

# **GLOBAL LIVESTOCK CRSP**

## **ANNUAL REPORT 2007**



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Cover Photo by Susan Johnson. *Stella Kuadoka, from Warabeba, Ghana is pictured on the front cover holding a child, Mercy Antobam. Stella is a participant in the Global Livestock CRSP ENAM project (Enhancing Child Nutrition through Animal Source Foods Management) that consists of micro-credit programs and entrepreneurial and nutrition education interventions in Ghana. She has completed four loan cycles with ENAM and is generating income through smoking and selling fish. Stella is still a group member and receives loans from the rural bank.*



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# **PREFACE**

Each year, the Global Livestock Collaborative Research Support Program publishes an annual report in compliance with grant requirements. The 2007 Annual Report documents work completed during the fiscal year, October 2006 to September 2007. The principal investigators for each project submit reports on research conducted with GL-CRSP funding. Each report is the expression of the principal investigator with minor editing by the Management Entity. All individual reports give the name, address, telephone number, and email address of the principal investigator for that project. Inquiries are welcome.



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## FOREWORD

### RESPONDING TO THE WORLD FOOD CRISIS

**Montague Demment, Director, GL-CRSP and David Wolking, Graduate Student, GL-CRSP/UC Davis, with contributions from Peter McPherson, President, NASULGC<sup>1</sup> and Danielle Knueppel and Franklin Holley, GL-CRSP/UC Davis**

*No single factor has caused the current food crisis, and no single solution exists to resolve it. To that end, the Global Livestock CRSP is responding with a comprehensive approach that encourages valuable partnerships and addresses risk management, market access, micro-enterprise and diversified livelihood strategies, health and nutrition, and capacity building and leadership to promote sustainable livelihood improvement in developing countries and help the poor adapt to increased food costs.*

#### **The Food Crisis: A Multi-faceted Dilemma**

Over time, events and circumstances have contributed to what is now known as the “World Food Crisis.” Decades ago, the prospect of famine led many to believe the world would soon run short of food. India and China faced continued famine throughout the 1950s. In the 1960s, investments in research that produced advances in technology and production methods greatly increased food production in important areas of Asia and parts of Latin America. Known as the Green Revolution, this effort became a landmark event that improved food availability for so many of the world’s poor and hungry.

In the decades following the Green Revolution, the world assumed that the newfound food abundance would continue, and blame for global hunger was shifted from production to distribution. The quote, “There is plenty of food on the planet; it is just a problem of distribution” became well known in donors’ halls. Few crop varieties or production systems were designed or adapted for the dry and marginal lands. Increases in food production occurred largely by extensification of agriculture into marginal lands. Governments and most international organizations cut back on agriculture development expenditures in developing countries. In 1990, about 12 percent of global Official Development Assistance (foreign aid) was for agriculture; now it is about four percent. In the early 1980s, 30 percent of World Bank lending was for agricultural purposes; but by the early 2000s it was down to 10 percent, despite the fact that about 75 percent of the world’s poor live in rural areas<sup>2</sup>.

At the same time, the donor community shifted its focus from long-term investment in fundamental development activities to short-term interventions and from core economic development issues to many of the problems created by a lack of broad-based economic development.

Food demand, however, continued to increase in the most disadvantaged communities, and world population increased steadily. Incomes in developing countries increased, especially in the more populated countries of Asia. Higher incomes meant people could afford more food and adapt their diets to include more meat, dairy products and processed foods, which require more energy and inputs than are necessary to produce

<sup>1</sup> National Association of State Universities and Land Grant Colleges

<sup>2</sup> Paper produced by the Agriculture and Natural Resources Team of DFID, the UK Department for International Development, “Official development assistance to agriculture,” November, 2004.

cereals alone. The result has been a dramatic rise in the global demand for cereals destined for animal feed, accelerated further by recent income increases in China.

Furthermore, agriculture around the world is often a subsidized and controlled industry. That practice has restrained market forces from driving comparative cost and production advantages. The subsidies encourage production in some countries but reduce production in others that may have a natural comparative advantage but cannot compete with subsidized food production in less efficient countries. In the face of global shortages, many countries have imposed trade restrictions that further hamper the ability of markets to elicit appropriate responses from buyers and sellers.

Finally, although it is not easy to determine the exact effect of biofuels on food prices, the use of maize in biofuel production has increased demand for maize and arable land, which further stimulates price increases. The World Economic Outlook from the International Monetary Fund states that higher fuel prices have played a role in the increased cost of food production. Higher prices in maize are predicted to increase the costs of partial substitutes (including wheat, rice and other edible oils) and increase the costs of animal rearing, as maize is an important ingredient in feedstock<sup>3</sup>.

### **Complex Problems Require Complex Solutions**

Without appropriate interventions, the food crisis is not likely to resolve itself. In determining the proper response we must take into consideration that “Food crop prices are expected to remain high in 2008 and 2009 and then start to decline as supply and demand respond to high prices; however, they are likely to remain well above the 2004 levels through 2015 for most food crops. Forecasts of other major organizations (FAO, OECD and USDA) that regularly monitor and project commodity prices are broadly consistent with the projections.”<sup>4</sup> It is unlikely that demand will decline markedly in the future so to lower prices supply needs to be increased. Increasing agricultural production will require input from developing countries, international organizations, and donors.

While many parts of Asia and Latin America benefited substantially from the Green Revolution and subsequent developments, a good number of African countries did not experience the same technological advancements. Over half of the people in Sub-Saharan Africa live in rural areas where they spend 80 percent of their income on food. Three-quarters of what the International Food Policy Research Institute (IFPRI) calls “the world’s ultra-poor” live in Sub-Saharan Africa, and there has been little success in decreasing this number<sup>5</sup>. In the recent past, African heads of state committed to increase expenditures of their national budgets dedicated to agriculture to 10 percent. Although this pledge represents a laudable goal, many countries have been unable to attain it. Strong action by developing country governments to support increased agriculture production and rural income generation is essential if the food crisis is to be successfully addressed.

Just as it did in the decades surrounding the Green Revolution, the United States government can contribute to solving the current world food crisis as well. Unfortunately, funding for agricultural research and development has been notably diminished in recent years, whereby the 2008 allocation of USAID funds includes no core

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3 “The World Economic Outlook: Spillovers and Cycles in the Global Economy,” paper by the International Monetary Fund, April, 2007.

4 Paper of the World Bank, “Rising Food Prices: Policy Options and World Bank Response,” April, 2008.

5 IFPRI, “The World’s Most Deprived: Characteristics and Causes of Extreme Poverty and Hunger,” <http://www.ifpri.org/media/20071106Deprived/mostdeprivedfindings07.asp>.

funding for the Consultative Group for International Agricultural Research; and funding for Title XII, the Famine Prevention and Freedom From Hunger Improvement Act that engages U.S. universities in building agriculture capacity in developing countries, has been reduced to only a small fraction of what it was two and three decades ago. The 2009 budget submitted by the President does not appear to increase agriculture funding above 2008 levels. (The supplemental bill does have new funds for agriculture, but a large fraction is for emergency food aid rather than long-term development investments). To reverse this trend and be instrumental in ending the current situation, the U.S. government and USAID should rediscover their previous commitment to agriculture and specifically food production.

The World Bank and the U.S. should lead the way back to sustained and substantial support for long-term agricultural development. In the last several years, USAID monies have increasingly been used to respond to critical immediate needs, including an array of natural disasters, with goods and services. While no one would argue the need for short-term relief, investment in the longer-term provides the capacity for people to deal with their short-term challenges. Most people at USAID believe that producing more food in the developing world is central to healthy and better lives and would welcome additional resources for that purpose. Programming funded by USAID needs to be integrated to support both the short-term relief efforts and longer-term agricultural development initiatives current world food crisis and as a whole. This approach effort to build scientific institutional, in developing be generated within those to not only solve the food to dynamic economic and

**“THE WORLD BANK AND THE U.S. SHOULD LEAD THE WAY BACK TO SUSTAINED AND SUBSTANTIAL SUPPORT FOR LONG-TERM AGRICULTURAL DEVELOPMENT.”**

research and sustainable to adequately address the sustainable development should include a major capacity, both human and countries so solutions can countries as a major step crisis, but enable transition social growth.

### **The GL-CRSP Response**

The CRSP model was designed in the late 1970s specifically to address these longer-term fundamentals through agricultural research, education and capacity training, and what would later become sustainable development. Through research conducted over the past decade, the Global Livestock Collaborative Research Support Program (GL-CRSP) has developed a comprehensive livelihood enhancement and support strategy that both assists rural households in responding to short-term shocks, as well focusing on longer-term capacity development and research essential to sustainable development. In a food crisis situation, GL-CRSP programming, developed around the theme of risk in a changing environment, is ideally suited to mitigate the consequences of rising food costs for rural households, while also supporting the households in their ability to take advantage of higher food prices.

**Risk Management.** The ability of households to respond to increasing food prices is, in essence, dependent on the extent to which the household is reliant on purchased food for subsistence. Pastoral producers in East Africa have become increasingly reliant on purchased foods, mainly cereals, due to population growth in the absence of corresponding increases in livestock productivity. The effect of diminished tropical livestock units per capita forces pastoralists to rely increasingly on non-livestock products for survival. This reliance on cereals puts pastoralists at high risk of food insecurity and malnutrition, especially during times of drought, when domestic grain markets are low in supply, and forage and water availability for livestock are increasingly scarce. Higher food prices reduce the purchasing power of pastoral households reliant on livestock sales, and drought significantly reduces the opportunities for transforming livestock assets into cash. In the face

of such challenges, enabling vulnerable communities to respond requires a multi-tiered strategy combining diversified income generating activities that support pastoral production with capacity building and training programs that help develop the group governance and management skills to mitigate risk.

GL-CRSP projects have developed a comprehensive risk management strategy focusing on diversifying livelihoods through income generating activities and the development of collective action groups to engage markets and improve incomes. Based on the research of the GL-CRSP Pastoral Risk Management (PARIMA) project, collective groups in Ethiopia have been successful in microfinance and livestock marketing and have since graduated into legally recognized producer cooperatives. The original PARIMA groups are located across five districts on Ethiopia's Borana Plateau and contain over 2,200 members, 76 percent of whom are women. The model has been so successful that organization of livestock collective action groups is ongoing across the border in northern Kenya and has been incorporated into a separate project focused on enhancing child nutrition in Ghana. These programs enable pastoral and agricultural households to develop strategies to cope with risk by increasing income generating activities and minimizing adverse impacts associated with external shocks, including rising food prices.

**Market Access.** Livestock represent a significant asset to pastoral and agro-pastoral communities throughout Sub-Saharan Africa. Transforming this asset into monetary income, however, requires access to markets and market information that enable producers to take advantage of preferable terms of trade. A main contributing factor to the rising cost of food is increasing global demand for livestock products, especially in rapidly growing economies, which diverts agricultural production away from food crops towards livestock feed. This presents a unique opportunity for pastoral producers to benefit from changing terms of trade, as extensive rangeland-based livestock production systems have the capacity to supply growing consumer demand at a considerably lower cost.

The fundamental obstacle to linking pastoral and agro-pastoral African producers with growing global livestock demand is market access. Imperfect information, infrastructural challenges, quality control and weak regulatory mechanisms, all contribute to arresting the possibilities of smallholder producer participation in regional and international livestock markets. The GL-CRSP has invested considerable resources in the development of appropriate and sustainable solutions to the market access challenge, culminating in the establishment of Livestock Marketing Information and Early Warning Systems (LINKS-LEWS) currently active in Ethiopia, Kenya, Tanzania, and Uganda. The LINKS-LEWS programs provide real-time forage availability, water resource, conflict, and market price information via Internet, radio, Short Message Service, and other channels, to policy makers, market traders and middlemen, and livestock producers throughout East Africa. The LINKS-LEWS technology suite has provided the necessary framework for pastoral producers to become informed, forewarned, and empowered in order to make production and marketing decisions that mitigate risk associated with adverse environmental and economic shocks.

GL-CRSP Livestock Early Warning and Market Information research has also been extended to Mongolia, where it has been successfully incorporated into eight aimags and institutionalized as a tool for improved prediction of forage availability, management of pastoral migration, and early detection of drought and other rangeland management concerns. A major step in ensuring the effective utilization of early warning and market information technologies is the education of herders and pastoralists on the benefits of LINKS-LEWS technologies. Activities focus on the development of herder cooperatives based on the American herder cooperative model. The success of these cooperatives is intended to improve pastoral livestock marketing thereby increasing herder income and livelihood and minimizing the possibilities for resource degradation and conflict.

Most recently, the USAID Mission in Mali identified an overall goal of improving productivity and income of producers in the northern region of Mali by enabling them to access technologies and build capacity through the development of an extensive livestock information system. In response to this goal and with strong Mission support, the GL-CRSP Mali Livestock and Pastoralist Initiative (MLPI) project was formed in early 2008. The objective of this effort was to take successful technologies and tools developed and implemented in East Africa and transfer them to Mali with emphasis on the northern regions of the country. MLPI will utilize LINKS technologies and PARIMA risk assessment tools to establish a livestock market information system (LMIS) and build capacity for improving options for marketing and fattening of livestock in the region. Through this integrated approach combining market access with improved income generating potential and risk management capability, the GL-CRSP has better insured pastoralists in East Africa, Mongolia and now West Africa against risks stemming from both internal and external sources.

**Micro-enterprise and Diversified Livelihood Strategies.** A critical component of adapting to rising food prices is the ability to both generate and accumulate capital and resources. Without this ability, households risk significant decline in purchasing power contributing to greater food insecurity and malnutrition, thus driving vulnerable populations into deeper cycles of poverty. For rural households, diversifying livelihood strategies offers a risk management mechanism that protects against over-reliance on a single production system. In the event of drought-induced crop failure, for example, a household may fall back on charcoal production for food purchases. Furthermore, diversified strategies allow a household facing rising food prices to revert to other livelihood strategies (e.g. collecting wild honey, or marketing crafts and other non-agricultural products) along with crops.

The GL-CRSP recognizes the critical contribution that diversified livelihood strategies make in risk management but has identified capacity building and social organization development as crucial elements in supporting the success of such strategies. Through comprehensive training and capacity building programs targeted at diverse groups of rural producers throughout Sub-Saharan Africa, GL-CRSP projects have developed women's collective action groups, producers organizations, water resource user associations, herder-alliances, and cooperatives that support income generating activities, micro-credit, and other livelihood enhancement programs, and provide social networks and resources for households to collectively manage risk.

Through GL-CRSP supported programs, these groups have successfully marketed thousands of livestock products to the Middle East, established nurseries and reforestation projects in the Rift Valley, launched successful micro-enterprises in water filtration technologies and agricultural processing, and provided credit and loan opportunities for previously marginalized populations. By supporting the development of social networks and organizations, GL-CRSP programs have enabled rural communities to develop greater market interconnectivity, both within and among villages and regions, thereby increasing the opportunities for livelihood diversification through greater access to regional markets.

**Health and Nutrition.** Higher food prices lower the purchasing power of the rural poor and can change household food consumption patterns. If rising costs of food are coupled with drought or poor harvest, the impact on rural communities can be devastating. Food insecurity is not only defined by the lack of access to a large enough quantity of food, but also by the lack of access to food of high, nutritious quality.

Households facing rising food prices may react by downsizing portions, eliminating meals, or substituting high calorie per unit cost foods, such as cereals, for other more nutritious foods, such as milk, meat, and horticultural products. Despite increasing the caloric terms of trade, households risk diminishing nutrition, especially in children and immuno-compromised populations. Malnutrition is a serious threat to capacity



and economy as it increases overall risks of disease and contributes to lower income generating potential through lost labor hours, compounding the effects of higher food prices.

Throughout its history, the GL-CRSP has been committed to understanding the linkages between nutrition, health, and human capacity and has developed several programs targeting enhanced nutrition through income generating activities, social network and organizational development, and improved livestock production, especially among children and mothers infected with HIV. GL-CRSP programs in Ghana and Kenya are actively employing interdisciplinary teams and public-private partnerships in efforts to spur community empowerment, centered on nutrition education and livelihood enhancement. Experimental field trials are underway to assess the potential use of animal source foods in diets of HIV-infected mothers and their children to support healthy immune system function and cognitive capacity development.

In addition, a nutrition extension course, the first of its kind, developed through the GL-CRSP, is being offered at the University of Ghana and is expected to assist in nutrition education efforts at the village level to minimize adverse health impacts associated with a low quality diet. While recognizing that education alone cannot protect against malnutrition in resource-constrained households, the GL-CRSP has integrated education, outreach, capacity building, and livelihood enhancement to enable women to use income generating activities to buffer rural households against risk, and in the face of this new crisis, against rising food prices. Remarkably, previously poor women in the program have successfully saved \$1000 in a year, attracting the attention of rural banks that now want to spread the program and are investing in training using the GL-CRSP approach and materials.

**Capacity Building and Leadership.** Primary, secondary and higher education are all necessary contributors to building a country's human capacity, including a strong agriculture sector. People trained and capable of performing in today's information-based global economies, able to create the standards, the laws, and the technologies that are essential for stable societies and economic growth, are much needed in developing countries to drive progress in the private and public sector. Development is about helping people acquire the necessary knowledge and tools so that their creativity and motivation can be harnessed as an important source of power for economic growth.

The Global Livestock CRSP recognizes human capacity building as a fundamental and essential component of development and our national security. The CRSP model, with long-term commitments and an interdisciplinary, problem-solving focus, embodies the essential characteristics that result in high rates of return of host country students (96 percent), well-trained individuals with vision and creativity, and potential leaders for their nation's scientific and political future.

In complementary fashion, our U.S. students not only participate in the solving of development problems, but also become globally competent to fill leadership roles in international endeavors. The GL-CRSP design provides for a wide range of training possibilities and employs both traditional and innovative strategies to achieve its training goals. From 1998-2007, the GL-CRSP has supported 252 students from 26 countries (40 percent women) in fields ranging from Rangeland Ecology and Management to Civil Engineering, Nutrition, and Veterinary Medicine. The GL-CRSP has also provided job, education, and life skill training to approximately 19,500 individuals (51 percent women) from 27 countries in various fields including, but not limited to: poultry production, micro-finance and credit, natural resource management, fiber production and quality assessment, zoonotic disease prevention and response, and child nutrition.

### **Partnerships in Knowledge are Critical**

Extending new knowledge to farmers and livestock producers in developing communities, especially in African countries, is a challenge. Personnel-intensive U.S. style extension systems have not been financially sustainable in most of Africa. New combinations and approaches to extension are required. Finally, universities have a critical role to play in development. The agriculture education and the problem solving capacity of African universities should not go unnoticed and should be supported as contributors to growth of the agricultural sector.

Host country universities and higher education are thus critical to development and form an integral part of the GL-CRSP model through partnerships and collaborations. It is these types of partnerships, that include public institutions, private enterprise, civil society, international and host country organizations and individuals, united to enhance livelihoods and develop a sustainable and profitable agriculture sector, that will have the capacity to appropriately respond to the world food crisis and significantly improve food production in the developing world.

## 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 involve researchers from 12 U.S. universities, eight host country universities, eight international research organizations, 54 foreign institutions, and the International Livestock Research Institute (ILRI). The program is currently active in three regions of the world: West Africa, East Africa 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 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 address 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 Global Livestock 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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## 2006-2007 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.
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 2006-2007 portfolio is comprised of 11 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.

### **2006-2007 GL-CRSP PROJECT PORTFOLIO**

**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 of Mongolia.

**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 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 Livestock Early Warning System (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 manuscript to be published in 2008.

**Improving Pastoral Risk Management in 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.

**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. Recent project activity has focused on building models of the biophysical and human dimensions of the watershed as they relate to watershed and human health and sustainability. Two projects build on past 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**).

**Pastoral Engagement, Adaptation, and Capacity Enhancement Project (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. The project will also help build capacity of the Afghan government personnel responsible for planning and implementing livestock development and rangeland resource management.

**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.

## KEY ACHIEVEMENTS

*The GL-CRSP utilizes demand-driven research focused on a problem model while simultaneously forming necessary collaborations and partnerships to implement sustainable solutions and address core development issues specific to project areas. 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, biotechnology, capacity building, community mobilization, conflict mitigation, food security, gender, higher education, HIV/AIDS, micro-enterprise, policy, and water.*

Key achievements from 2006-2007 in these areas include the following:

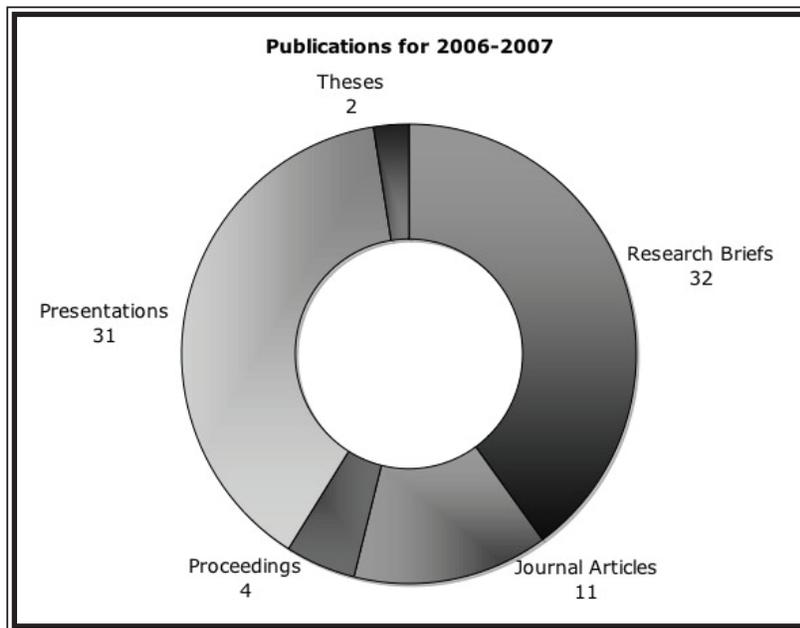
### AGRICULTURE ENABLING ENVIRONMENT

- In Tanzania, a total of 184 community leaders and public officials received Avian Flu School (AFS) training on poultry vaccination for Newcastle disease and the benefits of improving poultry health. Trainings on the recognition and early reporting of avian flu have fostered new strategies for veterinary extension, including strategies for increasing poultry vaccination, thereby improving poultry production.
- From 2006-2007, 28 pastoral households participating in the HALI project benefited from interventions of tuberculosis testing in livestock herds and disease counseling to improve the health of

their livestock. These households are heavily reliant on livestock for both subsistence and income, and the identification of bovine tuberculosis in the area represents a significant threat to herd health and productivity.

### APPLIED RESEARCH AND TECHNOLOGY

- The LINKS project is actively developing water resource monitoring tools as part of its Livestock Early Warning System (LEWS) to aid pastoral communities on the availability of water. These activities will enhance the capacity of pastoral communities to make decisions on migration and



minimize the likelihood of competition over water resources. For 2006-2007, the LINKS project trained 171 market monitors - 86 from Kenya, 51 from Ethiopia, and 34 from Tanzania. LINKS has also established a steady SMS (Short Message Service) text message-based reporting flow from 14 markets in Kenya, 15 markets in Ethiopia, and 14 markets in Tanzania.

- Since January 2007, weekly radio bulletins have been broadcasted using GOBI Forage LEWS/LINKS technology to provide information to herders on current and forecast forage conditions and drought prediction information by natural zone and soum. The target audience is estimated to be approximately 520,000 rural listeners distributed over the eight aimags in which GOBI Forage is active.

#### **BIODIVERSITY**

- The GOBI Forage Technology Suite covered over 75,000,000 hectares in 2006-2007 throughout eight aimags in Mongolia, representing a significant range of biodiversity potential for conservation, including critical habitat and plant species. Stakeholders use Gobi Forage products to reduce the number of animals grazing during drought periods, thereby decreasing potential losses in plant species biodiversity.
- HALI researchers have identified bovine tuberculosis in both wildlife and livestock in the Ruaha ecosystem, one of the largest intact conservation areas remaining on the African continent. An accurate assessment of diseases that threaten the persistence of key species, such as buffalo and lion, is essential for informing policy and management strategies to conserve the unique biodiversity of this region.

#### **BIOTECHNOLOGY**

- The Avian Flu School utilizes technologies such as the FluDetect test kit, a rapid antigen detection kit for birds, developed through biotechnology research. In the period 2006-2007, 152 animal health and human health professionals in Uganda, Kenya, Tanzania, Djibouti and Ghana were trained

in using the FluDetect test kit to incorporate it into their early detection program in the field.

