total of \$3,750 in fiscal year 2008. The POU-WID component leveraged a total of \$15,750 in fiscal year 2008 in addition to their USAID buy-in funding from WID of \$16,882.

of the River Njoro watershed that can maintain a targeted water quality and thus, ensure sustainability of the water resources.

#### RESEARCH BRIEFS

### The Potential of Using a Biological Monitoring Assessment Tool for Evaluation of Water Quality in the River Njoro Watershed, Kenya

*Authors: W.A. Shivoga, C. K. Kigen, Egerton University*

*Summary.* As land use changes from forest and wildlands to human settlements and agriculture in a watershed, it is accompanied by a decrease in water quality. Researchers report preliminary findings from the relationship between developed BioMAT water quality indices and different land use areas upstream of the sampling points. The BioMAT water quality indices decreased with decline in natural wildlands and with an increase in human activities. The Shannon Wiener Index increased downstream with low values where BioMAT water quality is also low. The cattle watering and sewage entry points had relatively low water quality. The indigenous forest and mixed agriculture dominated land use followed by grassland and then by bare land. The BioMAT water quality model obtained using Sigma Stat 2.03 statistical software,  $\text{BioMAT WQI} = 47.430 - (1.339 * \text{Agriculture}) - (0.867 * \text{Mixed Agriculture}) + (8.323 * \text{Bare Land}) - (6.745 * \text{Plantation Forest}) + (0.0171 * \text{Indigenous Forest})$  was a perfect fit at ( $p < 0.05$ ). It shows that bare land and plantation forest have high but contrasting influence on BioMAT water quality index. The relationship exhibited by BioMAT water quality index and areas of land use categories can be used in policy recommendations and guidelines to determine a development capacity

### Medicinal Plants of the Ogiek Community in the Upper Watershed of the River Njoro

*Author: Eunice W. Ngari, Egerton University*

*Summary.* The research on gender knowledge of medicinal plants among the Ogiek community of River Njoro watershed showed that both men and women of various ages know and use medicinal plants found within the watershed. A total of 94 plants were found to be used by the community to treat various diseases. The plants included trees, shrubs, herbs and grasses, found along riverbanks, in open uncultivated fields and in the forest. Men know more plants than women, but the responsibility of collecting, preparing and administering the drugs is mainly a female affair. The older men and women know more plants than the younger people. Medicinal plants are threatened to extinction mainly due to habitat destruction for cultivation and indiscriminate vegetation clearing for charcoal burning. Participatory three-dimensional mapping showed that women are able to locate plants mainly found along the river and in open fields as opposed to men who located plants deep in the forest. This is



*Gender separation is typical in all Ogiek Community activities. Photo by Patterson Semenyé.*

due to gendered responsibilities in the community. Men and women showed interest in being involved in conservation interventions, such as establishing tree nurseries and botanical gardens, and are willing to contribute labor and other materials needed for the interventions.

### **Modeling Tool to Assess the Economic Consequences of Changing Farming Systems for Resource-Poor Small Farmers in the Upper Njoro River Watershed, Kenya**

*Authors: Timothy Krupnik, University of California, Santa Cruz; Marion W. Jenkins, University of California, Davis; and Sian Mooney, Boise State University*

*Summary.* A modeling tool applying net present value economic analysis was developed to estimate long-term economic returns to labor and land for smallholder cropping systems in the upper River Njoro watershed. Production expenditures and income over a 15-year time horizon for a typical farm household cultivating 2.5 hectares of maize-bean intercrop, pyrethrum, and potato mix were characterized based on field work. Results (2003 values) indicate annual net present value returns to land under the current system average Ksh 3,488/acre (\$46/acre), and net farm income to the household averages Ksh 25,646 (\$342) per year. Net returns are particularly sensitive to maize yield and price, cost of seeds, and the discount rate. This tool can be adapted to evaluate the economic consequences to farmers of adopting alternative agronomic practices and cropping systems. Estimated changes in farm income can be quantified and used to assess whether economic incentives are necessary as part of efforts to investigate improved environmental land management and development programs in the Njoro watershed. Farmer field trials, research experiments, and pricing information provide the agronomic and economic data to characterize proposed new practices such as agroforestry, riparian tree planting, set-aside, and soil conservation in the model.

### **Livestock Production and Environment Interactions: Systems Characterization and Policy Issues in River Njoro Watershed, Kenya**

*Authors: Daniel Kyalo and Muhia Njeri, Egerton University*

*Summary.* Livestock production is an important contributor to rural development. Developing countries in the last two decades have witnessed changes in their market structure, climate, and demographic characteristics, resulting in rapid growth in the demand for livestock products and the increasing dependence on livestock for sustainable livelihood systems. In response to these changes, there have been rapid land use and land cover changes characterized by expansion of agricultural systems and decline in farm sizes. This has caused environmental degradation in several rural areas, including the River Njoro watershed. There is thus a need for policy intervention to encourage the adoption of sustainable livestock production systems. In the midst of the dilemma, the study outlined in this research brief identified and characterized livestock farmers in the Njoro River watershed to determine the factors that influence the livestock production systems. Researchers used cluster analysis in the study to characterize and classify livestock farmers in the River Njoro watershed based on herd structure, livestock management practices, risk behavior and household socioeconomic characteristics. The study identified three types of systems: a) intensive highly diversified and commercial systems, b) semi – intensive subsistence systems, and c) extensive semi – commercial systems. Based on these categories, results show that most farmers fall into category C, and policies should target improving their access to credit and extension services. Farmers in cluster A, on the other hand, are more market oriented. Therefore, they need policies on improving physical and financial infrastructure to enable them to gainfully participate in the market at a larger scale. Most generally, however, policy recommendations should enable farmers to continue benefiting from livestock production and, simultaneously, to manage natural resources in a sustainable way.

## Livestock Production Systems Response to Climate and Market Changes and Trends in the River Njoro Watershed, Kenya

*Authors: Daniel Kyalo and Mubia Njeri, Egerton University*

*Summary.* As markets change, farmers tend to respond to these changes through different adaptive capacities. Adaptive capacity is defined as the ability of farmers to cope with the effects of climate variability and change. Capacity varies among individuals, communities, socioeconomic groups and regions. The small-scale farmers who have low adaptive capacities tend to be vulnerable to changes in climate. Farmers also respond to changes in market demand and structure. Farmers who are endowed with more livelihood assets: financial, natural, social and physical are, on the other hand,

capable of responding to and benefiting from market opportunities. The degree to which the communities adapt to changes depends on the level of technology and the level of livestock and crop production. SUMAWA research findings indicate that there has been a movement from extensive systems into semi-intensive and intensive systems. Farmers are responding to climate variability and market changes through adjusting their systems. It was also noted that there is a general trend of declining herd sizes, and expansion of monogastric livestock, especially broilers. Therefore monitoring the various types and degrees of change will enable policy makers and development agencies to link the state of technologies to the vulnerability context of households. One of the ways to monitor the response of livestock farmers to changes in the environment is to observe the changes in their livestock management practices and the livestock production systems.

Degree Training for 2007-2008					
Name (Last, First)	Nationality	Gender (M/F)	University	Discipline	Degree
<b>SUMAWA</b>					
Baker (formerly Baldyga), Tracy	USA	F	University of Wyoming	Rangeland Ecology & Watershed Management	PhD
Chitty, Carrie	USA	F	University of Wyoming	Rangeland Ecology & Watershed Management	MS
Huckett, Stephen	USA	M	Utah State University	Forest, Range, and Wildlife Sciences	PhD
Jepyegeon, Emily	Kenyan	F	Moi University	Ecology	MS
Kigen, Charles	Kenyan	M	Egerton University	Ecology	MS
Kyalo, Daniel	Kenyan	M	Egerton University	Socio-Economics	MS
Ngari, Eunice	Kenyan	F	Egerton University	Gender	MS
Ngugi, Macharia	Kenyan	M	Egerton University	Hydrology	MS
<b>POU-WID</b>					
Langenbach, Killian	German	M	Center for Environmental Research, Leipzig	Environmental Engineering	PhD
Nyakach, Dennis	Kenyan	M	Egerton University	Civil & Environmental Engineering	BS
Tiwari, Sangam	Indian	F	UC Davis	Environmental Engineering	PhD
Wolking, David	USA	M	UC Davis	International Agricultural Development	MS
<b>NJORO WATER</b>					
Keightley, Keir	USA	M	UC Davis	Geography/GIS	PhD

### **Uncertainty in Multiple Objective Spatially Explicit Decision Support**

*Authors: Tracy (Baldyga) Baker, International Water Management Institute (IWMI)*

*Summary.* Underlying all decision support systems are criteria scoring and decision rules. A multiobjective decision support tool known as the Spatial Environment and Agricultural Decision Support (SEADS) tool was developed by SUMAWA scientists to create a tool that can be used by land managers and scientists in the identification of appropriate and desirable decisions for landscape management in settings where a variety of complementary and competing interests exist. The SEADS toolkit passes observational and model data through mathematical equations termed “scoring functions” that establish a score for various potential land use options; these scores can be used to support decisions made on the ground. As part of the Spatial Environment and Agricultural Decision Support tool development, an uncertainty analysis was carried out to determine the degree to which the scoring functions affect the final score in order to ensure that model outcomes are not improperly influenced by these functions. Seven methods were used to parameterize the three following scoring functions that are part of SEADS:

- 1) more is better, where higher values lead to higher scores such as groundwater recharge;
- 2) more is worse, where higher values lead to lower scores such as erosion rates; and
- 3) desirable range where the highest scores fall somewhere in the middle such as with annual water yield.

Results presented show that when using simulated data to parameterize scoring functions, it is critical to understand the probability distribution of model outputs. In this way, the Spatial Environment and Agricultural Decision Support tool presents an environment for analyzing trade-offs between land use alternatives, potential impacts on the natural environment, and differing land management preferences among decision makers.

### **Disaggregating Human Population for Improved Land Use Management**

*Author: Tracy (Baldyga) Baker, International Water Management Institute (IWMI)*

*Summary.* Understanding the spatial distribution of a population across a landscape is important in land use planning. In developing nations, where resources are limited, such information can facilitate more efficient decision-making and resource allocations. This brief examines three methods for better understanding the distribution of human population within a natural boundary based on available census data: simple areal weighting, binary dasymetric mapping, and global regression. The study area is a rapidly changing watershed located in Kenya’s Rift Valley. Variation in population estimates (ranging from 59,000 to over 150,000) resulting from different interpolation techniques underscores the importance of developing additional methods for spatially distributing population for improved land management and that census data alone are not sufficient to accomplish this task.

### **Hydrologic Modeling of the Downstream Impacts of Forest to Agriculture Conversion in the Mau Forest**

*Author: Scott Miller, University of Wyoming*

*Summary.* A significant portion of the forest within the upper River Njoro drainage basin was converted to agriculture between 1995 and 2003. This portion of the watershed lies within the Mau Forest, a significant water tower in Kenya that supplies both surface runoff and groundwater recharge within the Rift Valley. The Njoro River is a key contributor to Lake Nakuru National Park, which provides a host of ecological and economic services to the region. Previous research in the upper portion of the basin has identified deforestation as significantly altering the hydrologic regime of the River but was limited to a local analysis where relatively rich data were available. In this research project, a hydrologic model was used to identify how the changes in the upper part of the watershed would be manifest in

changes to the amount, timing, and apportionment of water both in terms of the riverine discharge and to groundwater recharge. We found that the overall amount of water delivered to the river terminus (Lake Nakuru) was relatively unchanged, but that the ratio of surface flow to groundwater recharge was significantly changed, that the timing of flow was altered, and that the number of low flow days increased. These findings have implications for both human and ecological stability and can provide guidance to planners tasked with watershed management and community development.

### The Potential for Culture of Nile Tilapia and African Catfish in the River Njoro Watershed

*Author: David Liti, Moi University*

*Summary.* A study was conducted to assess the potential for culture of two species, Nile tilapia (*Oreochromis niloticus*, Linnaeus) and African catfish (*Clarias gariepinus*, Burchell) at the high altitudes of Njoro river watershed. Growth performance of *O. niloticus* and *C. gariepinus* were evaluated for 180 days in ponds fertilized with organic manure and stocked at a rate of two fish m<sup>-2</sup> for tilapia, and 0.5 fish m<sup>-2</sup> for catfish. Breeding capacity was evaluated by injecting the females of *C. gariepinus* with a pituitary extract in physiological saline solution. Eggs were manually stripped from the females and fertilized with milt from the gonads of a sacrificed male catfish. Results from this study demonstrated remarkable growth in *O. niloticus* but poor growth and condition in *C. gariepinus*. After several attempts, the fertilized eggs from *C. gariepinus* failed to hatch, most probably due to low temperatures and the poor water quality of Njoro river. These results demonstrated the feasibility of *O. niloticus* culture at high altitudes of the Njoro river watershed. However, the culture of *C. gariepinus* was limited by poor growth performance and seed availability. In the mean time, the farming of Nile tilapia is therefore recommended. This research has identified some barriers and opportunities to fish farming in this region and provides a baseline for further inquiry into mechanisms for generating a sustainable aquaculture program.

### NJORO WATER COMPONENT:

#### Sustaining Lake Levels in Lake Nakuru National Park, Kenya: Development of a Water Balance Model for Water and Environmental Resource Management Decision Making

*Authors: Marion W. Jenkins, Stephen McCord, University of California, Davis; and Joseph Edebe, Kenya Wildlife Service*

*Summary.* Fluctuations in Lake Nakuru's water level, particularly since the mid 1980's, have been a source of concern for the sustainability of the Lake's unique ecosystem. To improve collective understanding of lake level fluctuation and drying, and explore impacts of regional population growth, increasing water extraction, and land use changes, a preliminary water balance model of the lake was developed and initial analyses undertaken. Direct rainfall is the largest inflow to the lake, followed by surface discharges and groundwater seepage. The lake's hydrologic balance appears to have changed substantially since the 1970's, with the proportion of water entering the lake rapidly as surface water rather than perennially as groundwater having increased, causing lake level and salinity to fluctuate more rapidly. This change is linked to an apparent increase since the 1970's in surface water runoff at the expense of groundwater recharge in the lake's River Njoro and other upstream watersheds. A declining groundwater table has the

Non-Degree Training for 2007-2008			
Country	Male	Female	Total
<b>SUMAWA</b>			
United States	2	1	3
Kenya	49	19	68
<b>Total</b>	<b>51</b>	<b>20</b>	<b>71</b>
<b>POU-WID</b>			
United States	0	1	1
India	0	2	2
Kenya	53	56	109
United Kingdom	0	1	1
<b>Total</b>	<b>53</b>	<b>60</b>	<b>113</b>

greatest negative impact on the sustainability of lake levels. Efforts to improve hydro-meteorological monitoring and data management for the greater Lake Nakuru area are called for with a priority on groundwater monitoring. These activities should be institutionalized as essential governance rather than undertaken piecemeal by short-lived projects.

#### POU-WID COMPONENT:

#### Development and Trial of the BioSand Filter to Improve Drinking Water Quality in High Risk Communities in the Njoro Watershed, Kenya

*Authors: M.W. Jenkins, S.K. Tiwari, University of California, Davis; D. Nyakach, W. Saenyi, Egerton University; K. Langenbach, Center for Environmental Research, Germany; and J. Darby, University of California, Davis*

*Summary.* Poor drinking water quality is a major community priority and public health concern in the Njoro Watershed. Low cost household point-of-use water treatment systems were identified as a promising intervention to address this problem, and the BioSand filter (BSF) was selected as the most sustainable and appropriate technology for high-risk households in the Njoro watershed. This brief reports the results of a three phase research program to develop and adapt the BioSand filter for local production and use, and test its effectiveness, acceptability, and health impacts among the target population segment in the Njoro watershed that uses river water for household domestic uses and drinking. Experimental results show that sand grain size, residence time, and hydraulic loading rate have significant effects on the microbiological removal performance of the BSF, and these parameters and operating guidelines can adapt to match local water source usage to maximize performance prior to local commercialization. In a six-month in-home trial of the locally adapted filter design with mothers in 30 rural and peri-urban households in the Njoro watershed, the filters matched controlled laboratory performance and demonstrated a very high level of user acceptability, satisfaction, and evidence of commercial demand.

#### PUBLICATIONS

Baldyga, T.J., S.N. Miller, C.M. Gichaba, and A.W. Shivoga. 2007. "Suitability of the Automated Geospatial Watershed Assessment (AGWA) tool in assessing hydrologic response and land cover change in River Njoro watershed, Kenya." *Egerton Journal of Science and Technology* 7:56-71.

Baldyga, T.J., S.N. Miller, K.L. Driese, and C. Maina-Gichaba. 2008. "Assessing land cover change in Kenya's Mau Forest region using remotely sensed data." *African Journal of Ecology* 46(1): 46-54.

Bett, E.K., J.K. Lagat, B.K. Njehia, and D.E. Ouma. 2007. "Determinants of on-farm tree planting decisions by smallholders in River Njoro watershed, Kenya." *Egerton Journal of Science and Technology* 7:79-92.

Chiuri, W., and D.W. Kyalo. 2008. "New common ground in pastoral and settled agricultural communities in Kenya: The role of the institutions and the gender implications." *Special Issue of the European Journal of Development Research*.

Kibichi, S., W.A. Shivoga., M. Muchiri., E. Enanga., and S.N. Miller. 2008. "Seasonality in water quality and its influence on the abundance and distribution of phytoplankton and chironomid larvae in Lake Nakuru, Kenya." *Verhandlungen der Internationale Vereinigung für Limnologie* 30:333-338.

#### DISSERTATIONS

Baldyga, T.J. 2008. *Spatially Explicit Multiple Objective Decision Support for Rural Watersheds*. PhD diss., University of Wyoming.

Tiwari, S.K. 2008. *Development and Implementation of Household Level Intermittent Slow Sand Filters for Rural Areas to Mitigate Water-Related Diseases*. PhD diss., Department of Civil and Environmental Engineering, University of California, Davis.

**PRESENTATIONS/PROCEEDINGS**

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Jenkins, M. 2008. "Biosand filter health impacts among households using unimproved water supplies in the Njoro Watershed." Ministry of Health Seminar, Crop Management Research Training Project (CMRT), September 25, Egerton University, Njoro, Kenya.

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unimproved water sources: A randomized controlled trial in Kenya.” *American Journal of Tropical Medicine and Hygiene*.

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Moi University, Kenya  
Nakuru District Medical Office of Health, Kenya  
Njoro River Water Resource Users Associations (NJOWRUA), Kenya  
Rift Valley Water Resources Management Authority, Kenya  
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Kenya Wildlife Service  
Lake Nakuru National Park, Kenya  
Moi University, Kenya  
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**GRAZINGLANDS AND GREENHOUSE GASES  
(3G)**

**PROJECT DESCRIPTION**

*Resulting from research conducted by the completed GL-CRSP projects, Livestock Development and Rangeland Conservation Tools for Central Asia (LDRCT) and Co-Benefits of Grassland Regeneration of Abandoned Wheat Areas for Carbon Sequestration, the GL-CRSP Grazinglands and Greenhouse Gases (3G) project is producing a scientific volume for the Journal of Rangeland Ecology and Management that helps managers and development agents incorporate rangeland and pasture conservation and management projects as candidates for generation of carbon credits.*

**PRINCIPAL INVESTIGATOR**

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**PROJECT INTRODUCTION**

Rangelands are vast and have the potential to be net sources or sinks of greenhouse gases. There is a rapidly developing potential to combine poverty alleviation, rangeland management, and the removal, or sequestration, of atmospheric greenhouse gases. Voluntary carbon credit markets, such as the Chicago Climate Exchange, are developing rapidly and sidestepping the stiff Kyoto regulations in favor of more flexible and far reaching methods. However, there has been very little emphasis on the role of rangelands in the generation of credits.

The 3G project was initiated in 2007 to help managers and development agents incorporate rangeland conservation and management projects as candidates for the generation of credits. The primary goal of the project is to develop and publish a special feature volume of peer-reviewed, original articles that documents and quantifies the role of rangelands in global greenhouse gas emissions and sequestration. The publication will include contributions from an international group of rangeland ecologists, economists, and social scientists, providing a unified scientific basis for incorporating rangelands in the

voluntary carbon-credit markets, as well as guidelines for how such credits can be applied to rangeland conservation and poverty alleviation projects.

**BACKGROUND**

High concentrations of greenhouse gases (also known as GHGs, including carbon dioxide, methane, and nitrous oxide) have been identified as major causes of present-day global warming. Most of this increase is due to the significant increases in fossil fuel burning, deforestation, and other forms of land conversion since the Industrial Revolution. Over the past 100 years, global air temperatures have increased by an average of about 1.33 ° F. Under current patterns of human energy consumption and land-use practices, this trend is expected to continue and, if unchecked, is projected to ignite a cascade of costly global environmental changes including rising sea levels, an increase in extreme weather events, changes in agricultural yields, increased pace of desertification, increased geographic ranges of deadly diseases such as malaria, and species extinctions. The observation that current global warming is largely driven by

human energy consumption and land conversion has inspired new ideas for how the international community can mitigate this shared problem and avoid serious environmental catastrophes. For example, the Kyoto Protocol, an agreement made under the United Nations Framework Convention on Climate Change (UNFCCC), calls for all ratifying countries to reduce GHG emissions by 5.2% (based on 1990 baselines) by the year 2012, or engage in emissions trading.

The concept of tradable carbon credits, developed by the 2005 Kyoto Protocol, is a means to collectively monitor and reduce global GHG emissions. One carbon credit is the equivalent of one metric ton of CO<sup>2</sup> emissions. Thus, one carbon credit represents the legal right to emit one ton of CO<sup>2</sup> or GHG equivalent. Participating countries place a cap on the annual amount of CO<sup>2</sup> emissions allowable. Businesses and industries within each country are then allotted a finite number of credits. Groups that can reduce their emissions below their quotas can sell excess credits to groups whose emissions exceed their allowable credits. In addition, groups that can document further reductions in CO<sup>2</sup>, e.g. through good land-use practices that sequester soil C, can apply for additional carbon credits for trade in national and international markets.

Rangelands account for about 40% of the Earth's surface and, if managed properly, have the capacity to store large amounts of atmospheric carbon and thus generate carbon credits. However, this capacity depends on developing and implementing sound land management practices that facilitate carbon storage and eliminate management practices that release carbon (e.g. heaving grazing, burning). The ability to participate in the carbon credit market will also require the development of cost-effective methods of measuring and verifying carbon sequestration in rangeland soils. In order to be competitive in the carbon credit market, the cost of measuring and managing carbon flux on rangelands cannot exceed the market value of carbon credits. These are significant challenges given the extreme variability of rangeland soils. The 3G project was initiated to address these challenges and help facilitate an active

role for rangelands in global warming mitigation, the carbon credit exchange, and poverty alleviation.

### FEATURED ARTICLES

The 3G project has commissioned a total of 14 manuscripts, most of which are currently under their first or second round of peer-review at *Rangeland Ecology and Management* (see below). Publication of the special feature is expected in 2009.

#### *Accepted papers:*

1. "Land-use influences carbon fluxes in northern Kazakhstan." Jorge Perez Quezada et al.

#### *Papers in second round of peer review:*

2. "Managing carbon sources and sinks in Australia's rangelands and tropical savannas." Garry D. Cook, Richard J. Williams, Christopher Stokes, Lindsay B. Hutley, and Andrew J. Ash.
3. "Issues and importance of soil carbon sequestration in grazinglands: Societal benefits and policy implications." Ron F. Follett.

#### *Papers after first round of peer review:*

4. "Requirements for range and pasturelands to generate certifiable emission reductions." Kellee James and Mike Walsh.
5. "Costs and benefits of supplying carbon from rangeland and pasturelands: Insights from the West African Sahel." Leslie Lipper, Celine Dutilly Diane, and Nancy McCarthy.
6. "Improving estimates of rangeland carbon sequestration." Joel Brown, Jay Angerer, Shawn Salley, Robert Blaisdell, and Jerry Stuth.
7. "Quantities and kinds of greenhouse gases exchanged in range and pasturelands as a function of management." Robert M. Rees, Kairsty Topp, and Li Changsheng.
8. "Conceptual models for understanding grazing effects on carbon and nitrogen stocks and fluxes in rangelands." Gervasio Piñeiro, José Paruelo, Martín Oesterheld, and Esteban Jobbágy.
9. "Ecosystem-scale estimates of productivity, respiration, and light-response parameters of world grasslands derived from flux-tower measurements." Tagir Gilmanov.

10. "Diurnal and seasonal patterns in ecosystem carbon dioxide fluxes in temperate grassland." Anita C. Risch and Douglas A. Frank.
11. "Spatio-temporal gradients of carbon stocks and fluxes in rangelands of the Rio de la Plata basin." José Paruelo, Gervasio Piñeiro, Germán Baldi, Santiago Baeza, Felipe Lezama, Alice Altesor, and Martín Oesterheld.
12. "Nutrient cycling, limitation and global change: A synthesis of Jasper Ridge." Benjamin Z. Houlton and Christopher B. Field.

***3G has also commissioned the following additions to the special feature that will be submitted to the journal shortly:***

1. "Analysis of interannual variability in ecosystem carbon fluxes regulated by climate in the northern Great Plains grassland." Li Zhang, Bruce K. Wylie, Lei Ji, Tagir Gilmanov, and Larry L. Tieszen.
2. "Patterns and controls on carbon pools in California rangeland soils: A regional analysis." Whendee L. Silver, Rebecca Ryals, and Valerie T. Eviner.

#### **PRACTICAL IMPLICATIONS OF THE 3G PROJECT**

Participation in the carbon credit market will require significant changes in rangeland management and verification of carbon sequestration. The special feature will provide a synthesis of carbon flux dynamics in rangeland ecosystems, an analysis of the effects of different management practices on carbon sequestration, and analysis of cost-effect strategies for measurement, validation, and participation in carbon-credit markets. This information is intended to serve as a unified, readily accessible set of guidelines for rangeland and development managers. Efforts to increase the ability of rangelands to sequester carbon and generate carbon credits will contribute to three of the eight Millennium Development Goals of 2015 adopted by the United Nations:

***Eradicate extreme poverty and hunger.*** Carbon credits can contribute to poverty alleviation by generating additional income in some of the poorest

areas of the world, often dominated by agriculture and pastoralism.

***Ensure environmental sustainability.*** By assigning a price to GHG emissions, the carbon credit market promotes sustainable land-use practices that store, or sequester, atmospheric carbon in plants and soils.

***Create a global partnership for development.*** The carbon credit market is an international concept that unites participating countries and groups under a single goal: reduction of global GHG emissions.