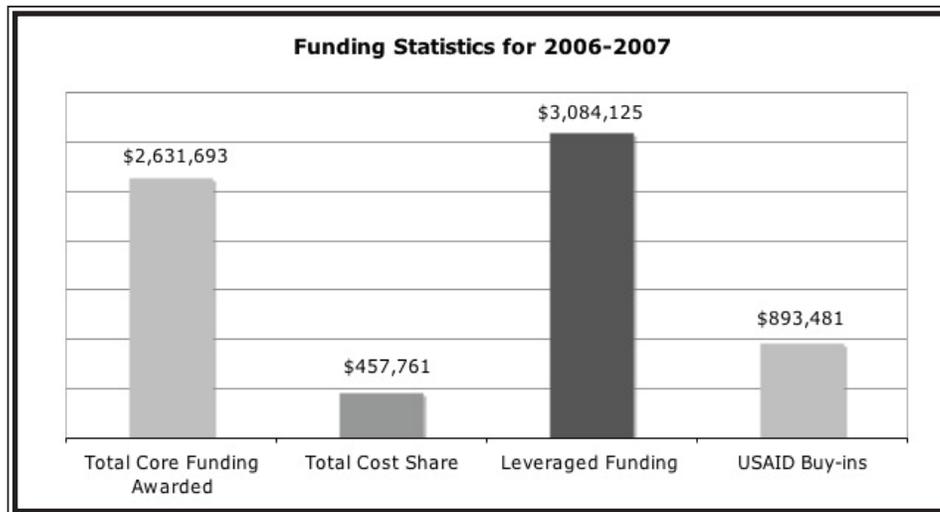
- The HALI project has introduced new immunomagnetic separation techniques allowing researchers to detect a high number of parasites in a river used heavily by people and livestock. The project is also employing immunofluorescent antibody staining techniques to test for the presence of these parasites in wildlife and livestock fecal samples to determine if these parasites are the same as those found in water sources. These technologies serve to inform Tanzanian water management agencies of the presence of harmful bacteria, greatly enhancing aid efforts to improve access to clean water for rural Tanzanians.

#### **CAPACITY BUILDING**

- The LINKS project has been supporting training programs at the policy, market/trader and producer/community levels to build the capacity of users to access, interpret and utilize the market information for decision-making. Approximately 5,687 individuals participated in market information system user capacity trainings at the national, regional, and local levels during 2006-2007.
- Through its national-level (Tier I) Train the Trainer program, the AFS trained 134 avian flu prevention and response instructors in the ministries of animal health, public health, agriculture and faculties of veterinary medicine in Nigeria, Kenya, Tanzania, Uganda, Ghana, and Djibouti. At the district level (Tier II), in Tanzania and Djibouti, 178 people were trained, while 184 Tanzanian villagers and community leaders received training at the village level (Tier III). Nearly 500 individuals received AFS training in year 2006-2007.

#### **COMMUNITY MOBILIZATION**

- The period 2006-2007 has proven to be yet another active and sustainable year for the 60 collective-action/micro-finance groups that have formed in southern Ethiopia since 2001, as part of PARIMA. This model of collective-action/micro-



finance has been adopted throughout the Oromia State of Ethiopia and extended to communities in the region. Total membership currently stands at 2,085, and the groups have merged into legally recognized cooperatives.

- The ENAM project community mobilization processes have included the formation of 35 community Credit and Savings Associations based on shared values and trust, the independent development of group bylaws and leadership capabilities, and communal activities. Association members have assisted each other in initiating communal activities, such as building smoking ovens and pooling resources for feed preparation for poultry operations.

### CONFLICT MITIGATION

- The Intergovernmental Authority on Development (IGAD) in Eastern Africa Conflict Early Warning System (CEWARN) utilizes the LEWS forage early warning system technology for identifying areas of forage deficiency as a potential resource-based conflict indicator. LEWS technology was incorporated into CEWARN in 2006-2007. CEWARN serves as the basis for initiating interventions for conflict prevention and mitigation throughout the Eastern Africa region, including the conflict ridden and volatile Horn.

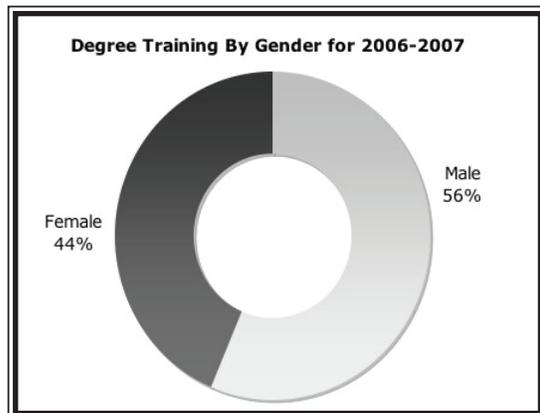
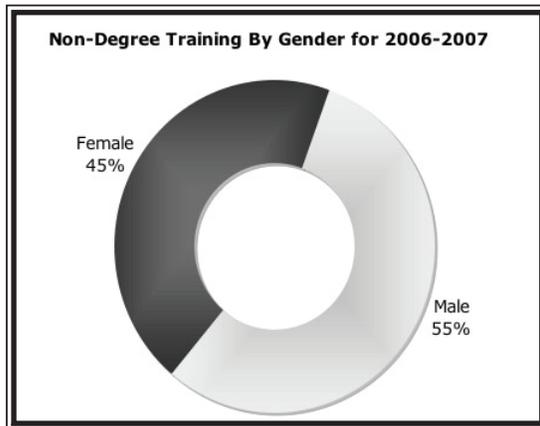
- In order to characterize natural resources and understand the elements of cross-border conflict along the Ethio-Kenya border, PARIMA interviewed over 200 pastoralists and mapped the area using GPS technology. Findings indicate that pastoralists have traditionally moved across the border in search of forage areas during dry periods, and such movements, and therefore livelihoods, are threatened by border conflicts and require the attention of research and development specialists and policy makers.

### FOOD SECURITY

- Preliminary results of the HNP Food Security Assessment of 31 HIV-infected Kenyan women and their children indicated that about half of the households had no source of income and relied on self-sustenance, or good will, for food. The majority could not afford three meals per day and consumed monotonous diets with little animal source foods. Over 75% reported no intakes of egg, meat or fish within the past 24 hours.
- The ENAM project has identified variation in food scarcity patterns in Ghana. Food shortages peaked during April-June, the primary rainy season in Ghana. The overall prevalence of food shortages was highest in the northern Guinea Savannah during this period, demonstrating the importance of targeting interventions by region and season.

## GENDER

- Informal education training sessions were held monthly in ENAM's project communities, with a total of 3,596 female and 59 male attendees. The micro-credit intervention reached 163 women. In addition, six professional women and eleven professional men were trained by Freedom from Hunger on implementing their "Credit with Education" program.
- Milk marketing is predominately a female task in Ethiopia. Therefore, it is noteworthy that women are the primary leaders of the 60 collective-action/micro-finance groups that have formed in southern Ethiopia since 2001 as part of PARIMA. Women also represent 79% of the cooperatives' 2,085 total members.



- Water treatment in the Njoro River watershed in Kenya is generally a female gender-specific role. Therefore, the POU-WID project's successful introduction of BioSand water filters (BSF) as a sustainable water treatment technology has greatly impacted gender and labor roles at the household level, where men have increased their involvement with water-related chores due to filter appreciation, including taking responsibility for re-filling the filters.

## HIGHER EDUCATION

- The ENAM project and its partners developed a course titled "Nutrition, Sustainable Livelihoods and Extension" to be offered by the Department of Nutrition and Food Science at the University of Ghana, Legon. This multi-disciplinary course is designed for students who plan to work in the area of community-based nutrition.

- Six advanced degrees (three M.Sc.s. and three Ph.D.s) were awarded to Ethiopian and Kenyan students supported by the LINKS, PARIMA, and SUMAWA projects in the fields of Range Science, Range Management, Hydrology, and Human Ecology during the period 2006-2007. The students completed their degrees at the University of Nairobi and Egerton University in Kenya, Alemaya University in Ethiopia, and Hebrew University in Israel with support from Texas A&M University, Utah State University, and the University of Wyoming.

## HIV/AIDS

- The HIV Nutrition Project (HNP) is evaluating the effect of protein quality and micronutrients in meat on the health and nutritional well-being of women living with HIV in rural Kenya and the health and development of their children. Thirty-one women participated in the Phase I Food Security Assessment, eighteen women and nineteen children were enrolled in the Phase II Preliminary Trial, and 88 families have been identified for the main nutrition intervention study.

**MICRO-ENTERPRISE**

- Three micro-credit loan cycles through the 35 ENAM project Credit and Savings Associations were completed with 100% repayment of loans. Interviews with 206 participants and their control households showed that women who engaged in Animal Source Food (ASF)-related Income Generating Activities (IGA) earned, on average, 3.5 Ghanaian Cedis (one U.S. Dollar ~ one Ghanaian Cedi) more per week than women engaged in IGA unrelated to ASF, a statistically significant amount. Diversity of ASF in the diet increased when mothers had an ASF-based income generation activity.
- The original 60 collective-action/micro-finance groups that have formed in southern Ethiopia as part of PARIMA have merged into legally recognized cooperatives. As of September 2007, cumulative savings on investments in livestock trading and other small-business activities equaled USD \$93,344. Internally extended loans over the past five years total 4,527 with a cumulative value of USD \$558,989 and a 100% repayment rate.

**POLICY**

- Livestock market information systems and early warning technologies developed by the LINKS/LEWS (Livestock Network and Knowledge System/Livestock Early Warning System) projects provide the basis for a National Livestock Market Information System (NLMIS) currently operating in Kenya. These technologies are also being adopted as part of a NLMIS program in Ethiopia, representing the integration of regional and transnational livestock markets in East Africa and providing policy support for natural resource management, market efficiency, and livestock monitoring.
- Following the Avian Flu School (AFS) briefing and training of community leaders and local government officials in Tanzania, the district of Iringa formulated and adopted a new policy to make Newcastle disease vaccination and improvement of poultry health a priority for development. A district-wide Newcastle disease vaccination program has since been implemented.



## WATER

- Diminishing lake levels in Lake Nakuru, Kenya, a primary water source for irrigation and household drinking water in the nearby town of Nakuru, threaten both agricultural and ecological sustainability, as the lake provides critical habitat to a number of keystone species. The SUMAWA/NJORO WATER project developed a water budget model for the lake and River Njoro to understand the balance between upstream surface and groundwater sources in sustaining lake levels. This model enhances the capacity of managers and policy makers to make critical decisions on water resource management.
- Further results of the POU-WID (Development and Marketing of Point-of-Use Household Filters for Drinking Water Improvement) project's investigation into the use of BioSand Filters (BSF) in 60 Kenyan households showed significant improvements in water quality, reductions in incidence of childhood diarrhea, and high levels of satisfaction and sustained use of the filters. At the end of the trial, 47 of the 60 households chose to purchase the BSF, including 23 of the 30 control households. As a result, the health and well being of 235 vulnerable people in the Njoro watershed have now been protected from drinking and using contaminated river water through the purchase and use of the BSF.

## GL-CRSP THEMES AND IMPACTS

*The GL-CRSP exists as a collaboration between developing and developed country institutions to create effective, sustainable change through research, short-term training programs designed to transfer skills and knowledge to stakeholder communities, and long-term degree programs investing in the future of developing country scientific research and development. The problem solving focus and commitment to capacity building and higher education of GL-CRSP's research support the development of the world's most precious natural resource – human and social capital. Four themes are critical to the problem solving focus of the GL-CRSP: Human Welfare and Nutrition, Natural Resource Management, Risk Management, and Zoonotic Disease. These themes encompass all GL-CRSP activities in 2006-2007 and represent the diverse areas of impact within the GL-CRSP development model.*

### HUMAN WELFARE AND NUTRITION

Development programs targeting human welfare and nutrition (e.g. improving diet diversification and decreasing micro-nutrient deficiencies) must be considered as primary policy objectives alongside agriculture and food aid programs and other initiatives in development planning. The utilization of income alone as the sole measure of success is both inadequate and detrimental to the proper assessment and evaluation of development programs and initiatives.

Human nutrition emerged as a prominent theme in GL-CRSP programming, as it is often neglected as a fundamental component of development and because animal source foods have much to contribute to the micronutrient status and dietary diversity that affect child development. Building on the efforts of the Nutrition CRSP, the GL-CRSP is committed to investigating the role of human welfare and nutrition in development. Two exemplary GL-CRSP projects focus on improving nutrition through animal source foods: the *Enhancing Child Nutrition through Animal Source Food Management (ENAM)* project, located in Ghana, and *Increasing Animal Source Foods in Diets of HIV-Infected Kenyan Women and their Children (HNP)*.



*Malnutrition among young children is common in GL-CRSP project villages. Marigat, Baringo District, Kenya. Photo by Chris Barrett.*

## NATURAL RESOURCE MANAGEMENT

The world is becoming increasingly unpredictable. The forces of weather, globalization, population, and disease create a dynamic environment that often challenges indigenous cultural, social, and economic systems. Severe weather events are more frequent and more intense. Their impact is compounded by growing populations living on marginal lands and using unsustainable cultivation techniques. The natural resource base, upon which the rural poor are so highly dependent, is degrading rapidly. The GL-CRSP is actively addressing pro-poor natural resource management by focusing on research and development at both the watershed and household levels. Through an interdisciplinary approach, GL-CRSP programming is impacting natural resource management strategies and livelihoods, while building the scientific and community capacity required to adapt and respond to changing climatic, environmental, and social systems.

The *Sustainable Management of Rural Watersheds (SUMAWA)* project addresses one of East Africa's most important natural resource management issues: water. The project actively develops the intellectual and social capital required to manage natural resources that are under attack by a growing population, increased livestock grazing and short-term extraction strategies that threaten a watershed and a major national park. National parks are a critical economic and social resource for the East African region. The GL-CRSP *Grazinglands and Greenhouse Gases (3G)* project is compiling years of research on the management and conservation of rangelands and their capacity to generate pro-poor income from the sale of carbon credits into a single volume.

This compendium is due for publication in the fall of 2008 and will provide policy makers and development practitioners with the tool-kit necessary to pursue the incorporation of rangeland management programs into global carbon markets and thereby generate a desperately needed additional source of income for pastoral livelihoods.

## RISK MANAGEMENT

Global Livestock CRSP (GL-CRSP) projects focus on arid and semi-arid environments, where human populations and

natural resources are most vulnerable and, in most cases, where biodiversity is most valuable. In these environments, access to resources, be they information, markets, or technologies, is limited. Economic, social, and political systems are in dramatic transition, as witnessed in Central Asia. Markets are in turmoil, particularly at the local and national levels. The natural resource base (e.g. water, vegetation, and soil), as well as tenure systems and the accessibility of resources, are under attack by short-term strategies that often emphasize survival and extraction. Food insecurity and malnutrition constrain human capacity and national



*Young herder with goats browsing in Ngambo, Kenya where forage is sparse and precipitation increasingly unpredictable. Photo by Chris Barrett.*

development. Impoverished populations are more exposed to risks than others because they are subject to highly variable weather and lack the personal and social resources to buffer unexpected perturbations in their lives.

FAO's 2004 Review of the Livestock Sector in the Horn of Africa identified risk as a central theme affecting the lives of poor livestock holders in developing countries. GL-CRSP project research indicates that a lack of coping options (e.g. alternative sources of income, information, connectivity to services and markets, weather prediction, mechanisms to manage natural resources, and resources to reduce malnutrition) is the primary obstacle to the development of these populations.

The GL-CRSP has, thus, focused extensively on this concept. The *Livestock Information Network and Knowledge System for Enhanced Pastoral Livelihoods in East Africa (LINKS)*, *GOBI Forage*, and *Improving Pastoral Risk Management on East African Rangelands (PARIMA)* projects deal directly with information flow and coping strategies for diversifying income and increasing links to markets for pastoralists. They both work directly with pastoral populations and their natural resource base. The *Livestock Trade in Ethiopia and Kenya (LiTEK)* project seeks to understand how terminal livestock markets function, in order to better understand how to connect interventions at the local level to national markets, which will ultimately lead to improvements in the ability of pastoralists to respond to drought.

## ZOONOTIC DISEASE

The Global Livestock CRSP recognizes the appearance of diseases that can be transmitted between animals and humans, or zoonoses, as an effect of the intensifying interface between humans, domestic livestock, and wildlife. The appearance of zoonoses is especially relevant for agricultural development where the rural poor, people often pushed onto marginal lands, are, in essence, at the gateway for zoonotic transmission. Lack of access to animal source foods from domestic livestock may lead communities to turn, unknowingly, to infected bush meat for animal protein, with potentially harmful results. Alternately, insufficient pasteurization or cooking of infected animal source foods, such as milk or beef, can result in disease transmission to humans.

The H5N1 highly pathogenic avian influenza (HPAI) virus, commonly known as Avian Flu, has flourished in Southeast Asia and has spread rapidly throughout the continent into the Middle East, Europe, and Africa. In response to Avian Flu threats in several African countries, the GL-CRSP *Avian Flu School (AFS)* was designed to help minimize the health and economic impact of HPAI by providing the training necessary to improve a community's ability to prevent, respond to and recover from an outbreak of HPAI. In Africa, where poultry health is also compromised by Newcastle disease, researchers have found that when looking for signs of Avian Flu in a flock, it is important to control for Newcastle disease, which has similar symptoms to Avian Flu. In addition to conducting Avian Flu trainings, the AFS is researching strategies for improving poultry health, including implementing a Newcastle disease vaccination program.

The GL-CRSP *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 in Tanzania. Recognizing the threat of zoonoses, such as bovine tuberculosis, and understanding their origins allows 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.

## **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 micro-credit 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.*

**LEAD PRINCIPAL INVESTIGATORS**

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**SUMMARY OF ACHIEVEMENTS**

- Three micro-credit loan cycles through the 35 ENAM project Credit and Savings Associations were completed with 100% repayment of loans. Interviews with 206 participants and their control households showed that women who engaged in Animal Source Food (ASF) -related Income Generating Activities (IGA) earned, on average, 3.5 Ghanaian Cedis (one U.S. dollar ~ one Ghanaian Cedi) more per week than women engaged in IGA unrelated to ASF, a statistically significant amount. Diversity of ASF in the diet increased when mothers had an ASF-based income generation activity.
- Informal education training sessions were held monthly in ENAM's project communities, with a total of 3,596 female and 59 male attendees. The micro-credit intervention reached 163 women. In addition, six professional women and eleven professional men were trained by

Freedom from Hunger on implementing their “Credit with Education” program.

ENAM Non-Degree Training for 2006-2007			
Country	Male	Female	Total
Ghana	59	3596	3655

- Entrepreneurial education modules were completed and implemented in the intervention communities during the second micro-credit loan cycle.
- The project is promoting sustainability of the project activities through a community-based peer-educator program. A workshop was held to review nutrition education materials with 19 female and nine male staff from the Ministries of Health and Agriculture, NGO’s and the ENAM field project to revise the educational material into a low-literacy format.
- Three additional time points of longitudinal data collection were completed. The longitudinal database contains baseline and three follow-up

time points of data collection for each of the intervention and control households.

- A Memorandum of Understanding was signed between the ENAM project/University of Ghana, Freedom from Hunger, Ghana (FFHG) and Heifer International to facilitate activities associated with funding obtained through the Women in Development (WID) program. FFHG carried out training with rural banks and ENAM project staff on their “Credit with Training” approach for microcredit. GL-CRSP’s Avian Flu School project, in collaboration with Heifer International, carried out a three-day poultry training in Techiman.
- ENAM research has shown that increasing women’s income is associated with a positive nutritional outcome, namely improved quality of diet. Children’s intake of animal source foods was associated positively with income.
- Outcomes of the ENAM project community mobilization processes have included the formation of 35 community savings associations based on shared values and trust, the



*Using a cooking competition as a learning tool on child feeding in Techiman, Ghana. Photo by Grace Marquis.*

ENAM Degree Training for 2006-2007					
Name (Last, First)	Nationality	Gender (M/F)	University	Discipline	Degree
Adjei, Gladys	Ghanaian	F	University of Ghana	Nutrition	MS
Agyei, Eric	Ghanaian	M	University of Ghana	Agriculture Extension	MS
Christian, Aaron	Ghanaian	M	University of Ghana	Nutrition	MS
Harding, Kimberly	Canadian	F	McGill University	Nutrition	MS
Homiah, Phillip	Ghanaian	M	University of Ghana	Agriculture Economics	MS
Kobati, Gloria	Ghanaian	F	University of Ghana	Nutrition	MS
Oluka, Samuel	Ugandan	M	University of Ghana	Nutrition	MS
Zuttah, Jacob	Ghanaian	M	University of Ghana	Agriculture Extension	MS

independent development of group bylaws and leadership capabilities, and communal activities. Association members have assisted each other in initiating communal activities, such as building smoking ovens and pooling resources for feed preparation for poultry operations.

- After collaborating with the Adventist Development and Relief Agency (ADRA) to show health promotion films on hygiene and malaria prevention to the entire community, communal labor groups formed to clean common areas in the communities.
- The ENAM project identified variations in food scarcity patterns in Ghana. Food shortages peaked during April-June, the primary rainy season in Ghana. The overall prevalence of food shortages was highest in the northern Guinea Savannah during this period, demonstrating the importance of targeting interventions by region and season.
- Data are being collected every four months to document improvement in food security among all households participating in the ENAM study and residing in the intervention and control communities. A modified version of the U.S. Food Insecurity questionnaire is being used.
- An ENAM study revealed that significantly more participants (100%) of the ENAM project had received a loan than non-participants (13.8%). More of the non-participants (92.5%) had either

never accessed loans before or had accessed loans only once, while most participants (70%) accessed loans twice or more within the period considered.

#### RESEARCH BRIEFS

##### **GL-CRSP Research Brief 08-01-ENAM: A Qualitative Assessment of Support Programs for Caregivers' Income Generation Activities in Ghana**

*Authors: Grace S. Marquis, McGill University; Elizabeth Vogel, Esi Colecraft, Iowa State University; Owuraku Sakyi-Dawson, University of Ghana*

*Summary.* The Enhancing Child Nutrition through Animal Source Food Management (ENAM) project was developed to address the effects of poverty on household food security and child nutrition in Ghana. Formative research in three regions of Ghana documented a perceived lack of income as the primary constraint to a household's ability to incorporate adequate amounts of animal source foods (ASF) in young children's diets. Increased consumption of ASF can enhance overall child nutrition and well-being, and prevent micronutrient deficiencies detrimental to growth and development. A review of 18 organizations was completed to identify strategies for supporting caregivers' income generation activities (IGA) in Ghana. Three strategies were identified: input credit, financial support and financial support using the credit union concept. Lending to groups

and designation of group members as guarantors for the loans were key components to the success of IGA programs. There was a low prevalence (22%) of support specifically targeting ASF-related IGA among the organizations reviewed. Although improved nutrition was a programmatic objective for most of the organizations, only two incorporated nutrition education in their activities. This lack of attention to nutrition in the majority of the microcredit programs reviewed is an important shortcoming. Nutrition and health interventions need to be integrated into IGA to assure that improved nutrition occurs with increased income. The lessons learned from these three approaches were used to design microcredit interventions for the ENAM project.



*Community mapping exercise in Winneba, Ghana. Photo by Esi Colecraft.*

**GL-CRSP Research Brief 08-02-ENAM: Does the Type of Income Generating Activity Caregivers Engage in Influence Children's Animal Source Food Consumption?**

*Authors: Aaron Christian, ENAM Project, Ghana; Anna Lartey, University of Ghana; Esi Colecraft, Iowa State University; Owuraku Sakyi-Dawson, University of Ghana; Grace S. Marquis, McGill University*

*Summary.* ENAM researchers tested the hypothesis that children of caregivers engaged in Animal Source Food (ASF)-related Income Generating Activities (IGA) were more likely to consume ASF than children of caregivers engaged in IGA unrelated to ASF. Data were collected via interviewer administered survey questionnaires with caregivers of young children in two rural communities from each of the three

ecological zones (coastal, forest transitional and interior savannah zones) of Ghana. Approximately 84% of the 529 caregivers who were interviewed engaged in IGAs: of these approximately 31% (n=156) were engaged in an ASF-related IGA. Caregivers engaged in ASF-related IGA earned about 13,000 Ghanaian cedis (US\$1.42) more per week than caregivers engaged in IGA unrelated to ASF, but this difference was not statistically significant. Children's consumption of ASF differed by ecological zone. After controlling for the effect of ecological zone,

children of caregivers engaged in ASF related IGA were significantly more likely to have consumed organ meats (P=0.01), shellfish (P=0.005), and milk (P<0.008) in the past week than children of caregivers engaged in IGA unrelated to ASF. A caregiver being engaged in an ASF-related IGA was not a significant predictor of their children's ASF diversity score; however, in the coastal and forest zones, children of caregivers engaged in ASF-related IGA tended to have higher mean dietary ASF diversity scores than children of caregivers engaged in IGA unrelated to ASF. Caregivers' engagement in ASF-related IGA may be beneficial to children's dietary ASF intakes. Therefore, efforts to promote ASF-related IGA among more caregivers in the communities studied are likely to improve children's ASF intakes.

**GL-CRSP Research Brief 08-03-ENAM: Participatory Rapid Assessment Summary**

*Authors: Grace S. Marquis, McGill University; Elizabeth Vogel, Esi Colecraft, Iowa State University; Owuraku Sakyi-Dawson, University of Ghana*

*Summary.* Childhood malnutrition remains a significant public health problem in sub-Saharan Africa, largely caused by sub-optimal feeding practices and poor diet quality. Deficiencies in micronutrients can lead to poor growth and impaired cognitive performance, among other health problems. Improving diet quality through the consumption of animal source foods (ASF) is one approach to enhance child well-being and prevent deficiencies in micronutrients. A multidisciplinary team of researchers from Iowa State University and the University of Ghana are utilizing participatory rapid assessments (PRA) to analyze ASF accessibility, availability and utilization in Ghana. This brief reports on the methodology of PRA and describes some of the tools common to this community-focused research approach. Several of the approaches used in this study include interviews with key informants, wealth ranking, community mapping, focus groups, semi-structured interviewing, food tracking, linkage diagramming through consensus building, and group intervention selection. This experience confirms that PRA helps to facilitate a holistic conceptual framework that includes the perspectives of all stakeholders, leading to a more successful selection and implementation of interventions.

**GL-CRSP Research Brief 08-04-ENAM: Enhancing Collaborations Between Research and Government Ministries: Lessons Learned from the ENAM Project in Ghana**

*Authors: Owuraku Sakyi-Dawson, Ben. K. Abunu, University of Ghana; Esi K. Colecraft, Iowa State University; Anna Lartey, University of Ghana; Grace S. Marquis, McGill University*

*Summary.* The ENAM project is a research and development intervention in Ghana, funded by USAID through the Global Livestock Collaborative Research Support Program. To ensure sustainability of the activities that enhance feeding of animal source foods (ASF) to preschool children, it is important that the processes and products of the ENAM project become institutionalized in the relevant government ministries. This research brief provides an analytical description of the collaboration between the ENAM

project and relevant government ministries in Ghana and lessons for institutionalization to enhance ASF feeding to preschool children. The findings show that a high level of interactive participatory collaboration has been achieved between the ENAM project and the relevant government ministries at different hierarchical levels and at multiple stages of the intervention. The initial impact of the intervention is positive with regards to poverty reduction and enhanced ASF consumption, as well as the enthusiasm of the relevant government ministries. Collaborations, however, have not yet enabled the ministries to reach a point of self-mobilisation for sustainable institutionalization of the ENAM interventions. This brief outlines further efforts and activities that are required to be undertaken by the ENAM project to enhance its institutionalization in relevant government ministries.

ENAM Funding for 2006-2007	
Total Core Funding	\$305,840
Total Cost Share	\$32,746
Leveraged Funding	\$39,341
USAID Buy-ins	\$177,961

**GL-CRSP Research Brief 08-05-ENAM: Development of a Nutrition Extension Course at the University of Ghana: A Step-By-Step Collaborative Process**

*Authors: Esi Colecraft, Iowa State University; Anna Lartey, University of Ghana; Grace Marquis, McGill University; Owuraku Sakyi-Dawson, Ben Abunu, University of Ghana; Lorna Butler, Iowa State University*

*Summary.* The use of participatory and qualitative information gathering and sharing during the planning grant phase of the ENAM project allowed for context-specific and multidisciplinary analysis of the constraints to ASF in children’s diets in Ghana. This process led to the development of a demand-driven problem model specifying causal links to constraints limiting the use of ASF in children’s diets and interventions to address these constraints. To improve the capacity of future nutrition professionals

in the use of extension principles that incorporate the sustainable livelihoods strategy for diagnosing community nutrition problems and designing appropriate interventions, the ENAM project management team proposed that training in nutrition extension should be incorporated into the nutrition curriculum offered through the Department of Nutrition and Food Science at the University of Ghana. A step-by-step process was undertaken, which included consultations with an international nutrition extension specialist, consensus-building discussion sessions, a workshop with stakeholders working in governmental and non-governmental programs and at the university, the development of a course description and outline, and the submission of a course proposal to the University of Ghana Academic Board. This resulted in the approval of an interdisciplinary course entitled "Nutrition, Sustainable Livelihoods and Extension," as a third year undergraduate elective course offered through the Department of Nutrition and Food Science at the University of Ghana. Stakeholder recommendations for the future included the development of a nutrition extension short course to upgrade the skills of current nutrition practitioners.

#### **ENAM PROJECT EXTERNAL EVALUATION PANEL REVIEW**

*In February 2007, the ENAM project underwent an External Evaluation Panel review conducted by Deborah Rubin, Nanna Roos and Alfred Neumann. The executive summary is provided below. A full report is available on the GL-CRSP website: <http://glcrsp.ucdavis.edu>.*

#### **Executive Summary**

The External Evaluation Panel (EEP) review from February 16-28, 2007, found the Enhancing Child Nutrition through Animal Source Food Management (ENAM) project to be making excellent progress and working effectively. It has an exceptionally well-organized, well-trained team that has worked together from the initial discussion of the planning grant, US and Ghanaian partners together, to forge a truly integrated multi-disciplinary project.

The ENAM project is intended to improve the current 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, especially for children between two and five years of age, by supporting a small microcredit program for mothers in this target group in conjunction with training on nutrition and business development. If the final results of the community intervention activities that combine income generative activities (IGA) with nutrition and microfinance education do show a significant increase of the intake on ASF by participants' involved in the study, then this will have important policy implications for Ghana and other parts of Africa. A successful set of results will demonstrate the value of this innovative and integrated approach to improve children's nutrition by addressing the multiple constraints on availability, access, and utilization of animal source foods (ASF). Based on their review, the panel is recommending extension of the ENAM project to September 30, 2008.

The positive accomplishments of the project thus far include:

- Successful achievement of all the major elements of its workplan on schedule;
- Development of excellent relationships at the University of Ghana;
- Formation of linkages with several key government ministries, including the Ministry for Food and Agriculture and the Ghana Health Services;
- Achievement of a strong student training program in field assessment techniques and data collection, as well as of degree-related course work;
- Cultivation of very strong community support, not only from the women participants in its credit groups, but also from local officials;
- Establishment of a functioning microcredit program that has helped its credit group members in establishing and expanding a range

of income generating activities (IGA);

- Identifying and addressing key gender issues in the project's design and implementation;
- Developing an integrated program of community level training for the caregivers on nutrition education and business development;
- Developing an upper-level cross-departmental university course on nutrition extension that has been approved by the university and is to be offered later this year;
- Forming linkages with NGOs (particularly Freedom from Hunger, Ghana and Heifer International, Ghana) for continuing key aspects of the project's development program.

The EEP offers the following recommendations to guide efforts in the extension year of the current project:

Give priority to data entry and analysis.

- Hire additional staff to ensure rapid data entry and analysis;
- Clarify and document project policies on key issues related to use and ownership of data emerging from the project;
- Jointly clarify the data analysis plan and establish who is to work with which data set.

Give priority to writing reports and publishing on both the initial research results as they emerge and on the methodologies used in establishing the various components of the project.

- Clarify and document the research question that is related to each project activity;
- Jointly develop a written statement on the principles of authorship for reports and papers to be written and published using project data;
- Jointly develop a publications plan identifying which topics are to be written up, in what sequence, and by whom;
- Jointly discuss and agree on the level of effort needed to accomplish these tasks;
- Include a write up of the process taken in developing the project methodology and key deliverables.

Postpone planned workshop to 2008.

- Build into the workplan for 2007-2008 the time and budget needed to liaise with key stakeholders (e.g., University of Ghana, key ministries, NGOs, rural banks, and communities) and engage their cooperation, participation, and support for the workshop;
- Plan for dissemination of the final report and one page fact sheets at the workshop.

Solidify linkages with key partners.

- With the GL CRSP – involve Avian Flu School trainings in a village poultry component;
- With USAID-WID office – develop a plan to measure change in women's income levels from baseline to end of project as well as changes in use of funds for children's nutrition;
- Improve reporting on linkages and leveraged funds;
- Establish relations with the Municipal Assembly and other District and Municipal governmental groups;
- Follow up with the Ministry of Women and Children.

Plan for institutionalization and sustainability.

- Develop non-degree short course on nutrition extension;
- Initiate thinking for relevant courses on other cross-disciplinary topics;
- Expand linkages across University of Ghana campus (e.g., School of Public Health);
- Approach the Ministry of Cooperatives to initiate the process of registering ENAM credit groups as cooperatives to access additional government and NGO services;
- Follow up with multiple Ministries to encourage their uptake of specific project deliverables;
- Hold discussions with key Ministries to identify policy-relevant research gaps that can be addressed through ENAM research efforts.

Refine objectives for Uganda component.

- Minimize time and funds expended on additional strengthening of the Ugandan component during the extension period to better consolidate results in Ghana.

## PUBLICATIONS

Colecraft, E., G.S. Marquis, R. Aryeetey, O. Sakyi-Dawson, A. Lartey, B. Ahunu, E. Canacoo, L.M. Butler, H.H. Jensen, E. Huff-Lonergan. "Constraints on the use of animal source foods for young children in Ghana: A participatory rapid appraisal approach." *Ecology of Food and Nutrition* 45: 351-377, 2006.

## PLANNED PUBLICATIONS

Marquis, G.S., K.B. Harding, M. Fox, E. Colecraft, O. Sakyi-Dawson. "Seasonal patterns of severe food shortages vary by region in Ghana." *Federation of American Societies for Experimental Biology (FASEB)*, 2007 (Abstract submitted and approved).

Colecraft, E.K., G.S. Marquis, A. Lartey, O. Sakyi-Dawson, B. Ahunu, L. Butler, M. Reddy, H. Jensen, E. Lonergan. "Regional differences in the magnitude and pattern of purchased ready-to-eat foods in the diets of rural Ghanaian children." *FASEB*, 2007 (Abstract submitted and approved).

Colecraft, E.K., G.A. Adjei, A. Lartey, G.S. Marquis. "Contribution of animal source foods to the total iron intake of children in coastal Ghana." *FASEB*, 2007 (Abstract submitted and approved).

Christian, A.K., A. Lartey, E. Colecraft, O. Sakyi-Dawson, B. Ahunu, G.S. Marquis. "Caregivers' income generation activities, income and child animal source food diversity." *FASEB*, 2007 (Abstract submitted and approved).

## TEAM MEMBERS

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## COLLABORATING INSTITUTIONS

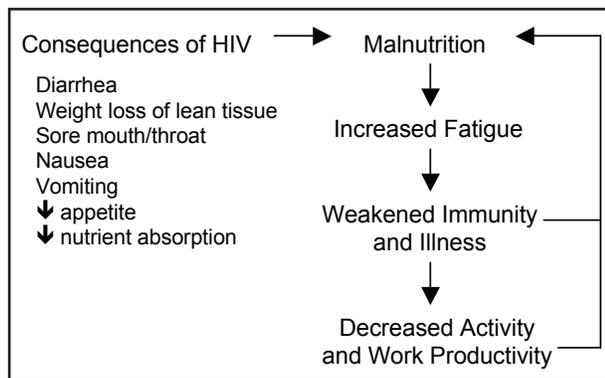
### Iowa State University (*lead institution*)

Freedom From Hunger, Ghana  
Heifer International, Ghana  
Makerere University, Uganda  
McGill University, Canada  
University of Ghana  
Volunteer Efforts for Development Concerns (VEDCO), Uganda

**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 bioavailability 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.*



*HIV's effects on body composition and quality of life.*

**PRINCIPAL INVESTIGATORS**

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**SUMMARY OF ACHIEVEMENTS**

- The Kenyan Co-Principal Investigators and senior HNP field staff worked with local community leaders to create awareness of the research project and to recruit study participants. Thirty-one women participated in the Phase I Food Security Assessment, eighteen women and nineteen children were enrolled in the Phase II Preliminary Trial, and 88 families have been identified for the main nutrition intervention study thus far.



*Anthropometry enumerator obtaining hand grip strength measures from a mother in the Phase II pilot. Photo by Vickie Chepkemoi Koske.*

- Preliminary results of the HNP Food Security Assessment of 31 HIV-infected Kenyan women and their children indicated that about half of the households had no source of income and relied on self-sustenance or good will for food. The majority could not afford three meals per day and consumed monotonous diets with little animal source foods. Over 75% reported no intakes of egg, meat or fish within the past 24 hours.
- Nine, primarily female, field assistants were hired and trained in nutrition and cognitive assessment techniques in order to obtain quality data in determining the impact of the nutrition intervention in the field trial.
- HNP field staff members involved in data collection received specific trainings in anthropometry, hand grip and pinch dynamometry, administration of the bioelectrical impedance analysis, nutrient intake, socioeconomic and food security assessments, morbidity training, and cognitive development assessments with the Bayley Developmental tool that has been adapted for Kenyan infants and young children.

HNP Non-Degree Training for 2006-2007			
Country	Male	Female	Total
Kenya	2	52	54
United States	0	1	1
Total	2	53	55

- Moi University administration at the Chepkoilel campus agreed to provide the space and to upgrade the production kitchen to accommodate food production appliances that are provided from the HNP GL-CRSP budget and will be used in the nutrition intervention production.
- A meat, soya or wheat porridge was created from all three types of biscuits. It was well-tolerated by infants and toddlers less than two years of age. Boiled and filtered water was added to the biscuit to make a porridge consistency.
- The already existing partnership between Moi University and Indiana University expanded beyond the Schools of Medicine and the Academic Model for the Prevention and Treatment of HIV (AMPATH) to now include the School of Public Health (Moi University), the School of Health and Rehabilitation

HNP Degree Training for 2006-2007					
Name (Last, First)	Nationality	Gender (M/F)	University	Discipline	Degree
Korir, Salome	Kenyan	F	University of Nairobi	Nutrition	PhD

Sciences (Indiana University), and the Schools of Medicine and Public Health (UCLA).

- Population Services International (PSI) is supplying treated bed nets at a subsidized rate of approximately one third of the commercial cost. Nets have already been distributed to Phase II participants and will be distributed to Phase III households at enrollment.
- Heifer International will be supplying purebred dairy goats and animal husbandry training to the HNP participants upon the completion of the 12-month intervention. Heifer field staff will undergo the AMPATH HIV training before meeting the study participants.
- Because it is important to the outcome of the HNP intervention study that contaminated household water does not contribute to health problems in participants, it was decided that

household water supplies will be screened, boiled and filtered. This action will convey the importance of safe drinking water on the health of project participants and their households.

- Due to sensitive issues surrounding HIV positive women in Kenya, stigma continues to be a significant roadblock for many women to learn their status. Through suggesting that animal source foods may benefit those at earlier stages of HIV infection, the HNP project is motivating individuals to become informed of their status.
- Because most of the hired field staff is from the local community and understands the local languages and customs, they are able to communicate effectively with study participants. This is a great strength for effective implementation and continued success of the HNP study.



*The food production team (Angela, Viola and Dorcas) putting nutrition intervention biscuits into the preheated oven to bake. Photo by Joseph Kariuki.*

## RESEARCH BRIEFS

**GL-CRSP Research Brief 08-01-HNP: Introduction to the HIV Nutrition Project (HNP): Increasing Animal Source Foods (ASF) in Diets of HIV-infected Kenyan Women and Their Children**

*Authors: Judith Ernst, Indiana University; Grace Ettyang, Moi University; Charlotte Neumann, UCLA; Winstone Nyandiko, Abraham Siika, Moi University; Constantin Yiannoutsos, Indiana University*

*Summary.* Many of the estimated 28 million people with human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) living in Sub-Saharan Africa also suffer from malnutrition. Reproductive-age women, their infants and young children are among the most vulnerable for malnutrition and progression of HIV to AIDS. As seen in eastern and southern Africa, mortality is increased in the malnourished. The HIV Nutrition Project

(HNP) research will be evaluating the effect of protein quality and micronutrients in meat on the health and nutritional well-being of women living with HIV in rural Kenya and the health and development of their children by means of a randomized nutrition feeding intervention. It will be determined 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 among these drug naïve women and enabling them to carry out their daily activities; and (3) supports the growth and development of their vulnerable children when compared to those given supplements with the same amount of energy, but with either soya or wheat protein. 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.

HNP Funding for 2006-2007	
Total Core Funding	\$ 251,720
Total Cost Share	\$ 40,636
Leveraged Funding	\$ 10,000

**GL-CRSP Research Brief 08-02-HNP: HIV Infection and Nutrition Status: The Importance of Food in Disease Management**

*Authors: Judith Ernst, Indiana University; Grace Ettyang, Moi University; Charlotte Neumann, UCLA; Winstone Nyandiko and Abraham Siika, Moi University*

*Summary.* Preliminary evidence suggests that improved nutrition early in human immunodeficiency virus (HIV) infection may delay progression to acquired immunodeficiency syndrome (AIDS) and delay the initiation or improve the effectiveness of antiretroviral drug therapy (ART). The scientific community has evolved in its appreciation of the value of food as an integral component of comprehensive care for individuals with HIV infection and AIDS. It is now well recognized that those who are food insecure and malnourished are more likely to fail drug treatment regimens. A body mass index (BMI) less than 18 at the initiation of ART is strongly predictive of death. In addition, weight loss

during the first four weeks of ART is also associated with death and a higher BMI is protective and is associated with better responses with ART. Patient response to nutrition intervention, however, may be confounded by the stage of HIV progression and other infections. That is, those who are in the earlier stages of the disease may respond better to aggressive nutrition intervention. The HIV Nutrition Project (HNP) "Increasing Animal Source Foods in Diets of HIV-infected Kenyan Women and Their Children" will evaluate the effect of protein quality and micronutrients in meat on the health and nutritional well-being of women living with HIV in rural Kenya and the health and development of their children by means of a randomized nutrition feeding intervention. Researchers will study if the inclusion of meat added as an ingredient to a biscuit, when compared to soy or wheat, will best protect the immune system and prevent severe infection, prevent the loss of body mass and enhance the quality of life. These women are not yet receiving antiretroviral

drugs and therefore are not yet experiencing metabolic inefficiencies associated with AIDS.

**GL-CRSP Research Brief 08-03-HNP: The Academic Model for the Prevention and Treatment of HIV (AMPATH) in Kenya**

***Authors: Winstone Nyandiko, Abraham Siika, Moi University; Judith Ernst, Indiana University; Grace Ettyang, Moi University, Charlotte Neumann, UCLA; Constantin Yiannoutsos, Indiana University***

*Summary.* In 2001, Moi University in Eldoret, Kenya joined with Kenya's second national referral hospital, Moi Teaching and Referral Hospital (MTRH) and Indiana University (IU) to establish the Academic Model for the Prevention and Treatment of HIV (AMPATH). AMPATH's missions were to (1) provide high-quality patient care; (2) educate patients and health care providers; and (3) establish a laboratory for clinical research in HIV/AIDS. Leveraging the power of our academic medical partnership, AMPATH has quickly become one of the largest and most comprehensive HIV/AIDS control systems in Sub-Saharan Africa, providing a system of care that has been described as a model of sustainable development. Delivery of services occurs in the public sector through hospitals and health centers run by Kenya's Ministry of Health. AMPATH currently implements prevention activities that touch the lives of millions of persons in a wide geographic area. The research arm of AMPATH, created to facilitate and manage the international research agenda being generated by Kenyan and US faculty, includes the GL-CRSP HIV Nutrition Project (HNP) "Increasing Animal Source Foods in Diets of HIV-infected Kenyan Women and Their Children," which is a collaborative initiative between AMPATH and faculty from Moi University, Indiana University and the University of California, Los Angeles.

**TEAM MEMBERS**

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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.*

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*Marion Jenkins serves as the Lead Principal Investigator for two collaborating GL-CRSP projects:*

***Development and Marketing of Point-of-Use Household Filters for Drinking Water Improvement (POU-WID)*** expands upon prior SUMAWA research and seeks to develop, manufacture, market and monitor usage and health impacts of low-cost slow-sand water filtration devices to improve water quality at the point of use in households in the River Njoro watershed. The project targets rural mothers and their children in agricultural households who suffer from water-borne diseases, in particular diarrhea, from lack of access to improved and safe water supplies in the watershed.

***Water and Sanitation-Related Conditions and Disease Burdens in the River Njoro Watershed (NJORO WATER)*** is tackling water and sanitation-related diseases in the River Njoro watershed, particularly diarrhea, as these diseases pose a development burden on poor rural agricultural households and have implications for water supply planning, environmental management, and development policy. Data collected under the SUMAWA project are being used to integrate and characterize domestic water source choice, water consumption and sanitation patterns in time and space across the watershed and analyze their relationships with patterns of water and sanitation-related diseases in the Njoro watershed.



## SUMMARY OF ACHIEVEMENTS

- Diminishing lake levels in Lake Nakuru, Kenya, a primary water source for irrigation and household drinking water in the nearby town of Nakuru, threaten both ecological and agricultural sustainability as the lake provides critical habitat to a number of keystone species. The SUMAWA/NJORO WATER project developed a water budget model for the lake and River Njoro to understand the balance between upstream surface and groundwater sources in sustaining lake levels. This model enhances the capacity of managers and policy makers to make critical decisions on water resource management.
- SUMAWA has helped facilitate the formation of the Water Resources Users Association in the River Njoro watershed, Kenya. Membership consists of three representatives from each of the member communities. To promote the participation of women in watershed rehabilitation, at least one of each of the three representatives is female.
- NJORO WATER launched an extensive study in the River Njoro watershed in Kenya to measure fecal coliform bacteria in river water across the watershed and identify problem areas. Cattle were identified as the major source of contamination, thereby indicating that better feeding and water management plans need to be explored.
- Prior SUMAWA research found the BioSand Filter (BSF) to be the best water treatment option for poor agricultural and

peri-urban households in the Njoro watershed. Results of POU-WID's subsequent investigation into the use of BioSand Filters in 60 Kenyan households showed significant improvements in water quality, reductions in incidence of childhood diarrhea, and high levels of satisfaction and sustained use of the filters. At the end of the trial, 47 of the 60 households chose to buy the BSF, including 23 of the 30 control households. As a result, the health and well being of 235 vulnerable people in the Njoro Watershed have now been protected from drinking and using contaminated river water through the purchase and use of the BSF.

- Water treatment in the Njoro River watershed in Kenya is traditionally a female gender-specific role. Therefore, the POU-WID project's successful introduction of BioSand Filters as a sustainable water treatment technology has greatly impacted gender and labor roles at the household level, where men have increased their involvement with water-related chores due to filter appreciation, including taking responsibility for re-filling the filters.



*Cattle watering at open access points along the River Njoro stream network are a common sight throughout the watershed. Photo by Sian Mooney.*

- A total of 14 small-scale operators have now been trained and certified as BSF artisans, able to take up local production and marketing in their communities, in advance of the start-up of three local enterprises planned in the Njoro watershed for 2007-08. An additional 40 BSF filters were produced by these artisans for sale to control households at the end of the trial and for installation at three clinics and one restaurant in the watershed.

## RESEARCH BRIEFS

### **GL-CRSP Research Brief 07-01-SUMAWA-NJORO WATER: Gross Fecal Pollution of a Rural Watershed in Kenya: Research Identifying Cattle as a Major Source in the River Njoro Watershed, Kenya**

**Author:** *Marion W. Jenkins, University of California, Davis*

*Summary.* Elevated levels of fecal pollution in surface water pose significant health risks for humans as well as livestock and degrade aquatic ecosystems. This brief presents preliminary findings on pollution research in the River Njoro Watershed, Kenya and explores actions to reduce gross pollution found throughout. NJORO WATER conducted an extensive survey and launched a yearlong program to measure fecal coliform bacteria in river water to quantify pollution levels across the watershed, pinpoint problem areas and identify major sources. Genetic methods were applied to track fecal sources and test for *Cryptosporidium spp.*, a water-borne pathogen causing severe diarrhea in young, old, and immuno-compromised human and cattle populations. A common pattern of fecal pollution peaking in August, significantly higher levels detected when cattle were present at a site, and widespread detection of cow fecal genetic markers, all lead to livestock, in particular cattle, as the most likely cause of gross fecal pollution and source of *Cryptosporidium* in the Njoro Watershed. Elimination of the widespread practice of in-river livestock watering through provision of watering troughs would quickly reduce gross levels of fecal

pollution, bringing immediate health benefits for humans, livestock, and ecosystems. Tackling the complex web of human-livestock-animal, resident-migratory, and rural-urban combinations of sources and actors contributing to fecal pollution in this and similar rural watersheds throughout Kenya requires a long-term, multi-pronged engagement process of joint local community and government action.