#### **TEAM MEMBERS**

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 CSIRO Sustainable Ecosystems, Australia  
 FLUXNET, USA  
 Food and Agriculture Organization (FAO), Italy  
 Laboratoire des Sciences du Climat et de l'Environnement, France  
 Scottish Agricultural College, Scotland  
 South Dakota State University, USA  
 Swiss Federal Institute for Forest, Snow, and Landscape Research  
 Universidad de Buenos Aires, Argentina  
 Universidad de Chile  
 University of California, Berkeley, USA  
 USDA Agricultural Research Service, USA  
 USDA Natural Resources Conservation Service, USA

## **RISK MANAGEMENT**

**PASTORAL ENGAGEMENT, ADAPTATION AND CAPACITY ENHANCEMENT  
(AFGHAN PEACE)**

**FORAGE MONITORING TECHNOLOGY TO IMPROVE RISK MANAGEMENT  
BY HERDERS IN THE GOBI REGION OF MONGOLIA (GOBI FORAGE)**

**MALI LIVESTOCK AND PASTORALIST INITIATIVE (MLPI)**

**LIVESTOCK INFORMATION NETWORK AND KNOWLEDGE SYSTEM  
FOR ENHANCED PASTORAL LIVELIHOODS IN EAST AFRICA (LINKS)**

**LIVESTOCK TRADE IN ETHIOPIA AND KENYA (LITEK)**

**IMPROVING PASTORAL RISK MANAGEMENT  
ON EAST AFRICAN RANGELANDS (PARIMA)**



**AFGHANISTAN PASTORAL ENGAGEMENT, ADAPTATION,  
AND CAPACITY ENHANCEMENT (PEACE) PROJECT**

**PROJECT DESCRIPTION**

*The Afghanistan PEACE project is focused on addressing the plight of nomadic herders in Afghanistan, and at the same time, facilitating the Ministry of Agriculture, Irrigation and Livestock (MAIL) in its efforts to improve livestock production and range management. To achieve this aim, the Afghanistan PEACE project has been implementing a Livestock Early Warning System (LEWS) program based on the GL-CRSP LINKS/LEWS technology suite to address native forage supplies issues; and a nutritional profiling system using Near-Infrared Reflectance Spectroscopy to investigate native forage quality concerns. The project also works directly with the Independent Department of Kuchi to facilitate their ability to resolve land access and conflict issues peacefully. The project is supported through leveraged funding from the USAID Mission to Afghanistan, grant 306-A-00-06-00521.*

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**SUMMARY OF ACHIEVEMENTS**

- PEACE has identified 225 plant species and has been developing the data set that will be used in the Livestock Early Warning System's (LEWS) Phytogrow model for forage prediction. This information can also be used to develop vegetation classifications for some of Afghanistan's Rangelands. These specimens have been mounted for use as herbarium specimens. The collection will be retained with PEACE until such time as the Afghan Ministry of Agriculture can house the specimens.
- A possible species new to science was discovered by PEACE project team members during the plant species identification process. The species belongs to the genus *Ochotonophila*, a genus in the Caryophyllaceae family. To date, only three species of *Ochotonophila* are known to exist in the world; and all are from Afghanistan.
- The University of Gottingen and the Munich Botanical Garden and Herbarium assisted PEACE with plant species identification. The leading authority, Dr. Dieter Podlech shared his Afghanistan species collection lists with the PEACE project. These lists range in date from 1965 to 1971 and include over 1,000 specimens, their location, collection number and the collection date. PEACE is converting this data to a more manageable GIS database for querying and mapping purposes. Once completed, this information will be made available on the PEACE web site, <http://www.afghanpeace.org>.

- The plant specimens that were mounted by PEACE have been photographed in order to assist with future plant identification. The digital photos provide a quick and portable reference for showing herders and livestock producers during field trips, in order to efficiently recheck common plant names (i.e., Dari and Pashto) and their uses.
- Historical climate data was completely digitized by PEACE for the LEWS this past year. The data includes 21 stations and each station has about 20 years of data. The project's main task has been to re-format the data and check it against the original hard copy so that it can be sent to Texas A&M University to undergo modeling techniques that will fill in the missing data. The end product will allow PEACE to compare current climate conditions with historic norms.
- This field season, PEACE completed vegetation sampling in seven Provinces. The condition of the early spring rangelands were not very good in 2008 and offered very little in the way of forage to female sheep and goats that require good nutrition to produce milk for their newborns. In some areas of the Northern Provinces the rains simply failed and forced many of the Kuchi to search for grazing areas in Tajikistan and Turkmenistan. Higher elevation rangelands fared slightly better, although these too were not extremely productive.
- PEACE has contracted two Kabul University graduates (Faculty of Agriculture) to accompany LEWS project activities this past year. In addition, PEACE continues to have five Ministry of Agriculture staff conducting vegetation sampling for the duration of the season.
- Initial model runs for the plant growth model component of LEWS have not yet been completed, partly due to security difficulties preventing PEACE from obtaining sufficient samples. The project hopes to visit several sites bypassed for security concerns next year, and with the 2nd year's survey data, predictions from the model should be attainable. In the meantime, the plant growth modeler at PEACE has been continuing to collect and parameterize the soil, weather, and survey information.
- In October 2007, the PEACE project commenced the first of three quality-controlled feeding (e.g. diet) trials with 10 male Karakul sheep. The Karakul is a breed of sheep favored by Kuchi herders because of its resistance to disease and parasites, and because the wool and hides from the breed command a high price. The quality-controlled feeding trial consisted of feeding the yearling male sheep with three different diets followed by the collection of fecal samples to predict dietary crude protein (CP) and digestible organic matter (DOM). Diet samples and fecal samples obtained during the feeding trials were shipped to Texas A&M University for chemical and NIRS analyses.
- Results of the fecal scans from Karakul sheep showed that H-values from the 100 samples were very low, meaning that there is still a good possibility that the Near Infrared Spectroscopy (NIRS) equations developed under the GL-CRSP LINKS and GOBI projects, may be adaptable in Afghanistan. The results of the chemical analysis of CP and DOM showed that the diets used in the feeding trials were in the expected nutritional range, and will now be used to aid predictive equation development.
- A pilot study was conducted to test a sampling method for acquiring market information about sheep, goats and cattle. Markets in six Afghan cities were visited for three days each during the months of July and August and traders were asked about the source of the animals they were selling. PEACE will follow up this survey with a more complete study collecting market information four times throughout the year to measure seasonal fluctuations in the animal markets. The results of the pilot showed that a clear majority of small ruminant animals originate from the Kuchi people. An interesting

### PEACE AND NEGOTIATION TRAINING

*One of the primary components of the Afghanistan PEACE project is to assist the Independent Department of Kuchi, Afghanistan in developing a strategy to solve conflicts across the country. PEACE has engaged the Department of Kuchi by providing their provincial directors and local leaders with peace and negotiation training. The PEACE strategy for resolving conflicts includes not only training Kuchi staff, but also helping them to prioritize and address specific land access and winter feed problems. Project achievements in Peace and Negotiation activities for fiscal year 2008 are highlighted below.*

- On November 4-7th, 2007, 26 Kuchi Representatives from 23 provinces attended a peace and negotiation training workshop implemented by the Sanayee Development Organization (SDO). The objective of training Kuchi representatives was to better prepare them to solve a variety of conflicts in their provinces. The workshop covered a multitude of topics and was delivered in the local languages of Pashto and Dari. Four experts from SDO presented material designed to give participants the basic tools to solve problems and conflicts, including: 1) Conflict definition; 2) Types of conflict; 3) Understanding the conflict process; 4) Methods to solve conflicts; and 5) Building and working towards peace.
- Reactions to the peace and negotiation workshop from the Kuchi representatives were overwhelmingly positive, and by the end of the fourth day most of the representatives said they were very happy with the messages delivered. There was also great interest in having peace and negotiation workshops held at the provincial level, to further disseminate conflict resolution skills and techniques.
- Over the past year, PEACE has been working with a conflict resolution consultant in Kabul and the Independent Department of Kuchi (IDK) to develop a general conflict resolution strategy. This consultant has taken on three conflict resolution workshops requested by the IDK to help resolve their highest-priority conflict involving a confrontation between the Kuchi and Hazara people over grazing rights in southern Bamyan. The Afghan Advisor to the President on Tribal Affairs sanctioned these workshops as a means to promote reconciliation between the Hazara and Kuchi prior to the start of the growing season. Each group sent 30 leaders to separate workshops to begin the training process, after which half of the leaders from each group attended a third joint workshop. Some positive outcomes of the workshop included:
  1. Mutual recognition of rights (grazing, education, and health)
  2. Action plans and practical suggestions for future collaboration (i.e creating joint local shuras/meetings)
  3. Exchange of contact information between participants to further promote communication and reconciliation
- Final evaluations of the PEACE conflict resolution workshops demonstrated an increased knowledge of conflict resolution methods, an increased knowledge of the other group's views, and concrete suggestions for future collaboration. These results provided a bit of optimism for a notably complicated situation. The next step in the resolution process will be to continue with the two groups in conducting follow-up evaluations, identifying local leaders for future cooperation, and providing support for local joint shura meetings.

result was found in the Kabul market regarding the unexpectedly large Kuchi ownership of cows. While Kuchi do own cows, the trend towards greater ownership of cows in Kabul deserves more attention and may be related to the large number of settled Kuchi near Kabul.

- Over the past year, PEACE has developed a good working relationship with the Department of Kuchi regarding the identification and use of Herder Alliances to disseminate LEWS and NIRS information. Creation of the information network that can be used to deliver timely information to herders requires intimate knowledge of how herders organize themselves. To accomplish this, PEACE has been working with the Director of Kuchi on initiating meetings (shuras) with Kuchi leaders within each Province in order to gain better seasonal information about challenges faced by the Kuchi, and to structurally initiate the foundations of herder alliances. Facilitation of Kuchi shura meetings in 12 Afghan Provinces began in May 2008, and represents a critical link between PEACE research and its application at the herder level.
- Enabling the Afghani Division of Natural Resources to produce and interpret early warning results requires extended face to face capacity building. PEACE spent four months in the field together with approximately nine MAIL staff, and additional time during the remainder of the year working with rangeland staff. Several one-day training seminars were delivered this year to MAIL staff from the Range department. They were trained on the LEWS component, data collection and entry for LEWS, and are beginning computer skills training.
- Senior students at Kabul University competed for a grant to carry out research in Afghanistan. The PEACE project has collaborated with the Chemonic's Accelerating Sustainable Agriculture (ASAP) project in sponsoring feeding trial research that will ultimately be conducted by students. Ten university students received internships for the Karakal sheep feeding trials this past year. Further research will work towards the development of nutritional profiling for goats in Afghanistan.
- The diet:fecal pair research conducted by PEACE offered opportunities for collaboration with the Kabul University and USAID's Advancing Afghan Agriculture Alliance (A4) program. As part of this collaboration, internships were offered to two third year students from Kabul University and involved full participation in all aspects of a feeding trial targeting improved dietary intake of sheep and goats. In addition to the two internships, six second and third year students were invited to participate in the feeding trials for a minimum of three days each. These students assisted by working side-by-side with the interns, in all phases of the trials.
- In collaboration with Kabul University, PEACE hosted two seminars on Feeding and Feeding Trials involving 20 students and two faculty members from Kabul University. The seminars included an overview of Texas A&M University's LEWs and NIRSs programs, discussions on protocol for drying fecal samples for shipment to the US, observed total forage consumption over the duration of the trial, and possible explanations for individual differences in consumption and weight gain.
- Over the past year, PEACE trained 170 individuals in peace and negotiation skills, livestock early warning system technology and application, and near infrared spectroscopy techniques. Several of these non-degree trainings were also provided to Mercy Corps staff on the monitoring of vegetation change in pastures undergoing restoration efforts. Mercy

PEACE Non-Degree Training, 2007-2008			
Country	Male	Female	Total
Afghanistan	169	1	170

Corps is promoting watershed protection and restoration in pastoral rangelands, and is utilizing PEACE expertise to design sampling protocol for monitoring species composition and coverage changes.

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Independent Department for Kuchi Affairs,  
Afghanistan  
Kabul University  
Mercy Corps  
Ministry of Agriculture Irrigation, and Livestock  
Department of Animal Health and Husbandry,  
Afghanistan  
Ministry of Agriculture Irrigation, and Livestock  
Department of Natural Resource Management,  
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Utah State University

**FORAGE MONITORING TECHNOLOGY TO IMPROVE RISK MANAGEMENT  
BY HERDERS IN THE GOBI REGION OF MONGOLIA  
(GOBI FORAGE)**

**PROJECT DESCRIPTION**

*The GOBI Forage project was initiated in 2004 to adapt Livestock Early Warning System (LEWS) technologies, developed by GL-CRSP projects in East Africa for Mongolia, to improve risk management by herders and other stakeholders in the Gobi Region. The program is comprised of four primary activities: forage quantity monitoring, the transfer of near infrared spectroscopy (NIRS) technology for forage quality monitoring, outreach and delivery of forage quantity and quality information, and development of herder alliances poised to benefit from the generated information. The GL-CRSP Gobi Forage program has also undertaken efforts to distribute information detailing forage availability and forecasts to herder and government target populations in eight Gobi aimags. These efforts have been complemented by an extensive training agenda. In 2007, the Gobi Forage program made the important transition from a research and development agenda to product distribution and outreach, and is in the process of collaborating with the World Bank's Sustainable Livelihood Initiative to institutionalize Gobi Forage products for use by Mongolian governmental and non-governmental agencies.*

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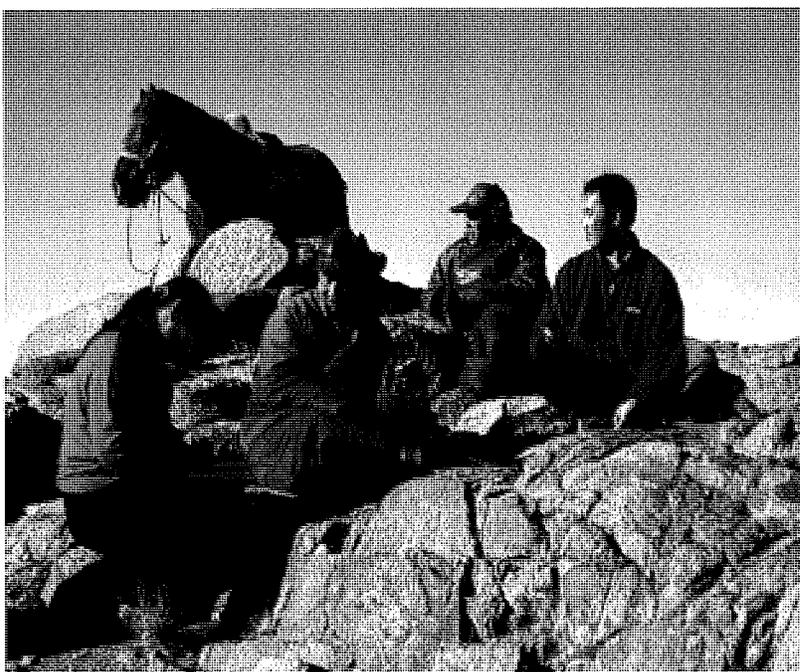
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**SUMMARY OF ACHIEVEMENTS**

- Weekly radio bulletins produced by Gobi Forage using information from the Gobi Forage Technology Suite continued to deliver timely and critical information on current and forecast forage conditions and drought prediction by natural zone and soum to an estimated audience of 520,000 rural listeners and herders. These radio broadcasts were the Gobi Forage products most commonly used by government officials (64.9% of those surveyed in an external evaluation study) in advising or making recommendations to herders, while 50% of herders surveyed in the same evaluation study scored Gobi Forage products (radio broadcasts and maps) a "4" or "5" out of "5" (most useful) in helping to guide their livestock movements.
- To date, the GOBI Forage Technology Suite, encompassing the livestock early warning system (LEWS) and livestock market information, covers over 75,000,000 hectares, representing a significant range of biodiversity potential for conservation including critical habitat and plant species. Stakeholders using GOBI Forage products to reduce the number of animals grazing during drought periods decreased potential losses in plant species biodiversity and minimized destruction of plant cover and exposure of soils to wind and water erosion. Such actions enabled by the adoption of GOBI technologies prevent a reduction of water quality to streams and lakes used for drinking water due to sediment loading.

- Three individuals (two men and one woman) were trained in GIS software for producing maps using geostatistical analyses in 2007-2008. Training on this technology is rare in Mongolia, and developing the capacity to use geostatistics will provide continued long-term sustainability of the forage mapping activities in Mongolia.
- Throughout the Gobi Forage program, multiple trainings for government personnel were conducted to introduce and facilitate the use of the Gobi Forage Project's technology suite. Amongst government officials, 53% of those surveyed in the 2008 Survey and Impact Evaluation Study had participated in the official training course on the use of Gobi Forage products. Of these individuals, a total of 41.2% ranked the training a "5" or "4" (most useful), while 31.4% ranked the training a "3" (average usefulness) in helping them understand how to use Gobi Forage products. As a result of the training program, over the ten months preceding the evaluation study, these officials relied upon Gobi Forage products to recommend livestock movements (68.8% of surveyed officials); to recommend provision of supplementary feed (53.3%); and to recommend culling/destocking livestock (37.7%).
- Food security is directly correlated with availability of food and the purchasing power for obtaining it. The use of the Gobi Forage Livestock Early Warning System (LEWS) provides herders with the tools to minimize herd loss to drought, as well as maximizing herd productivity through information regarding available forage. In addition, information on livestock prices allows herders to take advantage of favorable market conditions, leading to increased incomes. As reported in the 2008 Survey and Impact Evaluation Study, amongst those herders taking action based on information provided by Gobi Forage products, 35% reported a net increase in income, with 75% reporting this profit to be between 51,000 and 1,000,000 Mongolian Tugriks (approximately \$46 – \$910 USD).
- In an effort to complement their pastoral risk management program with a Livestock Early Warning System (LEWS) component, the World Bank's Sustainable Livelihoods Program (SLP) has identified the Gobi Forage project as a valuable addition in providing a LEWS component to its programming, and has expressed interest in funding the program in an additional eight aimags (the largest administrative units in Mongolia). Funding for the program is contingent upon the "Development Credit Agreement" between the World Bank and the Government of Mongolia, which was under review by parliament at the end of fiscal year 2008. The initial phase of this move toward institutionalization would be focused on capacity building

*Ms. D. Ariungerel of the Gobi Forage Survey and Evaluation Report team interviews herders in the Gobi Region of Mongolia. Photo by Dan Schar.*



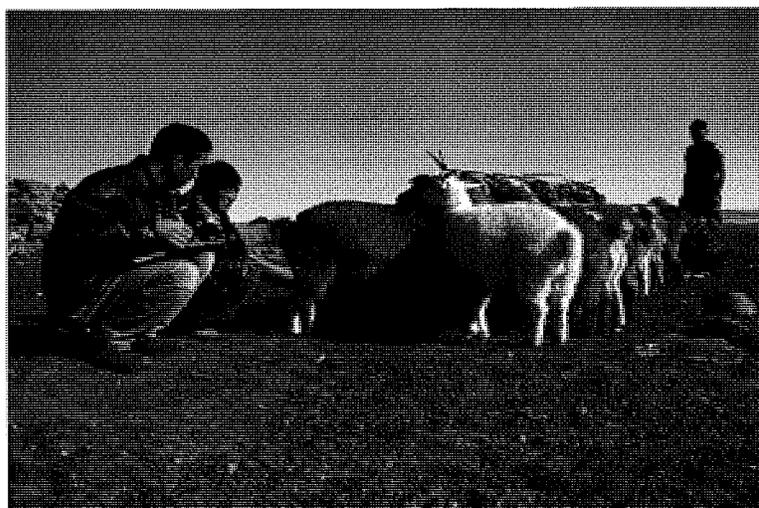
## SURVEY AND IMPACT EVALUATION STUDY RESULTS

*The 2008 Survey and Impact Evaluation Study on the Gobi Forage project was conducted among a total of 192 participants (115 herding households and 77 government officials) in 20 soums of the six Gobi aimags in which the program is implemented during the period of evaluation in October and November of 2007. Additionally, interviews were held with key stakeholders at the national level in Ulaan Baatar, Mongolia. Key achievements described in the Final Report of the evaluation are listed below:*

- Between March and October of 2007, the GL-CRSP Gobi Forage project delivered field-tested forage monitoring information to herders and government officials in the Gobi region of Mongolia. Gobi Forage has been exceedingly well received at the local level, with over 70% of herders and nearly 64% of government officials having some degree of familiarity with Gobi Forage products.
- Nearly half of herders surveyed reported that they had used Gobi Forage information in the months preceding the evaluation study to guide livestock movements, provide supplementary feed and change their rotational grazing strategy; 35% of these herders reported a net increase in income, with 75% reporting this profit to be between 51,000 and 1,000,000 Mongolian Tugriks (approximately \$46 – 910 USD).
- Amongst government officials surveyed, the vast majority (92%) indicated that they were able to “easily understand” Gobi Forage information and pass this information along to herders.
- Although herders much preferred to use traditional movement patterns and weather forecasts to guide their livestock movements, a cumulative total of approximately 50% of herders surveyed scored Gobi Forage products (radio broadcasts and maps) a “4” or “5” out of “5” (most useful) in helping to guide their livestock movements.
- Over the ten months prior to the evaluation study during which Gobi Forage products have been distributed, herders indicated that they had taken the following actions based on information gathered from the Gobi Forage products: moved livestock (51.3%); provided supplementary feed to their livestock (49.6%); and changed their rotational grazing strategy (40%).
- Printed maps (67.5%) and radio broadcasts (64.9%) were the Gobi Forage products most commonly used by government officials in advising or making recommendations to herders. Over the ten months preceding the evaluation study, 68.8% of officials surveyed had utilized these Gobi Forage products to recommend moving livestock; 53.3% to recommend providing supplementary feed; and 37.7% to recommend culling/destocking livestock.
- Amongst government officials, 61% of those surveyed who had utilized Gobi Forage products in decision making related to herders felt that their use of these products had resulted in a net increase in income, while 8% believed it had resulted in a net decrease in income for their soum or aimag.
- A total of 39% of herders currently surveyed “very strongly agreed” or “strongly agreed” (“4” and “5” out of “5”) that they had all the information they need in order to manage their herds effectively. This represents an increase of 105% over the same responses to this question (19% indicated “4” or “5” out of “5”) given during the baseline survey.
- Further, 78.9% of government respondents ranked Gobi Forage radio broadcasts a “4” or “5” out of “5” in terms of usefulness in guiding their recommendations on livestock movements. This represents an increase of 45% over the same responses to this question (54.5%) given during the baseline survey.

and technology transfer to the national host entity, with the long term goal of establishing an independent, sustainable, forage forecasting and delivery program in full operation by a Mongolian national institution.

- The GOBI project leveraged a total of \$1,166,500 in fiscal year 2008. \$500,000 of this figure is from USAID buy-ins.



*Mr. O. Mendbaatar interviewing a herder in the Omnogobi Aimag, Mongolia as part of the Survey and Impact Evaluation Study conducted in October and November of 2007. Photo by Dan Schar.*

### PROJECT IMPACT

- A Survey and Impact Evaluation Study (see box on previous page) was conducted on the Gobi Forage project in the fall of 2007. Results indicated that Gobi Forage technology has been exceedingly well received, with over 70% of herders having some degree of familiarity with Gobi Forage products. Almost half of the surveyed herders reported that they had used Gobi Forage information to guide livestock movements (51%), provide supplemental feed (49%) or change their rotational grazing strategy (40%). Almost one third (35%) reported a net profit and increased income resulting from these actions. An overwhelming majority (93%) of government officials found Gobi Forage products to be “very useful” in advising herders on grazing management and livestock movements.

GOBI GIS Training for 2007-2008			
Country	Male	Female	Total
Mongolia	2	1	3

### RESEARCH BRIEFS

#### Implementation of the Gobi Forage Project in Mongolia: An Example of GL-CRSP Technology Transfer

*Authors: Jay Angerer, Texas A&M University; Sean Granville-Ross, Mercy Corps, Mongolia; and Doug Tolleson, Institute of Animal Husbandry, Mongolia*

*Summary.* A series of droughts and winter disasters in Mongolia resulted in a series of discussions by USAID and the GL-CRSP to transfer the GL-CRSP Livestock Early Warning System (LEWS) technology that was developed in East Africa to Mongolia as risk mitigation for these extreme events. In 2004, the Gobi Forage project was initiated in the Gobi region of Mongolia using the blueprint for GL-CRSP LEWS implementation developed for East Africa. Overall, the transfer of the general technology was successful. The grid computing environment, web servers, software, and mapping procedures developed for East Africa enabled the seamlessly integration of Mongolian data into the LEWS system, thus saving approximately two years in development time. However, there were several implementation challenges, ranging from the lack of unified climate and satellite data sets for use in

the near real-time monitoring, to the absence of LEWS protocol for winter disaster monitoring data. The general protocols for implementing the forage quality monitoring have been successful and have resulted in the first in-country use of near infrared reflectance spectroscopy (NIRS) for livestock in Mongolia. Information delivery and outreach has been most successful using maps delivered by the postal service and national radio broadcasts for early warning bulletins in contrast to World Space Radio and Internet delivery in East Africa. The Gobi Forage program provides an example of successful GL-CRSP technology transfer that can be used as a model for other pastoral regions.

#### PUBLICATIONS

Angerer, J.P. 2008. Examination of High Resolution Rainfall Products and Satellite Greenness Indices for Use in Estimating Patch and Landscape Forage Biomass. PhD Dissertation, Texas A&M University.

#### PROCEEDINGS

Angerer J.P., L. Bolor-Erdene, M. Urgamal, and D. Tsogoo. 2008. "Verification of a forage simulation model used for a livestock early warning system in the Gobi region of Mongolia." Proceedings of the 2008 Joint Meeting of the 21st International Grassland Congress (IGC) and the 8th International Rangeland Congress (IRC). July 9-12, Hohhot, China.

Bolor-Erdene, L., J. P. Angerer, S. Granville-Ross, M. Urgamal, D. Narangarel, D. Tsogoo, T. Stewart, and D. Sheehy. 2008. "Gobi Forage: An early warning system for livestock in the Gobi region of Mongolia." Proceedings of the 2008 Joint Meeting of the 21st IGC and the 8th IRC. July 9-12, Hohhot, China.

Tolleson, D., G. Udval, S. Prince, and K. Banik. 2008. "Prediction of diet quality in Mongolian livestock with portable near infrared spectroscopy of feces." Proceedings of the 2008 Joint Meeting of the 21st IGC and the 8th IRC. July 9-12, Hohhot, China.

#### TEAM MEMBERS

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Richard Conner, Texas A&M University (*Lead Principal Investigator*)  
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Agricultural University of Mongolia  
Mercy Corps, Mongolia  
USDA-Foreign Agricultural Service, USA

## MALI LIVESTOCK AND PASTORALIST INITIATIVE (MLPI)

### PROJECT DESCRIPTION

*The Mali Livestock and Pastoralist Initiative (MLPI) was initiated with an overall goal of improving the productivity and income of the producers in the northern regions of Mali by building capacity and enabling them access to new technologies. Building on the successes of the Global Livestock CRSP's Livestock Early Warning System (LEWS), Livestock Information Network and Knowledge System (LINKS), Forage Monitoring Technology to Improve Risk Management by Herders in the Gobi Region of Mongolia (GOBI Forage), and Pastoral Risk Management (PARIMA) Projects, MLPI represents the integration of livestock market information systems (LMIS) and risk management programs designed to reduce risk and improve livestock marketing options for pastoralists in northern Mali. Activities for MLPI commenced in January of 2008.*

### PRINCIPAL INVESTIGATOR

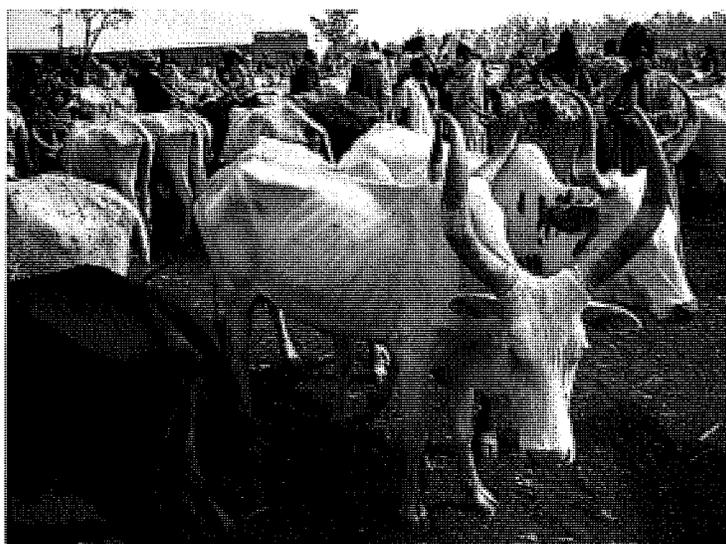
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### SUMMARY OF ACHIEVEMENTS

- USAID-Mali, as part of their Accelerated Economic Growth Initiative has identified an overall goal of improving the productivity and income of producers in the northern regions of Mali by enabling them access to technologies, and through the capacity building of all actors involved in the development of an extensive livestock system. The MLPI, building on the successful integration of GL-CRSP Livestock Market Information Systems (LMIS) at the national levels in Mongolia and Kenya, and the regional level in East Africa, is working with USAID-Mali to transfer LMIS technology to Mali, and to develop an integrated extension approach to reduce risk and support and enhance the production and management strategies of pastoral herders.
- An initial project evaluation conducted in January 2008 identified appropriate Malian government agencies and organizations for partnerships and support with MLPI project development, essential steps in beginning project institutionalization of methodologies to implement livestock risk managements strategies across the national, regional, district, and village levels. To date, MLPI consists of five partnerships, including four Malian institutions: the Observatoire du Marche Agricole (OMA), Direction Nationale des Productions et des Industries Animales (DNPIA), Institut D'economie Rurale (IER), and Institut Polytechnique Rural De Formation Et De Recherche Appliquée De Katibougou (IPR).