### **GL-CRSP Research Brief 07-02-SUMAWA-POU-WID: Point-of-Use Treatment Options for Improving Household Water Quality among Rural Populations in the River Njoro Watershed, Kenya**

**Authors:** *Sangam K. Tiwari and Marion W. Jenkins, University of California, Davis*

*Summary.* Rural access to improved water supplies in Kenya stands at 46%. Consequences are apparent in the River Njoro watershed, where a majority of households fetch and use polluted river water for some or all of their domestic water needs, suffering high rates of diarrhea, typhoid, and other water-borne diseases. Responding to expressed needs for improving water quality in the watershed, the SUMAWA project launched work to develop low-cost water treatment for household use. This brief reports findings from screening six point-of-use (POU) water treatment technologies applicable in developing countries. Operating characteristics, performance, costs, procurement, and local sustainability were reviewed, and suitability of use with river water by households in the Njoro watershed was assessed. Intermittent slow-sand filtration (known as the “BioSand Filter” or BSF), ceramic clay filtration (“Filtron” pot), and chlorine disinfection were identified as suitable. Among these, the BSF was selected as most promising for application development in the Njoro watershed on the basis of robust design, ease of use, no recurrent costs, high flow rate, and ability to treat highly turbid river water. A program to develop and test the BSF for use by high-risk households to treat polluted River Njoro water was launched in 2006 jointly with the Nakuru District Ministry of Health’s Public Health Division, Civil and Environmental

Engineering Departments of UC Davis, and Egerton University. As the program wraps up, results and practical learning will be shared in upcoming research briefs.

## PUBLICATIONS

### SUMAWA

Kibichii, S., W.A. Shivoga, M. Muchiri, and S.N. Miller. "Macroinvertebrate assemblages along a land use gradient in the upper River Njoro watershed of Lake Nakuru Drainage Basin, Kenya." *Lakes & Reservoirs: Research and Management* 12: 107–117, 2007.

Shivoga, W.A., M. Muchiri, S. Kibichii, J. Odanga, S.N. Miller, T.J. Baldyga, E.M. Enanga, and M.C. Gichaba. "Influences of land use/cover on water quality in the upper and middle reaches of River Njoro, Kenya." *Lakes & Reservoirs: Research and Management* 12: 97–105, 2007.

## PRESENTATIONS AND PROCEEDINGS

### SUMAWA

Baldyga, T.J., S.N. Miller, W.A. Shivoga, F. Lelo, M.W. Jenkins, G. Paige, and S. Mooney. "Rural planning in East Africa using a participatory spatial decision support system." *Proceedings of the ESRI Eastern Africa User Conference*. Kampala, Uganda, September 13 – 14, 2007.

Baldyga, T.J., S.N. Miller, W.A. Shivoga, F. Lelo, M.W. Jenkins, G. Paige, S. Mooney. "Development of a participatory spatial decision support system for East African rural planning." Paper and presentation at *AfricaGIS 2007*. Ouagadougou, Burkina Faso, September 17 – 21, 2007.

Bett, E.K. "Net present value analysis to assess the economic consequences of changing farming systems in the upper catchment of the River Njoro watershed." Presentation at the *Tenth Biennial Scientific Conference & Agricultural Forum*. KARI, Nairobi, Kenya, November 12 – 17, 2006.

Chiuri, W. and S.A. Ogalleh. "Integrating gender perspectives in water policies and institutions: realizing new options for effective water management." Accepted for publication in the *Proceedings of the CGIAR Gender and Water Forum*. Vientiane, Lao PDR, November 12 – 17, 2006.

Gichaba, C. "Community perceptions, priorities and participation in managing water and environmental resources in the River Njoro Watershed, Kenya." *Proceedings of the IUGG XXIV 2007*. Perugia, Italy, July 2-13, 2007.

Krupnik, T., M.W. Jenkins, S. Mooney, and E.K. Bett. "Net present value analysis to assess the economic consequences of changing farming systems in the upper catchment of the River Njoro watershed." Peer-reviewed paper and poster at *Tenth Biennial Scientific Conference & Agricultural Forum*. KARI, Nairobi, Kenya, November 12 – 17, 2006.

Martin, C., S.N. Miller, and L. Chiuri. "Split sex community based mapping using a 3-dimensional model of the River Njoro watershed." Poster presentation at *Society for Conservation GIS, 1st Conservation-GIS Conference*. Nairobi, Kenya, July 18-20, 2007.

## POU-WID

Tiwari, S.K., M. W. Jenkins, C. Maina-Gichaba, W. Saenyi, and J. Darby. "Development of intermittent slow sand filtration for rural households in the River Njoro watershed, Kenya." Abstract and oral presentation to the Special Session "Point-of-Use Water Treatment Technologies for Developing Global Communities," *AEESP Education and Research Conference*. Virginia Tech University, Blacksburg, VA, July 28-August 1, 2007.

## NJORO WATER

McCord, S. "Lake Nakuru water balance." Presentation and workshop with Lake Nakuru researchers, stakeholders, Kenya Wildlife Services, and students. CMRT, Egerton University, Njoro, Kenya, May 14, 2007.

McCord, S. "Preliminary results of Lake Nakuru water balance model." Presentation and workshop with Lake Nakuru researchers, stakeholders, Kenya Wildlife Services, and students. Kenya Wildlife Services Education Center Theatre, Lake Nakuru National Park, Nakuru, Kenya, June 13, 2007.

**TEAM MEMBERS**

Zakayo Akula, Egerton University  
 Fred Bwire, Ministry of Health-Molo District  
 Lois Chiuri, Egerton University  
 Jeannie Darby, University of California, Davis  
 Lesingo Francis, Njoro River Water Resources Users Association  
 Marion Jenkins, University of California, Davis  
 Stephen Kagiri, Ministry of Health-Njoro Division  
 Apollo Kariuki, Kenya Wildlife Service  
 Z. Gichuki Kariuki, Ministry of Health-Nakuru District  
 Francis Lelo, Egerton University  
 David Liti, Moi University  
 Jay Lund, University of California, Davis  
 Simon Macharia, Kenya Fisheries Department  
 Charles Maina-Gichaba, Egerton University  
 Stephen McCord, Independent Consultant  
 Scott Miller, University of Wyoming  
 Sian Mooney, University of Wyoming  
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 Patterson Semenyee, Egerton University  
 William Shivoga, Egerton University  
 Sangya-Sangam Tiwari, University of California, Davis  
 Jacynter Were, Water Resource Management Authority

**COLLABORATING INSTITUTIONS**

**University of Wyoming, Department of Renewable Resources (*lead institution*)**

Egerton University, Department of Environmental Science, Kenya  
 Kenya Fisheries Department  
 Kenya Wildlife Services  
 Kenyan Ministry of Health  
 Moi University, Department of Fisheries, Kenya  
 River Njoro Water Resource Users Associations (WRUA), Kenya  
 University of California, Davis, Department of Civil and Environmental Engineering

Non-Degree Training for 2006-2007			
Country	Male	Female	Total
<b>SUMAWA</b>			
United States	0	3	3
France	0	1	1
Germany	1	0	1
Kenya	49	15	64
<b>Total</b>	50	19	69
<b>POU-WID</b>			
United States	0	2	2
Germany	1	0	1
Kenya	19	9	28
<b>Total</b>	20	11	31
<b>NJORO WATER</b>			
United States	1	1	2
France	0	1	1
Japan	4	0	4
Kenya	18	2	20
<b>Total</b>	23	4	27

Degree Training for 2006-2007					
Name (Last, First)	Nationality	Gender (M/F)	University	Discipline	Degree
<b>SUMAWA</b>					
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
Jepyeon, Emily	Kenyan	F	Moi University	Ecology	MS
Kamau, Duncan	Kenyan	M	Egerton University	Hydrology	BS
Kigen, Chariles	Kenyan	M	Egerton University	Ecology	MS
Kyalo, Daniel	Kenyan	M	Egerton University	Socio-Economics	MS
Mutswenje, Mark	Kenyan	M	Egerton University	Hydrology	BS
Ngari, Eunice	Kenyan	F	Egerton University	Gender	MS
Ngugi, Macharia	Kenyan	M	Egerton University	Hydrology	MS
Nyakach, Dennis	Kenyan	M	Egerton University	Hydrology	BS
Ogalleh, Sarah	Kenyan	F	Hebrew University	Hydrology	Dip
Tiwari, Sangam	Indian	F	UC Davis	Environmental Engineering	PhD
<b>POU-WID</b>					
Langenbach, Kilian	German	M	Center for Environmental Research, Leipzig	Environmental Engineering	PhD
Nyakach, Dennis	Kenyan	M	Egerton University	Civil & Environmental Engineering	BS
Scott, Beth	British	F	London School of Hygiene & Tropical Medicine	Public Health	PhD
Tiwari, Sangam	Indian	F	UC Davis	Environmental Engineering	PhD
<b>NJORO WATER</b>					
Keightley, Keir	USA	M	UC Davis	Geography/GIS	PhD

SUMAWA Funding for 2006-2007	
Total Core Funding	\$236,654
Total Cost Share	\$38,123
Leveraged Funding	\$68,262
USAID Buy-ins	\$52,865

NJORO WATER Funding for 2006-2007	
Total Core Funding	\$34,974
Total Cost Share	\$621
Leveraged Funding	\$27,750

POU-WID Funding for 2006-2007	
Total Cost Share	\$519
Leveraged Funding	\$11,500
USAID Buy-ins	\$35,905

**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. The volume is scheduled for publishing in the fall of 2008.*

**PRINCIPAL INVESTIGATOR**

Emilio Laca, Ph.D., Associate Professor, Department of Plant Sciences, University of California, Davis, One Shields Avenue, Davis, CA 95616, Phone: (530) 754-4083, Email: ealaca@ucdavis.edu

**PROJECT SCOPE**

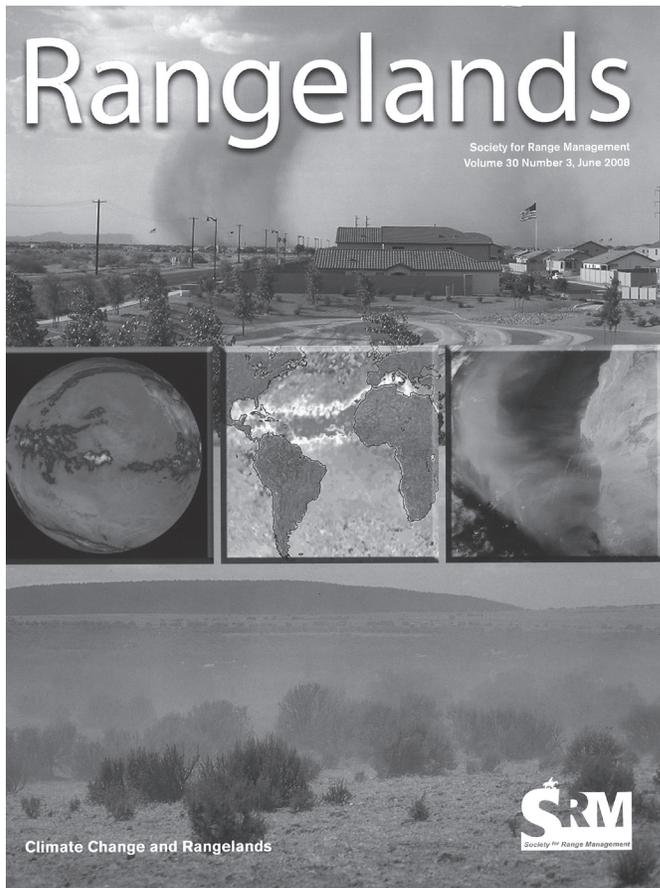
Rangelands, covering approximately one-fifth of the earth's surface, are ill-suited for crop production yet they possess extraordinary capacity for livestock production, providing the main source of forage for livestock, and thus, a subsistence base for some of the world's most disadvantaged communities. In addition to their productive capacity, rangelands also have the potential to be net sources, or sinks, of greenhouse gases, and if incorporated into a carbon exchange market, can significantly enhance livelihoods and promote sound ecological management practices.

The relatively recent appearance of voluntary carbon credit markets are effectively sidestepping stiff Kyoto protocol regulations in favor of more flexible and far reaching methods. The California Registry for example, provides a voluntary, yet rigorous framework for emissions trading. The Registry is also establishing a set of accounting principles for carbon through third party certification, enabling the capability to efficiently measure and verify emissions and to allow for their free trade and marketing. The concept is similar in essence to the Financial Accounting Standards Board (FASB) in that it

provides standards against which company finances may be appropriately analyzed and traded.

The movement towards more rigorous voluntary carbon credit markets is heavily dependent upon greater involvement with the scientific community to ensure that market trading is based on sound and reliable measurement of global carbon fluxes. While the scientific community was a critical partner in establishing the California Registry protocols, its involvement focused primarily on forest carbon fluxes and forestry management. To date, there has been little emphasis on the role of rangelands in the generation of credits. Incorporating rangelands into global carbon markets is critical to the reduction of Greenhouse Gas (GHG) emissions, as well as poverty reduction in arid and semiarid lands.

While most of what is known about the role of rangelands in carbon fluxes has been learned in the past five years, the last volume on the role of rangelands as potential carbon sinks was published more than five years ago. The Global Livestock CRSP 3G project (Grazinglands and Greenhouse



rangelands, this new compendium will move beyond a regional focus to the first global account of carbon fluxes assembled in one volume.

The compendium will be published as a special issue by the journal of *Rangeland Ecology and Management* in the late fall of 2008 and will be subdivided into three main themes: 1) Greenhouse Gases, Rangelands, and Poverty Alleviation, 2) Estimation and Quantification of Carbon Fluxes in Rangelands, and 3) Patterns of Carbon Flux in Rangelands of the World.

*The cover of Rangelands announces the special feature on Grazinglands & Greenhouse Gases due for publication in the journal of Rangeland Ecology & Management. Front and back cover images of Rangelands, Vol. 30, No. 3, June 2008. This issue and others can be accessed at <http://www.srmjournals.org>. Images reproduced with permission from Allen Press Publishing Services.*

Gas emissions) is in the process of compiling a scientific volume that describes rangeland carbon fluxes and assists managers and development agents to incorporate rangeland and pasture conservation and management projects as candidates for the generation of credits. It is the intention that these credits could then be used to offset the costs of development and poverty alleviation projects with positive outcomes for pastoral livelihoods.

Building on previous Global Livestock CRSP research conducted by the Livestock Development and Rangeland Conservation Tools for Central Asia (LDRCT) and Co-Benefits of Grassland Regeneration of Abandoned Wheat Areas for Carbon Sequestration projects, which provided the first models for carbon fluxes in Central Asian

## Grazinglands & Greenhouse Gases

A special feature in *Rangeland Ecology & Management* addressing the role of rangelands in:

carbon sequestration

the carbon credit market

poverty alleviation



Sponsored by the Global Livestock Collaborative Research Support Program with contributions from an international group of rangeland scientists, managers and economists. Publication expected in early 2009.

GL-CRSP: <http://glcrsp.ucdavis.edu>

*Rangeland Ecology & Management*: <http://www.srmjournals.org/>

Photo by E.A. Laca

Drawing on an interdisciplinary group of leading researchers in the scientific community, the volume will tentatively feature the following chapters within each theme:

**Greenhouse Gases, Rangelands, and Poverty Alleviation**

1. Requirements for range and pasturelands to generate tradable carbon offsets in the Chicago Climate Exchange.
2. Societal benefits and policy implications.
3. Supplying carbon sequestration from West African rangelands: opportunities and barriers.
4. The Mexican ProArbol program: support for the development of forestry carbon sequestration projects and the relationship with poverty alleviation policies.

**Estimation and Quantification of Carbon Flux in Rangelands**

5. Improving estimates of rangeland carbon sequestration: a systematic approach to estimate carbon fluxes from rangelands at landscape and regional scales.
6. Quantities and kinds of greenhouse gases exchanged in range and pasturelands as a function of management.
7. Estimation of regional net C flux and uncertainty based on mobile flux stations and downscaling of weather data: a scalable and objective methodology.
8. Cost-effective methods to determine spatio-temporal patterns of soil carbon stocks in range and pasturelands of California.

**Patterns of Carbon Flux in Rangelands of the World**

9. Ecosystem-scale estimates of productivity, respiration, and light-response parameters of world grasslands derived from flux-tower measurements.
10. Timing of carbon uptake on eleven rangeland sites in the United States.
11. Diurnal and seasonal patterns in ecosystem carbon dioxide fluxes in a temperate grassland.
12. Nutrient cycling, limitation and global change: a synthesis of Jasper Ridge.

13. Spatio-temporal gradients of carbon stocks and fluxes in rangelands of the Rio de la Plata basin.
14. Managing carbon sources and sinks in Australia's rangelands and tropical savannas.
15. Conceptual models of grazing effects on carbon and nitrogen dynamics in rangelands.
16. Landscape distribution of soil organic carbon in Eurasian grasslands and its relation to snow cover and erosion.
17. Land-use influences carbon fluxes in northern Kazakhstan.
18. On the ability of the ORCHIDEE global vegetation model to simulate carbon and water fluxes of a southern Siberian steppe.

By providing a detailed analysis and synthesis of global carbon fluxes and the potential for rangeland inclusion into global carbon markets within a single peer-reviewed volume, the GL-CRSP 3G project takes a crucial step towards the recognition of the importance of rangelands to the global carbon budget. Furthermore, the incorporation of livestock producers and rangeland managers into the global carbon agenda will provide both the potential for improved rangeland management, as well as income generating possibilities for some of the world's most disadvantaged.

3G Funding for 2006-2007	
Total Core Funding	\$26,880
Total Cost Share	\$7,630

## **RISK MANAGEMENT**

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

**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)**

**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 infra-red 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. In 2006-2007, the GL-CRSP Gobi Forage program undertook efforts to distribute information detailing forage availability and forecasts to herder and government target populations in six Gobi aimags. The program has since grown to encompass eight aimags, including Tov and Dornogobi. These efforts have been complemented by an extensive training agenda. In January of 2007, the Gobi Forage program made the transition from a research and development agenda to product distribution and outreach.*

**PRINCIPAL INVESTIGATORS**

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Jay Angerer, Ph.D., (Project Coordinator), Research Scientist, Department of Rangeland Ecology and Management, Texas A&M University, 1500 Research Parkway, College Station, TX 77845, Phone: (979) 458-3229, Email: jangerer@cnrit.tamu.edu

**SUMMARY OF ACHIEVEMENTS**

- Stakeholders, using GOBI Forage products to reduce the number of animals grazing during drought periods, decreased potential losses in plant species biodiversity. 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.
- Beginning in January 2007, weekly radio bulletins have been produced using information from the suite of GOBI Forage products to provide information to herders. Information provided in the bulletins includes current and forecast forage conditions and drought prediction information by natural zone and soum. The targeted audience is estimated to be 520,000 rural listeners distributed over eight aimags.
- In April 2007, monthly production of regional and aimag maps was started. The maps are produced with Mongolian language text and legends and are mailed to 135 soums within the eight aimags where GOBI Forage has implemented monitoring. Maps sent to soums include current and 60-day forecasted forage conditions, providing stakeholders with information needed for decision making.
- Since 2005, GOBI has completed calibration of forage models for over 300 monitoring sites and

has conducted verification of model outputs, resulting in over 400 verification samples for comparing model outputs field measurements. Results indicate a good correspondence between field forage standing crop measurements and forage model simulations.

- In 2006-2007, GOBI began production of value-added early warning products such as the vegetation condition index, rainfall deficit mapping, and Normalized Difference Vegetative Index (NDVI) maps. Day and night temperature maps and snow extent maps are being produced every 15 days for winter disaster monitoring.
- In January 2007, the GOBI Forage website (<http://glews.tamu.edu/mongolia>) was opened to the general public. The site was redesigned to allow users to examine regional, as well as aimag map products. To date, the map pages have received over 2,000 hits, with the most viewed aimag being Bayankhongor.
- Direct predictions of multi-species fecal nitrogen via portable near infrared reflectance spectroscopy (NIRS) were accomplished in May 2007. This equation was applied in the field at Bulgan soum. This represents the first

Mongolian derived portable NIRS equation and field predicted results.

- Advanced forage simulation model (PHYGROW) and Advanced ArcGIS training was conducted at Texas A&M for three Mongolian scientists from the Gobi Forage Team.
- Training on GOBI Forage products was conducted in 46 soums where GOBI Forage is currently monitoring forage conditions. Training included government officials, NGO personnel, and herders. A total of 372 individuals were trained in 2006-2007, including 181 women.

GOBI Non-Degree Training for 2006-2007			
Country	Male	Female	Total
Mongolia	191	181	372

- A workshop was held in late September for all of the major ministries, NGOs, and research organizations that have associations with range and pasture management to identify possible organizations where GOBI Forage could be institutionalized in Mongolia. It was decided in this workshop that a request for proposals should be tendered where interested organizations in Mongolia would apply to institutionalize GOBI Forage. The request for proposals is currently being prepared and will be tendered in November 2007.

- GOBI Forage hosted a joint field trip with the Swiss Development Corporation Green Gold Project, Mongolia Research Institute of Animal Husbandry, and the USDA Agricultural Research Service to examine ways of implementing a long-term rangeland health program for Mongolia. A plan was developed and presented to the government ministries that have associations



*The GOBI Forage team interviews a herder on the steppe in Bayankhongor Aimag. Photo by Dan Schar.*

with pasture and rangeland management in Mongolia.

- A pilot herder business alliance was organized in the Bayanhongor aimag of Mongolia, with an elected board of directors and general manager. A constitution for the alliance has been drafted, and over 300 herders have purchased shares. The alliance sought and has been granted registration within the Mongolian government.
- Information, accessible to both genders, was disseminated by outreach activities and through technology under the GOBI Forage project. Families and clan groups of Mongolian herders freely share radios, TV and written sources of information given the high literacy rate of all age groups and sexes.
- The GOBI Forage project strives to provide equal opportunity for men and women in both technology dissemination and training activities. In 2006-2007, 181 women participated in herder alliance training workshops on the utilization of GOBI Forage technologies, compared with 19 women participants in 2005-2006.

GOBI Forage Funding for 2006-2007	
Total Core Funding	\$150,000
Total Cost Share	\$24,952
Leveraged Funding	\$701,500
USAID Buy-In	\$50,000

## RESEARCH BRIEFS

### GL-CRSP Research Brief 08-01-GOBI: Development of Herder Alliances in the Gobi Region of Mongolia

**Authors:** *Enkhbayar Bayarmaa, Sovd Bayarmagnai, Mercy Corps Mongolia; Dennis Sheehy, Texas A&M University*

*Summary.* In 2006, a collaborative pilot project was initiated in Mongolia to test the applicability of

developing herder alliances based on the model of North American rural farm and ranch cooperatives. These alliances would be a conduit for the flow of livestock early warning information from the GOBI Forage project and would provide critical services to alliance members. A generic framework for organizing and implementing herder alliances was developed. The Bayanhongor herder alliance was initiated by electing a board of directors, establishing a constitution, and obtaining status as a legal entity in Mongolia.

From this pilot project, the GOBI Forage team learned that : 1) a critical mass of producers is needed to effectively initiate an alliance, 2) an existing infrastructure of technical experts and extension agents is required to raise initial awareness of the alliance and to facilitate the recruitment of livestock producers, 3) the initiation of an alliance requires a sponsoring organization to provide startup resources and capital because funds from initial membership shares are not adequate, 4) help is needed from government or non-governmental organizations to facilitate and connect the alliance to terminal markets, and 5) effort is needed to dispel the notion that the herder alliance is only a marketing middleman.

### GL-CRSP Research Brief 08-02-GOBI: Development of Portable NIRS Technology to Monitor Grazing Animal Nutrition in Mongolia

**Authors:** *Doug Tolleson, Institute of Animal Husbandry; S. Prince, K. Banik, Udval Gombosuren, Institute of Animal Husbandry; Dennis Sheehy, Texas A&M University*

*Summary.* Understanding the nutritional status of grazing animals is a critical step in improving livestock productivity in Mongolia. Utilization of near infrared reflectance spectroscopy (NIRS) on feces provides adequate assessment of diet quality, yet initially requires substantial laboratory infrastructure and capacity. The application of portable NIRS in remote settings, such as those found in Mongolia, shows promise as both a research and management

tool, as it allows for rapid assessment of diet quality in the field. Until Mongolian-specific calibrations are developed, application of fecal NIRS there is dependent on similarities in fecal chemistry between native and US animals. Fecal chemistry of Mongolian cattle and yak were highly analogous to US cattle, whereas Mongolian sheep and goats exhibited greater differences in fecal chemistry as compared to their US counterparts than did the larger ruminants. Due to these similarities, diet quality from Mongolian ruminant fecal samples can be determined using current US calibrations until either Mongolian specific or Mongolian enhanced calibrations are developed. Fecal NIRS can also be used to discriminate between pairs of sympatric species (i.e. cattle and yak, sheep and goat, horse and khulan). Further development of this discriminant technique will facilitate more efficient collection of samples (by non-livestock oriented individuals), thus expediting nutritional monitoring in large landscapes. Timely assessment of diet quality via fecal NIRS will augment the forage quantity measurements provided by the GOBI Forage project and provide a two-pronged decision support package for pastoralists and agriculture professionals. Portable NIRS yielded results comparable to static NIRS and can, thus, be used in field conditions. This “take the lab to the sample” approach with portable

NIRS can make near-real time, location specific nutritional monitoring available to the herders of Mongolia’s vast grazing lands.

**GL-CRSP Research Brief 08-03-GOBI: Verification of Simulation Model and Landscape Map Results for Near Real Time Forage Monitoring in the Gobi Region of Mongolia**

**Authors: Jay Angerer, Texas A&M University; Lhamsuren Bolor-Erdene, and Magsar Urgamal, Mercy Corps Mongolia**

*Summary.* Assessment of vegetation productivity on rangelands using conventional methods, such as clipping, can be very time consuming and expensive and becomes very impractical to do on a near real time basis. Near-real time information, however, is critical for timely decision-making in the face of drought and other disasters, especially in the Gobi region of Mongolia. In this study, GOBI researchers sought to assess the ability of a forage simulation model (PHYGROW) to accurately predict forage standing crop at 300 sites and whether the output from the simulation model could be combined with satellite greenness data to produce landscape maps of forage production on a near real-time basis. The assessment required three main steps: 1) model

calibration, 2) model validation, and 3) map cross-validation. For model calibration and validation, the researchers found that the PHYGROW model generally did a good job of predicting forage biomass at the monitoring sites with the variability in model predicted biomass to be less than the error associated with actual clipping for biomass production. An assessment of the cross-validation for the landscape maps found a good relationship between forage model biomass and the map interpolated biomass, thus indicating that the forage model outputs can be useful for creating near-real time maps of forage production. These technologies will provide timely information on forage conditions to increase lead time for making risk mitigation decisions by herder groups and policy makers.



*A herder examines the GOBI Forage calendar. Photo by Dan Schar.*

## TEAM MEMBERS

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Tim Brown, Texas A&M University  
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J. Richard Conner, Texas A&M University  
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Research Institute of Animal Husbandry  
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Mongolia, Institute of Animal Husbandry  
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Jason Jones, Texas A&M University  
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Urgamal Magsar, Mercy Corps  
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Research Institute of Animal Husbandry  
T. Tomon, Mercy Corps  
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Kristen Zander, Texas A&M University  
Steve Zimmerman, Mercy Corps

## COLLABORATING INSTITUTIONS

**Texas A&M University, Department of Rangeland  
Ecology and Management (*lead institution*)**

Agricultural University of Mongolia, Research  
Institute of Animal Husbandry  
Institute of Meteorology and Hydrology, Mongolia  
Mercy Corps, Mongolia  
Pact, Mongolia  
USDA - Foreign Agricultural Service  
World Bank Sustainable Livelihoods Program,  
Household Livelihoods Support Program

**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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Robert Kaitho (Project Coordinator), Ph.D., Research Scientist, Texas A&M University, 3502 Vienna Drive, College Station, TX, 77845, Phone: (979) 458-3215, Email: rkaitho@cnrit.tamtu.edu

**SUMMARY OF ACHIEVEMENTS**

- During 2006-2007, the LINKS project trained a total of 171 market monitors. Eighty-six of those trainees are from Kenya, 51 from Ethiopia, and 34 from Tanzania. LINKS has also established a steady SMS text message-based reporting flow from 14 markets in Kenya, 15 markets in Ethiopia, and 14 markets in Tanzania.
- The Center for Natural Resource Information Technology's website (<http://cnrit.tamtu.edu>) hosts both LINKS and LEWS data. The total number of visits to the page in 2006-2007 was 388,463, and 137.2 GB of data on livestock market information was downloaded, representing a substantial mobilization of community interest in livestock market information products, thereby enhancing market efficiency and producer marketing decisions. In East Africa, Kenya and Tanzania are the greatest users of this data.
- The recently developed Intergovernmental Authority on Development (IGAD) Conflict Early Warning and Response Mechanism (CEWARN) utilizes the LINKS/LEWS forage early warning system to identify areas of forage deficiency as a potential resource-based conflict indicator. This information serves as the basis for initiating interventions that are focused on conflict prevention and mitigation activities in the Horn of Africa region.



*LINKS training at the Maralal Livestock Market, Samburu District, Kenya. Photo by LINKS team member.*

- Livestock market issues have a large impact on pastoral household income levels due to the critical contributions of livestock and livestock products to livelihoods. Information on market prices generated by LINKS is used by producers to bargain for better prices for their livestock, increasing income and improving overall food security.
- Water, a fundamental requirement to pastoral livelihoods in East Africa, is also a scarce resource subject to competition, often resulting in conflict. The LINKS project is actively developing water resource monitoring tools as part of its Livestock Early Warning System (LEWS) to inform pastoral communities on the availability of water, thereby enhancing the capacity of pastoral communities to make decisions on migration and minimizing the likelihood of competition over water resources.
- LINKS training at policy, market-trader and producer-community levels to build the capacity of users to access, interpret and use the information for decision-making is ongoing. In the last year, approximately 5,687 individuals participated in market information system user capacity trainings at the national, regional, and local levels.
- Livestock market information systems and early warning technologies developed by the LINKS/LEWS project currently provide the basis for a National Livestock Market Information System (NLMIS) in Kenya. LINKS/LEWS technologies are also being adopted as part of a NLMIS program in Ethiopia. These NLMIS systems represent the greater integration of regional and transnational livestock markets in East Africa, providing integral policy support for natural resource management, market efficiency, and livestock monitoring.

#### **RESEARCH BRIEFS**

##### **GL-CRSP Research Brief 08-01-LINKS: Expansion of LEWS Activities in Ethiopia under the Pastoralist Livelihoods Initiative (PLI) Program**

***Authors: Laban MacOpiyo, Abdi Jama,  
FAO-IGAD; and Robert Kaitho, Texas A&M  
University***

*Summary.* In the recent past, pastoralists of Ethiopia have become increasingly food insecure and vulnerable to drought and other shocks, including conflict over limited grazing resources. This trend

is corroborated by high levels of food aid and evidence that coping mechanisms are becoming weaker. Through a Pastoralist Livelihoods Initiative (PLI) project that began in October 2005, USAID-Ethiopia supported Ethiopia in undertaking urgent and timely interventions to respond immediately to emergencies and to improve livestock production and early warning systems targeted at reducing the prospect of disasters due to recurrent droughts. The Livestock Information Network and Knowledge System (LINKS) project is one of the multiple partners that contributed significantly to the implementation of the PLI project, focusing its efforts on the drought and conflict-ridden regional states of Somali and Afar. This brief describes the contribution of the LINKS project towards the establishment and strengthening of the capacity of the Somali and Afar Regional states of Ethiopia to institute and manage region-wide, district-based pastoral livestock Early Warning Systems, providing the technological infrastructure for livelihood improvement and potential conflict reduction for Somali and Afar pastoralists.

**GL-CRSP Research Brief 08-02-LINKS: Assessment of Livestock Market Information Systems in the Highland Regions of Ethiopia**

***Authors: Laban MacOpiyo, Abdi Jama, FAO-IGAD; Abdirahman Ali, Pastoral Livelihood Initiative; and Mitiku Gobena, SPS-LMM***

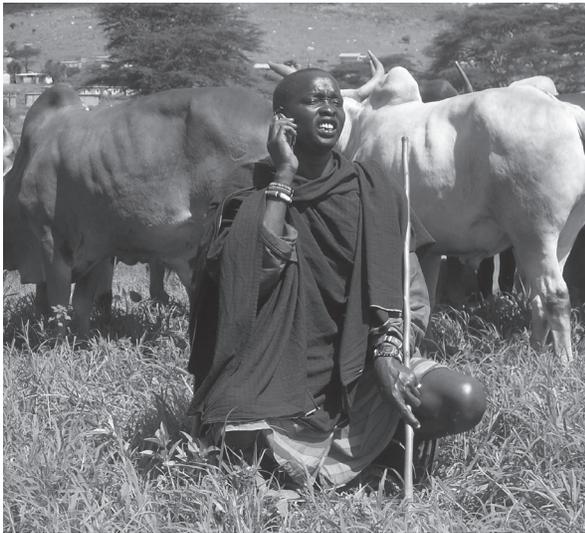
*Summary.* The lack of properly functioning markets has been pointed out as one of the key issues underlying the recurrent food crisis in Ethiopia and in other countries in the eastern Africa region. Many issues and constraints, however, need to be tackled in order to create an efficient livestock marketing system. The absence of livestock market information is one of such constraints facing livestock producers in the highlands of Ethiopia in their efforts to earn a fair return from the sale of their livestock. Access to market information enables these producers to seek out and compare the information available for different market outlets to realize the full potential profit by getting the best prices. The Sanitary and Phyto-sanitary Standards and Livestock and

Meat Marketing (SPS-LMM) program of Texas Agricultural Experiment Station commissioned an assessment of the livestock market information systems in the highland regions of Ethiopia. The main objective of the assessment was to inform on the prevailing status of livestock market information systems in these areas and subsequently help identify opportunities and constraints towards the development of a unified national livestock market information system in Ethiopia, integrating both pastoral and highland market systems. This brief describes the findings of that assessment study that was carried out by the Livestock Information Network and Knowledge System (LINKS) of the Global Livestock Collaborative Research Support Program (GL-CRSP) in collaboration with the SPS-LMM project.

**GL-CRSP Research Brief 08-03-LINKS: The National Livestock Marketing Information System (NLMIS) Comes of Age in Kenya**

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

*Summary.* Following consultations and demonstration of the functioning of the Information and Communication Technology (ICT) in reporting and disseminating livestock prices, stakeholders in livestock marketing information adopted the LINKS protocol to develop a national livestock marketing information system for Kenya. The system is a culmination of efforts of different stakeholders to give the country a unified system that provides information on prices of different livestock species that are traded in key livestock markets. The overall objective of the NLMIS is to increase market access for livestock producers and traders. The system allows users to bring down the costs of doing business by reducing reliance on brokers for information and to conduct market transactions on their behalf as illustrated by the case of one Peneti Ole Parmuat, a Maasai herder and trader from Kajiado district of southern Kenya.



Tirina Ole Kailonko searching for a suitable market for his livestock. Photo by LINKS team member.

## PUBLICATIONS

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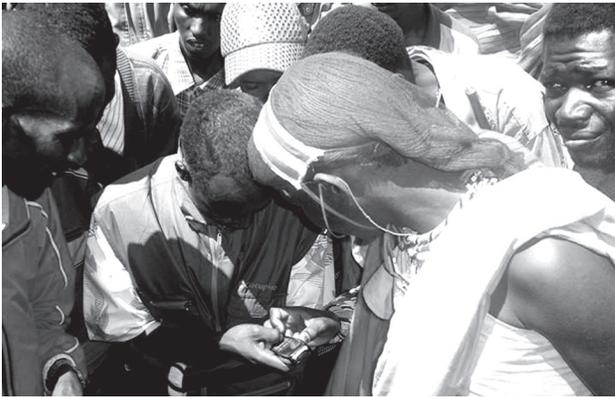
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Kariuki G., and R. Kaitho. "Application of information communication technologies in developing a national LMIS for Kenya." Paper presented at the 10th KARI Biennial Scientific Conference and Agricultural Forum. Nairobi, Kenya, November 12-17, 2006.

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Kariuki G., J. Ndung'u, and R. Kaitho. "Report on early warning harmonization workshop." Nairobi, Kenya, October 4, 2006.



*A crowd watches an SMS demonstration at a LINKS Market Information System training session at Maralal town market, Kenya. Photo by LINKS team member.*

Kaitho R., J. Ndung'u, and G. Kariuki. "A toolkit for monitoring and forecasting forage supply in the grazing lands of eastern Africa." Paper presented at the 10th KARI Biennial Scientific Conference/Kenya Agricultural Research Forum. Nairobi, Kenya, November 12 -17 2006.

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Marsabit, Moyale, Wajir, Mandera, Garissa and Ijara districts, Kenya." June 26- July 16, 2007.

### TEAM MEMBERS

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Mohamed Abdinoor, Save the Children - UK

Dubale Adamasu, FarmAfrica

Dabasa Adan, MoLFD

Abdifatah Ahmed Ismail, Save the Children - UK

Sidow Addou, FEWS NET

Ahmed Ali, Pastoral Livelihood Initiative (PLI)

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Jim Bucher, Texas A&M

George Chale, Ministry of Livestock Development, Tanzania (MoLD)

Wondemagen Chekol, Ethiopian Agricultural Research Organization

Hemed Chongono, MoLD

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Dhugassa Dirbaba, Livestock and Fisheries Marketing Department

Paul Dyke, Texas A&M University

Kebebe Ergano, LINKS-GLCRSP

Teshome Erkinah, Disaster Preparedness and Prevention Commission (DPPC)

Jemberu Eshetu, Livestock Marketing Authority

LINKS Non-Degree Training for 2006-2007			
Country	Male	Female	Total
Ethiopia	122	17	139
Kenya	5,352	321	5,673
Tanzania	41	14	55
Total	5,515	352	5,867

Husein Gedain, FEWS NET  
 Mike Giles, Save the Children - USA  
 Peter Golicha, MoLFD  
 Ezekial Goromela, ILRI  
 Abdulkarim Ahmed Guleid, Hope for the Horn  
 Julian Gutta, Ministry of Industry Trade and Marketing  
 Getachew Haile, Oromia Agricultural Research Institute (OARI)  
 Rashid Hersi, FEWS NET  
 Marta Hirpha, Oromia Pastoral Development Commission (OPaDC)  
 Belachew Hurrissa, Livestock Marketing Authority  
 Mohamed Hussein, MoLFD  
 Mohammed Hussein, KLMC/MoLFD  
 Mohamed Ismail, MoLFD  
 Abdi Jama, FAO-IGAD  
 Suleiman Kaganda, ILRI  
 Robert Kaitho, Texas A&M University  
 Roger Kamidi, International Livestock Research Institute (ILRI)  
 Gatarwa Kariuki, LINKS Project, GL-CRSP  
 James Kariuki, MoLFD  
 Dereje Kebede, FarmAfrica  
 Wilbrod Kensapa, MoLD  
 Guard Kiangi, MoLD  
 Lucy Kimani, FarmAfrica  
 Simon Kimari, MoLFD  
 Richard Kimayo, Kenya Livestock Marketing Council/MoLFD  
 Juma Kimosa, MoLD  
 Margaret Kingamkono, MoLD  
 Gideon Kinyonda, U.S. Geological Survey  
 Stanley Kirimi, MoLFD  
 Clemence Kiwonde, MoLD  
 Mathew Komen, University of Nairobi  
 Aneth Kotto, MoLD  
 Shigella Lambo, MoLD



*LINKS Market Information System training session at Isiolo market, Kenya. Photo by LINKS team member.*

Joel Lang'at, Arid Lands Resource Management Project (ALRMP)  
 Paul Lekadaa, MoLFD  
 Phillip Lekaere, MoLFD  
 Patwell Lekalesoi, MoLFD  
 Maduhu Limbu, MoLD  
 Laban Macopiyo, FAO-IGAD  
 Agnes Maiga, MoLD  
 Joseph Maina, MoLFD  
 Josphat Maina, Kenya Livestock Marketing Council/MoLFD  
 Reuben Marawiti, MoLD  
 Dominic Massawe, MoLD/Tanzania Livestock Marketing Project (TLMP)  
 Rabbiel Massawe, MoLD  
 Joseph Matere, ILRI  
 Adam Mbare, MoLD  
 Lorna Mbatia, MoLFD  
 Njunguna Mbogo, MoLFD  
 Alex Mbundu, MoLFD

LINKS Degree Training for 2006-2007					
Name (Last, First)	Nationality	Gender M/F	University	Discipline	Degree
Komen, Matthew	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

Dominic Mbuvi, MoLFD  
 Elias Mbwambo, MoLD  
 Calum Mclean, FAO  
 Shehe Mganga, MoLD  
 William Mnene, Texas A&M  
 Ahmed Mohamed, Pastoral Research Institute,  
 Somali Region  
 Abbas Mohamed, MoLFD  
 Suleiman Mohamed, Save the Children - UK  
 Sora Molu, MoLFD  
 Ian Moore, ILRI  
 Abdirahman Mstafa, MoLFD  
 Sylvester Msumari, MoLD  
 Paul Mtani, MoLD  
 Daniel Muggi, MoLD  
 Stanley Muli, MoLFD  
 Julius Mulongo, MoLD  
 Joseph Musyoka, MoLFD  
 Elizabeth Muthiani, Kenya Agricultural Research  
 Institute (KARI)  
 Nancy Mutunga, FEWS NET  
 Muthoni Mwangi, FAO  
 Anna Mwasanguti, MoLD  
 Angelo Mwilawa, ILRI  
 Jean Ndikumana, ILRI  
 Margaret Ndumia, MoLFD  
 Joseph Ndungu, LINKS Consultant, Kenya  
 James Nguo, Arid Lands Information Network  
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 Julian Ngutta, TLMP  
 Anunciata Njombe, MoLD  
 Sophia Njombe, MoLD/TLMP  
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 Robert Nkwama, MoLD  
 Charles Ntamuti, MoLD  
 Francis Nthimba, MoLFD  
 Ann Nyagweta, MoLFD  
 Bridget Ochieng, University of Nairobi/Tegemeo  
 Insititute  
 Paul Okuta, MoLFD  
 Rose Omaria, National Agricultural Research  
 Organization, Uganda (NARO)  
 John Ongori, MoLFD  
 Aloo Onyango, MoLFD  
 Noor Osman, MoLFD  
 Maurice Ouma, MoLFD  
 Hatibu Rajabu, MoLD

Guyo Roba, MoLFD  
 Abdinasir Saman, Kenya Livestock Marketing  
 Council/MoLFD  
 Ahmed Seid , Patoral Livelihood Initiative  
 Salum Sembe, MoLD  
 David Sendalo, MoLD  
 Abdu Shayo, MoLD  
 Amin Sheghembe, MoLD  
 Abdille Sheikh, MoLFD  
 Paul Solitei, Kenya Livestock Marketing Council/  
 MoLFD  
 Samuel Solomon, MoLD  
 Invocaviths Swai, MoLD  
 Romanus Swai, MoLD  
 Habtamu Teka, Oromia Pastoral Development  
 Commission  
 Doug Tolleson, Texas A&M  
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 Ari Wakole, MoLFD  
 Bernard Wanjohi, MoLFD  
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 Council/MoLFD  
 Jianjia Wu, Texas A&M  
 Samuel Yegon, MoLFD  
 Kristen Zander, Texas A&M  
 Ann Zhang, Texas A&M

LINKS Funding for 2006-2007	
Total Core Funding	\$350,000
Total Cost Share	\$88,025
Leveraged Funding	\$1,787,707
USAID Buy-In	\$266,000

#### COLLABORATING INSTITUTIONS

##### **Texas A&M University** (*lead institution*)

##### *Ethiopia*

ACDI-VOCA-Ethiopia  
 Farm Africa, Afar Pastoral Development  
 Coordination

Alemaya University, Ethiopia  
Bati Agricultural and Rural Development Office  
Dire Dawa Agriculture Office  
Dire Dawa Disaster Preparedness and Food Security (DPFS)  
Dire Dawa Rural Development Coordination Bureau  
Disaster Prevention and Preparedness and Food Security Bureau, Afar Region  
Disaster Prevention and Preparedness Commission  
Ethiopian Information and Communication Technology Development Authority (ICTAD)  
Ethiopian Telecommunication Agency  
Ethiopian Telecommunication Corporation  
FAO/Afar Livestock Recovery Project  
FEWS NET, Ethiopia  
Jijiga Pastoral Agro-pastoral Research Center  
Livestock, Crops, and Natural Resources Development Office  
Ministry of Agriculture and Rural Development  
Livestock and Fish Marketing Department  
Oromia Pastoral Development Commission  
Pastoralist Forum, Ethiopia  
Save the Children, UK and Jijiga office Moyale District, Somali Region, Ethiopia  
Somali Region Pastoral and Agro-pastoral Research Institute  
Somali Region Rural Development  
USAID -Southern Tier Initiatives (STI)  
Werer Agricultural Research Center

*Kenya*

Arid Lands Information Network (ALIN)  
Arid Lands Resource Management Project  
Farm Africa, Northern Kenya Pastoralist Capacity Building Project  
FEWS NET, Kenya  
First Voice Africa  
Food and Agriculture Organization  
Food for the Hungry International  
Kenya Livestock Marketing Council  
Ministry of Livestock and Fisheries Development  
Netherlands Development Organization (SNV)  
Regional Agricultural Trade Expansion Support Program  
Regional Center for Mapping of Resources for

Development  
Terra Nuova  
University of Nairobi, College of Agriculture and Veterinary Sciences (Kabete Campus)  
Vétérinaires Sans Frontières-Suisse

*Tanzania*

Ministry of Livestock Development  
Selian Agricultural Research Institute



**LIVESTOCK TRAINING IN ETHIOPIA  
AND KENYA  
(LiTEK)**

**PROJECT DESCRIPTION**

*LiTEK is a continuation of the Pastoral Risk Management Project (PARIMA, see page 54) as PARIMA enters the write-up phase. The LiTEK project has resulted in the publication of Pastoral Livestock Marketing in Eastern Africa: Research and Policy Challenges, edited by John G. McPeak and Peter D. Little (2006). In its current phase, LiTEK team members are producing the manuscript entitled Changing Livelihoods, Risky Environments: Social and Economic Change among Pastoralists in East Africa. Contributing authors include John G. McPeak, Peter D. Little, Cheryl R. Doss, and Christopher B. Barrett.*

**LEAD PRINCIPAL INVESTIGATOR**

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**SUMMARY OF ACHIEVEMENTS**

J.G. McPeak, P.D. Little, C.R. Doss, and C.B. Barret are contributors to the innovative, new book entitled *Changing Livelihoods, Risky Environments: Social and Economic Change among Pastoralists in East Africa*, due for publication in 2008. This important compilation addresses the following key issues:

- the extent to which risk perceptions, development priorities, income generations and dietary diversity vary by gender,
- efforts in East Africa to foster cross-community dialog on conflict resolution through local management committees and evaluation of the success of those efforts,
- livelihood generation strategies and their evolution over time,
- factors contributing to household food security or insecurity, and
- the role of humanitarian food aid in the study area.



*Treating sheep in East Africa. Photo by Chris Barrett.*

## RESEARCH BRIEFS

**GL-CRSP Research Brief 08-01-LiTEK: A Description of *Changing Livelihoods, Risky Environments: Social and Economic Change among Pastoralists in East Africa***

**Authors:** *John G. McPeak, Syracuse University; Peter D. Little, University of Kentucky; Cheryl R. Doss, Yale University; and Christopher B. Barrett, Cornell University*

*Summary.* The four authors listed above are currently compiling a manuscript entitled *Changing Livelihoods, Risky Environments: Social and Economic Change among Pastoralists in East Africa*. The book summarizes findings from their work with the GL-CRSP Pastoral Risk Management (PARIMA) project. While the final volume is expected to be published in 2008, this brief provides an early look at the book's content and outlines the aim of the book, the authors' approach, and the key findings that have emerged. *Changing Livelihoods, Risky Environments* focuses on providing insight into how livelihood strategies operate currently and how they have changed over time in pastoral areas, based on empirical evidence gathered in the context of the research conducted previously in the PARIMA project. Findings indicate that livestock remain

central to people's livelihoods, but the authors also document other important sources of income that both reduce poverty and vulnerability to poverty. The book presents evidence on how people view the risks they face and their priorities for future development in their community. Because information was collected from multiple sites, multiple households within a site, and multiple individuals within households, researchers are able to identify patterns that are largely generated by inter-community, inter-household, or intra-household differences.