*A Zebu-Peuhl cow in poor condition offered for sale at the Niamana Market near Bamako. The Niamana market is a daily market that serves as a terminal market in Mali, where animals go to slaughter in Bamako or are shipped to Senegal. Photo by Jay Angerer.*



- Building on technology developed by the LEWS/LINKS project and successfully transferred to Mongolia by the Gobi Forage project, MLPI is currently adapting and field-testing a new version of the Livestock Market Information System (LMIS). In addition, MLPI is researching three new activities aimed at enhancing pastoral livestock production and management, including an examination of burgu (a cereal grain) management strategies for livestock, supplemental feeding strategies for livestock nutrition improvement, and livestock fattening enterprises for market towns. At the end of September, market data for the LMIS was being collected by 32 MLPI-trained market monitors from six markets, with four of these in Northern Mali and two at the terminal markets near Bamako. The collection of this data represents the first market data that has been collected and made available to users on a near real time basis in Mali.
- The web portal interface and menus for the LMIS were translated into the French language, a critical step in institutionalizing the technology within Mali and local market infrastructures.
- A short message service (SMS) coding procedure specific to Mali livestock kinds and breeds was developed for entering data via SMS into the

GL-CRSP developed LMIS, better enabling the system to function within the new West African regional context. In addition, a livestock grading procedure was developed for capturing price differentials for different grades of animal by kind, breed, age and gender, thereby finalizing a critical step in linking the LMIS to the local livestock markets it is designed to serve.

- A survey was developed and conducted in the Niger delta on current perceptions of risk. The preliminary fieldwork was completed in June 2008, and a report was submitted to USAID – Mali summarizing the findings. A primary conclusion of the survey was that the overall diversity in livelihood strategies in the delta made analysis of risk perceptions both fascinating and complicated. The differences in the production systems that exist side by side, and often overlap, makes for a very intriguing set of issues. The focus of further studies will be expanded to not only risk perceptions, but to

MLPI Non-Degree Trainings for 2007-2008			
Country	Male	Female	Total
Mali	32	0	32

examine risk management and coping strategies, which are likely more applicable to development agencies.

- The MLPI leveraged a total of \$1,787,394 in fiscal year 2008 in addition to the USAID-Mali Mission funding of \$250,000.

#### TEAM MEMBERS

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#### COLLABORATING INSTITUTIONS

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Direction Nationale des Productions et des Industries Animales, Mali

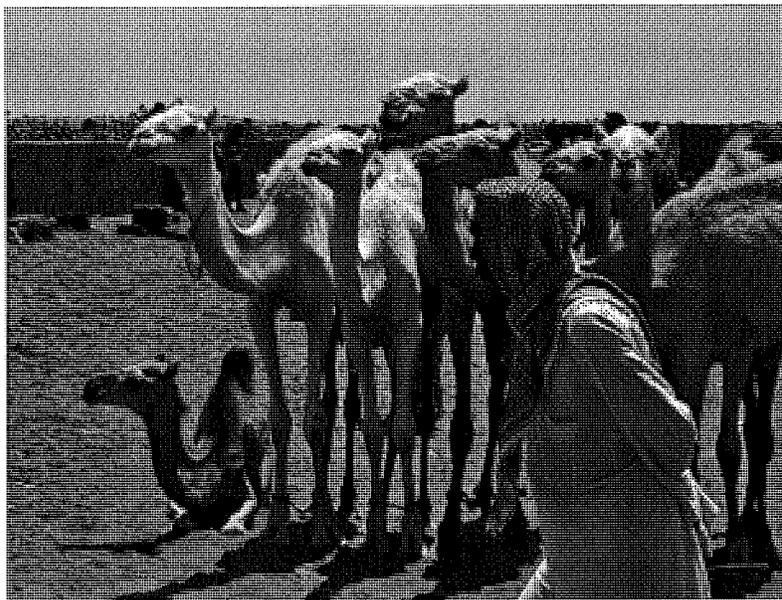
Institut d'Economie Rurale du Mali

Institut Polytechnique Rurale de Formation et de Recherche Appliquee de Katibougou, Mali

Observatoire du Marche Agricole, Mali

Syracuse University, New York, USA

USAID Mission to Mali



*A small herd of camels being offered for sale at the Wabaria market near Gao in Northern Mali. Improvement in marketing of livestock in the northern region of Mali is a primary objective of the Accelerated Economic Growth team at USAID-Mali. Photo by Jay Angerer.*

**LIVESTOCK INFORMATION NETWORK AND KNOWLEDGE SYSTEM  
FOR ENHANCED PASTORAL LIVELIHOODS IN EAST AFRICA  
(LINKS)**

**PROJECT DESCRIPTION**

*The GL-CRSP Livestock Information Network and Knowledge System (LINKS) project was developed from the GL-CRSP Livestock Early Warning System (LEWS) project, which was established in 1997. The LEWS project developed and applied a suite of information communication technologies to provide a regional decision-support framework for livestock early warning. The LINKS project is placing LEWS technology inside a broader livestock information and analysis system that is designed to improve livestock markets and trade, thereby enhancing the well-being of pastoralists in East Africa. LINKS technology was recently incorporated into the National Livestock Marketing Information System (NLMIS) active in Kenya. An additional LINKS-based NLMIS is undergoing development in Ethiopia.*

**PRINCIPAL INVESTIGATOR**

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**SUMMARY OF ACHIEVEMENTS**

- In fiscal year 2008, the LINKS project unveiled a new version of their flagship Livestock Information Network and Knowledge System, LINKS 3. LINKS 3 was developed on a new platform, allowing the provision of price information on all livestock categories to be disaggregated by species, breed, age, gender and grade (the earlier version provided information only on a Boran mature male grade two animal). In addition, LINKS refined the short message service (SMS) text messaging market reporting and updated their coding protocol. The new SMS system allows it to respond much faster and is more user friendly, as comprehensive information can now be appropriately decoded and provided to system users.
- In fiscal year 2008, National Livestock Marketing Information Systems (NLMIS) were launched for Kenya, Ethiopia and Tanzania. The elevation of the Livestock Information Network and Knowledge System technology suite to the national level demonstrates the appreciation and utility of the system, as well as the goodwill and commitment on the part of senior public managers to maintain and expand the system. Further integrating the LINKS system at the national level in Ethiopia, two major organizations in the pastoral development and livestock marketing sectors, Save the Children and Farm Africa, became important reporting entities by collaborating on market price reporting for livestock.



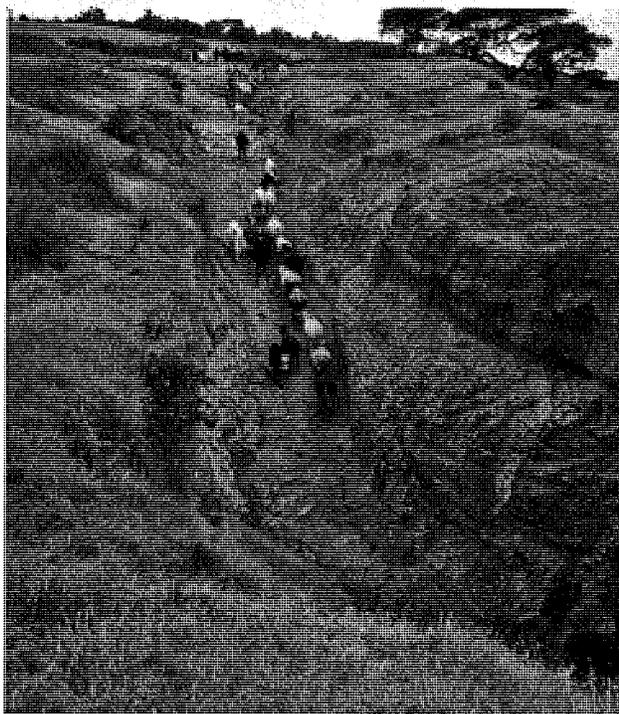
*Livestock traders at the Negelle livestock market, Ethiopia, one of the many livestock markets integrated with LINKS. Photo by Peter Little.*

- In fiscal year 2008, steady short message service (SMS) reporting flow was established from 18 markets in Kenya, 32 markets in Ethiopia and 30 markets in Tanzania. The corresponding country databases provide centralized and unified information at a national scale, linking markets, data monitors and users in a way never before achieved. The system has generated interest and support from stakeholders, and in Kenya there is a pledge to support seven additional markets.
- In fiscal year 2008, LINKS began the development of new monitoring tools under the NASA/LEWS project in Northern Kenya and Southern Ethiopia designed to assess water resources and predict water shortages. The intended beneficiaries of the water resource tools are pastoral communities, who are often water constrained and marginalized, and who often make decisions on when to initiate migration in order to ensure adequate water supplies and forage for their households and herds.
- In 2007, online access of LINKS market information was recorded at 43,800 visits/month, while short message service (SMS) requests were reported at 8,850 SMS/month. Weekly market information updates were also posted in boards mounted in many of the markets throughout East Africa being monitored by the project. In Kenya where LINKS has become the National Livestock Market Information System (NLMIS), these boards have the potential to reach roughly 10.5 million pastoralists, as pastoral areas carry about 30% of the total population estimated at over 35 million people. In Ethiopia, approximately 14 million rural residents in pastoral areas and major terminal markets (20% of Ethiopia's population of 70 million) are benefiting from postings of LINKS market information. In Tanzania, dissemination of information through local print media (news papers) twice a week, combined with expanded livestock market coverage in all regions has a potential to reach over 15% of the population of 40 million, or roughly six million rural residents.
- Research by LINKS utilizing a cross-sectional survey administered to 135 pastoral households from Garissa and Isiolo districts and 1,233 transactional survey data collected between September 2004 and September 2005 from three pastoral livestock markets in Kenya were used to analyze factors that influence beef cattle marketing behavior, with emphasis on the role of livestock marketing information. Results indicated that over 75% of the pastoral households used visual assessment considering

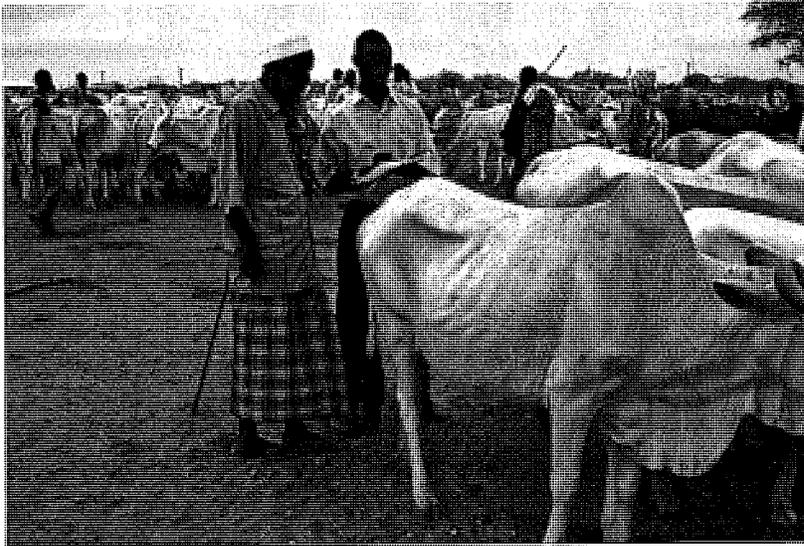
a number of attributes to peg prices to their animals before sale. These attributes were subsequently found to tally with the livestock categorization system developed by LINKS, demonstrating a direct connection between system design and applicability at the producer level.

- In fiscal year 2008, the Kenya Livestock Marketing Council, a major partner in the NLMIS with a registered membership of 4,000 livestock stakeholders, estimated that about 5% (525,000) of pastoralists have access to LINKS market information through its network, with an estimated 3% of these (15,750) using personal mobile phones and the LINKS short message service (SMS). In addition, the Ministry of Information disseminates LINKS market information through NURU, a monthly newsletter published in the Swahili language, which has a readership of over 20,000 in parts of eastern and northern Kenya. It was estimated by the Ministry that about 70% (14,000) of the readers are benefiting from the livestock marketing information disseminated through the newsletter.

- Through fiscal year 2008, the LINKS Project has continued to maintain Livestock Early Warning System (LEWS) output by preparing monthly situation reports, 10-d internet reports and additional reports through a list server. These reports are used as an input to the Greater Horn of Africa (GHA) Climate Outlook Forum and in preparing the GHA food security bulletin. The International Committee of the Red Cross (ICRC) has confirmed that the LEWS products are useful in their programming, and has suggested improvements to the products to make them more user friendly for ICRC utilization (e.g. including the prevailing exchange rates in the livestock markets section for the different country reports).
- The LINKS Livestock Market Information System (LMIS) databases provide the most comprehensive price information on livestock in East Africa, covering the highest number of markets and the longest time period. In fiscal year 2008, the Kenya Food Security Steering Group (KFSSG) recommended that LINKS data be used to construct thresholds for use as early warning and food security indicators in consultation with market sector working groups, to determine the status of food security among East African livestock producers, and to provide policy makers with information necessary for decision making. LINKS is currently working with the KFSSG to develop models for policy level interventions during emerging drought



*Cattle exiting a watering hole in Dubluk, Borana Region, Ethiopia. LINKS is currently integrating water resource monitoring tools into the Livestock Early Warning System (LEWS) to better assist pastoralists with migration decisions, in order to enhance water security among this vulnerable group. Photo by Peter Little.*



*A LINKS market monitor records animal attribute data at a livestock market in Garissa District, Kenya. Photo courtesy of LINKS project.*

crises based on early warning information. Such models can facilitate enhanced response to disaster situations, promote interventions such as accelerated off-take to allow phased and selective off-take of non-essential livestock for producers to relieve pressure on grazing and water resources or before prices collapse, and support livestock traders and exporters to buy livestock before deterioration of body condition or death of the animals.

- Markets that were hitherto not visible before implementation of the LINKS technology suite have attracted new competition due to the entry of new traders. For example, the Chepareria market in West Pokot (Kenya) now attracts traders from as far away as Mombasa, some 900 kilometers away. The market provides large numbers of quality goats for the up-market hotels along the coast. When these traders started sourcing their animals in Chepareria in January 2008, the prices of goats increased 50% in a space of two months, indicating the potential for LINKS to provide producers with increased returns.
- Local stakeholders benefiting from LINKS involvement have made collective decisions on priority areas of support to livestock marketing, including the development of

resource mobilization strategies to facilitate expansion and sustainability of the LINKS system. In the West Pokot and Baringo districts of Kenya, LINKS stakeholders organized district forums to map out livestock market development plans, including alternative strategies for disseminating information to producers, and organizing producers into local marketing groups. In addition, the West Pokot county council has ceded 20% of the revenue collected from the Chepareria market to support data collection/reporting and maintenance of the market infrastructure. This is a pioneer achievement for LINKS and represents a new model for local market financial sustainability within the LINKS network. Additional communities are being encouraged to follow West Pokot's example, and support their markets from resources generated from local wealth.

- In fiscal year 2008, 51 market monitors in Ethiopia, 86 market monitors in Kenya, and 34 market monitors in Tanzania were trained on the use of LINKS technologies and applications, as part of the LINKS capacity building and training activities. These activities included training on a new livestock products module developed in response to stakeholder requests regarding interest in an information system that can provide consistent price information

for assessing the welfare of pastoralists in terms of the cost of acquiring food, and the terms of trade between livestock/livestock products and major cereals purchased from the market or provided as donations by government and other relief agencies.

- Thirty-four of 159 (21%) LINKS market monitors and stakeholders trained in Kenya, Tanzania and Ethiopia in fiscal year 2008 were women, and LINKS continues to ensure the participation of all gender groups in training programs. Training has been conducted in 13 pastoral districts in Kenya covering 31 markets and reaching out to over 5,000 people, out of whom 10% were women.
- The LINKS project leveraged a total of \$1,613,577 in fiscal year 2008. \$30,000 of this figure is from USAID buy-ins.

Their purchasing power, however, is dependent on income, economic conditions and terms of trade between livestock and cereals, all of which change over time. The emergence of terms of trade that are not favorable to these households will erode their capacity to meet basic needs, and compromise their food security situation and overall socioeconomic welfare. The provision of market information through systems like LINKS equips planners and policy makers with the tools to track price trends, assisting in the improvement of decision-making and the development of appropriate interventions to mitigate the effects of deteriorating terms of trade for pastoral households. A market information system can also lead to changes in marketing behaviour at the household level, and understanding market signals can play an effective role in orienting producers towards markets. Market information systems inform producers empowering them to negotiate better livestock prices, enabling them to obtain better returns and generate cash for goods and services.

**RESEARCH BRIEFS**

**Tracking Terms of Trade for Pastoral Livestock Producers: The Case of Kenya.**

*Authors: Gatarwa Kariuki, LINKS; and Robert Kaitho, Texas A&M University*

*Summary.* Households practicing pastoral livestock production experience a myriad of problems including drought, poor infrastructure for communication and marketing, low income and food insecurity. With lifestyle changes and decreasing capacity of livestock to provide for basic needs, these households are increasingly dependent on the market for non-livestock-based food and non-food needs.

**From LINKS to NLMIS: Issues, Challenges and Lessons Learned.**

*Authors: Gatarwa Kariuki, LINKS; Muthoni Mwangi, FAO-Kenya; John Maina, Ministry of Livestock and Fisheries, Kenya; Qalicha Wario, Kenya Livestock Marketing Council; and Robert Kaitho, Texas A&M University.*

*Summary.* There is increasing recognition that information is an important tool in empowering people to make informed choices in order to make progress in their economic and social development. The suite of technologies developed by LINKS was adopted to develop and implement a national

LINKS Degree Training for 2007-2008					
Name	Nationality	Gender	University	Discipline	Degree
Komen, Mathew	Kenya	M	University of Nairobi	Agricultural Economics	MSc
Ochieng, Bridget	Kenya	F	University of Nairobi	Agricultural Economics	MSc
Omaria, Rose	Uganda	F	Makerere University	Veterinary Science	PhD
Zhang, Ann	Chinese	F	Texas A&M University	Range Science	PhD

livestock marketing information system (NLMIS) for Kenya. Lessons learned in the implementation of the NLMIS include: high initial system start-up costs of the system contrasted with modest running costs; and market selection criteria, which are dependent upon the importance of the market as a supply node, the interest and support of stakeholders, the availability of personnel to collect and report data, access to mobile phone network coverage, and turnover of staff affecting consistency in the flow of data. Development of necessary infrastructure (roads, water, abattoirs, and communication networks) is critical to NLMIS success, as is the need for a clear policy favorable to the development and use of information communication technology (ICT), especially in livestock related activities. The recently proposed concept of digital villages, local centers of ICT unified under a digital umbrella, could drastically improve the reach and impact of a NLMIS, as long as it addresses the special needs of poor, small scale, and remotely located livestock producing communities, who are far removed from hubs of economic activity in time and space.

**Empirical Analysis of the Factors Influencing Beef Cattle Marketing Behavior in Pastoral Areas of Kenya with Reference to the Role of Livestock Market Information**

*Authors: Mathew Komen, University of Nairobi; Gatarwa Kariuki, LINKS; and Robert Kaitho, Texas A&M University*

*Summary.* Research by LINKS has shown that livestock market information plays a significant role in improving the performance of pastoral production and marketing systems. Data sourced from a cross-sectional survey conducted using a questionnaire administered to 135 pastoral households from Garissa and Isiolo districts and 1,233 transactional survey data collected between September 2004 and September 2005 from three pastoral livestock markets in Kenya were used to analyze factors that influence beef cattle marketing behavior, with emphasis on the role of livestock marketing information. Results indicated that a majority of the respondents (73%) had access to radio, while 28%,

11% and 10% had access to a cell phone, newsprint and television respectively. To obtain information on livestock marketing, 75% of the respondents relied on their neighbors and their own personal visits to the market. On the need for price information from other markets, 77.8% of the respondents expressed a strong need, and out of these 32%, 54%, and 9% desired to have the information on daily, weekly, and monthly bases respectively, while 5% were indifferent about the frequency. A total of 96% of the respondents preferred to sell their animals within markets in their region citing length of trip, security, volume of sales and unfamiliarity with distance markets as the major factors influencing the decision, in that order. The study discovered that over 75% of the pastoral households used visual assessment to peg prices to their animals before sale. Subsequent analyses also showed that producers consider a number of attributes when pegging prices to their animals and these were found to tally with the categorization system developed by LINKS.

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Demment, M., D.L. Coppock and R. Kaitho. 2008. "New approaches for coping with pastoral risk." In: Multifunctional grasslands in a changing world. (ed.) XXI International Grassland Congress/ VII International Rangeland Congress. Hohhot, China. Vol. 1: 573.

LINKS Non-Degree Training for 2007-2008			
Country	Male	Female	Total
USA	3	0	3
Ethiopia	51	12	63
Kenya	56	6	62
Tanzania	49	16	65
Total	159	34	193

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#### PRESENTATIONS

Kariuki, G., and R. Kaitho. 2008. "Integrating market and forage information for livestock early warning." Presented at the World Vision

International GHA Pastoral Livelihoods Workshop. July 8 – 9, Isiolo, Kenya.

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Kariuki, G., and R. Kaitho. 2008. "The use of ICTs in service delivery, information sharing, and livestock marketing." Paper presented at the CAHNET Regional Experience Sharing Workshop, August, 26 – 27, Arusha, Tanzania.

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 Charles Wanyonyi, MoLFD, Kenya  
 Samuel Yegon, MoLFD, Kenya

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Arid Lands Information Network, Kenya  
Arid Lands Resource Management Project, Kenya  
AU-IBAR, Kenya  
Drought Preparedness and Prevention Commission,  
Ethiopia  
Ethiopian Department of Livestock and Fisheries  
Marketing, Ethiopia  
FAO-EXCELEX Program, Ethiopia  
Farm Africa, Ethiopia  
Famine Early Warning System (FEWS) Djibouti  
FEWS NET – East Africa Regional Office, Kenya  
FEWS Somaliland, Kenya  
Hope for the Horn, Ethiopia  
Inter-governmental Authority on Development  
(IGAD) Climate Prediction and Applications  
Center, Kenya  
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Pastoral and Agro-Pastoral Research Center,  
Ethiopia  
Pastoral Research Institute, Ethiopia  
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Kenya  
World Food Program, Kenya

## LIVESTOCK TRADE AND MARKETING IN ETHIOPIA AND KENYA (LiTEK)

### PROJECT DESCRIPTION

*The LiTEK project is documenting and synthesizing research findings of the GL-CRSP Pastoral Risk Management project. A decade of in-depth, interdisciplinary research by PARIMA in multiple ethnic communities across Ethiopia and Kenya offers an unprecedented, evidence-based, nuanced perspective on contemporary pastoralism in East Africa. The resulting book will explore how pastoralists and their communities have responded to an increasingly risky environment marked by climatic disturbances, armed conflicts, liberalized markets and politico-economic instabilities. The authors do so without losing sight of the fact that these are important but infrequent events in the lives of the pastoralists and argue that there is much to learn from understanding the pastoralists' adaptations to change and their behavior in non-crisis periods that draw comparatively little attention. Ultimately, the book will offer not only a unparalleled perspective on pastoralism as a subject unto itself, but it speaks to several contemporary global debates of consequence including poverty reduction, humanitarian versus long-term development assistance, climate variability, decentralization and community-driven development, and development and insecurity. The manuscript, entitled Changing Livelihoods, Risky Environments: Social and Economic Change among Pastoralists in East Africa is due to be published in 2008.*

### PRINCIPAL INVESTIGATOR

John McPeak (Lead Principal Investigator), Ph.D., Assistant Professor of Public Administration and Economics, Maxwell School, Syracuse University, 336 Eggers Hall, Syracuse, NY 13210, Phone: (315) 443-6146, Email: jomcpeak@maxwell.syr.edu

### SUMMARY OF ACHIEVEMENTS

- Analysis of the PARIMA research shows most pastoralists favor interventions that address basic human needs: access to safe water, health care, and education. Although livestock are central to pastoral systems, they are a distinctly second-order concern behind elementary human needs.
  - Pastoralists are often treated as a homogeneous mass of peoples and places. The project analyses reveals striking heterogeneity, especially over time and space, but also among households within specific pastoralist communities and in certain dimensions, among individuals within households.
- Features of the book that make it unique include:
- *Spatial and cross-cultural coverage.* The study covers different ethnic groups, and its spatial scope extends well beyond a limited set of communities allowing for generalizations about social and economic processes that are not possible with case studies of individual groups.
  - *Longitudinal data over a ten-year period of both drought and post-drought occurrences.* Extensive fieldwork from 1997-2006 in six sites in northern Kenya and five sites in southern Ethiopia provides the core data for analysis. The areas suffered the El Niño floods of 1997-98, a severe drought in 1999-2000, and a major drought again in 2005.

- *Household sampling technique.* The study employed a random household sampling technique based on local administrative units in Kenya and Ethiopia. Many communities of former pastoralists who have settled in the region were therefore included. This has provided insights into the livelihood strategies of expastoralists and settled populations as well as the dynamics of poverty and economic change in the area.
- *Data at multiple scales.* With the systematic collection of data at multiple scales, the study can not only make comparisons across communities but can also explore the behaviors and well being of different households within communities and of different individuals within households.

#### RESEARCH BRIEFS

##### **Documenting the Causes of Livestock Mortality Among Pastoralists in Ethiopia and Kenya**

*Author: John McPeak, Syracuse University*

*Summary.* A major source of risk facing pastoralists is the death of their livestock. Livestock deaths confront households not just due to the lost value of the animal itself, but also from the lost future potential of the animal to provide a flow of livestock products such as milk, blood, transport, or traction in the future. The well known ‘boom and bust’ cycle in arid and semi-arid rangelands is based on widespread, sudden deaths of animals, followed by a long slow process of rebuilding the herd. Researchers asked herders over the course of a boom and bust cycle from 2000 to 2002 to report on the reasons for each animal that died in their herd. This brief presents findings on their responses. The main finding is that deaths attributed to drought (58%) are the leading cause of animal death in the period. Researchers also find that animal disease (28%) and predators (6%) are significant contributors to animal deaths.

##### **In What Ways Are Pastoralists Integrated into the Cash Economy?**

*Author: John McPeak, Syracuse University*

*Summary.* In a prior research brief entitled “How Are They Surviving Out There? An Analysis of Total Income in the PARIMA Study Sites” (GL-CRSP Research Brief 08-02-LiTEK), the author described variation in total income across the PARIMA study sites. Researchers also investigated patterns in how total income was earned. In the current brief, however, the focus is shifted to cash income. The brief first summarizes the role cash income plays in determining total income then addresses how the households in the PARIMA sample obtain cash and discusses the implications of these findings. Information is presented on the degree of inequality in access to different kinds of cash income across households. Lastly, researchers contrast patterns seen in the total income presented in the previous brief with the patterns in cash income reported in this brief. Cash income from livestock sales is found to be most critical, in the sense of the largest percent, to those who have the lowest incomes, whether this is viewed from the perspective of the livelihood categories or the site averages. Livestock remain critical in all sites and are more important as a link to the cash economy in sites where average cash income is lower. In the Ethiopia sites, livestock are responsible for over half of all cash income. In contrast, in Kenya, livestock are generating at most half of total income. This information will thus help to shape policies and interventions to best suit the area in which they are implemented.

**PUBLICATIONS**

Doss, C., J. McPeak, and C.B. Barrett. 2008. "Interpersonal, Intertemporal and Spatial Variation in Risk Perceptions: Evidence from East Africa." *World Development* 36(8): 1453-68.

Little, P., J. McPeak, C.B. Barrett, and P. Kristjanson. 2008. "Challenging Orthodoxies: Understanding Poverty in Pastoral Areas of East Africa." *Development and Change* 39(4): 587-611.

**FORTHCOMING PUBLICATIONS**

Huysentruyt, M., C.B. Barrett, and J. McPeak. "Understanding Declining Mobility and Interhousehold Transfers Among East African Pastoralists." *Economica*.

McPeak, J., C. Doss, C.B. Barrett, and P. Kristjanson. "Do Community Members Share Development Priorities? Results of a Ranking Exercise in East African Rangelands." *Journal of Development Studies*.

**TEAM MEMBERS**

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Cheryl Doss, Yale University  
Peter Little, University of Kentucky  
John McPeak, Syracuse University (*Lead Principal Investigator*)

**COLLABORATING INSTITUTIONS**

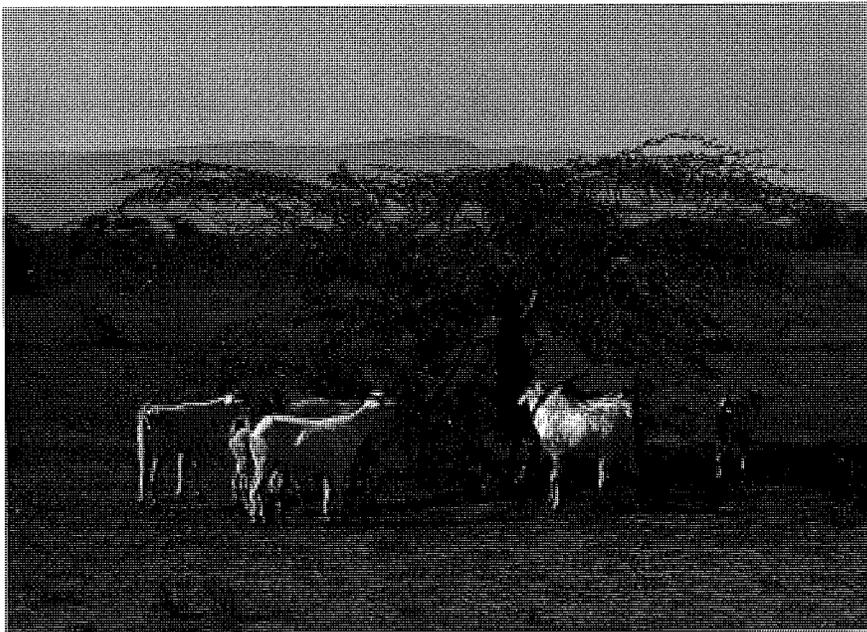
**Syracuse University, Maxwell School (*lead institution*)**

Cornell University, Department of Applied Economics and Management

University of Kentucky, Department of Anthropology

Yale University, Center for International and Area Studies

*For a full list of collaborators associated with the PARIMA research, see the next section.*



*Animal husbandry represents the most economically efficient use of East Africa's rangelands and is thus a crucial element of any viable strategy to support the livelihoods of tens of millions of people in the arid and semi-arid lands of Ethiopia and Kenya. Photo by Christopher Barrett.*

**IMPROVING PASTORAL RISK MANAGEMENT  
ON EAST AFRICAN RANGELANDS  
(PARIMA)**

**PROJECT DESCRIPTION**

*The PARIMA project was established in 1997 and conducts research, training, and outreach in an effort to improve the welfare of pastoral and agro-pastoral peoples with a focus on northern Kenya and southern Ethiopia. Foundation concepts include the exploration of opportunities to better diversify incomes and assets and how to improve access to natural resources, information, and various public services. Creating market linkages for pastoralists is a large component of PARIMA's work to protect against risk and bolster economic security. PARIMA has also facilitated the development of pastoral women's groups, building the capacity of women to manage their resources, identifying key opportunities for investment and designing systems of banking that work in their communities.*

**PRINCIPAL INVESTIGATOR**

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**SUMMARY OF ACHIEVEMENTS**

- In fiscal year 2008, two Kenyan and one Ethiopian graduate students affiliated with the PARIMA project have completed requirements for their degrees. Forty-nine Kenyan and Ethiopian researchers, educators, and extension personnel received non-degree training specifically related to improving their capacity to conduct research or outreach. Furthermore, 1,735 Ethiopian pastoralists received risk management training. As part of the Utah State University-PARIMA study abroad program, four American undergraduates and one American young professional received further education experiences in Ethiopia to expand their knowledge of international development issues.
- As part of the Utah State University-PARIMA study abroad program, four American undergraduate students traveled to Ethiopia to expand their knowledge of international development issues. The course was developed by PARIMA team members in order to expose U.S. university students to issues pertaining to agriculture, poverty and natural resource management in the developing world. Accompanied by relevant readings and Egerton University faculty affiliated with the PARIMA project, the students evaluated the effects of globalization on Ethiopia's economy with respect to livestock production, in addition to visiting several collective action groups initiated by PARIMA.
- The collective-action efforts of PARIMA have led to the mobilization of people in four districts in southern Ethiopia. During 2007-2008, all 60 of the voluntary, collective-action/micro-finance groups were graduated and aggregated into over 20 officially sanctioned and legally supported cooperatives. PARIMA team members estimate that a minimum of 11,000-15,000 local people have benefited directly from the project. No PARIMA-sponsored group has failed in their development progress over the last seven years.

- Three pastoral community leaders, originally mentored by PARIMA, were recognized at a 2008 national meeting by the Ethiopian prime minister as “development heroes and heroines” for their efforts in helping mobilize their communities of Moyale and Negele to create positive change.
- PARIMA conducted training with 1,651 pastoralists that will help them better engage in micro-finance. The training package created by PARIMA includes peer-mentoring, micro-finance and small business management, and livestock marketing. Pastoralists received initial training in 2002, and this year’s training was done as a follow-up for a majority of participants to further improve skills and aptitudes. As a result, participants report more success and confidence when seeking to increase their incomes and diversify their livelihoods.
- The membership of the collective-action/micro-finance cooperatives mentored by the PARIMA project stands at 2,300 (an increase of 215 members since 2006-2007). Women represent 76% of the members, and much of their efforts are focused on improving household milk marketing, a predominately female task. PARIMA has initiated research that seeks to understand how gender relations among pastoralists have been affected by the formation and efforts of these collective-action groups.
- Results of a PARIMA project experimental auction for improved milk quality in Moyale, Kenya indicate that consumers are indeed willing to pay for improved milk quality. For example, compared to younger women, older women would pay a 20% premium for higher-quality milk. Poorer consumers would pay a 19% premium simply for assurances on milk safety. These findings indicate that there are economic incentives to enhance milk quality and justify attention to basic technical and/or organizational interventions that could improve the quality of milk marketed by pastoralists and traders to town residents.
- PARIMA researchers have also confirmed that the cattle “boom-and-bust” cycle on the Borana plateau has strong elements of predictability, at least for the period between 1983 and 2005. This predictability could be important in terms of motivating pastoralists to think about diversifying assets and incomes, as well as helping relief and development agencies plan their activities. Resource degradation, population growth, and rainfall variation, however, may be working in tandem to further alter the production system and inhibit predictability of cattle die-offs. Although the next die-off should occur in 2011, researchers expect it to occur sooner due to these factors.
- In FY08, PARIMA held the annual cross-border meetings between Ethiopia and Kenya. Policy makers, pastoral leaders, and representatives of governmental and non-governmental organizations are present. The purpose of the meetings, held each year since 2001, has been to forge cross-border partnerships and cooperation dealing with trade, natural resource management, and defusing ethnic tensions.
- PARIMA team members conducted a preliminary assessment of women’s health problems among members of six collective-action groups from the Oromia Regional State during 2008. Conventional wisdom from local public-health authorities suggested that malaria and diarrhea would be the most common ailments in the area. PARIMA results, however, indicated that women are most concerned with challenges related to their reproductive health (pregnancy-related problems, sexually transmitted diseases, etc.) Community-action plans have been developed for implementation and include prioritizing attention to training skilled local birth attendants and investing in awareness raising, prevention, and treatment of sexually transmitted diseases.
- The PARIMA project leveraged a total of \$234,969 in fiscal year 2008. \$151,599 of this figure is from USAID buy-ins.

PARIMA Non-Degree Training for 2007-2008			
Country	Male	Female	Total
United States	3	4	7
Ethiopia	473	1396	1869
Kenya	16	1	17
<b>Total</b>	<b>492</b>	<b>1401</b>	<b>1893</b>

## RESEARCH BRIEFS

### What are Consumers in Moyale, Kenya Willing to Pay for Improved Milk Quality?

*Francis O. Wayua, Mohamed G. Shibia, Moses S. Mamo, KARI-Marsabit; Dee Von Bailey and D. Layne Coppock, Utah State University*

*Summary.* Pastoralists in northern Kenya and southern Ethiopia may be able to diversify income by selling milk to urban residents. However, milk sold in open-air markets is often low in quality because it has been transported long distances without refrigeration and is subject to spoilage, and/or because milk is adulterated prior to sale to boost volume or enhance appearance. Open-air markets are characterized by low-income consumers who must make choices about milk quality with virtually no information other than their own sensory perceptions. Researchers used an experimental-auction approach to determine what residents in Moyale, Kenya, are willing to pay (WTP) for improved milk quality. They also created milk samples that varied in taste and texture and asked participants to bid for them in order to reveal the value of their preferences. Results indicate that consumers are indeed willing to pay for improved milk quality. For example, compared to younger women, older women would pay a 20% premium for higher-quality milk. And poorer consumers would pay a 19% premium simply for assurances on milk safety. These findings indicate that there are economic incentives to enhance milk quality and justify attention to basic technical and/or organizational interventions that could improve the quality of milk marketed by pastoralists and traders to the residents of this border town.

### Are Cattle Die-Offs Predictable on the Borana Plateau?

*D. Layne Coppock, Getachew Gebru, and Solomon Desta, Utah State University; Sintayehu Mesele, OARI; Seyoum Tezera, PARIMA project*

*Summary.* Drought regularly affects rangelands and contributes to high death rates for livestock and poverty for pastoralists. But do livestock losses occur randomly simply when rainfall is low, or are they cyclical and predictable? Previously, PARIMA researchers proposed that high stocking rates—combined with low rainfall—trigger livestock die-offs on the Borana Plateau. It takes about six years for animal numbers to recover, setting the stage for another die-off when a dry year occurs. This “boom-and-bust” cycle is based on observed herd crashes in 1983-5, 1991-3, and 1998-9. Researchers predicted in 2002 that the next major die-off would occur during 2004-06. One goal of this brief is therefore to report on recent observations. Researchers also examined ecological change in relation to livestock patterns. Results confirm that a major crash occurred during 2005, verifying the prediction. The rangelands have been degraded by decades of heavy livestock grazing, resulting in bush encroachment and topsoil erosion. The questions remains as to whether the next livestock crash will occur “on schedule” around 2011. Researchers think not and expect the crash to occur sooner. Furthermore, they speculate that the production system is rapidly changing, a view shared by local pastoralists. Livestock carrying capacity is declining and animal die-offs will become more frequent and irregular.

### Successful Implementation of Collective Action and Human-Capacity Building Among Pastoralists in Southern Ethiopia: Lessons Learned, 2001-2008

*Seyoum Tezera, PARIMA Project; Solomon Desta, Getachew Gebru, and D. Layne Coppock, Utah State University*

*Summary.* Since 2000, the PARIMA project has implemented pilot risk-management activities



*Community members from southern Ethiopia engage in a participatory mapping effort to determine the health needs of pastoral women on the Borana Plateau. Photo by Seyoum Tezera.*

among poverty-stricken, semi-settled pastoralists in southern Ethiopia. The goal has been to improve human welfare via collective action and capacity building. Outcomes include progress in income generation, asset conservation, and livelihood diversification. The approach has been unique to southern Ethiopia in that a bottom-up, participatory perspective has dominated. It has focused on the priorities and felt needs of local people rather than development of livestock or agricultural technology. Fifty-nine collective-action groups were created. Dominated by women, they have included over 2,300 members and most groups have been recently merged to form cooperatives. Not one group has failed and many group members have emerged as key leaders of large cooperatives that include a wider variety of recruits. Creating sustainable impacts via collective action and capacity building requires time, patience, and skill—it is not a quick fix. The process of taking raw, illiterate volunteers and transforming them into functional and sustainable groups took three years on average. Ten lessons for success are forwarded as guidelines for pastoral development under similar circumstances.

### **Preliminary Perspectives on the Health Needs of Pastoral Women on the Borana Plateau Using Participatory Approaches**

*Seyoum Tezera, PARIMA Project;  
Solomon Desta and D. Layne  
Coppock, Utah State University*

*Summary.* Since 2000, the PARIMA project has conducted participatory research and outreach among pastoralists in southern Ethiopia. This has led to notable achievements in forming collective-action groups dominated by women, stimulation of sustainable micro-finance and micro-enterprise activities, and improving linkages of pastoral producers to livestock markets. Despite such gains, there are many

other challenges to be addressed. One is poor human health. Researchers used participatory and qualitative methods to conduct a preliminary assessment of women's health problems among members of six, established collective-action groups from the Borana and Gugi zones in the Oromia Regional State during 2008. Conventional wisdom from local public-health authorities suggested that malaria and diarrhea would be the most common ailments in the area. PARIMA results, however, indicated that women are most concerned with challenges related to their reproductive health (pregnancy, sexually transmitted diseases, etc.). Community-action plans have been developed for implementation and include prioritizing attention to training skilled local birth attendants and investing in awareness-raising, prevention, and treatment of sexually transmitted diseases. Improved health could have major effects on the welfare of pastoral women and the economic performance of collective-action groups.

**PUBLICATIONS**

Coppock, D.L., S. Desta, S. Tezera, and G. Gebru. 2008. "An innovation system in the rangelands: Using collective action to diversify livelihoods among settled pastoralists in Ethiopia." In *Innovation Africa: Enriching Farmer's Livelihoods*, ed. A. Waters-Bayer, C. Wettasinha, J. Njuki, P. Sanginga, and S. Kaaria. London: EarthScan, 104-119.

*Volume II: Proceedings of the 2008 Joint Meeting of the XXI International Grassland Congress and the VIII International Rangeland Congress*, July 9-12, Hohhot, China: 970.

Coppock, D.L., G. Gebru, S. Mesele, and S. Desta. 2008. "Are drought-related crashes in pastoral cattle herds predictable? More evidence of equilibrium dynamics from the southern Ethiopian rangelands." In *Multifunctional Grasslands in a Changing World, Volume II: Proceedings of the 2008 Joint Meeting of the XXI International Grassland Congress and the VIII International Rangeland Congress*, July 9-12, Hohhot, China: 1090.

**THESES/DISSERTATIONS**

Kebede, A. 2008. *Sustaining the Allideghi Grassland of Ethiopia: Influences of Pastoralism and Vegetation Change*. PhD diss., Department of Wildland Resources, Utah State University.

Desta, S., D. L. Coppock, G. Gebru, S. Tezera, and L. Gizachew. 2008. "Sustaining pastoral linkages to high-value livestock markets through collective action and public/private partnerships." In *Multifunctional Grasslands in a Changing World, Volume II: Proceedings of the 2008 Joint Meeting of the XXI International Grassland Congress and the VIII International Rangeland Congress*, July 9-12, Hohhot, China: 1071.

Mutinda, M. *Vulnerable Key Pastoral and Agro-Pastoral Resources in Baringo District, Kenya: Their Inventory, Management, and Rehabilitation*. PhD diss., Faculty of Environmental Science and Resource Development (FERD), Egerton University.

Ole Kai Kai, N. 2008. "Resource conditions and their influence on the well-being of communities in Marigat Division of Baringo District, Kenya." Master's thesis, Faculty of Environmental Science and Resource Development (FERD), Egerton University.

Gebru, G., D. Amosha, S. Desta, L. Gizachew, A. Kebede, and D.L. Coppock. 2008. "Engaging stakeholders to implement community-based rangeland rehabilitation plans in southern and northeastern Ethiopia." In *Multifunctional Grasslands in a Changing World, Volume II: Proceedings of the 2008 Joint Meeting of the XXI International Grassland Congress and the VIII International Rangeland Congress*, July 9-12, Hohhot, China: 1103.

**PROCEEDINGS**

Aboud, A.A., I. Tura, M. Mutinda, E. Lentoror, and D.L. Coppock. 2008. "Integrating the intensive and extensive rangeland management systems: The ideal choice for the Marsabit pastoralists, Kenya." In *Multifunctional Grasslands in a Changing World*,

Keya, G., M. Muga, M. Okoti, A. Adongo, M. Ngutu, D. Mbuvil, F. Wayua, and M. Shibia. 2008. "A participatory assessment of the development

PARIMA Degree Training for 2007-2008					
Name (Last, First)	Nationality	Gender (M/F)	University	Discipline	Degree
Kebede, Aimaz	Ethiopian	F	Utah State University	Range Ecology	PhD
Mutinda, Mark	Kenyan	M	Egerton University	Human Ecology	PhD
Ole Kai Kai, Nicholas	Kenyan	M	Egerton University	Human Ecology	MS

needs of semi-sedentary pastoralists in Kenya.” In *Multifunctional Grasslands in a Changing World, II: Proceedings of the 2008 Joint Meeting of the XXI International Grassland Congress and the VIII International Rangeland Congress*, July 9-12, Hohhot, China: 1105.

Mutinda, M., A.A. Aboud, and D.L. Coppock. 2008. “Community perceptions concerning key ecological resources at risk in Baringo District, Kenya.” In *Multifunctional Grasslands in a Changing World, Volume II: Proceedings of the 2008 Joint Meeting of the XXI International Grassland Congress and the VIII International Rangeland Congress*, July 9-12, Huhhot, China: 1005.

#### PRESENTATIONS

Amosha, D., G. Gebru and S.Desta. 2008. “Participatory community rangeland management and intervention options.” Invited presentation at the Borana Zone Pastoral Meeting on Awareness Raising and Formation of the Zonal and Woreda-Level Natural Resources Management Task Force, September 21-25, Yabello, Ethiopia.

Coppock, D.L., S. Desta, G. Gebru, and S. Tezera. 2008. “Collective action and capacity building reduces vulnerability among pastoralists.” Volunteer poster presented at the Second Joint Annual Conference of the American Forage and Grassland Council (AFGC) and the Society for Range Management (SRM), January 26-31, Louisville, Kentucky. Abstract on CD for the AFGC/ SRM Conference Proceedings.

Desta, S. and G. Gebru. 2008. “Changing pastoral livelihood strategies in a changing environment.” Invited Paper presented at a workshop on Improving Afar Pastoralist Livelihoods through Enhancing Livestock Production, Productivity and Market Access, August 30-31, Awash Buffet Hotel, Awash, Ethiopia.

Desta, S. and G. Gebru. 2008. “Pastoral livelihood strategies in Ethiopia past, present and

future.” Invited paper presented at CARE-Ethiopia Pastoralist Livelihoods Initiative (PLI) Lessons-Learned Bazaar, July 15-16, Global Hotel, Addis Ababa, Ethiopia.

Desta, S., G. Gebru, and D. Amosha. 2008. “Pastoralism: Concepts, research, development and the future.” Volunteer paper presented at the World Vision-Ethiopia Training Workshop on Pastoralism, September 17, Global Hotel, Addis Ababa, Ethiopia.

Desta, S., G. Gebru, and D. Amosha. 2008. “Pastoral development in Ethiopia: Lessons learned from over 50 years of experience.” Volunteer paper presented at the World Vision Training Workshop on Pastoralism, September 17, Global Hotel, Addis Ababa, Ethiopia.

Desta, S., S. Tezera, G. Gebru and D. Amosha. 2008. “Collective action and capacity building to empower pastoralists and alleviate poverty in southern Ethiopia: Successes and challenges for sustainability.” Invited paper presented at CARE-Ethiopia Pastoralist Livelihoods Initiative (PLI) Lessons-Learned Bazaar, July 15-16, Global Hotel, Addis Ababa, Ethiopia.

Gebru, G. and S. Desta. 2008. “Linkage of the Afar pastoral producers to primary markets: Challenges and opportunities.” Invited paper presented at a workshop on Improving Afar Pastoralist Livelihoods through Enhancing Livestock Production, Productivity and Market Access, August 30-31, Awash Buffet Hotel, Awash, Ethiopia.

Gebru, G. and S. Desta. 2008. “PARIMA’s experience on linking research to development.” Invited presentation for the Establishment of the Afar Regional Research and Extension Council, February 14, Awash Buffet Hotel, Awash, Ethiopia.

Gebru, G., B. Hurrissa, Y. Aklilu and S. Desta. 2008. “Commercialization of livestock production in the pastoral areas of Ethiopia: Issues.” Invited paper presented at the Ethiopian Society of Animal Production (ESAP) Annual Conference, October

8-10, Ethiopian Institute of Agricultural Research (EIAR), Hiruye Hall, Addis Ababa, Ethiopia.

Gebru, G., D. Amosha and S. Desta. 2008. "Alternative uses of *Prosopis juliflora*: Global perspectives." Invited presentation at the Harmonization Workshop on *Prosopis*, April 2-3, Awash Buffet Hotel, Awash, Ethiopia.

Gebru, G., D. Amosha and S. Desta. 2008. "Stakeholder alliance on the application of prescribed fire in Borana and Guji Zones." Invited paper presented at CARE-Ethiopia Pastoralist Livelihoods Initiative (PLI) Lessons-Learned Bazaar, July 15-16, Global Hotel, Addis Ababa, Ethiopia.

Gebru, G., S. Desta, and D. L. Coppock. 2008. "Linking pastoral producers to markets: Innovative experiences from the southern Ethiopian rangelands." Invited presentation at the International Seminar EU-Africa: Challenges for Rural Development and the Animal Health Control Organization Veterinarios sem Fronteiras Portugal, June 5-7, Faculdade de Medicina Veterinária, Pólo Universitário do Alto da Ajuda, Lisbon, Portugal.

LaMalfa, E., G. Gebru, T. Sexton, D. Amosha, S. Moats, R. Morrow, F. Taffa, L. Gizachew, D. Dallas, and D.L. Coppock. 2007. "Re-introduction of managed fire in the pastoral production systems of the southern Ethiopian rangelands." Volunteer poster presented at the Human Dimensions of Wildland Fire Conference, October 23-25, Fort Collins, Colorado.

Radel, C. 2008. "Study abroad, service learning, and critical perspectives on development." Invited panel presentation at the Annual Meeting of the Association of American Geographers, April 15-19, Boston, Massachusetts.

## REPORTS

Coppock, D.L., S. Desta, G. Gebru, E. LaMalfa, and G. Getachew (compilers). 2008. *Summary of the PARIMA 2008 Annual Meeting*, 16-19 March, Yabelo, Ethiopia.

LaMalfa, E. 2008. *Guidelines for the application of prescribed fire in the Borana rangelands of Ethiopia*. CARE-Ethiopia Pastoral Livelihoods Initiative (PLI).

LaMalfa, E., G. Gebru, D. Amosha, and D.L. Coppock. 2008. *Guidelines for monitoring the effects of prescribed fire in the Borana rangelands of Ethiopia*. CARE-Ethiopia PLI.

## AWARDS AND RECOGNITIONS

*PARIMA team members were recognized on several occasions for their contributions to livestock and community development in East Africa.*

The PARIMA team based in Ethiopia received a gold medal for outstanding project achievement for research and outreach work among pastoral communities on the Borana Plateau from the Ethiopian Society for Animal Production (ESAP) at the ESAP Annual Meeting held in Addis Ababa in October of 2007.

At the same meeting, PARIMA team member Dr. Getachew Gebru received a gold medal for outstanding professional contributions to ESAP.

Three PARIMA pastoral community leaders, Ms. Amino Ali (Negele), Mr. Abduba Haleke (Moyale), and Ms. Dikayo Woticha (Moyale), received recognition as "development heroes and heroines" for their collective-action leadership and community achievements from Ethiopian Prime Minister Meles Zenawi at the Annual National Pastoralist Day Celebration. The celebration was held in Adama, Ethiopia in February of 2008.

PARIMA team member Dr. Solomon Desta was elected to the Continuing Committee of the International Rangelands Congress (IRC) as a representative for sub-Saharan Africa. The Continuing Committee oversees planning for the following congress to be held in Argentina in 2011. This election occurred at the VIII International Rangelands Congress in Hohhot, China during July of 2008.