**GL-CRSP Research Brief 08-02-LiTEK: How Are They Surviving Out There? An Analysis of Total Income in the PARIMA Study Sites**

**Author:** *John G. McPeak, Syracuse University*

*Summary.* One of the most commonly used measures of well-being in economics is income. In the PARIMA study area, special care must be taken in measuring income as much of household income is derived from the household consumption of household-produced goods. This brief presents some preliminary findings on income generation patterns in the study sites when team members attempt to measure total income that includes both cash income and the value of home produced and consumed goods. Findings demonstrate that poverty is deeper and more widespread in the Ethiopian sites than in the Kenyan sites. Livestock remain central to income generation. Milk produced and consumed in the home, in particular, plays a prominent role in ensuring survival. Food aid is found to be an important source of income, but evidence suggests fears of widespread food aid dependence are not warranted. Income from cropping plays a minor role; and income that is generated by salary or wage labor is present in Kenya, but almost totally absent in the Ethiopian sites.



*Kemise Cattle Market, Ethiopia. Photo by Peter Little*

LiTEK Funding for 2006-2007	
Total Core Funding	\$89,401

LiTEK Degree Training for 2006-2007					
Name (Last, First)	Nationality	Gender (M/F)	University	Discipline	Degree
Chantarat, Sommarat	Thai	F	Cornell University	Economics	PhD
Villa, Kira	USA	F	Cornell University	Applied Economics and Management	MS

## PUBLICATIONS

No publications were produced as part of LiTEK in this fiscal year; however, the project itself will result in the publication of the manuscript entitled *Changing Livelihoods, Risky Environments: Social and Economic Change among Pastoralists in East Africa* in 2008.

## TEAM MEMBERS

Christopher Barrett, Cornell University  
 Eric Boyer, Syracuse University  
 Cheryl Doss, Yale University  
 Peter Little, University of Kentucky  
 John McPeak, Syracuse University

## COLLABORATING INSTITUTIONS<sup>1</sup>

**Cornell University, Department of Applied Economics and Management (*lead institution*)**

University of Kentucky, Department of Anthropology  
 Yale University, Center for International and Area Studies

<sup>1</sup> LiTEK is a development of the PARIMA project. Please refer to PARIMA's Collaborating Institutions for a complete listing of LiTEK collaborators.

**IMPROVING PASTORAL RISK MANAGEMENT  
ON PASTORAL 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 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.*

**LEAD PRINCIPAL INVESTIGATOR**

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**SUMMARY OF ACHIEVEMENTS**

- The period 2006-2007 has proven to be yet another active and sustainable year for the 60 collective-action/micro-finance groups that have formed in southern Ethiopia since 2001 as part of PARIMA. This model of collective-action/micro-finance has been adopted throughout the Oromia State of Ethiopia and extended to communities in the region. Total membership currently stands at 2,085, and the groups have merged into legally recognized cooperatives. Because milk marketing is predominately a female task, it is noteworthy that Ethiopian women are the primary leaders of these groups and represent 79% of their membership.
- As of September 2007, cumulative savings on investments in livestock trading and other small-business activities of the cooperatives equaled USD \$93,344.00. Internally extended loans over the past five years total 4,527 with a cumulative value of USD \$558,989.00 and a 100% repayment rate.
- PARIMA has also facilitated the creation of a network of 17 regional and 17 local partner organizations to achieve development impact in southern Ethiopia through the creation of the pastoral collectives described above. Members include federal and local governments, NGOs, and community-based organizations (CBOs).
- Through a truly collaborative effort requiring the use of indigenous knowledge, relaxation of policy constraints, use of modern technology, careful hands-on training, applied research and trust building, PARIMA has facilitated the re-introduction of prescribed fire on the Borana Plateau of southern Ethiopia to improve pastoral area management and protection.
- In order to understand the elements of cross-border conflict as it relates to natural resource management along the Ethio-Kenya border, PARIMA interviewed some 200 pastoralists and mapped the area using GPS technology. Findings

indicate that pastoralists have traditionally moved across the border in search of forage area during dry periods, and such movements, and therefore livelihoods, are threatened by current border conflicts.

#### RESEARCH BRIEFS

##### **GL-CRSP Research Brief 07-01-PARIMA: Collective Action among Agro-pastoralists in Baringo District, Kenya: Identifying and Nurturing the Entrepreneurs**

*Authors: Mark N. Mutinda, Stellamaris K. Muthoka, and Abdillahi A. Aboud, Egerton University; D. Layne Coppock, Utah State University*

*Summary.* The rural population of the Baringo District in the Rift Valley of north-central Kenya faces numerous challenges including widespread environmental degradation and poverty. The region has endured decades of failed development projects, proliferation of food aid, and has been studied extensively. PARIMA researchers have recently undertaken a different approach that focuses on bottom-up participatory action research and outreach among the Il Chamus and Tugen ethnic communities. The objective is to explore new ways to empower local people via provision of information, novel experiences, and initial access to resources to allow them to envision an alternative future and implement their own activities to better manage risks. This research brief details the first phase of this activity. Twelve potential entrepreneurs (six from each of the two ethnic groups) were carefully selected and sent on an extensive training and educational tour to Mwingi District in eastern Kenya. There, participants visited a variety of successful, community-led development projects. The tour helped to convince the entrepreneurs of neglected opportunities in Baringo. They have since taken a leading role in assisting their communities to form collective-action groups. Furthermore, the groups are now successfully registered with the Kenyan government and pursuing work plans aimed at improving their circumstances.

##### **GL-CRSP Research Brief 07-02-PARIMA: Stakeholder Alliance Facilitates Re-Introduction of Prescribed Fire on the Borana Plateau of Southern Ethiopia**

*Authors: Getachew Gebru, Solomon Desta, D. Layne Coppock, Utah State University; Lemma Gizachew, Oromia Agricultural Research Institute; Dadhi Amosha, Pastoral Risk Management Project; Feyissa Taffa, Oromia Pastoral Area Development Commission*

*Summary.* On the semi-arid Borana Plateau of Ethiopia, heavy grazing by livestock, reduced mobility of pastoralists, and lack of fire have contributed to conversion of open, mixed savanna communities to dense woodlands and bushes. The implementation of a new prescribed fire program to restore bush-encroached rangelands in southern Ethiopia—and hence increase herbaceous forage supplies for livestock—is given as an example of an integrated action involving multiple institutions to address resource-management problems. Planned fire was traditionally conducted over hundreds of years by pastoralists until the 1970s. The resumption of planned fire was preceded by key activities including: mobilization of the pastoral community, review of government proclamations regarding the use of fire, interaction with policy makers, capacity building among pastoralists and agency personnel on how to implement and manage planned fires, development of an overall prescribed burn plan, selection of geo-referenced sites, and then implementing large-scale burns on an annual cycle. The process has required a combination of indigenous knowledge, relaxation of policy constraints, use of modern technology, careful hands-on training, applied research, and building trust to create a truly collaborative approach. The key elements of change have been participatory action research, outreach, and engagement with a wide variety of stakeholders. One springboard for success has been the commitment of the Oromia Agricultural Research Institute (OARI) and the Oromia Pastoral area Development Commission (OPaDC) to support an authentic, demand-driven research agenda with a focus on applied and adaptive work in the pastoral areas.

PARIMA Degree Training for 2006-2007					
Name (Last, First)	Nationality	Gender (M/F)	University	Discipline	Degree
Haile, Getachew	Ethiopian	M	Alemaya University	Range Management	MS
Jillo, Abdulahi	Kenyan	M	Egerton University	Human Ecology	PhD
Mutinda, Mark	Kenyan	M	Egerton University	Human Ecology	PhD
Olekaikai, Nicholas	Kenyan	M	Egerton University	Human Ecology	MS

**GL-CRSP Research Brief 07-03-PARIMA: Building Effective Community Participation and Stakeholder Partnerships to Promote Positive Change in the Southern Ethiopian Rangelands**

*Authors: Solomon Desta, D. Layne Coppock, Getachew Gebru, Utah State University; Seyoum Tezera, Dadi Amosha, Pastoral Risk Management Project (Ethiopia)*

*Summary.* Recently there has been increased recognition that authentic community participation and creating strong inter-institutional partnerships are both important in the process of capacity building, generating innovation, and sustaining development achievements in rural Africa. In this brief, the authors summarize a process of community participation and formation of institutional partnerships in support of pastoral risk-management interventions over the past seven years on the Borana Plateau in the southern Ethiopian rangelands. Community involvement has been stimulated using Participatory Rural Appraisal (PRA) methods. This has resulted in the proliferation of pastoral collective-action groups that have diversified livelihoods, engaged markets, and improved incomes. Implementing and sustaining positive change, however, has also been related to building a dynamic network of 47 like-minded partners across Ethiopia and northern Kenya. These partners include community-based organizations, women's groups, policy makers, educators, researchers, private sector firms, various governmental and non-governmental development agents, among others. It is argued that widespread impact across such a large area could not have been achieved without the assistance of many partners that contribute complimentary resources and expertise to plug gaps that can otherwise impede progress.

Challenges and opportunities in creating and maintaining partner networks in support of such rural development are discussed.

PARIMA Non-Degree Training for 2006-2007			
Country	Male	Female	Total
United States	3	3	6
Ethiopia	669	1289	1958
Kenya	19	2	21
<b>Total</b>	<b>691</b>	<b>1294</b>	<b>1985</b>

**GL-CRSP Research Brief 07-04-PARIMA: Pastoral Conflict and Use of Key Resources along the Ethiopia-Kenya Border: Implications for Policy and Development**

*Authors: Anastasia Kagunyu, Shibia Mohammed, Michael Okoti, and Francis Wayua, Kenya Agricultural Research Institute - National Arid Lands Research Center (KARI); Sintayehu Mesele, Getachew Haile, Lemma Belay, Amsalu Tilahun, and Usman Kero, Oromia Agricultural Research Institute - Pastoral and Agro-Pastoral Research Center (OARI)*

*Summary.* The international border between Kenya and Ethiopia occurs in a remote rangeland area. The border has witnessed increased conflicts in recent years, especially between Gabra and Borana pastoralists. The border has also been subjected to heightened political tensions. In this study researchers from both sides of the border have joined together for the first time to conduct extensive field work. General objectives for this research are to characterize key natural resources

and pastoral migration routes along the border and better understand elements of cross-border conflict. Researchers interviewed some 200 pastoralists and mapped the area using GPS technology. Research findings indicate that pastoral communities have traditionally moved across the international border primarily in search of forage for livestock during dry periods. Such movements, however, have been recently curtailed due to conflicts, and many border sites are now considered “no-man’s lands.” Ethnic and political tensions have also negatively affected development projects and cross-border trade. There is an ongoing need for the Kenyan and Ethiopian governments, traditional leadership institutions, as well as local development agents and other elites to support peace and reconciliation initiatives if the situation is to improve.

**GL-CRSP Research Brief 07-05-PARIMA: Honey Production, Processing, Quality, and Marketing in the Mountains of Northern Kenya**

***Authors: Moses Lengarite, Anastasia Kagonyu, and Francis Wayua, National Arid Lands Research Center (KARI)***

*Summary.* Improving risk management for rangeland inhabitants can involve income diversification. Honey production is one possibility, as some locals already do it using traditional means. To what extent can honey production be expanded, the quality improved, and markets expanded? PARIMA researchers report here on a pilot study of honey production and marketing in the mountainous regions of Marsabit and Samburu Districts. Researchers used social science methods and technical assessments in an interdisciplinary approach and conclude from case studies of traders that honey production and processing can already be profitable in the area. Expansion of beeswax processing may further increase profitability. The Nyiru Mountains appear to be a key honey production zone, with peak production occurring during June to July and October. Local marketing systems should be strengthened by assisting the organization of traders and bee-keepers. To enhance the market competitiveness of local honey for urban consumers in Kenya, local honey requires improved

processing and quality assurances. To reduce costs, processed honey should be packaged in bulk using plastic jerry cans. To improve honey quality and price for market, traders should take care to blend crude (and uniformly ripe) honey from sources having similar viscosities, colors, and nectar source-plants.

**GL-CRSP Research Brief 07-06-PARIMA: Diffusion of Collective-Action Innovations among Pastoralists in Liben District, Ethiopia**

***Authors: D. Layne Coppock, Solomon Desta, Getachew Gebru, Utah State University; Getachew Kassa, Addis Ababa University; Seyoum Tezera, Pastoral Risk Management Project (Ethiopia)***

*Summary.* In 2001, PARIMA and her partners began to create collective-action groups among illiterate, settled pastoralists in Ethiopia. These groups—soon dominated by women—focused on savings-led microfinance, small business activity, and livestock marketing to increase incomes and diversify livelihoods. Fifty-nine groups, with over 2,100 members, were formed using intensive training methods, and they have subsequently merged into legally recognized cooperatives. Project team members regard this approach as successful and sustainable. Researchers were curious, however, if “the word has spread” and collective-action has spontaneously arisen beyond the immediate project area. Preliminary findings from recent surveys of settlements in Liben District indicate that diffusion of collective-action behavior has occurred. For example, nine of 20 settlements visited in a 2006 survey had groups that formed without project assistance three years earlier; these groups had 10 to 45 members each and included men only, women only, or women and men combined. These groups occur within a 10-kilometer radius of the original center of PARIMA activity in Liben, and group members pursue settled lifestyles. In contrast, collective-action innovations do not appear among traditional, mobile pastoralists in more remote areas. Uptake of collective-action innovations may offer many development benefits for new adopters, but sustaining the process requires vigilance and continued investment in awareness raising, training,

strengthening of partnerships, and attention to peace building and natural resource management.

**GL-CRSP Research Brief 07-07-PARIMA: Consumer Perceptions on the Quality and Marketing of Milk in Moyale, Kenya**

*Authors: Francis O. Wayua, Mohamed G. Shibia and Moses S. Mamo, National Arid Lands Research Center (KARI), Marsabit, Kenya*

*Summary.* Pastoral income diversification can depend on increasing market involvements. One option is for pastoralists to sell more dairy products to local towns. Researchers used focus-groups involving high-income households, low-income households, managers/owners of hotels and restaurants, and managers of a local milk-processing cooperative in Moyale, Kenya, to answer questions concerning why, how, and where they buy milk, how they assess milk quality, satisfaction with milk quality, and whether milk quality can be improved. All consumers recognize the value of high-quality milk. Higher-income consumers typically procure raw, packaged, or powdered milk at a quality and price they find satisfactory. Problems occur for low-income consumers, however, who must buy raw milk from traders at open-air markets. Traders pool raw milk from many sources and routinely adulterate it with water and other substances prior to sale. Low-income consumers are unsatisfied with the quality of milk they can buy. Discussants offered ideas as to how such problems might be addressed. These include raising awareness on milk-handling procedures and helping consumers organize to affect change in the behavior of traders. Local health authorities also need to be more vigilant about milk-quality enforcement. Some higher- and lower-income consumers said they could pay more for higher-quality milk.

PARIMA Funding for 2006-2007	
Total Core Funding	\$540,000
Total Cost Share	\$105,329
Leveraged Funding	\$67,000
USAID Buy-ins	\$303,500

**GL-CRSP Research Brief 07-08-PARIMA: Can Collective Action and Capacity Building Reduce Vulnerability among Settled Pastoralists?**

*Authors: D. Layne Coppock, Solomon Desta, Getachew Gebru, Utah State University; Seyoum Tezera, Pastoral Risk Management Project (Ethiopia)*

*Summary.* In 2001, PARIMA and her partners began to create collective-action groups among illiterate, settled pastoralists in southern Ethiopia. These groups—dominated by women—focused on savings-led microfinance, small business, and livestock marketing to increase incomes and diversify livelihoods. Fifty-nine groups with over 2,100 members were formed using intensive capacity-building methods. After six years, researchers wanted to compare group members with their neighbors who never participated in the PARIMA program. Team members surveyed 180 individuals from groups and paired control (traditional) communities. Respondents were asked to assess the extent that they perceived positive, negative, or no change in their lives over the past three years in terms of a variety of social, economic, and ecological attributes. Considered overall, an average of 81% of the sampled group members perceived that their lives had improved in everything from income and quality of life to personal confidence and human health. In contrast, an average of only 16% of control respondents felt the same way. These preliminary results suggest that collective action can be a viable development strategy here, especially among poor, settled, or displaced people living in peri-urban areas of the rangelands. Collective action, however, will be most sustainable when accompanied by intensive training, technical support, an effective legal framework, and growing market opportunities.

**PUBLICATIONS**

Haile, Getachew. “Impact of land use and land cover dynamics on the ecology of the Borana rangelands in Ethiopia.” Master’s thesis. Department of Animal Science and Range Ecology and Management, Haramaya Univ., 2006. 132 pp.

## PRESENTATIONS AND PROCEEDINGS

Coppock, D.L., S. Tezerra, S. Desta, G. Gebru, and C. Tadecha. "Change agents facilitate cross-border diffusion of collective-action innovations among pastoral women." Paper presented at the *Innovation Africa Symposium* co-sponsored by CIAT, International Institute for Rural Reconstruction), ILRI and Promoting Local Innovation. Kampala, Uganda, November 21-23, 2006.

Coppock, D.L., S. Desta, A. Wako, I. Aden, G. Gebru, S. Tezera, and C. Tadecha. "Sustainable livelihood diversification among women's groups of northern Kenya." Volunteer paper presented at the *60<sup>th</sup> Annual Meeting of the Society for Range Management*. Reno, Nevada, February 10-16, 2007.

Coppock, D.L., S. Desta, G. Gebru, and S. Tezera. "Implementing a virtuous cycle of livestock off-take, wealth conservation, and livelihood diversification to improve risk management and reduce poverty among pastoralists in southern Ethiopia." Invited symposium paper presented at the *13<sup>th</sup> Annual Meeting of the International Symposium for Society and Resource Management (ISSRM)*. Park City, Utah, June 17-21, 2007.

Desta, S., D.L. Coppock, A. Wako, I. Aden, G. Gebru, S. Tezera, and C. Tadecha. "Collective action by women's groups to combat drought and poverty in northern Kenya." Poster presented at the *Annual Conference on International Agricultural Research for Development (Tropentag)*. University of Bonn, Bonn, Germany, October 11-13, 2006.

Desta, S. "GL-CRSP PARIMA risk management research and outreach experiences in pastoral areas." Paper presented at the annual workshop for *Community Based Livestock Early Warning Systems (CB-LEWS)* sponsored by the Crisis Mitigation Office (CMO/AARNET), ILRI. Nairobi, Kenya, December 14-15, 2006.

Gebru, G., S. Desta, D. Amosha, and D.L. Coppock. "Role of participatory action research in

reviving endogenous rangeland management: A case from Southern Ethiopia." Invited paper presented at the *Annual Conference on International Agricultural Research for Development (Tropentag)* "Prosperity and Poverty in a Globalized World: Challenges for Agricultural Research". University of Bonn, Bonn, Germany, October 11-13, 2006.

Gebru, G. "Pastoralists moving into the public policy process: The case of pastoral communities in Oromia Regional State, Ethiopia." Paper presented at the *International Conference on the Future of Transhumance Pastoralism in West and Central Africa*. Abuja, Nigeria, November 21-26, 2006.

Gebru, G. "Experiences of the PARIMA project in natural resource management and savings and credit in Ethiopia." Paper presented at a meeting entitled Comparing and Supporting Endogenous Development in Africa (sponsored by COMPAS, Netherlands). Arusha, Tanzania, February 18-24, 2007.

Gebru, G., and D. Amosha. "Progress in outreach by the PARIMA project and modalities of operation." Paper presented at a meeting entitled *Harmonization of Governmental and Non-Governmental Activities in the Pastoral Areas of Ethiopia* (Organized by the Oromia Pastoral Area Development Commission). Adama, Ethiopia, July 2, 2007.

Gebru, G., S. Desta, and S. Tezera. "The GL-CRSP PARIMA intervention model in the establishment of saving and credit groups and pastoral cooperatives." Paper presented at a workshop entitled *Strengthening Microfinance Institutions and Savings & Credit Associations in Four Emerging Regions of Somali, Afar, Gumuz, and Gambella* (Sponsored by the Ethiopian Ministry of Federal Affairs). Ghion Hotel, Addis Ababa, Ethiopia, July 14, 2007.

Gebru, G. "Experiences on market support and commercial and slaughter de-stockings." Paper presented at the *Livestock Policy Forum* (Sponsored by the Federal Ministry of Agriculture and Rural Development, the Pastoral Livelihood Initiative

of USAID and Tufts University). Ethiopian Management Institute, Debre Ziet, July 26, 2007.

### **TEAM MEMBERS**

Abdillahi Aboud, Egerton University  
DeeVon Bailey, Utah State University  
Layne Coppock, Utah State University  
Solomon Desta, Utah State University  
Getachew Gebru, Utah State University  
Lemma Gizachew, Oromia Agricultural Research Institute  
Aliye Hussen, Oromia Agricultural Research Institute  
George Keya, Kenya Agricultural Research Institute  
Claudia Radel, Utah State University

### **COLLABORATING INSTITUTIONS**

#### **Utah State University, Department of Environment and Society (*lead institution*)**

Arid Lands Resource Management Project  
Community Initiatives Facilitation and Assistance  
Cornell University, Department of Applied Economics and Management  
Egerton University, Department of Environmental Sciences and Resources  
International Livestock Research Institute, ILRI  
Kenya Agricultural Research Institute  
Ministry of Livestock Development and Fisheries, Kenya  
Oromia Agricultural Development Bureau, Ethiopia  
Oromia Agricultural Research Institute, Ethiopia  
Oromia Cooperative Promotion Bureau, Ethiopia  
Oromia Pastoral Development Commission, Ethiopia  
Resource Conflict Institute  
Syracuse University, Maxwell School, Department of Public Administration  
University of Kentucky, Department of Anthropology  
USAID Mission to Ethiopia

## **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 program 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, as part of an initiative to research and improve village poultry health and productivity, 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), 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: msoffepl@suanet.ac.tz

### SUMMARY OF ACHIEVEMENTS

- The AFS, through its national-level (Tier I) Train the Trainer program, trained 134 avian flu prevention and response instructors in the ministries of animal health, public health, agriculture and faculties of veterinary medicine in Nigeria, Kenya, Tanzania, Uganda, Ghana, and Djibouti. At the district level (Tier II), in Tanzania and Djibouti, 178 people were trained, while 184 Tanzanian villagers and community leaders received training at the village level (Tier III). Nearly 500 individuals received AFS training in 2006-2007.
- A total of 74 women participated in the AFS trainings at all levels. Eighteen women attended the national level (Tier I) train-the-trainer workshops, resulting in trained instructors of both genders in each of the four AFS project

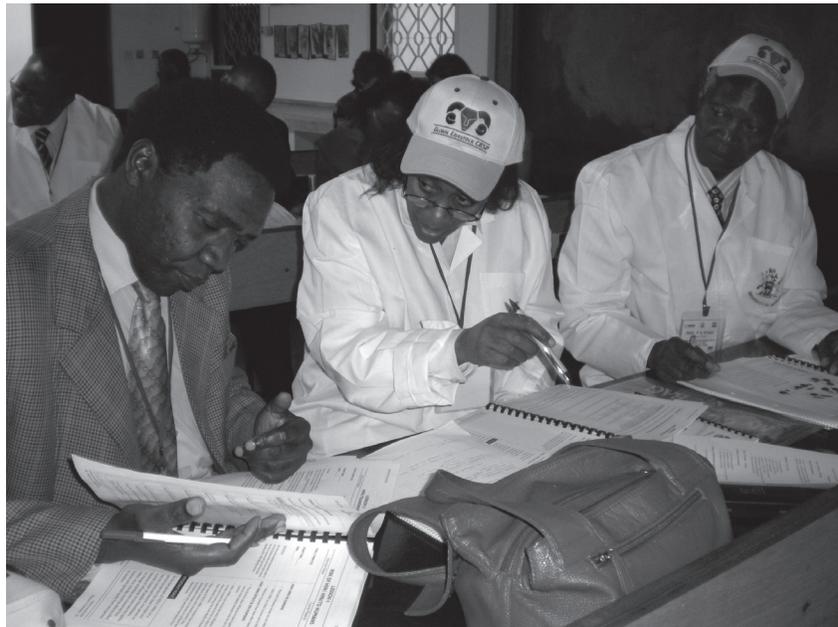
countries (Tanzania, Kenya, Uganda and Ghana). Furthermore, women's groups have been a target audience for trainings in the implementation of the village-level Newcastle disease vaccination and poultry health training program in Tanzanian villages.