## TEAM MEMBERS

Abdillahi Aboud, Egerton University  
DeeVon Bailey, Utah State University  
D. Layne Coppock, Utah State University (*Lead  
Principal Investigator*)  
Solomon Desta, Utah State University  
Getachew Gebru, Utah State University  
Lemma Gizachew, Oromia Agricultural Research  
Institute (OARI)  
Aliye Hussen, OARI  
George Keya, Kenya Agricultural Research Institute  
(KARI)  
Simon Kuria, KARI  
Joe Marere, International Livestock Research  
Institute (ILRI)  
Claudia Radel, Utah State University

## COLLABORATING INSTITUTIONS

**Utah State University, Department of Environment  
and Society (*lead institution*)**  
CARE-Ethiopia  
Egerton University, Kenya  
International Livestock Research Institute (ILRI),  
Ethiopia  
International Livestock Research Institute (ILRI),  
Kenya  
Kenya Agricultural Research Institute (KARI)  
Oromia Agricultural Research Institute (OARI),  
Ethiopia  
Oromia Cooperative Promotion Commission  
(OCPC), Ethiopia  
Oromia Pastoral Area Development Commission  
(OPaDC), Ethiopia  
USAID Mission to Ethiopia  
Utah State University, Department of Economics



## **ZOONOTIC DISEASES**

### **AVIAN FLU SCHOOL (AFS)**

**HEALTH FOR ANIMALS AND LIVELIHOOD IMPROVEMENT  
IN THE RUNGWA-RUAHA ECOSYSTEM IN TANZANIA (HALI)**



## AVIAN FLU SCHOOL (AFS)

### PROJECT DESCRIPTION

*The Avian Flu School (AFS) was designed to help minimize the health and economic impact of H5N1 highly pathogenic avian influenza (HPAI) by providing the training necessary to improve a community's ability to prevent, respond to and recover from an outbreak of HPAI. The AFS collaborates with faculties of veterinary medicine, the ministries of agriculture and health and with various international agencies involved in HPAI response to conduct effective training courses. The multi-tiered, train-the-trainer program is designed to educate animal health, public health, and agricultural extension workers about HPAI, enabling them to deliver this information at the community level in developing countries. The project works at three levels. Tier I is the training of instructors among existing professionals at the national level. Tier II is the training of district veterinarians, agricultural extension staff, wildlife managers and public health workers and is to be conducted by the new AFS instructors, trained in Tier I. Tier III works at the village level, whereby individuals trained in Tier II further transfer their knowledge and skills to community leaders and villagers. Additionally, the AFS implemented a village-level training and research project in three regions of Tanzania where Newcastle disease vaccinations are being conducted and monitored.*

### PRINCIPAL INVESTIGATORS

Carol J. Cardona (Lead Principal Investigator), D.V.M., Ph.D., A.C.P.V., Associate Veterinarian, Associate Extension Specialist, Population, Health and Reproduction, Veterinary Medicine Extension, School of Veterinary Medicine, University of California, Davis, CA 95616, Phone: (530) 754-4041, Email: cjcardona@ucdavis.edu

David Bunn (Project Manager), M.S., Analyst, Wildlife Health Center, University of California, Davis, TB 128 Old Davis Rd., Davis, CA 95616, Phone: (530) 752-3122, Email: dabunn@ucdavis.edu

Peter Lawrence Msoffe (Co-Principal Investigator), Bv.S.C., Ph.D., Department of Veterinary Medicine and Public Health, Sokoine University of Agriculture, P. O. Box 3021, Chuo Kikuu, Morogoro, Tanzania, Email: msoffep1@suanet.ac.tz

### SUMMARY OF ACHIEVEMENTS

- Newcastle disease vaccination of chickens undertaken by AFS in the three wards of Iringa, Morogoro and Mtwara, Tanzania, resulted in zero identified and/or documented Newcastle disease outbreaks during FY 08 in all project sites, a marked improvement over previous years when in 2006, 53% of households in the three research project sites reported outbreaks, and in 2007 16% of households reported outbreaks after only one round of vaccination.
- In the Iringa District, Tanzania, AFS community mobilization activities for vaccinating chickens have been so effective, that the District has formally adopted poultry vaccination as a district-wide priority development program. Declaring May 5, 2008 "Kuku Day" (Chicken Day), officials launched a district-wide Newcastle vaccination program based on the results of the AFS village-level Newcastle disease and Avian Flu control project.

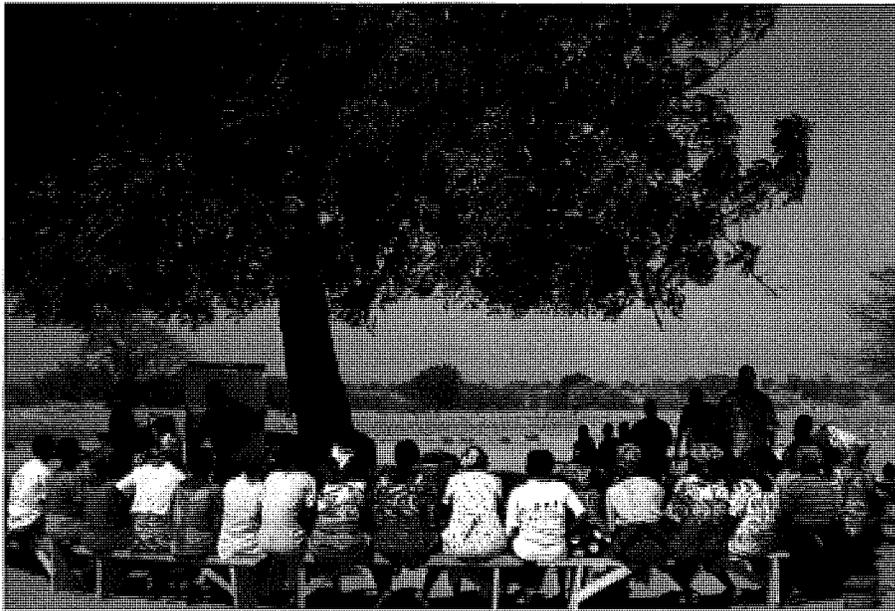
AFS Non-Degree Training for 2007-2008			
Country	Male	Female	Total
Ghana	7	23	30
Kenya	15	11	26
Tanzania	230	137	367
Uganda	19	6	25
<b>Total</b>	<b>271</b>	<b>177</b>	<b>448</b>

briefing of local leadership, in addition to the primary project focus of training community implementers, women's groups and other local groups in disease education and poultry health. In fiscal year 2008, 326 local community leaders participated in trainings throughout the various wards and districts in East and West Africa where AFS is active.

- In fiscal years 2007 and 2008, the AFS program has trained over 140 Avian Flu prevention and response instructors from the ministries of animal health, public health and faculties of veterinary medicine in eleven African countries, including Nigeria, Kenya, Tanzania, Uganda, Ghana, Djibouti, Benin, Rwanda, Burundi, Sudan, and Ethiopia.
- With regard to the village-level Newcastle disease vaccination and poultry health training, women's groups have been one of the targeted audiences for the training and implementation of the program, as women traditionally take care of poultry production and health in rural African households. In fiscal year 2008, 137 women were trained at the local level, up from 74 in 2007.
- The AFS project design has been very effective in mobilizing communities through the
- In Tanzania, over 500 community leaders and public officials have been trained in the basics of poultry vaccination for Newcastle disease and the benefits of improving poultry health. In addition, thousands of rural households in the Iringa District, and hundreds of households within the study areas of Morogoro and Mtwara are benefiting from the AFS Newcastle disease vaccination program and overall improvements in poultry health related to AFS outreach and poultry production education efforts.
- To build the sustainable capacity for the poultry vaccination and biosecurity improvement objectives of the project, AFS formed farmers groups and trained group leaders across three wards in Tanzania: Mlowa, Ufukoni, and Mzumbe. To date, AFS has formed 37 farmer's groups in Mzumbe ward, with leaders from 20 groups receiving training on formation and sustaining groups, writing of group constitutions,

*Dr. Carol Cardona leads a laboratory session of the AFS in Morogoro, Tanzania. Twenty-two Tanzanian veterinarians, public health and agricultural extension staff participated in the training-of-trainers program. In the laboratory session, participants learned how to teach the collection of diagnostic samples from chickens. Photo by David Bunn.*





*The AFS Poultry Health for Development Program conducted village poultry health and production courses for women participating in the ENAM Program in Ghana. The women from the Navrongo ENAM community in northern Ghana are seated in the shade of a tree for the training course, which involved demonstrations of chicken and guinea fowl husbandry and vaccination. Photo by David Bunn.*

and work plans. Group formations are underway in Mlowa and Ufukoni wards. A total of 345 farmers, group leaders, veterinarians and other animal health workers attended these AFS workshops, including 132 women.

- AFS partnerships with local faculties of veterinary medicine and animal science to implement the AFS program and village-level vaccination and poultry health strategies has the benefit of building local capacity at African universities. In addition, AFS also builds the training capacity of the ministries of health, agriculture and veterinary services by training staff of these ministries to conduct animal health workshops on Avian Flu and other topics including adult training methods. Between 18 and 22 faculty or ministry staff have been trained to teach others in each of the project countries of Tanzania, Kenya, Uganda, and Ghana.
- The three faculties of veterinary medicine at the University of Nairobi in Kenya, Makerere University in Uganda, and the Sokoine University of Agriculture in Tanzania are utilizing portions of the AFS curriculum in the instruction of veterinary students in poultry medicine, ensuring attention to village-level poultry production and

health issues for all up and coming veterinary health practitioners.

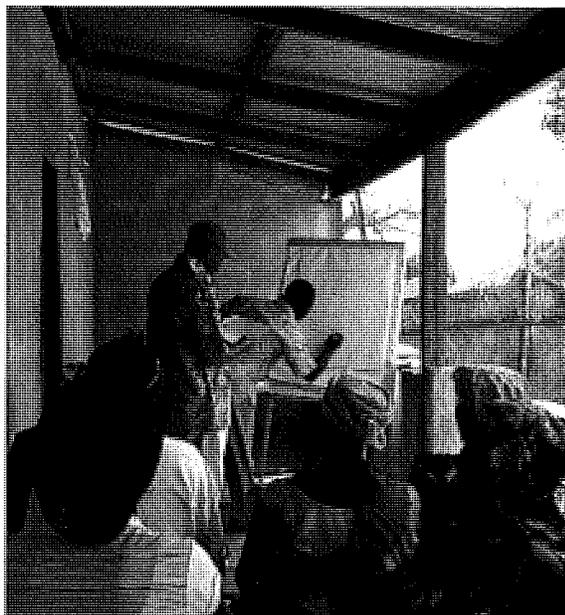
- A village poultry centre established by AFS at the Sokoine University of Agriculture is scheduled for launch in December 2008, part of the project's efforts to create an Africa-specific poultry health curriculum for training field veterinarians. AFS team members from Ghana, Togo, Uganda, Kenya and Tanzania conducted and evaluated the Poultry Health and Disease (PHD) Pilot Course featuring the new poultry health curriculum and field guide in Morogoro, Tanzania. The participants included 21 field veterinarians from across the country.
- In addition to the village poultry center and poultry disease handbook, AFS has developed and begun field-testing of an Africa-specific guide to clinical diagnoses of poultry diseases. AFS team members collected and tested samples from more than 200 sick chickens to validate the guide to clinical diagnoses of poultry diseases.
- The AFS project leveraged a total of \$459,000 in fiscal year 2008. \$109,000 of this figure is from USAID buy-ins.

## RESEARCH BRIEFS

**A Poultry Health Program for Developing Countries**

*Authors: Carol Cardona, University of California, Davis; Peter Msoffe, Sokoine University of Agriculture; George Aning, University of Ghana; Paul Mbutia, University of Nairobi; Denis Byarugaba, Makerere University; and David Bunn, Heather Zornetzer, and Suzanne Byrd, University of California, Davis.*

*Summary.* The GL-CRSP Poultry Health for Development Project was developed in response to the need among rural households in Africa for information to prevent poultry diseases and to improve production. Poultry is a vital resource for rural families and communities across Africa. Women and children at the village level often raise chickens, ducks, guinea fowl, and other poultry. Besides providing food for immediate consumption, the sale of eggs and birds provides money to buy food during droughts, to purchase materials for the home, and pay for school fees and health care during an emergency. Unfortunately, poultry diseases kill as much as 80 percent of the smallholder poultry in Africa. Yet there are cheap and effective vaccines and treatments for the common poultry diseases, such as Newcastle disease (ND) and fowl pox, and there are husbandry practices that improve production. However, there is no Africa-specific curriculum to train veterinarians and extension staff on how to assist communities to improve poultry health and production. This project developed and piloted a new poultry health and production curriculum for training in Africa. The curriculum includes a new clinical signs and necropsy diagnostic decision-tool. The new PHD curriculum is now available for use by extension training programs across Africa.



*At the village level, the AFS project uses a variety of mechanisms to train communities. Women's groups were utilized in Ufukoni ward in Tanzania and in Ghana (pictured). Drama was a popular technique used in Tanzania. Photo by David Bunn.*

**An Overview of the Newcastle Disease – Avian Influenza Control Research Project**

*Authors: Peter Msoffe, Sokoine University of Agriculture and Carol Cardona, University of California, Davis.*

*Summary.* The GL-CRSP Newcastle Disease-Avian Flu Control Research Project, a sub-project under the Avian Flu School, is aimed at designing a sustainable system for Newcastle disease vaccination programs in rural villages, assessing the prevalence of poultry diseases, and designing methods and strategies for improving poultry health at the village level in Tanzania. The project involved five major activities across villages in three wards selected for the study:

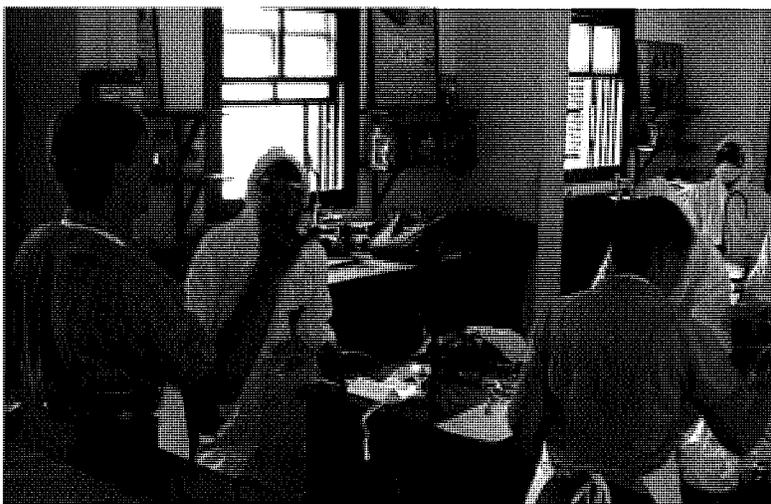
AFS Degree Training for 2007-2008					
Name (Last, First)	Nationality	Gender (M,F)	University	Discipline	Degree
Knueppel, Danielle	USA	F	UC Davis	International Agricultural Development	MSc

1) the support of local leaders to ensure the long-term sustainability of district- and village-level efforts to improve poultry health and productivity; 2) the training of village chicken vaccinators and record-keepers to implement the vaccination program and to provide adequate documentation of chicken disease, productivity, and the impact of the Newcastle disease vaccinations; 3) the vaccination of village chickens by village vaccinators in the selected villages; 4) conducting socio-economic surveys in a sample of households participating in the project to assess the importance of chicken production to their livelihoods; and 5) the collection and evaluation of diagnostic samples of poultry diseases in project villages. To date, the project has organized, supervised and conducted ND vaccination twice in all three wards and thrice in Iringa and Mtwara. Project results indicate that the briefing and training of local policymakers and of local agricultural leaders is very important to the success and sustainability of village-level Newcastle disease vaccination programs and poultry development efforts, and that Newcastle disease vaccination yields dramatic and rapid increases in the productivity of village chickens. Furthermore, university-based poultry veterinary scientists may serve as key extension agents for the improvement of poultry health and productivity at the village level.

### **A Socioeconomic Impact Assessment of a Chicken Newcastle Disease Vaccination Project on Households in Rural Tanzania**

*Author: Danielle Knueppel, University of California, Davis.*

*Summary.* The purpose of this study was to assess the socioeconomic impact of a chicken Newcastle disease vaccination project on villagers and households in rural Iringa, Tanzania. Key informant interviews and a cross-sectional survey were conducted in February and March 2008. Households that took part in the survey were located in either one of the three project villages, where chickens were vaccinated for Newcastle disease, or one of the three control villages, where chickens were not vaccinated. Findings showed that households in the project villages kept significantly more chickens than households in control villages. There was no significant difference in income earned from chicken and egg sales between households in project and control villages. Likewise, no significant difference in the frequency of chicken consumption among mothers and children from project and control village households was found. However, both mothers and children from project village households consumed eggs more frequently than mothers and children from control village households. Women in project villages reported higher measures of empowerment than women in control villages, and households in project villages showed a trend towards less household food insecurity. Interestingly, measures of support for the vaccination of chickens were greater in control villages than in project villages. Based on these findings, the vaccination of chickens against Newcastle disease appears to have a beneficial impact for rural households involved in small-scale, indigenous chicken production.



*David Bunn directs participants at the Avian Flu School laboratory session in Ghana, July 2007. Photo by Carol Cardona.*

#### FORTHCOMING PUBLICATIONS

Beltran-Alcrudo, D., D. Bunn, C.E. Sandrock, and C.J. Cardona. 2008. "Avian Flu School, a training approach to prepare for H5N1 highly pathogenic avian influenza." Sokoine University of Agriculture, Faculty of Veterinary Medicine.

#### TEAM MEMBERS

Nicole Anchell, University of California, Davis (UCD) Veterinary Extension  
George Aning, University of Ghana  
Walter Boyce, UCD Wildlife Health Center  
David Bunn, UCD Wildlife Health Center (*Project Coordinator*)  
Denis Byarugaba, Makerere University Faculty of Veterinary Medicine  
Carol Cardona, UCD Veterinary Extension (*Lead Principal Investigator*)  
Paul Mbutia, University of Nairobi Faculty of Veterinary Medicine  
Ayubu Msago, Wildlife Conservation Society, (WCS) Tanzania  
Peter Msoffe, Sokoine University of Agriculture Faculty of Veterinary Medicine  
Amandus Muhairwa, University of Agriculture Faculty of Veterinary Medicine  
Madundo Mtambo, University of Agriculture Faculty of Veterinary Medicine  
H.A. Mwamhehe, Veterinary Investigation Center Veterinary Services, Tanzania  
Christian Sandrock, UCD Medical School

#### COLLABORATING INSTITUTIONS

**University of California, Davis Wildlife Health Center, School of Veterinary Medicine, California, USA (*lead institution*)**  
District Councils in Iringa, Mtwara-Mikindani, and Mvomero, Tanzania  
Department of Veterinary Services, Kenya  
GL-CRSP ENAM Project  
Heifer Project International, Ghana  
HISANI Arts Community Theatre Project, Tanzania  
Makerere University, Uganda  
Ministry of Agriculture, Animal Industry and Fisheries, Uganda  
Ministry of Health, Kenya  
Ministry of Health, Uganda  
Ministry of Livestock and Fisheries Development, Kenya  
Veterinary Investigation Center, Tanzania  
Sokoine University of Agriculture, Tanzania  
University of Nairobi, Kenya  
Welcome Trust, Tanzania (Project on the Improvement of Livelihoods of the Rural Poor through Education on Health, Management, and Marketing of Free-Range Local Chickens)  
WCS, Tanzania Ruaha Landscape Program  
University of Ghana

**HEALTH FOR ANIMALS AND LIVELIHOOD IMPROVEMENT IN  
THE RUAHA ECOSYSTEM, TANZANIA  
(HALI)**

**PROJECT DESCRIPTION**

*Recognizing the threat of diseases that are transferable from animals to humans, or zoonoses, and understanding their origins allow for the development of prevention and risk mitigation strategies to protect both the original reservoir hosts and wildlife, as well as domestic livestock and human organisms to which they are vectored. The Health for Animals and Livelihood Improvement (HALI) project was established in 2006 and is a stakeholder-driven research and capacity-building program to assess the effects of zoonotic disease and water management on animal health, biodiversity, and livelihoods in the Ruaha ecosystem, Tanzania.*

**PRINCIPAL INVESTIGATOR**

Jonna Mazet (Lead Principal Investigator), D.V.M., M.P.V.M., Ph.D., Professor, Department of Medicine and Epidemiology, Co-director, Wildlife Health Center, University of California, Davis, CA 95616, Phone: (530) 754-9035, Email: jkmazet@ucdavis.edu

Deana Clifford (Project Coordinator), M.P.V.M., Ph.D., Associate Veterinarian, Wildlife Health Center, TB 128–Old Davis Road, Davis, CA 95616, Phone: (530) 752-5603, Email: dlclifford@ucdavis.edu

**SUMMARY OF ACHIEVEMENTS**

- HALI project team members have detected bovine tuberculosis (BTB), a proven threat to carnivores and ungulates, in wildlife and sympatric cattle in the Ruaha ecosystem, one of the largest intact conservation areas remaining in Africa. BTB also poses a threat to human populations, and represents a significant zoonotic disease of interest for areas with high concentrations of wildlife, livestock, and rural human inhabitants. Stemming the spread of BTB among wildlife and livestock is essential to species conservation, and integral to overall ecosystem health.
- Due to the isolation of *Mycobacterium bovis*, the causative agent of bovine tuberculosis, from a buffalo and an impala, the HALI team has been granted permission by the Tanzanian government to sample 35 live buffalo for bovine tuberculosis, an important step in understanding the burden of disease among the buffalo population, a particularly vulnerable group for infection with bovine tuberculosis.
- In collaboration with the community-based wildlife management association (MBOMIPA) and Ruaha National Park, tissues have been collected from an additional 23 wild animals (including HALI's first animal from within the Ruaha National Park boundaries). Tissues are currently being cultured for tuberculosis at Sokoine University of Agriculture (SUA). HALI researchers are continuing to collect samples from wildlife to determine the prevalence and species distribution of infection and to identify geographic areas where risk of bovine tuberculosis transmission between wildlife and livestock may be high.



HALI team member Howard Kombe testing a goat for TB in one of the HALI project households. Photo by Julius John.

trade and health at 18 households. Results from the socio-economic study are currently being analyzed and prepared for publication, and should be released in Spring 2009.

- Sampling of livestock (n=919 cattle) at rural households to date as part of HALI project livestock disease surveillance efforts indicates that 21% have positive tuberculosis reactors. In addition, project researchers have collected 228 lymph node samples, 191 serum samples, 35 reproductive tracts, and 2 lung samples (animals with suspect lesions) from slaughtered livestock in the region. Samples are being cultured for *Mycobacterium bovis*, the causative agent of bovine tuberculosis, and Brucella exposure at SUA. Data indicate that at least 5% of lymph nodes are positive for *M. bovis*, including four small ruminants. Isolation of BTB in lymph nodes from slaughtered sheep and goats is of interest as not much attention has been paid to a potential role for small ruminants in bovine tuberculosis transmission.
- Project researchers have completed 159 socioeconomic surveys of pastoralist households during the wet season, and conducted a smaller survey in both the wet and dry seasons on a subset of 30 households. Additionally, the team completed village stakeholder meetings in 20 villages and administered household diaries to study detailed patterns of consumption,

- HALI project research has identified disease as the number one reported cause of livestock deaths in the Ruaha ecosystem. To date, 62 pastoral rural households have benefited from HALI project interventions on tuberculosis and other pathogen testing in their livestock herds, and through disease counseling to improve the health of their livestock and families.

• HALI project research investigating zoonotic disease indicates that 75% of the family members in the 159 vulnerable study households have never been tested for tuberculosis. Vulnerable groups, including those infected with HIV, are at higher risk of contracting infectious diseases being studied by HALI, especially tuberculosis. As the majority of households in the HALI study are located more than a one-hour walk from a health clinic or dispensary, HALI project efforts to investigate disease and provide education and prevention programs in these marginalized communities are critical to promoting their health and inclusion in disease prevention and treatment programs.

- HALI project research indicates that 67% of the 159 study households reported sharing drinking water with livestock, while only 18% of these households thought sharing water with livestock posed a disease transmission risk. In addition, 65% of study households reported that

HALI Non-Degree Training 2007-2008			
Country	Male	Female	Total
USA	5	18	23
Tanzania	422	242	664
<b>Total</b>	<b>427</b>	<b>260</b>	<b>687</b>

wildlife entered their source of drinking water. So far, investigations into water quality in these water sources identified 19 species of *Salmonella* bacteria and the protozoal parasites *Giardia* and *Cryptosporidium*, illustrating a greater need for public health education and water quality improvements in the region.

- Currently, conducting bacterial and protozoal isolation work is not feasible for Tanzanian agencies, and the HALI project is providing important water quality data, including data on pathogen loading and disease, to the Rufiji Basin Water Office, the government body charged with managing the watershed in Ruaha. HALI's collaboration with the Rufiji Basin Water Office represents a critical step towards improving water quality monitoring and surveillance in the Watershed, and towards improving access to clean water for rural Tanzanians.
- In fiscal year 2008, HALI project team members briefed 38 community leaders (including 9 women) representing all 21 villages in the project study area on disease and socio-economic research findings, leading to enhanced cooperation and collaboration through a workshop focusing on the assessment of community-level tradeoffs for future interventions in development and agriculture. Preliminary results of the workshop indicate that investments in farmer's associations/cooperatives and health and education are the most important attributes from local stakeholder perspectives, while investment in extension services appears to be the least important attribute.
- HALI project team members have expanded existing technologies in the Sokoine University of Agriculture (SUA) Faculty of Veterinary Medicine's research and diagnostics program, and

introduced four new technologies to detect and characterize bacterial and protozoal pathogens. These technologies, which include: spoligotyping of tuberculosis strains; Immunomagnetic Separation (IMS) coupled with Direct Fluorescent Antibody Testing (DFA) to detect zoonotic protozoa; specific antisera tests to identify bacteria; streamlined field coliform testing methods; and expanded biochemical and PCR-based characterization methods for pathogens, are part of an integrated ecosystem management technique designed to intervene at the interfaces of animal-humans and the environment. These technologies have been transferred to SUA, and are now in routine use, with SUA staff and students competent in running all analyses and assays.

- Three SUA laboratory technicians and a HALI Master's student received training from HALI team members in biochemical and serological methods utilized to characterize bacteria. By supporting SUA staff and improving their laboratory capacity, the HALI project is providing initial investments in sustainable advanced technologies, and more importantly, helping to solidify SUA's reputation as the



*Hippos in a pool in Ruaha National Park. The HALI project is investigating water quality in the park as part of their zoonotic disease surveillance program. Photo by Howard Kombe.*

leading diagnostic center for zoonotic diseases in Tanzania.

- The HALI project has improved equipment and laboratory space at its collaborating institution, the Veterinary Investigation Centre-Iringa (VIC), and trained a senior lab technician on water quality and coliform testing. Through these capacity-strengthening measures, HALI activities have enabled the VIC labs to independently engage in disease surveillance investigations, a critical component to ensuring sustainable disease monitoring at the Ruaha ecosystem scale.
- In collaboration with the District Veterinary Office, the HALI project organized its first education and outreach event on zoonotic disease, celebrating World Rabies Day in Makifu Village, Tanzania, one of the project's 21 study villages. An estimated 550 people, including approximately 300 children attended the event on September 28th, which featured an educational video, awareness and prevention brochures, and options for treatment and response regarding the disease.
- Thirty-one veterinary health professionals from eight countries (Canada, India, Nigeria, Uganda, Sri Lanka, Tanzania, Mexico and the United States) were trained in wildlife and ecosystem health through the Envirovet Summer Institute, an event co-organized by the HALI project, and co-sponsored by the Global Livestock CRSP, along with 7 other organizations, and individual donors. Five African nationals participated in Envirovet, including a Tanzanian government livestock veterinarian, the Ruaha National Park veterinarian, and the HALI project field coordinator, demonstrating a significant development impact on capacity building.
- The HALI project leveraged a total of \$355,339 in fiscal year 2008. \$20,000

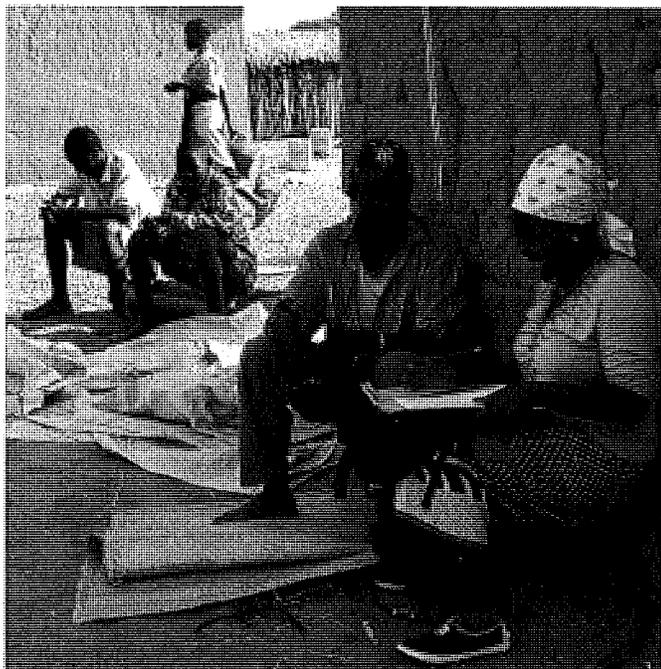
of this figure is from USAID buy-ins, associated with the USAID Rungwa-Ruaha Landscape Program.

## RESEARCH BRIEFS

### Disease Perceptions in Pastoralist Households at the Human-Livestock-Wildlife Interface in Tanzania

#### *Health for Animals and Livelihood Improvement (HALI project) Team Members*

*Summary.* Diseases that can be transmitted between animals and humans are the most significant cause of emerging infectious diseases in people. Pastoralist people living in close proximity to both livestock and free-ranging wildlife may be at high risk of infection. Often depending on limited water sources that are shared with animals, pastoralists have little access to health care and rely on traditional food consumption practices that may increase their risk of contracting infection from animals. As part of the GL-CRSP sponsored Health for Animals and



*HALI project team member Mariam Nguvava interviewing a pastoralist as part of the HALI socio-economic and livelihood analysis activity. Results of the survey are currently being analyzed. Photo by Howard Kombe.*

Livelihood Improvement (HALI) project assessing the impact of emerging zoonotic disease on health and livelihoods of pastoral communities in the sensitive Ruaha region of Tanzania, 160 pastoralist households comprising three ethnic groups (Maasai, Sukuma, and Barabaig) were surveyed to: 1) assess local knowledge and perceptions regarding zoonotic and water-borne disease risk, 2) assess local beliefs about where disease in livestock originates, and 3) determine the prevalence of traditional household water and food consumption practices that may increase risk of disease. Results indicates that 67% of the 159 study households reported sharing drinking water with livestock, while only 18% of these households thought sharing water with livestock posed a disease transmission risk. Of the three groups participating, Maasai were the most likely to report that disease in people could come from livestock and also expressed concerns that neighboring livestock herds were a source of disease. The influence of household factors (ethnicity, disease history, wealth, education, access to health care, proximity to wildlife) on disease perceptions and prevention practices is being assessed. Given the widespread lack of knowledge regarding disease transmission in the most highly mobile segments of rural Tanzanian society, policy-makers and development professionals must address deficiencies in local knowledge to improve public health and avoid risks associated with animal movements.

### **Spatial Analysis of Livestock Disease Reports in Communities bordering Ruaha National Park, Tanzania**

#### ***Health for Animals and Livelihood Improvement (HALI project) Team Members***

*Summary.* Livestock disease is a critical economic issue for pastoralists, as it strongly affects herd productivity, which in turn can impact household income and nutrition. Disease is also an ecological issue, with zoonoses (diseases that can be transmitted between animals and people) affecting human populations. In addition, the exchange of disease between livestock and wildlife affects conservation and livelihood outcomes. Recognizing these issues

and their importance, the HALI project sought to quantify disease prevalence and distribution in the communities bordering Ruaha National Park, Tanzania. Livestock disease losses were documented using household surveys conducted in 21 communities bordering the southern edge of the park. Data from the HALI project were also combined with reported livestock loss data from carnivore conflict surveys, which examined all livestock losses, including disease, theft, and predation. Neither pastoralists living closer to park boundaries, nor those living in areas with high wildlife densities had higher losses to disease. In contrast, households located farther from the village center reported greater livestock losses. Households living farther from water also reported more losses; possibly reflecting poorer water sources (with greater contamination, higher densities of use), or the effects of increased nutritional stress from walking farther to water or simply less frequent watering. Although exposure to wildlife was not an important factor driving disease losses, this does not imply that the perception of disease from wildlife is not important. Instead, it may indicate that livestock are more of a disease risk for wildlife than vice versa. The relationship between disease losses and distance from the village centers suggests that access to veterinary care, markets for veterinary supplies, and information on livestock husbandry may be important factors in mitigating disease losses. Both local and regional strategies to increase livestock productivity should consider within-village variation and ensure that more remote households have access to extension and veterinary services. Livestock extension and veterinary interventions should be keenly aware of spatial variation in livestock losses and target their efforts accordingly.

### **Capturing Women's Voices: Gender Roles in Pastoralist Households and Women's Participation in Socioeconomic Research in Tanzania**

#### ***Health for Animals and Livelihood Improvement (HALI project) Team Members***

*Summary.* In pastoralist society in Tanzania, control of resources, decision-making, and labor responsibilities

HALI Degree Training for 2007-2008					
Name (Last, First)	Nationality	Gender M/F	University	Discipline	Degree
John, Julius	Tanzanian	M	Sokoine University of Agriculture	Preventive Veterinary Medicine	MPVM
Kitambi, Anette	Tanzanian	F	Sokoine University of Agriculture	Preventive Veterinary Medicine	MPVM
Masozera, Michel	Rwandan	M	University of Vermont	Ecological Economics	PhD
Mtui, Imelda	Tanzanian	F	University of Dar es Salaam	Sociology	BS
Nyato, Flora	Tanzanian	F	Tumaini University, Iringa	Tourism and Natural Resources	BS
Wolking, David	USA	M	University of California, Davis	International Agricultural Development	MS

all vary according to gender. Understanding the role of gender in traditional livestock production systems is essential for effective research, development, and policy formulation. The Health for Animals and Livelihood Improvement team is investigating the effect of water limitation and disease on the health and economic well being of households in communities bordering Ruaha National Park, as well as assessing people's attitudes toward disease, disease management, and livestock/wildlife extension. Given the differential effects that health and water scarcity may have on pastoralist women, it was essential that women's perspectives be heard. Researchers endeavored to include women's voices in our socioeconomic research despite cultural challenges. When socioeconomic surveys were administered to households, women participated most in questions addressing water, sanitation, and household health, and were more likely to give detailed answers to questions when men were not present. Women tended to be more willing to participate in surveys administered by a female, and responsiveness improved when the interviewer spent time with the children and ate food with the family. Results from focus group meetings and village leader interviews showed that most economic activities are conducted and owned by men with women participating in very specific activities, such as chicken husbandry, operation of local restaurants, and selling local alcoholic brews. Despite being well represented in village focus groups, women remained reluctant to voice their opinions without encouragement from the moderators. Overall women's participation in decision-making in pastoralist households is limited to the areas and activities socially assigned

to them. At the community level, their participation in decision-making is almost non-existent, even though women play a role in community activities. Our initial findings and observations suggest that the position of pastoralist women in the Ruaha landscape has improved slightly in recent years, evidenced by women becoming more involved in associations for development and more young girls attending school.

#### PROCEEDINGS

Clifford, D.L., R. Kazwala, P. Coppolillo, J. John, B. Mbano, T. Mlengeya, E. Alex, D. Kambarage, and J.A.K. Mazet. 2007. "Bovine tuberculosis at the wildlife-livestock interface in the Ruaha Ecosystem, Tanzania." Abstracts of the 6th Tanzania Wildlife Research Institute (TAWIRI) Scientific Conference, December 3-6, Arusha, Tanzania.

Clifford, D.L., R. Kazwala, P. Coppolillo, J. Erickson, and J.A.K. Mazet. 2008. "Assessing the health and economic impacts of zoonotic disease and water scarcity at the wildlife-livestock-human interface in Tanzania." Abstracts of the Second International Conference on Health and Biodiversity (COHAB), February 25-28, Galway, Ireland.

Sadiki, H., D.L. Clifford, R. Kazwala, P. Coppolillo, J. Erickson, J. John, and J.A.K. Mazet. 2008. "Why health matters: Conservation at the wildlife-livestock-human interface in the Ruaha Ecosystem, Tanzania." Abstracts of the Pathways to Success Conference: Integrating Human Dimensions into Fish and Wildlife Management, September 28 – October 2, Estes Park, Colorado, USA.

## PRESENTATIONS

Clifford, D.L. 2007. "M. bovis in the Ruaha Ecosystem, Tanzania." Presentation at the Bovine Tuberculosis Network Workshop, November 27-28, Arusha, Tanzania.

Clifford, D.L. 2007. "Bovine tuberculosis at the wildlife-livestock interface in the Ruaha Ecosystem, Tanzania." Presented at the 6th TAWIRI Scientific Conference, December 3-6, Arusha, Tanzania.

Clifford, D.L. 2008. "Assessing the health and economic impacts of zoonotic disease and water scarcity at the wildlife-livestock-human interface in Tanzania." Presented at the 2nd International Conference on Health and Biodiversity (COHAB), February 25-28, Galway, Ireland.

Clifford, D.L. 2008. "Using an integrated ecosystem-health approach to assess the health and economic impacts of zoonotic disease and water scarcity in Tanzania." Presented as an invited speaker on Human, Animal, and Ecosystem Health. May 21, Woodrow Wilson Center, Washington D.C., USA.

Clifford, D.L. 2008. "Introduction to the Envirovet Summer Institute Developing Country Session-Tanzania." Presented at the Envirovet Summer Institute Developed Country Session, July 2, White Oak Conservation Center, Yulee, Florida.

Masozera, M. 2008. "Health for Animals and Livelihood Improvement: Socioeconomic research component." Presented to the International Livestock Research Institute (ILRI), August 13, Nairobi, Kenya.

Sadiki, H. 2008. "Why health matters: Conservation at the wildlife-livestock-human interface in the Ruaha Ecosystem, Tanzania." Presentation & Scholarship Recipient: Pathways to Success Conference: Integrating Human Dimensions into Fish and Wildlife Management, September 28 – October 2, Estes Park, Colorado, USA.

## REPORTS

Clifford, D.L. 2008. "Health for Animals and Livelihood Improvement Project in the Rungwa-Ruaha Ecosystem, Tanzania." Annual Progress Report submitted to Tanzania Wildlife Research Institute and Tanzania Commission on Science and Technology, August 23.

## TEAM MEMBERS

Epaphras Alex, Tanzania National Parks  
David Bunn, University of California, Davis, Wildlife Health Center  
Tylis Chang, Albert Einstein Medical College  
Deana Clifford, University of California, Davis, Wildlife Health Center (*Project Coordinator*)  
Michael Clifford, University of California, Davis, Wildlife Health Center  
Peter Coppolillo, Wildlife Conservation Society  
Jon Erikson, University of Vermont  
Jona Fitwangile, Sokoine University of Agriculture  
Dominic Kambarage, Sokoine University of Agriculture  
Rudovick Kazwala, Sokoine University of Agriculture  
Ally Kitime, Sokoine University of Agriculture  
Michael Kock, Wildlife Conservation Society  
Howard Kombe, Sokoine University of Agriculture  
Julius Keyyu, Tanzania Wildlife Research Institute  
S.L.S. Maganga, Sokoine University of Agriculture  
Asha Makweta, Wildlife Conservation Society, Tanzania  
Jonna Mazet, University of California, Davis, Wildlife Health Center (*Lead Principal Investigator*)  
Bakari Mbano, Wildlife Conservation Society, Tanzania  
Dee McAloose, Wildlife Conservation Society  
Woutrina Miller, University of California, Davis, Wildlife Health Center  
Titus Mlengya, Tanzania National Parks  
Ayubu Omari Msago, Wildlife Conservation Society, Tanzania  
David Mutekanga, Wildlife Conservation Society, Tanzania  
Hamza Mwamhehe, Veterinary Investigation Center, Iringa Tanzania

Hellen Ngowi, Sokoine University of Agriculture  
Mariam Nguvava, Wildlife Conservation Society,  
Tanzania  
Harrison Sadiki, Sokoine University of Agriculture  
(*Field Coordinator*)

**COLLABORATING INSTITUTIONS**

**University of California, Davis Wildlife Health  
Center, California, USA (*lead institution*)**

Sokoine University of Agriculture, Tanzania

Tanzania National Parks, Tanzania

Tanzania Wildlife Research Institute, Tanzania

University of Vermont, USA

Veterinary Investigation Center, Iringa Tanzania

Wildlife Conservation Society, Tanzania

## **GL-CRSP SMALL GRANTS**

**AFGHANISTAN LIVESTOCK WORKSHOP (ALW)**



## AFGHAN LIVESTOCK WORKSHOP (ALW)

### PROJECT DESCRIPTION

*On May 17-19, 2008 representatives from various international and Afghan implementing agencies attended a GL-CRSP-sponsored Afghan Livestock Workshop (ALW) facilitated by the Afghan PEACE project and organized by the Advancing Afghan Agriculture Alliance (A4). The workshop, held in Kabul, Afghanistan, focused on harnessing the collective experiences of the different organizations to identify key priorities in their activities, explore possibilities for program collaborations, and to develop strategies for raising livestock awareness at the producer, ministerial and donor levels.*

### PRINCIPAL INVESTIGATORS

Kevin T. McNamara (Lead Principal Investigator), Ph.D., Professor, Department of Agricultural Economics, Purdue University, 403 W. State Street, West Lafayette, IN 47907-2056, Phone: (765) 494-4236, Email: mcnamara@purdue.edu

Michael Jacobs, Ph.D., Research Scientist, Department of Ecosystem Science & Management, Texas AgriLife Research and Extension, Texas A&M University, Horticulture/Forest Science Building, Room 305, 2138 TAMU, College Station, TX 77843-2138, Phone: (979) 845-5579, Email: mjacobs@cnrit.tamu.edu

### SUMMARY OF ACHIEVEMENTS

- Participants identified four program areas that offer opportunities to raise livestock sector growth: 1) capacity building; 2) information for analysis, decision-making, and policies; 3) value-chain development; and 4) advocacy – to raise the profile of livestock production in Afghanistan as a critical economic activity affecting the livelihoods of most rural families. An Integrated Livestock Development Approach was designed as a result of this workshop.
- Fifty-one host-country and international organizations with a stake in Afghan livestock sector development attended the workshop. New collaborations were formed, and a unified approach to the livestock sector in Afghanistan was adopted in order to strengthen sector development, promote policy change where it is most needed, and improve communication and coordination between the Ministry and current projects that address livestock issues.
- A committee was formed to engage senior planners in the Ministry of Agriculture, Irrigation, and Livestock (MAIL) in putting policies and strategies into practice and to communicate the results of the livestock workshop. Communication with the MAIL has been established, and advisors to the new Minister have been responsive.
- Team members have launched a weblog that hosts comments regarding the Afghan Livestock Workshop and other livestock activities in Afghanistan, provides access to project reports, and contains links to partners and related institutions. The weblog, entitled “Livestock Activity in Afghanistan,” can be visited at <http://afghanlivestock.blogspot.com/>.

ALW Non-Degree Training for 2007-2008			
Country	Male	Female	Total
Afghanistan	16	0	16
France	1	0	1
Germany	3	0	3
UK	3	0	3
USA	14	1	15
Total	37	1	38

**REPORTS**

McNamara, Kevin T. and M. Jacobs. 2008. "Afghanistan Livestock Workshop Report." Lafayette, IN: International Programs in Agriculture, Purdue University.

Motamed, M. 2008. "Synthesizing Research and Program Activity in Afghanistan's Livestock." Lafayette, IN: International Programs in Agriculture, Purdue University.

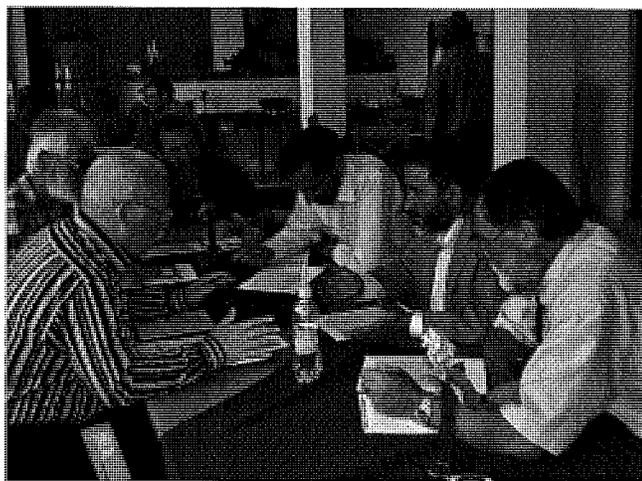
Motamed, M. and K.T. McNamara. 2008. "GL-CRSP Afghanistan Livestock Workshop Summary." Lafayette, IN: International Programs in Agriculture, Purdue University.

**TEAM MEMBERS**

Bruce Grogan, University of California, Davis  
 Michael Jacobs, Texas A&M University  
 Kevin McNamara, Purdue University (*Lead Principal Investigator*)  
 Mesbah Motamed, Consultant  
 David Sherman, Dutch Committee for Afghanistan

**COLLABORATING INSTITUTIONS**

**Purdue University, Department of Agricultural Economics (*lead institution*)**  
 Accelerating Sustainable Agriculture Program (ASAP)  
 – Chemonics International, Afghanistan/USA  
 Advancing Afghanistan Agriculture Alliance (A4)  
 Afghan PEACE Project  
 Afghan Voice Agency (AVA), Afghanistan/UK  
 Afghanistan Research and Evaluation Unit (AREU)  
 Agriculture and Horticulture Development Board (AHDB), UK  
 Aha Khan Development Network, Afghanistan  
 Catholic Relief Services, Afghanistan/USA  
 Citizens' Network for Foreign Affairs, USA  
 Cornell University, USA  
 Dutch Committee for Afghanistan, Netherlands/Afghanistan  
 Food and Agriculture Organization (FAO), Italy  
 Kabul University, Afghanistan  
 Kansas State University, USA  
 Mercy Corps, Afghanistan/USA  
 Ministry of Agriculture, Irrigation, and Livestock (MAIL), Afghanistan  
 Mission d' Aide au Developpement des Economies Rurales (MADERA), Afghanistan/France  
 Texas A&M University, USA  
 United States Department of Agriculture (USDA)



*Participants at the GL-CRSP Livestock Workshop in Afghanistan worked in small groups to identify constraints facing the livestock sector. Photo courtesy of the PEACE project.*

## GL-CRSP TRAINING SUMMARY FOR 2007-2008

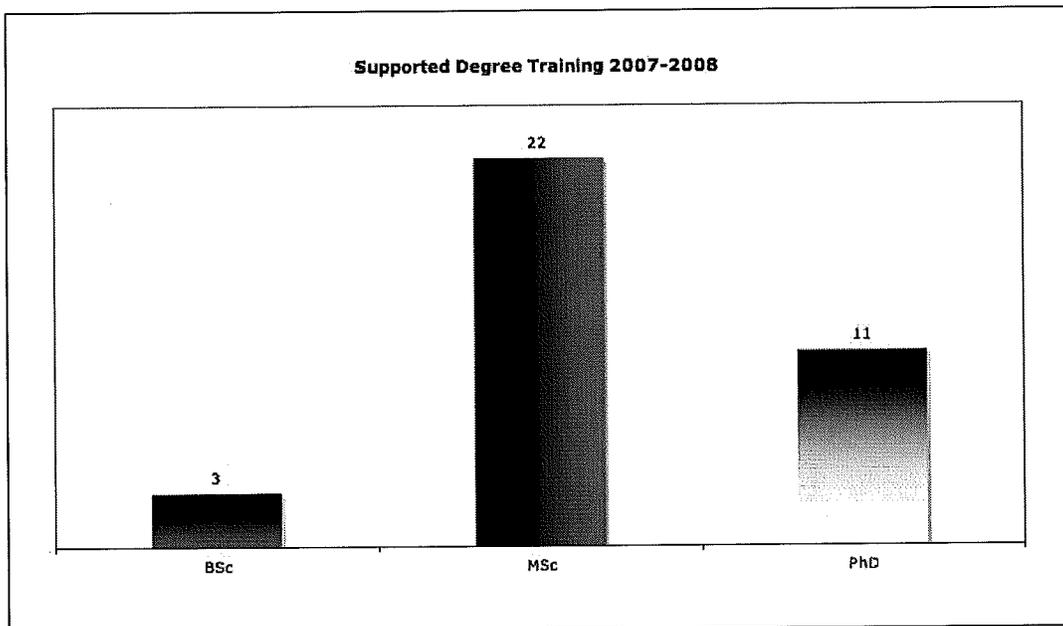
*Training has always been integral to the CRSP portfolio, and the Global Plan of the GL-CRSP recognizes human capacity building as a fundamental component of research and development. The GL-CRSP design, therefore, provides for a wide range of training possibilities and employs both traditional and innovative strategies to achieve its training goals.*

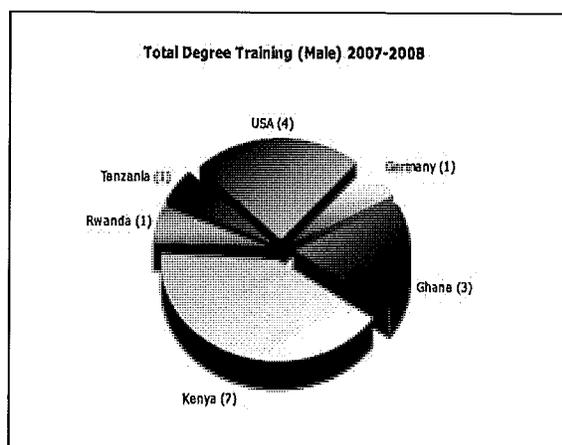
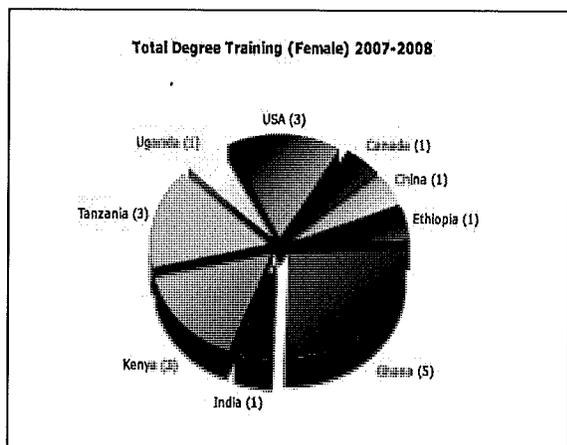
**Degree Training.** The GL-CRSP provides funding for operational and research costs to both U.S. and host-country graduate students. Project team members are encouraged to leverage funds to support tuition.

**Non-Degree Training.** Short-term training provides a cost effective means to build capacity. Training workshops and courses build capacity for not only students, but for community members, project participants, host country professors, researchers and other development professionals as well.

### DEGREE TRAINING STATISTICS FOR 2007-2008

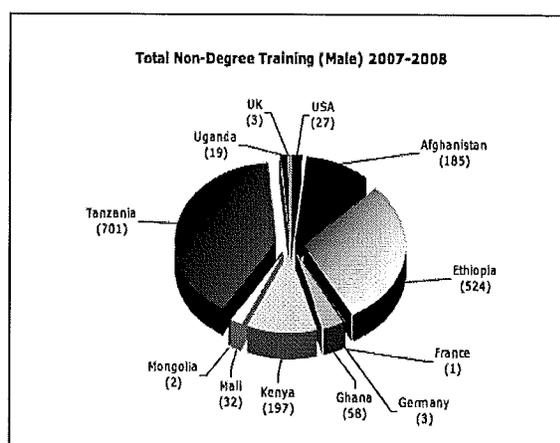
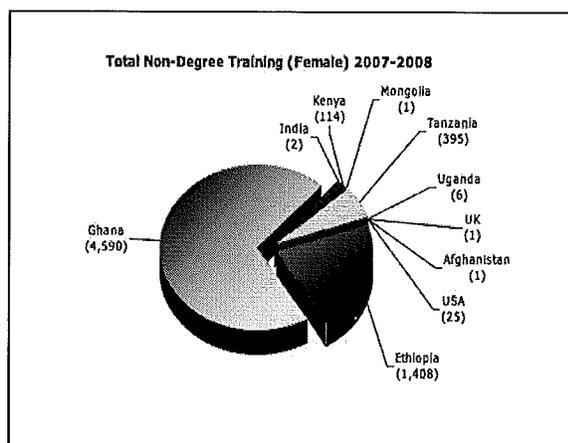
- Thirty-six individuals (19 females and 17 males) were supported in long-term degree training programs in nutrition, veterinary medicine, civil and environmental engineering, geography, agricultural economics, range science, ecology, hydrology, sociology, and agricultural extension.
- Two individuals completed PhD programs, two completed MSc programs, and two completed their Bachelor's degrees this year.
- Approximately 69% of the supported students are from African countries.
- Thirty-two are continuing students from previous years, and four are new students.





### NON-DEGREE TRAINING STATISTICS FOR 2007-2008

- In 2007-2008, there were a total of 8,295 attendances at all GL-CRSP project trainings. Many participants attended multiple trainings.
- Approximately 3,846 individuals were supported in short-term and long-term knowledge and technical skill training programs on topics ranging from nutrition, health, and livelihood enhancement, to conflict resolution, livestock marketing, database management, and appropriate technology development.
- In total, 2,200 females and 1,646 males were trained through GL-CRSP projects.
- Of the individuals attending GL-CRSP non-degree training sessions, approximately 94% were from African countries.



## THE JIM ELLIS MENTORSHIP PROGRAM



Named in honor of Dr. Jim Ellis, a renowned scientist, mentor and GL-CRSP principal investigator, these awards provide partial support to students in order to improve the overall quality of their research. The program provides funds to conduct research in specialized facilities or field settings away from their home campuses and to provide opportunities for greater diversity in collecting data and more creativity in analysis than would otherwise be possible. The awards are intended to provide supplemental funds for students already working on GL-CRSP projects.

### JIM ELLIS AWARD RECIPIENTS FOR 2007-2008

*Lynda Larmkie Hagan*, from the University of Ghana, conducted research in collaboration with the ENAM project in Ghana. Her thesis will be entitled, "Identifying the Influence of Male Household Members on the Expected Outcomes of the ENAM Project Community-based Interventions." This study assesses the effects of the male adult on the key expected outcomes of the ENAM project microcredit and nutrition education interventions. The key expected outcomes that will be analyzed are whether loans are used to improve caregivers' income generating activities, whether caregivers have increased incomes, and whether animal source foods will be allocated to children at family meal times.

*Danielle Kneuppel*, from the University of California, Davis, conducted research in collaboration with the AFS project in Tanzania. Her thesis is "An Impact Assessment of a Poultry Newcastle Disease Vaccination Program on Villagers in Rural Tanzania." Danielle compared three villages in the Iringa region, where chicken vaccinations have taken place with three villages that have not implemented the vaccination program. Danielle relied upon key informant surveys with village leaders and household surveys with female caregiver respondents as the methodology used for collecting data.

*Bolor-Erdene Lhamsuren*, from the Mongolian State Pedagogical University, conducted field research with the GOBI Forage project in Mongolia. His PhD dissertation is titled, "Application of TERRA MODIS Data for Forage Monitoring, Using Ground Information: Example of Hujirt Sum of Unurhangai Aimag and Bugat Sum of Gobi-Altai Aimag." The objective of the study is to use TERRA MODIS satellite data



to monitor the amount of forage in forest-steppe areas with a high density of livestock. The question addressed will determine whether an increased resolution of satellite imagery will provide increasing predictability when using it as a variable or covariate for pasture biomass estimation.