AFS Non-Degree Training for 2006-2007			
Country	Male	Female	Total
Austria	1	0	1
China	1	0	1
Djibouti	32	4	36
Egypt	1	0	1
Ghana	22	2	24
Israel	1	0	1
Jordan	1	1	2
Kenya	17	4	21
Tanzania	322	56	378
Uganda	22	4	26
United States	2	3	5
<b>Total</b>	<b>422</b>	<b>74</b>	<b>496</b>

- Following the AFS briefing and training of community leaders and local government officials in Tanzania, the district of Iringa formulated and adopted a new policy to make Newcastle disease vaccination and improvement of poultry health a priority for development and has implemented a district-wide Newcastle disease vaccination program.
- The Avian Flu School utilizes technologies, such as the FluDetect test kit, a rapid antigen detection kit for birds, developed through biotechnology research. In 2006-2007, 152 animal health and human health professionals in Uganda, Kenya, Tanzania, Djibouti and Ghana were trained in using the FluDetect test

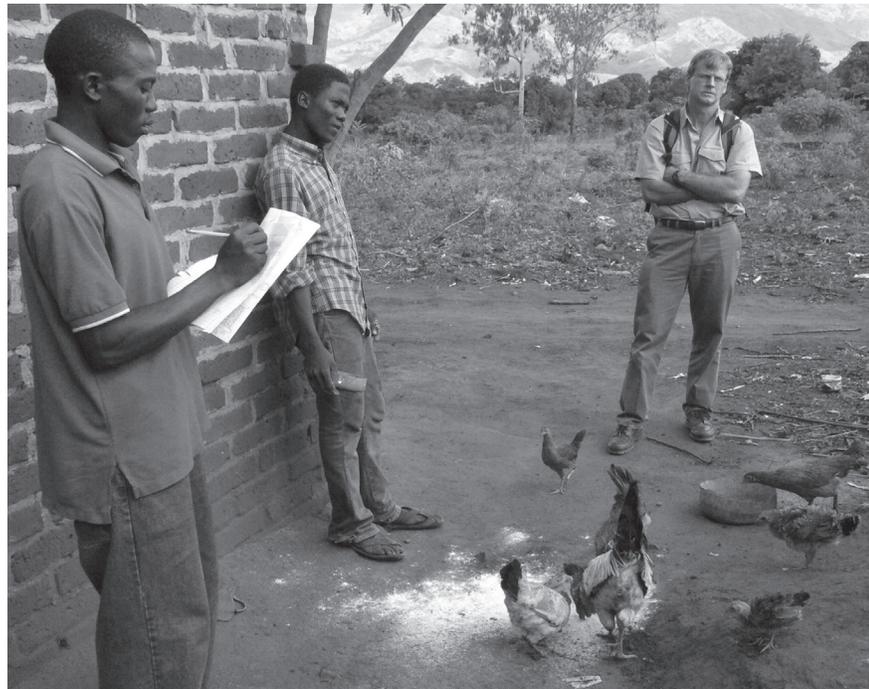
kit so that they may incorporate it into their early detection program in the field.

- The three faculties of veterinary medicine in Kenya, Uganda and Tanzania decided to incorporate and utilize portions of the AFS curriculum in the instruction of veterinary students in poultry medicine.
- In Tanzania, a total of 184 community leaders and public officials received training on poultry vaccination for Newcastle disease and the benefits of improving poultry health. Trainings on the recognition and early reporting of avian flu have fostered new strategies for veterinary extension, including strategies for increasing poultry vaccination.
- Improving the health and productivity of village poultry can improve food security for the rural poor. The AFS developed and is researching strategies for extending poultry health training and veterinary extension to villages. For example, strategies for increasing poultry vaccination are being studied in three wards of Tanzania.



*At a national-level AFS training in Kenya in July 2007, animal and human health professionals are trained to be avian flu prevention and response instructors. Photo by David Bunn.*

- Chicken production is an appropriate activity for micro-enterprise development. Small investments can allow households to develop small poultry production businesses. However, a few diseases have significantly limited the potential of chicken production in developing countries. The AFS project has developed strategies for improving chicken health and production.



- Thousands of rural households in Tanzania are benefiting from the Newcastle disease vaccination program in Iringa District, and hundreds of households within the study areas of Morogoro and Mtwara regions are benefiting from Newcastle disease vaccination and improvements in poultry health.

*While speaking with village poultry farmers in Morogoro, Tanzania, AFS team members, including Project Manager, David Bunn, assess the effectiveness of the Newcastle disease vaccinations and learn of poultry health problems. Photo by Danielle Knueppel.*

AFS Funding for 2006-2007	
Total Core Funding	\$305,729
Total Cost Share	\$72,342
Leveraged Funding	\$159,000
USAID Buy-ins	\$50,000

## RESEARCH BRIEFS

### GL-CRSP Research Brief 08-01-AFS: An Assessment of the Avian Flu School's Interactive 'Train the Trainer' Courses

**Author:** Carol Cardona, University of California, Davis

**Summary.** 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 a HPAI outbreak, and to respond to and recover from an outbreak. AFS is a multi-tiered, train-the-trainer program designed to educate animal health, public health, and agricultural extension workers about H5N1 HPAI, enabling them to deliver this information at the community level in developing countries. A pilot program of the four-day course, which consists of four modules and a practical session, was taught at the University of California, Davis; Sokoine University of Agriculture, Morogoro, Tanzania; and Texas A&M University in 2006. A total of 83 teachers, observers, coordinators, and trainees participated in the pilot courses. Course evaluation scores, provided by trainees, improved from four out of five during the first pilot course at UC Davis to over 4.4 out of five for the last pilot course at Texas A&M. Evaluation scores for the individual modules similarly improved. After minor modifications to the content in response to comments received during the pilot courses, additional courses were taught in Tanzania, Kenya, Uganda, Ghana, and Djibouti.

**GL-CRSP Research Brief 08-02-AFS: An Overview of the Newcastle Disease – Avian Influenza Control Research Project**

***Authors: Peter Msoffe, Sokoine University; Carol Cardona, University of California, Davis***

*Summary.* In 2007, the Newcastle Disease Avian Flu Control Research Project, a sub-project under the Global Livestock CRSP Avian Flu School, was initiated in Tanzania. The project is aimed at: 1) designing a model for a sustainable Newcastle disease vaccination program in rural villages, 2) assessing the prevalence of poultry diseases, and 3) designing methods and strategies for improving poultry health at the village level. Village chicken vaccinations were organized, supervised and conducted by trained village vaccinators in selected villages in three wards, one ward each in Mtwara, Morogoro and Iringa regions. The briefing and training of local policy makers and local agricultural leaders is very important to the success and sustainability of village-level Newcastle disease vaccination programs and poultry development efforts.

**TEAM MEMBERS**

David Bunn, Wildlife Health Center, UC Davis  
Carol Cardona, UC Davis  
Pete Coppelillo, Wildlife Conservation Society, Tanzania  
Peter Lawrence Msoffe, Sokoine University of Agriculture  
Madundo M. Mtambo, Sokoine University of Agriculture  
Amandus P. Muhairwa, Sokoine University of Agriculture  
Hamsa A. Mwamhehe, Veterinary Investigation Centre, Tanzania  
Christian Sandrock, University of California, Davis

**COLLABORATING INSTITUTIONS**

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

Department of Veterinary Services, Kenya  
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  
Sokoine University of Agriculture, Tanzania  
Texas A&M University  
University of Nairobi  
USAID Mission to Tanzania  
Veterinary Investigation Centers, Tanzania  
Wildlife Conservation Society, Tanzania

**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, 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 research shows that bovine tuberculosis is present in both wildlife and livestock in the Ruaha ecosystem, one of the largest intact conservation areas remaining in Africa. An accurate assessment of diseases that threaten the persistence of key species, such as buffalo and lion, is essential for conserving the unique biodiversity of this region.
- Preliminary results have confirmed that livestock management is a gendered activity, whereby women are primarily responsible for milking and management of small ruminants, while men concentrate on herding. Women, however, do handle transactions for the sales of milk, goats and chickens, suggesting that increases in productivity could benefit women and children through greater food security and income generation.
- Development assistance should target those populations where the impact will be the greatest. Therefore, recognizing the economic significance of livestock in rural Tanzanian households and, subsequently, the exposure of women and children to zoonoses through their close physical association with livestock highlights the importance of HALI's screening of women in livestock-keeping households in an attempt to minimize potential outbreaks.
- HALI provides educational opportunities for African women through degree and professional training support. In 2006-2007, three women had key roles with the project: Dr. Annette Kitambi led an investigation of water-borne disease; Ms. Britz completed a veterinary student externship; and Ms. Mariam Nguvava provided key support as a socio-economic research assistant.

- The HALI project has introduced new immunomagnetic separation techniques allowing researchers to detect a high number of parasites in a river used heavily by people and livestock. The project is also employing immunofluorescent antibody staining techniques to test for the presence of these parasites in wildlife and livestock fecal samples to determine if the same parasites are found in water sources. These technologies serve to inform Tanzanian water management agencies of the presence of harmful bacteria, greatly enhancing aid efforts to improve access to clean water for rural Tanzanians.
- Water quality information generated by the HALI project will be helpful in assessing whether other non-bacterial sources of pollution are present in the Great Ruaha and its tributaries. Data monitoring of phosphorous levels can be used as an indicator of fertilizer runoff into water sources due to the relative deficiency in phosphorous in surrounding soils.
- HALI's commitment to gender diversity is evidenced by the composition of team members; seven of 25 team members are women, with four women serving in a significant advisory capacity. While this composition ensures a favorable gender balance within the project team, it also has programmatic value.
- HALI researchers have confirmed the presence of bovine tuberculosis and brucellosis in wildlife and livestock in the Ruaha landscape, establishing disease as a threat to livestock productivity and therefore household food security. To date, 28 pastoral households have benefited from tuberculosis testing of their livestock herds and disease counseling to improve the health of their livestock.
- Tanzania's livestock sector is the third largest in Africa. As it is increasingly integrated with markets, the presence and dynamics of zoonoses and other diseases will become regionally and internationally significant. Findings from HALI inform policy mechanisms and aid the application of the Tanzania Veterinary Act, along with local sale and movement restrictions to protect Tanzania's livestock market.
- The Lunda-Mkwambi Wildlife Management Area (MBOMIPA) association is charged with sustainably managing natural resources for the benefit of its 21 member villages. HALI has trained 20 game scouts from MBOMIPA on avoiding exposure to zoonotic diseases and on the use of handheld GPS units and digital cameras for the documentation of hunter and poached-killed animal locations. The training provides skills benefiting both scouts and MBOMIPA's mandate to manage wildlife.
- HALI is supporting and enhancing the research and diagnostic capacity of Sokoine University of Agriculture (SUA) by utilizing recently available technologies (including polymerase chain reaction for tuberculosis) and introducing new diagnostic methods for water-pathogen testing, solidifying SUA's reputation as a leading diagnostic center for zoonotic diseases in Tanzania.
- HALI collaborated with the Veterinary Investigation Centre (VIC) in Iringa to utilize existing lab space for HALI water microbiology work. As a result of this partnership, the project has made several improvements to the laboratory which will allow the VIC to better diagnose infectious disease outbreaks in livestock.
- The HALI project is actively building capacity within Tanzanian agencies to do advanced water health studies. For example, techniques developed by HALI are currently being adopted to study water pollution and flamingo die-offs at Lake Manyara in northern Tanzania.

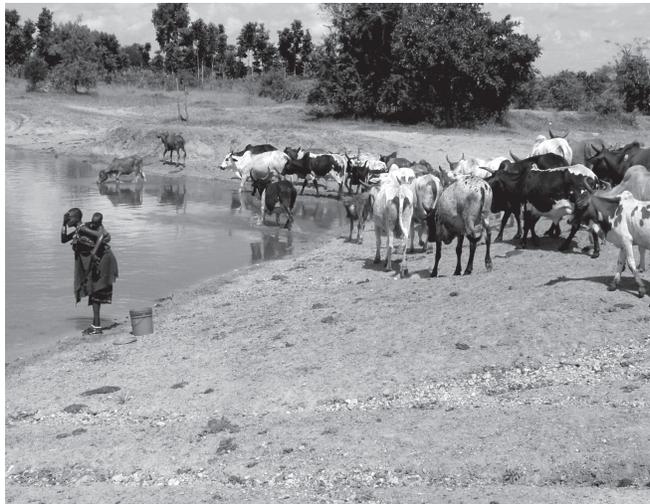
HALI Funding for 2006-2007	
Total Core Funding	\$340,496
Total Cost Share	\$46,837
Leveraged Funding	\$212,065
USAID Buy-In	\$17,250

## RESEARCH BRIEFS

**GL-CRSP Research Brief 08-01-HALI: Evaluating and Managing Zoonotic Disease Risk in Rural Tanzania**

***Authors: Deana Clifford, University of California, Davis; Rudovick Kazwala, Sokoine University of Agriculture; Peter Coppolillo, Tanzania Wildlife Conservation Society***

*Summary.* Daily workloads and livelihoods in rural communities depend heavily on the availability of natural resources. When water is scarce, workloads increase, as more distance must be traveled to acquire adequate supply for consumption, hygiene, and livestock. In addition, water limitation brings people, livestock and wildlife together, increasing contamination of the limited water sources, as well as the potential for disease transmission. Nowhere is the risk of waterborne illness and zoonotic disease more important than in the high HIV/AIDS prevalence regions of East Africa. Assessing the impacts of zoonotic diseases, like bovine tuberculosis on health, economic livelihoods, and conservation requires a multi-disciplinary approach, uniting specialists from a wide variety of fields including medicine (veterinary



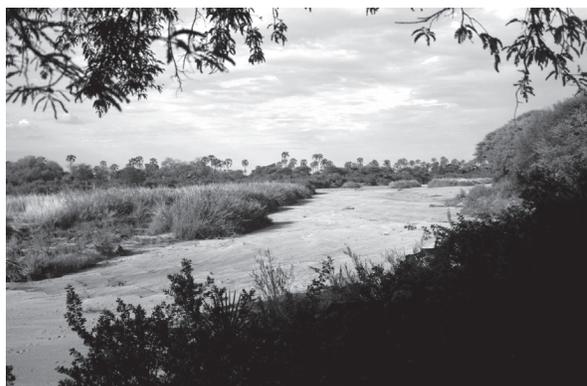
*Maasai woman sharing water sources with livestock. Shared water sources increase the risk associated with disease transmission between wildlife, livestock, and humans. Photo by Joe Brownlie.*

and human), ecology and conservation, sociology, and economics. Support from the Global Livestock CRSP is allowing an objective assessment of emerging zoonotic disease impact on health and livelihoods of pastoral communities in the sensitive Ruaha region of Tanzania. Results will inform management and policy to improve human, livestock, and wildlife health; facilitate economic development through improved livestock productivity and wildlife-based tourism; and strengthen local capacity to diagnose zoonotic disease problems and to design disease prevention programs.

**GL-CRSP Research Brief 08-02-HALI: The Unintended Consequences of Development Assistance: The Case of Usangu Irrigation Schemes**

***Authors: Peter Coppolillo, Tanzania Wildlife Conservation Society; Deana Clifford and Jonna Mazet, University of California, Davis***

*Summary.* Development projects aimed at improving agriculture in rural communities have been a cornerstone of international aid to developing countries. The intended results of improved local livelihoods and access to increased trade have been variably realized, and, in some cases, there have been dramatic unforeseen negative consequences on the environment with regional and national impacts. In the Usangu region of Tanzania, smallholder rice schemes established with development assistance in the 1980s and early 90s precipitated a cascade of unintended outcomes, many of which are still being realized. The primary and direct effect was that legal channelization of water facilitated a proliferation of illegal diversions and satellite farms surrounding the rice schemes. The resultant loss of water was (and remains) the central driver of the environmental and socioeconomic cascade of unintended effects. The most notable of those effects include: a 77% reduction in the area of the Ihefu swamp, over 60% loss of dry season habitat in Ruaha National Park, the collapse of fisheries in Mtera Reservoir,



*The Great Ruaha riverbed in October (left) and the flowing river in December (right). The drying of this normally perennial river may increase disease transmission among people, livestock and wildlife, as all are forced to share diminishing dry season water sources. Dry Ruaha photo by Peter Coppolillo. Flowing Ruaha photo by Deana Clifford.*

increased potential for transmission of disease among livestock, wildlife and people (both waterborne and other), and the loss of hydroelectric power produced by the Mtera hydroelectric plant. The social and economic costs of these unintended consequences remain untallied, but the power crisis alone likely costs the Tanzanian economy around one billion U.S. dollars. Two conclusions arise from this case: 1) development assistance projects must control the propagation of unintended consequences or risk having a negative net benefit, and 2) the perception that developing countries, like Tanzania, are not financially able to manage water sustainably should be replaced by the idea that those countries cannot afford the consequences of unsustainable water resource management.

**GL-CRSP Research Brief 08-03-HALI: Disease Perceptions in Pastoralist Households at the Human-Livestock-Wildlife Interface in Tanzania**

*Authors: Deana Clifford, University of California, Davis; Michel Masozera, University of Vermont; Mariam Nguvava and Peter Coppolillo, Tanzania Wildlife Conservation Society; Jonna Mazet, University of California, Davis*

*Summary.* Diseases that can be transmitted between animals and humans are the most significant cause of emerging infectious diseases in people.

Pastoralists living in close proximity to both livestock and free-ranging wildlife may be at high risk of infection. Pastoralists often depend on limited water sources that are shared with animals, have little access to healthcare, 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 Livelihood Improvement project (HALI) 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 indicate that many pastoralist households do not believe that diseases can be transmitted to people from their livestock or wildlife. Many also believe that sharing water with animals (livestock or wildlife) does not pose a health risk to people. 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, including ethnicity, disease history, wealth, education, access to health care, and proximity to

wildlife, on disease perceptions and prevention practices will be further assessed by the HALI team. 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.

**GL-CRSP Research Brief 08-04-HALI: From the Ground Up: HALI Builds Capacity to Address Complex Disease Issues to Improve Livestock Trade in Tanzania**

*Authors: Deana Clifford, University of California, Davis; Rudovick Kazwala, Sokoine University of Agriculture; Hamza Mwambebe, Veterinary Investigation Centre, Iringa; Jonna Mazet, University of California, Davis*

*Summary.* In order to open up legal trade opportunities for livestock products, regional authorities must be able to ensure that animals and animal products are free of transmissible diseases that could have economic consequences on neighboring and distant regions targeted for trade. Obtaining this “disease-free” status requires local diagnostic and surveillance capacity not often present in rural areas of developing countries. In the southern highlands of Tanzania, there is no lack of willpower, only a lack of opportunity for people to gain necessary skills to tackle complex livestock disease problems. The HALI project recognizes that highly motivated individuals can make the difference in these rural communities and, therefore, invests in training and regional capacity building. In their first year of laboratory and field-based research training, HALI students are already improving the regional

capacity to detect economically important livestock diseases. For example, HALI student Dr. Julius John joined a small governmental investigatory team to evaluate an outbreak of pneumonia in small ruminants in 2007. Because of his participation, diagnostic sample size was increased, and Rift Valley Fever was quickly identified resulting in the rapid implementation of control measures. After only one year of HALI training, students like Dr. Annette Kitambi are lecturing to university students about disease transmission and water quality. In addition, project researchers are noticing the diffusion of this knowledge to others. Students, for example, are educating households about preventing the transmission of bovine tuberculosis to other cattle and family members. They are also training game scouts to protect themselves from diseases carried by the animals that they handle. By training individuals who will then share their skills and knowledge with others, HALI is building long term capacity to both investigate and respond to zoonotic disease challenges in Tanzania. Obtaining regional disease-free status will also require bolstering laboratory capacity and access to scientists and research institutions. To this end, the HALI project has partnered with the Veterinary Investigation Centre in Iringa, Tanzania to increase zoonotic disease surveillance in the region and has augmented the technical capacity at Sokoine University of Agriculture’s Faculty of Veterinary Medicine.

**PRESENTATIONS AND PROCEEDINGS**

Clifford, D.L. “Health for Animals and Livelihood Improvement Project in the Rungwa-Ruaha Ecosystem, Tanzania.” Interim Progress Report for Tanzania National Parks, Tanzania Wildlife Research Institute, and Tanzania Commission on Science and Technology, March 1, 2007.

HALI Degree Training for 2006-2007					
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

Clifford, D.L., R. Kazwala, P. Coppolillo, D. Kambarage, T. Mlengeya, J. Erickson, and J.A.K. Mazet. "Health for Animals and Livelihood Improvement (HALI) in the Ruaha Ecosystem, Tanzania." Proceedings of the *21st annual meeting of the Society for Conservation Biology*. Port Elizabeth, South Africa, July 1-5, 2007.

Mazet, J.A.K. and D.L. Clifford. "Community-based conservation – is it effective?" Presentation and discussion session for graduate veterinary course at the University of California, Davis, VME 294B – Conservation Biology and Veterinary Medicine. Davis, California, March 6, 2007.

Clifford, D.L., R. Kazwala, P. Coppolillo, D. Kambarage, T. Mlengeya, J. Erickson, and J.A.K. Mazet. "HALI in the Ruaha Ecosystem, Tanzania." Poster presentation created for GL-CRSP donor meeting, Switzerland, June 2007.

Clifford, D.L. "HALI in the Ruaha Ecosystem, Tanzania." Presentation given in a special symposium on Linking Biodiversity and Health at the *21st annual meeting of the Society for Conservation Biology*. Port Elizabeth, South Africa, July 1-5, 2007.

Mazet, J.A.K. and R. Kazwala. "Linking Habitat, Wildlife, Livestock and Human Health: The HALI Project." Presentation given at the *Envirovet Summer Institute*. White Oak Conservation Center, Yulee, Florida, June 26, 2007.

Britz, E., D.L. Clifford, and J.A.K. Mazet. "Water-related risk factors associated with diarrhea in pastoralist households or rural Tanzania." Poster presentation given at the UC Davis School of Veterinary Medicine Open House and Orientation Day and at the STARS in Science meeting. Davis, California, October 12, 2007.

Mazet, J.A.K. "Using epidemiology to evaluate the linkages among wildlife, human, and livestock health." Presentation given to the UC Davis Graduate Group in Epidemiology (EPI 290). Davis, California, October 11, 2007.

## TEAM MEMBERS

Epaphras Alex, Tanzania National Parks - Ruaha  
David Bunn, UC Davis Wildlife Health Center (WHC)  
Tylis Chang, Albert Einstein Medical College  
Deana Clifford, UC Davis WHC  
Michael Clifford, UC Davis WHC  
Peter Coppolillo, Wildlife Conservation Society (WCS)  
Jon Erickson, University of Vermont  
Jonas Fitangile, Sokoine University of Agriculture (SUA)  
Harrison Gabriel, SUA  
Dominic Kambarage, SUA  
Rudovick Kazwala, SUA  
Ally Kitime, SUA  
Michael Kock, WCS  
Howard Kombe, SUA  
Julius Kyeyyu, Tanzania Wildlife Research Institute  
S.L.S. Maganga, SUA  
Jonna Mazet, UC Davis WHC  
Bakari Mbano, WCS, Tanzania  
Dee McAloose, WCS  
Woutrina Miller, UC Davis WHC  
Titus Mlengeya, Tanzania National Parks  
Aybu Omari Msago, WCS, Tanzania  
Hamza Mwamhehe, VIC, Tanzania  
Hellen Ngowi, SUA  
Mariam Nguvava, WCS, Tanzania

## COLLABORATING INSTITUTIONS

**University of California, Davis, Wildlife Health Center, School of Veterinary Medicine (lead institution)**

Sokoine University of Agriculture  
Tanzanian National Parks  
Tanzanian Wildlife Research Institute  
University of Vermont  
Veterinary Investigation Centre, Tanzania  
Wildlife Conservation Society, Field Veterinary Program and AHEAD (Animal Health for the Environment and Development)  
Wildlife Conservation Society, Tanzania

## GL-CRSP TRAINING SUMMARY FOR 2006-2007

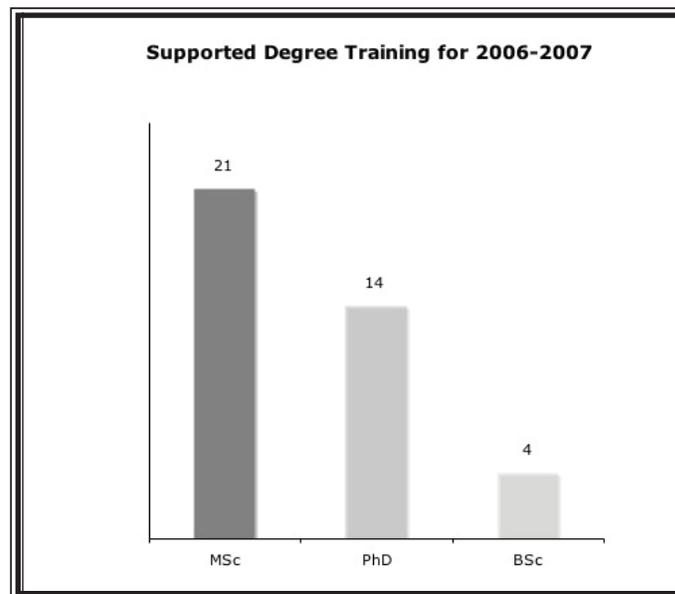
*Training has always been integral to the CRSP portfolio, and the Global Plan of the GL-CRSP recognizes human capacity building as a fundamental component of research and development. The GL-CRSP design, therefore, provides for a wide range of training possibilities and employs both traditional and innovative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

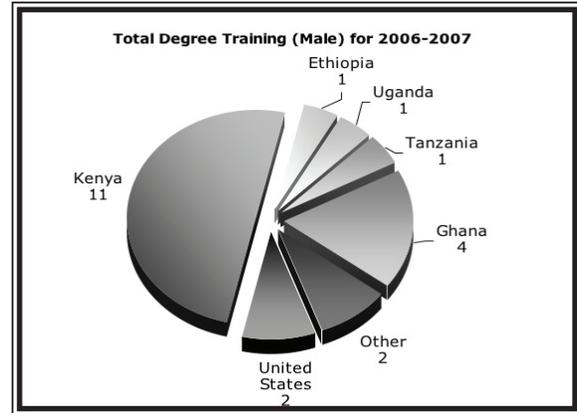
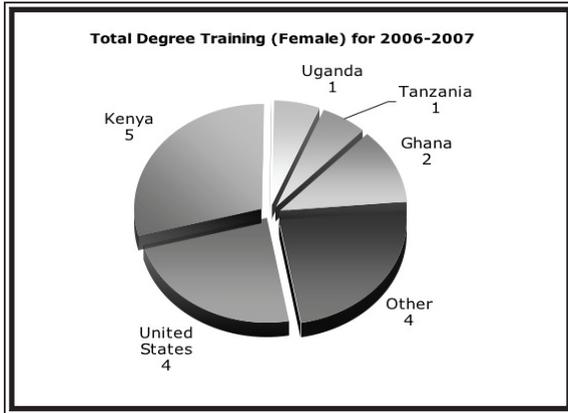
**Degree Training.** The GL-CRSP provides funding for operational and research costs to both U.S. and host-country graduate students. Project team members are encouraged to leverage funds to support tuition.