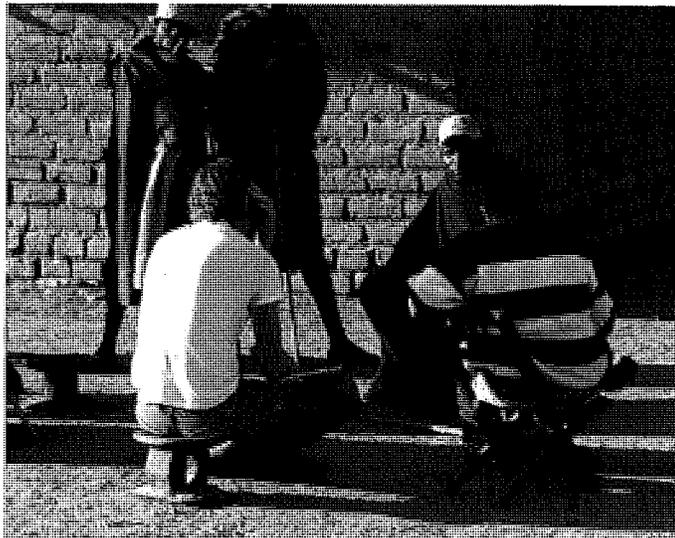
*Jim Ellis Fellow Bolor-Erdene Lhamsuren conducting field work on forage monitoring in the forest-steppe areas in the Gobi region of Mongolia. Photo courtesy of Bolor-Erdene Lhamsuren.*

*Elizabeth Micah*, from the University of Ghana, conducted research in collaboration with the ENAM project in Ghana. Her thesis will be entitled, “The Consumption and Nutrient Contribution of Ready-to-Eat Foods to the Total Dietary Intakes Among Children 2-5 Years in Ghana.” Preliminary data from the ENAM project shows that a significant proportion of caregivers feed their children with purchased ready-to-eat (RTE) food; however, there is a paucity of information about the contribution that RTE foods make to the diets of rural populations, particularly young children. In this study, the RTE foods consumed by young children will be weighed, and the information will be used to provide a detailed analysis of the caregiver’s decision to offer RTE foods, the magnitude of the RTE food use, and its contribution to macro- and micronutrient intakes of young children in rural Ghana.

*Richard S. Mwakapuja*, from Sokoine University of Agriculture in Tanzania, conducted field research with the AFS project in Tanzania. His thesis will be a “Study on Disease Surveillance of Village Chickens Vaccinated Against Newcastle Disease in Rural Communities in Morogoro, Tanzania.” The purpose of his research will be to determine if vaccination for Newcastle disease results in survival of younger birds; if so, whether this will be creating a shift in the median age of the village flock, and whether the shift in the median age means that more of the flock is susceptible to infectious coyza. This project will measure antibody titers against Newcastle disease in vaccinated and unvaccinated village chicken populations and will include the creation of an age distribution profile and the implementation of a survey for infectious coyza.

*Katherine Osei-Boadi*, from the University of Ghana, conducted research in collaboration with the ENAM project in Ghana. She is conducting an “Assessment of the Nutritional Status of Vegan and Non-vegetarian Children.” Her study compares the diets, dietary diversity, dietary habits and other indicators of nutritional status among vegan and non-vegetarian children in the Greater Accra region. Study findings may reveal the realities of vegan diets, given the constraints of peoples’ daily lives, and so provide evidence for careful situational analysis and appropriate recommendations for veganism in Ghana.

*David Wolking*, from the University of California, Davis, conducted research in collaboration with the HALI project in Tanzania. His thesis is a study on the “Prevalence and associated risk factors of Cryptosporidium and Giardia in neonatal livestock in the Ruaha Ecosystem, Tanzania.” Through this research, David will investigate the prevalence of the protozoal zoonotic pathogens Cryptosporidium and Giardia in neonatal livestock among pastoralist households in the Ruaha region, with the aim of identifying management practices that reduce the risk of infection among livestock and their caretakers.



*Jim Ellis Fellow David Wolking interviews Sukuma herders in the Pawaga Division of Iringa District, Tanzania. Mr. Wolking is investigating disease among neonatal livestock in collaboration with the GL-CRSP Health for Animals and Livelihood Improvement (HALI) project. Photo courtesy of David Wolking.*

## BORLAUG LEAP FELLOWSHIP PROGRAM

The Borlaug LEAP (Leadership Enhancement in Agriculture Program) is a fellowship program funded by the United States Agency for International Development (USAID) to enhance the quality of thesis research of graduate students from developing countries who show strong promise as leaders in the field of agriculture and related disciplines as defined by Title XII. LEAP is part of the overall Borlaug International Agricultural Science and Technology Fellows Program sponsored by the USDA. Upon completion of research, each Borlaug LEAP fellow publishes a research brief sharing his or her findings and the implications of the research. Twelve research briefs were published in FY08, and their summaries are featured below followed by a list of the new Norman E. Borlaug LEAP Fellows for 2007-2008.

### **Research Brief W06-08-01-LEAP: The Effects of HIV/AIDS on Household Agricultural Land Productivity in Southeastern Uganda**

*Author: Maction Komwa, George Mason University*

*Summary.* This research brief contributes to the body of evidence available regarding the effects of HIV/AIDS on agricultural households and, in particular, the relationships between appropriate diet, labor, and health status in southeastern Uganda. We present preliminary results from a cross-sectional study that was conducted in summer 2007, which was a follow-up study to the semi-structured interviews conducted in 2006. We completed interviews with 322 adult residents of 246 households. Fifty-six were HIV-infected individuals, 120 were family members of persons living with HIV/AIDS, and 146 were people who were living with no HIV-infected household members. More than 90% of study participants knew someone with HIV/AIDS and correctly identified HIV transmission modes and prevention methods. Approximately 91.6% of participants believed that a person with HIV infection should eat special nutritious foods, and participants with HIV-infection reported eating more fruits and vegetables than other participants. Furthermore, 93.2% of participants believed that a person with HIV-infection should work fewer hours to conserve energy, but we found no differences in reported work hours by HIV status. Additional research is required to further examine health beliefs about special foods and reduced labor, and how these behaviors might contribute to longer, healthier lives for people living with HIV in Uganda.

### **Research Brief S06-08-02-LEAP: Asset Poverty, Technology Adoption and Livelihoods in Rural Ethiopia**

*Author: L. Saweda Onipede Liverpool, University of Illinois, Urbana-Champaign*

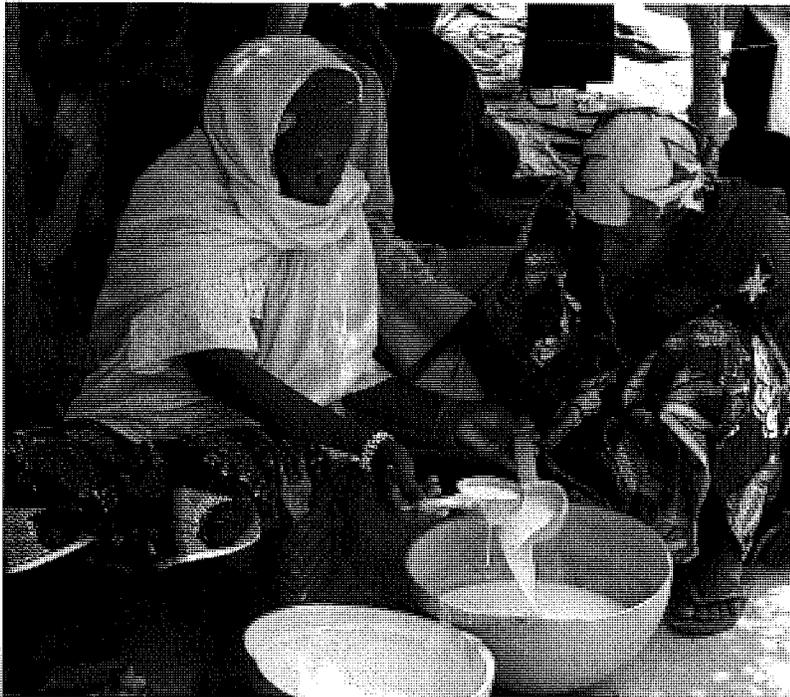
*Summary.* Traditional income measures of poverty do not distinguish between chronically poor households and those experiencing more temporary poverty due to passing conditions. Furthermore, income-based classifications consider non-poor households to be both those that are at risk of falling into poverty as well as those that are not at risk. The tendency to group households that are likely to exit poverty independently with other poor households who cannot exit poverty without assistance, however, can undermine the targeting of interventions to alleviate poverty and distort evaluation of anti-poverty programs. Newly developed asset-based poverty measures enable more nuanced identification of poverty status that can lead to better program targeting. This study uses panel data from Ethiopia to generate an asset-based poverty classification scheme. Regression results are used to derive an asset index and classify households into various categories of poverty. The asset-based poverty classifications are found to predict future poverty status more accurately than income-based measures, implying that the asset-based measure could be used to more carefully target

and evaluate poverty interventions. This implication for program evaluation was further tested via an analysis of the differential impact of governmental, non-governmental, and donor programs on the behavior and wellbeing of rural households. In particular, I consider the impact of micro-credit services on Ethiopian farmers in differing degrees of asset poverty. Results show that the impact of participating in these programs on household livelihood and the adoption of new technologies varied with poverty status. Similarly, results further reveal that the impact of modern technologies (use of chemical fertilizer, pesticides or irrigation) varies with asset-poverty status. These findings imply that distinct institutions and technologies may be required for households with specific, identifiable poverty characteristics.

**Research Brief S06-08-03-LEAP: Identification of Variables Driving Poverty Reduction Among Rural Coffee and Non-coffee Growers in Rwanda**

*Author: Abdoul Murekezi, Michigan State University*

*Summary.* The research described in this brief makes an empirical contribution to poverty analysis of rural households in Rwanda. The objectives of the research are to identify variables driving poverty reduction in Rwanda and elucidate any difference between farmers growing coffee and non-coffee growers. The report also connects the current findings to further analysis that will be performed using recent data, which were not ready yet for use at the time of writing this brief. Regression analyses have been undertaken using two different data sets collected in 2001 from 498 coffee growers and 4376 non-coffee farmers. The results indicate that households that grow a wide range of staple crops, who possess a large number of livestock and who are engaged in the commercialization of eggs and milk production are less likely to be poor. People who attended primary school and have a small family size are more likely to be among the more prosperous. Households headed by females are more likely to be poor. Poverty incidences are found to be more prevalent in the southern province of Rwanda. The results also show that, although there are similarities between



*Borlaug LEAP fellow Mamadou Chetima investigated drought and food insecurity in the Sahel. Here, women sell sour milk at the Samari market. Livestock products are sources of income and some are directly integrated into the household alimentation. Photo by Mamadou Chetima.*

coffee growers and non-coffee growers in terms of critical factors of poverty reduction, there are important differences that need to be taken into consideration when a poverty reduction program is implemented.

**Research Brief Su06-08-04-LEAP: Vulnerability to Drought and Food Insecurity in the Sahel: Preliminary Findings from 25 Years of Human and Livestock Population Dynamics in Western Niger**

*Author: Mamadou Mai K. Chétima, Cornell University*

*Summary.* Vulnerability to drought and resulting food insecurity have increased within agropastoral communities of Western Niger since 1983. Farmers from several Nigerien villages were selected to participate in a study of livestock husbandry and development in 1983. From 1983 through 1987, 1994 to 1995, and then from 2006 to 2007, members of 56 households, their descendents and their livestock were monitored in two study villages, Sadeize Kwara and Samari. Preliminary analysis of the data from the last 25 years shows the following: (1) increases in village human population; (2) decrease in crop yields per hectare; (3) fewer animals per household and per capita; (4) conversion of grazing land to crop land; (5) increase in migration of villagers for employment and longer periods spent away from the village; and (6) diminished ability of the community to support itself in times of food crises. These preliminary findings indicate that farmers' livelihoods have been seriously altered since the first data collection in 1983. The information gathered provides a baseline for further study and development programs to combat economic vulnerability in agropastoral areas. The changes observed with respect to human demography, livestock-based coping strategies, community resilience, and off-farm sources of income offer a framework for policy-making to mitigate existing food insecurity and its severity in other semi-arid regions.

**Research Brief S07-08-05-LEAP: Up in Smoke: Biomass Burning, Land Cover Change, and Atmospheric Emissions in the Sudanian Savannas of Cote d'Ivoire**

*Author: Moussa Koné, University of Illinois, Urbana-Champaign (Co-authors: Thomas J. Basset and Johnson N. Nkem)*

*Summary.* The environmental change literature depicts West African savanna fires as intense and highly destructive. It assumes that burning takes place in the middle and late-dry seasons, views African savannas as one of the "burn centers" of the planet, and considers biomass burning to be an important source of greenhouse gas emissions. The research presented in this brief, however, took a political-ecological approach to advance the understanding of burning regimes and to present a more accurate assessment of land use and land cover change in the Sudanian savannas of Côte d'Ivoire. Findings show that contemporary agricultural and pastoral practices generate early fires that result in low burning intensity, more frequent and small fires, and inefficient combustion. The results also show that the Sudanian savannas are complex and differentiated ecosystems composed of several vegetation types, and that grass biomass load is declining while woody vegetation cover is increasing over time. Increased tree vegetation cover will sequester more carbon dioxide. The knowledge generated here is crucial for environmental decision-making. Updated and accurate environmental information is critical for formulating sound environmental policies. The findings are particularly relevant to current debates on the environmental impact of agricultural and pastoral systems in West Africa and to policy discussions focused on global climate change.

**Research Brief Su06-08-06-LEAP: Genetic Diversity of Cacao Collections in Nigeria**

*Author: Peter O. Aikpokpodion, University of Ibadan (Co-authors: Mark J. Guiltinan and Maria Koesnikova-Allen)*

*Summary.* Effective use of the available genetic resources to develop improved planting materials depends on the knowledge of genetic diversity present in a plant collection. In this study, thirteen microsatellite markers, or short segments of DNA that have a repeated sequence, were used to study genetic diversity in field gene bank collections and farmers' cacao (*Theobroma cacao L.*) accessions in Nigeria. Results showed that genetic diversity was appreciably high in farmers' materials; however, it was relatively lower than in germplasm collections. Restricted gene flow and spatial differentiation was found among cacao accessions grown in farmers' fields. In field gene bank collections, this study showed that a smaller proportion of genetic diversity present had been used in developing varieties distributed to farmers. Some cacao varieties that have been under utilized in past breeding programs were also identified. A strong positive relationship was found between genetic diversity of parent stock and cocoa bean size and weight of their hybrid progenies. This study provides evidence for policy makers of the need for an efficient seed delivery system (for example, cacao tree nurseries), which provide farmers with easy access to improved planting materials. Research findings provide information to promote future germplasm introduction and can be used to guide various development strategies.

**Research Brief W06-08-07-LEAP: Combined Organic and Mineral Nutrient Sources Regulate Nutrient Cycling**

*Author: Pauline Chivenge-Nhamo, University of California, Davis (Co-author: Johan Six)*

*Summary.* Organic resources (OR) play an important and dominant role in soil fertility improvement through short-term nutrient supply and long-term build-up of soil organic matter (SOM). This brief describes the results of a study undertaken to document the influence of the addition of both high and low quality OR with or without mineral nitrogen fertilizer (MR) on crop production and soil organic carbon dynamics. Results indicated that crop yields were improved by the addition of OR. High quality OR produced higher yields than did low quality OR. Furthermore, a higher rate of OR application resulted in higher yields than a lower rate of application. The addition of MR increased crop yields for the low quality OR but not the high quality OR. The addition of MR also increased the decomposition of low quality OR, which led to lower proportions of macroaggregates and total carbon (C) and nitrogen (N) compared to the application of OR alone. There were no differences, however, in these measurements when MR was added to high quality OR. Furthermore, OR quality had no effect on soil organic C and N or long-term aggregate turnover dynamics. These results suggest that when available, high quality OR offer the greatest potential to increase crop yields and improve soil fertility in the long-term. When only low quality OR is available, however, due to local conditions and resource constraints, they should be applied in combination with MR.

**Research Brief W06-08-08-LEAP: Exploring the Role of the School-Community Relationship As an Enabling Factor in Environmental Learning**

*Author: Nicolette (Nikki) Kohly, Rhodes University*

*Summary.* Agricultural and educational researchers recognize the critical value of an integrated, multidisciplinary approach to education in building a food-secure world, reducing poverty, and conserving and enhancing natural resources. However, schools generally contribute little to communities in the context of food gardening

and environmental learning. The main objective of this qualitative research was to explore the role of school-community relationships in enabling environmental learning in the context of school-community food gardens and agroforestry activities. Preliminary findings suggest that the role of school-community links in enhancing environmental learning is variable. An active involvement of community members in school programs is likely required, with an emphasis on an experiential learning approach. However, this depends to a large extent on the availability of parents or concerned community members and their willingness to engage in voluntary school-based activities. Factors that could potentially strengthen the role of school-community links in supporting environmental learning include: allowing space for informal learning, mediating learning in civil society settings, ongoing facilitation by a committed coordinator, community buy-in and accountability, and addressing public interests through tangible benefits.

**Research Brief F06-08-09-LEAP: Transfer of Governance and Partnership Skills Among Producer Marketing Organizations in Uganda**

*Author: Richard F. Miiro, Makerere University (Co-authors: Robert E. Mazur, Pascal Sanginga, and Frank B. Matsiko)*

*Summary.* Leaders of farmer-owned producer marketing organizations have received training in governance and partnership management. Research has shown, however, that receiving training does not necessarily result in knowledge transfer or use in the workplace unless certain conditions are fulfilled. The study presented in this brief was conducted to determine the factors and processes that affect the transfer of governance and partnership management skills for leaders of producer marketing organizations and to determine whether transferred skills enhance the prospects of long-term development and sustainability of the organizations. Results from qualitative interviews with leaders of the producer marketing organizations revealed that there was a moderate to high degree of transfer of governance and partnership management skills. This was due to a highly participatory and motivating training approach, opportunity to practice, close supervision, and built-in accountability structures. Most organizations exhibited positive prospects for long-term development and sustainability. Indicators of potential sustainability included formation of associations at higher levels, diversifying marketable agricultural products, initiating savings and credit schemes, and expanding membership.

**Research Brief S06-08-10-LEAP: Promoting Participation of Agricultural Households in the Milk Market: Evidence from Northern Cote d'Ivoire**

*Author: Jeanne Y. Coulibaly, Purdue University (Co-authors: Joseph V. Balagtas, Mohammad Jabbar, and Asfaw Negassa)*

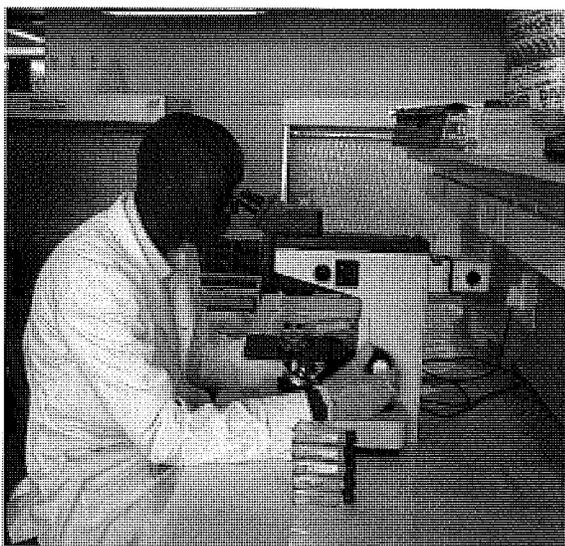
*Summary.* Increased participation in agricultural markets may alleviate poverty among rural households in Africa. Thus, understanding the determinants of market participation is important for the design and evaluation of development policies. The study described in this brief makes an institutional analysis of dairy markets and evaluates determinants of dairy market participation by agricultural households in Côte d'Ivoire. Results can be used to draw policy recommendations that take into account a larger population of agricultural households. For example, the implications of higher market prices or lower transactions costs can be evaluated for not only the volume of marketed surplus from existing cattle owners, but also for the propensity of rural households more broadly to adopt livestock. The analysis of rural dairy markets in Côte d'Ivoire also represents a rare look at market participation in West Africa. Market participation has been the focus of several economic studies in East Africa, but very few analyses address the issue of participation in

dairy markets in West Africa. Thus, this study provides an empirical analysis of the performance of the rural dairy market in Côte d'Ivoire and derives some implications for public policy in the design and evaluation of dairy market development.

### Research Brief Su06-08-11-LEAP: Evaluation of a Potential Vaccine for East Coast Fever in African Cattle

**Author:** Daniel Kerage, Kenyatta University (Co-authors: Simon Graham, John Harty, and Duncan Mwangi)

**Summary.** *Theileria parva* is a parasite transmitted to cattle by the brown-ear tick. It is the cause of East Coast Fever (ECF), a deadly disease in African cattle. The ECF research group has been successful in identifying a number of *Theileria parva* parasite antigens that are targeted by the immune system. These antigens have been tried in cattle as vaccines to induce immunity that can protect the cattle from the disease. These vaccines, however, were unable to induce full protective immunity. As a result, recombinant live attenuated



Borlaug LEAP Fellow Daniel Kerage checking on the proliferative status and integrity of *Theileria parva* infected lymphoblasts. Photo by Victor Riitho.

*Listeria monocytogenes* expressing three defined antigens from *Theileria parva* was evaluated in this study in the way of a vaccine to determine its potential to induce full protection in cattle against *Theileria parva*. *Listeria monocytogenes* has been used to make a vaccine and shown to induce strong immunity in mice and non-human primate animals and is currently being tried as a vaccine carrier against human cancer. Experimental studies using the recombinant *Listeria monocytogenes* vaccine, however, indicated that the *Theileria parva* antigens in the vaccine are poorly expressed and recognized by specific immune cells maintained in the lab. The vaccine failed to adequately demonstrate the desired potential of inducing the required immunity (antigen-specific CTL) that can protect the cattle against disease. Research findings from this study will have implications in vaccine formulation in other diseases including cancer where the induction of T-cell immunity is very important.

### Research Brief Su06-08-12-LEAP: Roundworms Useful as Biological Control Agents in the Central Rift Valley, Kenya

**Author:** Shelmith W. Mwaniki, University of Nairobi

**Summary.** In agriculture, nematodes are roundworms that can be either beneficial to plants (by preying on harmful insects) or harmful pests that attack plants. Entomopathogenic nematodes, more specifically, belong to the first group and are insect parasitic nematodes that are useful as biological control agents of insect pests on agricultural crops. Chemical insecticides effectively control insect pests, but they are associated with environmental pollution and operator hazards. Entomopathogenic nematodes, on the other hand, occur naturally in soils and are easy to isolate, culture and apply for insect pest control. Soil factors including soil

pH and soil organic carbon may influence nematode function. This study determined entomopathogenic nematode distribution and identity in the Central Rift Valley region of Kenya. A survey for the nematodes was carried out in October 2005, and nematodes were extracted from soils using the greater wax moth as bait. Overall, 30-50% of soil samples yielded nematodes at the rate of 18-71% per agro-ecological zone. Thirty-six percent of sites from cultivated areas and 17% of wild habitat sites tested positive for nematodes. Nematodes occurred at various rates depending on the percent of soil carbon, soil pH, and sea level of the study sites. Thirty-three nematode isolates were collected from soils of the Rift Valley region of Kenya, resulting in the identification of six distinct nematodes. Four of these nematodes were reported in Kenya for the first time, and one was confirmed as new.

#### NORMAN E. BORLAUG LEAP FELLOWS 2007-2008

*Fredrick Ayuke*, Kenyan, is enrolled in the PhD program at Wageningen University in the Soil Biology Department. Fredrick's mentors are Dr. Johan Six of the University of California, Davis, and Dr. Bernard Banlauwe of TSBF-CIAT.

*Idris Amusan*, Nigerian, is enrolled in the PhD program at Purdue University in the Plant Breeding and Genetics Department. Idris' mentors are Dr. Gebisa Ejeta of Purdue University and Dr. Abebe Menkir of IITA.

*Sommerat Chantarat*, Thai, is enrolled in the PhD program at Cornell University in the Economics Department. Sommerat's mentors are Dr. Christopher Barrett of Cornell University and Dr. Andrew Mude of ILRI.

*Presidor Kendabie*, Nigerian, is enrolled in the PhD program at the University of Pretoria in the Genetics Department. Presidor's mentors are Dr. Andrew Paterson of the University of Georgia and Dr. Abdou Tenkouano of IITA.

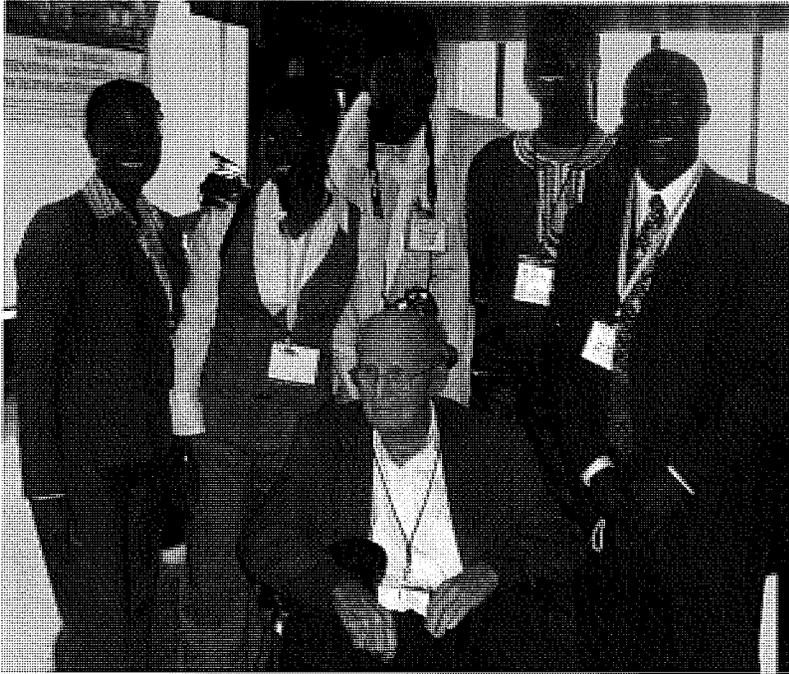
*Rafael Martinez-Garcia*, Mexican, is enrolled in the PhD program at the University of Arizona in the Environmental Science/Aquaculture Department. Rafael's mentors are Dr. Kevin Fitzsimmons of the University of Arizona and Dr. Raul Ponzoni of the World Fish Center.

*Michel Masozera*, Congolese, is enrolled in the PhD program at the University of Vermont in the Environment and Natural Resources Department. Michel's mentors are Dr. Jon Erickson of the University of Vermont and Dr. Esther Schelling of ILRI.

*Fulgence Mishili*, Tanzanian, is enrolled in the PhD program at Purdue University in the Agricultural Economics Department. Fulgence's mentors are Dr. James Lowenberg-Deboer of Purdue University and Dr. Jonas Chianu of TSBF-CIAT.

*Kiddo Mtunda*, Tanzanian, is enrolled in the PhD program in the Plant Breeding Department at the University of Kwazulu Natal, South Africa. Kiddo's mentors are Dr. Tim Setter of Cornell University and Dr. Edward Kanju of IITA.

*Moses Okpeku*, Nigerian, is enrolled in the PhD program at the University of Abeokuta in the Animal Breeding



*Borlaug LEAP Fellows with Norman E. Borlaug (seated) at the 2008 World Food Prize Symposium. Standing from left to right: Pauline Nhamo, Lenis Liverpool, Mamadou Chetima, John Recha, and Idris Amusan. Photo by Susan Johnson.*

and Genetics Department. Moses' mentors are Dr. Michael O'Neill of the University of Connecticut and Dr. Olivier Hanotte of ILRI.

*Alex Owusu*, Ghanaian, is enrolled in the PhD program at George Mason University in the Earth Systems and Geoinformation Sciences Department. Alex's mentors are Dr. Sheryl Beach of George Mason University and Dr. Liangzhi You of IFPRI.

*John Recha*, Kenyan, is enrolled in the PhD program at Cornell University in the Soil and Crop Sciences Department. John's mentors are Dr. Johannes Lehmann of Cornell University and Dr. Louis Verchot of ICRAF.

*Haroon Sseguya*, Ugandan, is enrolled in the PhD program at Iowa State University in the Sustainable Agriculture and Sociology Departments. Haroon's mentors are Dr. Robert Mazur of Iowa State University and Dr. Jemimah Njuki of CIAT.

*Ravelina Velasco*, Filipino, is enrolled in the PhD program at the Institute of Graduate Studies at Central Luzon State University in the Fish Genetics Department. Ravelina's mentors are Dr. Russell Borski of North Carolina State University and Dr. Raul Ponzoni of the World Fish Center.

## **APPENDIX**

Project Funding.....	117
Collaborating Institutions .....	119
Publications.....	123
Glossary .....	136



**GL-CRSP PROJECT FUNDING  
2007-2008**

Project	Total Core Funding	Total Cost Share	Leveraged Funding	USAID Buy-ins	Total Supplemental Funding
3G	\$ 123,144	\$ 35,954	--	--	--
AFS	\$ 311,781	\$ 87,316	\$ 350,000	\$ 109,000	\$ 459,000
ALW	\$ 78,627	\$ 21,573	--	--	--
ENAM	\$ 400,135	\$ 35,207	\$ 80,685	--	\$ 80,685
GOBI	\$ 60,002	\$ 8,031	\$ 666,500	\$ 500,000	\$ 1,166,500
HALI	\$ 331,466	\$ 53,020	\$ 335,339	\$ 20,000	\$ 355,339
HNP	\$ 313,361	\$ 53,895	\$ 56,000	--	\$ 56,000
LINKS	\$ 340,015	\$ 61,274	\$ 1,583,577	\$ 30,000	\$ 1,613,577
LITEK	NCX	\$ 18,740	--	--	--
MLPI	\$ 94,025	\$ 83,135	\$ 1,787,394	\$ 250,000	\$ 2,037,394
NJORO WATER	NCX	\$ 8,829	\$ 3,750	--	\$ 3,750
PARIMA	\$ 550,000	\$ 114,292	\$ 83,370	\$ 151,599	\$ 234,969
POU WID	NCX	\$ 15,892	\$ 15,750	\$ 16,882	\$ 32,632
SUMAWA	\$ 203,830	\$ 33,901	\$ 28,817	\$ 31,595	\$ 60,412

NCX -- No Cost Extension



**COLLABORATING INSTITUTIONS  
2007-2008**

ADVANCED RESEARCH INSTITUTES	State, Country	Institution Type	GL-CRSP Project(s)
Agricultural University of Mongolia	Mongolia	Academic	GOBI
Alemaya University	Ethiopia	Academic	LINKS
Columbia University	New York, USA	Academic	LINKS
Cornell University	New York, USA	Academic	PARIMA, LITEK, LINKS, ALW
Egerton University	Kenya	Academic	PARIMA, SUMAWA
Idaho State University	Pocatello, Idaho	Academic	SUMAWA
Indiana University	Indiana, USA	Academic	HNP
Iowa State University	Iowa, USA	Academic	ENAM
Kabul University	Afghanistan	Academic	ALW, PEACE
Kansas State University	Kansas, USA	Academic	ALW
Makerere University	Uganda	Academic	AFS, ENAM
McGill University	Canada	Academic	ENAM
Moi University	Kenya	Academic	SUMAWA, HNP
Purdue University	Indiana, USA	Academic	ALW
Scottish Agricultural College	Scotland	Academic	3G
Sokoine University of Agriculture	Tanzania	Academic	AFS, HALI
South Dakota State University	South Dakota, USA	Academic	3G
Syracuse University	New York, USA	Academic	PARIMA, MLPI, LINKS
Texas A&M University	Texas, USA	Academic	LINKS, GOBI, ALW, PEACE
Universidad de Buenos Aires	Argentina	Academic	3G
Universidad de Chile	Chile	Academic	3G
University of California, Berkeley	California, USA	Academic	3G
University of California, Davis	California, USA	Academic	SUMAWA, AFS, HALI
University of California, Los Angeles	California, USA	Academic	HNP
University of Ghana	Ghana	Academic	AFS, ENAM
University of Kentucky	Kentucky, USA	Academic	PARIMA, LITEK, LINKS
University of Nairobi	Kenya	Academic	AFS, LINKS
University of Vermont	Vermont, USA	Academic	HALI
University of Wyoming	Wyoming, USA	Academic	SUMAWA
Utah State University	Utah, USA	Academic	PARIMA, LINKS, SUMAWA, PEACE
Yale University	Connecticut, USA	Academic	LITEK

CGIARs	State, Country	Institution Type	GL-CRSP Project(s)
International Livestock Research Institute (ILRI)	Kenya, Ethiopia	CGIAR	PARIMA, LINKS

GOVERNMENTAL ORGANIZATIONS	State, Country	Institution Type	GL-CRSP Project(s)
Agriculture and Horticulture Development Board (AHDB)	UK	GO	ALW
Department of Veterinary Services	Kenya	GO	AFS
Direction Nationale des Productions et des Industries Animales (DNPIA)	Mali	GO	MLPI
District Council of Iringa	Tanzania	GO	AFS
District Council of Mtwara-Mikindami	Tanzania	GO	AFS
District Council of Mvomero	Tanzania	GO	AFS
Drought Preparedness and Prevention Commission (DPPC)	Ethiopia	GO	LINKS
Ethiopian Information and Communication Technology Development Authority (ICTAD)	Ethiopia	GO	LINKS
Ghana Health Services	Ghana	GO	ENAM
Independent Department for Kuchi Affairs	Afghanistan	GO	PEACE
Intergovernmental Authority on Development, Climate Prediction and Applications Center	Kenya	GO	LINKS
Kenya Department of Fisheries	Kenya	GO	SUMAWA
Kenya Livestock Marketing Services Division	Kenya	GO	LINKS
Kenya Meteorological Department - Radio and Internet Project (RANET)	Kenya	GO	LINKS
Kenya Wildlife Service (KWS)	Kenya	GO	SUMAWA
Ministry of Agriculture and Rural Development, Livestock and Fish Marketing Department	Ethiopia	GO	LINKS
Ministry of Agriculture, Animal Industry and Fisheries, Uganda	Uganda	GO	AFS
Ministry of Agriculture, Irrigation, and Livestock	Afghanistan	GO	ALW, PEACE
Ministry of Food and Agriculture-Women in Agricultural Development	Ghana	GO	ENAM
Ministry of Health, Kenya	Kenya	GO	AFS, SUMAWA
Ministry of Health, Uganda	Uganda	GO	AFS
Ministry of Industry, Trade and Marketing	Tanzania	GO	LINKS
Ministry of Livestock and Fisheries Development, Kenya	Kenya	GO	AFS, LINKS, PARIMA
Ministry of Livestock Development	Tanzania	GO	LINKS
Observatoire du Marche Agricole (OMA)	Mali	GO	MLPI
Oromia Pastoral Development Commission (OPaDC)	Ethiopia	GO	LINKS, PARIMA
Regional Center for Mapping of Resources for Development	Kenya	GO	LINKS
Rift Valley Water Resources Management Authority	Kenya	GO	SUMAWA
Tanzania Livestock Marketing Agency	Tanzania	GO	LINKS
Tanzania National Parks (TANAPA)	Tanzania	GO	HALI
United States Geological Survey (USGS)	USA, Kenya	GO	LINKS
USDA Agricultural Research Service	USA	GO	3G
USDA Foreign Agricultural Service	USA	GO	GOBI, ALW
USDA Natural Resources Conservation Service	USA	GO	3G
Veterinary Investigation Centers	Tanzania	GO	AFS, HALI

NATIONAL RESEARCH INSTITUTES/ORGANIZATIONS	State, Country	Institution Type	GL-CRSP Project(s)
Agriculture Research and Training Institute, Ukiriguru	Tanzania	RI	LINKS
Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)	Argentina	RI	3G
CSIRO Sustainable Ecosystems	Australia	RI	3G
Institut d'Economie Rurale du Mali	Mali	RI	MLPI
Kenya Agricultural Research Institute (KARI)	Kenya	NARS	PARIMA
Laboratoire des Sciences du Climat et de l'Environnement	France	RI	3G
Mpwapwa Livestock Research Institute	Tanzania	RI	LINKS
National Range Research Center	Kenya	RI	LINKS
Oromia Agricultural Research Institute (OARI)	Ethiopia	NARS	PARIMA, LINKS
Pastoral and Agro-Pastoral Research Center	Ethiopia	RI	LINKS
Somali Region Pastoral and Agro-pastoral Research Institute	Ethiopia	RI	LINKS
Swiss Federal Institute for Forest, Snow and Landscape Research	Switzerland	RI	3G
Tanzanian Wildlife Research Institute (TAWIRI)	Tanzania	RI	HALI

PRIVATE SECTOR	State, Country	Institution Type	GL-CRSP Project(s)
Akyimpem Rural Bank	Ghana	Private	ENAM
Accelerating Sustainable Agriculture Program-Chemonics, International	USA/Afghanistan	Private	ALW
Chicago Climate Exchange	Illinois, USA	Private	3G
Fiagya Rural Bank	Ghana	Private	ENAM
Kenya Livestock Marketing Council	Kenya	Private	LINKS
Naara Rural Bank	Ghana	Private	ENAM

REGIONAL ORGANIZATIONS	State, Country	Institution Type	GL-CRSP Project(s)
Disaster Prevention and Preparedness and Food Security Bureau	Ethiopia	Regional	LINKS
Institut Polytechnique Rural de Formation et de Recherche Appliquée de Katibougou	Mali	Regional	MLPI
Nakuru District Medical Office of Health	Kenya	Regional	SUMAWA
Oromia Cooperative Promotion Commission	Ethiopia	Regional	PARIMA
Somali Region Rural Development	Ethiopia	Regional	LINKS

UNITED NATIONS ORGANIZATIONS	State, Country	Institution Type	GL-CRSP Project(s)
Food and Agriculture Organization	Ethiopia, Kenya, Afghanistan	UN	LINKS, 3G, ALW
World Food Programme	Kenya	UN	LINKS
Environmental Programme	Kenya	UN	SUMAWA

NON-GOVERNMENTAL ORGANIZATIONS	State, Country	Institution Type	GL-CRSP Project(s)
Advancing Afghanistan Agriculture Alliance	Afghanistan/Indiana	NGO	ALW
Afghan Pastoral Engagement, Adaptation, and Capacity Enhancement (PEACE)	Afghanistan/USA Various	NGO	ALW
Afghan Voice Agency (AVA)	Afghanistan/UK	NGO	ALW
Afghanistan Research and Evaluation Unit (AREU)	Afghanistan	NGO	ALW
African Union/InterAfrican Bureau for Animal Resources (AU-IBAR)	Kenya	NGO	LINKS
Aha Khan Development Network	Afghanistan	NGO	ALW
Arid Lands Information Network (ALIN)	Kenya	NGO	LINKS
Arid Lands Resource Management Project (ALRMP)	Kenya	NGO	PARIMA, LINKS
CARE Ethiopia	Ethiopia	NGO	PARIMA
Catholic Relief Services	USA	NGO	ALW
Citizens Network for Foreign Affairs (CNFA)	USA	NGO	ALW
Community Initiatives Facilitation and Assistance (CIFA)	Kenya	NGO	PARIMA
Dutch Committee for Afghanistan - Veterinary Programmes (DCA-VET)	The Netherlands/ Afghanistan	NGO	ALW
Farm Africa	Ethiopia	NGO	LINKS
FLUXNET	USA	NGO	3G
Freedom From Hunger, Ghana	Ghana	NGO	ENAM
Heifer International, USA, Ghana and Kenya	USA, Ghana, Kenya	NGO	ENAM, HNP
HISANI Arts Community Theater Project	Tanzania	NGO	AFS
Hope for the Horn	Ethiopia	NGO	LINKS
Mercy Corps, Afghanistan	Afghanistan	NGO	ALW, PEACE
Mercy Corps, Mongolia	Mongolia	NGO	GOBI
Mission d' Aide au Developpement des Economies Rurales (MADERA)	France	NGO	ALW
Njoro River Water Resource Users Associations (NJOWRUA)	Kenya	NGO	SUMAWA
Sanayee Development Organization	Afghanistan	NGO	PEACE
Save the Children, UK	Ethiopia	NGO	LINKS
Volunteer Efforts for Development Concerns (VEDCO)	Uganda	NGO	ENAM
Wellcome Trust	Tanzania	NGO	AFS
Wildlife Conservation Society (WCS)	New York, USA	NGO	HALI
Wildlife Conservation Society, Tanzania	Tanzania	NGO	AFS, HALI

USAID	State, Country	Institution Type	GL-CRSP Project(s)
FEWS NET	Ethiopia, Kenya, Djibouti, Somaliland	USAID	LINKS
USAID Mission to Ethiopia	Ethiopia	USAID	PARIMA
USAID Mission to Afghanistan	Afghanistan	USAID	PEACE
Women in Development	Ghana, Kenya, Ethiopia	USAID	ENAM, PARIMA, SUMAWA

**GL-CRSP PUBLICATIONS & PRESENTATIONS  
2007-2008**

**PUBLICATIONS**

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## **GLOSSARY**

3G	Grazinglands and Greenhouse Gas Emissions (GL-CRSP project)
A4	Advancing Afghan Agriculture Alliance
A-AARNET	ASARECA Animal Agriculture Research Network
AAU	Addis Ababa University
ACDI	Agricultural Cooperative Development International
ADB	African Development Bank
ADRA	Adventist Development and Relief Agency Canada
AEESP	Association of Environmental Engineering and Science Professors
AFGC	American Forage and Grasslands Council
AFS	Avian Flu School (GL-CRSP project)
AgSS	Agriculture Sector Strategy
AHDB	Agriculture and Horticulture Development Board, UK
AHEAD	Animal Health for the Environment and Development, WCS Programme
AID	Agency for International Development, Washington D.C., USA
AIDS	Acquired Immune Deficiency Syndrome
ALIN	Arid Lands Information Network
ALRMP	Arid Lands Resource Management Project
ALW	Afghan Livestock Workshop (GL-CRSP project)
AMPATH	Academic Model for Providing Access to Healthcare
ANOVA	Analysis of Variance
APDA	Afar Pastoral Development Association
AR	Action Research
AREU	Afghan Research and Evaluation Unit, Afghanistan
ART	Antiretroviral Therapy
ASAL	Arid and Semi-Arid Land
ASAP	Accelerating Sustainable Agriculture Program
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASF	Animal Source Foods

AU/IBAR	African Union/Inter-African Bureau for Animal Resources
AVA	Afghan Voice Agency, Afghanistan/UK
BLM	Bureau of Land Management
BMI	Body Mass Index
BSF	BioSand Filters
BTB	Bovine Tuberculosis
CAHNET	Community Animal Health Network
CBE	Commercial Bank of Ethiopia
CB-LEWS	Community Based Livestock Early Warning Systems
CBO	Community-Based Organization
CEWARN	Conflict Early Warning System
CFU	Colony Forming Unit
CGIAR	Consultative Group for International Agricultural Development
CIAT	International Center for Tropical Agriculture
CIC	Community Information Centers, Ethiopia
CIDA	Canadian International Development Agency
CIFA	Community Initiatives Facilitation and Assistance
CMO	Crisis Mitigation Office
CMRT	Crop Management Research Training
CNFA	Citizens' Network for Foreign Affairs, USA
CNP	Child Nutrition Project (GL-CRSP project)
CNT	Control
COHAB	Conference on Health and Biodiversity
CONICET	Consejo Nacional de Investigaciones Cientificas y Tecnicas, Argentina
CP	Crude Protein
CRSP	Collaborative Research Support Program
CSA	Credit and Savings Association
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
CSU	Colorado State University
CU	Cornell University
DFA	Direct Flourescent Antibody
DFID	Department for International Development, United Kingdom

DNPIA	Direction Nationale des Productions et des Industries Animales, Mali
DOM	Dissolved Organic Matter
DPFS	Dire Dawa Disaster Preparedness and Food Security, Ethiopia
DPIRP	Drought Preparedness Intervention and Recovery Programme
DPPC	Disaster Preparedness and Prevention Commission
DRR	Department of Relief and Rehabilitation
EARO	Ethiopian Agricultural Research Organization
EEP	External Evaluation Panel
EGAT	Economic Growth and Trade
ELFMD	Ethiopian Livestock and Fishery Marketing Department
ENAM	Enhancing Child Nutrition through Animal Source Foods (GL-CRSP project)
EPA	Environmental Protection Agency
ERMIS	Environmental Research Mapping and Information Systems
ESAP	Ethiopian Society of Animal Production
ESRI	Environmental Systems Research Institute
ESSP-IFPRI	Ethiopia Strategy Support Program
EU	Egerton University
FANTA	Food and Nutrition Technical Assistance Project
FAO	Food and Agriculture Organization, United Nations
FAO FSAU	Food Security Assessment Unit
FARM-Africa	Food and Resource Management, Africa
fasb	Financial Accounting Standards Board
FASEB	Federation of American Societies for Experimental Biology
FCI	Forage Condition Index
FERD	Faculty of Environmental Science and Resource Development
FEWS NET	Famine Early Warning System Network
FFHG	Freedom from Hunger, Ghana
FHI	Food for the Hungry International
FVA	First Voice Africa
FY	Fiscal Year
GHA	Greater Horn of Africa
GHG	Greenhouse Gas

GHS	Ghana Health Services
GIS	Geographic Information System
GL-CRSP	Global Livestock Collaborative Research Support Program
GO	Government Organization
GOBI	GOBI-Forage (GL-CRSP project)
GPS	Global Positioning Systems
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
H5N1	Avian Flu Virus
ha	Hectare
HAART	Highly Active Retroviral Treatment
HALI	Health for Animals and Livelihood Improvement (GL-CRSP project)
HH	Hope for the Horn
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
HNP	Increasing Animal Source Foods in Diets of HIV-infected Kenyan Women and Their Children, HIV Nutrition Project (GL-CRSP project)
HPAI	Highly Pathogenic Avian Influenza
HQ	Headquarters
HU	Haromaya University
HU	Hawassa University
IBRTP	Index-Based Risk Transfers Products
ICARDA	International Center for Agricultural Research in the Dry Areas
ICPAC	IGAD Climate Prediction and Applications Centre
ICRC	International Committee of the Red Cross
ICT	Information and Communication Technology
ICTAD	ICT Assisted Development
IDK	Independent Department of Kuchi
IEHA	Initiative to End Hunger in Africa
IER	Institut D'économie Rurale, Mali
IFPRI	International Food Policy Research Institute
IGA	Income Generating Activities
IGAD	International Governmental Authority on Development
IGC	Intergovernmental Conference (EU)

IGC	International Grasslands Congress
ILRI	International Livestock Research Institute
IPAL	Integrated Project for Arid Lands
IPR	Institut Polytechnique Rural de Formation et de Recherche Appliquee de Katibougou
IRC	International Rangelands Congress
ISSRM	International Symposium for Society and Resource Management
ISU	Iowa State University
IU	Indiana University
IWMI	International Water Management Institute
KARI	Kenya Agricultural Research Institute
KDA	Kenya Rural Enterprise Program Development Agency
KFSSG	Kenya Food Security Steering Group
kg	Kilogram
KLMC	Kenya Livestock Marketing Council
KLTA	Kenya Livestock Traders Association
KMD	Kenya Meteorological Association
KREP	Kenya Rural Enterprise Project
Ksh	Kenya Shilling
KWS	Kenya Wildlife Service
LDRCT	Livestock Development and Rangeland Conservation Tools for Central Asia (GL-CRSP project)
LEAP	Leadership Enhancement in Agriculture Program
LEWS	Livestock Early Warning System (GL-CRSP project)
LINKS	Livestock Information Network and Knowledge System (GL-CRSP project)
LiTEK	Livestock Marketing in Ethiopia and Kenya (GL-CRSP project)
LLC	Limited Liability Company
LMIS	Livestock Market Information System
LSHTM	London School of Hygiene and Tropical Medicine
LULCC	Land Use and Land Cover Change
MAIL	Ministry of Agriculture, Irrigation, and Livestock, Afghanistan
MADERA	Mission d' Aide au Developement des Economies Rurales, Afghanistan/France
MBOMIPA	Lunda-Mkwambi Wildlife Management Area, Tanzania
MDP	Marsabit Development Program

ME	Management Entity
MLPI	Mali Livestock Pastoralist Initiative (GL-CRSP project)
MLRI	Mpwapwa Livestock Research Institute
MoAAIF	Ministry of Agriculture, Animal Industry and Fisheries, Uganda
MoARD	Ministry of Agriculture and Rural Development
MoFA	Ministry of Food and Agriculture, Ghana
MoLD	Ministry of Livestock Development, Tanzania
MoLFD	Ministry of Livestock and Fisheries Development, Kenya
MOU	Memorandum of Understanding (also MoU)
MoWAC	Ministry of Women and Children Affairs, Ghana
MST	Microbial Source Tracking
MTRH	Moi Teaching and Referral Hospital
MU	Makerere University
MU	Moi University
MUAC	Mid-Upper Arm Circumference
NAAPI	Namulonge Agricultural and Animal Production Institute
NACC	National AIDS Control Council, Kenya
NAFTA	North American Free Trade Agreement
NALRC	National Arid Lands Research Center
NARC	Natural Agricultural Research Council
NARO	National Agricultural Research Organization, Uganda
NASA	National Aeronautic and Space Agency
NASCOP	National AIDS and STI Control Program, Kenya
NASULGC	National Association of State Universities and Land Grant Colleges
ND	Newcastle Disease
NDVI	Normalized Difference Vegetation Indices
NGO	Non-Governmental Organization
NHANES	National Health and Nutrition Education Strategy
NICHD	National Institute of Child Health and Human Development
NIRS	Near Infrared Reflectance Spectroscopy
NJOWRUA	Njoro Water Resource Users Association
NLMIS	National Livestock Market Information System

NNP	National Nutrition Programme
NPNL	Non-Pregnant, Non-Lactating
NPP	Net Primary Production
NPT	Non-Participant
NRCS	National Resource Conservation Service (United States)
NSF	National Science Foundation
OADB	Oromia Agricultural Development Bureau
OARI	Oromia Agricultural Research Institute
OCPB	Oromia Cooperative Promotion Bureau
ODPPC	Oromia Disaster Prevention and Preparedness Commission
OECD	Organization for Economic Cooperation and Development
OFDA	Office of Foreign Disaster Assistance (USAID)
OIE	World Organization for Animal Health
OMA	Observatoire du Marche Agricole, Mali
OPaDC	Oromia Pastoral Development Commission
ORCHIDEE	Observatoire Radar Coherent Heliporte d'Investigation des Elements Ennemis (French)
OSSREA	Organization for Social Science Research in Eastern and Southern Africa
PAR	Participatory Action Research
PARIMA	Pastoral Risk Management (GL-CRSP project)
PCAE	Pastoral Concern Association of Ethiopia
PCR	Polymerase Chain Reaction
PEACE	Pastoral Engagement, Adaptation, and Capacity Enhancement (GL-CRSP project)
PEER	Pool for External Evaluation of Research
PENHA	Pastoral and Environmental Network for the Horn of Africa
PEPFAR	President's Emergency Plan for AIDS Relief
PHD	Poultry Health and Development
PHYGROW	Plant Growth/Hydrology/Yield Simulation Models
PI	Principal Investigator
PIN	Peace Initiative Network
PLI-EW	Pastoral Livelihoods Initiative - Early Warning
PLMMO	Pastoral Livelihoods Movement Model
PLWHA	Persons Living With HIV/AIDS

POU	Point of Use
POU-WID	Point-of-Use Household Filters for Drinking Water Improvement (GL-CRSP project)
PRA	Participatory Rapid Assessment
PRA	Participatory Rural Appraisal
PSI	Population Services International
PT	Participant
RANET	Radio and Internet
RAP	Research Activity Plan
RATESP	Regional Agricultural Trade Expansion Support Program
RATIN	Regional Agricultural Trade Intelligence Network
RCI	Resource Conflict Institute
RCMRD	Regional Center for Mapping of Resources for Development
RECONCILE	Resource Conflict Institute
REDSO	Regional Economic-Development Services Office for East and Southern Africa (USAID)
RI	Research Institute
RIAH	Research Institute of Animal Husbandry, Agriculture University of Mongolia
RIING	Research to Improve Infant Nutrition and Growth
RNP	Ruaha National Park
SALTCLICK	Semi-Arid Lands Training and Livestock Improvement Centres of Kenya
SANREM	Sustainable Agriculture and Natural Resource Management CRSP
SCC	Samburu County Council
SCF - UK	Save the Children Fund (United Kingdom)
SEADS	Spatial Environment and Agricultural Decision Support
SLP	Sustainable Livelihoods Program
SRM	Society for Range Management
SCF - USA	Save the Children Fund (United States)
SDDP	Samburu District Development Programme
SDO	Sanayee Development Organization, Afghanistan
SHILDA	South Highlands Livestock Development Association, Tanzania
SMS	Short Message Service
SNV	Netherlands Development Organization
SPS-LMM	Sanitary and Phytosanitary Livestock Meat Marketing Project, Texas A&M

SR-CRSP	Small Ruminant Collaborative Research Support Program
SRI	Serere Research Institute
STI	Southern Tier Initiative
SUA	Sokoine University of Agriculture
SUMAWA	Sustainable Management of Watersheds: the River Njoro, Kenya (GL-CRSP project)
SWAT	Soil and Water Assessment Tool
TAMU	Texas A&M University
TANAPA	Tanzania National Parks
TAWIRI	Tanzania Wildlife Research Institute
TB	Tuberculosis
TCC	Technology Coordinator Council
TLMP	Tanzania Livestock Marketing Project
TN	Total Nitrogen
TP	Total Phosphorous
TZ	Tanzania
UCD	University California, Davis
UCLA	University of California, Los Angeles
UG	University of Ghana
UK	United Kingdom
UKY	University of Kentucky
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UONBI	University of Nairobi
USAID	United States Agency for International Development
USD	United States Dollar
USDA ARS	United States Department of Agriculture Agricultural Research Service
USU	Utah State University
UT	Utah
UV	University of Vermont

UW	University of Wyoming
VCI	Vegetation Condition Index
VEDCO	Volunteer Efforts for Development Concerns
VIC	Veterinary Investigations Center
VOCA	Volunteers in Overseas Cooperative Action
VS	Veterinary Services
VSF	Veterinaires Sans Frontiers - Suisse
WB	World Bank
WBSLP	World Bank Sustainable Livelihoods Program
WCS	Wildlife Conservation Society
WCSFVP	Wildlife Conservation Society Field Veterinary Program
WEAP	Water Evaluation And Planning System
WFP	World Food Programme
WHO	World Health Organization
WID	Women in Development
WMO	World Meteorological Organization
WRMA	Water Resource Management Authority, Kenya
WRUA	Water Resource Users Association, Kenya
WTO	World Trade Organization





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