**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 2006-2007

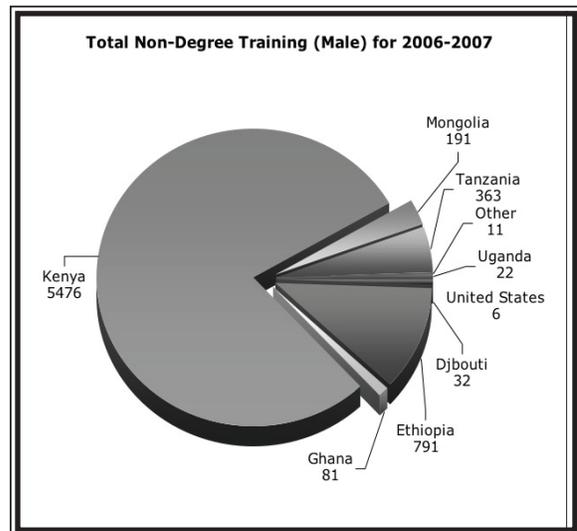
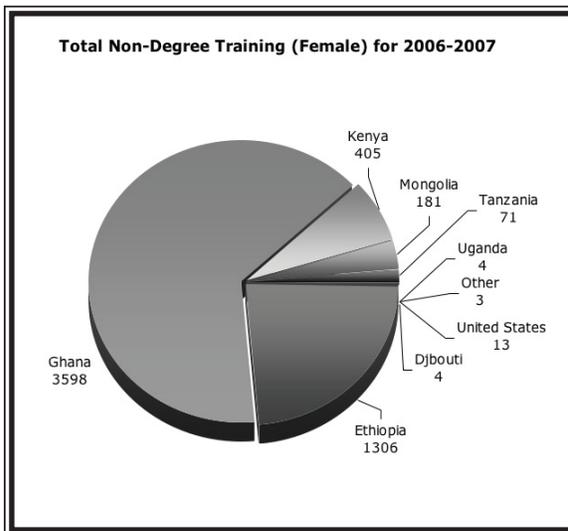
- Thirty-nine individuals (17 females and 22 males) were supported in long-term degree training programs in nutrition, veterinary medicine, agricultural economics, range science, human ecology, and hydrology. Three of these individuals completed Ph.D. programs, and three completed M.Sc. degrees this year.
- Approximately 72% of the supported students are from African countries.
- Twenty are continuing students from previous years, and 19 are new students.





**NON-DEGREE TRAINING STATISTICS FOR 2006-2007**

- In 2006-2007, a total of 12,558 people participated in GL-CRSP project trainings. Many participants attended multiple trainings, resulting in 27,078 total attendances at all trainings.
- Approximately 6,708 individuals were supported in 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.
- An additional 5,850 individuals (350 females and 5500 males) underwent long-term, seven-month livestock awareness trainings in livestock marketing in eastern Africa.
- In total, 5,585 females and 6,973 males were trained through GL-CRSP projects.



## 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 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 2006-2007

### *Kimberly Harding, Ph.D. Candidate, Nutrition, McGill University, ENAM Project*

Ms. Harding received a Bachelor of Kinesiology (Honours) from McMaster University in 2004. During her undergraduate degree she spent one summer volunteering in rural El Salvador on a home construction project. This experience initiated her interest in international development. Before returning to further her studies in that area, she spent two years teaching English in Japan. Jim Ellis funding enabled her to complete research for her masters thesis, entitled “Dietary Intakes and Nutritional Status of Rural Ghanaian Children: Are Season and Attending Daycare Important Determinants?”

**Research problem.** High rates of child malnutrition are a serious concern in Ghana, particularly in rural areas. In order to address this problem, the study looked at two potential determinants of rural children’s diets in two distinct agro-ecological zones of Ghana:

1. Seasonal changes in food availability in the northern Guinea Savanna zone
2. Daycare center feeding programs in the mid-country Transitional zone

**Research design and methods.** In the northern Guinea Savanna, interview-administered questionnaires with caregivers were used to collect 24-hour dietary recall along with other relevant information (morbidity, demographic and socio-economic data). Data were collected on 190 children aged two to five years in the ‘lean’ season, prior to harvesting (June-July) and then again on the same children in the ‘plenty’ season, following harvesting (November-December). Height, weight and hemoglobin data were also collected (height and weight in both seasons and hemoglobin in the ‘plenty’ season only). Northern Ghana was chosen for this aspect because the area has only one annual rainy season, and therefore only one harvest, compared to the rest of the country, which has two wet seasons and hence two harvests.

In the mid-country Transitional zone, interview-administered questionnaires with caregivers were used to collect 24-hour dietary recall along with other relevant information (morbidity, demographic and socio-economic data). Data were collected on 199 children aged two to five years, approximately half of whom attend a daycare center with a feeding program, the other half of whom do not attend any school. Height, weight and hemoglobin data were also collected. The mid-country transitional zone was selected for this aspect because the ENAM communities in this zone have daycare centers with feeding programs.

**Results.** Data were analyzed for an abstract submitted for the Experimental Biology conference entitled: “A comparison of child nutritional status in two agro-ecological zones of Ghana: Is location an important determinant?” The analysis compared child anthropometric nutritional status in the two zones (northern Guinea Savanna and mid-country Transitional) and found no differences in rates of underweight (weight-

for-age), wasting (weight-for-height) or stunting (height-for-age). Both mean weight-for-age and weight-for-height Z-scores, however, were significantly lower in the northern Guinea Savanna as compared to the Mid-country Transitional. There was no significant difference in mean height-for-age Z-score between the two zones.

**Implications of findings for science and development.** The findings thus far show that effective nutrition intervention programs need to understand the selective influence that geographic location may have on child nutrition in Ghana in order to be timely and locally appropriate. Results from the remainder of the data will provide information on determinants of dietary intake and nutritional status of rural Ghanaian children. This information will contribute to the understanding of the malnutrition problem in Ghanaian children and can inform future interventions and policy recommendations in the area of child health in Ghana.

***Michel Masozera, Ph.D. Candidate, Ecological Economics, University of Vermont, HALI Project***

Mr. Masozera was trained as a biologist and received his undergraduate degree with a specialization in wildlife ecology and conservation from the University of Kisangani, Democratic Republic of Congo. After working in Nyungwe, Rwanda with the Wildlife Conservation Society (WCS) as a Project Manager, he went to on pursue a Master of Science degree in Forest Resources and Conservation, with a specialization in socio-economics and policy at the University of Florida, Gainesville.

His thesis focused on the socioeconomic impact analysis of the conservation of Nyungwe Forest National Park. Upon graduation, Mr. Mazozera returned to Rwanda, his home country, to work in conservation at the national level as the Country Program Director for the Wildlife Conservation Society (WCS). In 2005, he began to pursue a Ph.D. in ecological economics at the University of Vermont, where he began collaborating with the GL-CRSP HALI project.

**Research summary.** Mr. Masozera's dissertation research aims at assessing how water management and disease affect the health and livelihoods of pastoral and agropastoral communities at the human, livestock and wildlife interface in the Rungwa-Ruaha Landscape, Tanzania. Specifically, the study will: 1) Assess the effect of water limitation and disease on Maasai, Barabaig and Sukuma household economies, 2) Estimate the economic impact of water flow reduction on disease among pastoralists and their livestock, and 3) Assess agropastoralists' and pastoralists' attitudes toward disease, disease management and livestock/wildlife extension services.

Accomplishments in 2006-2007 include the following:

- Training of two socioeconomic research assistants (Eric Guga and Miriam Nguvava).
- Completion of the cross-section socioeconomic survey for one wet and dry season (one full year). With a target of 30 subsamples, 15 have been surveyed, and the remaining 15 will be surveyed before the end of December.
- Initiation of village-level surveys to capture information on other economic activities. This information will complement the socioeconomic surveys and will help to develop the village economy models.
- Initiation of district- and village-level focus group surveys. This information will be used in designing a questionnaire that will be provided at district-level workshops to evaluate the trade-offs among different land use options in August 2008.

Altogether, this data will provide a socio-economic profile of household productivity and consumption, which will form the basis for assessing the social and economic dynamics and spatial patterns in the community, to allow for a linkage between socio-economic elements, livelihoods, disease, and water management practices in Ruaha.

### **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.

### **BORLAUG LEAP FELLOWS FOCUSING ON LIVESTOCK RESEARCH IN 2006-2007**

#### ***Caroline Wambui, Ph.D. candidate, Animal Science, Egerton University***

Kenyan, Caroline Wambui is currently enrolled in the Ph.D. program at Egerton University, Njoro, Kenya, in the Animal Science Department. Ms. Wambui's research will investigate the anthelmintic potential (potential to expel parasitic worms) of browse species commonly used as fodder in Kenya. It is expected that from this study, browse species with anthelmintic properties will be identified and recommendations extended to farmers on their utilization as protein supplements and usage in the control of intestinal worms. Furthermore, the research is expected to help reduce the use of synthetic oral drenches that are not only expensive, but have residual effects in animal products, which could be detrimental to human health. Dr. James Muir of Texas A&M University and Dr. John Githiori of ILRI are mentoring Ms. Wambui. She will be conducting her field research under the supervision of Dr. Githiori in Kenya.

#### ***Sommarat Chantarat, Ph.D. candidate, Economics, Cornell University***

Thai, Sommarat Chantarat is currently enrolled in the Ph.D. program at Cornell University in the Economics Department. Ms. Chantarat's research will investigate the application of various index-based risk transfers products (IBRTPs) to pastoralist and agro-pastoralist populations in East Africa and will offer several important extensions to the broader, emerging literature on IBRTPs. IBRTPs represent a promising option for managing climate-related risks to which pastoral and agropastoral households are exposed. IBRTPs are financial instruments that make payments based on realizations of an underlying – transparent and objectively measured – index (e.g. amount of rainfall over a season, cumulative temperature or area average livestock mortality) relative to a pre-specified threshold. Dr. Christopher Barrett of Cornell University and Dr. Andrew Mude of ILRI are mentoring Ms. Chantarat.

#### ***Michel Masozera, Ph.D. candidate, Ecological Economics, University of Vermont***

Rwandan, Mr. Masozera is currently a Ph.D. candidate in Ecological Economics at the University of Vermont. A detailed description of Mr. Masozera's background and research can be found above under the Jim Ellis Mentorship Awards section. Dr. Jon Erickson of the University of Vermont, and Dr. Esther Schelling of ILRI are mentoring Mr. Masozera.

**APPENDIX A: ACRONYMS  
2006-2007**

3G	Grazinglands and Greenhouse Gas Emissions (GL-CRSP project)
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
AFS	Avian Flu School (GL-CRSP project)
AgSS	Agriculture Sector Strategy
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
AMPATH	Academic Model for Prevention and Treatment of HIV/AIDS
APDA	Afar Pastoral Development Association
AR	Action Research
ART	Antiretroviral Therapy
ASAL	Arid and Semi-Arid Land
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
BLM	Bureau of Land Management
BMI	Body Mass Index
BSF	BioSand Filters
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
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
CNP	Child Nutrition Project (GL-CRSP project)
CRSP	Collaborative Research Support Program
CSU	Colorado State University
CU	Cornell University
DFID	Department for International Development, United Kingdom
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)
ERMIS	Environmental Research Mapping and Information Systems
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
FEWS NET	Famine Early Warning System Network
FFHG	Freedom from Hunger, Ghana
FHI	Food for the Hungry International
FVA	First Voice 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
ICT	Information and Communication Technology
ICTAD	ICT Assisted Development
IEHA	Initiative to End Hunger in Africa

IFPRI	International Food Policy Research Institute
IGA	Income Generating Activities
IGAD	International Governmental Authority on Development
IGC	Intergovernmental Conference (EU)
ILRI	International Livestock Research Institute
IPAL	Integrated Project for Arid Lands
ISSRM	International Symposium for Society and Resource Management
ISU	Iowa State University
IU	Indiana University
KARI	Kenya Agricultural Research Institute
KDA	Kenya Rural Enterprise Program Development Agency
KLMC	Kenya Livestock Marketing Council
KLTA	Kenya Livestock Traders Association
kg	Kilogram
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
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)
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
NASCOP	National AIDS and STI Control Program, Kenya
NASULGC	National Association of State Universities and Land Grant Colleges
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
NLMIS	National Livestock Market Information System
NNP	National Nutrition Programme
NPP	Net Primary Production
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
OPaDC	Oromia Pastoral Development Commision
ORCHIDEE	Observatoire Radar Coherent Heliporte d'Investigation des Elements Ennemis (French)
PAR	Participatory Action Research
PARIMA	Pastoral Risk Management (GL-CRSP project)
PCAE	Pastoral Concern Association of Ethiopia
PEACE	Pastoral Engagement, Adaption, 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
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
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
SALTICK	Semi-Arid Lands Training and Livestock Improvement Centres of Kenya
SANREM	Sustainable Agriculture and Natural Resource Management CRSP
SCC	Sambura County Council
SCF - UK	Save the Children Fund (United Kingdom)
SCF - USA	Save the Children Fund (United States)
SDDP	Samburu District Development Programme
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
TCC	Technology Coordinator Council
TLMP	Tanzania Livestock Marketing Project
TN	Total Nitrogen
TP	Total Phosphorous
TZ	Tanzania
UCD	University California, Davis
UCLA	Univeristy of California, Los Angeles
UG	University of Ghana
UK	United Kingdom
UKY	University of Kentucky

UNAIDS	Joint United Nations Programme on HIV/AIDS
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
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
UV	University of Vermont
UW	University of Wyoming
VCI	Vegetation Condition Index
VEDCO	Volunteer Efforts for Development Concerns
VIC	Veterinary Investigations Centre
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
WHC	Wildlife Health Center, UC Davis
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

**APPENDIX B: COLLABORATING INSTITUTIONS  
2006-2007**

<b>ADVANCED RESEARCH INSTITUTES</b>	<b>State, Country</b>	<b>Institution Type</b>	<b>GL-CRSP Project(s)</b>
Agricultural University of Mongolia	Mongolia	Academic	GOBI
Alemaya University	Ethiopia	Academic	LINKS
Cornell University	New York, USA	Academic	PARIMA, LITEK
Egerton University	Kenya	Academic	PARIMA, SUMAWA
Indiana University	USA	Academic	HNP
Iowa State University	Iowa, USA	Academic	ENAM
Makerere University	Uganda	Academic	AFS, ENAM
McGill University	Canada	Academic	ENAM
Moi University	Kenya	Academic	SUMAWA, HNP
Sokoine University of Agriculture	Tanzania	Academic	AFS, HALI
Syracuse University	New York, USA	Academic	PARIMA
Texas A&M University	Texas, USA	Academic	LINKS, AFS, GOBI
University of California, Davis	California, USA	Academic	SUMAWA, AFS, HALI
University of California, Los Angeles	California, USA	Academic	HNP
University of Ghana	Ghana	Academic	ENAM
University of Kentucky	Kentucky, USA	Academic	PARIMA, LITEK
University of Nairobi	Kenya	Academic	AFS, LINKS
University of Vermont	USA	Academic	HALI
University of Wyoming	Wyoming, USA	Academic	SUMAWA
Utah State University	Utah, USA	Academic	PARIMA
Yale University	Connecticut, USA	Academic	LITEK
<b>CGIARs</b>	<b>State, Country</b>	<b>Institution Type</b>	<b>GL-CRSP Project(s)</b>
International Livestock Research Institute (ILRI)	Kenya, Ethiopia	CGIAR	PARIMA

GOVERNMENTAL ORGANIZATIONS	State, Country	Institution Type	GL-CRSP Project(s)
Arid Lands Information Network (ALIN)	Kenya	GO	LINKS
Department of Veterinary Services	Kenya	GO	AFS
Disaster Preparedness and Prevention Commission (DPPC)	Ethiopia	GO	LINKS
Ethiopian Information and Communication Technology Development Authority (ICTAD)	Ethiopia	GO	LINKS
Ethiopian Telecommunication Agency	Ethiopia	GO	LINKS
Ethiopian Telecommunication Corporation	Ethiopia	GO	LINKS
Kenya Department of Fisheries	Kenya	GO	SUMAWA
Kenya Wildlife Service (KWS)	Kenya	GO	SUMAWA
Livestock, Crops, and Natural Resources Development Office	Ethiopia	GO	LINKS
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 Health, Kenya	Kenya	GO	AFS, SUMAWA
Ministry of Health, Uganda	Uganda	GO	AFS
Ministry of Livestock Development	Tanzania	GO	LINKS
Ministry of Livestock and Fisheries Development, Kenya	Kenya	GO	AFS, LINKS, PARIMA
Oromia Agricultural Development Bureau (OADB)	Ethiopia	GO	PARIMA
Oromia Cooperative Promotion Bureau (OCPB)	Ethiopia	GO	PARIMA
Oromia Pastoral Development Commission	Ethiopia	GO	LINKS, PARIMA
Regional Center for Mapping of Resources for Development	Kenya	GO	LINKS
Tanzania National Parks (TANAPA)	Tanzania	GO	HALI
USDA Foreign Agricultural Service	USA	GO	GOBI
Veterinary Investigation Centers	Tanzania	GO	AFS, HALI

NATIONAL RESEARCH INSTITUTES/ORGANIZATIONS	State, Country	Institution Type	GL-CRSP Project(s)
Institute of Meteorology and Hydrology, Mongolia	Mongolia	RI	GOBI
Jijiga Pastoral Agro-pastoral Research Center	Ethiopia	NARS	LINKS
Kenya Agricultural Research Institute (KARI)	Kenya	NARS	PARIMA
Oromia Agricultural Research Institute (OARI)	Ethiopia	NARS	PARIMA, LINKS
Selian Agricultural Research Institute	Tanzania	RI	LINKS

Somali Region Pastoral and Agro-pastoral Research Institute	Ethiopia	RI	LINKS
Tanzanian Wildlife Research Institute (TAWIRI)	Tanzania	RI	HALI
Werer Agricultural Research Center	Ethiopia	RI	LINKS
<b>NON-GOVERNMENTAL ORGANIZATIONS</b>			
ACDI-VOCA	Ethiopia	NGO	LINKS
Arid Lands Information Network (ALIN)	Kenya	NGO	LINKS
Arid Lands Resource Management Project (ALRMP)	Kenya	NGO	PARIMA, LINKS
Community Initiatives Facilitation and Assistance (CIFA)	Kenya	NGO	PARIMA
Farm Africa	Ethiopia, Kenya, Tanzania	NGO	LINKS
First Voice Africa	Kenya	NGO	LINKS
Food for the Hungry International	Kenya	NGO	LINKS
Freedom From Hunger, Ghana	Ghana	NGO	ENAM
Heifer International, Ghana and Kenya	USA, Ghana, Kenya	NGO	ENAM, HNP
Mercy Corps, Mongolia	Mongolia	NGO	GOBI
Netherlands Development Organization (SNV)	Kenya	NGO	LINKS
Pact, Mongolia	Mongolia	NGO	GOBI
Pastoralist Forum	Ethiopia	NGO	LINKS
Population Services International	Kenya	NGO	HNP
Resource Conflict Institute	Kenya	NGO	PARIMA
River Njoro Water Resource Users Associations (WRUA)	Kenya	NGO	SUMAWA
Save the Children, UK	Ethiopia	NGO	LINKS
Terra Nuova	Kenya	NGO	LINKS
Veterinaries Sans Frontieres-Suisse	Kenya	NGO	LINKS
Volunteer Efforts for Development Concerns	Uganda	NGO	ENAM
Wildlife Conservation Society, Field Veterinary Program and AHEAD	Washington, D.C., USA	NGO	HALI
Wildlife Conservation Society, Tanzania	Tanzania	NGO	AFS, HALI
World Bank Sustainable Livelihoods Program	Mongolia	NGO	GOBI

PRIVATE SECTOR	State, Country	Institution Type	GL-CRSP Project(s)
Kenya Livestock Marketing Council	Kenya	Private	LINKS

REGIONAL ORGANIZATIONS	State, Country	Institution Type	GL-CRSP Project(s)
Bati Agricultural and Rural Development Office	Ethiopia	Regional	LINKS
Dire Dawa Agriculture Office	Ethiopia	Regional	LINKS
Dire Dawa Disaster Preparedness and Food Security (DPFS)	Ethiopia	Regional	LINKS
Dire Dawa Rural Development Coordination Bureau	Ethiopia	Regional	LINKS
Disaster Prevention and Preparedness and Food Security Bureau	Afar Region, Ethiopia	Regional	LINKS
Regional Agricultural Trade Expansion Support Program	Kenya	Regional	LINKS
Somali Region Rural Development	Somali Region, Ethiopia	Regional	LINKS

UNITED NATIONS ORGANIZATIONS	State, Country	Institution Type	GL-CRSP Project(s)
Food and Agriculture Organization	Ethiopia, Kenya	UN	LINKS

USAID	State, Country	Institution Type	GL-CRSP Project(s)
FEWS NET	Ethiopia, Kenya	USAID	LINKS
USAID Mission to Ethiopia	Ethiopia	USAID	PARIMA
USAID Mission to Tanzania	Tanzania	USAID	AFS
USAID Southern Tier Initiatives (STI)	Ethiopia	USAID	LINKS

**APPENDIX C: GL-CRSP PROJECT FUNDING  
2006-2007**

Project	Total Core Funding	Total Cost Share	Leveraged Funding	USAID Buy-ins	Total Supplemental Funding
3G	\$26,880	\$7,630	\$-	\$-	\$-
AFS	\$305,729	\$72,342	\$159,000	\$ 50,000 (USAID Djibouti Mission)	\$209,000
ENAM	\$305,840	\$32,746	\$39,341	\$ 177,961 (USAID WID)	\$157,302
GOBI	\$150,000	\$24,952	\$701,500	\$ 50,000 ( USAID Mongolia Mission)	\$751,500
HALI	\$340,496	\$46,837	\$212,065	\$ 17,250 (USAID Global Conservation Program)	\$229,315
HNP	\$251,720	\$40,636	\$10,000	\$-	\$10,000
LINKS	\$350,000	\$88,025	\$1,787,707	\$ 198,000 (USAID Ethiopia Mission)	\$2,053,707
				\$ 68,000 (USAID SPS)	
LITEK	\$89,401	\$-	\$-	\$-	\$-
NJORO WATER	\$34,974	\$621	\$27,750	\$-	\$27,750
PARIMA	\$540,000	\$105,329	\$67,000	\$ 303,500 (USAID Ethiopia Mission)	\$370,500
POU WID	\$-	\$519	\$11,500	\$ 35,905 (USAID WID)	\$11,500
SUMAWA	\$ 236,654	\$38,123	\$68,262	\$ 52,865 (USAID WID)	\$121,127